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Linda Fleisher^a, Venk Kandadai^a, Eileen Keenan^a, Suzanne M. Miller^a, Karthik Devarajan^a, Karen J. Ruth^a, Michele Rodoletz^b, Eric J. Bieber^c & David S. Weinberg^a

^a Fox Chase Cancer Center, Cheltenham, Pennsylvania, USA

^b HealthForumOnline, Philadelphia, Pennsylvania, USA

^c Geisinger Health System, Danville, Pennsylvania, USA

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Build It, and Will They Come? Unexpected Findings From a Study on a Web-Based Intervention to Improve Colorectal Cancer Screening

LINDA FLEISHER, VENK KANDADAI,
EILEEN KEENAN, SUZANNE M. MILLER,
KARTHIK DEVARAJAN, AND KAREN J. RUTH

Fox Chase Cancer Center, Cheltenham, Pennsylvania, USA

MICHELE RODOLETZ

HealthForumOnline, Philadelphia, Pennsylvania, USA

ERIC J. BIEBER

Geisinger Health System, Danville, Pennsylvania, USA

DAVID S. WEINBERG

Fox Chase Cancer Center, Cheltenham, Pennsylvania, USA

Given the extensive use of the Internet for health information, Web-based health promotion interventions are widely perceived as an effective communication channel. The authors conducted this study to determine use of a Web-based intervention intended to improve colorectal cancer screening in a population of women who are at average risk and noncompliant to current screening recommendations. The study was a randomized controlled trial designed to compare the effectiveness of colorectal cancer screening educational materials delivered using the Internet versus a printed format. In 3 years, 391 women seen for routine obstetrics/gynecology follow-up at 2 academic centers provided relevant survey information. Of these, 130 were randomized to the Web intervention. Participants received voluntary access to a password-protected, study-specific Web site that provided information about colorectal cancer and colorectal cancer screening options. The main outcome measures were self-reported and actual Web site use. Only 24.6% of women logged onto the Web site. Age was the only variable that differentiated users from nonusers ($p = .03$). In contrast, 16% of participants self-reported Web use. There was significant discordance between the veracity of actual and self-reported use ($p = .004$). Among true users, most (81%) logged on once only. These findings raise questions about how to increase use of important health communication interventions.

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Address correspondence to Linda Fleisher, Fox Chase Cancer Center, 510 Township Line Road, Cheltenham, PA 19012, USA. E-mail: linda.fleisher@fcc.edu

Worldwide Internet usage is growing rapidly, increasing by 300% since 2008 (<http://www.internetworldstats.com/stats.htm>). In the United States, 3 of 4 adults report using the Internet, with more than half logging on to seek health information (Fox & Jones, 2009; Fox & Rainie, 2002; Hesse et al., 2005; Murray et al., 2003; Risk & Dzenowagis, 2001; Ybarra & Suman, 2006). The most current data from the Pew Internet and American Life Project suggest that 61% of adults look online for health information. The Internet is the third most cited source of information or assistance for dealing with a health or medical issue (Fox & Jones). These trends are not consistent for all adults. For example, a recent study suggests that nearly 70% of adults between 50 and 64 years of age go online, whereas about 38% of adults 65 years of age and older go online, a significantly lower adoption rate than the general population (Rainie, 2010). A descriptive study examining computer use among elderly populations (65 years of age and older) revealed that frustration, physical and mental limitations, mistrust, and time issues were barriers to use (Gatto & Tak, 2008). Given this expansive, growing use of the Internet among the general adult population, a host of health-related commercial and research Web sites have been developed (Impicciatore, Pandolfini, Casella, & Bonati, 1997). Research has shown that the Internet may empower patients to improve their health behaviors and to take a more active role in their health care (Bass et al., 2006). Web-based educational interventions may represent an important way to educate relevant populations about critical health issues and to spur the uptake of recommended disease prevention behaviors. Target populations include not only those with an elevated risk for a specific disease, but those at average risk where prevention or early detection is of known value.

Because of the potential effect, a vast amount of research dollars are invested in the development of a portfolio of Web-based interventions addressing a broad array of health issues. A 2009 search of the federal database of funded biomedical research projects (e.g., National Institutes of Health and multiple other federal agencies) provided more than 2,000 studies involving the Internet and the Web for health promotion and/or health behavior change. More than 100 of these projects are in the cancer domain. Although these research efforts focus on the effectiveness of interventions in controlled settings, few report the actual uptake or use of the interventions, despite the availability of tracking software to validate actual usage (Evers, 2006). The issue of engagement, not only from the perspective of the health communication messages and approach, but from the initial step of taking action to open or access the Web-based intervention, is critical to the ultimate test of effectiveness.

For the study reported here, we conducted a randomized, controlled, prospective trial comparing the effect of a Web versus a printed letter intervention on colorectal cancer (CRC) screening adherence among women who have not completed colorectal screening in accordance to screening guidelines. Both interventional arms contained identical educational content; however, the delivery channel and format differed; for example, the Web version is purposefully more visually appealing and media rich. We hypothesized that the Web intervention would, compared with print or control, represent a preferred communication channel and that participants exposed to that intervention would demonstrate greater uptake of CRC screening.

Our preliminary findings reported here highlight an emerging, and unanticipated issue in Web-based health promotion interventions; namely, the underuse of these interventions in “real world” settings. When this project was in development, we implicitly assumed, as did consultants and reviewers, that study participants would embrace the use of the Web intervention as an easily accessible, highly engaging

communication channel. However, results to date indicate surprisingly modest use of the Web intervention, raising important questions about the use, effectiveness and effect of this type of health communication tool. A review of the current literature provides little insight, as actual Web usage by study participants is often not reported, especially when Web use occurs outside a directly observed research environment or in more natural settings. While unexpected, these findings regarding Web usage patterns are important to more fully understand, as they could inform planning and implementation of Web-based health interventions and encourage ongoing dialogue among health communication researchers regarding research methodology.

Method

Overview

This NCI funded study, conducted by Fox Chase Cancer Center, was designed to test the effect of a print versus Web-based intervention to improve CRC screening among women seeking care through obstetrics/gynecology practices. Eligible women who consented to the study were randomized to either the control or one of the two intervention arms. We conducted baseline and follow-up interviews with all study participants. A secondary goal of the study was to determine the usage of each of the interventions, through Web-tracking software and self-report.

Eligibility

Study participants for this institutional review board–approved trial were drawn from obstetrics/gynecology practices at Geisinger Health System and Emory University. Both institutions have sophisticated electronic medical record systems that integrate clinical scheduling with searchable clinical data repository capabilities. Using electronic screens reflecting the study’s eligibility requirements, we searched both electronic medical record systems for routine appointments 4–6 weeks in advance. Eligibility criteria included (a) being female; (b) being 50 years of age or older; (c) being at average risk for CRC defined as no personal history of colorectal polyps, CRC, inflammatory bowel disease, or CRC in more than one first-degree relative; (d) being nonadherent with standard CRC screening recommendations at the time of index appointment (to be deemed nonadherent meant that all of the following were true: no at-home fecal occult blood testing in the last 12 months, and no barium enema, flexible sigmoidoscopy, or colonoscopy in the past 5 years); and (e) having reported Internet access at home and/or work.

Participant Randomization

We contacted potentially eligible women initially by telephone. Upon contact, we confirmed eligibility and obtained verbal consent. All participants completed a baseline survey that included demographic and medical history information as well as data from several accepted psychometric scales (Radloff, 1977), anxiety (Spielberger, 1983), and information-seeking preferences (Miller, 1987). Participants were also queried about their knowledge and expectations regarding CRC and CRC screening as well as their beliefs about the risk of developing CRC and intention to participate

in CRC screening (Prochaska, 1986; Prochaska & DiClemente, 1992; Prochaska & Velicer, 1997; Rakowski, 1999; Rakowski, Clark, & Ehrich, 1999).

After we collected baseline data, participants were randomized 1:1:1 to the usual care (control) arm or one of the two interventional arms (Web and print). The Web and print interventions were identical with regard to health-related informational content. Each contained essential information about CRC screening (i.e., rationale, description of recommended screening regimens and associated benefits/risks, sources of additional CRC-related information). Message construction was based on information gleaned from our survey of average risk women (Weinberg, Turner, Wang, Myers, & Miller, 2004). Control participants completed the same baseline and follow-up telephone surveys (4 months and 12 months) as did other participants; however, no additional CRC-related information was provided.

Web-Based Intervention

The development of the Web-based intervention included a systematic approach to pretesting of messages, layout, and usability testing as recommended by the National Cancer Institute's Making Health Communications Work and usability.gov, one of the National Cancer Institute's Web site that includes human factors approaches and usability guidelines. Pretesting was performed on approximately 50 women who fit eligibility criteria but were not included in the study. On the basis of our usability testing, we anticipated that participants could review the information on the site in about five minutes. In addition to educational material developed by the research team, hot links were provided for several carefully reviewed external Web sites devoted to CRC and CRC screening maintained by the American Cancer Society, National Cancer Institute, the Centers for Disease Control, the *Journal of the American Medical Association's* Patient Page, MedlinePlus, and the Colon Cancer Alliance. The Web site content was refined on the basis of this formative research before study initiation to assure usability, medical accuracy, and literacy level (seventh- to eighth-grade reading level as per established guidelines for health communications).

As part of the initial recruitment, participants randomized to the Web intervention were assisted over the telephone in developing a username and password at the completion of the baseline survey. Each received the study site URL and log-in instructions for the secure, private section of the Fox Chase extranet Web portal system. With their unique username and password, these participants could privately view the portal site as often and for as long as they wished. Of note, a follow-up letter was mailed to these participants by standard post within 3 business days following the phone call. This letter contained the Web site use information and their username and password for later reference. Access to the Web intervention was available from any computer with Internet access.

Follow-Up Telephone Survey

Per study design, up to 15 attempts were made to contact participants by telephone 4–5 months after their index appointment. In addition to providing psychometric information similar to the baseline survey, participants were also asked about their receipt and use of any study materials, including Web site use. Participants were asked first whether they recalled receiving study-related information about Web

access to CRC screening materials. Next, they were asked whether they logged onto the study Web site. They were also queried about their perception of, and satisfaction with, the CRC screening information they received. For comparison, participants in the print intervention were also asked about their use of study materials at the 4 month telephone survey.

Web-Based Intervention Assessment

In addition to self-reported use, participant use of the Web-based intervention was electronically tracked to determine whether the intervention was accessed by the study participant and, if so, how often and how much time was spent viewing the information.

Web site usage statistics and hyperlink tracking were accomplished with the NetTracker Professional software package. This package captures and stores longitudinal usage data at the level of the individual user. It is important to note that the package functions as a server-only solution that does not rely on client licenses or hidden javascript downloads to the participant's Web browser. This capacity ensures accurate data collection by avoiding browser and user specific issues that might result from the use of differing Web browsers, browser versions, and browser-computer or network security parameter settings.

Each time a participant clicked on a link within the Web site, a request was sent to the server. The server processed the request and recorded in a database the following information: the unique participant username, the page requested, current date and time of the request, and the amount of time passed since they last clicked a link. From this information, we determined which pages the participant viewed and how frequently and approximately how long they spent on each page. This security information also allowed us to monitor the number of times an individual logged in, the amount of time spent on the site, and the number and frequency of embedded hyperlinks to other CRC information sites used.

Statistical Methods

Participants randomized to the Web intervention arm who had completed their 4-month telephone survey were the primary focus of analysis. Self-reported Web use was determined from responses to questions on the 4-month telephone survey. Actual Web use for each participant, including Web pages visited and time spent on each page, was tracked as described earlier. If a participant had visited the Web site for any length of time, she was classified as a Web user.

The strength of the agreement between self-reported Web use and actual Web use was assessed with Kendall's tau-b, a nonparametric correlation statistic with values between -1 and $+1$. We tested the discordance between self-report and actual Web use using McNemar's test. To identify predictors of three endpoints, actual Web use, self-reported Web use, and accuracy in reporting Web use, we selected numerous variables from the baseline questionnaires. The potential predictors included demographics, information-seeking preferences (Monitor-Blunter-Style-Scale [MBSS]), risk-related knowledge, expectancies/beliefs, and stage of change. We used a significance level of .05 to determine predictors of these endpoints. We assessed differences using nonparametric tests including the Wilcoxon rank sum test

for continuous variables and Fisher's exact test for categorical variables. We conducted all analyses using SAS statistical software (Version 9.1).

Results

From June 2006 to August 2009, 740 women were enrolled in the overall study. Of this group, 391 had completed a 4-month follow-up survey. The randomization process assigned 170 of these women to the Web arm. As a result of a technical error, 35 of these women were not granted immediate access to the study Web site; therefore, they were not included in these analyses.

Of the 135 women able to log onto the Web intervention at will, 5 provided non-interpretable answers to items on the 4-month telephone survey and were excluded from analysis (e.g., Question: "Did you receive information about how to obtain CRC screening information on the Web?" Response: "No"; follow-up question:

Table 1. Demographics of Web use arm participants ($N=130$)

Variable	<i>n</i>	%
Race		
White	126	96.9
Non-White	3	2.3
Missing	1	0.8
Age (years)		
50–59	95	73.1
60–69	23	17.7
70–79	9	6.9
80–94	3	2.3
Education		
High school or less	44	33.9
Some college or vocational studies	29	22.3
College graduate	57	43.8
Employment		
Part time	21	16.2
Disabled or retired	33	25.4
Full time	67	51.5
Student or unemployed	9	6.9
Marital status		
Married or cohabitating	96	73.9
Single, divorced, or widowed	33	25.4
Missing	1	0.7
Income		
≤\$30,000	17	13.1
\$30,000–\$60,000	31	23.8
>\$60,000	37	28.5
Did not answer	41	31.5
Missing	4	3.1

“Did you go to/use the Web site listed in the information you received?” Response: “Yes”).

All subsequent results pertain to the remaining 130 women. The majority were White and between the ages of 50 and 59 years, consistent with the predominance of participants from the rural Pennsylvania site (Table 1). Approximately 65% ($n=86$) had at least some college education and nearly 75% ($n=96$) were married. Nearly 70% ($n=88$) had part- or full-time employment. Of those willing to provide a report of income, 13% ($n=17$) described an annual income of less or equal to \$30,000, 24% ($n=31$) between \$30,000 and \$60,000 and 29% ($n=37$) more than \$60,000. Nearly one third of participants declined to report their income.

Tracked Web Use

Of participants randomized to the Web-based intervention ($n=130$), 32 (24.6%) actually logged onto the Web site on the basis of tracking data. For these 32 participants, the majority logged on only once ($n=26$). The amount of time spent on the site ranged from less than 1 minute to 22 minutes, with a median of 5 minutes. There were seven pages (one introductory page and six pages with CRC content) in the site, and the range of total requested pages (the total number of pages the participant visited, counting multiple visits per page if opened more than once) was 1–18 pages, with a median of 6 pages. The most frequented pages were “Who Should Get Screened?”, “Screening Methods,” and “What Can You Do?” The final page of the site has a list of recommended Web sites for additional information on colon cancer screening. Twenty-eight percent ($n=9$) visited an external site. The two most frequently recorded sites were the National Cancer Institute’s page on CRC screening ($n=5$) and the cancer.org page “Can colon and rectum cancer be prevented?” ($n=4$). A few participants linked to the *Journal of the American Medical Association*’s Web site and the CDC fact sheets. One participant linked out to the Medline-Plus site; no one linked to the Colon Cancer Alliance site. The time between consent to participate in the study and the first visit to the site ranged from 0 to 154 days, with a mean of 20 days. Of those who used the site, 25% went on the same day as the telephone consent.

Self-Reported Web Use

We found discrepancies in self-report and actual usage in both directions. As shown in Table 2, the discordance between self-reported and actual Web site use

Table 2. Actual Web use and self-reported use

	No Web used		Web used		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Self-reported no Web use	92	94	22	69	114	88
Self-reported Web use	6	6	10	31	16	12
Total	98	100	32	100	130	100

Note. $p=.004$.

was significant ($p = .004$), with those who used the Web less likely to self-report usage. In addition, 6% of those who did not use the Web reported they did on the follow-up interview.

Predictors of Web Use

We examined differences among those who did and did not use the Web site. The only significant demographic differences among those who used the Web site and those who did not was age, with users between the age of 50 and 59 years more likely to use the Web than those 60 years of age and older ($p = .03$). We did not find any significant relations between information-seeking preference scores, CRC knowledge, perceived CRC risk, intention to participate in CRC screening, attitudes about CRC screening nor perceptions about screening and disease-related anxiety with actual or self-reported Web use. In an effort to identify predictors of accurate Web use reporting, the study population was divided into three groups: (a) actual Web users, (b) those with a mismatch of self-reported Web use and actual use, and (c) those whose self-report was consistent with actual use. There were no significant demographic factors that discriminated between these three groups including education or income.

Self-Reported Use of Print Materials

For comparison purposes, we asked women randomized to the print intervention arm ($n = 171$) whether they had read the intervention materials. Approximately 25% reported that they did not look at the materials, whereas 42% said that they looked at it once, and more than 30% stated they reviewed the material at least twice.

Discussion

Despite the common perception that health-related Internet use is broad and increasing, only 1 in 4 women logged onto the Web site in this research study. Although this was not a controlled setting wherein all participants are automatically logged into the intervention, this is a significantly low uptake rate. In addition to the underuse of the site, actual and reported Web use was discordant. Nearly 40% reported using the Web site, but did not. Conversely, 20% of women who reported no Web use in reality logged on. These findings of considerable Web underuse are surprising. They call into question many assumptions about the real-world effect of Web resources for health promotion, especially patient-centered interventions that depend on voluntary use.

Easy access to the highly interactive, multimedia driven Web has created a perception that if we build inviting Web sites the public will come. Although it is reasonable to predict that women historically noncompliant with CRC screening will demonstrate a lower usage rate in a study about CRC screening, these same women fit demographic profiles typically associated with high health prevention use. Among this group of women, nearly 90% indicated that they accessed the Internet and used e-mail and nearly 83% reported spending on average 1 hour per day on the Internet. Even younger participants, although more likely to log on than older women, visited the Web site less than 30% of the time. In addition, although by no means a guarantee of Web use, all participants voluntarily agreed to a research project explicitly

studying the Internet as a means of health promotion. On the basis of some of our preliminary data, it is reasonable to assume that the majority of participants would use the intervention Web site when asked to do so.

There is a growing body of literature to suggest that true Web use is less than perceived. For example, a self-help Web program for panic disorder reported a 99% nonusage rate (Farvolden, Denisoff, Selby, Bagby, & Rudy, 2005) and fewer than 1% of participants completed the 12-week program. Another study using a five-module depression program, *Moodgym*, found that only 97 out of 19,607 (0.5%) participants spontaneously completed all five Web modules. Despite the subsequent introduction of a more proactive, directive approach, only 22.5% completed the modules (Christensen, Griffiths, & Jorm, 2004; Christensen, Griffiths, Korten, Brittliffe, & Groves, 2004). Another study, focused on a physical activity Web site, showed only 76% of those randomized to the Web-based intervention actually visited the site (Leslie, Marshall, Owen, & Bauman, 2005). A recent study (Silvestre, Sue, & Allen, 2009) reported the discrepancy between the number of persons who registered to use a secure health portal and subsequent usage. Fewer than 30% of those who registered accessed the site two or more times in a 6-month period. The authors did find that registration and usage increased over time, especially as new functionality was added to the site.

In contrast to measured use, self-report may misrepresent true use for a variety of reasons including evaluation apprehension, social desirability and cognitive limitations, as well as mere forgetfulness (Gosling, Vazire, Srivastava, & John, 2004). This is highlighted in our findings in which almost 70% of those who used the Web site did not remember using it 4 months later. Descriptions of the effect of various health interventions, delivered through any channel, which require participant-initiated action, should be viewed cautiously. While not a specific goal of this study, it is reasonable to revisit the question of why many patient-oriented interventions, Web, print or other, have had modest or no effect on improving health behaviors. In our study, nearly 75% of women randomized to the print (as opposed to the Web) intervention claimed to have read the study materials at least once. Viewed in the context of the Web tracking data, the veracity of these responses is uncertain. When interventions reported in the literature are found to have less positive effect than desired, it is unclear whether this represents a failure of the intervention content or rather a lack of use of the intervention. Although the number of publications focused on Web-based interventions is growing, few report actual usage data. Tracking as a means of corroborating Internet use is necessary when ultimately trying to design and evaluate how effective a Web tool is for mainstream use. To date, no published systematic reviews use Web-tracking as a criterion to judge methodological quality of Internet interventions relying on self-report. Study designs adequate to investigate these interventions in a variety of settings hinge upon realistic enrollment and follow-up rates.

If collected, tracking data would help to determine the real versus the expected use of these interventions. More needs to be learned about why some individuals are proactive and seek out the information on the Internet, how individuals approach and process Web-based information, how that information subsequently informs behavior, and what individual differences influence these outcomes. Drawbacks exist, however, with overreliance on tracking. For example, a lengthy duration on a particular Web page does not necessarily translate into an individual being actively engaged for that length of time.

Although it is clear that the Internet is a mainstream communication channel, we have much to learn about how it is actually used and by whom. In the realm of disease prevention, including cancer prevention, what are the most effective ways to increase the initial engagement with e-health tools? Typically, at-home Web use is voluntary and unsupervised and health promotion rather than disease treatment and management may be less compelling. Emerging technology provides a fertile ground for growth, but also presents new challenges. More research is needed to explore innovative ways to integrate health messages in other types of venues, such as social networking sites. Interventions may need to be marketed to increase usage, while more reliable navigational cues to direct viewers to higher quality sites are required to maximize positive effect. Our findings and others raise questions about the potential effect of Web-based interventions to improve health behavior when targeted at healthy or at-risk individuals, as opposed to those aimed at populations already affected by a specific disease where they may be more likely to seek information. Innovative marketing strategies may be needed to increase the salience and relevancy of these Web-based interventions to those more recalcitrant individuals. Our findings show that 25% of those who did access the site, did so on the first day they were contacted. Future research could explore the benefit of more proactive approaches, such as telephone reminders or other cues to action, to increase usage among those who do not log on immediately.

Our unexpected findings and similar findings in other emerging research raise questions about research methodology, marketing of interventions, and additional questions for future research (see the Appendix). Although our study was initially designed to answer questions regarding the effectiveness of the Web as a health communication channel, our disappointing findings on use raise new questions about the challenges posed by Web-based interventions. From the perspective of health communication research, investigators have been responding to increased pressure to provide more informed and interactive resources to patients (Kirsch & Lewis, 2004). Funding has significantly increased; in 2008, the National Institutes of Health provided more than 26 million dollars in funding for prevention projects that used the Internet (National Institutes of Health Office of Extramural Research, 2009). It is not clear that when new interventions are built, target audiences will come.

This study has several important limitations. Most important, we assumed that Web use would be widespread. In retrospect, greater attention to understanding barriers at the practical level such as challenges related to unique password use to ensure privacy, or the speed of Web connectivity, modem versus broadband, would have been useful. These and related issues should be considered in future research. In addition, there may be specific barriers related to colorectal screening, particularly in a historically noncompliant group that are not generalizable to other health domains.

Rather than simply continue to develop new technology-based interventions, reallocation of resources towards programs designed to understand how the Internet can best be exploited to improve health may have greater immediate effect. For those currently funded research projects, more data regarding actual use should be reported to fully describe and elucidate this phenomenon. In addition, successful strategies to increase engagement and use should also be reported. For example, we added a reminder letter to encourage those in the Web arm to log into the Web site. Of those who remembered the letter, 46% logged on in comparison with 12% of those who did not remember the letter. As in other industries in which the

initial goal is to market the Web site, these types of strategies may be required, especially for health promotion among less compliant populations. As these Web-based interventions are used in community and practice-based settings, additional efforts will be required to ensure patients log in and take the first step. Personalized letters from their physician and follow-up calls may be necessary (Toobert, Strycker, Glasgow, & Bagdade, 2002). Health promotion and disease prevention interventions have limited effect when left to passive diffusion. Therefore, documented active strategies and their outcomes need to be reported to expand our knowledge and arsenal of approaches to improve the uptake of these new and emerging Web-based interventions in order to reduce future unexpected results.

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Appendix

Questions about Web-Based Intervention Research

Research Methodology

- How is actual usage tracked and reported?
- How many participants actually use the intervention?
- Since self-report of usage may be unreliable, is it a sufficient measure in Web-based interventions?
- What is the expected nonusage to inform study design and sample size?
- How does nonusage vary in populations and interest in health topic or issue?
- Should all studies use tracking software and report both actual and self-reported usage?

Web-Based Interventions

- Are those people less likely to participate in prevention behaviors also less likely to be engaged by e-health tools?
- What kinds of innovative approaches are needed to integrate health education and motivational messages into other uses of online information?
- Are Web sites an appropriate way of reaching people for prevention and screening, including those who are noncompliant?

Research Questions

- Does the Web only reach people already in the “action stage” of taking health protection steps, similar to past experience with “health fairs”?
- What research is needed to determine innovative ways to encourage and increase usage among print and Web-based interventions, especially those that address more difficult health behaviors or are self-navigated?
- How do we consistently track usage of online interventions and reporting those data to generate new approaches and research questions?
- Are limited usage and overreporting common problems across other online research interventions?