

## TRANSLATING AN EFFECTIVE GROUP-BASED HIV PREVENTION PROGRAM TO A PROGRAM DELIVERED PRIMARILY BY A COMPUTER: METHODS AND OUTCOMES

Josefina J. Card, Tamara Kuhn, Julie Solomon, Tabitha A. Benner, Gina M. Wingood, and Ralph J. DiClemente

We describe development of SAHARA (SISTAS Accessing HIV/AIDS Resources At-a-click), an innovative HIV prevention program that uses a computer to deliver an updated version of SiSTA, a widely used, effective group-level HIV prevention intervention for African American women ages 18-29. Fidelity to SiSTA's core components was achieved using: (1) video clips featuring group discussions and modeling of appropriate sexual- and contraceptive-related behavior; and (2) interactive Flash modules facilitating cognitive rehearsal, providing learning experiences through games and quizzes, and providing opportunities for simulated role-play. A preliminary outcome study of SAHARA conducted at Planned Parenthood, Atlanta, found that SAHARA, when followed by a brief 20-minute wrap-up group session facilitated by a health educator, was effective in promoting consistent condom use for vaginal sex. We discuss the potential advantages and challenges of an intervention like SAHARA delivered by computer to an individual, versus one like SiSTA delivered by a health educator to a small group.

HIV prevention efforts have slowed the spread of HIV both in the United States and worldwide and have saved many lives (Card et al., 2007; Centers for Disease Control and Prevention [CDC], 2001; UNAIDS, 2008). Until an effective vaccine is developed, preventing transmission requires the deployment of effective, culturally competent prevention strategies that address one or more routes of transmission, including sex, injection drug use, parent-to-child transmission, and transmission in health care settings.

In the past decade and a half, many interventions aimed at preventing the spread of HIV have been put into practice and found effective in changing HIV risk-related behavior. These include *individual-level* and *small group-level interventions* that seek to directly influence the knowledge, attitudes, skills, and behaviors of persons who

---

Josefina J. Card, Tamara Kuhn, and Tabitha A. Benner are with Sociometrics Corporation, Los Altos, CA. Julie Solomon is with J. Solomon Consulting, LLC, Mountain View, CA. Gina Wingood and Ralph DiClemente are with the Rollins School of Public Health, Emory University, Atlanta, GA.

This study was supported by a Small Business Innovation Research grant from the National Institute of Mental Health (Grant R44 MH077212-02).

Address correspondence to J. J. Card, Sociometrics Corporation, 170 State St., Suite 260, Los Altos, CA 94022; e-mail: jjcard@socio.com

participate in intervention activities; *community-level interventions* that influence the knowledge, attitudes, skills, and behaviors of an entire community both directly and indirectly, often through a focus on changing social norms; and *structural interventions* that indirectly influence risk behavior by effecting changes to policies, laws, organizational practices, or other structures that are related either to risk behaviors or to access to behavioral prevention information, tools, or services (Card, Benner, Shields, & Feinstein, 2001; Card et al., 2007; CDC, 2001; Copenhaver et al., 2006; Crepaz et al., 2006; Darbes, Crepaz, Lyles, Kennedy, & Rutherford, 2008; Des Jarlais, 2000; Herbst et al., 2007; Johnson et al., 2008; Kirby, Laris, & Rolleri, 2006; Lyles et al., 2007; Noar, 2008). The first two types of HIV prevention interventions have typically been delivered by health professionals working in schools, clinics, or community-based organizations; the third type has generally been ushered in by lawmakers and policy makers (Blankenship, Friedman, Dworkin, & Mantell, 2006, Bonell, Hargreaves, Strange, Pronyk, & Porter, 2006).

In this article we describe how, under the auspices of a National Institute of Health Small Business Innovation Research (SBIR) grant, we developed and evaluated a computer-delivered version of an effective HIV prevention group-level intervention. The article is the collaborative work of staff at Sociometrics Corporation who translated the effective group-based HIV prevention program to a program delivered primarily by computer and the developers of the original, effective group-based program at Emory University.

Computer-based interventions have been shown to have the potential to be at least as effective as human-delivered interventions at influencing HIV risk behaviors (Lighfoot, Comulada, & Stover, 2006; Noar, Black, & Pierce, 2009). Moreover, they can often be implemented at lower cost, afford greater flexibility of intervention administration, and allow more customized tailoring to individual users' needs. Thus, the translation procedures we describe are potentially applicable to the gamut of efficacious individual-level and group-level HIV interventions that seek to change risky behavioral antecedents.

We begin by describing the steps we took in translating the widely used, effective HIV prevention group-level intervention called SISTA (Sisters Informing Sisters on Topics About AIDS) into a computer-delivered intervention called SAHARA (SISTAs Accessing HIV/AIDS Resources At-a-click). We then describe briefly a preliminary outcome study that showed that the computer-delivered intervention, when followed by a brief 20-minute wrap-up session with a health educator, was effective in promoting consistent condom use during vaginal sex among African American women aged 18-29. Details of the outcome study are provided in a separate paper (Wingood et al., 2011). We include highlights here to demonstrate the real-world success of our translation efforts.

## DEVELOPING SAHARA

SISTA is a group-level, gender- and culturally relevant intervention designed to increase condom use with African American women aged 19-29. Five peer-led group sessions, 2 hours each in length, are conducted that focus on ethnic and gender pride, HIV knowledge, assertiveness skills training, behavioral self-management around sexual risk reduction behaviors, and coping skills. The intervention is based on social learning theory as well as the theory of gender and power. SISTA has the following seven "core components," which the developers believe to be respon-

TABLE 1. Steps in Developing SAHARA

---

<b>Step 1. Develop a plan to translate the group-level intervention to a multimedia intervention.</b>
a. List components of the original group-level program.
b. Develop an initial plan or outline for translating components of the group-level program to a computer-based program, making sure that all core components of the original program are preserved (Table 2).
c. Meet with developers of the original program to discuss and secure their approval for the translation plan.
d. Finalize the translation plan based on developer input.
<b>Step 2. Develop and test the software for the computer-based intervention.</b>
a. Produce an interactive, multimedia DVD product that brings the program to life (Table 3 gives table of contents or list of modules comprising the product).
i. Write detailed storyboard for each module.
ii. Create (shoot and edit) video clips.
iii. Create and record narrator scripts.
iv. Program multimedia content and integrate all the above components into Flash modules.
b. Have the product reviewed by the original program developers.
c. Have the product reviewed by representatives of the target audience.
d. Revise the software based on these reviews.

---

sible for the program's effectiveness: (a) the use of small-group sessions to discuss the session objectives, model skills development, role-play women's skills acquisition, and address the challenges and joys of being an African American woman; (b) the use of a skilled facilitator(s) to lead the group sessions; (c) use of cultural and gender-appropriate materials to promote pride and enhance self-worth in being an African American woman (e.g., the use of poetry by African American women); (d) the teaching of communication skills, both verbal and nonverbal, to show that the woman cares for her partner and needs to protect herself (e.g., negotiation skills, assertive communication skills); (e) instruction on how to effectively and consistently use condoms (i.e., condom use skills); (f) discussion of cultural and gender-related barriers and facilitators to using condoms (e.g., providing information on African American women's risk of HIV infection); and (g) emphasis on the importance of partner's involvement in safer sex (i.e., enhancing partner norms supportive of condom use). (CDC Diffusion of Effective Behavioral Interventions, 2010).

In the mid 1990s, SISTA developers showed that SISTA participants were more likely to use condoms consistently for vaginal sex than control group participants 3 months postintervention (adjusted OR [AOR] = 2.1; 95% confidence interval [CI] = 1.03-4.15,  $p < .04$ ; DiClemente & Wingood, 1995). Since that seminal study, SISTA has been disseminated widely and implemented by scores of health educators to hundreds of African American women aged 19-28.

We translated SISTA into SAHARA (SISTAS Accessing HIV/AIDS Resources at a Click), an innovative HIV prevention program that delivers an updated version of SISTA via two 1-hour computer sessions, followed by a brief, 20-minute in-person wrap-up with a health educator. SAHARA takes only a quarter of the time to deliver as SISTA. Yet it retains many of the interactive features of the original five-session SISTA intervention (DiClemente & Wingood, 1995; Wingood & DiClemente, 2006) via a combination of video clips featuring group discussions and modeling of appropriate sexual- and contraceptive-related behavior as well as interactive modules that facilitate cognitive rehearsal, provide learning experiences via games and quizzes, and provide opportunities for simulated role-play.

Table 1 summarizes the steps we took in developing SAHARA. The steps should be generalizable to other efforts aimed at translating an individual- or group-level intervention to a computer-based intervention.

TABLE 2. Initial Plan for SISTA-to-SAHARA Translation

Existing Five-Session Group SISTA	Two-Session SAHARA Translation
<b>SISTA Session 1: Ethnic/gender pride</b>	<b>SAHARA Session 1: Enhancing ethnic/gender pride and awareness of HIV risk</b>
1. Welcome, introductions, and ground rules	Narrated introduction and tutorial are presented on how to use the program.
2. Readings from African American poetry	Poetry is presented in text format and read by a narrator.
3. Discussion of positive aspects of being an African American woman and identification of African American women role models	Thought questions are presented in text and audio formats; after each question, the screen freezes so the user can think about answers; video presentations follow of young African American women discussing the issues.
<b>SISTA Session 2: HIV education</b>	
4. Personal values clarification activity—participants identify values most important to them (e.g., spirituality, family)	User prioritizes values by clicking on them and dragging them to categories. (Audio component facilitates this activity for persons with limited literacy skills.) Then thought questions are presented; screen freezes so user can think about answers; user can then click to see/hear sample responses.
5. Examination of gendered factors that increase African-American women's HIV vulnerability (e.g. douching and depression)	Series of screens presents vulnerability factors in text, icons, and audio. User completes brief interactive quiz to test knowledge; quiz can be repeated if desired.
6. Activity in which participants select "hypothetical sexual partners" by examining many attributes of a potential partner (e.g., being physically attractive, being trustworthy, having the potential to earn money, being a drinker)	User is presented with profiles of hypothetical partners (via audio and visuals) and asked to rank their desirability by clicking on and dragging photos. Thought questions are presented; screen freezes while user thinks about answers. User can click to see/hear sample responses.
<b>SISTA Session 3: Assertiveness skills training</b>	<b>SAHARA Session 2: Enhancing communication, condom use and healthy relationship skills.</b>
1. Examination of assertive, passive and aggressive communication styles	Examples of styles and characteristics of each are presented in text and audio formats. In a brief interactive quiz, user identifies the communication style of vignettes presented via text and audio. Computer provides feedback on responses to reinforce learning.
<b>SISTA Session 4: Behavioral self-management</b>	
2. Instruction in how to refuse unsafe sexual requests using "I" statements, and norm-setting exercises that promote consistent condom use and dispel common myths	Sample scenarios are presented via audio and text. Screen freezes while user is encouraged to imagine how she would respond and to practice the response in her head.
3. Modeling of proper condom use	Video clip demonstrating proper condom use is presented.
4. Condom use role-plays	Sample scenarios are presented via audio and text. Screen freezes; user is encouraged to imagine how she would respond and to practice the response in her head. Then the user participates in a simulated role play by viewing sample requests for unsafe sex and selecting responses.
<b>SISTA Session 5: Coping skills</b>	
5. Examination of characteristics of healthy and unhealthy relationships	Series of screens presents characteristics via text, pictures, and audio. User completes brief interactive knowledge-based quiz that can be repeated if desired.
6. Graduation ceremony	Video of health educator congratulating the user on completing the program and providing reinforcement and encouragement.

### STEP 1. DEVELOPMENT OF TRANSLATION PLAN

The first step was to develop a plan to translate the group-level intervention to a computer-administered multimedia software program. First, we listed the components of the 5-session group-level intervention (Table 2, column 1) and developed a plan for translating each component to its multimedia equivalent (Table 2, column 2). Then we met with developers of the original group-level program to make sure that our translation plan included—directly or in simulated fashion—all of the seven original program's "core components" noted earlier.

## STEP 2. SOFTWARE DEVELOPMENT

Armed with a translation plan approved by the original developers as faithful to SISTA's core components, we set out to produce an interactive, multimedia software program that could be run with basic computer hardware and software.<sup>1</sup> This would allow members of the target population (African American women aged 18-29) to run SAHARA directly, either at home<sup>2</sup> or through computers housed at health care agencies and community-based organizations that they interact with (e.g., Planned Parenthood clinics). Software development included creation of a table of contents listing the multimedia product's modules, creation of a detailed storyboard for each module, creation of the video clips and narrator scripts specified in the storyboard, and programming and integration of the multimedia components. All programming was developed using Adobe Flash and its ActionScript scripting language.

Flash was determined to be optimal for the large scale multimedia development required for this project because it allows easy integration of video, audio, animation, custom navigation features and complex interactivity and branching. Flash has been shown to be an effective development method for interactive learning (Hammerston, 2005; Mayer, Dow, & Mayer, 2003). Flash has an almost universal user base. Over 98% of U.S. computers have installed Flash software; a free Flash download is available for those who do not have the software.

Table 3 provides the final table of contents for SAHARA and a short description of each of the program's major modules.

As noted in Table 3, SAHARA consists of two sessions, each taking approximately 1 hour to complete. Each session is broken into smaller modules requiring approximately 2-8 minutes to complete, and in some instances the modules are broken into smaller individual activities. All modules include full narration, include at least one video segment, and give the user control of pacing via pause and play buttons. All of the core components of the SISTA program (Step 1) are included in SAHARA. Discussions in SAHARA among a small group of young African American female friends (the SISTAS) simulate the use of small group sessions in SISTA. A skilled female African American health educator guides the SAHARA sessions. In keeping with best practices in multimedia education, each of the SAHARA modules is made available to the user both as an integrated part of the program and as a repeatable stand-alone module to allow for self-paced learning and repetition of material (Atkinson & Gold, 2002; Goldman & Torrisi-Steele, 2005; Light & Cox, 2001; Mayer & Chandler, 2001). To give the reader a feel for the SAHARA program, a free sampler is available from [http://www.socio.com/other/sahara\\_sampler/start.html](http://www.socio.com/other/sahara_sampler/start.html)

## EVALUATING SAHARA: RETENTION OF INTERVENTION EFFECTIVENESS

The SAHARA field implementation also included a brief 20-minute small-group discussion that took place immediately following the second computer-based video

1. Hardware/Software requirements for SAHARA are: Windows XP or Vista, 1Ghz processor or higher, 512MB or more RAM, USB 2 port (for the flash-drive version), 400MB free hard disk space (for the download version), computer speakers or headphones, and a mouse.

2. Because SAHARA's efficacy has thus far been tested only in a field setting in which the computer-delivered intervention was followed by a 20-minute review session with a health educator, it is important that the postintervention review session with a health educator take place whether the SAHARA intervention is taken at home or in a clinic or community-based organization.

TABLE 3. Table of Contents for SAHARA

Title	Content
<b>Session 1</b>	
Welcome to SAHARA, Sista!	Introductory presentation about the program including the name and purpose. Recitation of a poem about racial pride by an African American poet.
Optional Computer Tutorial	Demonstrates the basic navigational functions of the program and provides opportunity for learning to use a mouse.
What Does It Mean to Be a Black Woman?	Short video segments of a group of Sistas with each Sista stating what it means to her to be a Black woman, followed by a segment in which the user is asked to think about what it means to her to be a Black woman.
Who Is a Strong Black Woman in Your Life?	Video segment of each Sista sharing a description of a strong Black woman in her life. The user is asked to think about and identify a strong Black woman in her life.
What's Most Important	Multimedia presentation explaining the concept of personal values, an interactive exercise in which the user selects and ranks the values most important to her, two "think about it" segments in which the user thinks about why it is difficult to identify values important to her and the importance of knowing her values, and a video segment of the Sistas discussing what is important to them.
My Body, My Spirit	Multimedia presentation on the value of the body followed by video segments of each Sista describing how she honors her "temple."
What's All This About HIV and AIDS?	Multimedia presentation that defines HIV and AIDS and describes their impact on African American women.
How Can I Protect Myself?	Multimedia presentation about the levels of HIV risk for specific activities followed by a game that allows the user to evaluate her comprehension of the material and reinforces the information.
Other Infections . . . Curable? Or Not?	Short multimedia introduction to STIs. The user controls an interactive STI selection mechanism to view in-depth information about specific STIs.
Risk Factors and My Life	Multimedia presentation about what puts young African American women at risk, reviewing the relationship of personal choices to risk. A short interactive game in game show format on the risks of douching. A multimedia presentation on the influence of the media in the user's life. Video segment of the group of Sistas discussing risk factors in their lives.
Men! (The Dating Game)	Multimedia segment about the decisions women make when choosing a sexual partner, reviews the concept of identifying desirable characteristics in the men they date. The user is presented with an interactive "dating game" in which she selects men to date based solely on appearance. She is given the opportunity to think about her choices and the usefulness of selecting partners based on superficial characteristics. The user is then presented with a series of potential partners and is asked to decide if she would date that person. The positive and negative characteristics of each partner are discussed by the Sistas in video segments.

AMOUR: 5 Options	Multimedia segment about 5 safe/safer sex options. Includes a video wrap up of Session 1 by a health educator.
<b>Session 2</b>	
Welcome Back! Let's Talk Sex Passive, Aggressive, or Assertive?	Video segment with a health educator welcoming the user to Session 2 and briefly reviewing concepts from Session 1. Multimedia segments describing each of the communication types followed by video segments demonstrating each communication type followed by a multimedia segment on using assertive communication techniques with a partner.
Diggin' on James	User is presented with a scenario in which she must make a decision about whether to participate in a high risk sexual activity. After making a decision she is asked to think about how the scenario and decisions would have been different if a condom had been available.
Condoms: Putting AMOUR to Work Condoms: His Excuses, Your Comebacks	Detailed multimedia segment describing 5 safe/safer sex options. Includes a video segment of a couple modeling a condom use negotiation. Condom use negotiation simulation requiring the user to select an appropriate comeback to a series of excuses put forth by a prospective sexual partner.
Condoms: Hands On!	Video segments of a health educator demonstrating how to use a male condom and a female condom, followed by a video segment of the Sistas practicing putting condoms on a proxy to further demonstrate and reinforce the concepts.
Ask Sista Shamika: What Advice Would You Give?	User views a series of questions/answers about sex and HIV from an advice columnist. The user is presented with a letter requesting advice and asked to think about what advice she would give to the author.
Thinking About Relationships: Healthy and Unhealthy	Multimedia presentation overview of healthy and unhealthy relationships. The user is presented with an interactive game where she determines whether common elements of relationships are healthy or unhealthy.
Warning Signs: Relationship Violence	Multimedia presentation about physical and emotional abuse in relationships, early warning signs of relationship violence, and the dangers to be aware of when breaking off an abusive relationship.
Healthy Relationships Stay Strong, Sista!	Multimedia presentation describing the elements of a healthy relationship. Video segment with the SAHARA health educator providing encouragement to implement the information from the program and congratulations on completing the program.

*Note.* STIs = sexually transmitted infections.

session; the group typically included 4-6 women. This small group, facilitated by a health educator, provided an opportunity for program participants to practice two skills taught in the computer sessions: (1) condom negotiation and (2) hands-on practice of correct male and female condom application, using anatomical models.

We wanted to see if the 2-hour SAHARA multimedia program, in conjunction with the 20-minute review session with the health educator, was effective in bringing about the sexual and contraceptive behavior changes that the much lengthier original SISTA group-level intervention was able to achieve.

An outcome study was conducted at Planned Parenthood, Atlanta, Georgia, from April 2006 to March 2007. The SAHARA recruitment team screened a total of 506 women to see if they fit the age range and criteria of the study (unmarried, non-cohabiting African American women aged 18-29 reporting having had unprotected vaginal sex in the past 90 days). Of these 506 individuals, 346 were not eligible to participate in the study. The primary reasons that participants were not eligible included their being married or living with their partner (35%) and not being sexually active or using condoms 100% of the time (34%). Thus, a total of 160 were eligible to participate in the study. Of the 160 eligible women, 135 women actually participated, yielding a participation rate of 84%.

The 135 participants were randomized to one of two conditions: 67 (49.7%) to SAHARA, the digitized HIV risk reduction intervention, and 68 (50.3%) to a general health education control condition. Like the SAHARA condition, the control group was facilitated by a trained African American female facilitator. Participants in the control condition participated in a 1-hour group session that consisted of 15-minutes of general health information and a 30-minute video produced by the CDC on the importance of HIV prevention for African American women. For the final 15 minutes, the facilitator answered questions participants had pertaining to the HIV prevention video. All participants in the control condition also received brochures on proper nutrition and HIV prevention for African American women. The control condition was designed to represent "usual care"; that is, it represented clients' typical exposure to health and HIV prevention education at Planned Parenthood.

The outcome study hypothesis was that participants in the SAHARA condition would exhibit more consistent condom use in the 3 months following the intervention relative to control group participants receiving Planned Parenthood's "usual standard of care."

Of the 67 participants assigned to the SAHARA HIV risk reduction intervention, 60 (89.6%) completed both of SAHARA's computer-administered intervention sessions (see Table 3) and the 20-minute group session described earlier; 58 (87%) also completed the 3-month follow-up assessment. Of the 68 participants allocated to the general health education condition, 58 (85%) completed the 60-minute health education group session and the 3-month follow up assessment.

#### INSTRUMENTATION AND DATA COLLECTION

Data collection occurred at baseline and at 3-month follow-up. The baseline assessment was administered via audio computer-administered survey interview (ACASI) and assessed sociodemographics, HIV knowledge, condom use self-efficacy, communication frequency, and condom barriers using scales previously validated with African American women. To enhance confidentiality, codes rather than names were used; none of the facilitators had access to ACASI information. To minimize potential interviewer bias, ACASI monitors were blind to participants' condition. At the 3-month follow-up, participants were reassessed with similar measures. To enhance

accurate reporting of sexual behavior, we used the timeline followback methods that incorporated recall enhancing (i.e., using a 90-day calendar) to provide visual cues to aid in retrospective recall of sensitive behavior. There is evidence for the feasibility, reliability, and validity of this method for enhancing recall of HIV-associated sexual behavior (Carey, Carey, Maisto, Gordon, & Weinhardt, 2001).

The HIV knowledge scale ( $\alpha = .70$ ) was adapted from a previous HIV knowledge scale developed by the study authors (DiClemente & Wingood, 1995). It contained 10 items; responses were reported as either true or false. Higher scale scores indicated greater HIV knowledge. An example of a scale item is "Having an STD increases a person's risk of getting HIV". The condom use self-efficacy scale ( $\alpha = .89$ ) contained 9 items; responses ranged from 1 (a lot) to 5 (none). Lower scale scores indicated greater self-efficacy in using condoms correctly. An example of a scale item is "How much of a problem would it be for you to unroll a condom fully to the base of the penis?" (Wingood & DiClemente, 1998).

The primary outcome, consistent condom use during vaginal sex in the prior 90 days, was calculated as condom use during every episode of vaginal intercourse (100% of the time) with a main partner. Consistent condom use was chosen as the primary outcome measure because findings from prospective studies indicate that condoms, when used consistently, can provide a 70-100% reduction in the risk of HIV transmission. Specifically findings from the European Study Group on Heterosexual Transmission of HIV observed no seroconversions among couples who used condoms consistently, whereas the seroconversion rate among inconsistent condom users was significantly higher: 4.8 per 100 person-years (De Vincenzi, 1994). Furthermore, consistent condom use has been used as a primary outcome in several CDC-defined evidence-based HIV interventions for African American women (DiClemente & Wingood, 1995; DiClemente, Wingood, & Harrington, 2004).

The ACASI also assessed the proportion of condom protected vaginal intercourse acts in the prior 90 days. This item was assessed by first asking participants, "In the past 90 days, how many times did you have vaginal intercourse?" Responses to this question would serve as the denominator in calculating the variable proportion of condom protected vaginal intercourse acts. Subsequently, participants would be asked, "In the past 90 days, when you had vaginal intercourse how many of these times was a condom used?" Responses to this question would serve as the numerator in calculating the variable proportion of condom protected vaginal intercourse acts. Vaginal sex was defined as when a man puts his penis into a woman's vagina. This definition of vaginal sex has been used previously with this target population (DiClemente & Wingood, 1995). Similar questions were posed to participants to assess the proportion of condom protected oral sex acts in the prior 90 days.

## RESULTS

On average, outcome study participants were 24 years of age, approximately a third had completed at least 2 years of college, and nearly a third reported living alone. Additionally, the majority of women (70%) were employed and worked on average 30 hours a week.

At 3 months postintervention, adjusting for the baseline value of the mediator, the study cohort, and partner payment of living expenses, participants randomized to the digitized HIV intervention were more knowledgeable about sexually transmitted infection (STI) prevention (intervention mean = 9.45 [ $SD = 0.09$ ] vs. comparison

mean = 8.99 [ $SD = 0.09$ ];  $p < .001$ ) and reported higher scores on the measure of condom use self-efficacy (intervention mean = 30.81 [ $SD = 0.52$ ] vs. comparison mean = 28.96 [ $SD = 0.51$ ];  $p < .012$ ). At 3 months postintervention, adjusting for the baseline value of the behavioral outcome and the study cohort, participants randomized to the digitized HIV intervention reported a higher percentage of condom protected sex acts (intervention percent = 85.3 [ $SD = 10.1$ ] vs. comparison percent = 52.8 [ $SD = 9.5$ ];  $p < .03$ ). Additionally, participants randomized to the digitized HIV intervention were more likely to use condoms consistently for vaginal sex (AOR = 5.9; 95% CI = 1.09-31.95,  $p < .039$ ). This SAHARA OR—adjusted to control for consistent condom use at baseline, use of contraception, financial dependence on partner, marijuana use in the past 30 days, and condom use barriers—compares favorably with the AOR obtained for the original SISTA program at a similar time period of 3 months postintervention. The comparable OR for SISTA on the variable consistent condom use for vaginal sex was 2.1, 95% CI = 1.03-4.15,  $p < .04$ . (DiClemente & Wingood, 1995)

In sum, positive knowledge, self-efficacy, and risk reduction behavior effects were obtained from the use of SAHARA, the shorter, less expensive, easier to administer version of SISTA, a widely disseminated HIV prevention program for African American women.

## DISSEMINATING SAHARA

To facilitate dissemination to a broad range of users with varying needs, *SAHARA Professional* is being made available on two platforms: USB flash drive, also sometimes called a thumb drive or flash key, and Internet download. The program is aimed at a health educator audience and includes the SAHARA software plus a printed User's Guide/Facilitator's Manual with instructions on how to set up the computer program and how to conduct the 20-minute group session after the second and final computer session.

Each dissemination method (USB flash drive and Internet download) was chosen because it provides a specific advantage to the purchaser or end user. Distribution on the USB flash drive allows an implementing agency to provide the end user with the flash drive to use in the privacy of her home or at a public computer of her choosing. This allows flexibility for program participants and reduces the physical space and resources required of the agency to implement the program. The use of flash drives also allows implementing agencies to purchase a small number of drives and reuse them with larger numbers of participants, significantly reducing the per participant program implementation cost. Agencies with more resources can permanently distribute the drives to participants and encourage them to review the program at a later time or to pass the program along to others, eventually leading to viral dissemination of the program among the target population.

The Internet download version of SAHARA is an installed software product accompanied by a perpetual license that allows the purchaser to install and use the software on a single computer forever without additional cost. This distribution method allows purchasers to pay for and download the software via the Internet and immediately install the product to their computer. Because the software is installed, it eliminates the possibility of lost, stolen, or damaged media that may occur with USB drive-based distribution. This format is cost-effective for agencies that want to make the program available on computers at their site long term.

## DISCUSSION

There are numerous advantages and challenges to consider when developing or implementing a computer-based HIV intervention. On the plus side are several cost and logistical advantages such as lower program delivery costs, greater administration flexibility and access for program participants, and a level of fidelity of program delivery that is difficult to maintain in in-person program formats using different health educators. The other primary advantages lie in the ability of a computer-based program to tailor the materials displayed to an individual user. Where in-person programs often have to reach a broad spectrum of group session participants, a computer-based intervention can be programmed to present specific, tailored information based on a user's specific response to interactive activities.

Table 4 describes in further detail the advantages and challenges of computer-based HIV prevention programs compared to the more traditional health-educator-facilitated, in-person group-level programs. An advantage of electronic SAHARA is its low distribution price relative to its parent SISTA program. On the Sociometrics Web site, SAHARA sells for about the price of a textbook (\$60 for the flash drive version and \$35 for the download version). In contrast the SISTA replication package sells for significantly more (\$350 for the printed program-in-a-box version). Although printed SISTA can be obtained from the CDC at little or no cost, an organization must meet severe requirements (relating to confidentiality, cultural competence, data security, informed consent, legal and ethical policies, linkage of services, personnel policies, referrals, safety, selection of target populations, volunteers, and program evaluation) before it can do so (CDC DEBI, 2010). Fidelity of program delivery is assured by the computer delivery of SAHARA. In contrast it is easier for health educators to change or adapt group SISTA during implementation. In addition, the Group SISTA experience could vary more than the SAHARA experience, as a function of the charisma or skills of the health educator delivering the SISTA program.

As shown in Table 4, there are a number of challenges that may need to be addressed when developing or implementing a computer based prevention program. Many of these challenges can be addressed during program development through careful planning and collaboration with those responsible for technology development. For example, knowing that future program updates to address changes in either science or fashion and language may eventually be needed, SAHARA was developed using a modular format. The program comprises more than 125 modular files. Each can be replaced without requiring edits to any of the surrounding programming which significantly reduces the costs of updates. Similarly, the decision to make the program available on a portable USB flash drive helped address the challenge of agencies having limited computer hardware available for participant use. By making the program entirely portable it can be used at any time, anywhere a computer is available.

## CONCLUSION

As a recent, large review and synthesis of meta-analytic evidence regarding behavioral interventions to reduce HIV-related sexual risk behavior concluded, "Insights from translational work suggest that additional interventions that maximize the feasibility of translation and dissemination may need to be developed" (Noar,

TABLE 4. Advantages and Challenges of Computer-Based Prevention Interventions

Factor	Advantages of Computer-Based Interventions	Challenges of Computer-Based Interventions
Cost of program delivery	Cost of acquiring/delivering a program is relatively low because limited staff time, materials and space are required. Lower cost of program delivery can make it more feasible to deliver the program, serve more participants, and devote a greater percentage of resources to other key aspects of programming, such as participant recruitment and retention, staff training, etc. (Downs et al., 2004; Fotheringham, Owies, Leslie, & Owen, 2000; Marsch & Bickel, 2004; Newman, Kenardy, Herman, & Taylor, 1997; Noar et al., 2009; Thomas, Cahill, & Santilli, 1997).	The number of clients who can participate in the program at any given time is limited to the computers (hardware, software, Internet, etc.) available in the settings in which the intervention can be accessed (e.g., in the agency, the participant's home, etc.).
Fidelity of program delivery	Content and administration formats are held constant. In staff-delivered programs, especially in contexts of poor staff training and high staff turnover, implementation drift is common (Atkinson & Gold, 2002; Downs et al., 2004; Lightfoot et al., 2006; Marsch & Bickel, 2004).	
Physical access	Computers can decrease physical barriers to program participation by allowing access according to a flexible schedule and from various locations—including a participant's home (Fotheringham et al., 2000; Goldman & Torrisi-Steele, 2005; Lightfoot et al., 2006; Noar et al., 2009; Schneider, Schwartz, & Fast, 1995; Weinhardt, Mosack, & Swain, 2007). An audio component and use of pictures, icons, etc. can make the intervention accessible to persons with limited literacy skills (Marsch & Bickel, 2004).	Computer literacy and comfort vary across groups. A "tutorial" at the beginning of the intervention can help improve computer literacy and comfort.
Tailoring to address clients' demographic characteristics and risk levels	Tailoring a program to address clients' demographic characteristics and risk levels is key to successful outcomes (CDC, 2001; Kelly et al., 2000; Kennedy, Mizuno, Hoffman, Baume, & Strand, 2000; Kirby, 2001; Pedlow & Carey, 2004; Raj, Amaro, & Reed, 2001; Stanton et al., 2005; Vinh-Thomas, Bunch, & Card, 2003; Wilson & Miller, 2003). Computer-based programs can include customization and branching that tailors program content to characteristics of users, such as gender, ethnicity, sexual orientation, risk level and patterns, etc. (Downs et al., 2004; Fotheringham et al., 2000; Goldman & Torrisi-Steele, 2005; Marsch & Bickel, 2004; Noar et al., 2009).	Branching can involve significant programming costs. As target populations, risk/protective factors, fashions, and the state of the science change over time, additional, potentially expensive, programming and multimedia development are required to update the product.
Tailoring to address clients' learning styles	Computers can allow for self-paced learning, variable time on task, and repetition of material, promoting more complete and sustained learning (Atkinson & Gold, 2002; Goldman & Torrisi-Steele, 2005; Light & Cox, 2001; Weinhardt et al., 2007).	

<p>Appeal of and engagement with the intervention</p>	<p>Computers can decrease psychological barriers to program participation. In particular, people feel more comfortable interacting with a computer rather than with other people about sensitive health topics, owing to increased confidentiality (Fotheringham et al., 2000; Goldman &amp; Torrisi-Steele, 2005; Robinson, Patrick, Eng, &amp; Gustafson, 1998; Weinhardt et al., 2007). Computer interventions can afford the opportunity to practice skills with little or no embarrassment (Atkinson &amp; Gold, 2002; Evans, Edmunson-Draner, &amp; Harris, 2000; Goldman &amp; Torrisi-Steele, 2005). The novelty of receiving the material through a new medium, particularly those that include multimedia elements, may make messages received through that medium more attractive. (Atkinson &amp; Gold, 2002; Fotheringham et al., 2000; Hawkins, Gustafson, Chewning, Bosworth, and Day, 1987; Sproull &amp; Kiesler, 1991).</p>	<p>Some people may prefer the social environment afforded by an in-person intervention.</p>
<p>Opportunities for modeling and feedback</p>	<p>Video clips can provide appropriate modeling opportunities (e.g., the cognitive side of skills building). In-person programs may provide poor modeling opportunities or inaccurate feedback. Computer programs can consistently provide accurate feedback on knowledge, in contrast to feedback from other program participants or poorly trained staff.</p>	<p>Interaction with a staff member is needed to assess clients' behavioral skills and provide corrective/constructive feedback and positive reinforcement (Goldman &amp; Torrisi-Steele, 2005; Light &amp; Cox, 2001).</p>
<p>Opportunities for social norm setting (addressing external motivation to change)</p>	<p>Authentic characters, those similar to the user, in videos and imagery can help to establish a social norm in which the target skills/behaviors are seen as desirable (i.e., the affective side of skills-building).</p>	<p>An in-person component or interaction with a staff member via the phone or Internet may provide additional key social support for change.</p>
<p>Intellectual property protection of intervention program materials</p>	<p>Unlike printed materials that are easily copied, computer-based materials can be protected via software programming to prohibit unauthorized sharing or copying of materials.</p>	<p>Identifying and implementing intellectual property protection solutions can be costly, requiring programmers and technology expertise.</p>

2008, p. 351). Computer-administered programs can continue to retain the interactive learning features of their efficacious forebears, while reaching audiences harder to reach in group settings by health educators (e.g., rural audiences, out-of-school youth populations, bedridden or homebound AIDS patients). Our experience with the SISTA to SAHARA translation gives hope that such computer-based adaptations will maintain the effectiveness of their health educator-facilitated originals, with the potential for larger-scale dissemination and implementation. The outcome study we conducted included a wrap-up 20-minute group discussion session with a health facilitator. Future work will test whether similar positive findings can be obtained from use of the computer-delivered intervention alone. The field of HIV prevention should be the ultimate beneficiary of the explorations seeking to bring effective HIV prevention in formats that are easier to disseminate widely at lower cost.

## REFERENCES

- Atkinson, N. L., & Gold, R. S. (2002). The promise and challenge of eHealth interventions. *American Journal of Health Behavior, 26*, 494-503.
- Blankenship, K. M., Friedman, S. R., Dworkin, S., & Mantell, J. E. (2006). Structural interventions: Concepts, challenges and opportunities for research. *Journal of Urban Health, 83*, 59-72.
- Bonell, C., Hargreaves, J., Strange, V., Pronyk, P., & Porter, J. (2006). Should structural interventions be evaluated using RCTs? The case of HIV prevention. *Social Science and Medicine, 63*, 1135-1142.
- Card, J. J., Benner, T., Shields, J. P., & Feinstein, N. (2001). The HIV/AIDS Prevention Program Archive: A collection of promising prevention programs in a box. *AIDS Education and Prevention, 13*, 1-28.
- Card, J. J., Amarillas, A., Conner, A., Dull Akers, D., Solomon, J., & DiClemente, R. (2007). *The complete HIV/AIDS teaching kit*. New York: Springer.
- Carey, M. P., Carey, K. B., Maisto, S., Gordon, A. B., & Weinhardt, L. S. (2001). Assessing sexual risk behavior with the timeline followback (TLFB) approach: Continued development and psychometric evaluation with psychiatric outpatients. *International Journal of STDs and AIDS, 12*, 365-375.
- Centers for Disease Control and Prevention. (2010). Retrieved September 10, 2010 from [http://www.cdc.gov/hiv/topics/prev\\_prog/ahp/resources/guidelines/pdf/pro\\_guidance\\_SISTA.pdf](http://www.cdc.gov/hiv/topics/prev_prog/ahp/resources/guidelines/pdf/pro_guidance_SISTA.pdf)
- Centers for Disease Control and Prevention. (2001). *Compendium of HIV prevention interventions with evidence of effectiveness*. Retrieved February 16, 2005, from <http://www.cdc.gov/hiv/pubs/HIVcompendium/hivcompendium.htm>
- Centers for Disease Control and Prevention. (2008). *Interventions: SISTA*. Retrieved June 20, 2008, from <http://www.effectiveinterventions.org/go/interventions/sista>
- Copenhaver, M. M., Johnson, B. T., Lee, I. C., Harman, J. J., Carey, M. P., & the SHARP Research Team. (2006). Behavioral HIV risk reduction among people who inject drugs: Meta-analytic evidence of efficacy. *Journal of Substance Abuse Treatment, 31*, 163-171.
- Crepaz, N., Lyles, C. M., Wolitski, R. J., Passin, W. F., Rama, S. M., Herbst, J. H. et al. (2006). Do prevention interventions reduce HIV risk behaviours among people living with HIV? A meta-analytic review of controlled trials. *AIDS, 20*, 143-157.
- Darbes, L., Crepaz, N., Lyles, C., Kennedy, G., & Rutherford, G. (2008). The efficacy of behavioral interventions in reducing HIV risk behaviors and incident sexually transmitted diseases in heterosexual African Americans. *AIDS, 22*, 1177-1194.
- Des Jarlais, D. C. (2000). Structural interventions to reduce HIV transmission among injecting drug users. *AIDS, 14*(Suppl. 1), S41-S46.
- De Vincenzi, I. (1994). A longitudinal study of human immunodeficiency virus transmission by heterosexual partners. *New England Journal of Medicine, 331*, 341-346.
- DiClemente, R. J., & Wingood, G. M. (1995). A randomized controlled trial of an HIV sexual risk reduction intervention for young African American women. *Journal of the American Medical Association, 274*, 1271-1276.
- DiClemente, R. J., Wingood, G. M., & Harrington, K. F. (2004). Efficacy of an HIV prevention intervention for African American adolescent girls: A randomized controlled trial. *Journal of the American Medical Association, 292*, 171-179.

- Downs, J. S., Murray, P. J., Bruine de Bruin, W., Penrose, J., Palmgren, C., & Fischhoff, B. (2004). Interactive video behavioral intervention to reduce adolescent females' STD risk: A randomized controlled trial. *Social Science and Medicine*, 59, 1561-1172.
- Evans, A. E., Edmunson-Drane, E. W., & Harris, K. K. (2000). Computer-assisted instruction: An effective instructional method for HIV prevention education? *Journal of Adolescent Health*, 26, 244-251.
- Fotheringham, M. J., Owies, D., Leslie, E., & Owen, N. (2000). Internet-based strategies in teaching and research. *American Journal of Preventive Medicine*, 19, 113-120.
- Goldman, J. D. G., & Torrisi-Steele, G. (2005). Pedagogical design considerations in sex education on interactive multimedia using CD-ROM: An example of sexual intercourse. *Sex Education*, 5, 189-214.
- Hammerton, M. (2005). To flash or not to flash – the use of macromedia flash as an effective tool for the production of e-learning materials in higher education. In *HEA bioscience, physical science and materials science proceedings of the Science Teaching and Learning Conference 2005* (pp. 161-163).
- Hawkins, R. P., Gustafson, D. H., Chewning, B., Bosworth, K., & Day, P. M. (1987). Reaching hard-to-reach populations: Interactive computer programs as public information campaigns for adolescents. *Journal of Communication*, 37, 8-28.
- Herbst, J. H., Beeker, C., Mathew, A., McNally, T., Passin, W. F., Kay, L. S. et al. (2007). The effectiveness of individual-, group-, and community-level HIV behavioral risk-reduction interventions for adult men who have sex with men: A systematic review. *American Journal of Preventive Medicine*, 32(4 Suppl.), S38-S67.
- Johnson, W. D., Diaz, R. M., Flanders, W. D., Goodman, M., Hill, A. N., Holtgrave, D. et al. (2008). Behavioral interventions to reduce risk for sexual transmission of HIV among men who have sex with men. *Cochrane Database Systematic Reviews* [online], 16, CD001230.
- Kelly, J. A., Heckman, T. G., Stevenson, L. Y., Williams, P. N., Ertl, T., & Hays, R. B. (2000). Transfer of research-based HIV prevention interventions to community service providers: Fidelity and adaptation. *AIDS Education and Prevention*, 12(Suppl. A), 87-98.
- Kirby, D. (2001). *Emerging answers: Research findings on programs to reduce teen pregnancy*. Washington, DC: National Campaign to Prevent Teen Pregnancy.
- Kirby, D., Laris, B.A., & Rollieri, L. (2006). *Sex and HIV education programs for youth: Their impact and important characteristics*. Washington, DC: Family Health International. Retrieved March 18, 2007 from <http://www.etr.org/recapp/programs/Sex-HIVedProgs.pdf>.
- Light, G., & Cox, R. (2001). *Learning and teaching in higher education: The reflective professional*. London: Sage.
- Lightfoot, M., Comulada, S., & Stover, G. (2006). Computerized HIV prevention intervention for adolescents: Indications of efficacy. *American Journal of Public Health*, 96, 10-13.
- Lyles, C. M., Kay, L. S., Crepaz, N., Herbst, J. H., Passin, W. F., Kim, A. S. et al. (2007). Best-evidence interventions: Findings from a systematic review of HIV behavioral interventions for US populations at high risk, 2000-2004. *American Journal of Public Health*, 97, 133-143.
- Marsch, L. A., & Bickel, W. K. (2004). Efficacy of computer-based HIV-AIDS education for injection drug users. *American Journal of Health Behavior*, 28, 316-327.
- Mayer, R. E., & Chandler, P. (2001). When learning is just a click away: Does simple user interaction foster deeper understanding of multimedia messages? *Journal of Educational Psychology*, 93, 390-397.
- Mayer, R., Dow, G., & Mayer, S. (2003). Multimedia learning in an interactive self-explaining environment: What works in the design of agent-based microworlds? *Journal of Educational Psychology*, 95, 806-813.
- Newman, M. G., Kenardy, J., Herman, S., & Taylor, C. B. (1997). Comparison of palmtop-computer-assisted brief cognitive-behavioral treatment to cognitive-behavioral treatment for panic disorder. *Journal of Consulting and Clinical Psychology*, 65, 178-183.
- Noar, S. M. (2008). Behavioral interventions to reduce HIV-related sexual risk behavior: Review and synthesis of meta-analytic evidence. *AIDS Behavior*, 12(3), 335-353.
- Noar, S. M., Black, H. G., & Pierce, L. B. (2009). Efficacy of computer technology-based HIV prevention interventions: A meta-analysis. *AIDS*, 23, 107-115.
- Pedlow, C. T., & Carey, M. P. (2004). Developmentally appropriate sexual risk reduction interventions for adolescents: Rationale, review of interventions, and recommendations for research and practice. *Annals of Behavioral Medicine*, 27, 172-184.
- Raj, A., Amaro, H., & Reed, E. (2001). Culturally tailoring HIV/AIDS prevention programs: Why, when, and how. In S. Kazarian & D. Evans (Eds.), *Handbook of cultural health psychology* (pp. 195-239). San Diego, CA: Academic Press.
- Robinson, T. N., Patrick, K., Eng, T. R., & Gustafson, D. (1998). An evidence-based approach to interactive health communication: A challenge to medicine in the infor-

- mation age. *Journal of the American Medical Association*, 280, 1264-1269.
- Schneider, S. J., Schwartz, M. D., & Fast, J. (1995). Computerized, telephone-based health promotion: II. Stress management program. *Computers in Human Behavior*, 11, 205-214.
- Sproull, L., & Kiesler, S. (1991). *Connections: New ways of working in the networked organization*. Cambridge, MA: MIT Press.
- Stanton, B., Guo, J., Cottrell, L., Galbraith, J., Li, A., & Gibson, C. (2005). The complex business of adapting effective interventions to new populations: An urban to rural transfer. *Journal of Adolescent Health*, 37, 163.e17-e26.
- Thomas, R., Cahill, J., & Santilli, L. (1997). Using an interactive computer game to increase skills and self-efficacy regarding safer sex negotiation: Field test results. *Health Education and Behavior*, 24, 71-86.
- UNAIDS (2008, January 4). *UNAIDS annual report 2007: Knowing your epidemic*. Retrieved June 27, 2008, from [http://data.unaids.org/pub/Report/2008/jc1535\\_annual\\_report07\\_en.pdf](http://data.unaids.org/pub/Report/2008/jc1535_annual_report07_en.pdf).
- Vinh-Thomas, P., Bunch, M. M., & Card, J. J. (2003). A research-based tool for identifying and strengthening culturally competent and evaluation-ready HIV/AIDS prevention programs. *AIDS Education and Prevention*, 15, 481-498.
- Weinhardt, L. S., Mosack, K. E., & Swain, G. R. (2007). Development of a computer-based risk-reduction counseling intervention: Acceptability and preferences among low-income patients at an urban sexually transmitted infection clinic. *AIDS and Behavior*, 11, 549-556.
- Wilson, B. D. M., & Miller, R. L. (2003). Examining strategies for culturally grounded HIV prevention: A review. *AIDS Education and Prevention*, 15, 184-202.
- Wingood, G.M., Card, J.J., Er, D., Solomon, J., Braxton, N., Lang, D. Seth, P., Carreine, J. & DiClemente, R.J. (2011). Preliminary efficacy of a computer-delivered HIV intervention for African-American women. *Psychology & Health*, 26, 223-234.
- Wingood, G. M., & DiClemente, R. J. (2006). Enhancing adoption of evidence-based HIV prevention interventions for African American women. *AIDS Education and Prevention*, 18(Suppl. A), 161-170.
- Wingood, G. M., & DiClemente, R. J. (1998). Gender-related correlates and predictors of consistent condom use among African American women: A prospective analysis. *International Journal of STD and AIDS*, 9, 139-145.