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Development of an Internet Coping Skills Training Program for Teenagers With Type 1 Diabetes

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Abstract

The purpose of this study was to develop an Internet coping skills training program and to evaluate its feasibility and acceptability compared with an Internet education intervention for teenagers with type 1 diabetes. A multiphase mixed-methods design with focus groups, a randomized pilot study, and a program evaluation was used. Teenagers with type 1 diabetes, parents, and health professionals were included in the development and evaluative phases along with the research and information technology team. The pilot study included 12 teenagers with type 1 diabetes (mean [SD] age, 14.4 [1.90] years; 58% female; mean [SD] duration of diabetes, 5.9 [3.0] years). Psychosocial data and HbA_{1c} levels were collected at baseline and at 3 and 6 months. Results indicate that the development of a psychosocial Internet intervention was complex and required multiple iterations of development and evaluation. Results of this study also indicate the feasibility and acceptability of translating a group-based intervention for teenagers with type 1 diabetes to the Internet. Thus, this study demonstrates a systematic approach to Internet intervention development. Including teenagers with type 1 diabetes and a multidisciplinary professional team into the intervention design was critical to the success of this project.

Keywords

Adolescents with type 1 diabetes; Coping skills training program; Internet

The Diabetes Control and Complications Trial demonstrated that in adolescents older than 13 years, intensive management and improved metabolic control reduced complications by 27% to 76%.¹ However, intensive management of type 1 diabetes (T1D) is complex and requires frequent monitoring of blood glucose, frequent insulin injections or use of continuous subcutaneous insulin infusion, and regular visits to healthcare providers. Significant effort on the part of the adolescent and the family is necessary to achieve treatment goals.

Normal childhood development can present challenges to T1D management. In adolescence, metabolic control tends to deteriorate as a combined result of insulin resistance that accompanies the hormonal changes of adolescence and lower adherence to the treatment regimen often associated with the desire for autonomy.² The shift from parental support to peer support is normal during adolescence; however, it can place an adolescent with T1D at increased risk for poorer health outcomes. Fear of nonacceptance with peers may make an adolescent with T1D reluctant to disclose his/her diagnosis or deliberately miss blood glucose monitoring, insulin injections, or boluses, which can cause a decline in metabolic control.³

Moreover, during this developmental stage, parental support is viewed less favorably, and relationships between parent and adolescent often become more conflictual. Less family support and increased family conflict have been consistently associated with poorer diabetes self-management, metabolic control, and psychosocial adaptation in adolescents with T1D.^{4, 5} Youth with T1D are also at increased risk for psychiatric disorders, particularly depression. Approximately three times more adolescents with T1D have psychiatric disorders than do their age-mates, and the prevalence of depressive symptoms in youth with T1D has been reported to be 12% in children and 18% in adolescents.^{6,7} Considering the significant challenges to adolescents and their families in living with T1D, there is a great need to develop innovative interventions that are appealing to this age group and potentially efficacious in improving health outcomes.

Interventions promoting adolescent-parent teamwork in diabetes self-management or family problem solving have contributed to sustained parental involvement, less family conflict, and improved metabolic control.⁸⁻¹⁰ Coping skills training (CST) has also demonstrated improved health outcomes in adolescents with T1D.^{11,12} CST is a behavioral and psychosocial group intervention based on social cognitive theory designed to increase competence and mastery by retraining nonconstructive coping styles and patterns of behavior into more constructive behaviors.¹³ CST for adolescents with T1D is based on the premise that learning more adaptive coping skills will improve their ability to solve problems and manage their diabetes. It represents a potentially efficacious psychosocial intervention to disseminate to a broader adolescent audience.

The Internet is a promising way to reach adolescents with T1D, given its accessibility and appeal to adolescents. Access to the Internet is becoming increasingly available nationwide and has risen to its highest level ever, with 75% of Americans currently using the Internet. The fastest-growing Internet user populations are groups that were once considered victims of the digital divide: His-panics, blacks, and older Americans.¹⁴ A 2005 Pew Report indicated that 70% of whites and English-speaking Hispanics and 57% of blacks use the Internet.¹⁵ Schools, libraries, and other public access points continue to serve groups who do not have access to the Internet at home (ie, unemployed, blacks, Asian Americans). Younger persons are even more likely to use the Internet. More than 80% of Americans aged 12 to 35 years use the Internet, with 97% of adolescents between the ages of 12 and 18 years reporting usage in 2002.¹⁶ Thus, Internet interventions for adolescents are likely to reach a diverse national population.

Attracted by the Internet's potential reach, its economies of scale, and its ability to provide interaction and individualization of interventions, clinicians and scientists are beginning to translate their health-related interventions to the Internet.¹⁷ In particular, there has been a growth in mental health and behavioral health interventions in the past decade.¹⁸ From 1996 to 2003, there was a 12-fold increase in Medline citations for health-related Internet interventions.¹⁹ Several systematic reviews of health-related Internet interventions have reported positive, albeit quite variable effect sizes on knowledge, behavior, and clinical outcomes.^{19,20}

Developing efficacious health-related Internet interventions is complex. Researchers are finding that the translational process of moving an in-person intervention to an Internet intervention is difficult and presents considerable challenges. Adapting content to a new medium and taking advantage of the unique capacities of the Internet while simultaneously considering the intervention theory as well as learning principles of interactive media can be daunting tasks.¹⁷ Technological and user difficulties may also be encountered if not considered in the intervention development process.²¹ Thus, it is increasingly advocated that designing

health-related Internet interventions requires expertise from diverse perspectives and a systematic approach.²²

In general, the design of health-related Internet interventions for youth is based on principles of communication theory, social learning theory, and interactive technology. Health-related Internet interventions that use interactive technology contribute to experiential learning when they include simulations, challenges, repetition, and feedback.^{23,24} Internet interventions can also be developed specifically to improve self-efficacy and health behavior by providing appealing role-model characters who demonstrate skills, decisions, and consequences of decisions in a virtual world very similar to that of the participant. Youth have been shown to be highly attentive to characters they feel are targeted to their age and life context.²⁵ In addition, interactive elements of Internet interventions enhance knowledge, skills, communication, and support through self-assessment, rehearsal of health behaviors in a simulated environment, and supportive feedback.²⁴ Results of several studies point to the potential benefits of Internet psychosocial interventions for youth on emotional well-being^{26,27} and behavior change such as smoking cessation and weight loss.^{28,29}

Collectively, the research on Internet interventions for youth illustrates the feasibility of conducting rigorous behavioral research over the Internet, with some programs demonstrating improvements in health outcomes. Therefore, the purpose of this study was to develop an Internet CST program and to evaluate its feasibility, acceptability, and preliminary efficacy compared with an Internet education intervention for adolescents with T1D.

METHOD

A multiphase, multimethod approach was used to accomplish the study aims. For the first phase, focus groups and a think-aloud method were used to assist in the development of the intervention.³⁰ Teenagers and parents shared their thoughts as they reviewed a prototype of the intervention. Detailed field notes from these interviews were analyzed with a content analysis approach that incorporated data display matrices to identify themes across participants.³¹ Results were used to revise and further develop the intervention Web site (TEENCOPE). Simultaneously, a Web site was designed to provide T1D-related education (Managing Diabetes). For the second phase, a randomized pilot study was undertaken to evaluate the feasibility, acceptability, and preliminary efficacy of the intervention. After providing informed consent, participants completed online data and were randomized to the TEENCOPE or the Managing Diabetes Internet interventions. TEENCOPE consisted of five weekly sessions on self-talk, communication skills, social problem skills, stress management, and conflict. Managing Diabetes consisted of four weekly sessions on glucose control, nutrition, exercise and sick days, and new technology. Follow-up data were collected at 3 and 6 months after intervention and securely transferred to a spreadsheet database, which was converted to a data analysis program, SPSS version 13.0 (SPSS Inc, Chicago, IL). Feasibility and acceptability data were measured by recording the number of times participants logged on to the program, sessions completed, and sites visited when logged on. For TEENCOPE participants, activity on the discussion board was also recorded (ie, how many postings). Acceptability regarding the Internet Web sites was also evaluated with a satisfaction survey, which was completed at the end of the program. Further revisions to the sites were made after completion of the pilot study. For the final phase of the study, the sites were systematically evaluated by an independent reviewer for visual appeal, information, comprehension, engagement, and design logic as well as by diverse adolescents with T1D for acceptability. Thus, there were multiple iterations to the development and evaluation of these Internet programs.

Measures for the Pilot Study

Demographic data were collected on sociodemographic and clinical variables (ie, duration of diabetes, type of diabetes treatment). Glycosylated hemoglobin (HbA_{1c}) levels are routinely measured quarterly in patients with T1D, providing objective criteria of metabolic control over the most recent 8 to 12 weeks. Analyses were performed using the Bayer Diagnostics DCA 2000 and a finger-stick blood sample (reference range, 4.2%–6.3%). The reliability of this method is high. These data were collected from chart reviews, obtaining the HbA_{1c} value at the closest corresponding date to the online data collection date.

Psychosocial data were collected online from adolescents at a separate secure Internet site. Selected instruments were aligned with the conceptual framework of the intervention and had evidence of adequate reliability and validity in adolescent samples.^{32–37} Participants were compensated for their time completing questionnaires with a \$20 gift card. To facilitate the timely completion of data collection, participants who completed questionnaires within 1 week of enrollment were eligible for a prize drawing (\$20 gift card).

Quality of life (QOL) was measured by the Pediatric Quality of Life Inventory (PedsQL teenager version), which was developed to evaluate QOL in children with chronic health conditions.³² The PedsQL consists of a 15-item core measure of global health-related QOL and a 28-item supplemental measure assessing diabetes-specific QOL. The diabetes-specific QOL measure consists of five discrete subscales: general diabetes QOL, general T1D treatment QOL, specific T1D treatment QOL, worry, and communication. Higher scores reflect better QOL.^{32,33}

Stress was measured by the Perceived Stress Scale, a 14-item scale that measures the degree to which situations in one's life are appraised as stressful. Items evaluate feelings of stress and hassles during the past month.³⁴ Respondents rate items on a five-point Likert scale ranging from 0 (never) to 4 (very often), with higher scores indicative of greater perceived stress.

Coping was measured with the Issues in Coping With IDDM-Child scale, a self-report measure of children's and adolescents' perceptions of how hard or difficult to handle (14 items; total score, 0–42) and how upsetting (12 items; total score, 12–36) issues are related to their T1D management.³⁵ Higher scores indicate more difficulty or upset.

Self-efficacy was measured with the Self-efficacy for Diabetes Scale, a self-report measure of the self-perceptions or expectations held by persons with diabetes regarding their personal competence and confidence in their ability to successfully manage their T1D (24 items; total score, 24–120).³⁶ Higher scores indicate less self-efficacy.

Psychosocial adjustment was measured with the Children's Depression Inventory, a 27-item self-report instrument on depressive symptoms in youth that yields total scores from 0 to 54.³⁷ Higher scores reflect more symptoms.

Lastly, acceptability was measured with a five-item satisfaction survey that elicited information on satisfaction with the overall intervention and with individual sessions. Items were rated on a five-point scale, ranging from not at all helpful or satisfied to very helpful or satisfied. An open-ended question elicited feedback on ways to improve programs.

Data Analysis

Qualitative data from the focus groups, think-aloud process, and the satisfaction survey were analyzed by a content analysis method. Coding categories were developed either by survey question or by section of the Internet intervention (ie, home page, characters, sessions, etc). Data display matrices were developed to facilitate the ability to compare responses and identify

themes across participants. For quantitative data, descriptive statistics were computed to describe the sample characteristics (SPSS version 13.0). For the pilot study, groups were compared on major variables using χ^2 and *t* tests to make certain that random assignment equally distributed the sample. Repeated-measures analysis of variance (ANOVA) was used to examine the difference between groups on each of the dependent variables. Each model had one between-subjects factor (group assignment) and one within-subject factor (time). Main effects and interaction effects for each outcome variable were tested.

RESULTS

Intervention Development

TEENCOPE, the Internet version of CST, was developed to consist a series of interactive Internet sessions that were adapted directly from a previously developed CST protocol. The Internet protocol was initially developed collaboratively with health professionals (nurses and clinical psychologists) and a Web-development team (computer programmers, Web designers, graphic artists, and illustrators). Feedback was elicited from adolescents and parents who previously participated in a group-based CST several times during the early development of TEENCOPE to ensure market appeal to the target population.

Initially, an outline of the intervention was developed, and a focus group with three adolescents with T1D and their parents was convened to identify what they liked and disliked regarding the Web sites that they frequent as well as issues, concerns, and ideas for the intervention. Teenagers reported liking the idea of T1D-related scenarios being presented and the ability to interact with the Web site. If characters were used, teenagers wanted the ability to hear what the characters were thinking or experiencing. They expressed strong feelings that they did not want it to resemble school-based activities that involve testing, repetition, or competition. Teenagers also reported that they liked Internet pages that were highly visual, without a lot of text, and without the need to scroll down the page. Parents highlighted the need for visual examples, sequencing, and the opportunity to practice. They also expressed concerns about security and privacy. This feedback was incorporated into the development of the Internet interventions.

Next, the Internet site for TEENCOPE was developed, which included the logo (Figure 1), the log-in page, the rules of conduct, the home page, and two sessions. A cast of ethnically diverse characters with T1D was created, and a graphic novel format was used to present problematic social situations for teenagers with T1D. A range of scenarios and different approaches to solving the problems were carefully developed to present common issues that teenagers with T1D might encounter with friends, parents, or guardians that were relevant across diverse cultures.

A subsequent evaluation session was held with the three adolescents who had participated in the previous focus group and their parents. Each adolescent and the parent group were provided with a computer to access the TEENCOPE Internet site. A think-aloud technique was used, whereby participants were asked to think out loud about what they were seeing on the Web site, what they liked, what they disliked, and anything that came to mind as they were navigating through the program. When providing instructions, it was emphasized that we were not looking for approval, rather a constructive critique of the intervention. A research assistant recorded the participants' comments and prompted them to think out loud. Parents participated in a similar evaluation as a group. Transcripts of this evaluation session were synthesized and used to revise and further develop the TEEN-COPE site. The responses of the adolescents and their parents were overwhelmingly positive. Adolescents spoke favorably of the format, the characters, and the scenarios presented—"This is really cool. I love the characters. I want to name them. I like that you can see the (insulin) pumps"; "I can definitely relate (to the

characters)”; “I really like the graphic novels.” They also responded positively to the content of sessions—“The body questions really make me aware of how much my body is affected by stress”; “Great stress relieving examples—I would try them all.” Suggestions for improvement included clarifying some of the directions, requesting more information about the kind of stress the characters experienced, and providing better alternatives for some character dialogue.

A Web site on diabetes education was also carefully designed (Managing Diabetes) to be appropriate and acceptable to adolescents with T1D and to serve as a control condition. The education Internet intervention modeled an education in-person program for adolescents with T1D and was adapted for delivery via the Internet by simplifying content, illustrating pages, and incorporating interactive problem-solving components.

In the development of both TEENCOPE and Managing Diabetes, design decisions were made after careful consideration of the psychological and communication theories underlying prevention and disease management interactive technology for children (ie, simulation, challenge, motivation, repetition, and feedback). In addition, design decisions specific to health-related Internet interventions included determining the site information architecture, the content and presentation style, the personalization of information, the amount of interaction, and the technological features including maintaining security and confidentiality.¹⁷ Table 1 illustrates the design decisions for the two Internet sites. The primary difference between the Managing Diabetes and TEENCOPE sites was in the content (diabetes education vs coping skills for living with T1D) and in the development of role model characters in the CST program who demonstrate the coping skills, decisions, and consequences of decisions in a virtual world very similar to that of the targeted population. In addition, TEENCOPE provides participants the ability to obtain feedback from peers as well as a professional; the discussion board in TEENCOPE was moderated by a health professional who posed questions and contributed to the discussion topics. The differences between programs were intended to test the difference between an educational program and a more interactive, coping skills program based on social learning theory, the conceptual framework for the CST intervention.

Feasibility and Pilot Study

Once the Web sites were complete, institutional review board approval was obtained and 12 teenagers with T1D were recruited from a university-based pediatric diabetes program and randomized to the TEENCOPE or Managing Diabetes intervention. There was a 74% acceptance rate for participation in the study. Ages of the participants ranged from 13 to 16 years, with a mean (SD) of 14.4 (0.90) years; 58% were female ($n = 7$); mean (SD) duration of diabetes was 5.9 (3.0) years, and 50% were on pump therapy. One participant was Hispanic, and the remainder were white. Mean (SD) HbA_{1c} level was 7.7% (1.2%), and psychosocial variables indicated generally good QOL. Groups were equivalent at baseline.

Once baseline data collection online was completed by all participants, sessions were uploaded weekly to the secure Web server, and participants were sent an e-mail when a new session was available. Participation in the TEENCOPE program was excellent, with many participants completing the session on the evening that the session was uploaded. Of the six participants in the TEENCOPE group, five completed all five sessions, and one participant completed four sessions. Over the 5 weeks of active intervention, eight messages were posted on the discussion board, with 14 responses. Participation in the education program was less enthusiastic. Three participants completed all four sessions, two participants completed two sessions, and one participant completed no session. E-mail prompts and telephone calls were completed to encourage participation in both groups as needed.

Online data collection was completed after the intervention. Repeated-measures ANOVA indicated that there were trends for better diabetes self-efficacy ($p = .12$) in both groups.

TEENCOPE participants demonstrated trends for better diabetes self-efficacy ($p = .20$), better coping (less hard) ($p = .07$), better general T1D treatment QOL ($p = .20$), and less perceived stress ($p = .20$) compared with the education group. Education participants demonstrated trends for better diabetes communication over time ($p = .20$) (Table 2).

Patterns of usage indicated good participation in both Internet interventions that slightly decreased over time. There were a total of 120 log-ins over the duration of active intervention, with an average of 17 log-ins per week. TEENCOPE participants engaged in the Internet program more than education participants did, with twice as many log-ins over the duration of the program (TEENCOPE log-ins = 81; education log-ins = 39). Individual participant log-ins ranged from 5 (approximately once per week for an education group participant) to 24 (approximately four times per week for a TEENCOPE participant). Collectively, these patterns of usage indicate that while both programs were appealing to adolescents, the TEENCOPE Web site showed promise for engaging adolescents to a greater extent.

Satisfaction with the Internet interventions was high. Both groups reported that the program was helpful, the content presentation was good, time spent was worthwhile, and the site was easy to navigate. There was no significant difference between groups on these criteria, and there was no significant difference between TEENCOPE participants and Managing Diabetes participants in how often adolescents practiced skills presented in sessions. There were trends of significance for TEENCOPE participants to report that the program was more enjoyable ($p = .12$).

Further Development and Feasibility Work

Based on the evaluations of participants of the pilot study, further development and revision of the Internet sites were undertaken. Animations were added to the TEEN-COPE site, illustrating a more complex social situation, per the recommendations of teenagers. The Managing Diabetes site was revised to have greater visual appeal by decreasing text and increasing pictures of diverse teenagers. The program was also revised to have five sessions rather than four sessions (ensuring comparability) and to increase the overall health promotion content of sessions because this was particularly appealing to the teenagers who completed the program (eg, suggestions for strategies to prevent colds and flu).

Upon completion of these revisions, an independent review of both sites was undertaken by other T1D health professionals (medical and nursing) to systematically evaluate the Web sites for visual appeal, information, comprehension, engagement, and design logic. Each Web page was rated on a five-point scale (1 = poor, 5 = excellent) for each of these criteria with the exception of design logic, which was rated as yes or no. Total mean scores per session were calculated for the first four criteria, and for design error, a total count was calculated. Sessions of Web sites demonstrated mean scores ranging from 2 (fair) to 4 (very good), with few pages receiving a 1 (poor) or a 5 (excellent). In general, both sites demonstrated good to very good evaluative scores. The scoring and recommendation for each page were reviewed, with particular attention paid to sessions with a mean score less than 3.0. These data provided insight into which specific aspects of each Web site should be further revised. All design errors were corrected.

The last phase of this intervention development project was aimed at determining the acceptance of the revised Web sites by adolescents with T1D of diverse race/ethnicity from clinic sites of a future clinical trial of the intervention (black, $n = 5$; Hispanic, $n = 5$). The mean (SD) age of these participants was 14.0 (1.15) years, mean (SD) duration of T1D was 4.4 (2.95) years, 40% were female, and 90% used injection therapy. Semistructured interviews were completed with adolescents after they completed several sessions. Results of the Managing Diabetes site analysis indicated that 90% of teenagers liked it, 90% thought it was clear and

interesting, and 80% thought that the site was appropriate for teenagers. Comments included the following: "For education purposes, I thought it was just right for teenagers." Another stated, "I liked reading the information about food and insulin dose changes." Teenagers who disliked the site felt that it was more appropriate for adults and needed to be more interactive. An important suggestion for improvement included simplifying some of the problem-solving exercises. Results of the TEENCOPE site analysis showed that 90% of teenagers liked it, 90% thought it was clear and interesting, and 80% thought that the site was appropriate for teenagers and they could relate to the characters and scenarios. Comments for the TEENCOPE site included the following: "I liked the positive and negative sides of the conflict. That made me think a lot. The scene presented was true...but, most of all I liked knowing that other teenagers know how I feel. That made me feel good." Another teenager stated, "I felt like you could open up. This program lets teenagers open up.... Kids don't feel like they're alone when they answer the questions." She added, "I could relate [to the characters] because all of them made points that I feel I have." Suggestions for improvement included increasing the font size for the TEENCOPE site and enhancing the graphics. Older teenagers thought that the TEENCOPE site was most appropriate for younger teenagers. Comments and feedback from minority teenagers were very similar to the comments and feedback received from teenagers at the primary site. Final revisions to both interventions were made based on this evaluation.

DISCUSSION

Collectively, the results of this multiphase Internet intervention development study indicate the feasibility and acceptability of translating a successful group-based CST intervention for adolescents with T1D to the Internet. Preliminary efficacy findings demonstrate the potential of the TEENCOPE intervention to improve select health outcomes in adolescents with T1D and provide effect sizes for a future clinical trial.

Results from the various phases of designing the Internet sites also indicate that the development of Internet interventions is complex and time-consuming. Consideration of a wide range of factors was required, and a multidisciplinary and multimethod iterative approach to intervention development, incorporating targeted users into the development and evaluation of the Internet sites, was important to the process. Involving adolescents with T1D in all phases of the developmental process was extremely valuable. Adolescents were engaged in the process and provided excellent feedback as well as creative suggestions for improvement.

A multidisciplinary team was also essential. Experts with respect to the content, intervention development research, Web information technology, and illustrators collaborated in the development, implementation, and evaluation of the Managing Diabetes and TEENCOPE Internet sites. The iterative aspect of design and evaluation took 10 months to complete and cost approximately \$85 000. Thus, considerable expertise, time, and financial resources are required for the development of health-related Internet sites that are accurate and grounded in scientific evidence, use theories of interactive technology, and are acceptable to the targeted population.

Overall, adolescents with T1D found the Managing Diabetes and TEENCOPE Internet sites acceptable. In qualitative analyses, they particularly liked the information presented and the problem-solving exercises. In quantitative analyses, both groups demonstrated good to excellent completion of sessions; however, TEENCOPE participants demonstrated more engagement by significantly higher usage and significantly greater enjoyment compared with Managing Diabetes participants. Keeping participants engaged in Internet programs over time has been a factor reported to be important to evaluating intervention efficacy. There was no attrition in the pilot study; however, one participant assigned to the Managing Diabetes intervention did not complete any sessions. Studies of health-related Internet interventions have

shown that there is a positive relationship between the frequency with which users log on (proxy for utilization) and beneficial outcomes.^{29,38} When health-related Internet interventions are created with a sequential progression of content, usage becomes an important proxy for attendance. As with in-person interventions, reminder systems are often critical to optimize attendance. In this study, automated e-mails were generated when new sessions were posted; however, approximately 50% of participants also required reminder telephone calls to complete sessions. Many participants did not regularly check e-mail accounts, a surprising finding of this study. With the advent of online social networks, instant messaging, and text messaging, e-mail may not be the preferred method of communication for adolescents. Other investigators evaluating health-related Internet interventions have also reported the need for developing an effective reminder system to promote the completion of sessions or tasks associated with the intervention.³⁹

The inclusion of a health professional as an adjunct to the TEENCOPE Internet intervention was also an important consideration in design and development. Health-related Internet interventions can vary considerably on the availability and role of professional support. There is some indication that as the involvement of health professionals in health-based Internet interventions decreases (ie, no direct contact with health professionals), the potential for efficacious outcomes decreases.⁴⁰ The TEENCOPE Internet program included a health professional (a clinical psychologist) as the moderator who contributed to the conversations in the discussion board to stimulate discussion, provide feedback, and provide suggestions for problem solving. In addition, the moderator of TEENCOPE played an important role in evaluating the safety and psychosocial integrity of participants. All postings to the discussion board were reviewed within 24 hours for appropriate content and language as well as for any indications of psychosocial distress of participants. There were no incidences of inappropriate postings or psychosocial distress. Seventeen percent of participants (n = 2) scored above the criterion score for elevated depressive symptoms at some point during the duration of the study and were contacted by a clinical psychologist for further evaluation.

Ensuring the safety of participants in a health-related Internet intervention, particularly one designed for children and adolescents, is also an important consideration in the design and development phase. Participants were informed at the beginning of the program that these health-related Internet interventions were not a substitution for ongoing medical and/or psychological care, and participants were reminded to discuss questions and issues with their parents and healthcare providers. However, the moderator did serve as a health professional who could answer questions related to diabetes stress.

Implementing health-related Internet interventions also requires sophisticated technological support and state-of-the-science programming to maintain functionality and security of the Internet sites. Internet sites for this study were password protected, with all data encrypted and stored on a secure server with hardware and software firewalls to protect information within the server. No security or functional issues occurred in the pilot study.

CONCLUSION

This study demonstrates a systematic approach to Internet intervention development. A multiphase, multimethod approach for the development of a health-related Internet intervention for adolescents with T1D was used. The inclusion of teenagers with T1D and a multidisciplinary professional team into the intervention design and evaluation was critical to the success of this project. Results of this study indicate the feasibility of translating an efficacious in-person psychosocial program for teenagers with T1D to the Internet. In addition, the intervention was acceptable to teenagers. A multisite clinical trial is in progress.

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FIGURE 1.
TEENCOPE logo.

Table 1

Design Decisions of TEENCOPE and Managing Diabetes

	TEENCOPE and Managing Diabetes Sites	TEENCOPE Site Only
Information architecture	Sessions created with a progressive presentation of content (tunnel architecture) New sessions uploaded weekly on the same day	Home page allowed for access to all aspects of program (free-form matrix)
Content and presentation style	Created site in a format targeted to adolescents Simple, attractive page layout Easy to navigate Geared toward age group Limited amount of text on page Consistent colors, fonts, illustrations (pictures for Managing Diabetes site and graphic images for TEENCOPE site) Education content for Managing Diabetes and coping skills for TEENCOPE Provided within-site links to more detailed information Summarized main points at the end of each session Presented scenarios to encourage problem solving with nontailored feedback	Created an incentive to complete the session (could view other teenagers' responses to a session only once participant completed the session) Created cast of diverse role model characters with T1D Created social situations common to teenagers with T1D and consequences of decisions Elicited evaluation of role model characters' decisions Provided opportunity to learn from other teenager participants (able to view answers to problem-solving scenarios, discussion board) Provided suggestions at the end of session to practice the coping skill of the week Provided opportunity for professional feedback (moderated discussion board)
Personalization and interaction	Able to personalize home page Home page welcomes participant by name Encourages to discuss issues and concerns with parents and healthcare providers	Assigned to TEENCOPE as a group (n = 6) Created a personal profile page to share information about self (eg, favorite sports) Provided opportunity for teenagers to view other group members posting within session Provided moderated discussion board
Technological features	Log-in and password-protected site Secure server with encryption Automated e-mails generated to teenagers when a new session was uploaded Systematic monitoring of site and users	First name only Agreement for rules of conduct Automated e-mails were generated to inform participants of site activity

Table 2

Pilot Study Results (n = 12)

	CST 0	CST 3	CST 6	Education 0	Education 3	Education 6	Significance
Children's Depression Inventory ^a	12.0	8.0	8.0	6.6	8.6	3.8	
Self-efficacy Diabetes ^a	55.5	40.2	39.0	40.4	43.2	39.0	Time = .12; Grp/time = .20
COPE: how upsetting ^a	19.0	17.8	16.2	16.4	15.8	14.3	Time = .25
COPE: how hard ^a	18.8	17.6	17.5	15.6	18.8	16.5	Grp/time = .07
Overall QOL	78.8	81.7	78.3	77.0	73.7	77.5	Grp/time = .29
General T1D treatment QOL	76.0	93.8	86.5	66.3	71.3	78.1	Time = .30; Grp/time = .20
Specific T1D treatment QOL	73.2	82.9	79.8	85.7	80.7	84.8	Grp/time = .26
Diabetes communication	83.3	88.3	76.4	75.0	78.3	81.3	Grp/time = .11
Diabetes worry	75.0	83.3	83.3	75.0	81.3	77.1	
Stress ^a	27.3	24.8	24.2	25.0	27.6	23.3	Grp/time = .20
Metabolic control ^a (HbA _{1c})	8.0	8.2	8.1	7.3	7.4	7.6	

^a Lower score = better.