



Optimizing Health Outcomes by Integrating Health Behavior and Communication Theories in the Development of e-Health Promotion Interventions

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This article is available from: <http://www.ehealthinternational.org/>

Abstract

The Internet is becoming increasingly important as a portal for significant health information for women. Rapid advancements in computer technology have led to a growing interest among practitioners and cancer researchers in the potential of web-based health promotion interventions to improve breast and cervical cancer screening. Mounting evidence suggests that theoretically-derived computer-tailored eHealth promotion interventions are much more effective for engaging users and optimizing behavioral outcomes in online interventions. To date, the theoretical foundations of such interventions have been derived largely from the domains of health services and information and communication technology (ICT). However there is a notable divide between the two fields of study. Information and communication technology draws largely on engineering and human computer interface (HCI) design emphasize user input in the design. Health services researchers rely mainly on theories of change and learning design online interventions independent of users. Several authors have called for the integration of these theories to achieve the best possible ehealth promotion. In this paper, we discuss how researchers could integrate the methodological elements and theoretical models of health services in the design and development of web-based health promotion interventions, with a specific focus on the promotion of cancer screening behaviors in women. In addition, we discuss how Internet-based interventions can be developed in a manner that is more theoretically congruent with what is known about health behaviors and Internet engagement.

Introduction

The Internet is becoming increasingly important as a portal to important health information for women^{1, 2}. Rapid advancements in computer technologies have spawned a recent and growing interest among practitioners and cancer researchers regarding the potential of web-based health promotion interventions to affect behavioral change. The majority of research that has assessed such interventions has been derived from information and communication technology (ICT) or health services research. These fields draw on different theoretical bases (i.e., ICT uses theories

of engineering and human computer interface; health services relies on theories of learning and change) and have different emphases (i.e., health services research focuses on methodological rigor; ICT emphasizes user involvement in the design of the intervention). It has become apparent that in order to ensure that web-based health promotion interventions are relevant, feasible, usable, and functional for specific populations, the integration of these fields is necessary.

In this paper, we will discuss why and how the theoretical and methodological expertise of the fields of health services and ICT should be integrated in the design and development of web-based health promotion interventions, with a specific focus on the promotion of cancer screening behavior in women. Breast and cervical cancer continue to be leading causes of morbidity and mortality among women worldwide, and regular screening continues to be an important tool in the early detection and treatment of these cancers. Thus, we discuss how integrating the expertise of ICT and health service research scholars, Internet-based interventions can be developed in a manner that is more theoretically congruent with what is known about health behaviors and Internet engagement.

eHealth and Health Promotion

The term ehealth refers to the use of emerging technology (Internet) to enhance health and healthcare³. Despite the momentum of ehealth as a field in itself, the issue of health promotion within ehealth has only recently gained popularity among behavioral researchers and health practitioners as an emerging area of study⁴. This growing interest in the Internet as an "intervention channel" through which individuals are provided with health information and the tools to adapt health-related behaviors is largely attributable to rapid advancements in computer technologies (e.g., faster modems, digital technologies, high speed processors, faster hard drives) and ever increasing public computer access⁵.

The Internet is becoming an increasingly popular tool for people to access information about their health⁶⁻¹¹. The Internet is searchable and interactive⁸, providing immediate and individualized feedback in a variety of formats (audiovisual and textual content), which can be tailored to the developmental, psychosocial, behavioral, and biological needs of target populations¹². The anonymous nature of the Internet allows individuals to access sensitive information often required to make important health promotion and treatment decisions¹³⁻¹⁵. These elements make the Internet a great source of personal empowerment for the user, a key principle of health promotion^{13, 16}. As such, online health promotion interventions are rapidly emerging as an important means for influencing health risk behaviors^{6, 17-19}.

While Internet usage rates are highest among teens and young adults, nearly all of whom have access via home, school, or community centres^{20, 21}, an increasing number of older populations are accessing the Internet. Nearly one

in six Canadians regularly access the Internet for health-related information²², making health the most searched topic in Canada²³. Recent evidence suggests a shift from illness-centered to health promotion focused search on the Internet^{2, 22}.

The Internet has emerged as the leading source of cancer information for women^{8, 24}. Exploratory models have been used to better understand why women use the Internet to obtain health information, revealing that online health information seeking is greater among women from higher income and educational levels²⁵. The challenge for social scientists is to develop interventions that will minimize these disparities, equalizing access of health information for demographically diverse populations.

eHealth Promotion and User Engagement

While cervical and breast cancer can be prevented with appropriate screening and follow-up, many women continue to underutilize these screening programs^{26, 27}. At the same time, the use of information technology (IT) for cancer prevention in primary care facilities (e.g., computer-generated reminder systems) has shown modest effects on cancer screening behaviors to date²⁸. Despite a rapidly growing number of online health promotion interventions, researchers and practitioners currently have a poor understanding of how to effectively engage users in these programs and the factors associated with long term behavioral outcomes²⁷. Thus, the issue of engagement is an important consideration for researchers and practitioners in the development of online interventions for women to promote participation in screening among women.

Engagement refers to an individual's participation in accessing, receiving and continuing medical treatment, as well as actively participating in disease management decisions; fostering engagement will contribute to an individual's personal well-being, satisfaction with healthcare services, and self-efficacy or sense of personal empowerment^{29, 30}. Interactive multimedia computer-based interventions can be powerful in their capacity to engage individuals in health promotion behaviors^{17, 31}. While most Web sites tend to be "user-centered" (designed for specific user or target populations), they are not typically designed by the user. Web designers often fail to involve users in the design process. Hence, many Web sites follow a generic format, and do not effectively reflect the evolving needs of specific populations. This mismatch between what sites offer and the

needs of the target populations highlights a growing need to get the "user" engaged in the development process³². Engaging users in the program design and implementation process is necessary to establish web-based approaches that are more likely to keep individuals engaged and effectively influence behavioral outcomes.

Several researchers have identified factors influencing women's participation in cervical cancer screening programs³³⁻³⁶ and mammography utilization^{37, 38}. Findings include psychosocial and cultural barriers^{27, 35, 37-42}, as well as poor knowledge about risk factors and cancer screening guidelines^{27, 38, 42-44}. These findings suggest that effective online cancer prevention interventions must address the factors that act both as barriers and also foster user engagement. At the same time, some criticisms of engagement research in ehealth are that it has: (1) not effectively addressed the barriers to engagement, (2) relied on unrepresentative samples, (3) failed to address developmental, ethnic and geographic differences, and (4) has largely utilized correlational rather than longitudinal or prospective designs.

Web-Based Cancer Screening Interventions and the Role of Theory

Theory is an important and powerful tool for researchers in making informed decisions in the development of effective health communications^{45, 46}, including cancer screening interventions⁴⁷. While early cancer screening utilization studies have traditionally focused on the sociodemographic factors influencing women's participation^{48, 49}, in recent years, a growing number of researchers have become interested in the utility of social cognitive variables to explain this phenomenon. A number of researchers have used psychosocial theories, such as the Transtheoretical Model (TTM)⁵⁰, the Health Belief Model (HBM)⁵¹, the Theory of Reasoned Action (TRA)³⁶ and the Theory of Planned Behavior (TPB)⁵² to examine screening intentions and behaviors. However, these models have been found to be moderate (e.g. TPB) to poor (e.g. HBM) predictors of behavior. A criticism has been that by postulating a direct relationship between behavioral intentions and subsequent behavior, these models fail to acknowledge the contextual processes or factors impacting on intentions, particularly in more ethnically diverse populations^{53, 54}.

The use of theoretical frameworks is also integral to the effective dissemination of cancer screening interventions^{55, 56} from early planning of the intervention through to the evaluation and final reporting stages. While web-based approaches to

health promotion and disease prevention have limited impact when left to passively diffuse⁵⁶, theory-guided dissemination strategies have been found to promote the widespread adoption of these innovative interventions thereby maximizing clinical benefits⁵⁷. However, little attention has been paid to dissemination and uptake of these programs at both the individual and organizational level⁵⁸. Glasgow and colleagues (2004) suggested three potentially useful theoretical models for the dissemination of cancer screening interventions including: (1) Diffusion of innovations theory (DoI)⁵⁹; (2) The Reach, Efficacy, Adoption, Implementation, Maintenance (RE-AIM) framework⁶⁰; and, (3) Social Ecologic (SE) framework⁶¹. Innovation diffusion research has attempted to explain the variables that influence how and why users adopt a new information medium, such as the Internet⁶², and requires a multi-level approach to screening that utilizes multiple interventions instead of a single intervention⁵⁹. RE-AIM is a framework used to assess the public health impact of interventions on targeted populations⁶³; screening interventions that are simple, flexible, easily implemented by non-researchers and have stakeholder buy-in tend to offer the greatest sustainability⁶⁴. The SE model is a systems theory approach that addresses the relationships and effects that occur at the interpersonal, organizational, community, and intercultural levels. While guiding frameworks like the SE model have shown promise in promoting healthy lifestyles⁶¹, applying these models to the design of screening interventions is challenging since models must be tailor-made for each population. Thus, other theories need to be integrated into these multi-level frameworks, and there is limited research available to guide model development.

Tailoring Interventions to Promote Screening Behaviors in Women

A vast amount of health information is available to consumers on the Internet, much of which is provided in a resource-list format with hyperlinks to related health information¹⁸. While evidence suggests that health-related Web sites can be effective in increasing knowledge levels as well as change individual attitudes about specific health behaviors, these changes do not necessarily translate into desired affects on outcome behaviors⁶⁵. Web sites offering health information using a 'one size fits all' approach provide little in the way of individualized feedback and thus may be viewed by users as irrelevant⁶⁶; health researchers have found limited engagement of users over time with transient or no change in behaviors⁶⁷. However, there is mounting evidence that theoretically-derived computer-tailored

eHealth promotion interventions are a much more effective way of attracting and engaging users⁶⁸.

Tailored interventions can be defined as "any combination of information or change strategies intended to reach one specific person, related to the outcome of interest, and derived from an individual assessment⁶⁹". To date, tailored health communications (THC) have 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 change⁷⁰. Early research on tailoring has focused on health promotion and disease prevention, such as cancer-related lifestyle behaviors (e.g. smoking cessation, exercise) and early detection (e.g., breast and colorectal screening), as well as informed decision making⁷¹.

Several social cognitive models have gained popularity during the rapid growth of tailored communications and the trend towards the customization of health information. The Transtheoretical Model (TTM)⁷², which describes an individual's readiness to adopt specific health behaviors, quickly gained popularity in the development of health promotion strategies⁷³. The TRA and TPB presume that an individual's behavioral intentions are formed through their underlying beliefs about the behavior, social normative pressures to engage in this behavior, and the perceived ease or difficulty to engage in this behavior. These theories have commonly been used as a conceptual framework to study the factors influencing women's mammography utilization (Ashing, 1999; Rutter, 2000) and cervical cancer screening intentions and behaviors (Jennings-Dozier, 1999; Jennings-Dozier, 1997; Sheeran, et al., 2001; Sheeran & Orbell, 2000; Bish, Sutton & Golombok, 2000) in health services research.

More recently, researchers have utilized an integrated approach to THC, known as 'behavioral construct tailoring', which involves choosing promising variables from a variety of health behavior models to determine modifiable risk factors or changeable determinants of health⁷⁴. Integrated models are necessary for these complex multi-level approaches in order to identify potential variables that can be tailored to better explain the variances among individual differences in health behaviors⁷⁵. While online THCs have achieved modest success in changing cancer-related behaviors such as smoking, diet and screening⁶⁶, it is becoming increasingly apparent that the integration of THCs with persuasion and message effects approaches offer greater promise⁷⁶. Such

an approach allows researchers to identify key leverage points for the customization of messages targeting individuals at unique points along the behavioral pathway. In doing so, they are able to enhance the relevance and salience of specific health information thereby increasing the motivation of users to attend to and process this information, leading to greater motivation for behavioral change⁷³.

While tailored online health communication strategies relate to the development of messages based on the assessed need and interests of ehealth consumers, the eHealth Behavior Management Model matches these behavior change messages with existing online health information⁷⁷. This behaviorally focused model combines the theoretical underpinnings of the TTM or Stages of Change theory (based on the premise that individuals can be classified in one of five stages of readiness to change from "no interest" to "active interest" in changing a given behavior) and TPB (based on premise that those with strong intentions toward change are more likely to engage in a behavior particularly if they hold the attitude that it is necessary), integrated with concepts from persuasive communication. Key to persuasion communication are the concepts of response dependence and transactional communication which relate to the sending and receiving of information, much like the two-way communication between health provider and consumer. Most cancer prevention resources on the Internet rely largely on one-way communication, but the eHealth Behavior Management Model provides a feedback loop allowing for back and forth communication between researcher and user. Using this theoretically-derived approach, researchers are able to assess consumer health needs based on their readiness to change and match them to pre-selected Web sites using a staging algorithm, thereby increasing their access to reliable online health information and promoting their movement towards more active stages of behavioral change. This model also operates as a diagnostic tool for researchers and practitioners enabling them to identify an individual's readiness for change, the issues of most interest to them, as well as providing them with the information they need to tailor their interventions⁷⁸.

Integrating Behavior Change Models for Effective Cancer Communications

In a review of the theories and models used to guide cancer screening research, Curry and Emmons⁷⁹ emphasized the need for the integration of theoretical frameworks that include variables from various different domains. Behav-

ioral prediction theories can be useful for guiding researchers in the identification of specific behaviors and their underlying beliefs. However, these theories do not provide guidance as to how best to develop effective messages⁴⁵. They argue that communication theories are necessary for the development of persuasive messages to change these beliefs and intentions, thereby motivating behavioral change⁴⁶. As such, health behavior theories and information processing theories are complementary in nature⁸⁰. Health researchers are becoming increasingly aware of the role of persuasion in the prevention of cancer^{81, 82}, integrating concepts from theories such as the Elaboration Likelihood Model (ELM)⁸³ and the Heuristic-Systematic Model (HSM)⁸⁴ in the development of cancer prevention strategies. According to research in the field of persuasion, the following considerations of the receiver are important in the effective delivery of cancer communications: (1) identifying the receivers' belief structures; (2) considering the context and where they are in the cancer control continuum; and (3) tailoring messages to address the receivers' cognitive motivational resources⁷⁶.

One theory that is gaining recognition among health researchers to predict health behavior is the Integrative Model (IM)⁸⁵, which has been used to predict cancer screening behaviors⁸⁶ and lifestyle intentions⁸⁷. Although several theories exist to explain and predict health-related behaviors, it is argued that there are only a few key variables that need to be considered in the development of such interventions⁴⁶. The IM is a general theory that integrates important variables derived from three popular psychosocial theories: Health Belief Model, Theory of Reasoned Action, and Social Cognitive Theory. According to the model, behavioral intentions are determined by three primary psychosocial factors including: (1) Attitudes-learned predispositions to judge a behavior in a positive or negative light; (2) Perceived norms-beliefs about whether or not others support the behavior; and, (3) Self-efficacy- perceived ability to perform specific behavior⁸⁵. The underlying premise of this model is that an individual is more likely to engage in a target behavior if their intentions to perform it are strong, they have the skills and abilities necessary to perform it, and they do not encounter barriers in their environment to prevent them from engaging in the behavior^{45, 46}. For instance, women holding strong beliefs that getting a Pap-smear test will result in positive outcomes likely hold positive attitudes toward the behavior. However, negative beliefs about Pap screening (e.g., it is embarrassing or painful) may negatively affect women's appraisal and their

ensuing behavior. Similarly, beliefs and practices of friends or family members towards Pap testing and perceived beliefs about the personal resources required to enact the behavior may influence women's intentions to get a Pap test⁸⁸. The decision to go for a mammogram may be very different from deciding to obtain a Pap test, and specific beliefs associated with each of these decisions need to be addressed to effectively influence intentions.

According to the IM, individuals who intend to perform a specific behavior but are unable to do so because they lack the skills or resources are very different from those who have no intention and lack the motivation to engage in the behavior. Consequently, the intervention that is required to promote a specific health behavior changes according to the nature of the person's intentions⁴⁶. The intention-behavior matrix is a useful tool for classifying a target population in terms of an individuals' intentions and engagement, helping researchers identify if they need to intervene at the level of the underlying beliefs or skills building to minimize barriers⁴⁵. The relative importance of these variables (attitudes, social norms, self-efficacy) is determined by both the behavior and population being studied. Thus, prior to developing behavioural change communications it is vital that researchers consult the target population to determine the degree to which their intentions to perform an identified behavior are under attitudinal, normative, or self-efficacy control⁸⁵. For example, evidence suggests that social norms are a significant predictor of cervical cancer screening intentions in young university women^{36, 89}, while attitudes were the most significant predictor of behavioral intentions in older, more ethnically diverse populations^{51, 90}. Effectively targeting underlying beliefs will in turn influence attitudes, norms, and self-efficacy.

Understanding how individuals acquire cancer prevention information is also important in the development and delivery of effective online cancer prevention interventions. Evidence suggests that when viewers receive cancer prevention information either intentionally (seeking) or unintentionally (scanning) in an engaging manner, they will more likely intend to engage in cancer prevention such as Pap screening⁹¹. The majority of research in this area has focused on the deliberate information seeking behaviors of cancer patients^{92, 93} and much less is understood about how non-diagnosed individuals acquire cancer-related information. Evidence suggests that less deliberate and incidental

information acquisition is much more common among the cancer-free.

The potential of the Internet to provide vast amounts of health information in an interactive and engaging manner has led to a dramatic increase in research exploring the influence of health information-seeking and scanning on health behavior acquisition⁹⁴. The Internet has become a powerful source of cancer risk and prevention information. While commonly associated with active seeking of information⁹⁵, less purposeful scanning of cancer information on the Internet is prevalent and has important implications for health outcomes⁹¹. As such, understanding how individuals acquire information via this medium and its impact on health behaviors is an important consideration in the development of online cancer control strategies⁹⁶.

Hull and colleagues (2007) recently used an online survey to test the efficacy of the IM in predicting how seeking and scanning cancer information influenced cancer screening intentions. A total of 2,489 participants between the ages of 40-70 years responded to theory-based questions about their health screening (prostate, breast, colon) behaviors. Findings indicated that both seeking and scanning behaviors (SSB) were associated with cancer screening intentions, which were for the most part mediated by attitudes, social norms and self-efficacy. Despite the cross-sectional design and lower than anticipated response rate, this study provides promising evidence that an integrated model has the capacity to predict health promotion behaviors. Inadequate measures of attitudes, social norms, perceived behavioral control and SSB may have contributed to the lack of significance between these variables as mediators in the relationship between SSB and behavioral intentions, highlighting the importance of developing effective measures of the theoretical constructs.

While a long tradition exists between health services and ICT, very little information is available to guide researchers in the development of online health education and behavior change interventions. To address this gap, Skinner and colleagues⁹⁷ created the Spiral Technology Action Research (STAR) Model as a framework to direct health practitioners and researchers in the development, implementation and evaluation of online health promotion interventions. There is ample evidence that the success of ehealth promotion interventions relies largely on utilizing integrated health behavior change models, as well as consultation with the target population to

establish target behaviors and underlying beliefs. The STAR model, consisting of five iterative cycles, allows researchers to engage users in the process of integrating ICT development with health promotion principles, behavior change theories, quality improvement, and community mobilization practices⁹⁸. These cycles and the goals of each include: (1) Listen- collaborating with target population to assess their needs and how they view the technology; (2) Plan- developing a plan to address the assessed needs and necessary technical requirements; (3) Do- implementing the plan by developing a graphical layout of the interface design in consultation with the user to ensure relevance and engagement; (4) Study- reviewing the prototype design, images, and functionality with the target population prior to full website development and implementation; and, (5) Act- launching the website, complete with feedback mechanisms necessary for revising and updating. The STAR model has been used in the development, implementation and evaluation of an online smoking prevention and cessation intervention for adolescents (www.smokingzine.org), and offers promise for other web-based cancer communication approaches.

Challenges and Recommendations for Future Research

The Internet is becoming an increasingly popular tool for women to access cancer risk information; however, little is known about the strategies they use to retrieve this information on the Internet, as well as how they determine if the information is credible or not, and integrate this knowledge into behavioral change⁹⁹. Thus, further research is needed to explore the different ways women retrieve and find meaning in online health promotion information. Using theory to gain a better understanding of how women use the Internet for health reasons is necessary in order to address the challenges influencing their engagement in online health promotion interventions. In addition, the challenges facing engagement research lends itself to Internet-based research¹⁰⁰. Rapidly advancing computer technologies provide an opportunity for engagement researchers to design complex theoretically-derived tailored Internet-based interventions that will allow them to target populations based on developmental needs within a larger social and cultural context using longitudinal designs.

In order to be effective, ehealth resources need to be relevant and accessible to the target population. While theories exist to guide ehealth promotion and ICT design, the integration of these theories is necessary to ensure the usability,

effectiveness and accessibility of ehealth promotion interventions. To better understand how women retrieve and interpret cancer screening information, future research needs to focus on engaging target users in the interface design and implementation process. Developing online interventions increases the potential for researchers to collaborate with users in real-time design which will undoubtedly enhance the relevance of the content, thereby engaging users and motivating behavioral change⁷³. Participatory frameworks such as the STAR Model that engage the users in the development, evaluation and dissemination of ehealth promotion resources, offers great promise as a guide for future eHealth promotion research.

While researchers consistently identify theory-driven interventions as a marker of success, a majority of online health promotion interventions continue to be derived from a combination of logic and the developers' previous experience¹⁰¹. Although limited in number, studies utilizing theoretical designs to assess the effectiveness of interactive web-based health promotion interventions on health-related behaviors offer great promise¹⁰². The efficacy of these types of interventions delivered via the Internet has not yet been well established. Screening interventions based on integrated theoretical models has been found to increase screening intentions and behaviors⁹¹. However, the limited use of these frameworks in web-based interventions has been identified as a major gap in the literature. Additional research is needed to establish the optimum mix of human computer interactions (HCI) design and behavior change principles required in computer-based screening promotion programs with the greatest level of impact¹⁰³.

The finding that multi-level tailored online health interventions can optimize behavioral outcomes highlights the need for the development and testing of web-based interventions using relevant theoretical frameworks and longitudinal or prospective designs. The challenge currently facing researchers is the integration of theoretical models from multiple disciplines into causal chains that explain the complex nature of health behavior change. While limited, preliminary research suggests that frameworks such as the eHealth Behavior Management Model¹⁰⁴ and the Integrative Model⁹¹ are effective in influencing health behavior change intentions. Further study is needed to explore the benefits of these models in the development and evaluation of communication strategies focusing on health behavior change.

Conclusion

Rapid advancements in Internet technologies coupled with increasing computer access provide a significant potential for researchers and health practitioners to use the Internet as a cost-effective and innovative tool in the delivery of ehealth promotion interventions. In this overview of theoretically derived online health promotion interventions it is apparent that health related disciplines have largely overlooked how best to persuade behavioral change in specific populations. Although the integration of theoretical models has been presented as the ideal, there are very few examples of the effective use of integrative designs in online health interventions. This gap in the literature may be partially explained by the complexity and time involved in these interdisciplinary study designs. Clearly, there is a need for health and ICT researchers to be more intentional in their collaboration with regard to the tailoring of online ehealth promotion interventions. Online interventions are not without their challenges (i.e., geographic disparities in Broadband access). However, as individuals become increasingly attracted to online information, behavioral health researchers must recognize the importance of tailoring theoretically-derived online interventions in a manner that will engage individuals to adopt health behaviours.

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