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Developing a Web-Based Health Promotion Intervention: A Case Study From a Brief Motivational Alcohol Program

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Public health researchers and practitioners reporting findings from intervention studies seldom report in depth the processes of intervention development. However, such information would be useful for several reasons: (a) it would help guide the development of new interventions and refinement or revision of existing ones, (b) it would provide a framework and methodology on which other health practitioners and researchers could build, and (c) it would increase transparency of the development process and enhance the interpretation of the intervention's effects. The purpose of this article is to begin addressing the "black box" of Web-based intervention development by presenting the method for developing a Web-based, brief, motivational alcohol intervention program that has shown evidence of efficacy for college students, called Michigan Prevention & Alcohol Safety for Students.

Keywords: *intervention development; alcohol use; Internet; college; health promotion program*

Researchers and practitioners reporting findings from intervention studies seldom provide detail about intervention development. Rather, intervention development is typically described in a few brief sentences (Bartholomew, Parcel, Kok, & Gottlieb, 2006). Progress in efficiently developing effective health promotion programs would likely benefit from

an open discussion of the intervention development methods that researchers and practitioners find useful. This information would guide both the development of new and the refinement of existing intervention programs. As this information was reported and applied, it would contribute to a body of intervention development methods that could be refined and enhanced.

A basic incongruity exists between the importance placed on careful health promotion program evaluation and the lack of an ongoing dialog in peer-reviewed publications that would yield a methodology for program development. Instead, discussion of intervention development is typically restricted to university courses on basic theoretical and methodological foundations of intervention, and existing models for planning health programs, although informative (Bradley, Wiles, Kinmonth, Mant, & Gantley, 1999; Campbell et al., 2000; Holbrook, Thabane, Shcherbatykh, & O'Reilly, 2006; McKenzie, Neiger, & Thackeray, 2009), tend to be nonspecific and lack a detail about best methods for developing health promotion programs. For example, intervention mapping describes general steps to program development, implementation, and evaluation (Bartholomew et al., 2006). Other common models include Precede-Proceed

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(Green & Kreuter, 2005), Multilevel Approach to Community Health (Simons-Morton, Green, & Gottlieb, 1995), CDCynergy 3.0 (CDC, 2008), and SMART (Neiger & Thackeray, 1998). Although helpful, these models treat intervention development as a single global step rather than a detailed process for developing specific types of programs, such as those delivered over the World Wide Web. In addition, the complexity of intervention development is overlooked in peer-reviewed literature (Bartholomew et al., 2006), and results of program evaluations are tested and reported without a development protocol being established and/or reported (Armstrong et al., 2008). The result is a health promotion program development “black box” that practitioners and researchers are left to navigate on their own. That navigation would be more efficient if it were guided by a map. This is especially true for complex or intensive intervention approaches, such as Web-based intervention programs.

Regular reporting of methods used to develop effective Web-based programs would have several benefits. It would increase the transparency of program nuances and aid the interpretation of evaluation findings, improve program sustainability in other priority populations, and generate discussion about methods used to develop programs (Armstrong et al., 2008). An ongoing dialog about intervention development methods would identify what worked and what did not, leading to program development methods that, similar to the programs they yield, are evidence-based.

The purpose of this article is to begin addressing the black box of Web-based intervention development by presenting the method used to develop a Web-based

brief motivational alcohol intervention program called Michigan Prevention & Alcohol Safety for Students (M-PASS), which has shown evidence of efficacy for college students.

► INTERVENTION DEVELOPMENT

M-PASS began as a broad conceptualization with sufficient detail for its potential merit to be judged. It was conceived as a theory-based tailored brief motivational intervention consisting of four sessions delivered over the Internet to prevent and reduce at-risk drinking among freshmen college students. This initial conceptualization took place during the process of obtaining funding to develop and evaluate the program.

Development of M-PASS involved five phases: (a) identification of best practices, (b) designing the intervention, (c) developing intervention content, (d) constructing the intervention, and (e) pretesting and finalizing the intervention. Details about each phase are presented below. Evaluation results are published elsewhere (see Bingham et al., 2010).

Identification of Best Practices

Formative research to identify best practices was the first major phase of M-PASS development. The aims of this phase were to (a) define the health problem, (b) understand the current context in which the health problem occurred, and (c) identify effective program components used in other alcohol interventions. Although several models for identifying best practices exist (e.g., Interactive Domain Model, BEHAVE Framework, positive deviance approach), the model used for M-PASS closely approximated the Knowledge, Attitude and Practice model.

The target behavior of M-PASS was at-risk drinking (ARD) among college students, which was defined by guidelines from the National Institute on Alcohol Abuse and Alcoholism, and research on college drinking. In addition to the immediate drinking behaviors (e.g., quantity and frequency of drinking), ARD was also defined by its outcomes, including longer term health consequences and short-term risks and the negative physical, legal, personal and academic impacts on college students (Hingson et al., 2002; Wechsler et al., 2002).

To better understand the context of ARD on college campuses, two sources of empirical data were used. Qualitative data were collected from focus groups with college students that examined various aspects of drinking behavior and the drinking culture (e.g., attitudes toward alcohol use; when, where, and why drinking occurred;

and students' reasons for drinking and not drinking). Quantitative data from a biennial survey of university students were used to generate a profile of students' attitudes, beliefs, and drinking behaviors (Boyd, McCabe, & Morales, 2005).

Next, literature and Web searches were conducted to isolate evidence-based computerized alcohol interventions. The common elements, techniques, and methods used across interventions that seemed promising were assessed, along with their potential usefulness for the planned intervention. Example interventions included electronic Check-Up to Go (<http://www.e-chug.com>), AlcoholEdu (Wall, 2007), and My Student Body (Chiauszi, Green, Lord, Thum, & Goldstein, 2005). From this search, individually tailored feedback (Evers et al., 2003) and motivational interviewing (MI; Rollnick & Miller, 1995), both of which had been found to be effective with high-risk college drinkers (Carey, Scott-Sheldon, Carey, & DeMartini, 2007; Juarez, Walters, Daugherty, & Radi, 2006; Walters, Vader, & Harris, 2007), were planned for the intervention. Other elements, techniques, and methods planned for M-PASS included a harm-reduction approach to message development, decisional balance, feedback on consumption, feedback on normative beliefs, goal-setting, additional related resources, alternative strategies, normative comparisons, values clarification, blood alcohol content calculator, and an option for printing out a personal report.

Given that MI was found to be one of the common best practices, several major types of motivational strategies for preventing and reducing ARD were planned for the M-PASS intervention. These strategies would be implemented using instantaneous interactivity using computerized algorithms to collect data interactively from students and formulate and deliver intervention messages in a manner that would approximate face-to-face interactions. Elements of language style consistent with MI, such as expressing empathy, developing discrepancies, and supporting self-efficacy, which would raise awareness of alcohol-related issues in a nonconfrontational manner, were planned to motivate students to explore behavior change. Furthermore, supportive peers were planned to guide the participants through each of the sessions. The peers would be two-dimensional avatars depicting realistic static visualization (by photographs) of four resident advisors (RAs) in different poses, with motivational text written in text bubbles on the Web pages. Although there is little research on the efficacy of avatars for enhancing health outcomes, the literature supports the educational potential of using avatars, such as those found in Second Life, as more powerful than using textual messages in health interventions (Boulos, Hetherington, & Wheeler, 2007;

Nieuwboer, Maes, & Swanepoel, 2005). Although the M-PASS avatars would not be manipulated to match participant characteristics or preferences, they would be selected to represent diversity in features like gender, race, hair style, and clothing. Their use was thought to offer a more personal, accessible way to collect data and provide motivational feedback, and to have a positive effect on the priority population's perception of the source of motivational feedback and content and on their attitude and involvement in the intervention (Nieuwboer et al., 2005). Other modes for human-computer interaction, such as using animated 3-D virtual personas and audio, were considered but for reasons of time and cost were not selected. RAs were selected because they interact daily with college students, are a familiar source of information, are essentially the same age, and are able to listen, give feedback, and relate to students from a been there, done that perspective.

Designing the Intervention

Once best practices were identified, the design of intervention materials began. Because evidence suggests that health promotion programs are more effective if they are theory-based (Painter, Borba, Hynes, Mays, & Glanz, 2008), the first step in designing M-PASS, or any health promotion intervention, was to develop the conceptual framework that would identify and organize the concepts, definitions, and propositions related to health behavior change (Glanz, Lewis, & Rimer, 1997). In general, a conceptual model for an intervention may be based on a single theory, or it may borrow compatible concepts from multiple theories.

For M-PASS, appropriate theories—not only those that were specific to reducing risks associated with ARD but also those that explained behavior change more broadly—were considered. Because no single behavior change theory explained the entire spectrum of ARD risk reduction, compatible concepts from four relevant theories were selected and organized into a conceptual framework. Concepts were not selected based on their relevance to a Web-based platform but rather to their relevance to reducing ARD-related risks. Four sequential domains associated with movement through the stages of change and reduction in ARD within the college context made up the conceptual framework: (a) raising awareness of ARD, (b) benefits of and barriers to behavior change, (c) keys to self liberation, and (d) planning for contingencies (Figure 1). These domains were defined by sets of concepts that provided the basis for identifying what content to tailor, how to tailor it, what information the tailored message would convey, and from what social context.

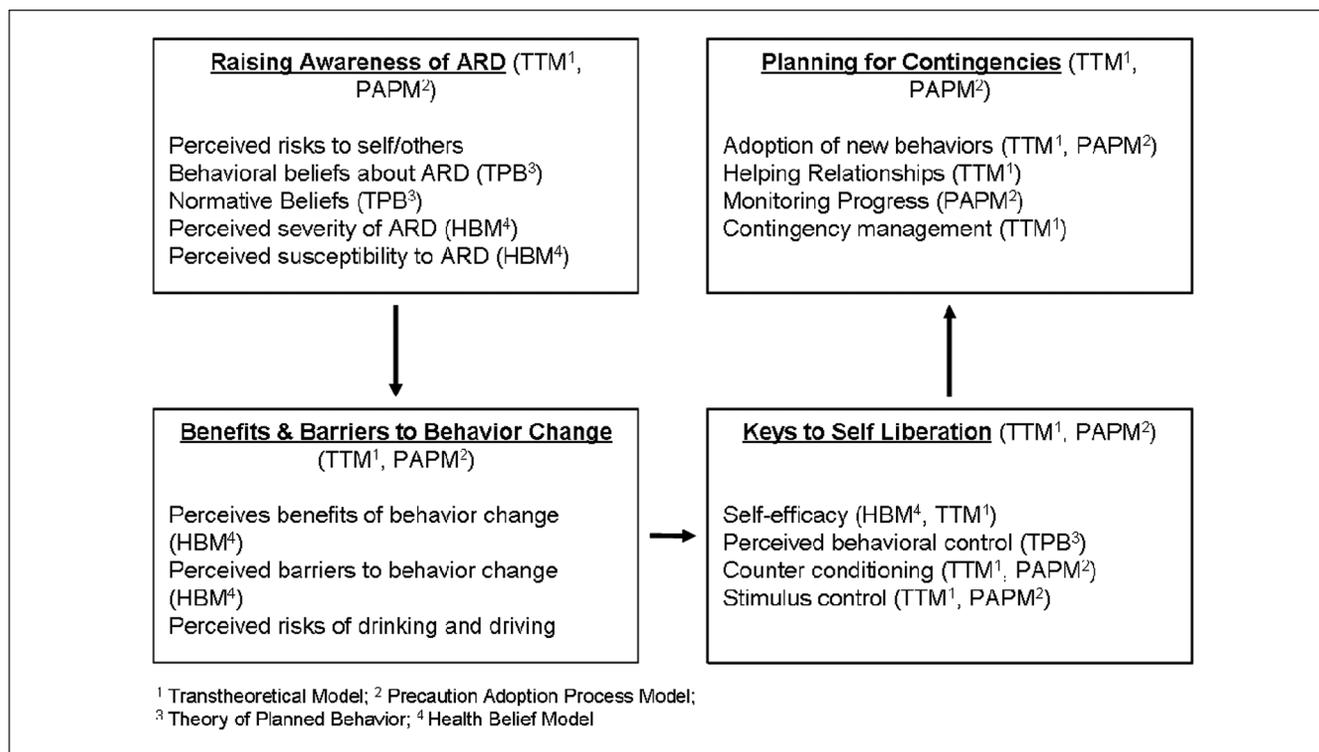


FIGURE 1 Conceptual Framework

Once established, the conceptual framework informed what objectives M-PASS would have. For example, the first objective was to raise students' awareness of ARD by having them examine their perceptions of drinking, explore their beliefs, consider their perceptions of ARD norms, and identify ways that their personal priorities were supported or impeded by their alcohol use behaviors. While identifying objectives, it became apparent whether the conceptual framework provided the detail needed to design an effective behavior change program. If there had been insufficient detail, the conceptual framework would have been adjusted. Table 1 offers a brief summary of each session and description of the activities that were planned for the intervention.

While identifying objectives, logistics and practicalities for the planned intervention unfolded. For example, the project team planned for an intervention that would consist of four Web sessions, one for each domain of the conceptual framework; would be linear in that participants would progress sequentially from Session 1 to 4; and would be customized around three groups of 1st-year college students: high-risk drinkers, low-risk drinkers, and nondrinkers. Dividing the participants into these groups simplified message tailoring, which was

to be qualitatively different for high-risk drinkers (i.e., risk reduction messages), low-risk drinkers (i.e., risk avoidance messages), and nondrinkers (i.e., postponement of risk exposure).

Finally, methods to measure the constructs in the conceptual model, obtain the needed information for tailoring messages, and deliver intervention content and feedback messages were determined. Although the Internet may be an impersonal medium for transferring health promotion messages and may present navigational challenges for participants, the numerous advantages of using a Web-based platform counter these shortcomings. For example, by using Web pages and surveys backed by a database, a Web-based platform would have the advantage of offering an interactive experience for the participants by collecting data automatically and generating tailored feedback instantly. Additional benefits include enhanced convenience, novelty, and appeal with computer-savvy audiences and flexibility (Fotheringham, Owies, Leslie, & Owen, 2000). It would also be a very cost-effective way (Whiteley, Bailey, & McInnis, 2008) to reach many students during a developmental period when ARD tends to increase.

TABLE 1
M-PASS Session Activities, Objectives, and Descriptions

<i>Session</i>	<i>Activity Name</i>	<i>Objective</i>	<i>Description</i>
1	Alcohol 101	To sort out fact from fiction surrounding alcohol use	Student indicates “fact” or “fiction” after each alcohol statement. Misinformation is corrected or accurate information is enforced.
	Reality Check	To evaluate normative beliefs and correct misperceptions	Student fills out a Drinking Norms Worksheet and receives normative feedback.
	Making Connection	To appreciate severity and recognize susceptibility of ARD	Based on student’s perceptions, he or she receives information that relates alcohol consequences to personal values.
	Cold Hard Cash & Calories	To appreciate the costs of alcohol use and the extra calories consumed	Student learns how many extra calories have been consumed because of his or her or others’ drinking levels and cash spent.
2	It’s a Balancing Act	To identify benefits of behavior change	Student selects benefits of drinking less or not drinking at all.
	Breaking Down Barriers	To identify barriers to behavior change	Student selects barriers to drinking less or not drinking at all and is presented with a score card of both benefits and barriers.
	Driving Sober, Riding Safe	To avoid drink-driving and riding with drunk drivers	Student is presented with alternative strategies to drink-driving and riding with drunk drivers.
3	Strategies that Work	To increase self-efficacy	Student takes a self-efficacy survey and receives tailored feedback. Student also selects alternative strategies to drinking and/or being in the drinking scene.
	Jumpin’ In	To practice making smart decisions	Student responds to scenarios where he or she may be tempted to drink or pressured by others to drink.
4	Planning for Success	To adopt new behaviors	Student sets alcohol- or value-related goals, selects strategies to reach goals, and learns to monitor progress.
	Jumpin’ Out	To reinforce management of low-risk or nondrinking behavior	Student responds to scenarios where alcohol-related consequences are present.

NOTE: M-PASS = Michigan Prevention & Alcohol Safety for Students; ARD = at-risk drinking.

Developing Intervention Content

One of the largest tasks of developing M-PASS was writing the content. As with previous phases, content development was highly reliant on the conceptual framework to provide direction, definition, and structure. First, key concepts, topics, and targets of the intervention were identified. Key concepts were the primary ideas and constructs that the intervention would address (e.g., costs associated with ARD). Each key concept included topics (e.g., education outcomes and achievement, and the effects of ARD on students’ personal safety, attractiveness, and health). For each topic, one or more targets were identified. The targets were the knowledge, behaviors, attitudes, and beliefs about the topics that M-PASS would need to change or reinforce for the students to feel motivated and to change their behavior.

Targets used to address the topics just listed included recognition of the effects of ARD on academic performance, realizing the importance of having strategies to avoid risky sexual situations involving alcohol, understanding the possible negative effects of alcohol on others’ perceptions, and the association between the caloric content of alcohol and weight gain. Although key concepts, topics, and targets were identified based on the conceptual model, their meaning and relevance to the priority population were provided by other sources, such as information gathered from focus groups conducted while identifying best practices.

Most interventions involve some amount of tailoring. In a computerized intervention, tailoring can be extensive. To achieve the degree of tailoring needed for M-PASS, a tailoring plan was written. The tailoring plan was a

logical sequence of decision points that guided the writing of the intervention content so that messages would address the key concepts, topics, and targets to be delivered in a way that would match the characteristics and needs of the priority population. One method for addressing this complex task was to identify intervention personas so that the text of the intervention messages would be written to “fit” each of these personas.

The concept of personas came from product design and marketing, where it was used to ensure that the products being developed or marketed would have the appropriate content for all segments of its intended audience (Loeber & Cristea, 2003). Although the use of intervention personas in developing Web-based health promotion programs has not been reported in the literature, it was thought to be a useful tool for writing the M-PASS content. Adapting this tool, a set of intervention personas to be targeted by the intervention was identified. This set collectively described all segments of the 1st-year college student population that were critical to the intervention. For example, one persona represented the student population that on average consumed more than three alcoholic drinks a day, binge drank at least once a month, drank and drove regularly, valued academic success, and recognized the potentially negative effects of drinking on academic performance but lacked the self-efficacy needed to reduce alcohol use. Because M-PASS was designed to have complex tailoring needs, it became necessary to find the optimal number of personas that would collectively address the characteristics and needs of the priority audience while still being feasible to accomplish. Although not ideal, the personas that were identified and targeted had to be generalized across race and ethnicity, class, and gender. From this set of personas, a series of if-then statements were written into an algorithm whereby the tailoring plan was established.

Once the tailoring plan was developed, a program map was prepared. This map provided a detailed outline of the intervention content to be written that would match the dimensions and characteristics of the personas. For M-PASS, the program map included the specific topics to be covered, Web site interactivity needed, the location of static text (i.e., basic sentence structure that is not tailored) and tailored text (i.e., dynamic text that is inserted into the static text to tailor messages), the measures to obtain the data needed to tailor intervention messages, where measurement would take place, and the mode of message delivery (e.g., screen text, interactivity). Using the program map as a guide, the appropriate intervention script was written, including static text, tailored text, and tailoring logic for each segment of the map. The style of language used when

writing the script was consistent with MI (e.g., expressing empathy, developing discrepancy, rolling with resistance, and supporting self-efficacy). Draft scripts were reviewed by the project team, external expert reviewers, and members of the priority audience and revised accordingly.

Constructing the Intervention

Constructing a health promotion intervention depends on the mode of delivery, which depends on the type of health promotion messages to be delivered. Modes of message delivery include audiovisual materials (audiotapes, instructional television, video), computerized instruction (World Wide Web, CD-ROM, Web-based program), or written materials (pamphlets, study guides, workbooks; McKenzie et al., 2009). Figure 2 demonstrates the sort of sequence and type of tasks that were involved in constructing M-PASS. The figure illustrates, in general, the iterative nature between the project team and the creative resources that were contracted to produce M-PASS (Bartholomew et al., 2006).

The creative people, including a lead Web designer and four graduate and undergraduate students, participated in project meetings where the project team's intent was conveyed in detail. As Bartholomew and colleagues (2006) suggested, two types of design documents were used: a series of design documents (script) from the project team to the creative people and a series of production design documents (mock-up Web pages) from the creative people to the project team.

The Web program was then constructed in three very general steps. These steps can be applied to any intervention regardless of the delivery mode. First, the creative people built mock-up Web pages using the script as a guide and designed the interface that allowed members of the priority audience to interact with the Web program. Mock-ups were created using HTML, XHTML, CSS, and Javascript, as well as other Web development and production tools (e.g., Macromedia Dreamweaver). Graphic elements were designed using Illustrator, Photoshop, and Fireworks. Second, the appeal, functionality, and content of the mock-up pages were tested with the project team and priority population representatives (including college students). This was an iterative process of product review, constructive feedback, and revision. And third, the project team rewrote and revised the intervention materials, and the creative people modified and revised the corresponding mock-up pages. This process was repeated until no more suggestions were made for the Web pages. These pages, including graphics and interactivity, made up the front end of the M-PASS Web site, the portion that was viewed using an Internet browser.

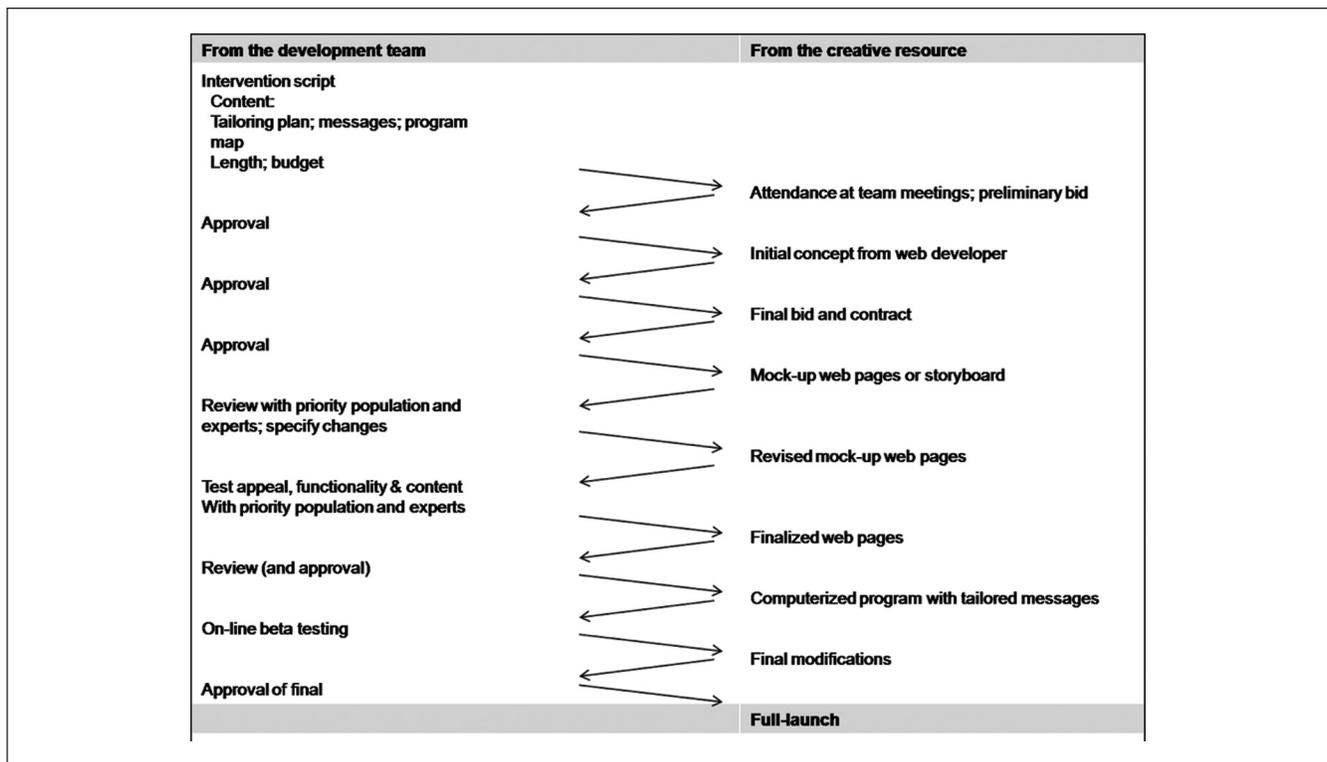


FIGURE 2 Developing Web-Based Interventions
SOURCE: Adapted from Bartholomew et al. (2006, p. 249).

In general, intervention materials can be finalized for delivery using whatever delivery mode has been selected. For M-PASS, an external agency was hired to program the Web site using a database of messages and the tailoring plan for matching the messages to the individuals. Like other Web-based tailored interventions, this expert system (a software system that mimics the deductive or inductive reasoning of a human expert; Velicer, Prochaska, & Bellis, 1993) integrated a data collection tool (baseline survey and Web site interactivity); several databases, including at least one data file of feedback messages and another for storage of data collected from the participants; decision rules; and a tailoring program (Dijkstra & De Vries, 1999).

Pretesting and Finalizing the Intervention

The final step in developing M-PASS was to pretest as much of the final intervention content and visuals as possible for priority audience reaction to guide final revisions prior to implementation. Eight students were recruited by e-mail to participate in a workshop to pretest the Web pages customized to high-risk drinkers. They

took the baseline survey and each of the four Web sessions, completing a paper-and-pencil survey evaluation after each session. Focus group discussions were also held separately with male and female participants to determine attention, comprehension, strengths and weaknesses, and overall appeal of M-PASS, and to identify changes to improve the Web program and/or intervention content.

According to overall survey responses, they read an average of 75.4% of the text on the Web screens. On a scale from 1 (*not at all*) to 4 (*very*), participants were on average somewhat engaged in the program, found the program to be somewhat relevant, and considered the program to be somewhat useful, interesting, and valuable. On a scale from 1 (*none of it*) to 4 (*all of it*), participants on average indicated that some of the information was new to them. On a scale from 1 (*low*) to 10 (*high*), participants on average gave the M-PASS program an overall rating of 6.3.

The workshop participants talked about several strengths of the program. One said, "I liked that the [information] was personalized and that the program only discussed things that were relevant to me." Another

participant said that the program “helped me to put my habits into perspective, and it helped me realize my dangerous decisions.” Session 3 “gave good suggestions to cut down on drinking” and “it was really engaging; and I liked the [graphic display] that showed confidence levels. They were awesome!” Session 4 “helped [students] put goals into perspective.” The “shorter sessions keep the kids focused on the whole thing. [Session 4] was clear and easily accessible.”

Some of the weaknesses of the program included a lengthy first session, too much text to read (e.g., “I didn’t really read all of what [the RAs] were saying”), repetitive text within and between sessions (e.g., “It seemed a little repetitive”), and lack of new information (e.g., “[The program] gives information that is already known to us” and “I felt like I knew a lot of what was being said”).

Based on some of the findings from the pretest, small revisions were made to the intervention. Some of the RA messages were condensed, shortened, and reworded to reflect input from the workshop participants. The limited revisions made to M-PASS are a limitation discussed in the next section.

► LIMITATIONS

In general, limitations to intervention development can be significant because they risk compromising the success of the intervention. However, behavioral research occurs not in a test tube but in the real world, with many time, method, and resource constraints. For this reason, it is important for research findings to include descriptions of such constraints so study findings can be accurately interpreted. There are several limitations associated with the intervention development methodology presented in this article. First, one drawback to using a Web-based format is that it was difficult to measure the quantity and quality of interaction that participants had with the Web program. For example, data collected on start and end times for each session were not necessarily meaningful indicators of how much time students actually spent on the Web site because they may have done other activities while completing the session, such as answering a phone call or browsing other Web sites. Second, M-PASS was pretested with only a small sample of priority population representatives. Therefore, participant reaction to the Web-based intervention may not have been generalizable to all 1st-year students at the participating university. Third, because of the impending launch date of the intervention, only small revisions were made to the program. If more time and resources had been available, more substantial revisions could have been made based on pretest findings. Fourth, the Web screens customized to low-risk-and nondrinkers were not pretested because

they were still in development. Hence, these screens were revised and adapted based on reaction from high-risk drinkers. Other revisions may have been made if the relevant Web screens were pretested with relevant students. Fifth, participants who pretested the intervention were not asked about what they thought about the Web-based format of the intervention. Including this information in the pretest would have contributed to validating the format chosen for delivering the intervention. Sixth, using RA peers as avatars would only have been effective if participants “believed” in the role that the avatars took; plus there was not much information found in the literature to guide the selection of effective avatars. Lastly, M-PASS participants were not able to tailor their RA avatars to their personal specifications and modify them based on preference and beliefs. This may have affected the legitimacy of the avatars as representing supportive peers.

► DISCUSSION

This article attempts to open the black box of Web-based intervention development. M-PASS was presented as a case example to show how this method of intervention development was applied. The processes of intervention development are seldom reported in peer-reviewed reports, or they are presented in a highly abbreviated form, but are rarely sufficiently detailed to provide an understanding of the steps and processes going into intervention preparation (Centers for Disease Control and Prevention [CDC], 1999). This is unfortunate for three main reasons. One is because more information about intervention development may aid in interpreting study findings, especially in the case of highly complex health promotion interventions (Campbell et al., 2000). Second, it is important for setting the “frame of reference for all subsequent decisions in an evaluation, such as comparing with similar interventions and facilitating attempts to connect intervention components to their effects” (CDC, 1999). Third, more information may guide other researchers and practitioners in identifying an effective and efficient process for developing their own interventions. Further discussion of intervention development methods and approaches in the peer-reviewed literature would fill an important gap and contribute positively to the methodology of intervention development.

It is unclear why development protocols are underreported in the primary literature. One reason may be due to the tendency for scientific publications to favor the testing of hypotheses rather than the processes leading to the outcomes that form the material tested. Another may be a greater value placed on what programs work and do not work, while forgetting the process of designing

and developing an intervention that is effective. However, reporting on the processes could have long-term pay-offs for the field of health promotion through the identification of best practices for effective and efficient health program development.

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