How to Develop CD-ROMs for Diabetes Education: Exemplar “Reproductive-Health Education and Awareness of Diabetes in Youth for Girls” (READY-Girls)

With the rising prevalence of diabetes and the need to prevent serious complications, interactive health technologies (IHTs), such as read-only memory compact disks (CD-ROMs), have the potential to provide both standardized and tailored health behavior interventions to improve diabetes self-management.\textsuperscript{1} Additionally, computer-based multimedia presentation helps people learn information more rapidly than traditional classroom lectures.\textsuperscript{2} Interactivity and multimedia presentation facilitate active learning and retention of knowledge over time.\textsuperscript{3} Instant access to information, as provided by a multimedia CD-ROM, allows users to get immediate feedback, which is also known to facilitate learning.\textsuperscript{2} IHTs are especially useful if they incorporate theory-based principles and provide individualized feedback and tailored information.\textsuperscript{14}

CD-ROM diabetes self-management interventions have been found to be feasible and effective in a variety of health care settings.\textsuperscript{1} Primary care studies by Glasgow et al.\textsuperscript{1,5,6} have shown that CD-ROMs for diabetes can be integrated into busy clinical practices to be used as adjuncts to standard care and as stand-alone resources.

CD-ROM programs present an educational media ideally suited to engage teenaged users. Given that every medical visit by a woman or adolescent girl with diabetes is considered a preconception visit,\textsuperscript{7} the importance of preconception counseling (PC) to plan future pregnancies cannot be overemphasized to teens.\textsuperscript{8} The American Diabetes Association (ADA) recommends that all women of childbearing potential receive PC,\textsuperscript{9} yet most diabetic women in the United States present to the health care system after conception.\textsuperscript{10-12} Therefore, to prevent unplanned pregnancies, the adolescent period before sexual activity begins is an ideal time to target for providing this information.

Previous PC programs focused on women who were imminently planning...
Pregnancy, and Diabetes. Want to Know About Sexuality, Women With Diabetes: What Teens

This program is a self-directed information delivery method that teens can do initially alone and that provides for follow-up discussion with a health care professional. The goals of the program are to raise the awareness of adolescents with type 1 diabetes about PC and to remove some of the barriers by eliminating the need for health care providers to directly initiate discussion of such a sensitive and uncomfortable topic. It also removes the mystique of what and how much to tell teen patients. This article describes the steps involved in developing an IHT program such as a CD-ROM and offers recommendations from lessons learned from READY-Girls.

Selecting Content, Format, and Theory: READY-Girls Program

READY-Girls is aimed at increasing diabetic adolescents’ awareness and knowledge of reproductive health issues and enhancing positive attitudes, self-efficacy, communication skills, and intentions of performing health-promoting reproductive behaviors. The project development team chose a stand-alone computer-based program rather than facilitator-led instruction to allow for complete fidelity of implementation. Implementation of the program is standardized for all users. Such standardization ensures that the integrity of the program will be maintained in all settings irrespective of health care provider training, site differences, or other factors that often come into play when such programs are implemented in the field.

Teen-targeted educational interventions that facilitate early and long-term reproductive health behavior changes could increase the proportion of women with diabetes who seek PC, preplan their pregnancies, and thereby improve their pregnancy outcomes. The program’s basic message to teens is one of reassurance, that although uncontrolled blood glucose levels could cause reproductive health problems, with tight glycemic control, almost all women with diabetes can have healthy sexual functioning, healthy pregnancies, and healthy babies. This information has the potential to set new standards of practice for certified diabetes educators and other health care professionals and become an integral part of all diabetic adolescent education that focuses on empowering teens to make informed choices.

The program has a solid foundation in evidence-based practice as described in research, literature, and standards of practice, such as the reproductive health awareness curriculum of Georgetown University’s Institute of Reproductive Health,17 the ADA’s published guidelines on PC,9 and input from well-qualified health professional consultants. (A full list of consultants and references is available in Ref. 14.)

The program’s content validity was achieved through a formal consensus process of the consultants listed in the READY-Girls book,14 who are experts in the areas of adolescent health, diabetes, PC, family planning, and reproductive health. A focus group of young women with diabetes previewed the CD-ROM during its development phase for content, language, and presentation. User feedback was incorporated. Overall, adolescent women participating in the focus group felt that the information presented was relevant to their health issues.

The project team began by adopting the reproductive health awareness approach of the Georgetown University program17 to foster healthy behaviors by enhancing healthy attitudes and providing knowledge and skills development in body awareness/self-care, gender, sexuality, and interpersonal communications. Reproductive health awareness is an educational approach that is designed to help people learn to observe their own body, understand its normal changes, and know what is healthy and typical for them. For this population, it is beneficial to think about diabetes issues that influence their reproductive health, to communicate with health care providers, and to make decisions that can have a positive impact on their reproductive health.

The ADA’s fundamental components of PC were also incorporated into the program. These included discussions on the effects of diabetes on pregnancy and risks of complications, on the importance of tight metabolic control and of preplanning a pregnancy with PC, and on how to prevent an unplanned pregnancy. In addition, empirically based strategies and facts were incorporated from major studies and state programs.11–13

Several of the successful components of teen pregnancy prevention programs (e.g., emphasis on abstinence and delay of sexual initiation, improving communication, and skills building)18–20 were also integrated into the CD-ROM awareness educational program. Project staff chose to target teens starting at 13 years of age because of the onset of puberty and because sexual activity is occurring among middle school students, and several programs have had success in targeting this age group.21

The READY-Girls program simplifies difficult concepts through text, original graphics, and animated explanatory representation. Both CD-ROM and book formats are designed to be easily integrated into clinical settings. These stand-alone tools have been successful for other health behaviors.22

A feasibility study randomized 47 adolescent women (ages 16–20 years) with type 1 diabetes into one of three groups: CD, book, or a standard care control group. Subjects in each intervention group received only one comprehensive session of the education program 1 hour before their routinely scheduled diabetes clinic visit. Results indicated that both the CD and book were effective formats.23 Although the information is similar in both formats, it is recommended that the CD-ROM and book be used sequentially to reinforce education messages.

Satisfaction with the CD-ROM program was assessed in a recent READY-Girls randomized, controlled trial of 88 adolescents with type 1 diabetes. The sample was recruited from two sites and randomized into an intervention group (n = 43) or a standard care group (n = 45). During three sequential routine diabetes clinic visits, teens in the intervention group viewed the CD-ROM’s first two parts and read the book. The sample’s age range was 13.2–19.7 years, with a mean age of 16.7 ± 1.7 years, and 5.7% (n = 5) were African American. A standardized four-item (4 = strongly agree, 1 = strongly disagree) paper-and-pencil self-report satisfaction
scale assessed subjects’ perceptions of the CD-ROM’s utility, format, and difficulty or ease of handling. The results, shown in Table 1, indicate that nearly 100% of the teens in the intervention group believed that the CD-ROM helped them learn more about reproductive health, and > 95% said it was easy to understand and use.

Program efficacy has been established through other process and short-range outcome evaluations, and those results are presented elsewhere. Revisions have been proposed to meet the changing needs of the target population (e.g., adolescents with type 2 diabetes). New formats, including a computer-based DVD with live character video clips and comic book segments have been selected because they are among the media that youth use for entertainment. The Centers for Disease Control and Prevention has identified entertainment-education messages as an effective vehicle for health promotion and has set those targeted at youth as a high priority for research.

Because theory-based multimedia interactive computer interventions have shown positive results, READY-Girls was based on the Expanded Health Belief Model (EHBM). EHBM has been shown to predict preventive health behaviors (e.g., seeking PC and preventing unplanned pregnancies) and determine targets for interventions designed to change behavior. Therefore, the message, framework, and strategies of the educational program were tailored according to the constructs of this model.

The EHBM is based on fundamental tenets of patient education and behavior. Derived from psychosocial theories, it posits that behavior is influenced by the following attitudes and beliefs of individuals: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, perceived self-efficacy, intention, and motivational cues. In addition to the major dimensions of the EHBM, embedded within the model are other cognitive and mediating or modifying variables (e.g., knowledge of reproductive health issues, other psychosocial and demographic variables, adherence to diabetes regimen, current sexual practices, and current personal health status) that can potentially influence the outcome.

Table 1. CD-ROM Satisfaction

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<th>13–15.9 years</th>
<th>16–19.9 years</th>
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<tr>
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<td>% strongly agree % agree</td>
<td>% strongly agree % agree</td>
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<td>n</td>
<td>13 13</td>
<td>24 24</td>
</tr>
<tr>
<td>Helped to learn about type 1 diabetes and preconception counseling</td>
<td>69 31</td>
<td>79 17</td>
</tr>
<tr>
<td>Easy to read and understand</td>
<td>77 23</td>
<td>88 8</td>
</tr>
<tr>
<td>Easy to use</td>
<td>77 23</td>
<td>88 8</td>
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<tr>
<td>Enjoyed the CD-ROM</td>
<td>39 46</td>
<td>38 46</td>
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The model provided the theoretical foundation and guided the development and evaluation of the READY-Girls program. To change reproductive health behavior, the intervention was designed to alter the cognitive factors (beliefs, attitudes, awareness, and knowledge) in the EHBM by providing subjects with information (some of which may provide mild fear arousal), by using modeling and persuasion strategies and by providing decision-making and communication skills. For example, the program focuses on changing teens’ attitudes regarding their perceived susceptibility to and severity of unplanned pregnancies, their perceived benefits of and barriers to seeking PC, and their behaviors regarding intending to and actually using effective family planning and seeking PC. The program raises awareness of PC and encourages responding to motivational cues. All of the information is embedded in a decision-making framework with the acronym STAR (stop, think, act, and reflect).

READY-Girls Program

The best prevention programs include proven skills-training components that involve instruction and demonstration of specific skills and an opportunity for practice. READY-Girls was organized into several segments and presented in an interactive manner with an informative phase and a skills-practice phase. Practice sessions for two decision-making skills (delaying sexual activity and seeking PC) were included in the program. This structure accomplishes two goals. It 1) frames the information in a way to improve conceptual understanding of the material and 2) allows users to customize their experience with an interactive intervention.

The educational program was designed for a fifth-grade reading level. Media used for instructions consisted primarily of animated episodes with voice-over narration. Voice-overs, graphics, and simple text highlighted key points. Although the strength of a CD-ROM interactive environment is that users can go in any direction desired, some degree of linearity was needed for the educational process. For example, users were directed from one segment to another and had the opportunity to replay a segment.

Components and goals of this educational program are to:

- Increase awareness of reproductive health issues as they relate to diabetes
- Increase awareness and understanding of the benefits of PC and its components
- Help users understand risks and complications of diabetes and pregnancy to infants and mothers
- Help users understand the importance of both preventing an unplanned pregnancy and of planning an intended pregnancy
- Alter beliefs and attitudes that will promote the intent or actual behavior of both seeking PC and preventing an unplanned pregnancy
- Teach users to make decisions using the STAR method
- Help users practice making decisions regarding reproductive issues
- Improve users’ ability to talk to health care professionals about diabetes and pregnancy and reproductive health issues
Phases of CD-ROM Development

Design and development of the interactive CD-ROM for the READY-Girls program included the following phases:

1. Editorial development, including analysis of the program requirements, editorial reviewing of all material available regarding the educational program, and content editing for the interactive media format.

2. CD-ROM architecture, including categorizing all the available content into transcripts and sections for the CD-ROM, creating information and user interaction flowcharts, structuring each section on the CD-ROM, and creating a CD-ROM map.

3. CD-ROM design, including creating initial CD-ROM sketches, incorporating reviews and approvals, and creating final designs of all screens, including illustrations, text, animation, navigation buttons, icons, and video clips.

4. CD-ROM production, including optimizing all design elements and CD-ROM assets for the interactive media, including conversion of line artwork into digital formats, indexing the content, reviewing a CD-ROM prototype on multiple platforms (i.e., PC- and Macintosh-based systems), and making final adjustments.

5. CD-ROM reviewing and testing, including proofing and reviewing final computer files for content accuracy, checking visual design consistency, and verifying all interactive links and CD-ROM navigation.

6. Evaluation of the interactive CD-ROM prototype, including obtaining users’ opinions on clarity of instruction, user friendliness, impact of personalized segments, visual attractiveness of screen displays, meaningfulness, comprehensiveness, and perceived relevance.

Incorporating the previous users’ feedback, an iterative procedure was used to produce progressively refined versions of the software in the final stage of development. All necessary revisions were incorporated, including reviewing users’ feedback, changing CD-ROM structure and design elements, making programming changes, and performing final testing and debugging, and a master copy was released.

Lessons Learned About CD-ROM Program Development

- Select a program or production company that meets the technical needs of the project.¹ ¹³ ¹⁰
- Establish ownership and copyright through a legal contract between the researchers’ institution and a multimedia production company, if one is to be used, before development.
- Confirm the accuracy of all information. Content validity is crucial. Consult with a panel of experts in the topic area. Specific content must be determined before “fancy features” are considered.¹
- Oversee the writing of the transcripts that will be used for text and voice-over narrations.
- Establish face validity (appearance), interest, and utility, which are necessary for user participation.¹ ¹³ ¹⁰
- Obtain feedback from focus groups of members of the target audience. This information is invaluable in evaluating both content (e.g., wording) and features of the program.

- Select technology based on today’s rather than tomorrow’s application.¹
- Choosing from among CD-ROMs, DVDs, Internet programs, or hybrids must include consideration of which technologies are emerging, which will be most rapidly accepted, and which will be more accessible for the target audience. Selection decisions should also include when to use technology, what types, for what groups, under what conditions, and what degree of human contact is necessary.¹

Conclusion

CD-ROMs can provide self-directed standardized educational interventions to improve diabetes care in a variety of settings. Self-instructional interactive computer-based programs such as READY-Girls can be integrated in clinical settings and used as an educational and skill-development resource for patients. These programs can be reliably adapted with complete fidelity to health care and educational settings with limited personnel or financial resources and can be operated with minimal personnel demands or other costs. They can be used before, during, or after clinical sessions to take advantage of time spent in waiting rooms and exam rooms.

Some programs may be feasible for home use as well. Patients can use programs alone initially and can gain from them the communication skills needed for follow-up discussions with health care providers.

HT programs have the potential to be widely disseminated and to influence practice. The information in READY-Girls, for example, could set new standards of practice for health professionals and be an integral part of all diabetic adolescent education. READY-Girls can potentially improve reproductive health outcomes and the quality of life of women with diabetes and their children. By providing reproductive health information and decision-making skills and promoting communication with health care providers, this program can empower adolescents to control their reproductive health and make informed healthy choices for themselves and their future children.

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