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Chronic Health Conditions and Internet Behavioral Interventions:

A Review of Factors to Enhance User Engagement

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Abstract

The objective of this study was to review the evidence about what factors influence user engagement in Internet-based behavioral interventions for chronic illness. We conducted a systematic review of the recent published literature. Searches of MEDLINE (using Ovid and PubMed), The Cochrane Library, and PsycINFO, from January 2000 to December 2008, were completed. Additional articles were identified from searching the bibliographies of retrieved articles. We identified studies of interactive health communication interventions delivered via the Internet that, apart from delivering health information, had another component such as interactive tools to manage illness, decision support for treatment, or social support. We restricted the age range to adulthood. The search identified 186 abstracts; 46 articles were reviewed. We used a qualitative approach called “positive deviance” to study those interventions that have succeeded in engaging users where most have failed. Some ways to improve user engagement in Internet interventions suggested by our review include addressing health concerns that are important and relevant to an individual patient or consumer and an individualized approach, such as personally tailored advice and feedback. Interventions that are part of larger health management programs that include clinicians appear to be especially promising.

Keywords

Chronic illness; Health behavior; Internet; Nursing informatics; Review article

BACKGROUND

The Internet provides unprecedented opportunities for patients and consumers to be proactive in their own healthcare. In 2008, 74% of all American adults went online, and 61% looked online for health information.¹ Of these, 60% reported that their most recent search

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had an impact on their own health or the way they care for someone else, 38% reported that the information changed the way they cope with a chronic condition or manage pain, and 49% said the information changed the way they think about diet, exercise, or stress management. The Internet provides timely access to relevant information and the ability to communicate with both providers and peers. It is especially promising for people living with chronic health conditions and coping with challenges that often include social isolation, burdensome care routines, and anxiety about the future. However, with the rapidity of technological advances, keeping pace with the proliferation of new interventions is difficult, and published reviews are quickly outdated.

One such review, published in 2002, observed that Internet-based intervention studies generally lacked methodological quality and thus did not provide evidence of the effects of the interventions on health outcomes.² A review by Nguyen et al³ reported that Internet-based educational interventions moderately improved health outcomes for diverse clinical populations and that user satisfaction has generally been positive. Wantland et al⁴ conducted a meta-analysis (20 studies from 1996 to 2003) of self-care interventions for chronic illness and found broad variability in study designs and outcomes measured. Only five studies reported usage statistics, and these varied widely. In this meta-analysis, Web-based interventions did show improved outcomes compared with non-Web. In a more recent review, Carlbring and Andersson⁵ found that the Internet was a promising way to deliver psychological treatment, particularly cognitive behavior therapy.

Because the published literature reviews to date did not answer our questions about which factors influence user engagement, we reviewed the current literature on interactive Internet-based interventions for chronic illness self-management to investigate user engagement.

METHODS

Goal Statement

Our goal was to provide an overview of the characteristics of Internet behavioral interventions for chronic conditions that influence user engagement. We were interested in understanding what features or components (eg, instructional videos, personal stories, e-mail support, tailored feedback, etc) are most effective in encouraging users to log in and to continue to use the intervention for the amount of time needed to produce the desired health behavior change.

Definitions

Many terms have been used to describe activities conducted over the Internet for physical and mental health purposes (eg, eHealth, e-interventions, computer-mediated intervention, Web-based therapy, cybertherapy, etc).⁶ The field of Internet-supported interventions is expanding rapidly, and typical of a pioneering field, there are not yet accepted standards or consistent terminology used.^{7–10} This section provides the definitions that we have adopted for our study.

Adherence refers to using an Internet program as prescribed. Not using a program as prescribed typically reflects a decreased treatment dose and thus suboptimal treatment.¹¹

Attrition refers to dropping out of the study before completion or stopping use of the Internet program. To understand the determinants of attrition, the characteristics of any subpopulations should be assessed to determine who continues to use the program. To answer the question of what works and what does not, attrition measures are important. For example, in cases of high dropout rates, efficacy measures alone will underestimate the impact of an application on a population who continues to use it.¹²

Interventions (Internet or Web) refer to Internet-based prevention and treatment programs. These are typically based on effective and empirically validated face-to-face behavioral interventions. Internet interventions go beyond education and information-only Web sites. They address behavioral skills, offer opportunities for practice and mastery, and provide feedback and reinforcement, leading to behavior change, symptom improvement, and improved health-related quality of life. Internet interventions are generally personalized and tailored to the user; highly structured; semiguided to fully guided; interactive; and enhanced by graphics, animations, audio, and video.¹¹

An *effective intervention* is defined as one that produces the desired outcome or effect.

Engagement—User engagement refers to how the participant interacts with the Web program. This interaction may be a simple action (eg, a mouse click) to move to another screen, or more complex tasks such as completing a quiz or entering diary information. Engagement also includes how long or how often the participant uses the Web program. There is growing evidence that program usage is often less than the developers envisioned.¹² Engagement is difficult to measure, and although it is often possible to analyze server data measures such as number of log-ins, time spent, or number of pages viewed, this information is often difficult to interpret. For example, a Web intervention may require users to work through the material in a specified order (no skipping), yet some users thoroughly read the information, whereas others skim, thus creating different levels of engagement.

Positive deviance refers to a qualitative approach to problem solving that examines the practices of individuals who have succeeded where others have failed. Positive deviance is based on the observation that in every community there are certain individuals or groups whose uncommon behaviors and strategies enable them to find better solutions to problems than their peers, while having access to the same resources and facing similar or worse challenges. This approach has emerged over the past 20 years to solve particularly complicated problems by studying the strategies used by companies, communities, and individuals who have succeeded where their peers have been unsuccessful. This method has been widely applied to other industries and is only recently being applied to healthcare.^{13–16}

Marsh and colleagues¹³ have described three distinct steps in positive deviance: (1) identify “positive deviants,” defined as individuals, units, or organizations that have had an unusual degree of success; (2) study these positive deviants using qualitative methods (interviews and observation) to identify the practices they use; and (3) compare practices between those who are more and those who are less successful to understand which practices are the most likely to be effective. For example, Bradley and colleagues^{17,18} have used positive deviance to improve the care of patients with a myocardial infarction. Qualitative interviews and

observations with a range of individuals from 11 hospitals identified 28 specific practices that successful hospitals used to reduce the time to treat patients with a myocardial infarction. The use of these practices was then compared between 365 hospitals of varying performance, and only 10 of the 28 practices were associated with success.¹⁷ The results, published in the *New England Journal of Medicine* in 2006, have been used to identify a smaller number of practices that are now the focus of interventions to improve myocardial infarction care.¹⁷

Web site or *Web program* includes the content (the actual treatment information), how that content is displayed (appearance, organization), and how that content is delivered (simple text, graphics, illustrations, video, audio, animations, etc).

Sample Selection

Searches of MEDLINE (using Ovid and PubMed MeSH), PsycINFO, and the Cochrane Library from 2000 to 2008 were completed to identify relevant studies. We used the keywords “Internet” and “chronic disease” in the search strategy, as these were the terms identified in PubMed MeSH, the US National Library of Medicine’s controlled vocabulary used for indexing articles for MEDLINE/PubMed.¹⁹ Additional articles were identified manually from searching the bibliographies of retrieved articles. We excluded articles published in languages other than English. We attempted to identify studies of interactive health interventions delivered via the Internet that, apart from delivering information, had another component such as interactive tools to manage illness and provide decision support for treatment or social support. Age range of participants in studies was restricted to adulthood. No restrictions were placed on the study methodologies identified. The literature search revealed 186 citations. Three reviewers independently reviewed abstracts and selected relevant publications. Articles were retained in the study if selected by one or more of the reviewers. Data were extracted on the study design, sampling/recruitment method, assessment of outcome, details of the intervention and control, participants, outcome measures reported, follow-up, attrition, and results. Articles that did not include this basic information were not retained for analysis.

A statistical summary of the results was not conducted, as a meta-analysis was not our intent. Rather, we identified themes, basing our approach on “positive deviance” methods. We used positive deviance to identify the features of Internet interventions that have resulted in higher user engagement and features that have resulted in lower engagement, and we chose “attrition” as the measure of user engagement. Although attrition does not capture all elements of user engagement, it is a logical metric and one that is most consistently and uniformly reported. Studies were ranked according to level of attrition during the intervention period.

Analysis

A review of these abstracts led to retrieval of 32 full-text articles for assessment. Additional articles were identified from the bibliographies, and 46 studies were subsequently identified for inclusion and are listed in Table 1.

The articles selected for analysis covered a range of conditions including panic disorder,²⁰ depression,^{21–24} eating disorders,^{25,26} stress associated with tinnitus,²⁷ asthma,²⁸ smoking cessation,^{29,30} insomnia,³¹ stress,^{24,32–34} weight loss,^{35–41} nutrition,^{42,43} chronic pain,^{44–47} headache,^{48–50} heavy drinking,⁵¹ diabetes,^{52,53} drug dependency,⁵⁴ physical activity and health promotion,^{55–58} cardiovascular disease,^{53,59–61} cancer,^{62,63} HIV risk reduction,⁶⁴ interventions for parents of ill children,^{65,66} and rural chronically ill women.^{67,68} In the following section, we describe five studies reporting the lowest attrition and five studies reporting the highest attrition.

RESULTS

Studies With Low Attrition

Attrition ranged from zero to 85% (median = 24%) in the 39 studies reporting attrition. The studies described below reported low attrition rates, ranging from 0% to 8%. In one study reviewed, Schulz et al⁴⁷ conducted a pilot study of an Internet intervention for chronic low-back pain for the Italian-speaking population of Switzerland. Three medical professionals moderated the Web site and provided tailored information to the participants. Also, the intervention included social networking features for participants to share their experiences through a forum and chat room. The contents of the Web site were dynamic in nature. New articles, exercises, and multimedia files were written by the health professionals and added weekly. Compared with the control group that had no exposure to the Internet intervention, Internet participants reported a decrease in pain and use of pain medication, increase in activity, and fewer medical consultations. The availability of professional feedback and social support and the dynamic nature of the Web site appear to be the key features that engaged users, contributing to a zero attrition rate.

The study of Cousineau et al³² was a psychological intervention (cognitive behavioral skill building) for women experiencing infertility. Participants completed an initial assessment, which was the mechanism to provide tailored feedback. All of the women were all actively seeking medical care. Participation may have been enhanced by the short duration of the study and \$100 cash incentive.

Southard et al⁶¹ evaluated an Internet cardiac rehabilitation program that links patients with a case manager. Participants set personal goals, had access to a registered dietitian and an online discussion group, and received small rewards (key chains and magnets) for logging in weekly, entering their physical data, completing educational modules, and communicating with the case manager. Fewer cardiac events occurred in the Internet intervention group. Weight changes were significant, whereas other differences such as blood pressure and lipid levels did not reach statistical significance.

In a weight loss maintenance intervention, Harvey-Berino et al^{37,41} reported low attrition. The Internet arm included e-mail contact with a therapist; self-reported dietary, exercise, and weight information; and moderated video and e-mail discussion sessions. Although the Internet intervention was not as effective as minimal or frequent in-person therapist support, low attrition was attained. The authors point out that the Internet group members were

initially engaged in a 24-week face-to-face weight loss intervention and were accustomed to seeing each other.

Buhrman et al⁴⁶ evaluated a cognitive behavioral therapy intervention for chronic back pain. In addition to providing close monitoring and tailored feedback via the Internet, the intervention used telephone contact to increase support, motivation, and compliance. This study reported attrition of 8%.

Studies With High Attrition

Strom et al⁵⁰ recruited participants for an Internet relaxation training intervention for recurrent headache using advertisements in print media. Participants kept a headache diary and reported their practice of the relaxation techniques. The content was delivered weekly, but was not tailored individual treatment and did not include a face-to-face treatment component with the Internet intervention. Fifty-six percent of the 102 participants who met inclusion criteria dropped out of the study, leaving only 20 of 45 in the treatment group for the 6-week study duration.

Andersson et al²⁷ evaluated an Internet intervention using cognitive behavioral self-help treatment for distress associated with tinnitus. There were 27 nonresponders (51%) in the treatment group. Only seven participants reported clinically significant improvement; however, the majority found the treatment to be beneficial. The authors were not able to disarticulate the effects of the intervention and concluded that the Internet is best used as a complement to clinic care.

Van Straten et al²⁴ evaluated an intervention for depression and work-related stress. The program was dynamic in nature; every week, the contents and exercises changed, and feedback on completed exercises was provided. The study reported that 39% of the 97 people who completed the first assignment completed the entire 4-week course. Statistical and clinical effects were reported that were more pronounced for completers and those with more severe baseline problems.

Bickel et al⁵⁴ examined an intervention that was grounded in an evidence-based behavioral therapy for opioid dependence. The study retained 58%, 53%, and 62% of participants in the standard, therapist-delivered, and computer-assisted treatment study arms, respectively. The results suggest that when computerized treatment is integrated into other treatment components, the results may be comparable to exclusively therapist-delivered treatment alone that is more expensive.

Devineni and Blanchard⁴⁹ studied an Internet intervention for chronic headache and reported 38% dropout rate; however, compared with symptom monitoring alone, the intervention group reported significantly greater decrease in headache activity.

Because these studies differed substantially in possible reasons for attrition (ie, studies with demanding expectations early in the study), it is difficult to determine exact causes for attrition. In the discussion section, we address factors that engage the participant, as well as discuss the complexity of determining which factors impact user engagement, improve adherence, and reduce attrition (Table 2).

DISCUSSION

There is a growing body of research to support that effective Internet interventions produce changes in participants' behaviors that reduce symptoms and improve health. However, little is actually known about the mechanisms or components of the interventions that have the greatest impact,¹¹ and few formal evaluations consider user engagement or adherence to the Internet interventions when assessing the overall impact on health outcomes. We used the positive deviance approach, described previously, to select the five studies with the lowest attrition studies (those who "succeeded") and the five studies with highest attrition (those who "failed"). We examined these "deviants" in detail to understand how the Internet interventions differed. Thus, our qualitative review of the manuscripts focused on 10 studies, representing the two extremes of lowest and highest attrition.

This research identified two characteristics contributing to Internet interventions that engage users: (1) the intervention targets participants with pressing health concerns, and (2) the intervention adapts to individual needs. For example, interventions that target a pressing health concern for a specific population, such as secondary prevention of cardiac failure⁶¹ or distress in women undergoing fertility treatment, appear to be more effective.³²

Methods that adapt the intervention to an individual's specific needs are more likely to engage users. Successful programs for weight loss have been demonstrated^{39,41,69} and often include record keeping, personalized feedback, and accountability. Tailored online communication varies the content or presentation to an individual based on a limited set of variables that are believed to influence the individual's receptiveness to a message. Computer tailoring has become increasingly popular in the last decade and generally has been found to be more effective than nontailored equivalent applications.^{70,71} Steele et al⁵⁸ demonstrated that interventions tailored to individual needs are more successful. For example, they found that their Internet intervention was best suited for obese participants with potentially greater outcome effect than traditional face-to-face interventions.

Interventions that include functionality for social networking and support, either between the patient and clinician or peer-to-peer, can meet the individual's specific needs. Interventions that include a clinician coach appeared especially promising. In a study of diabetic patients by Barrera et al,⁵² participants in the arms with coach and peer support had significantly increased perceived availability of social support. Allen et al⁴⁴ concluded that a nurse coach is a possible way to engage and empower patients to manage chronic illness. There are also beneficial safeguards to adding a clinician coach or moderator to oversee the clinical aspects of the discussions. The Internet now supports a range of open sharing and collaboration, such as blogs, wikis, virtual health libraries, bulletin boards, and discussion groups, and applications incorporating newer gaming technology are growing.⁷²

Attrition and Engagement: Improving Adherence

As a result of these studies, social support, new and engaging material, a theoretical framework of cognitive skill building, interaction with a case manager, tailored feedback, and phone support were features that contributed to decreased attrition.

In reviewing the literature to understand user engagement and attrition, it is important to distinguish between usage of an intervention in a natural setting (study effectiveness) versus usage in clinical trial studies (study efficacy). For example, Clarke et al²³ had very low enrollment in their study of depression among HMO members but point out that the low rates are not an indication of the acceptability of this intervention offered outside a research study. The features of randomized trials (a chance of being assigned to the control group, repeated reminders to complete assessments, burdensome questionnaires) may create barriers that lower enrollment rates. On the other hand, the ability to offer incentives may increase adherence in the study setting, as may telephone reminders.²³

The ease of enrolling in Internet studies is likely to impact adherence. For example, the literature suggests that multiple contact models and well-timed educational materials are more effective,³⁰ yet these did not keep users engaged in an Internet smoking intervention. Commenting on their inability to hold the interest of the majority of the study's enrollees, the researchers speculated that because it is easy to enroll on the Internet, smokers who use this method may be less motivated than those who enroll in face-to-face sessions.

The results of randomized controlled trials (RCTs) testing Internet-delivered self-help programs generally provide evidence to support development for a range of chronic health conditions.⁵ There are a number of important advantages. Time constraints are removed for both patient and provider. The use of aliases may reduce social barriers to seeking face-to-face therapy and expand program reach. Interactive Internet interventions may offer computerized tracking for some measures of compliance with therapy and be a cost-effective way to helping people master new skills versus just providing basic information.

An essential component of a behavior change intervention is program dose. For Internet interventions, log-in rates and average session times serve as proxy measures. We found that the reporting of usage was not uniform across studies. Some studies reported the percentage of participants who logged in at least once; others reported average number of times per week or over the study duration, number of Web site hits, pages viewed, or average time spent. In assessing adherence to the intervention, it was often not clear what the dosage or usage should be.

In one of the few studies to discuss intervention dosage, Cousineau et al^{32,73} reported that 36% of participants in their intervention for infertile women spent an appropriate estimated dose of 90 minutes or more. In another study, Steele et al⁵⁸ determined that participants who were exposed to at least 75% of the material had greater improvement than those who completed less; thus, they used their study results to set the appropriate "dosage" of their intervention to be 75%. Not surprisingly, log-in rates tended to decline over time (even for studies reporting lower attrition), with the largest drops experienced early in the intervention. McKay et al⁵⁷ reported that overall attrition was 13%, yet usage dropped from a mean of 2.7 log-ins during the first 2 weeks to 0.5 log-ins during the last 2 weeks. This intervention included incorporated goal setting, tailored feedback, a personal coach, and peer support groups in an 8-week intervention to increase physical activity among diabetes patients.

Some possible strategies to engage users and prevent high attrition include adapting the intervention treatment to the specific individual's problems (eg, tailoring or nurse coach), combining face-to-face interactions with the Internet intervention, including dynamic content to prevent the user from "getting bored," and determining if specific variables predict attrition or low compliance.⁵⁰ Because these strategies may add to the cost of the intervention, for some online interventions that can bring about desired health behavior change, it may be cost-effective to accept high rates of attrition to reach a larger population as the incremental cost per user is so low.⁵³

Study Limitations

Some limitations of our review were that it was difficult to find all relevant articles in this area, although the scope of chronic illness and health conditions was intentionally broad. As a result, we may have overlooked relevant studies. However, using the MeSH database reduced the possibility of searching incorrect keywords. Because this was a review of peer-reviewed, published journal articles in English, we may have eliminated interventions that otherwise would have served our research question. Also, many of the studies did not describe the features of the Web-based intervention in detail. Thus, it was not possible to determine with certainty what features may have enhanced or hindered user engagement and impacted attrition. We reviewed studies that included RCTs as well as studies conducted in natural settings; this difference may have impacted user attrition in either a positive direction or a negative direction. Also, in studies with high dropout rates, how dropouts are treated statistically is important in determining the intervention's effectiveness. For example, if losses to follow-up are excluded, the results of the likely effects might be overstated.

Another study limitation relates to the fact that Internet interventions are increasingly complex, and it is a challenge to tease out the specific features that contribute or detract from the intervention's ability to keep users engaged. For example, Houston and Ford²⁹ found that the addition of a motivational introductory page improved the health outcomes studies, but because other changes were made, the results were far from conclusive. In one of the few studies to test specific "pieces" of the intervention, Andersson et al⁴⁸ compared a self-help program for headache that included e-mail support and weekly telephone support to the same program without telephone support and found no differences. In addition to the technical specifications of the intervention, there are other factors to consider that influence the use of the Internet or Web-based program/intervention. These include characteristics of the user and the user's environment (eg, demographic variables, disease pathology and severity, cognitive factors, attitudes and beliefs, motivations, influences of family/friends, etc), in addition to the program content (eg, source and style of the message, whether grounded in a sound conceptual model or theoretical framework), the overall attractiveness or quality of the Web site, and the interaction between peers or with the therapist group leader (eg, e-mail, phone, face-to-face support). It is also important to assess both the short-term improvements and sustained gains. As van den Berg⁷⁴ points out, more research is needed to determine the minimal duration of interventions to produce long-term changes.

CONCLUSION

In conclusion, the complexity of multifaceted Internet interventions makes it difficult to determine with certainty what individual features of these interventions are most effective; however, based on the results of this review, we identified several key elements of successful Internet interventions. In addition to targeting a pressing health concern that is relevant to the user, some ways to improve engagement in an Internet intervention suggested by our review include an individualized initial approach (eg, face-to-face contact to introduce the site) and personally tailored advice and feedback. Interventions that are part of a larger health management program that includes clinicians appear to be especially promising.⁶¹ Yet, for the full potential of Internet-based interventions for chronic illness to be realized, there are remaining questions to answer. In addition to testing the overall impact of Internet interventions, we need to understand the mechanism by which such interventions influence health behavior and health outcomes. We need to investigate factors that predict attrition and explore strategies for increasing exposure/dosage as well as understanding which target populations are best suited for a specific Internet intervention. A substantial effort has been made to use the Internet to deliver online prevention and treatment programs over the past decade. We need to understand what works and why; thus, more mixed methods studies that examine isolated variables of the interventions would assist in moving this area of research forward. Internet-supported interventions in delivering behavioral health interventions are likely to increase. We need to continue to build a structurally sound basis from which this field can continue to expand.

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Table 1

Studies Included in Literature Review

Author (Year)	Chronic Condition	Study Design	Sample Size (n)	Attrition %	Subject Age Range (Mean), y	Variables in Intervention ^d								Results
						1	2	3	4	5	6	7	8	
Allen et al (2008) ⁴⁴	Chronic pain, impaired mobility, depression	Single arm study (121)			22–82	X			X	X				Suggests + findings
Andersson et al (2002) ²⁷	Distress associated with tinnitus	RCT, 6 wk, 1 y follow-up (F/U) 1: Internet (53), 2: wait list (64)		51	18–70 (48)	X				X				+
Andersson et al (2003) ⁴⁸	Headache	RCT, 6 wk		32	18–59 (40)	X	X	X	X	X	X	X		+ Coping and health outcomes (both groups)
Atherton (2000) ²⁸	Asthma	1: Internet + phone (24); 2: Internet (24) Retrospective, 6 mo (437)			(36.5)	X	X		X					Positive
Barrera et al (2002) ⁵²	Type 2 diabetes	RCT, 3 mo 1: information only; 2: information and personal coach 3: information and social support; 4: information, personal coach and social support (160)		23	(59)	X				X	X			Inconclusive
Bickel et al (2008) ⁵⁴	Opioid dependents	RCT, 23 wk 1: Internet (45); 2: face-to-face (45) 3: Standard care (45)		1:38 2:47 3:42	1:(30) 2:(26) 3:(30)	X		X					X	+
Booth et al (2008) ³⁵	Weight loss	RCT, 12 wk 1: Internet diet + exercise (27) 2: Internet exercise only (26)		27	25–70 (46)	X	X	X	X				X	Neutral
Brattberg (2006) ⁴⁵	Chronic pain, work burnout (and on sick leave)	RCT, 20 wk, 1 y F/U 1: Internet (30); 2: waitlist (30)		16	18–65 (47)	X			X				X	+
Buhrman et al (2004) ⁴⁶	Chronic back pain	RCT, 6 wk, 3-mo F/U 1: Internet (22); 2: waitlist (29)		8	18–65 (45)	X						X		+
Carlbjörk et al (2001) ²⁰	Panic disorders	RCT, 7–12 wk (41) 1: Internet; 2: waiting list		37	21–51 (34)	X	X	X		X				+
Celio et al (2000) ²⁵	Body dissatisfaction and eating disorders	RCT, 8 wk, 4 mo F/U 1: Internet (24); 2: classroom (15)		24	18–36 (20)	X	X	X	X	X	X	X	X	+

Author (Year)	Chronic Condition	Study Design	Sample Size (n)	Attrition %	Subject Age Range (Mean), y	Variables in Intervention ^a								Results
						1	2	3	4	5	6	7	8	
Christensen et al (2002) ²²	Depression	3: Waitlist (19) Descriptive (1096)		48		X		X	X					+
Clarke et al (2002) ²³	Depression	RCT, 32 wk 1: Internet (144); 2: usual care (155)		26		X								-
Cook (2007) ⁵⁵	Workplace health promotion	RCT, 3 mo 1: Internet (209); 2: print (210)		1:15 2:13		X								+
Cousineau et al (2008) ³²	Psychological distress	RCT, four arms Two exposure, two control (190)		4	(34)	X								+
Cullen and Thompson (2008) ⁴²	Healthy family eating behavior	Descriptive (67)				X		X						+
Cussler et al (2008) ³⁶	Weight loss maintenance	RCT, 12 mo 1: Internet (66); 2: self-directed (69)		18	(48)	X	X	X	X	X	X		X	Neutral
Devineni and Blanchard (2005) ⁴⁹	Chronic headache	RCT, 4 wk, 2-mo F/U 1: Internet (39); 2: waitlist (53)		38	(42)	X	X							+
Goessens et al (2008) ⁵⁹	Cardiovascular disease risk	Cross-sectional, pilot study (50)			(55)	X	X	X	X	X	X		X	+
Harvey-Berino et al (2002) ³⁷	Weight loss maintenance	RCT; three arms, 22 wk 1: Internet (15); 2: in-person (14) 3: Control (15)		4	(46)	X	X	X	X	X	X	X		
Houston and Ford (2008) ²⁹	Smoking cessation	Descriptive, feasibility (231)		66		X	X							Neutral
Kerr et al (2008) ²¹	Depression	RCT, 12 mo 1: Internet (206); 2: usual care (196)		1:25.5 2:31.7	(41)	X	X	X	X	X	X	X	X	+
Lange et al (2003) ³³	Posttraumatic stress	RCT, 5 wk, 6 wk F/U 1: Internet (122); 2: control (62)		36	(39)	X	X	X	X	X	X			+
Lau et al (2008) ⁶⁴	HIV risk reduction	RCT, 6 mo (477)		41	>50% 21-30	X				X	X			-
Lenert et al (2003) ³⁰	Smoking cessation	Descriptive, pilot (49)		47		X		X	X					Neutral
Linke et al (2007) ⁵¹	Heavy drinking	Descriptive cohort (10 000)			(37)	X	X		X					+
Lorig et al (2006) ⁵³	Heart disease, lung disease, diabetes	RCT, 6 wk, 1 y F/U 1: Internet (354); 2: usual care (426)		18	(57)	X		X	X	X	X			+
Marshall et al (2003) ⁵⁶	Physical activity	RCT, 8 wk 1: Internet (327); 2: print (328)		3	(43)	X			X					-

Author (Year)	Chronic Condition	Study Design	Sample Size (n)	Attrition %	Subject Age Range (Mean), y	Variables in Intervention ^a								Results
						1	2	3	4	5	6	7	8	
McKay et al (2001) ⁵⁷	Physical activity for diabetes patients	RCT, 8 wk	1: Internet (38); 2: information only (40)	13	(52)	X	X	X	X	X	X	X		+
Oenema et al (2001) ⁴³	Nutrition	RCT, pretest and posttest	1: Internet (96); 2: information only (108)		(44)	X		X	X					+
Owen et al (2005) ⁶²	Coping, breast cancer	RCT, 12 wk	1: Internet (32); 2: waitlist (30)	15	(52)	X								Mixed
Ruwaard et al (2007) ³⁴	Work-related stress	RCT, 7 wk	1: E-mail (177); 2: waitlist (62)	21	22–60	X				X				Mixed
Scherrer-Bannerman et al (2002) ⁶⁰	Cardiac surgery	Qualitative	1: Internet (21); 2: print (51)		(63)	X								+
Schulz et al (2007) ⁴⁷	Chronic back pain	RCT, 5 mo	Internet (20); usual care (15)	0	(45)	X				X	X			+ trend
Southard et al (2003) ⁶¹	Coronary heart disease	RCT, 6 mo	Internet (53); usual care (51)	4	(62)	X	X	X	X	X	X			+
Stevens et al (2008) ³⁸	Weight loss maintenance	Preliminary report (348)		20	(56)	X	X	X	X				X	+
Steele et al (2007) ⁵⁸	Physical activity	RCT, 12 wk	1: Internet only (62); 2: Internet mediated (65); 3: face-to-face (65)	17	(39)	X								+
Strom et al (2000) ⁵⁰	Recurrent headache	RCT, 6 wk	1: Internet (20); 2: waitlist (25)	56	(37)	X	X	X						+
Strom et al (2004) ³¹	Insomnia	RCT, 5 wk	1: Internet (30); 2: waitlist (51)	24	(44)	X	X	X						+
Tate et al (2001) ³⁹	Weight loss	RCT, 6 mo	1: Internet (46); 2: information only (46)	15 at 3 mo	(40)	X	X	X	X	X	X			+
van Straten et al (2008) ²⁴	Depression, anxiety, work-related stress	RCT, 4 wk	1: Internet (107); 2: control (106)	45	(45)	X		X			X			+
Wade et al (2006) ⁶⁵	Parents of children with traumatic brain injury	RCT, 14 weekly sessions	1: Internet (26); 2: Internet information (20)	15		X					X			+

Author (Year)	Chronic Condition	Study Design	Sample Size (n)	Attrition %	Subject Age Range (Mean), y	Variables in Intervention ^a								Results
						1	2	3	4	5	6	7	8	
Weinert et al (2005), ⁶⁷ (2008) ⁶⁸	Rural chronically ill women	RCT, 22 wk, 2 y F/U 1: Independent Internet (82) 2: Mediated Internet (82); 3: control (69)		27	(54)	X			X					
Winzelberg et al (2000) ²⁶	Eating disorders	RCT, 8 wk, 3-mo F/U 1: Internet (31); 2: classroom (29) Description of development		27	(20)	X	X			X	X			+
Wise et al (2007) ⁶⁶	Pediatric asthma (for parents)					X	X	X	X	X	X	X		+
Womble et al (2004) ⁴⁰	Weight loss	RCT, 1 y (47)		34	(44)	X								-

^a 1 = Text instruction; usually structured modules; 2 = diary; journal; 3 = progress report; feedback; 4 = tools for goal setting, planning, calculators; 5 = peer discussion group (moderated); 6 = e-mail support (clinician); 7 = telephone support; 8 = face-to-face support.

Table 2

Results: Interventions With Lowest and Highest Attrition

Author Year Country	Chronic Condition	Study Design Sample Size (n)	Attrition, %	Variables in Intervention ^d	Results
Lowest Attrition					
Schulz et al (2007) ⁴⁷ (Switzerland)	Chronic back pain	RCT, 5 mo 1: Internet (20) 2: Usual care (15)	0	1, 5, 6, 8	+
Cousineau et al (2008) ³² (USA)	Distress in infertile women	RCT, four arms (190)	4	1	+
Southard et al (2003) ⁶¹ (USA)	Prevention of coronary heart disease	RCT, 6 mo 1: Internet case management (53) 2: Usual care (51)	4	1-3, 5, 6	+
Harvey-Berino et al (2002) ^{37,41} (USA)	Weight loss maintenance	RCT, 22 wk 1: Internet (15) 2: In-person (14) 3: Control (15)	4	1-7	-
Buhrman et al (2004) ⁴⁶ (Sweden)	Chronic back pain	RCT, 6 wk 1: Internet (22) 2: Waitlist (29)	8	1, 7	+
Highest Attrition					
Strom et al (2000) ⁵⁰ (Sweden)	Recurrent headache	RCT, 6 wk 1: Internet (20) 2: Waitlist (25)	56	1-3	+
Andersson et al (2002) ²⁷ (Sweden)	Tinnitus distress	RCT, 6 wk, 1 y F/U 1: Internet cognitive behavior therapy (53), 2: wait list (64)	51	1, 6	+
van Straten et al (2008) ²⁴ (the Netherlands)	Depression, anxiety, work-related stress	RCT, 4 wk 1: Internet (107) 2: Control (106)	45	1, 3, 6	+
Bickel et al (2008) ⁵⁴ (USA)	Opioid dependents	RCT, 23 wk 1: Internet (45) 2: Face-to-face (45)	1:38 2:47	1, 3, 8	+

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Author	Year	Country	Chronic Condition	Study Design	Sample Size (n)	Attrition, %	Variables in Intervention ^a	Results
Devineni and Blanchard	(2005) ⁴⁹	(USA)	Chronic headache	3: Standard care (45) RCT, 4 wk, 2-mo F/U 1: Internet (39) 2: Waitlist (53)	3:42 38	1,2		+

^a 1 = Text instruction; usually structured modules (weekly or self-paced); 2 = diary, journal; 3 = progress report; feedback; 4 = tools for goal setting, planning, calculators; 5 = peer discussion group (moderated); 6 = e-mail support (clinician); 7 = telephone support; 8 = face-to-face support.