

CHAPTER

6

How to Deliver Physical Activity Messages

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**"I KNOW I SHOULD START EXERCISING,
BUT I DON'T KNOW WHERE TO BEGIN!"**

ELECTRONIC TECHNOLOGIES AS COMMUNICATION CHANNELS FOR PHYSICAL ACTIVITY MESSAGE DELIVERY

In this age of electronic media and wireless communication, there are multiple ways to deliver a physical activity program. The Internet, computers, and mobile phones can be harnessed to customize and automate physical activity intervention programs that can provide instruction, motivational messages, goal setting, and feedback in ways never before possible. In addition, there are new types of devices to use with these technologies for collecting information from individuals about their activity patterns. Devices such as pedometers, heart rate monitors, and GPS units—as well as technologies that have accelerometers, gyroscopes, and temperature sensors built into them—can provide monitoring and feedback to individuals, coaches, or health care providers about activity levels and other health indicators. This chapter sorts through and explains the barrage of electronic technologies and how they have been implemented and evaluated as channels for delivering physical activity programs. Before we delve into each type of technology and present step-by-step recommendations for their use, we will provide some background on ways of thinking about communication systems.

A COMMUNICATION MODEL APPLIED TO DELIVERING PHYSICAL ACTIVITY INTERVENTIONS

Berlo's (10) S-M-C-R model of communication defines communication as a process that works through a *Source* that delivers the *Message* through a *Channel* to a *Receiver*. When we apply the S-M-C-R model to deliver physical activity interventions, the *Source* is you and your intervention system, which includes the decision rules that determine the appropriate *Message* to send. The *Message* is the content of the intervention and is delivered through different *Channels*, such as printed materials, Web sites, text messages, or Twitter "tweets" that are *Received* by users interested in changing or maintaining their physical activity level. Velicer and colleagues (111) added the *Feedback* channel to the S-M-C-R model to explain how a behavior change intervention determines the specific elements on which to tailor the intervention for the *Receiver*. This information could come from survey responses to questions about motivation and barriers to being physically active and from sensor data collected from a pedometer, accelerometer, or other data capture device to determine levels and patterns of physical activity.

For the technologies presented in this chapter that serve as the *Source*—*Message* channels and *Feedback* channels (S-M-C-R-F)—we emphasize designing interventions to influence physical activity through human computer interaction (HCI) rather than computer mediated communication (CMC) (36). In HCI, the *Receiver* interacts with computerized message channels such as mobile phone texting or a Web site that delivers content determined by computer algorithms and *Feedback* channels such as a sensor device that captures physical activity levels. CMC, on the other hand, facilitates person-to-person communication through technologies such as instant messaging, Skype, or WebEx. The distinction between HCI and CMC is subtle but important. One important difference is that CMC allows for one-to-one communication and does not "scale up" to allow you to reach a large number of individuals

in a timely and cost-effective manner. The automatic approach of HCI is designed to mimic the experience that occurs through CMC and face-to-face interactions.

HCI opens the range of possibilities for how physical activity interventions can be delivered. One-to-one, face-to-face interaction was the typical way people received a physical activity intervention through a trainer or health care provider. Similarly, one-to-many interactions to deliver an intervention were typically delivered through group sessions or classes. Now, HCI can simulate many of the aspects of one-to-one interactions but deliver “customized” programs to many people through interactive Web sites, mobile applications, and computer-tailored print materials. Thus, HCI allows scaling of one-to-one interactions so they can be delivered as one-to-many interactions. In addition, social media technologies such as Facebook allow for many-to-many delivery for physical activity promotion. Many-to-many delivery can happen, for example, when you post a physical activity tip on your Facebook page and many people see your post and repost your tip on their pages, linking you to people who you did not contact directly. This chapter presents multiple examples of types of HCI actions possible with different communication technologies.

Continuing with how the S-M-C-R-F model applies to technologies for delivering physical activity interventions, there are important aspects about the *Receiver* to consider. Ideally, you want to develop and direct your intervention program to those in different phases of physical activity “readiness” (97). For example, knowing a person is new to physical activity and is in the Adopter phase would lead you to develop a program different from one designed for someone who is already active and needs motivation to stay a Maintainer. Similarly, someone who was previously active but currently is not—for example, because of injury or pregnancy—would likely get a different kind of intervention geared toward the Relapse phase. Many other aspects of the *Receiver* may be important to determine, which can help customize the intervention *Message*, such as age, gender, and physical activity goals. The latter might be a key part of your intervention program, and you will need to determine whether someone is interested in intentional leisure types of physical activity (e.g., running, swimming, team sports) or increasing activity through incidental-utilitarian types of activity such as taking the stairs instead of the elevator or walking to destinations instead of driving.

This brings us to the type of *Message* content you will need to develop that will be delivered in your physical activity intervention. Kreuter (61) conceptualized a spectrum of communication content types, from a completely generic content to a completely individualized tailored content. With generic content, there is the assumption that “one size fits all” and intervention content does not need to be altered based on characteristics of the individual. “Tailored” intervention content is designed for one particular individual based on his or her specific characteristics (e.g., motivation level for physical activity, perceived barriers to being active). In between generic and tailored communication is content “targeted” to a subgroup of people, usually based on one or more demographic characteristics (e.g., age and sex). The type of *Message* content you use in your intervention may be determined by factors such as the nature and size of the target population, the budget, and HCI technologies that will be used in the *Message* and *Feedback* channels of your intervention. In this chapter, we will mainly focus on developing tailored interventions and how different technologies facilitate delivering tailored message content.

The sections of this chapter focus on the communication *Channels*, both for content and for feedback to the *Source*. We begin with computer-generated print materials, and then turn to electronic media such as Internet, video, and interactive voice recognition (IVR). Next, we present two newer technologies for intervention delivery: Short Message Service (SMS) text messaging and social networking platforms. From there, we switch to the feedback devices such as pedometers, accelerometers, heart rate monitors, and GPS units. The chapter concludes with ways that *Message* and *Feedback* channels can be integrated into smart mobile applications and other technology platforms. This chapter is geared to those interested in creating their own physical activity intervention program either through developing a “custom” system or by using “off the shelf” commercial products.

COMPUTER-GENERATED PRINT MEDIA

The “gold standard” for delivering physical activity programs is face-to-face contact with a health professional or a certified personal trainer (79). However, the time and cost of these programs often makes them inaccessible to many people. There is a long history of physical activity instructions and self-help materials delivered through books, pamphlets, and newsletters. Print materials can be used to provide a structured self-help program or to supplement face-to-face training sessions. Print materials can be handed out at the point of service, such as athletic clubs, gyms, health care clinics, and work-sites, or they can be mailed directly to patients, employees, club members, and clients. Electronic print materials can also be e-mailed to individuals or made accessible on Web sites. Providing print materials is a way for health professionals to deliver information to their patients that they do not have time to cover during a clinic visit or as a means to reinforce messages they give at a counseling session. The printed materials serve as a reminder to the individual and information that the client can refer to between clinic visits or sessions.

Since the early 2000s, considerable information about physical activity has become available on the Internet, and 8 in 10 U.S. Internet users have searched for health information on the Web (<http://pewinternet.org>). Thus, Internet sources have a wide reach for interested consumers, yet the quality of information and appropriateness to the individual may vary considerably. Electronic print materials can consist of existing generic print materials simply provided directly on the Web. Organizations such as the *American Heart Association*, *American College of Sports Medicine*, the *American Academy of Family Physicians*, and *American Council on Exercise (ACE)* have online materials available. However, a major advantage of electronic print media is the potential to customize materials either for groups or to individuals. Customizing information to a group is often called “market segmentation” or “targeting.” For example, developing a monthly physical activity newsletter just for seniors would provide specific information about types of physical activity that would appeal to this population age segment.

On the other hand, tailored materials are designed to mimic the strengths of individual counseling such as interpersonal contact, interactivity, and immediacy of feedback. Tailored information can range from superficially “personalized” materials that use a person’s name to generate interest but deliver generic information, to highly individualized tailoring that provides feedback based on assessed knowledge, attitudes, and behavior history.

Tailored electronic print materials require information to be collected to tailor the messages and feedback. Information can be collected by mail, at a kiosk, or online. How data are collected and the information is delivered determine the immediacy of the information. There will be a significant delay if a person must mail a survey and the survey information has to be entered into a computer system to generate a tailored feedback report. In comparison, a computer kiosk or online assessment can be completed and immediately tailored for the individual, and delivered to them.

Evidence

Multiple reviews of tailored health behavior studies generally have concluded that tailoring “works” (84). For example, when reviewing eight studies that specifically compared tailored to nontailored print materials, Skinner and colleagues (102) found tailored information enhances the impact of the printed intervention materials (in terms of being better remembered, read, and perceived as relevant) compared to nontailored materials. Skinner et al. also found tailored print materials to be more effective than nontailored for changing health behaviors (*e.g.*, diet, physical activity, smoking, mammography screening).

However, only one of the eight studies focused on physical activity. Similarly, from a review of 30 studies on physical activity and diet behavior change, Kroeze (63) concluded that the evidence in support of computer-tailored interventions for diet was strong. However, from the 10 physical activity-tailored intervention studies, the evidence was not sufficient to conclude in favor of computer-tailored interventions.

Several studies have demonstrated that tailored print material interventions work for promoting physical activity. For example, Marcus and colleagues (72) demonstrated that stage-targeted materials outperformed standard *American Heart Association* generic print materials. Marcus (73) compared tailored print materials to tailored Internet delivery, and to standard Internet delivery, which consisted of links to six publicly available physical activity Web sites. The tailored print and Internet groups received the same information and groups were instructed to complete physical activity logs. Participants in all three groups ($N = 249$) increased activity from being sedentary to between 80 to 90 minutes of physical activity a week over 12 months. The findings suggest that all three types of programs were effective likely because they included prompted self-monitoring with physical activity logs, which is known as an important behavior change strategy.

A similarly designed study randomized sedentary adults to print and telephone-delivered tailored interventions, or to a control group condition (74). A total of 14 contacts were made over 12 months with materials either mailed or delivered by telephone health counselors in the print and telephone groups, respectively. Although both intervention programs increased physical activity by an additional 40 minutes/week compared to the control condition at 6 months, by 12 months only the print materials condition was significantly more active than the telephone and control groups. These findings suggest that both intervention modes may be effective for helping people in the adoption of physical activity, but the print materials may be more effective than telephone counseling for maintaining physical activity. It may be that having the printed tailored intervention materials available to review at any time is helpful in keeping a person motivated to be physically active.

Some studies have examined the effect of tailored print materials targeting both physical activity and diet behaviors. Van Keulen (55) randomized individuals to receive either four computer-tailored letters, four motivational interview telephone calls, a combined intervention (two letters and two calls), or a control group. Interventions were delivered within 12 months and all three interventions improved physical activity and diet compared to the control group. Another study randomized breast and prostate cancer survivors to receive a 10-month program of either tailored or nontailored mailed print materials for improving physical activity and diet behaviors (29). Although cancer survivors in both programs improved health behaviors, the tailored program was found to be more effective.

Unfortunately, there is no definitive evidence on how much printed materials need to be tailored to be effective, or exactly what factors need to be tailored. For example, demographic characteristics, level of motivation, perceived barriers, and use of behavior change constructs are just some of the factors that could be the basis for tailoring intervention materials. It is also not known how often tailored interventions need to be delivered. For example, counter to intuition, a single mailing of print materials was more effective at promoting physical activity than multiple mailings (75).



Step-by-Step

Kreuter (61) outlined a five-step process for developing tailored intervention materials. The steps presented in Table 6.1 incorporate Kreuter's steps, with additional decisions that need to be made when developing a print-based tailored intervention program.

TABLE 6.1 Steps in the Process of Developing a Print-Based Tailored Intervention

Step	Key Questions and Tasks
1. Preliminary Steps	<p>What is the purpose of program? Is it to supplement or enhance a “face-to-face” program, or will this be a “stand-alone” self-help program?</p> <p>Who is your target audience? Will the program target multiple phases of physical activity, such as adoption, maintenance, and relapse?</p> <p>In what setting will the printed materials be distributed? Possibilities include an individual’s home, gym, worksite, or health care clinic. The setting may influence the look, content and “branding” of the print materials.</p>
2. Intervention Content	<p>Will the structure of the intervention be a newsletter, a report, or a pamphlet? Will the content be based on a scientific theory and evidence? Theories and models of persuasion and behavior change can be drawn from fields of communication, psychology, and sociology (Neuhauser 2003). On which determinants of physical activity do you want to focus? How extensively will the content be tailored?</p>
3. Partnering with Experts	<p>The decisions in steps 1 and 2 will lead you to determine who to partner with to develop the printed materials. Do you need a graphic designer, computer programmers, a printing company, copyeditor, or health care professionals?</p>
4. Gathering and Storing Information	<p>How will the determinants of physical activity be measured? Do validated survey measures exist? How will collected information be stored in a database?</p>
5. Creating the Intervention System	<p>Create tailored messages that vary by levels of the measured determinants. Develop algorithms and a computer program for determining how survey responses about determinants are linked to specific tailored messages. The algorithms are rules or decisions that the computer follows to “act” like the human expert (e.g., coach, counselor, health care provider).</p>
6. Other Considerations	<p>Consider what the appropriate reading level should be for your printed materials. It is recommended that health literature be written at a 6th-grade reading level so it is accessible to lower literacy individuals.</p> <p>What is the time frame for the delivery of the intervention materials? For example, will it be weekly, monthly, or semiannually? The time frame is an important consideration and relates to the overall structure of the printed materials and how much content will need to be developed.</p>



Case Scenario 6.1

You are hired by a large business to assist with a yearlong “Workplace Wellness” initiative for their employees. Your job is to create print materials to help employees increase their physical activity levels.

Worksite: Customer service center

Number of employees: 500

Age range: 18–60

Case Scenario 6.1 *continued*

Gender: 65% women

Education: 25% high school graduate, 65% college degree, 10% graduate degree

Main physical activity barrier: Most of the employees sit at a computer for 8 hours a day, 5 days a week.

Because you will not be providing any other counseling to these individuals, the materials must stand-alone and be self-explanatory. The materials need to target multiple phases of physical activity (*i.e.*, adoption, maintenance, and relapse) as this is a yearlong program and the employees will likely start at different physical activity levels. You determine that the best way to deliver these materials is via e-mail, as this method is efficient and inexpensive. In addition, the employees may be more likely to read the materials if the e-mail comes from a reliable source like the Human Resources or Health Services department. The materials will be in a newsletter that employees can easily print out or that can be read on the computer. The content will be based on Social Cognitive Theory. Because the employees are sedentary for most of the week, the focus of the materials will be on environmental determinants of physical activity such as access and time barriers. About 40% of the content will be generic, but given the demographics of the company, you decide it is best to tailor the remaining 60% of the content on age, gender, and the current phase of physical activity. You hire a behavioral health consultant to help base the content on evidence-based behavior change theories and a computer software engineer to help you create computer algorithms for tailoring the content. You also plan to hire a copyeditor and a graphic designer so the product has a professional look and is attention grabbing. The determinants of physical activity will be measured quarterly with a validated, electronic questionnaire distributed to the employees via e-mail. Information will be collected on a secure database. Finally, the computer algorithms will link the information collected from these questionnaires to specific tailored messages to create the tailored print materials.

ELECTRONIC MEDIA: INTERNET AND INTERACTIVE VOICE RESPONSE

Electronic media such as Internet-based and automated telephone systems have the potential for reaching many individuals at a low cost. For example, the Internet has global reach, with widespread adoption in the U.S. (*e.g.*, 79% of adults use the Internet: pewinternet.org, August 23, 2011) and about 30.2% (approximately 2.1 billion people) of the global population, with rapid growth observed in developing areas such as Africa (2527% growth since 2000) and the Middle East (1987% growth since 2000: Internet World Stats, 2011). There are many advantages of computer/Web-based interventions for health behavior change, such as ease of dissemination, access, anonymity, interactivity, and graphical interfaces. Further, after initial setup costs, maintenance of these Web sites is relatively low-cost (8). Interactive voice response (IVR) systems are computer-directed interactions via the telephone (*e.g.*, when you call a company, your initial interactions are often with a computer-automated voice, which is an IVR system). These technologies have gained popularity, not only for call service centers but also for health promotion because they can be automated to provide a variety of health services ranging from automated appointment reminders to data gathering and physical activity coaching.



Evidence for Internet Interventions

Several scientific reviews have explored the value of Internet-based interventions (16,28,82, 114). In general, most reviews have suggested insufficient evidence for Internet-based interventions as an effective strategy for physical activity interventions. Despite this, a more meta-analysis exploring the efficacy of Internet-based interventions as social marketing for behavior change more generally, not just for physical activity promotion, showed “small but statistically significant effects” across 30 studies (28). Almost all of these previous reviews highlight the early nature of Internet-based programs, along with the need for additional research.

When interventions did show evidence of working, it tended to be when they were compared to no-treatment control groups (12,49,50,78,103). There was less supportive evidence of Internet-based interventions relative to other active forms of intervention, such as tailored print-based media (73). A study comparing two Web sites showed that a neighborhood-focused Web site that was updated often resulted in significantly improved physical activity participation over a 26-week period relative to a nontailored motivationally focused Web site (34).

Short-term intervention programs seem to be more effective than longer-term programs (28). A major problem of most Internet-based interventions is that people stop using the program regularly with many showing low return visit rates to the Web sites (32). Internet-based interventions had attrition rates greater than 20%, suggesting the continued need to explore methods for improving adherence.

When designing a Web-based intervention, there are two major types of design features to consider: those features that improve the return/retention rate of the use of the Web site and those features that promote physical activity. Each of these types of features will be discussed in turn based on previous literature and specific recommendations will be given.

Previous research has explored differences in attrition rates that occur based on recruitment strategies (e.g., clinical trials vs. commercially available Web sites). Research from clinical trials suggests the value of including multiple methods of communicating (i.e., e-mail, text message) along with peer interaction / social support to improve adherence to Web-based interventions (16,18,114). A few studies have explored program adherence using a Web-based intervention among individuals not part of a clinical trial (81,112). Results from one study suggest that only 4.8% of the individuals who visited the open-access Web site registered to use it, and even among registered users, the vast majority (i.e., approximately 92%) stopped using the Web site after one month and did not return despite e-mail reminders. This dropout rate was markedly higher compared to participants in the clinical trial (i.e., 40% drop out by month one) who were instructed to access the same Web site.

Another study explored dropout and retention rates for a commercially available weight-loss Web site, *The Biggest Loser, Australia* (81). This Web site was advertised on *The Biggest Loser, Australia* TV show and included a paid subscription plan ranging from 12 weeks to 52 weeks. When looking at data from those who paid for the subscription, the number of participants returning after the first month to use the Web site dropped to fewer than 50% of the eligible participants by weeks 9–12 of the program among those who signed up for a 12-week subscription. Among participants who signed up for a 52-week subscription, nonuse rates increased the most during the first 16 weeks of the program, with a relatively steady rate of nonuse of approximately 60% occurring from week 21 onward.

Web sites need to be designed with content easily accessible at all page levels of the site. One study explored what factors (e.g., demographics, self-determination beliefs) predicted surfing depth in a physical activity and nutrition behavior change Web site (51). This study highlighted a variety of good practices for the development of a Web site. From a design standpoint, the researchers did a small prototyping phase with a small sample of the target population. In addition, participants determined how difficult (i.e., how many clicks) it was to get to various information within a Web site, thus aiding in understanding how the structure

of the information impacts use. As a result, the researchers gathered a great deal of valuable metrics for understanding user behavior (*e.g.*, number of clicks, time spent on each page—information that can be gleaned using tools like Google Analytics). Findings from this study suggested that the Web site had an average penetration of only two layers (*i.e.*, two additional clicks to content areas beyond the home page), which is lower than the four to eight clicks more commonly observed in other successful Web sites. Although e-mail reminders were shown to help increase the depth of exploration, the results were considered largely inconclusive based on the relatively small depth that participants entered into the Web page.

The aforementioned studies highlighted that use of these Web site interventions was higher among the highly educated, the overweight, and women (19,80,112). An interesting opportunity for practitioners is the development of intervention Web sites that work more effectively among other population segments, particularly men—which has been highlighted more generally within physical activity promotion research (87,113).

With regard to promoting behavior change, a variety of theories have been used when developing Web-based interventions, with the most effective Web-based interventions using Social Cognitive Theory, the Transtheoretical Model (see Chapters 1 and 4), and/or the Theory of Planned Behavior (16,115). In addition, although results are inconclusive, physical activity interventions that frame information based on tailored messages, gain-framed messages, and to improvements self-efficacy appear to hold the most promise for improving physical activity (67). Two qualitative reviews have each identified five key components to effective weight-loss intervention Web sites. One suggested self-monitoring, counselor feedback and communication, social support, use of a structured program, and use of an individually tailored program as key components (56). The other review concluded that intervention developers should aim to re-create the human experience, personalize it to the individual, create a dynamic experience, provide a supportive environment, and build upon sound behavior change theory (9) (see Chapter 3). As can be seen, common parallels between these two studies are a focus on personalizing/tailoring, social support, solid communication techniques, and structured/evidence-informed/theoretically based programs.



Evidence for Interactive Voice Response (IVR) Systems

Several studies suggest that telephone-based interventions delivered by humans can be widely disseminated and result in improved physical activity (30,117). Researchers have also explored the use of interactive voice response (IVR) systems (also known as automated telephone-linked computer systems) as a health care tool (85). These systems have high potential value because they can be used for simple tasks such as appointment reminders and for complicated tasks such as delivering fully automated advice and feedback about physical activity as well as other health behaviors. A meta-analysis of IVR telephone systems showed that automated calls were effective at promoting improved processes of care (*e.g.*, coming to appointments) and disease states (*e.g.*, improved glycemic control) (69).

Although there is limited research on IVR systems for promoting physical activity, several results have been promising (59). For example, the most rigorous study to date examining the utility of IVR telephone systems showed that an automated phone system was more effective than an attention control condition at promoting physical activity for 12 months and was equally as effective as a human-delivered telephone counseling program (59).

Some studies have identified characteristics that improve IVR user acceptance. Specifically, IVR systems are less accepted when: (a) similar content is repeatedly given, (b) interactions are inflexible and feel driven by the needs of the computer rather than the user, (c) users feel like the system is condescending, (d) the IVR system makes the users feel guilty, (e) little introduction leads to poor perceptions of the system, including the perception that the system is a telemarketer, and (f) intervention content was not delivered quickly enough (3,33,42). Several studies have also identified ways to improve IVR systems. For example, IVR systems that were generally accepted

included a detailed description of the IVR system prior to its use, and a chance to contact a human if problems arose with the program (42,59). Interestingly, some participants expressed a strong affinity for the automated voice akin to that of a mentor or close friend (54).

As with other technology systems, there are several companies who have already developed the basic architecture for IVR systems. Development of an IVR system often involves contacting these companies and working on developing appropriate content, including a specific set of decisions and rules about the appropriate times to call.



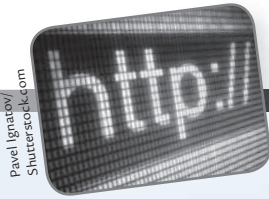
Step-by-Step

Table 6.2 summarizes key steps to take when developing an electronic media intervention. Although Table 6.2 begins with similar preliminary steps identified in Table 6.1, Table 6.2

TABLE 6.2 Steps in Developing an Electronic Media Intervention

Step	Key Questions and Tasks
1. Identify the user group.	Who will use the system? What behaviors will be promoted? What are the known constraints? Be as specific as possible.
2. Observe.	What is the potential user currently doing related to the behavior? Why? Among those doing well, why are they doing well? Among those doing poorly, why?
3. Identify theory(ies).	Which theories of behavior change fit best with the issues observed with the group? Which theory has the most empirical support? What does current theory not include that was observed?
4a. Develop prototypes.	Develop potential ideas. Highlight differences and come up with competing hypotheses.
4b. Test users.	Concept phase: Goal is to see if how you defined your concept is how potential users see it. Show prototypes and observe if they are “getting it” as expected. User experience: Goal is to identify the simplest, most intuitive means of moving through the system. Observe how a participant moves through a system focused on trying to understand expectations of the user. Note the full system does not need to be functional (<i>e.g.</i> , the backend storage and data processing) to get a sense of user experience. Functional Prototype: Put it altogether, including the back-end and see if it works as planned. Previous steps will help to minimize painful lessons.
4c. Iterate	Aggregate lessons learned from user testing and go back as far as step 1 but likely 4a, depending on the results. During iteration, the goal is to move from concept prototypes to user-experience prototypes to fully functional prototypes.
5. Test system among “experts.”	When the fully functional prototype is up and running, have several folks, including individuals who may not be your user testers but may be knowledgeable and around (<i>e.g.</i> , colleagues) to use it to help identify obvious bugs in the system. Iterate based on lessons learned.
6. Test within a small sample group.	Goal is to identify other glaring problems with the system.
7. Launch the system (but remember to monitor and update).	Be prepared to monitor the system while it is going and to fix/iterate problems that arise, particularly by monitoring system use via tools such as Google Analytics.

includes additional development steps such as developing prototypes, iterative development cycles, and user testing that are critical for building interactive electronic media programs.



Case Scenario 6.2

You are developing an intervention to increase walking and strength training for older adults who are caregivers of frail spouses.

Gender: Mostly women

Age: 65 and over

You begin by observing older adults using Web pages in their homes and conduct interviews with them about opportunities for being active. This lets you “walk a mile in their shoes.” Next, you decide that you want to include theory-based behavior change strategies such as self-monitoring, goal setting, and framing information in a gain-focused manner. Afterward, you begin the process of developing prototypes and user testing. In the concept phase, you mock-up several drawings and text descriptions of different goal setting formats. When you show participants the different goal framings, you find out the wording does not elicit the concept you intended and you have to go back and create new paper prototypes for goal setting. In the user experience phase, you test different self-monitoring formats by exploring ease of use and observing how users enter their information into the system. When a fully functional prototype is built, you have new users test the systems for longer lengths of time. In addition, you invite several colleagues to try the system for a few days, and they find several instances of system crashes, incomplete links, and poorly worded content. These errors are corrected and another group of users test the system. These users respond with general interest to the Web site but feel some parts are cumbersome. You revise the user interface to conform better to the users’ needs. At this stage, your system has been well vetted, and your IT team can continue to monitor and resolve minor problems to maintain your Web site.

TEXT MESSAGING

Short-messaging services (SMS; also known as text messaging) is an inexpensive, instantaneous form of two-way communication that transmits brief written messages via a mobile phone. It is the most widely available and frequently used mobile data service (66,104). Almost everyone in the U.S. has a cell phone, with 302.9 million wireless subscribers as of Dec 2010 (*i.e.*, 96% of the total U.S. population, with over 26.6% in wireless-only households; www.ctia.org). In addition, 98% of cell phones worldwide have SMS capabilities with 187.7 billion monthly text messages sent in the U.S. The popularity of texting may even increase as cell phone companies are increasingly including unlimited texting in calling plans. What makes mobile phone technology unique compared to other forms of communication, such as landlines or the Internet, is that mobile phone ownership and the use of cell phones is as prevalent among those from lower socioeconomic groups as among those from the general population (60,121). SMS is often used for “push” technology, where information is transmitted to a user without the user having to initiate the request. Push technology contrasts with other mobile

technology that may require a “pull” from a user, such as calling a telephone number or accessing an Internet Web site. Pull technology is also used in SMS when messages ask the user to respond or when the user initiates dialogue to receive information. Push and pull technology and other features of SMS may be particularly useful to help individuals make healthful lifestyle decisions made continuously throughout the day, such as reducing screen time or engaging in a daily workout.

Using SMS for promoting health behavior is a rapidly growing area (35,62) as mobile phones have many capabilities that can be used for health promotion (88). SMS technology can collect and deliver time- and context-sensitive information in succinct messages that can be read discreetly. These messages are asynchronous—that is, they can be accessed any time or place convenient for the user. The messages will also be stored on the phone even if the phone has been turned off, and messages will be delivered when the phone is turned back on. SMS technology can reach rural areas or places with limited cellular service because it requires a lower bandwidth compared to phone calls made with mobile phones. These SMS features can be useful for a wide variety of health behaviors and conditions, such as simple appointment reminders or complicated tasks like weight loss counseling (88,89).

One of the reasons SMS is effective at promoting health behavior is that many SMS features relate to important constructs in behavior change theories such as cues to action, reinforcement, goal setting, goal reminders, and feedback. In addition, research has shown that SMS programs improve social support (40), self-monitoring (99,100), perceived control (49), anxiety (93), and self-efficacy (40) (also See Chapter 3).

Evidence

SMS has shown to be effective at improving many health-related behaviors such as diabetes management (39,40) and smoking cessation (15,94). To date, two studies focused on physical activity have shown positive results. In a nine-week trial conducted by Hurling and colleagues (49), 77 healthy adults received access to an interactive Web site with a feedback facility, wrist accelerometers for self-monitoring, and tailored supplemental messages. Participants choose to receive the messages by either e-mail or SMS. These messages offered participants solutions for perceived barriers and included scheduled reminders for weekly physical activity. This text message program helped increase moderate-intensity physical activity by approximately 2.25 hours per week. In another study conducted by Shapiro and colleagues (100), 58 children and their parents used SMS to self-monitor physical activity levels for 8 weeks. After three 90-minute educational group sessions, the children and parents were instructed to send two messages a day denoting their physical activity, and for each message they received automated SMS feedback. The results showed that using SMS improved adherence to self-monitoring physical activity. However, a third study by Newton (83) did not find that SMS was effective at increasing physical activity. In this 12-week trial, 78 adolescents received a pedometer and generic motivational messages to increase step count. The results showed that sending text messages to adolescents decreased step count and did not change BMI. The null results found in this SMS trial may be because of to the use of generic messages rather than tailored messages.

Other SMS research has been conducted where physical activity was not the primary aim in the trial, but it was incorporated into the program. Four of these studies, which focused on weight loss as the primary aim, sent diet and physical activity messages to participants. In a study conducted by Joo and Kim (52), a weight reduction program that included access to a public health center and pedometers, printed materials, an initial

nutritional assessment by a registered dietitian, and SMS, helped participants lose 1.6 kg of weight in 12 weeks. Patrick and colleagues (89) found that their SMS program, which was supplemented with brief monthly counseling calls and printed materials, helped decrease participants' weight by 2.88 kg in 4 months. Haapala and colleagues (44) found that their SMS program, which did not include supplemental intervention strategies, decreased participant weight by 4.5 kg in 12 months. Gerber and colleagues (41) also conducted an SMS-only weight management program that focused on perceptions of use and found that women receiving text messages about weight loss had positive attitudes toward the incoming messages. Two studies focused on Type 2 diabetes control and incorporated physical activity messages into the program. Both of these studies were primarily SMS-based and were supplemented with a Web site. At 12 months, both studies (57,120) showed that SMS improved HbA1C among other measures related to diabetes control. With the exception of only one study, all of the aforementioned SMS research conducted has shown that SMS is effective at either improving physical activity levels or assisting in health promotion related to physical activity.

Frequency of text message transmission and duration of the program are important program characteristics. In general, frequency of messages usually reflects the expected frequency of the target behavior (35). For physical activity SMS studies, frequency varied greatly among the different programs. One study with a physical activity component showed success with sending up to five messages a day (89) and others found success with weekly messages (41,49,52,57,120). Another study left it up to the participants to decide on the number of text messages they wanted to receive (44). As for the duration of the program, most of the successful physical activity or health promotion studies were between 6 to 12 months.

It is important to note that SMS programs are often combined with other intervention strategies or materials, such as interactive Web sites, a paper diary for self-monitoring, consultations with health professionals, or printed materials. All of the physical activity SMS studies have included supplementation in their programs. Most common was use of Web sites (44,49,57,120), counseling calls (41,89), or interaction with health professionals (57,120).



Step-by-Step

There are many companies that offer SMS services available to individuals or businesses. One of the most popular health SMS-based programs available to individual consumers is “text4baby” that offers women support through pregnancy. To date, there are no SMS programs for physical activity commercially available to individuals, but some companies offer these programs to businesses. For instance, Santech Inc. (www.santechhealth.com) is one company that offers tailored mobile phone diet and physical activity-based programs, such as “Text4Diet” that is a program geared toward weight loss in the general adult or teen populations.

There are also ways to create your own SMS programs for clients. After deciding on what SMS program characteristics are a good fit for you and your client (*e.g.*, personalization, interactivity), you can search online for companies that offer bulk-messaging services. Many of these programs are free (*e.g.*, Google Voice) or have a small fee per message sent (*e.g.*, www.bulksms.com; callfire.com). These Web sites offer many advanced features that make sending general nontailored messages simple and effortless because you can easily create address books, automatically schedule messages, track message delivery, and much more. See Table 6.3 for tips on how to write an effective text message. See Table 6.4 for sample physical activity messages.

TABLE 6.3 How to Write an Effective Text Message

What to Include	Why	Example
Positive affect	<ul style="list-style-type: none"> • Attention grabbing • Message becomes more salient • Increases feedback 	<ul style="list-style-type: none"> • Using words like “happy,” “sweet,” or “nice”
Gain-framed	<ul style="list-style-type: none"> • Persuasive 	<ul style="list-style-type: none"> • Framing message in terms of benefits rather than costs of physical activity
Nonverbal cues	<ul style="list-style-type: none"> • Readers better interpret the message • Increases socio-emotional appeal • Using playful language creates a friendly, informal, conversational tone and in turn fosters relationships • Manipulation of grammatical markers: indicate pauses (....), express exclamation (!), or signal tone of voice (SHOUT) • Minus features: an absence of certain language standards present in normal writing, such as a lack of capitalization at the beginning of a sentence 	<ul style="list-style-type: none"> • Vocal spelling: “weeeeeelllll” • Lexical surrogates: “mhmm” • Spatial arrays (emojis)
Powerful language	<ul style="list-style-type: none"> • Attention grabbing • Message becomes more salient 	<ul style="list-style-type: none"> • Powerful: “always” or “never” • Powerless: “sort of,” “maybe,” tag questions (“isn’t it?”), hesitations (“um”), intensifiers (“really”), or fragmented sentences
Clarity	<ul style="list-style-type: none"> • Less mental processing effort • Less distraction 	<ul style="list-style-type: none"> • Regular text supplementation (only when completely necessary) • Pictures • Animation • Audio • When using shortcuts, shortening words (e.g., “wk” for “week”) is clearer than respelling (e.g., “c u” for “see you”)

TABLE 6.4 Physical Activity Text Message Samples

<i>Education</i>
By exercising as little as 30 min a day, you can improve your health and live longer!
Physical activity boosts mental wellness—It can increase relaxation, concentration, and happiness
<i>Strategies</i>
Start with a small physical activity goal and commit regularly
Use variety to keep your interest up. Walk one day, swim the next, go for a bike ride on the weekend
<i>Tips</i>
The simplest change you can make to improve your heart health effectively is to start walking. It's enjoyable, free, easy, and great exercise
Look for chances to be more active during the day. Walk the mall before shopping or take the stairs instead of the escalator
<i>Reminders</i>
Remember to put on your pedometer today!
Grab a friend and go for a 30 min walk before the day is over
<i>Motivational</i>
The time to get moving is NOW!
Stick to your goal of getting 12,000 steps on your pedometer today. You can do it!



Case Scenario 6.3

This case scenario presents the use of tailored, one-way messages to serve as prompts and cues to action.

Client: Brian

Client information:

- 18-year-old male
- A high school cross-country runner

Brian has asked you to help him prepare for cross-country team tryouts in the fall.

After designing a workout for him, you want to send it via SMS daily reminders so he can easily stay on track throughout the summer. One tailored, one-way pushed message each day will serve Brian's needs. See Table 6.5 for sample text messages that could be sent to Brian to help him prepare for the upcoming cross-country season.

continued

Case Scenario 6.3 *continued*

TABLE 6.5 Sample Text Messages for Brian's Cross-Country Running Training

Day	Text Message
Monday	Hi Brian- today's workout: 45 min tempo run. It's hot outside today- remember to hydrate
Tuesday	Brian, today's workout is 60 min interval training (10 x 400m)
Wednesday	Today's workout: 30 min easy with 15 min extra stretching. Keep up the good work, Brian!
Thursday	Hi Brian- today's workout 45 min Fartlek; incorporate at least 3 hills
Friday	Today's workout is 45 min interval training (5 x 1000). Brian, get to the track before 4pm, it closes at 6pm today
Saturday	Brian, here is today's workout: 10k long run. Remember to run at a conversational pace
Sunday	Good job this week, Brian!



Case Scenario 6.4

This case scenario presents the use of tailored, two-way messages that serve as personalized feedback, social support, and goal setting.

Client: Megan

Client information:

- 35-year-old female
- Employed full-time, married, two children
- Overweight (BMI = 29)

Megan's doctor recommends that she exercise at least 30 minutes a day to lose weight. She has come to you for help, and she does not have time to come in for counseling because of her busy schedule. Two tailored, pushed messages each day will serve Megan's needs. Some messages will also need to be interactive to uncover Megan's personal barriers to meeting her exercise goal. See Table 6.6 for sample text messages that could help Megan exercise at least 30 minutes a day.

Case Scenario 6.4 *continued***TABLE 6.6** Sample Text Messages to Help Megan Exercise 30 Minutes a Day

Day	Text Message
Mon AM	Megan, what is preventing you from exercising 30 min a day? A) I forget B) I don't have time C) It's too hard D) Something else (<i>Megan answers B</i>)
Mon PM	Breaking up your physical activity into 3 ten-min sessions throughout the day will give you the same benefit as doing 30 min at one time
Tues AM	You can do little things throughout the day to increase your physical activity-like taking the stairs instead of the elevator
Tues PM	Combo physical activity with time spent with your friends/family. Take walks together or just play at the park
Weds AM	Hi Megan- How much physical activity did you do yesterday? A) <30 min B) 30 min C) >30 min (<i>Megan answers A</i>) Megan, you should aim for at least 30 min of physical activity per day. Try again tomorrow :)
Weds PM	To increase your daily physical activity, try incorporating walking meetings outdoors with coworkers
Thurs AM	Need more time in your day to get a workout in? Put your gym clothes in your car in the morning—you'll be ready to go after work
Thurs PM	Try wearing wrist weights as you do chores around the house—this is a great way to combine exercise and chores.
Fri AM	Hi Megan- How much physical activity did you do yesterday? A) <30 min B) 30 min C) >30 min (<i>Megan answers B</i>) Good job, Megan! Keep up the good work. Try increasing your workouts by 5 min tomorrow
Fri PM	Increasing your physical activity is easier if you can distract yourself. Try chatting with friends while you walk or put on your favorite music

Limitations

Although SMS offers many valuable features that can be used for promoting physical activity, there are limitations with this technology. First, the main limitation is that information sent via SMS must be brief because each message must be 160 characters or less. Senders may send multiple messages at once, but because of the small screens on cell phones, lengthy messages are difficult to read (e.g., surveys). Second, there is usually a time commitment to set up an SMS program (e.g., writing messages, importing mobile phone numbers). Third, some messages may not be received because of disconnected mobile phone or full in-boxes, but messages are usually received when the phone is in service again. The SMS program also can be disrupted if the cell phone is lost or stolen. However, the same limitations exist with other forms of communication such as the postal system. Fourth, using SMS technology may marginalize certain populations, such as those who are illiterate or do not have access to a mobile phone for financial reasons; however, these limitations will be reduced as mobile technology advances (incorporating voice response

systems or sending pictures instead of texts) and the total cost of cell phone ownership decreases. Finally, using SMS for health promotion is in an early stage of research, and there are still many open questions on best practices for effective behavior change.

SOCIAL MEDIA

Social networking sites (*e.g.*, Facebook, My Space) are a type of social media comprised of personal Web pages that facilitate communication with other users. On these Web pages, users build online profiles, and share updates about themselves, including photos and links to their favorite groups or events, and comment on others' updates. A key feature of these sites is that users can link to others' profiles, which is how the social network develops (31). Users can choose from thousands of different health-related groups and applications that interest them (*e.g.*, *Diabetes Daily*, *Ultra Running*, and *National Health and Wellness* from Facebook). These sites can educate, engage, and empower clients and health professionals because they offer a source to learn about health issues and interact with a community of individuals with similar interests. Social networking sites are one of the most popular forms of social media (98) and, as such, they have great potential to advance health promotion.

Over the last 5 to 10 years, social networking sites have become one of the most popular sites to visit on the Internet. As of November 2010, 93% of teens (12 to 17 years old) were online, and of these users, 73% used a social networking site. Adults (>18 years old) were not far behind with 77% online, and of these users, 61% used social networking sites. Furthermore, 80% of all daily Internet users visit social network sites (<http://pewinternet.org>). Although young adults are still more likely to access social networks sites, the fastest growing demographic of Facebook users is older adults (>65 years old)—three times as many older adults signed up for Facebook in May 2010 than in May 2009 (119). Also, social media use in the United States is independent of education, race/ethnicity, or health care access (21). As social network technology advances and access increases, it is anticipated that the popularity of online social networking will continue to grow worldwide (48).

The popularity of social networking sites can be attributed to their many unique features. Not only are these sites easy to use and cost effective (*i.e.*, most are free), but they are also user-controlled and generated. In other words, social media sites are not static: They are interactive or users publish their own content and comment on other peoples' content. These sites are also easily accessed because they can be adopted on a variety of devices (*e.g.*, computer, mobile phone, electronic tablet). Social network sites differ from other online communities because of their ability to enable users to display their social networks. This unique feature of visually displaying a list of friends accessible to others is hypothesized to result in connections among individuals that would not have otherwise been made (13). Overall, online social networks allow users to connect and communicate to other users more quickly and easily than other forms of social media.

The connections made through online social networks have great potential for positively influencing health because an individual's social environment plays an important role in many different types of health behavior (86,116), including physical activity (6). One reason is because social networks can affect the perception of social norms, or customary rules that govern behavior in groups of people, which is a dominant force that shapes behavior (22). Perception of social support is another factor within an individual's social environment associated with more positive health behavior and health outcomes in general (110). In addition to affecting an individual's social environment, online social network sites also allow access to information and resources (91), which has been shown to increase empowerment (38,70). Empowerment plays an important role in supporting behavior as individuals seek positive health behavior and lifestyle changes (4,5). Taken together, these psychological constructs can have a powerful impact on individuals' health behavior and outcomes.

Evidence

Research on the use of social networks for health promotion is limited, but evidence is growing especially in the area of health communication. In a Facebook study regarding diabetes, researchers found that about 65% of posts included unsolicited sharing of diabetes management strategies, more than 13% of posts provided specific feedback to information requested by other users, and almost 29% featured an effort by the poster to provide emotional support to other members of the community (43). In another study that focused on breast cancer survivor groups on Facebook, researchers found that this social network site had over one million members and 620 groups. Within these groups, 44.7% were created for fundraising, 38.1% for awareness (about 900K members), 9% for product or service promotion related to fundraising or awareness, and 7% for patient/caregiver support (65). These studies demonstrate that Facebook provides a forum for many different types of health communication, from reporting personal experiences and receiving feedback to reaching mass groups of people for awareness of important public health issues.

To date, one health behavior change intervention has used online social networks. In this physical activity-based Facebook intervention, researchers evaluated StepMatron—a Facebook application designed to provide a social and competitive context for daily pedometer readings to motivate physical activity (37). Researchers found that participants who used the Facebook application to record steps had logged more steps than simply recording steps without the social context. Although more research needs to be conducted in the area of behavior change and social networking sites, the findings from the StepMatron study offer encouraging results that demonstrate the potential of online social networks to motivate behavior change (37).

Step-by-Step

Table 6.7 is a list of some popular social networking sites. Peruse these sites and see which ones have the features and functionality that meet your needs. From the Practical Toolbox 6.1 recommends other resources to consult for more in-depth step-by-step information.

TABLE 6.7 Some Popular Social Networking Sites

Social Network Site	Description
Facebook: http://www.facebook.com	The largest general social networking site worldwide
My Space: http://www.myspace.com	Entertainment (music, movies, celebrities, TV, and games) social networking site
Linked In: http://www.linkedin.com	Business and professional social networking site
Hello Health: http://www.hellohealth.com	Social networking site that connects health care providers and individuals through e-mail, instant messaging, and video chat
Dlife For Your Diabetes Life! http://www.dLife.com	Diabetes patients, consumers, and caregivers social networking site
Athlinks: http://www.athlinks.com	Race results and social network for endurance athletes
Twitter: http://twitter.com	A social networking and micro-blogging service utilizing instant messaging, SMS, or a Web interface



From the Practical Toolbox 6.1

FURTHER RESOURCES FOR USING SOCIAL MEDIA SITES

For more in-depth step-by-step directions, many books are available, including the following:

- *The Twitter Book* by Tim O'Reilly and Sarah Milstein
- *From Facebook to Twitter and Everything in Between: A Step-by-Step Introduction for Social Networks for Beginners and Everyone Else* by Todd Kelsey

There are also many more business-related features on Facebook to help grow your business and build your client base, such as adding Facebook to your Web site. To learn about these

features and many more, there are books available that focus on using social networks for professional use, including the following:

- *Reaching Your Online Community with Facebook, LinkedIn, and More* by Tom Funk
- *Doing Business on Facebook* by Vander Veel

Most social media sites also have a user-friendly step-by-step guide on how to get started on their sites and how to use more advanced features, such as the following examples:

- <https://support.twitter.com>
- <http://developers.facebook.com>

FACEBOOK

Facebook is arguably the most popular social networking site and can help you reach out to existing or potential clients. Many of the Facebook features described here, such as pages and groups, are also features on other social networking sites. Therefore, much of the information covered in this section applies to other sites as well.

- **Pages:** A “page” is a collection of information about a person, business, or organization. To be a member of Facebook, you need to set up a profile page—it can be a personal and/or professional page. Potential clients can find you by viewing your profile and vice versa. (Tip: You can include a link to your business Web site or other Web sites you think your clients will find useful.)
- **Networks:** A “network” is a group of people with a real-world connection but who might not know each other (e.g., people who are connected through a common school, region, workplace). You can browse through profiles of people in your network to look for potential clients based on various kinds of information, such as age or specific interests. Likewise, others in the network will be able to find and connect with you for your services. The introductions made through your network are safer and less awkward than introducing yourself to people to whom you have no known connection.
- **Groups:** A “group” is a collection of people with the same interests (e.g., clubs, companies, public sector organizations). Groups are a way of enabling a number of people to come together online to share information and discuss specific subjects. You can join one or start your own. This is a great way to network new clients (e.g., participate in industry-related groups, events, discussions) or communicate with current clients (e.g., send messages, exchange ideas, set up meetings).
- **Events:** An “event” is similar to a group, but users RSVP to in-person events. Advertising or promoting an event through Facebook is a quick and easy way to

invite many people at once. For example, you could create an event for Ride Your Bike to Work Day and send invites to your clients.

- **Newsfeeds:** A “newsfeed” is a constantly updated list of the things your Facebook friends are doing on the site (*e.g.*, adding applications, attending events, writing on Walls, commenting on notes and photos, befriending each other). This feature enables you to catch up quickly up on your clients’ recent activities.
- **Marketplace application:** This application lets you post and answer want-ads. You can use Marketplace to advertise your business or find those who are looking for a health professional. This application is unique because you can view someone’s profile before you contact him or her to conduct business, which makes the transaction safer than want-ad advertisements from the newspaper or sites like Craigslist.”

TWITTER

Twitter is another popular social networking site. Twitter is similar to Facebook in many ways, such as users have profiles, it streams updates, and you can meet new people through networking. However, Twitter focuses on communication via short messages of 140 characters or less called “tweets.”

- **Tweet:** “Tweets” are similar to text messages because they are short, concise, easy to read and write messages, but they are sent and received in real-time and can be sent through a variety of channels (*e.g.*, computer, phone, tablet). You can choose to have your tweets be public or private.
- **A following:** On Twitter, you choose whose messages you want to subscribe to or follow. You can ask your clients to follow you on Twitter to distribute exercise ideas/comments or news about organized events. Likewise, you can also follow your clients—for instance, you can monitor their physical activity or weight loss progress through their tweets. (Tip: The great thing about Twitter is that you can choose to send public messages and, as such, potential clients can view your conversations with current clients. This offers the opportunity to promote your business because potential clients can see your responsiveness or customer service toward current clients.)
- **Links:** Twitter can be a way to refer potential or current clients to your other sites (*e.g.*, business profile, blog, Facebook page) by posting the link with a creative headline.

SOCIAL NETWORK GROWTH

Whichever social media site you use, the success of your page or group will depend on the social network of people who develops around it. Social networking is about sharing and interaction, so it is important to create a following of users—the more users you have, the faster the social network will develop (53). To create a loyal following of users, the content in your site should be constantly updated so it remains interesting and engaging to your target audience. The more engaging the site, the more users will suggest to other friends to like or subscribe to your site. As a result, your network will grow. Focus on long-term relationship building strategies such as observing the culture and dynamics of the online community that you join. Research what your target audience is interested in and what they find interesting, enjoyable, and valuable (53). Do not be discouraged if at first the response to your site is slow, as you need time to develop a following. See section From the Practical Toolbox 6.1 for more information on social networking tips and strategies (31). Also, From the Practical Toolbox 6.2 provides cautions to health professionals using social networking sites.



Case Scenario 6.5

This sample scenario presents the use of Facebook and Twitter for physical activity promotion. The scenario demonstrates how Facebook and Twitter can offer individuals social support, provide perceptions of social norms, and influence feelings of empowerment.

Client: Daniel

Client information:

- 33-year-old male
- Diagnosed with Type 2 diabetes mellitus
- Obese (BMI = 31)

Daniel has come to you for help to increase his physical activity levels. He's been feeling depressed lately because of his disease and has lost the motivation to exercise. You suggest that Daniel join Diabetes Daily, an online support group on Facebook for diabetic patients. See Figures 6.1 through 6.3. You also suggest that Daniel follows Everybody Walk, a walking group on Twitter. See Figures 6.4 and 6.5.

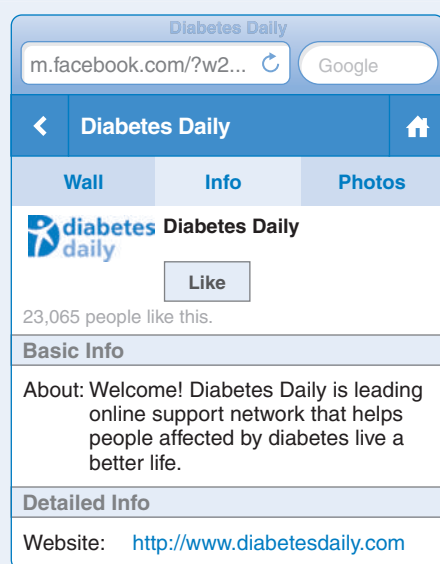


FIGURE 6.1. Facebook Group, Diabetes Daily. (Reprinted with permission from Diabetes Daily.)

Diabetes Daily If you aren't exercising, try committing to 5 minutes of daily exercise every day for a month. Everyone can find 5 minutes, right?

It's important to form a habit. Once you have a habit, add a minute each week. Or 30 seconds. You have a lifetime to increase the duration, but it's important to get started.

Jul 17 via HootSuite

89 people 35 comments

FIGURE 6.2. Sample post from the Diabetes Daily group. (Reprinted with permission from Diabetes Daily.)

Case Scenario 6.5 *continued*

FIGURE 6.3. Sample comments on Diabetes Daily from Daniel and other group members (edited for privacy). (Reprinted with permission from Diabetes Daily.)

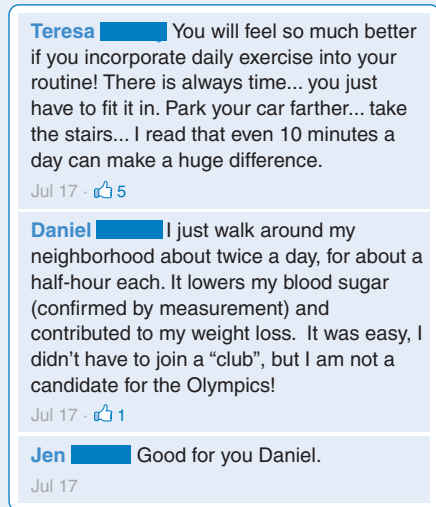
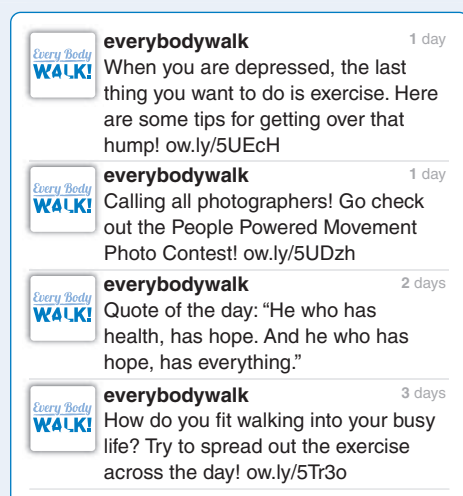


FIGURE 6.4. Twitter group, Everybody Walk. (Reprinted with permission from Everybody Walk.)



FIGURE 6.5. Sample posts from Everybody Walk. (Reprinted with permission from Everybody Walk.)





From the Practical Toolbox 6.2

CAUTIONS WHEN USING SOCIAL NETWORKING SITES

When using social network sites as a health professional, there are important considerations to remember.

1. You must remain professional at all times. Be aware that pictures or information you post could be seen by clients and could promote the distortion of boundaries and compromise trust between you and your clients (64). It is recommended that you set up a separate page for your professional use independent of your personal page or use the privacy settings on your personal page (*e.g.*, be selective of who is viewing photos/videos that others “tag” you in).
2. Be mindful of the legal issues surrounding sharing personal information — most importantly, be sure you are in compliance with the Health Insurance Portability and Accountability Act (HIPAA). There have been reports of lawsuits against health providers because of private information appearing on public Web sites (47,76). To be safe, you can guard against hackers by checking if the site is adequately protected against those who may get access to private information.
3. Individuals may misinterpret your online comments (31). In online communication, an array of cues frequently used in face-to-face communication will be absent, such as voice inflections and body gestures. If you need to communicate particularly important or sensitive issues, traditional forms of communication (*e.g.*, phone calls, office visits) may be more appropriate. In general, you should conduct yourself on social network sites as you would in real life, and remember that mishaps can travel fast through your online social network.

PHYSICAL ACTIVITY MONITORING DEVICES

The modern-day health and fitness professional has a distinct advantage over previous generations: the ability to use sensor systems to monitor health behaviors and the outcomes of their clients and give feedback about this information to the client. These kinds of feedback loops can help tailor program goals and keep clients motivated. Sensor-based devices for health behavior monitoring have proliferated over the last decade because of the rise of cheap microelectromechanical systems (MEMS) and rapid improvements in data analytics. Previously if an individual wanted to measure their physical activity or exercise, he or she had to rely on pen and paper, stopwatches, or simple mechanical pedometers. Today, anyone who wants to track their workouts or daily activity can choose from a variety of different tools to meet their needs (also see Chapter 2). Monitoring devices can be a key component of a physical activity program that integrates objective measurement for self-monitoring with information feedback for motivation. This section will describe some of the common sensor systems that can be used to measure, track, and change health behaviors. We will focus mostly on physical activity behaviors, as those sensor systems have been the most widely developed in recent years.



PEDOMETERS

Currently, the most common method to determine the extent of daily physical activity is a pedometer. Pedometers are worn on the hip and display the total steps taken for a day, and in some cases the amount of time a person spends moving. The low cost and ease of use make pedometers an ideal tool for a wide range of individuals wishing to start a physical activity program and track their progress. Pedometers do have important limitations that have been addressed by more sophisticated sensing technologies. These limitations include issues related to the accuracy of derived step counts, the inability to discern intensity of movement, and the lack of daily energy expenditure information (108).

Current public health recommendations call for 10,000 steps/day for able-bodied adults, 11,000 for female children, and 13,000 for male children (President's Council on Physical Fitness and Sports, 2002; Hatano, 1993). As with all exercise and activity programs, it is important to take into account the activity and health history of the individual before providing numerical step guidelines (109). A pedometer allows individuals to understand and work toward these activity recommendations. Numerous studies have showed that pedometers are an effective tool for increasing physical activity in adults and youths (17,71). Intervention and observational studies have indicated that the pedometers use can lead to a daily increase of approximately 2,000 steps/day (17) and moderate weight loss (92). It should be noted that pedometer interventions were more effective when used in conjunction with a self-tracking program (*e.g.*, daily step diary), goal setting tied to daily step counts, and when study participants were mostly sedentary at the onset of the intervention. One of the most widely validated low-cost electromechanical pedometers is the Yamax Digiwalker series, which has been shown to be highly accurate ($\pm 1\%$) for assessing step counts (27). One caveat of using electromechanical pedometers is the effect of speed of movement on accuracy. Walking at slower speeds (< 3.0 mph) may not produce the force required to trigger the mechanical lever, and therefore the pedometer will underreport the number of steps (27). This is an important consideration when choosing devices for individuals who are inactive or are of older age.

It is important to note that many modern pedometers use accelerometers instead of electromechanical mechanisms to more accurately assess step counts. Both the New Lifestyles (NL series) and the Omron HJ-710 ITC are validated accelerometer-based pedometers (26,27,45) and have been used in physical activity interventions. These devices are not without drawbacks, as they tend to overestimate energy expenditure (27). A recent study of free-living individuals showed that the Omron pedometer may underestimate steps because of a 4-second filter, which limits the recording of steps to only bouts lasting longer than 4 seconds (101).

ACCELEROMETERS

The proliferation of low-cost accelerometers has changed rapidly the ability of pedometers and other similar sensors to measure human movement. Accelerometers are usually small microchips that contain systems for measuring the gravitational force (*g*-force) acting on the device. It is important to note that each sensor will have a specific sensitivity to detect a certain range of *g*-force. Typically, accelerometers measure *g*-force along a given axis. Uni-axial accelerometers, when oriented correctly, measure *g*-force along the “*y*” or vertical axis. A dual-axis accelerometer includes the “*y*” axis and the horizontal “*x*” axis, and a tri-axial accelerometer includes the “*z*” axis in addition to the “*y*” and “*x*” axis. Measuring movement only along one axis has limitations as only the vertical displacement of the

sensor will be detected. Adding horizontal (x) and sagittal (z) displacement can increase the accuracy of movement detection.

Accelerometers are used in combination with microprocessors in movement-sensing devices. These microprocessors interpret the g-force readings supplied by the accelerometer. Most devices have proprietary algorithms that take the accelerometer data and translate it into useful movement information such as: (a) the number of steps taken, (b) the time spent moving, (c) the intensity of the movement, (d) the distance traveled, and (e) the calorie expenditure of the user. It is important to note that accelerometers are best used when trying to measure primarily leg-based movements that involve a ground reaction force. These movements, such as walking and running, typically make up the majority of daily human movement (107). Movements not captured well are water-based activities, such as swimming, and activities with little to no ground-reaction force, such as cycling (20).

The vast amount of evidence for accelerometers for the measurement of physical activity has focused on research-grade devices like the Actigraph models. Most accelerometers, as mentioned earlier, process the raw gravitational signal and output time-stamped data (typically called a “count”) used to determine the activity intensity, the time spent moving, and the time wearing the device (7). Numerous studies have been conducted to determine the validity of different accelerometer models produced by various manufacturers. These studies conduct “side-by-side” comparisons of the proprietary “counts” and research-derived cut-points for translating “counts” into physical activity intensities (96). These devices, although they tend to be more accurate than mechanical pedometers, are more expensive (> \$300 for the device and software) and do not have an external display to provide feedback to the user. Therefore, these types of accelerometers manufactured for research purposes are rarely, if ever, used as a tool for feedback in physical activity interventions.

HEART RATE MONITORS

Heart rate monitors are one of the most commonly used activity-related biosensors. Heart rate monitors have sensors that measure the electrical signals derived from heart muscle contraction and relaxation—termed electrocardiography (ECG). Currently available heart rate monitors usually consist of two components, a chest strap and a receiver—typically a watch or other display system. ECG signals can be processed and transmitted to the receiver where the heart rate is displayed. In some cases, raw ECG signals are sent to the receiver, and they are processed into heart rate and other variables like heart rate variability (HRV, the period between R spikes during heart function). Heart rate monitors are an ideal device when real-time feedback about physical activity intensity is needed. This may explain their popularity with trainers or health professionals who are creating personalized training methods to improve the cardiovascular fitness of a client or athlete.

Numerous studies have examined the validity of different heart rate monitors (typically manufactured by Polar Electro) and showed the devices to be consistent with clinical ECG monitors (11,68). Many researchers have examined the use of heart rate monitors for estimating energy expenditure and found variable but positive results (1,25,77). The common theme among studies examining energy expenditure is the valuable increase in accuracy when objective biometric information such as maximal heart rate and VO₂ are added to the estimation software.

Heart monitoring is not without its limitations. Typically, all-day wear of heart rate monitors is burdensome to individuals and data quality issues arise during long-term monitoring (14). It is also important to understand that data derived from heart rate monitoring can be affected by many different factors, such as hydration levels, temperature, illness, and altitude (1,2).

GLOBAL POSITIONING SYSTEMS

For users who accurately want to track their outdoor activities, global positioning systems (GPS) are ideal. Personal GPS devices are based on the same technology common

in vehicle navigation systems. A small computer chip in the device communicates with GPS satellites orbiting the earth and determines precise location information. This location information is processed and data regarding location (latitude/longitude), speed of travel, and distance traveled is made available. Most commercial GPS units produced for physical activity tracking are used for running and cycling, but they can be used to track most, if not all, outdoor activities. Although stand-alone GPS units are available, most are bundled with additional sensors to measure heart rate or another important variables such as pedal cadence (revolutions per minute) for bicycling.

The objective data (*i.e.*, speed, distance, pace) derived from GPS units do not differ as a function of activity type or individual characteristics. However, the most common concern when using GPS devices is their accuracy. Studies examining commercial GPS units have showed them to be accurate for determining the velocity of running and walking as well as stationary position (95,106,118). These studies have also highlighted a few known issues that may affect data accuracy, including moving in a curvilinear manner (*e.g.*, the curve of a track) and traveling at high speeds (*e.g.*, sprinting). This is in addition to environmental factors external to the movement type that can affect accuracy. These include traveling in or around locations with a high number of tall buildings that can cause signal interference and traveling in locations without clear and unobstructed views of the sky (105).



Step-by-Step

When deciding if using a monitoring system is appropriate for clients or patients, it is best first to understand the relationships among the types of data gathered, the ability to monitor different activities, and the cost of the devices. This information is presented in Table 6.8. Noticeably absent from this list is activity related to strength and resistance training. Compared to aerobic activities, the objective measurement of strength training is currently lacking, although developments in muscle activity sensing are being explored and may prove to be useful for measurement and tracking purposes.

TABLE 6.8 Features of Pedometers, Accelerometers, Heart Rate Monitors, and GPS Devices

	Mechanical Pedometer	Accelerometer	Heart Rate Monitor	GPS
Outputs				
Steps	X	X		
Distance	X	X		X
Intensity		X	X	
Energy Expenditure		X	X	
Speed/Pace		X		X
Activities				
Walking	X	X	X	X
Running (indoors)	X	X	X	
Running (outdoors)		X	X	X

continued

TABLE 6.8 Features of Pedometers, Accelerometers, Heart Rate Monitors, and GPS Devices (Continued)

	Mechanical Pedometer	Accelerometer	Heart Rate Monitor	GPS
Cycling			X	X
Swimming			Some models	Some models
Cost	\$20–\$50	\$50–\$150	\$75–\$300	\$150–\$350
Advantages	Ease of use	Higher cost; more accurate	More accurate intensity	Very accurate speed and distance
Disadvantages	Can be inaccurate; no intensity information	Proprietary algorithms to calculate outcomes	Can be burdensome to wear	Costly; only works for outdoor activities



Case Scenario 6.6

Client: Jonathan

Client information:

- He is 50 years old
- Recently discharged cardiac surgery patient. He has undergone the typical rehabilitation program administered at the outpatient clinic.
- His doctor has told him that he needs to remain active and try to lose weight.
- He is not comfortable with new technology.
- He does not have access to a gym.

Jonathan has been referred to you to develop an activity plan and stay accountable.

In this scenario, you would most likely use a low-cost pedometer and a daily step goal plan to help encourage Jonathan to be active in his everyday life. You may find it useful to conduct a baseline assessment to understand his current activity levels and create an appropriate plan that gradually increases his step counts. As someone not comfortable with technology, developing a daily step tracking sheet that he can share with you would be ideal.



Case Scenario 6.7

Client: Grace

Client information:

- 35 years old
- Prefers to train indoors at her local gym.
- She is comfortable with technology.

Case Scenario 6.7 *continued*

Grace is moderately physically active and wants to increase her activity and fitness level to train for and compete in an upcoming half-marathon. She has hired you to help her plan her weekly training plan.

In this scenario, you would most likely recommend a heart rate monitor as the best activity monitoring tool. She probably will be participating in aerobic activities using the treadmill and indoor track. A heart rate monitor is the ideal tool for measuring her current fitness state and providing feedback on activity intensity. Many heart rate monitors provide methods for downloading and saving data to a computer or device-specific Web site. You can encourage Grace to share this data with you to better understand if she is following the training program and determine its effect on her fitness level and her recovery from prescribed workouts.

INTEGRATING ACROSS MULTIPLE TECHNOLOGY CHANNELS

Technological advancements such as video streaming, faster processing power, wireless connectivity, and extended battery life and storage capacity have been key contributors in the development of many of the previously mentioned messaging and feedback technologies. As we have presented in this chapter, there are many different types of technologies to measure, track, and give feedback on physical activity. Different combinations of these technologies can be found in some commercially available systems and services. These integrated systems allow users to interact with their data, interact with other users, and receive expert knowledge. The center point or gateway of many integrated systems is the smart mobile phone. This section introduces the smartphone and its features as a way of integrating technologies for physical activity interventions. We describe commercially available integrated systems, and then describe how physical activity and data can be shared across multiple systems to create unique and highly customized interventions.

Smartphones and Their Potential for Physical Activity Interventions

Smartphones have many capabilities that can be harnessed for promoting health (88). Beyond the basic capabilities for two-way communication via voice or text messaging, many mobile phones have built-in cameras, gigabytes of storage, an Internet browser, can transmit data to outside networks, and some even include global positioning systems (GPS), built-in accelerometers, connectivity to WiFi, and wireless communication with external devices via Bluetooth (*e.g.*, heart rate monitors, external accelerometers). These smartphone features are ideal for creating an integrated intervention system.

Current evidence suggests that mobile telephones coupled with Internet services can promote increased physical activity (49). In addition, previous research has suggested that personal digital assistants (PDAs) were effective in increasing physical activity over 8 weeks relative to an assessment-only control (58). Some studies have also demonstrated the potential of using the background of a mobile phone as a “glance-able display” for providing feedback to individuals (23). Beyond this, few studies have explored systematically if these new mobile phone features can be used to promote physical activity.

Consolvo and colleagues (24) identified eight design considerations when developing effective persuasive technology interventions for promoting physical activity: (a) Abstract

and Reflective (*i.e.*, do not display raw data but instead abstract that information to something meaningful to the individual and inspires reflection); (b) Unobtrusive (*i.e.*, have the system only be there when wanted/needed and not be bothersome otherwise); (c) Public (*i.e.*, representations of personal information must be done in such a way that it can be displayed in public without making the user uncomfortable), (d) Aesthetic (*i.e.*, to maintain use, the system must fit with a user's sense of style and aesthetic), (e) Positive (*i.e.*, reward good behaviors rather than punish bad ones), (f) Trending / Historical (*i.e.*, provide a sense of past behaviors), and (g) Comprehensive (*i.e.*, take into account the key behaviors that fit into a person's lifestyle). These design considerations are not only conceptually important to interventions, but also can be implemented successfully with smartphones.

Commercially Available Integrated Intervention Systems

Many commercially available integrated systems typically include self-tracking along with interactive Web and/or mobile experiences. The interactive platforms offer more flexible opportunities for *Sources, Messages, Channels, Receivers, and Feedback*, which in theory should lead to systems that adapt to the user rather than forcing the individual to adapt to the system. An ideal integrated system: (a) fosters quick and easy communication between multiple devices (*e.g.*, pedometers, Web sites, smartphones) with minimal to no effort for the user; and (b) optimizes each component of the system to perform its role in physical activity promotion without creating additional burden on the user because of technical needs (*e.g.*, feedback is given when and where it is needed, not where it is convenient for the system). The broader goal is the development of systems that integrate into a person's life and daily routine to provide added value with minimal additional burden to the user. Much work is still needed to meet these ideals.

Current systems offer a variety of different tools and capabilities for reaching these mentioned ideals and most often they follow a schema that involves four key functions. First, the platform allows users to upload and view data gathered from a device or sensor system. These data are typically downloaded from the device using a device-specific application or uploaded to a Web site wirelessly. Second, the platform provides ways to visualize data derived from the sensors. Visualizations are meant to be highly interactive, simple to understand, and informative, though it is important to emphasize that highly interactive does not necessarily equate to informative (122). Third, the user can use the system to set a goal, or in some cases multiple goals, that pertain to physical activity, diet, body weight, or sleep. The system then presents feedback to indicate daily and/or weekly progress toward the goal. In some cases, goal attainment is attached to virtual-rewards, such as badges and positive messages. Lastly, the majority of commercial systems have begun integrating a social networking component into their platform. These are often manifested as the platform sending information about the user's behavior to social networking sites, such as Facebook and Twitter on the user's behalf. Some integrated commercial systems enable users to "friend" each other through the platform and engage in friendly competitions and challenges. The most common of these methods is through providing a leaderboard, where a user is compared to their "friends" on a common metric, such as steps per day or calories burned.

One example of an integrated intervention system is the FitBit (Fitbit, Inc., www.fitbit.com). The FitBit is a small accelerometer-based physical activity monitor the size of a typical flash memory stick. It wirelessly syncs physical activity data to a Web interface when it is within range of its USB receiver, which is plugged into a computer. The device has a small display on it to provide feedback on steps taken, miles traveled, calories expended, and activity history. The activity history is a glance-able display of a flower. The flower grows when the person is active and serves as a visual metaphor for the amount of activity achieved in the last three hours. The Web interface allows users to see their current and historical data, set goals, log activities, and see where they rank among their friends who

also use a Fitbit. The Web interface can be accessed on a computer or smartphone. Other examples of commercial integrated systems currently available include Garmin Connect (Garmin, Ltd.), Nike+ (Nike, Inc.), and Runkeeper (FitnessKeeper, Inc.).

Data Sharing across Systems and Technologies

Although the aforementioned commercially available integrated systems offer platforms for behavioral tracking and messaging, the true technological strength of many of these systems is the ability to gather and share data, which is critical for an integrated system. Many of the companies that offer physical activity intervention products have begun offering ways for users and other application developers to access data to create additional services or systems that potentially increase the functionality of the core platform. This is possible by using an Application Programming Interface (API) to interact with the platform and user data.

An API is specific programming code that allows for applications to communicate with each other and pass information back and forth. APIs allow for applications to both pull (read) and push (write) data based on the needs of the application. For example, the popular fitness application Runkeeper (FitnessKeeper, Inc.) allows many different applications to read and write data to a user's profile through its own Health Graph API. If a user has a Runkeeper profile, but prefers to use a different mobile phone-based run tracking application, data gathered from it can be pushed (written) to the user's Runkeeper profile. APIs are not limited to product-application-to-product-application communication. Developers can also create their own Web-based applications that pull in user data and use alternative methods of data visualization and feedback that supplements and enhances the user experience. Ideally, this increased connectivity between devices allows for a physical activity system to gather data from multiple sources, aggregate this information, and provide feedback to an individual using the channel of choice for that individual at the appropriate time.

When a company offers an API for its product, it is saying to the world, "take our product and integrate it with your product or make our product better." This access and openness provides others with the opportunity to use products in creative ways and customize products for specific needs. The proliferation of APIs offers an exciting new way to interact with clients and patients who use integrated technology platforms in their training or care. Working with an API requires expertise in computer programming for Web or mobile device applications. Documentation is usually available for an API to illustrate the communication schema and what types of data are accessible.

TAKE-HOME MESSAGE

We hope this chapter served as a useful resource with examples of what is currently possible and how one can start to use the available technology channels to promote physical activity in people's lives. However, we have also raised a note of caution that the scientific evidence to support effectiveness of tailored print and Web-based interventions for physical activity is currently limited, and research is ongoing to determine what factors need to be included in these programs. Even fewer studies have been conducted to evaluate interventions that use mobile and social network technologies to influence physical activity. Using these technologies to deliver physical activity interventions is a rapidly evolving field in both academic research and commercial settings. It is a challenge for researchers and practitioners to keep up with the pace of technology advancements. Ideally, the science and evidence should drive the

application of the technology. These technology channels can be used to create persuasive intervention programs by closely following the tenets of behavior change theory. Although new and exciting technologies will continue to offer a variety of communication and persuasion mechanisms, we caution against using such a technology just because it is new and exciting.

Although print materials will likely continue to have a place in physical activity promotion programs, other technologies such as SMS, social networks, and mobile phone applications are likely to be more effective tools to engage individuals daily. These technologies have the potential to transform physical activity interventions because they are easy and convenient to use and have become integrated within the daily lives of most individuals. Print materials can still be considered an important part of a physical activity messaging system. Even when deploying technology-based interventions, there may be the need to prompt individuals to refer to print or online resources for educational or review purposes. Interactive Web sites and Web-based interventions typically provide a location for accessing tailored information and/or materials for “self-paced” learning.

SMS interventions may be of particular interest as a basis for an intervention program because many people have access to this readily used and inexpensive technology. Several studies have shown that SMS helps individuals increase physical activity levels, lose weight, and improve diabetes control. Similarly, online social networks have tremendous potential because they offer the opportunity to facilitate health promotion by increasing communication and accessibility among health care providers, patients, and others who have similar interests. Online social networks may be the ideal technology for fitness professionals without IT support to develop custom pages or IVR systems. Having an online social network as part of a physical activity intervention offers individuals new opportunities for empowerment and helps shape their perceptions of social support and social norms, which are important health behavior determinants.

It is the integration of these different technology channels that can provide individuals with a compelling ongoing user experience for both adoption and maintenance of physical activity. Decisions on which technology channels to use for a physical activity intervention requires a balanced understanding of the needed skills, the resources available, and the level of customizability needed for the development of a particular type of intervention. These factors must be taken into account when deciding among developing a custom *de novo* intervention system, using previously developed devices and systems, or customizing commercial platforms through open APIs. Mobile and wireless technologies are a rapidly changing landscape of devices, systems, and services that will continue to offer many possibilities for delivering physical activity interventions.

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