Factors Associated with Use of Interactive Cancer Communication System: An Application of the Comprehensive Model of Information Seeking

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Abstract

In order to provide insights about cancer patients' online information seeking behaviors, the present study analyzes individuals' transaction log data and reports on how demographics, disease-related factors, and psychosocial needs predict patterns of service use within a particular Interactive Cancer Communication System (ICCS). Study sample included 294 recently diagnosed breast cancer patients. Data included pretest survey scores of demographic, disease-related, and psychosocial factors and automatically collected ICCS use data over the 4-month intervention. Statistical analyses correlated pre-test survey scores with subsequent, specific types of ICCS service usage. Patterns of online cancer information seeking differed according to the patients' characteristics, suggesting that lower income, less educated women and those lacking in information-seeking competence use the computer and online services to the same or a greater degree if those services are made available to them. Results of this study can inform more effective resource development for future eHealth applications.

Keywords

Introduction

The rapid growth of the Internet has increased the availability, accessibility and use of information and support for people with serious illness. For instance, the National Cancer Institute's Health Information National Trends Survey (HINTS) found that the Internet is second only to healthcare providers as an information source among women who have had breast cancer (Rutten, Moser, Beckjord, Hesse, & Croyle, 2007). The 2005 HINTS survey indicated that 59.5% of breast cancer patients who have been online have visited an Internet site specifically to learn about cancer (Rutten et al., 2007). Such trends are consistent with the growing recognition that rather than passive recipients, patients actively seek information to make informed decisions (Johnson & Meischke, 1993; Kaplan, Ganiats, & Frosch, 2004).

Information seeking, often conceptualized as "the purposive acquisition of information from selected information carriers" (Johnson, 1997, p.26), is an effective strategy to cope with cancer-related challenges to quality of life, to help people decide about treatment, and to adopt healthy behaviors (Bandura, 1986; Green & Roberts, 1974; Gotcher & Edwards, 1990; Johnson, 1997; Zemore & Shepel, 1987). A variety of online information and support tools (e.g., expert advice, online support group, interactive guides) have been found to develop patients' competencies and increase control through the cancer diagnosis and treatment (Eysenbach, 2003). Thus individuals' orientation to and engagement with specific types of resource across the cancer journey may be as important as the content of those resources. Several patient characteristics contribute to health information and support seeking among breast cancer patients, but few studies have systematically examined how they predict use of different types of online information.

Moreover, few empirical studies have used actual observational data to examine patients' online cancer information seeking behaviors. Instead, most research has studied information seeking processes either by experimental manipulation or by participant self-reported recall (Josefsson, 2006). While these methodological approaches are surely useful, the former cannot reflect natural variations in online information seeking behaviors and the latter relies too heavily on recall and subjective perception to have authenticity as a behavioral record. Transaction log data, despite having its own drawbacks, does at least provides 'real-time' use statistics that document the specific steps in individuals' information searches (Nielsen, 1993) and thus direct evidence of interactions between patients and online resources (Kurth, 1993; Nicholas, Huntington, & Williams, 2003).

Therefore, to understand the effects of online cancer information and support seeking behaviors, this study analyzes individuals' transaction log data and reports on how demographics, disease-related factors, and psychosocial needs predict different patterns of use. We focus on a particular Interactive Cancer Communication System (ICCS), the Comprehensive Health Enhancement Support System (CHESS) "*Living with Breast Cancer*" program. CHESS provides patients and their families with a comprehensive range of conceptually distinct information, social support and interactive learning services. Several research studies have shown that CHESS' unique service components contribute to a range of benefits, including improved quality of life, participation in healthcare decisions, and effective use of healthcare services (Gustafson et al., 1998; Gustafson et al., 2001; Gustafson et al., 2002; Gustafson et al., 2005; Gustafson et al., 1999; Hawkins et al., 1997; Shaw et al., 2007; Shaw et al., 2008; Wise, Han, Shaw, McTavish, & Gustafson, 2008). We posit that these promising effects also depend upon what type of ICCS resources people use.

We draw our theoretical foundation from Johnson's (1997) Comprehensive Model of Information Seeking (CMIS), which has been widely used to explain the communication

channel selection (including traditional mass media and interpersonal networks) of cancer information seekers. The CMIS draws concepts and findings from a synthesis of three large theoretical traditions that incorporate uses and gratification research, the health belief model, and a model of media exposure and appraisal (for an extensive discussion, see Johnson, 1997).

CMIS: Factors Predicting Information Seeking

The CMIS identifies three components that include antecedent factors (e.g., demographics, illness experience, salience, needs and beliefs), information carrier factors (e.g., utility of channels), and information seeking behaviors. Borrowing from the CMIS framework, this study considers three categories of potential antecedents to information seeking: demographics, disease-related factors, and psychosocial needs.

Demographic factors

Within the CMIS, demographic antecedent factors predict information seeking. Earlier research suggested that demographics generally explained small amount of variances in information seeking (Lenz, 1984), but more recent studies have shown that age, race, and education predict differential use of various health information resources (Atkinson, Saperstein, & Pleis, 2009; Carlsson, 2000; Freimuth, Stein, & Kean, 1989; Johnson, 1997; Leydon et al., 2000). For example, elderly and less-educated people were less likely to rely on newer and more specialized sources and African Americans are often unwilling to share cancer information beyond their family boundary (Johnson, 1997). While studies of the digital divide persistently show that the disadvantaged are less likely to use and find information on the Internet in a naturalistic setting (e.g., Rideout, Neuman, Kitchman, & Brodie, 2005), we focus on how the disadvantaged (e.g., elderly, African Americans, and low-educated) will seek out different sources of information and support within an ICCS after they were provided free computer hardware, Internet service, and training. That is, by removing the barrier of access to technology, we posit that demographic characteristics might reflect differences in experience, preferences, and comfort with a mouse-driven medium and on-screen text.

Disease-related factors

According to CMIS, the level of individuals' direct experience with the disease will predict their information needs and information seeking behaviors (Johnson, 1997; Johnson & Meischke, 1993). For example, cancer stage is a key factor, as treatment choices, side effects, and prognosis are very different for patients with early-stage vs. advanced breast cancer (Czaja, Manfredi, & Price, 2003; Gotay, 1984; Johnson, 1997). In addition, each phase of the cancer journey (e.g., treatment decision, chemotherapy, radiation) comes with its own set of concerns and thus may influence the type (Mills & Sullivan, 1999; Luker et al., 1996) and extent of information seeking (Czaja, Manfredi, & Price, 2003; Leydon et al., 2000; Murero, D'Ancona, & Karamanoukian, 2001). For instance, in preparing for surgery or treatment, patients may prefer information about the nature of their illness or treatment options; during treatment about managing side effects; and afterwards about moving on or validating their decision-making (Johnson, 1997). For our analysis, disease-related factors, include whether a woman had key events (e.g., surgery or treatment) occurred before or after joining the ICHS study, and how that affected use of the ICCS.

Psychosocial needs

Finally, the CMIS points out that individual's health beliefs and perceived salience of the information influence information seeking. For instance, an individual's "perception of the extent to which he or she can shape or control events" (Johnson, 1997, p. 73), has been

found to enhance the ability to seek out and use cancer information in making a health care decision (Leydon et al., 2000; Lichter, 1987). Patients with higher self-efficacy and information competence may be more likely to seek out relevant information within an ICCS. Some research findings suggest those with the greatest knowledge and research skills at baseline may be best able to use and benefit from a new information resource. However, we wonder whether patients with low self-efficacy may find that the ease and privacy ICCS allows them to use eHealth resources to augment their competence in dealing with their cancer and treatment decisions (Shaw et al., 2008). Likewise, people with lower quality of life may be more motivated to use such resources.

According to CMIS, psychological salience, or "the personal significance of cancer-related information to the individual" (Johnson, 1997, p. 72), is an underlying motivation to seek out information. Information seeking can compensate for a lack of social support and can build upon one's growing information base (Shaw et al., 2008). Moreover, lower functional, psychological, and emotional well-being have also been found to motivate information seeking in support of lifestyle and cognitive/emotional adjustments (Shaw et al., 2008).

Types of CHESS Services: 'Information Channels'

The CMIS assumes that these antecedents of information seeking are conditioned by how people evaluate the utility of communication channels and in turn they determine people's information seeking strategies and outcomes (Johnson, 1997). CHESS provides three different information delivery strategies that are each presumed to have unique 'utility' depending on individuals' antecedent profile.

User-driven Information services

Information services are the primary communication strategy used in most health-education Web sites. They are user-driven in the sense that the user is the primary determinant of where s/he goes and what s/he sees. There may be prompts from the computer, but the computer is not, for the most part, guiding the user. The computer is a passive participant in the information delivery process; it tends not to guide or direct. Examples of this would be Library Articles or Frequently Asked Questions where the user asks to see articles on certain topics, or Personal Stories where the user can read about the experiences and thoughts of other individuals who faced the same sorts of challenges that the user faces. The user selects these services, indicates the kind of information s/he wants, and the computer delivers the information via text, audio or video files.

Computer-user collaborative Interactive services

In Interactive services, the computer takes an active role in guiding the user; it makes suggestions, offers feedback, identifies deficits, and may encourage the user's behavior. In these services, the computer plays a role traditionally identified as counseling/coaching, or teaching. Interactive services use patients' data inputs to provide feedback or prompts, in keeping with the notion that information will be most useful when it is consistent with users' particular contexts and/or preferences (Hawkins, Kreuter, Resnicow, Fishbein, & Djikstra, 2008; Rafaeli, 1988). Interactive services include the following: Action Plan helps women make desired lifestyle changes by walking them through their goals, assets, obstacles to increase their likelihood of success; Decision Aid, empowers women to make treatment decisions based on their own values and priorities, such as reducing the likelihood of recurrence or obtaining minimally invasive or noxious treatments; Health Tracking encourages women to track their physical symptoms and psychosocial status over time and points out how some factors may relate to one another; and Journaling guides women though a choice of open or guided writing exercises to help them make sense of their cancer

experience, relieve stress and improve emotional well-being. Taken together, interactive services are based on adult learning theories positing that activities that promote self-reflection, critical analysis and application of relevant information, and systematic planning and decision-making are more effective in promoting self-efficacy and behavioral change than passive use of information (Bandura, 1986; Jarvis, 2004; Mezirow & Associates, 2000; Merriam & Caffarella, 2007; Merriam & Heuer, 1996).

Person-to-person Communication services

CHESS Communication services enable patients to communicate with each other or privately with an expert. Here the computer is no longer a passive agent, but is tool that links people together. This computer-mediated person-to-person connection can enhance interpersonal processes such as social support, teaching, and conversation. We posit that peer-to-peer and patient-to-expert communication are two conceptually distinct sub-categories within Communication services.

Discussion Group—The Discussion Group provides a forum for anonymous peer-to-peer sharing of information and support. It is a text-based, asynchronous bulletin board that has consistently been the most frequently used CHESS service (Han, Shaw, Hawkins, Pingree, McTavish, & Gustafson, 2008; McTavish, Pingree, Hawkins, & Gustafson, 2003; Shaw et al., 2007). The groups are monitored by a trained facilitator to ensure that discussions are supportive and do not contain unchallenged inaccurate or harmful information. However, the facilitator does not take an active role in guiding the women about what they should communicate about. Research indicates that informational and emotional support from similar others can help people cope with a chronic illness (Gray, Fitch, Davis, & Phillips, 1997; McTavish et al., 2003; Shaw, McTavish, Hawkins, Gustafson, & Pingree, 2000). Patients can not only exchange and learn from practical information about their own experiences with breast cancer but also give and receive strong and empathic support (Meier, Lyons, Frydman, Forlenza, & Rimer, 2007; Preece & Ghozati, 2001).

Ask an Expert Service—Ask an Expert enables patient-initiated patient-expert dialogue. Patients use the secured internal email system to ask questions of an expert trained by the National Cancer Institute and receive a response within 48 hours. To answer patients' questions, the Expert uses well-established medical textbooks (e.g., Diseases of the Breast) or computer resources (e.g., the NCI's Physician Data Query database). The CHESS expert is highly interactive and responsive to the user's particular life context and takes into account the patient's individuality by encouraging her to make sense of expert information in the context of her specific health and psychosocial concerns (Siegel, 2005).

Research Questions and Hypotheses

Based upon the above discussion, this study applies Johnson's (1997) CMIS to explore how demographics, disease status, and psychosocial needs predict different types of service use within the CHESS "*Living with Breast Cancer*" program. Few studies have explored whether and how elderly, less-educated, and African American breast cancer patients seek and use ICCS resources when traditional barriers are removed by providing computer hardware, Internet service, and training). Thus, we put forth the first research question.

> RQ1. What is the relationship between demographic factors and use of different types of CHESS services, when breast cancer patients are provided free computer hardware, Internet service, and training?

Likewise, we pose the second research question to explore whether a woman's cancer stage and her experience with key events (i.e., surgery or treatment) before or after the start of

intervention predict different types of CHESS service use. To exclude confounding effects, we explore those relationships after controlling for the aforementioned demographic factors.

> RQ2. What is the relationship between disease-related factors and use of different types of CHESS services, after controlling for the demographic factors?

In addition, we will test for three hypotheses about the relationships between psychosocial needs and service use. First, the great range of resources and information present in CHESS Information services, and its ease of use, will make them useful, especially for those who lack in competence in information and health care. This expectation also holds for the use of the Ask an Expert where the CHESS expert appraises individuals' needs, provides salient information, and helps them make sense of it. Previous CHESS research also found that patients with the greatest deficits in their competence were more likely to seek out resources that will satisfy unmet needs (Shaw et al., 2008).

> H1: Patients with lower level of information competence will be more likely to use Information and Ask an Expert service.

Second, by appraising patient's particular context, the Interactive learning tools teach people how to apply knowledge gained from information into competencies to deal with cancer and compensate for disruption of quality of life. Further, because Interactive services also provide tailored feedback based on the user's response/characteristics, the ongoing use of these services may provide patients with a sense of being cared for (Hawkins et al., 2008; Lee, 2004; Walther, Pingree, Hawkins, & Buller, 2005).

> H2: Patients with lower levels of information competence, social support, and quality of life (such as functional and emotional well-being and breast cancer-related concerns) will be more likely to use Interactive service.

Third, in CHESS discussion groups, patients can engage in emotionally deep conversations with other patients who have, or are going through, similar challenges. Thus, participating in discussion groups can help patients manage their quality of life (Hoybye, Johansen & Tjornhorj-Thomsen, 2005) and give and receive social support in lieu of or in addition to their usual social networks.

> H3: Patients with lower social support and quality of life (such as functional and emotional well-being and breast cancer-related concerns) will be more likely to use the Discussion Groups.

Methods

Procedures

The data analyzed in this study were originally collected as a part of two larger *CHESS: Living with Breast Cancer* intervention studies of 353 women. The earlier study was funded by the Department of Defense and the National Library of Medicine (DOD/NLM). Women with recently diagnosed breast cancer were recruited from cancer centers in Madison WI, Cleveland OH, Detroit MI, and Rochester MN. One-hundred and twenty-two women were randomized to CHESS and completed a pretest survey. Recruitment began in 2000 and ended in 2003. The more recent study, funded by the National Cancer Institute and the John and Mary Markle Foundation, was the Digital Divide Pilot Project (DDPP) in which underserved breast cancer patients in rural Wisconsin and Detroit, Michigan were given access to full CHESS for 4 months. In the DDPP, a pretest survey was conducted with a sample of 231 patients. Recruitment was conducted between 2001 and 2003.

Patients were eligible if they were within 180 days of their diagnosis, not homeless, able to read and understand an informed consent letter, and able to understand and answer sample

questions. Once a patient was referred to the study, a research team member explained the purpose of the study, reviewed eligibility criteria with the patient, explained the risks and benefits of being involved, including that they would need to fill out surveys, and that their computer use would be monitored. The majority of DOD/NLM participants and almost all DDPP participants were loaned computers for use in their homes. All participants in the DDPP study and the CHESS group in the DOD/NLM study received personal training to learn how to use the computer and the Internet. However, the majority of time was spent on learning how to use CHESS. They also had ongoing technical support available to them if they needed it.

A total of 353 subjects were recruited but only 294 were within the 180-days-from-diagnosis cutoff. The sample characteristics of the two intervention studies differed especially by education level and their race. In the CHESS group of the DOD/NLM study, about 60% of participants had more than some college education (including associate/technical or bachelor's or graduate degree) and only 23.7% were African American, while in the DDPP study about the same 60% of participants had high school degree or received some college education and 35.9% were African American. Accordingly, this study merged the two samples to balance out the unique characteristic of each sample and increase the statistical power.

Measures

CHESS service use—To keep track of patients' CHESS use, an automatic data collection system was developed to capture each keystroke in participants' use of the system. Each user's record was identified by her code name and contained the date, time, URL of every Web page requested, and text or data inputs. Using a computer program developed by the authors, we created and analyzed four-month transaction log files from both studies that contained all participants' activities within the CHESS system. To construct our metric of usage (i.e., days used), we first summarized every user's daily usage by each service entry (e. g., Questions & Answers, Instant Library, Resource Guide, Resource Directory, Web Links, and Personal Stories for Information services) and combined them by broader service categories (i. e., Information, Discussion group, Ask an Expert, and Interactive services), so that the combined data tell us how many days patients accessed to each of four service categories during the four-month period (Han et al., 2009).

Furthermore, CHESS service use was operationalized as the number of days participants accessed each of four different types of services. While time spent (as measured by minutes) is a common metric for use of information systems, previous qualitative and quantitative CHESS studies confirmed that people who showed commitment to the system by using systematic information seeking strategies over time were more successful than those who either browsed the system on a few occasions or just spent more time with the system (Smaglik et al., 1998; Han et al., 2009). For example, a qualitative study of HIV/AIDS patients' CHESS use (Smaglik et al., 1998) noted that many users who spent the most time with the system actually benefited very little or not at all, because their use was exclusively concentrated in the bulletin-board Discussion Group feature. In contrast, those who improved most from pretest to post-test used the system much less overall, but they seemed to be focused and systematic in pursuing topics across multiple CHESS services and over time. One key reason this overall amount of use has not worked well to explain effects of ICCS is because such systems typically contain a variety of content, some of which may be more beneficial than others, and thus an overall amount of use has little practical meaning (Chory-Assad & Tamborini, 2003; Johnson, Braima, & Sothirajah, 2000). Based on this logic, this study employed number of days as a meaningful measure of commitment to ICCS use. That is, some patients rack up a lot of minutes early in the intervention and never come

back (Boberg et al., 1995; Gustafson et al., 2001), but more days of use may imply greater perceived usefulness and investment in the system (, which leads to more benefits).

Antecedents

Demographic factors: Surveys administered at pre-test included demographic factors of age, race (a dummy variable with African American coded 0 and Caucasian coded 1), and education.

Disease-related factors: Surveys also included disease-related measure of stage of cancer (a dummy variable with early stage (stage 0, 1, 2) coded 0 and late stage (3, 4, or inflammatory) coded 1). Additionally, we asked participants the date of surgery (i.e., lumpectomy or mastectomy) and the start and end date of chemotherapy and radiation treatments. From that information, we generated additional disease-related variables to represent when women joined their CHESS study relative to their treatment or surgery schedules. Mastectomy and lumpectomy were coded separately, because they have different effects on body image and quality of life (Arora et al., 2000). Therefore, our measures included 1) mastectomy occurred after they got CHESS (post-CHESS) ('yes' code 1, n = 46/ pre-CHESS coded 0, n = 180), 2) lumpectomy post-CHESS ('yes' code 1, n = 36/pre-CHESS coded 0, n = 213), 3) chemotherapy post-CHESS ('yes' code 1, n = 106/pre-CHESS coded 0, n = 67), and 4) radiation post-CHESS ('yes' code 1, n = 135/pre-CHESS coded 0, n = 20). Women who did not have surgeries or treatments were excluded from the analysis.

Psychosocial factors: Measures of five psychosocial factors at pre-test included: information competence, social support, functional well-being, breast cancer-related concerns, and emotional well-being. See Appendix for the exact wording of all the items belonging to these scales. For all measures, scale scores are calculated as averages across scale items.

A health information competence scale (M = 2.59, SD = .86) assessed a woman's perception that she could get and use health information (Gustafson et al., 2001; Gustafson et al., 2005). The five-point scale ranging from 0 to 4 asked whether participants agreed or disagreed with statements such as "I can figure out how and where to get the information I need" (inter-item r = .50).

Social support (M = 3.05, SD = .83) used six items (Cronbach's α = .88) on a five-point scale ranging from 0 to 4 to assess how true statements such as "There are people I could count on for emotional support" were (Gustafson et al., 2005). Social support assessed the informational and emotional support of friends, family, coworkers, and others. This scale was developed for previous CHESS studies (Gustafson et al., 2001; Gustafson et al., 2005).

The five-item functional well-being subscale (M = 2.45, SD = .99) of the Functional Assessment of Cancer Therapy-Breast (FACT-B) was used to assess the impact of breast cancer on quality of life; it is widely used and has been validated extensively in other studies (Brady, Cella, Mo et al., 1997; Cella et al., 2003). Respondents were asked, on a five-point scale ranging from 0 = not at all to 4 = very much, if, for example, they are "able to work (including working in home)" (Cronbach's α = .84).

A six-item emotional well-being subscale of the FACT-B (M = 2.46, SD = .99) used a five-point scale ranging from 0 to 4 how often participants had felt, for example, "sad". These items were reversed so that higher score means higher level of emotional well-being (Cronbach α = .86). Finally, we used the eight-item breast cancer-related concerns subscale of the FACT-B (M = 1.54, SD = .72) to assess the degree of concern about potential emotional, physical, and body image consequences of cancer, its treatments and their side

effects (Gustafson et al., 2005). Respondents were asked, on a five-point scale ranging from 0 = *not at all* to 4 = *extremely*, how much they agreed or disagreed with the statements such as "I worry about the effect of stress on my health" (Cronbach α = .70).

Analysis

To examine how demographic, disease-related, and psychosocial factors are associated with ICCS usage and service selection, two analytic processes were used. First, we performed zero-order correlation analyses to explore relationships between demographic factors and CHESS services usage. Second, to examine relationships between disease-related and psychosocial factors and individual CHESS service use, we used partial correlation analyses controlling for three demographic factors. Thus, those partial correlations reflect using more or less of a service than individual's demographic factors (e.g., age, education, and race) would predict. Regression analyses were not performed because significant correlations among the antecedent variables produced colinearity that would moderately affect the coefficients.

Results

Descriptive statistics

Table 1 presents characteristics of the current study sample that include age, race, education, and stage of cancer (early or late). The participants analyzed in the current study (n = 294) had a mean age of 51 years and had a diverse educational background with about 40% having at least an associate or technical college degree. The racial characteristics of the sample were 68.2% Caucasian and 31.8% African American. Almost three fourths had early stage cancer (stage 0, 1, 2) and one fourth were had late stage (stage 3, 4, or inflammatory).

Table 2 shows descriptive statistics of CHESS service use for the four-month period. Note that both means and medians are presented, along with minima and maxima, as distributions were typically highly skewed by some heavy users. Study participants used Discussion Group service most, with an average 15.2 days of use. Ask an Expert was used the least, with an average 3.2 days of use. Most women made moderate use of both Interactive and Information services, with an average 4.7 days of use. Since these CHESS use measures were positively skewed, we took the logarithms (after adding 1 minute to all scores to eliminate non-loggable zeros) and used them in all subsequent analyses.

Correlates of individual CHESS service use

Demographic factors—The top sections of Table 3 present zero-order correlations between three demographic factors and days of use for each of the four groupings of CHESS service (RQ1). The findings generally indicate that demographic characteristics predict differences in Discussion Group use, less so for Interactive services and Ask an Expert, and not at all for Information services. That is, older participants used the Discussion Group fewer days ($r = -.20$, $p < .01$). Women with higher levels of education used the Interactive services ($r = -.20$, $p < .01$) and Ask an Expert ($r = -.21$, $p < .01$) fewer days than women with lower levels of education. Consistent with prior CHESS studies, Caucasian women used Discussion Group significantly more ($r = .20$, $p < .01$).

Disease-related factors—The middle sections of Tables 3 show partial correlations between disease-related factors and individual CHESS services use, after controlling for the aforementioned demographic factors (RQ2). Late stage breast cancer patients spent more days in Interactive services ($r = .17$, $p < .05$) and Discussion Group ($r = .20$, $p < .01$). Regarding how treatment or surgery affected use, women whose mastectomy occurred after they joined CHESS spent fewer days (average 4.4 days) in Interactive services ($r = -.16$, p

< .05). That is, in post-mastectomy patients used Interactive services more (average 5.7 days). Patients spent fewer days in Ask an Expert ($r = -.18$, $p < .05$) if they had radiation therapy after they joined CHESS (average 2.4 days vs. 3.9 days for pre-CHESS group). Interestingly, however, women who had chemotherapy after they joined CHESS spent more days using Information services (average 5.4 days vs. 4.0 days for pre-CHESS group)—the only significant predictor for Information services ($r = .18$, $p < .05$). Overall, disease-related factors uniquely predicted different types of CHESS service use.

Psychosocial factors—Psychosocial factors were significantly correlated with use of the Interactive and Communication services, but not the Information services. In the test for the first hypothesis, we found that prior level of information competence ($r = -.15$, $p < .05$) was significantly and negatively correlated with use of Ask an Expert service. But there were no significant relationships between their levels of competence and Information service use. However, the second hypothesis was fully supported. After controlling for age, education, and race, four out of five psychosocial needs (i.e., information competence, social support, functional and emotional well-being) were significantly and negatively correlated with number of days used in Interactive services ($-.14 \leq r \leq -.19$, minimum $p < .05$). Although breast cancer-related concerns had significant and positive relationship with Interactive service use ($r = .14$, $p < .05$), all of these five findings suggest that those who had lower quality of life, social support, and competencies spent more days using the Interactive services. Finally, partially supporting the third hypothesis, only the FACT quality of life measures had significant negative relationships with Discussion Group use (functional well-being at $r = -.14$, $p < .05$ and emotional well-being at $r = -.16$, $p < .05$).

Discussion

Although the above paragraphs have presented the correlations between specific antecedents and use of different types of CHESS service, it is perhaps useful to step back and look at the overall picture of those correlations. Correlations are quite concentrated for some combinations of antecedents and service use, scattered for others, and essentially non-existent for others. In particular, neither demographics, disease-related factors (with one small exception), nor needs predicted CHESS Information service use.

Among demographic variables, education accounted for significant correlations with use of interactive services and Ask an Expert, with less educated women using more. Use of Discussion Group was the one type of service that was most significantly correlated with demographic factors. It is worth reiterating that participants were provided free computers, Internet service and individualized computer training. Thus, these findings provide unique insights into how breast cancer patients use an ICCS when barriers of access, cost, and basic web skills are removed. Nonetheless, older, less educated, and African American women used the Discussion Groups less than their younger, highly educated, and Caucasian counterparts—suggesting that older women may have been less comfortable in typing and sharing their personal experiences beyond their family boundaries with anonymous others (see Squires et al., 2005 for similar findings for CIS research). African American women may also have been reluctant to share their cancer experiences in a predominantly white and anonymous CHESS discussion group (Freimuth, 1993; Simpkins & Brenner, 1984; Shaw et al., 2006). Furthermore, women with lower educational levels may not have sufficient autonomy or knowledge to seek additional information, thus preferring guidance from the computer or CHESS expert over peer-to-peer discussion group (See Eysenbach, 2008a, 2008b for a similar discussion). Although lack of access, cost, and basic web skills were equalized, these findings emphasize that eHealth researchers should also consider situational/cultural characteristics of the population when delivering needed information and support.

Correlations with disease-related factors were spread more evenly across types of CHESS services, emphasizing the need to tailor information and its delivery to cancer patient's health and treatment/surgery status. These results suggest that psychosocial and survivorship challenges may differ for early and late stage women. According to Wilson, Anderson, and Meischke's (2000) focus group study, women with late stage breast cancer report that the medical system does not meet educational needs about treatment and their social network does not provide needed support. Thus, higher use of Interactive services and Discussion Group among advanced cancer patients may have filled these unmet needs.

Since needs for information and support change throughout the cancer journey (Squires et al., 2005), we also compared CHESS use patterns of women who had received their cancer treatments before and after they joined the study. Our results found that women who had a mastectomy before joining CHESS used the Interactive services more, suggesting they may have found the computer-guided reflection, analysis and feedback tools useful for dealing with their body image and lower physical and functional well-being after surgery (Arora et al., 2001). Further, women whose radiation therapy occurred before the study made more use of Ask an Expert, suggesting that experts may help women make meaning of their post-treatment side effects by addressing between-the-cracks issues, or interpreting ambiguities they may have encountered. However, women whose chemotherapy started after joining the study preferred the static expert information to the interactive services, the peer support, or the human expert, suggesting that accessible, accurate and timely information was most helpful during the run-up to treatment, preparation and coping phases (Echlin & Rees, 2002). But given the limitations of coding for both topic and type of service, it is not possible to identify the specific informational topics people accessed during this phase of their cancer trajectory. Future studies should test our hypothesis that people will access thematic content relevant to their cancer journey by correlating use of CHESS content with the patient's cancer treatment events.

Most intriguing is how psychosocial needs contributed to substantial variation in the types of service use. Pretest levels of psychosocial measures were unrelated to use of CHESS information; However, one or two factors were related to use of Discussion Group or Ask an Expert, suggesting that psychosocial vulnerability may have reduced women's sense of competence to seek and apply relevant information to their cancer challenges and encouraged them to rely more on the expert (Eysenbach, 2008a, 2008b). Similarly, lower functional and emotional well-being correlated with increased giving and receiving emotional and informational support in Discussion Group. For the Interactive services, however, low scores on all pretest measures of quality of life, social support, and competence were associated with greater use. These results suggest that these "deficits" may not be barriers to ICCS use, but rather motivators to use the more demanding and engaging interactive learning tools—which are the least-used CHESS services. This is particularly noteworthy because Decision Aid, Action Plan, Health Tracking, and Journaling require substantial thought and input, often over time, in order to receive the tailored computerized coaching or feedback. We posit that users' active engagement may make such feedback more meaningful.

In summary, our results suggest that the CMIS is a useful framework for understanding cancer patients' resource selection and usage within an ICCS. More importantly, these results also highlight that multiple components improve the usefulness of ICCSs for patients of diverse backgrounds throughout their cancer trajectory. That information and support seeking differed by demographics, disease status, and psychological factors underscores the value of comprehensive integrated ICCS to address such needs and concerns and confirms other research finding that the success of ICCSs rests on the fact that different system components meet complex needs along the disease continuum. These resources allow

patients to control the type, content, and timing of the resources they need to create meaning, be better informed, and develop skills to manage their disease more effectively (Walther et al., 2005).

Of course, this study has several limitations. First, despite the socioeconomic and racial diversity of this sample, our findings may be generalizable only to the population of breast cancer patients who would have accepted and used CHESS. Second, while this study contributes to understanding patients' characteristics that led to information seeking from available services within an ICCS, we assessed cancer patients' information seeking behaviors over the entire four-month period. However, given that needs continue to change through survivorship and, alas, recurrence (Leydon et al., 2006), longitudinal assessment is needed to provide detailed insights into the dynamic relationships between patients' needs and information seeking behaviors over the course of the disease trajectory (Squires et al., 2005). Third, this study focused on information seeking behavior within CHESS website only but future research should expand this inquiry beyond CHESS service usage and examine breast cancer patient's general information channel preferences among various media and resources.

Another limitation is that even though these results identify factors predicting use of several kinds of ICCS service, we were almost unable to predict use of Information services with either demographic, disease-related (one small exception), or psychosocial need measures. One might speculate that CHESS Information services provided a base of knowledge about the disease and treatments that all patients shared before going on to make individual choices, but there is still large variability in how much breast cancer patients used Information services. Unlike the other three types of CHESS services, we couldn't account for that variation.

Even with these limitations, this study provides several important implications for future research on health informatics. First, patient's recall is limited, because they are less likely to replicate in detail past information seeking behaviors when the physical and emotional urgency that drove their deliberate searching and browsing is no longer salient. Thus, we contend that eHealth researchers should analyze transaction logfiles, which provide unobtrusive and direct assessment of patients' online information seeking behaviors. This method provides hard, objective evidence of online information seeking behaviors unlike methods that rely on either subjects' recall or experimental manipulation, which can hardly appraise cancer patients' authentic lived experience. Second, findings from this study provide clear insights on resource development for effective eHealth applications. Because patients have very different reasons for using conceptually distinctive services, eHealth applications should contain diverse tools and components addressing their complex and evolving needs. In addition, given patients with the greatest deficits in their resources and psychosocial competence were more likely to use the computer and online services, online access and training should be made available to breast cancer patients who do not have it.

Acknowledgments

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Appendix: Question wording

Emotional Well Being, a 6 item scale. All items were scored on a 5-point scale (not at all, a little bit, somewhat, quite a bit, very much).

1. I feel sad (reversed)

2. I feel nervous (reversed)

3. I am worried about dying (reversed)

4. I am worried that my illness will get worse (reversed)

5. I feel like my life is a failure (reversed)

6. I feel like everything is an effort (reversed).

Functional Well Being, a 5 item scale. All items were scored on a 5-point scale (not at all, a little bit, somewhat, quite a bit, very much).

1. I am able to work (including working in home).

2. My work (including work in home) is fulfilling.

3. I am able to enjoy life "in the moment".

4. I am sleeping well.

5. I am enjoying the things I usually do to relax.

Breast Cancer Related Concerns, a 8-item scale. All items were scored on a 5-point scale (not at all, a little bit, somewhat, quite a bit, very much).

1. I was self conscious about the way I dress.

2. I was bothered by swollen or tender arms.

3. I worried about the risk of cancer in other family members.

4. I was able to feel like a woman (reversed).

5. I worry about the effect of stress on my health.

6. I was short of breath.

7. My change in weight bothered me.

8. I feel sexually attractive.

Social Support, a 6-item scale. All items were scored on a 5-point scale (not at all, a little bit, somewhat, quite a bit, very much).

1. There are people I could count on for emotional support.

2. There were people I could count on when I needed help doing something.

3. There are people who will help me evaluate (or understand) things I am finding out about my illness.

4. There are people who can help me find out the answers to my questions.

5. There are people who will fill in for me if I am unable to do something.

6. I am pretty much all alone.

Health Information Competence Scale, a 2-item scale. All items were scored on a 5-point scale (disagree very much, disagree, neither agree or disagree, agree, agree very much).

1. I can figure out how and where to get the information I need.

2. I feel that I am in control over how and what I learn about my health.

Table 1

Sample characteristics

	N = 294
Age	
Mean (SD)	51.29 (11.45)
Race	
Caucasian	197 (68.2%)
African American	92 (31.8%)
Education	
Some junior high	2 (0.7%)
Some high school	27 (9.3%)
High school degree	66 (22.7%)
Some college	77 (26.5%)
Associate or technical degree	40 (13.7%)
Bachelor's degree	48 (16.5%)
Graduate degree	31 (10.7%)
Stage of cancer	
Early (stage 0,1,2)	222 (75.5%)
Late (stage 3,4 or inflammatory)	72 (24.5%)

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Table 2

Descriptive statistics of CHESS service use measures (four-month period)

CHESS services	M	Mdn	SD	Min.	Max.
Information service					
# of days	4.7	3.0	5.2	0	35.0
Interactive service					
# of days	4.7	3.0	4.8	0	27.0
Discussion group					
# of days	15.2	5.0	23.1	0	108.0
Ask an Expert					
# of days	3.2	1.0	5.4	0	38.0

Table 3

Correlations between information seeking factors and CHESS service use[a]

CHESS services	Days used			
	Information	*Interactive*	*Discussion Group*	*Ask an Expert*
Demographic factors (3)				
Age	.01	−.01	−.20**	.00
Education	−.08	−.20**	.08	−.21**
Race (Caucasian=1)	−.02	−.07	.20**	−.03
(Controlling for demographic factors)				
Disease-related factors (5)				
Stage of Cancer (late = 1)	.00	.17*	.20**	.10
Mastectomy after join CHESS (yes = 1)	.02	−.16*	−.08	−.12
Lumpectomy after join CHESS (yes = 1)	.06	−.05	−.02	−.04
Chemo after join CHESS (yes = 1)	.18*	.04	.11	.02
Radiation after join CHESS (yes = 1)	−.11	−.12	−.06	−.18*
Psychosocial factors (5)				
Information competence	−.07	−.18**	−.07	−.15*
Social support	−.01	−.19**	−.12	−.11
Functional well-being	−.02	−.17**	−.14*	−.12
Breast cancer-related concerns	−.01	.14*	.10	.06
Emotional well-being	−.06	−.14*	−.16*	−.07

Note:

[a]CHESS use statistics were log-transformed due to the positive skewness of the distribution.

**
$p < .01$,

*
$p < .05$; $N = 121 – 239$.