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# Interactive Online Health Promotion Interventions: A "Health Check"

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## Abstract

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*As an increasingly popular medium by which to access health promotion information, the Internet offers significant potential to promote (often individualized) health-related behavioral change across broad populations. Interactive online health promotion interventions are a key means, therefore, by which to empower individuals to make important wellbeing and treatment decisions. But how "healthy" are interactive online health promotion interventions? This paper discusses a literature review (or "health check") of interactive online health interventions. It highlights the types of interactive interventions currently available and identifies areas in which research attention is needed in order to take full advantage for the Internet for effective health promotion.*

## 1. Introduction

The Internet has become an increasingly popular medium by which to retrieve health promotion information [1, 2]. Its desirability is driven by its ability to deliver health information quickly, efficiently, and on demand, together with the fact that the data it delivers is continuously available, searchable, and can be browsed in a non linear (interactive) fashion [1]. Furthermore, the Internet has the ability to provide health information seekers with immediate and individualized feedback, using a combination of audiovisual and textual content that can be tailored to users' developmental, psychosocial, behavioral, and biological needs [3].

Interactive online health promotion interventions have been shown to be more effective in terms of promoting health-related behavioral change outcomes (including increased exercise time, knowledge of nutritional status, knowledge of asthma treatment, and participation in healthcare, and slower health decline, improved body shape perception, and weight loss maintenance) than traditional, offline mechanisms [4]; although it is outside the scope of this paper to discuss the effectiveness of *traditional* health promotion interventions per se, it is worth noting that empirical data in this regard is currently limited. Interactive online health promotion interventions are, therefore, a key means by which to empower individuals to make important health promotion and treatment decisions [5].

Despite the obvious advantages presented by Internet-based health promotion, it is important to recognize that interactive online health promotion is an *emerging* area of research: evidence regarding the efficacy of these programs in terms of long term behavioral outcomes is, to date, limited. To better understand current gaps in the research, and to help direct future research in this area, we must first consider and understand the status quo of interactive online health interventions. The remainder of this paper discusses the findings of a literature review of interactive online health promotion interventions. It highlights the types of interactive interventions currently available, and identifies areas in which research attention is needed in order to take full advantage of the Internet for *effective* health promotion.

## 2. Health Information Seeking

With nearly one in six Canadians accessing the Internet for health-related information [6], health is the most searched topic on the Internet in Canada [7]. Figures for the U.S.A. are even higher, with 80% of the population using the Internet to look for information on a variety of health issues [8, 9]. Although the general make-up of the Internet population has not changed significantly since 2002, there *has* been a significant shift in the most commonly searched health topics [8]. Canadians, for example, are most likely to search for information about specific diseases (56%), lifestyle (50%), and analysis related to specific symptoms (46%) [6]. In contrast, Americans generally access information on the Internet to help themselves or others better cope with an illness, typically searching for advice and support (36%), information about expert or professional services (34%), and treatment options (26%) [10]. While information about specific diseases and treatments continue to be the most popular health topics among North American Internet users, a significant increase has

been observed in the percentage of Internet users who searched for information about diet and nutrition (51% in 2004 compared to 44% in 2002) and exercise and fitness information (42% in 2004 compared to 36% in 2002) [8]. These observed information seeking trends, in terms of the *type* of health information which is being sought on the Internet, may reflect a motivational shift from illness-centered to health promotion focused searching (that is, from a curative to preventative approach to health and wellbeing); it reflects a growing public interest in managing and monitoring their personal health in an interactive fashion. The following sections discuss the various types of interactive online health promotion interventions that are being developed in light of these observed health information seeking trends.

## 3. Health Dialogue Systems

Health Dialogue Systems (HDSs) are automated systems that use natural language 'dialogue' to emulate face-to face communication with a healthcare provider: they represent a paradigm shift from healthcare delivered solely by health professionals to healthcare that is augmented by computer-assisted dialogue [11-14]. HDSs can, for example, be used to provide health counseling to promote education and lifestyle behavior change, or to facilitate chronic disease management [11, 15].

In situations where cost, access, and inconvenience may make healthcare prohibitive for people, HDSs have the potential to provide a more continuous and comprehensive system of care. Mobile technologies (e.g., cell phones) can, for instance, be coupled with real time sensors to support the provision of continuous feedback and advice for medical problems, and thereby facilitate timely and proactive behavioral user responses [12]. Similarly, automated HDSs have the capacity to prompt individuals about their symptoms or behaviors, thus increasing general health awareness. Perhaps the biggest limitation of HDSs, however, is their inability to *accurately* mimic the *natural* flow of face-to-face communications. Traditional, in-person counseling is based on ongoing interactive dialogue between a healthcare provider and a patient, during which the healthcare provider tailors feedback to the patient based on the patient's personal characteristics, current status, and previous communication that has taken place. To fully realize the potential of HDSs as an effective online health promotion intervention, research is therefore needed in terms of investigating means by which these systems can be more representative of, and responsive to, the intricacies of conversational behaviors [15, 16].

## 4. Tailored Health Communications

Tailored Health Communications (THCs) are any combination of information and behavior change strategies that are tailored to individuals based on their specific informational needs regarding a particular health issue or outcome [17-19]. To date, much of the research on THCs has been conducted on print materials (e.g., brochures and pamphlets) which tend to be developed for broad audiences. Behavioral scientists are, however, realizing the utility of the Internet in terms of providing *targeted* health education materials to meet the unique needs of specific subpopulations in a cost-effective manner [20, 21]: recent advancements in Web 2.0 technologies have made it possible to develop *electronic* tailored health promotion interventions that can help address the health information needs of diverse populations [22]. To date, however, only a limited number of studies have been conducted to evaluate the effectiveness of computer-based health promotion programs [23]; many questions remain, therefore, about the quality of these interventions.

THC research has thus far focused on providing specific content to target users based on demographic and behavioral variables, typically derived from theoretically based assessments of the precursors to behavior change [24]. Early research on tailoring has focused on health promotion and disease prevention, such as cancer-related lifestyle behaviors (e.g. smoking cessation, exercise, etc.) and early detection (e.g., breast and colorectal screening), as well as informed decision making [19]. During the rapid growth of tailored communications and the trend towards the customization of health information, the Trans-Theoretical Model (TTM) [25], which describes an individual's readiness to adopt specific health behaviors, quickly gained popularity in the development of health promotion strategies [21]. At the same time, researchers have frequently utilized an integrated approach to THC, known as behavioral construct tailoring, choosing promising variables from a variety of health behavior models to determine modifiable risk factors or changeable determinants of health [18].

Despite findings that tailoring based on variables of health behavior change can have significant influence on behavioral outcomes [26], there may be limits to achievable outcomes using this strategy [24]. For example, different sets of barriers may exist for different cohorts with respect to the same health issue; as observed by Kreuter *et al.* [26], THCs to promote breast screening were found to be more effective (than traditional mechanisms) among women who had previously been screened for breast cancer but were behind schedule for their annual mammograms, but no more effective for women who had never previously been screened. An opportunity exists, therefore, for collaboration between

behavioral and communication scientists to explore the effectiveness of different tailoring variables, message strategies, and formats at different points along the behavioral pathway. In addition, most interactive online health promotion strategies are typically determined by what researchers or web designers view as relevant to the target audience: unsurprisingly, this approach meets with a limited degree of success. There is a real need to develop and test interactive online health interventions that are designed by experts in *collaboration* with users [21].

Researchers and practitioners regularly express concern that more vulnerable populations may have limited access to computers and may, therefore, be less skilled and/or comfortable navigating computer-based THCs. That said, recent advances in computer technologies (such as the delivery of content in multimedia formats, allowing for the use of audio and video to augment textual information [27]) provide an opportunity to overcome the barriers commonly associated with the effective delivery of computer-based THCs to populations most at risk [18]. For example, Bellis *et al.* [17] explored the feasibility of a tailored multimedia intervention designed to prevent and control sexually transmitted infections (STIs) by targeting sexual behaviors in at-risk populations. Using TTM [25] constructs, they provided participants (recruited from an urban sexual health clinic) with information, tailored on the basis of their individual levels of motivational readiness, about the importance of getting STI test results and timely treatment. After using the system, participants were asked to assess the navigation and content of the site. Ninety-five percent of the participants found the site "very easy" to navigate, 78% indicated that they "liked the program a lot", and 92% reported that they intended to change their behaviors in the future. Bellis *et al*'s findings provide evidence that computer-based THCs are considered engaging and agreeable by populations which are generally considered resistant to emerging computer technologies.

While the above study highlights that acceptability of the intervention was high, as were intentions to modify future behaviors, it is important to note that there was no evidence that exposure to this intervention ultimately led to long-term behavior change in the population studied. This is representative of the fact that, although online THCs often affect significant improvements in behaviors in the short term, there is limited evidence that the behavioral changes they encourage are sustained (or sustainable) over time. In an attempt to modify patient behavior and prevent future vascular events, Scandinavian researchers developed an electronic THC for transient ischemic attack (TIA) and stroke patients which was individualized to each patient's educational level, risk profile, and symptoms [28]. They conducted a between-groups study (a randomized control trial) in which the control group received information from a physician, while the study group received information from a physician *and* the electronic THC system. Their results indicated that knowledge scores were significantly higher in the latter group at six weeks but that the difference between the groups was no longer significant at 12 weeks, suggesting that there were no lasting effects brought about by the electronic THC. The small sample, relatively high drop out rate (10%), and selection bias may have all attributed to this outcome; a more important cause may, however, have been the fact that the researchers did not assess the patients' level of motivation and tailor the educational THC accordingly. While knowledge is an important component of any health promotion program, evidence suggests that knowledge alone is insufficient to induce behavioral change [29, 30]. These and other similar findings highlight the need to use a theoretically-derived, longitudinal design to study and identify the specific components of interactive online THC promotions that contribute to long-term behavioral outcomes.

THC interventions have evolved from 1G (or "first generation") formats, whereby individuals completed a paper-based questionnaire which was subsequently entered by a third party into a computer program in order to generate appropriate feedback, to 2G formats in which individuals interact directly with the computer technology. To date, 1G formats have been the more widely utilized, and have demonstrated a significant impact on health behaviors such as, for example, smoking cessation [31]. Although modest impacts on health behavior have been shown with online THCs which adopt a traditional, linear approach to issues such as smoking and diet and exercise, researchers believe that these programs would be more effective if developed using a "message effects" approach which targets the receiver's beliefs and attitudes [21]. While 2G online THCs formats have demonstrated a greater impact than 1G formats on behavioral intentions and disease management, this "message effects" approach has not been widely tested [32-34]. Newly emerging 3G electronic THC formats use both iterative and ipsative feedback, and are structured in a modular rather than linear fashion, allowing for feedback which is more sensitive to the needs of the user. A recent trend of computer-generated feedback reports is well suited for the tailoring of self-help materials; such reports have proven to be more effective than no intervention [35]. Using this format, individuals complete an online survey and an algorithm library, based on a theoretical framework of motivation and change (such as the TTM [25]), generates results tailored to the individual's specific characteristics (e.g., gender, level of dependence, etc.). The information is either provided to the individuals electronically or via print materials.

While promising, the results have been mixed for computer-tailored interventions with respect to their *actual impact* on behavioral change. For example, a review of internet-based interventions for smoking cessation discovered that only 47% of the 19 eligible studies conducted between 1995 and 2004 found statistically significant outcomes, and no real patterns were detected in terms of the subject or design which led to these differences [31]. That being said, it is likely that the technological complexities of 3G THCs make them substantially more difficult to evaluate. The process for meaningfully and effectively evaluating 3G THCs is thus, perhaps, a research topic in its own right. In fact, as yet it remains unclear which computer-based interventions are most effective in promoting behavior change; while THCs are rapidly emerging on the Internet, they are rarely or inadequately evaluated [e.g., 32].

Tailored health interventions offer real potential as a public health approach to improve health behaviors. While research of tailored programs *has* provided some encouraging evidence [19, 36], suggesting that they are superior to traditional generic interventions, there is much yet to be understood about the underlying contexts and mechanisms contributing to the efficacy of such approaches. Thus, future research is needed to engage users in the process of identifying the variables and the formats that will incur the greatest impacts on outcome behaviors over time.

## 5. Interactive Health Communication

Interactive Health Communication (IHC) technologies range from computer-generated personal reminder calls [e.g., 37] to virtual environments that simulate visits with a specialist in a doctor's office setting or support group interactions [e.g., 38, 39]. According to the Science Panel on Interactive Communication and Health (1996), the purposes of IHCs include: (1) disseminating important health information to individuals or populations; (2) promoting informed decision making in users; (3) utilizing theory-based behavioral health interventions to promote health; (4) enabling individuals with similar health issues or concerns to connect and offer support and understanding; (5) using systems-based information sources to promote self-care; and (6) managing and optimizing demands on health services [40].

Evidence suggests that, in order for knowledge to translate into behavior change, users must be provided with an opportunity to practice their skills in an interactive environment (e.g., games); as users master these skills, they develop an increased sense of self-efficacy over their environment, thereby increasing the likelihood that they will engage in behavioral change in real-life situations [41]. IHC research is effectively responding to a deficit in this respect in traditional online interventions, which tend to rely on the use of textual content to increase user knowledge levels, and as a result have seen limited behavioral impacts [42]. As such, IHC tools have the potential to positively influence user knowledge and attitudes, and thereby affect health behaviors. Despite an increasing number of IHC interventions, evidence supporting the efficacy of these programs is mixed [33, 34, 39, 43]. A lack of significant outcomes suggests the need for more rigorous testing to identify perceived acceptability of these interactive online interventions [28, 44].

To date, IHC research has typically neglected to incorporate active end-user participation in the design and implementation of systems, which may be largely responsible for poor study outcomes. In response to this identified shortfall, McDaniel *et al.* [33] developed, in focus-group interview-based consultation with 100 representative women, a computer-mediated smoking cessation program for inner-city women. Tailored smoking cessation messages were delivered simultaneously using text and audio to address low literacy levels, and navigation was facilitated by a touch-screen monitor. The system was structured according to the principles of the Trans-Theoretical Model of Behavior Change (TTM) [25], but only navigated through the first three stages of change (*pre-contemplation*, *contemplation*, and *preparation*) since the goal of the program was to *motivate* current smokers to quit. In usability studies conducted with women from the target user population, no significant relationships were found between usability scores and age, health status, or previous computer usage; usability was, however, rated highest by minority women and women with an education greater than high school level. Stage of change was found to be significantly related to usability scores; women in the pre-contemplation stage (just thinking about quitting) were least satisfied with using the program, compared to women in the stages of contemplation or preparation. Women's favorable attitudes towards smoking were significantly decreased, and they were significantly more willing to substitute another behavior for smoking when tempted to smoke. Although the results of this study are somewhat limited by the lack of a control group, the findings support the need for user input in the design of computer-based health promotion programs in order to maximize acceptability of the program and behavioral outcomes [33].

While limited in number, studies utilizing theoretical designs to assess the effect of interactive online health promotion interventions on health-related behaviors are promising [33]. For example, using a tailored information approach, Hurling *et al.* [43] developed and tested an automated dialogue module for overcoming users' perceived barriers to exercise: their IHC was founded in the Theory of Planned Behavior (TPB) [41],

in which an individual's behavioral intentions are said to be formed through their underlying beliefs about the behavior, social normative pressures to engage in the behavior, and the perceived ease or difficulty to engage in the behavior. The efficacy of the system was evaluated using a 10-week pilot study in which participants were assigned to either a control group or to a test group. An electronic diary style exercise planner was used, in which intentions were described in terms of day, time, and place. These intentions were reinforced by means of Short Messaging Service (SMS) text or e-mail reminders which were sent to individuals' mobile phones. Although the two versions of the system essentially provided the same functionality, the test system was more interactive than the control system in that it: (1) allowed users to see their level of activity in relation to group norms – participants in the control group only had access to data about their own level of performance; (2) contained an automated dialogue module to help users identify their key exercise barriers – this augmented the simple "pick list" of barriers that was available to the control group members; and (3) provided the option to have e-mail or SMS text reminders of exercise benefits and planned exercise sessions. At a seven month follow-up, a significantly higher percentage of the test group members (75%) had logged on to the system over the study period compared to the control group (43%); the test group also reported significantly higher levels of satisfaction and motivation to exercise, as well as increased exercise levels, suggesting that more interactive approaches (e.g., e-mail and/or SMS text reminders) increased users' perceived control over implementing their intentions. These findings, while limited by the reliance on self-reported exercise activity, add to a growing body of evidence that more interactive computer-based health promotion programs are more engaging and have a greater positive impact on target behaviors. At the same time, additional research is needed to establish the optimum blend of human-computer interaction design principles and behavior change principles within a computer-based health promotion program in order to achieve the greatest level of impact on behavior change [43].

IHC systems in the field of medicine have adopted Artificial Intelligence (AI) techniques, primarily to enhance the diagnostic skills of physicians and medical students, but increasingly to include patient education and decision making support. For example, the Prostate Interactive Education System (PIES) and treatment-decision tool was developed using AI techniques in order to provide tailored information to men with a diagnosis of prostrate cancer [39]. PIES combines user input with animation, video, text, and still photos to educate patients about potential treatment options in order to help them cope with the difficult period of uncertainty following their diagnosis. This highly interactive Intelligent Tutoring System (ITS) centers around a virtual tutor (or information specialist), and has the capacity to: (1) educate individual patients; (2) detect patient errors; (3) assess when and where mistakes are made; (4) correct flaws in the logic; and (5), respond to patients' misunderstandings about the information provided. In this way, PIES can "learn" about individual users and tailor information to each individual's specific needs. Patients can speak to "specialists" in a non-threatening virtual environment at their own pace, learn about other patients' personal experiences via an online library of videotaped testimonials, and attend virtual support groups, all within an expert system that is constantly monitoring their progress and additional educational needs. Focus group findings indicated that the patients and their spouses much preferred the interactive format of PIES compared to books or brochures; the men shared most favorable attitudes about visiting the online doctor's office and support group sessions, as well as viewing the video clips of other prostrate cancer survivors' personal stories. Feedback from this research has led to the development of the Virtual Information Specialist and Interactive Tour (VISIT) software application; it provides a more proactive ITS, which continually assesses users' informational needs, alerting them of any un-accessed information, and actively leading them to these resources [39].

Existing IHC research, albeit limited, suggests that *interactive* online systems are superior to traditional online interventions (which rely on text-based acquisition of knowledge) in their ability to influence health behaviors. Unfortunately, a review of evaluation studies of such systems [45] reveals that the majority of evaluative work is weakened by the use of small unrepresentative samples and quasi-experimental design methods, and a focus on process rather than outcomes. Small sample sizes make it difficult to generalize study outcomes to larger populations, fueling a growing need for researchers to conduct studies that include broad population samples. Similarly, quasi-experimental studies raise issues about the validity of outcomes. While limited in number, more rigorous randomized control trial designs are emerging within online health promotion research [23, 28, 46]. As previously mentioned, there is a notable lack of research that measures the impact of interactive online health promotion interventions on health-related behaviors *over time*. While the future holds many opportunities for researchers and practitioners to enhance patient education using highly interactive systems, the success of these innovative interventions will rely on researchers and developers actively involving users in the design and implementation process.

## 6. Challenges and Recommendations for Future Work

Despite a rapidly growing number of interactive online health promotion interventions, researchers and practitioners currently have a very poor understanding of how to effectively engage users in these programs and the factors associated with long-term behavioral outcomes. Interactive, multimedia, computer-based interventions can be powerful in their capacity to engage individuals in health promotion behaviors; engaging users in the program design and implementation process is, however, necessary in order to establish which online approaches are more likely to keep individuals engaged and positively influence behavioral outcomes. The fact that most online health intervention studies are unable to determine causality and long-term impacts on health behaviors also highlights the need for research into the development and testing of evaluation techniques which use relevant theoretical frameworks and longitudinal designs to assess the efficacy of interactive online health promotion interventions. In summary, future research in this field needs to focus on: (1) means by which to effectively engage users in the design and implementation process of interactive online health promotion interventions; (2) means by which to rigorously test not only the usability, but also the long-term behavioral impacts, of interactive online health interventions; and (3), how best to merge theories and approaches from psychology, healthcare, education, software design, and other relevant disciplines in the design and evaluation of interactive online health promotion interventions.

## 7. Conclusions

While a disparity continues to exist between offline and online health information seekers (characterized by age, income, and education level), this digital divide is becoming less of an issue as time passes and computer access becomes more widespread. The popularity of the Internet as a resource for health-related information will continue to grow as an ever increasing number of people gain access to computers and high-speed Internet connections. Rapid adoption of broadband Internet connections across populations, coupled with rapidly advancing computer technologies, has presented a very real opportunity for health researchers to develop innovative and interactive multimedia online health promotion interventions with broad appeal to diverse populations. With increasing consumer demand for more innovative interactive online health promotion interventions, there is a growing need for researchers to develop and effectively evaluate theoretically derived, interactive, online, behavior-change programs, targeting a variety of health behaviors across broad populations.

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