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Literature Review about Prevention Content Literature

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Introduction

The Office of Disease Prevention and Health Promotion (ODPHP), located in the Office of Public Health and Science at the U.S. Department of Health and Human Services (HHS), was established by Congress to provide a central focus for stimulating and coordinating Federal activities in prevention. This focus includes developing and disseminating prevention information to the public. Recent advances in information and communication technologies provide new opportunities for ODPHP to more effectively reach its intended consumer audiences with key information, interactive tools and recommendations about prevention.

ODPHP's new opportunities occur against a backdrop of increasingly urgent interest in finding effective ways to communicate health information to America's diverse population. *Healthy People 2010* established the elimination of health disparities as a major goal for the nation. In 2002, the Institute of Medicine (IOM) published *Speaking of Health: Assessing Health Communication Strategies for Diverse Populations*, a report that stimulated interest in how best to reach harness communication theory and technologies to reduce health disparities. In 2004, a report from the Agency for Healthcare Research and Quality (AHRQ) entitled *Literacy and Health Outcomes*, coupled with a new IOM report, *Health Literacy: A Prescription to End Confusion,* focused public attention on the role of health literacy in influencing health disparities. *Healthy People 2010* and the IOM define health literacy as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" (IOM, 2004). As a federal government agency, ODPHP strives to be responsive to the needs of America's diverse audiences while simultaneously serving all Americans across a range of channels, from print through new communication technologies.

The purpose of this literature review is to provide a foundation for ODPHP's efforts by assessing the current state of knowledge about the prevention information and communication needs of diverse audiences, as well as the most effective formats, channels, messages, interactive tools and materials for prevention information and communication. ODPHP is particularly interested in identifying communication methods to reach low-literacy audiences as well as to enhance health literacy across the general population. The review limited itself to eight prevention topics identified by ODPHP: healthy eating, physical activity, obesity and overweight, immunization, tobacco, preventive screenings, substance abuse and injury prevention. Identification of gaps in the research literature will guide the design of new audience research, as well as development of a prototype for a new evidence-based strategy for prevention communication.

The review of the literature was guided by four key questions:

- Which audience characteristics are the strongest determinants of homogeneity in terms of needs and abilities for seeking, using, and processing prevention information?
- In what ways and to what extent is currently available prevention information responsive to these patterns?
- Is prevention information that is targeted in content, design, and delivery to different audience segments based on these characteristics better received and more likely to lead to preventive decisions and actions than information that is not targeted on these characteristics?

- How can prevention information be effectively presented online?

To answer these questions, this document is organized into five major sections, following a description of the methodology. Four of these sections address the four questions listed above; the final section contains a set of conclusions and recommendations to ODPHP.

Methods

A comprehensive review of the research literature was conducted to identify relevant literature published within the past five years. The parameters of the review included:

- Research articles that appear in Federal publications, peer-reviewed academic journals, research reports, dissertations and symposia;
- Articles written within the last five years (with the exception of tobacco, where the search extended for ten years);
- Studies conducted on American populations, and
- Research conducted on the topic areas of concern to ODPHP, including audience segmentation, audience knowledge and interest in prevention topics, audience capacity to understand and apply health risk information, audience experience with Internet-seeking behavior, and others.

Databases used to assist in the identification of articles to be reviewed included: PsychINFO, PsychArticles, CINAHL, Communication and Mass Media Index, Communication Abstracts, Health and Pyschosocial Instruments, Medline, PubMed, Social Sciences Abstracts, Social Sciences Citation Index, Sociological Abstracts, ACM Digital Library, ArticleFirst, Dissertaton Abstracts, Education Full Text, ElsevierScienceDirect, ERIC, HCI Bibliography from SIGCHI, and Principia Cybernetica Web. Additional online databases that were consulted included www.scirus.com, www.sciencedirect.com, www.bmj.com, www.bmn.com, and www.ama-assn.org. Two web sites were consulted for articles on collaborative filtering: the bibliography on collaborative filtering, http://jamesthornton.com/cf/ and the University of California at Berkeley School of Informatio Management & Systems bibliography, http://www.sims.berkeley.edu/resources/collab. Experts and colleagues in the field also identified additional materials, as did reference lists from selected articles.

Appendix 1 contains a complete list of the search terms used to identify articles for this review.

Question 1: Homogeneity in Audience Characteristics

When seeking to develop effective communication to meet the needs of America's diverse population, *Speaking of Health* identified three broad diversity-respecting communication strategies that have emerged from the literature:

- The construction of a unified communication program with a common denominator message that will be relevant across most populations.
- The construction of a unified communication program with systematic variations of message executions to make them appeal to different segments, while retaining the same fundamental message strategy.
- The development of distinct message strategies and/or distinct interventions for each target segment.[1]

ODPHP's primary mechanism for providing health prevention information to the public is currently www.healthfinder.gov, a portal to governmental and other credible health-related web sites. healthfinder® currently supports audience segmentation with its "just for you" sections that allow users to select a single factor, such as gender, age, or race/ethnicity, to receive more targeted information. The first research question--Which audience characteristics are the strongest determinants of homogeneity in terms of needs and abilities for seeking, using, and processing prevention information?—seeks to establish if there is an evidence base that supports a more refined audience segmentation strategy based on information-seeking or other psychographic variables that would be more effective than demographics alone in delivering targeted health prevention information.

Mass Media Use Patterns and Health Information

In the United States, health information is delivered through a variety of mass media channels. The public's interest in health issues has increased over the last two decades and the media industry has responded with health-related media content (Atkin and Wallack, 1990). Television and radio channels both air public service announcements aimed at changing health behavior. Television also serves as the country's "storyteller" and broadcasts different programs relating to health, doctors, and patients, as well as news programs dedicated to medical dramas (Atkin and Wallack, 1990). Magazines feature health topics such as cancer, obesity, and mad cow disease and one-quarter of articles in daily newspapers cover health topics (Atkin and Wallack, 1990). Thousands of Internet websites offer resources and support group information for virtually every known ailment. People vary in their use of the mass media and hence the kinds of health information to which they may be exposed. Appendix 2 summarizes differences in media use by age and ethnicity.

Gender, education, income and age are all factors that influence how much attention people pay to health information presented on the media. According to preliminary results from the Health Information National Trends Survey (HINTS) (Hesse, 2003):

[1] Institute of Medicine (2002). *Speaking of Health: Assessing Health Communication Strategies for Diverse Populations*, Washington DC, page 6.

- Women are more likely than men to pay attention to health topics across all media;
- The more affluent are more likely to report paying attention to health topics for all media, except television where interest is about equal across all income groups;
- Education influences the degree to which people pay attention to health topics on all media, except television where interest is about equal. The discrepancy is greatest for attention to health information on the Internet, with college-educated respondents reporting much higher interest than those without a high school diploma;
- Age influences how much attention people pay to health topics by media. Adults 35 to 64 report the highest levels of interest across media; older adults report an equal level of interest in health topics in the newspaper as other adults, while reporting a considerably lower amount of attention (nearing "not at all") paid to health topics on the Internet.

Within these comparisons, the amount of attention paid to health in the media generally fell in the range of "a little" attention to "some" attention. Among those with no high school diploma, attention paid to health issues fell between "a little" and "not at all."

Race and ethnicity also influence what topics are of most concern to those paying attention to health information. African Americans are more likely to identify alcoholism, drug addiction, and HIV/AIDS as the most pressing health concern whereas Whites list cancer, alcoholism and drug addiction, and unplanned teenage pregnancies (Brodie et al., 1999). These patterns tend to correlate to the self-identified and perceived health problems afflicting the different cultural communities.

Health Information-Seeking

Information management consists of communicative and cognitive activities—such as seeking, avoiding, providing, appraising, and interpreting stimuli from the environment—that contribute to a person's knowledge or beliefs (Brashers, Goldsmith, & Hsieh, 2002). The study of health information management focuses mainly on information seeking, but recent research finds that information avoiding is also part of the process. People who believe they are at risk for a disease, or are already ill, may avoid information when it is distressing or when it conflicts with established beliefs that give them comfort. They may avoid diagnostic information and information about common warning signs (such as warning signs for cancer or heart disease) that would help them understand and interpret their symptoms. And, they may avoid health risk awareness messages to avoid anxiety, especially if they feel healthy and have no signs or symptoms of illness. The research on health information avoiding has documented a variety of circumstances like this, where people avoid information because they prefer not to know (see Brashers, Goldsmith, & Hsieh, 2002, for a review of this literature). In cases where people avoid health information, mediated sources of information may be more successful than face-to-face communication because they are convenient to use, have asynchronous capabilities, and enable people to develop social networks while maintaining a certain amount of anonymity and control (Street, Gold, & Manning, 1997).

According to an analysis of the Healthstyles syndicated marketing research database by Porter & Novelli (Powerpoint presentation, undated), the consumer audience can be segmented into five health information types, based on two broad sets of characteristics—degree of reliance on physicians for health information and level of activity in seeking out such information (Porter & Novelli, personal communication, 2004):

- The Uninvolved (14%): Younger consumers likely to describe their health as good or fair who value health less than others, expend less energy on prevention and exhibit low interest in health information.
- Doctor Dependent Passives (20%): Consumers of lower socio-economic status (SES) who describe their health as excellent or very good, hold lower values for health and prevention, and express low interest in health information.
- Moderates (28%): Middle aged, generally healthy adults with above average household income who value good health and actively try to prevent disease; most value health information, but don't enjoy searching for it and some may lack skills to do so.
- Doctor Dependent Actives (20%): Older, low SES adults, many of them African-American, who value health and prevention but experience more health problems; they are actively seeking health information and capable of finding it, but may have difficulty interpreting it.
- Independent Actives (19%): Affluent women in very good health who highly value health and prevention and place the highest importance on health information; they are very skilled at finding and understanding health information.

This audience segmentation approach is highly predictive of adults' use of multiple sources of health information when making health-related decisions. However, although almost four out of ten adults (Doctor Dependent Actives and Independent Actives) in this analysis are actively seeking health information, their use of the Internet to obtain this information differs sharply[2]. Half of Independents use the Web to find health information, compared to only 20% of the Doctor Dependent Active). Moderates (44%) and the Uninvolved (37%) are more likely than Doctor Dependent Actives to use the Internet to search for health information, despite their lower overall interest in health information.

Online Health-Information Seekers

Demographics

The number of Americans who use the Internet continues to grow with approximately 54% of the U.S. population (143 million) using the Internet in 2001 and about 66% using a computer (NTIA, 2002). Almost two-thirds (63%) of the U.S. adult population uses the Internet; usage is higher among youth, with more than three-quarters of those between 12 and 17 online.

A review of the use of computers and the Internet using two reports – "A Nation Online: How Americans Are Expanding Their Use of the Internet" and "Falling Through the Net: Defining the Digital Divide" shows that Internet usage is increasing for all segments of the population. For example, increases in computer and Internet usage are seen across income and education levels, gender, age, and race (NTIA, 2002). However, despite the increases substantial disparities continue to exist in the areas of income, education, age, and race.

[2] Because the source of this information is undated, it is not clear how current the following estimates of online health-seeking are.

- ***By income*** – individuals in high-income households are more likely to use the Internet than individuals in low-income households. Approximately 79% of families with an income of $75,000 or above use the Internet compared to 33% of families with an income of $15,000-$24,999.
- ***By education*** – education has an independent effect from income on computer and Internet usage rates: the higher the level of education the more likely an individual is to use a computer or the Internet. For example, 81% of individuals with a bachelor's degree use the Internet compared to 40% with a high school diploma or equivalent.
- ***By age*** – a cohort effect is seen when looking at computer and Internet use: children and teenagers are the most likely computer users (70%) while adults over the age of 55 are the least likely users (37%).
- ***By race/ethnicity*** – Internet use differs: Whites and Asian Americans (60%) use the Internet far greater than African Americans (40%) and Hispanics (32%).
- ***By geographic location*** – residence does not impact Internet use in that both rural and urban individuals using the Internet at similar rates. However, race and ethnicity impact Internet use when stratified by geographic residence. For example, only 24% of rural Blacks use the Internet compared to 51% of rural whites.
- ***By gender*** – males and females use computers and the Internet at similar rates.

Age is a major predictor of Internet use with more children and adolescents using the Internet than any other age group (NTIA, 2002). The American Cancer Society found that adolescents want "personalization and respect" and "activities, color, movement, sights and sounds" on web sites. Adolescents prefer to be led as opposed to conducting their own search (Neray, 1997).

As a group, online seniors are predominately white, highly-educated, and living in households with higher incomes. However, this pattern is changing as more seniors with moderate incomes and those whose education ended with a high school diploma are coming online at rapid rates (Fox, 2004).

Once online, wired seniors are as likely as younger users to go online on a typical day and to use the Internet for activities such as email and using a search engine to answer specific questions. Wired seniors are among the least likely of groups to download music, video or game files, but they are among the most likely to play a game online. However this age group is the most likely to seek online information compared to other age groups (NTIA, 2002)

The rates for Internet use are similar with men slightly more likely to use the Internet than women (NTIA, 2002; Madden and Rainie, 2003). However, women are more likely than men to seek health information on the Internet, 40% compared to 30% for men (NTIA, 2002).

Appendix 3 summarizes patterns of online use by age and ethnicity.

The number of "health seekers"—Internet users who search online for information on health topics, whether they are acting as consumers, caregivers, or e-patients—continues to increase as more and more Americans become veteran Internet users. The longer that someone is online, the more likely he or she is to do more things online, to feel confident about their ability to find valuable information on the Web, and to report using that information to make decisions in their lives. The primary Internet

activity is email (84% of users), product or information searches (67%) and news, weather, or sports (62%) (NTIA, 2002).

Internet search rates pertaining to health services or practices information vary greatly depending on the study and source of data. Estimates of persons using the Internet for health information include 35% (NTIA, 2002); 40% (Baker et al., 2003); 60% (Pew, 2002); and 80% (Madden and Rainie, 2003). A plausible explanation for the range of estimates is the sampling methodology and response rates (Baker et al., 2003). In the studies reporting higher Internet use, online recruitment and low response rates for corresponding telephone surveys may potentially bias findings. These discrepancies in Internet use for health information point to the need for longitudinal data collection and surveillance using standardized tools.

Although disease information is the single most popular topic of interest, some prevention topics, including diet and nutrition, exercise, mental health, sexual health, substance abuse and smoking cessation, are also popular.

Consumers appear to trust personal doctors, medical universities, and the federal government when it comes to the source of online information (Dutta-Berman, 2003). Furthermore, this study found that unhealthy consumers relied more on information presented by hospitals and insurance companies (Dutta-Berman, 2003). This research suggests that a segmented approach to providing health information via the Internet may work better than a blanketed approach and such options should be further explored.

Online health seekers tend to be more health conscious and engage in more healthy activities than non-seekers, according to a recent study (Dutta-Berman, 2004). This research suggests that underlying motivation is the strongest predictor of people using media, including the Internet, to search for information. However, when groups, such as patients seek health information on the Internet, illness severity is one indicator that has been shown to impact Internet use (BCG, 2003). Those patients with more severe conditions, frequent doctor visits, and greater number of prescription drugs use the Internet more than other patients (BCG, 2003).

In one study of online health information-seeking, women (85%) are more likely than men (75%) to have searched for at least one of 16 health topics (Fox & Fallows, 2003). The same disparities in the overall patterns of online use are also reflected in online health information-seeking:

- Seniors (70%) are less likely than younger Internet users (80%) to be health seekers;
- Better educated and higher-income Internet users are more likely to be health seekers than those with low incomes and low education;
- Veteran users (2-3 years experience) are more likely than newcomers to be health seekers (77% compared to 59%).

Although Whites (82%) are more likely than African Americans (76%) or English-speaking Hispanics (75%) to be health seekers, those differences diminish when other demographic factors are held constant. Those with high education levels are more likely than the less educated to be health seekers; race and ethnicity does not predict online health-seeking behavior (Fox & Fallows, 2003). This finding is confirmed in a study from the Center for Studying Health System Change (Tu and Hargraves, March 2003).

There have been few empirical studies about how racial/ethnic populations and low literacy groups have used the Internet for health information. Fogel (2003) reviewed the research literature published between 1966 and 2003 about how these populations used the Internet for cancer information. He found only eight articles. African Americans and Hispanics were most frequently the largest study population in these articles; two addressed American Indians and one studied Asian Americans.
A study by Tu and Hargraves (March 2003) indicates that level of education is the most important predictor of whether people will be health information seekers: 55% of people with postgraduate education in a national survey said they sought health information, compared with only 25% of those without a high school diploma. The information gap is even greater for Internet use: People with a postgraduate education are more than seven times as likely as those without a high school diplomas to use the Internet as a resource for health information (29% vs. 4%).

Various researchers have attempted to categorize the online health-seeking audience. For example, the Pew study (Fox & Fallows, 2003) identified three particular groups of health seekers:

Those searching on behalf of someone else: Over half (57%) of health seekers said they were looking for someone else when they conducted their most recent health information search. Parents (65% vs. 50%), women (62% vs 50%), healthy people (59% vs. 32%), and those between 30 and 49 (62% compared to 38% age 65 and older) were most likely to be included in this group. Health and health care is often a highly social activity, and a single search is likely to benefit more people than just the individual conducting it.

Those with a disability or chronic illness: The Pew study included 15% of respondents with a disability, handicap or chronic disease that prevents them from participating fully in work, school, housework or other activities. Disability and chronic disease increases with age, e.g., 5% of 18-29 year-olds compared to 28% of Americans over 65. Those with a disability have the lowest levels of Internet access in the country; a 2002 Pew survey found that only 38% of those with a disability go online, compared to 58% of all Americans at that time. They are also less likely to have friends or family who go online. Of those who do go online, one-fifth report that their disability makes using the Internet difficult. However, those who do go online are very active users: 87% of disabled or chronically ill users have searched for at least one health topic. Each of 16 health topics considered in the July 2003 Pew survey was more popular with disabled or chronically ill Internet users than with the rest of the Internet population.

Home caregivers: About 11% of Americans live with someone who is disabled or chronically ill and 70% of that group is a primary or secondary caregiver. Wired home caregivers are avid online health seekers, but are most likely to search for information on treatment, procedures or drugs.

A study for the California HealthCare Foundation identified three groups of health-seekers: the well, the newly-diagnosed, and the chronically-ill and their caregivers. Of these groups, only the well search for prevention information and they do so only episodically, with little loyalty to particular web sites (Cain, Sarasohn-Kahn and Wayne, 2000).

Women (76%) are also more likely than men (70%) to report that the Internet has improved the health and medical information and services they receive. Similarly, younger health seekers are more likely to report receiving such benefits, as shown in Table 2 (Fox & Fallows, 2003).

Table 2. Percentage Reporting Benefits from Online Health-Seeking

Ages	Percentage Who Say They've Benefited
18-29	80
30-49	72
50-64	71
65+	61

There were no significant differences in perceptions of benefits among health seekers of varying levels of income and education. However, those with high-speed Internet access at home (81%) were more likely than dial-up users (71%) to cite benefits.

Most respondents to the Pew survey reported that they do not search for health information very frequently, usually only every few months or less often. On a typical day, only 6% of those online look for health or medical information, compared to 49% who use email, 19% who research a product or service, and 5% who buy a product online. Moreover, more than half of those who are seeking health information are doing so on behalf of someone other than themselves (Pew, July 2003).

In fact, according to the Center for Studying Health System Changes, a majority of Americans (62%) in 2001 sought no information about a health concern. Those who did (38% or about 72 million people) relied more often on traditional sources such as books and magazines than on the Internet. People with chronic conditions were more likely to be health seekers, yet more than half of this group did not. The consumers who are most challenging to reach with health information are those with less education and lower incomes; they are disproportionately uninsured, male and minority. (Tu and Hargraves, March 2003).

Question 1: Summary of Findings

Our first research question was "Which audience characteristics are the strongest determinants of homogeneity in terms of needs and abilities for seeking, using, and processing prevention information?" The evidence presented suggests that gender, education, income and age are strong determinants of someone's interest and activity in searching for health information, regardless of media. Well-educated, affluent adult women younger than 65 are the most active health information consumers. This finding cuts across ethnic lines, although levels of access to online health information vary by racial/ethnic group.

Concern about a specific illness or diagnosis is most likely to prompt a search for health information. Health prevention information does not appear to be a major priority for most health information-seekers. Moreover, most Americans do not routinely seek out information about health issues.

One promising audience segmentation strategy grounded in health information-seeking that has successfully been used in the HealthStyles marketing research that some federal agencies, such as the U.S. Centers for Disease Control and Prevention (CDC), have tapped is a two-dimensional approach that considers the individual's reliance on his or her physician and degree of activity in health information-seeking. Three of the five audience segments identified in HealthStyles may be possible target audiences because their audience profiles suggest they are likely to have difficulty obtaining, processing and/or understanding basic health information, i.e., they may have low to medium levels of health literacy:

- Doctor Dependent Passives (20%): Consumers of lower socio-economic status (SES) who describe their health as excellent or very good, hold lower values for health and prevention, and express low interest in health information.
- Moderates (28%): Middle aged, generally healthy adults with above average household income who value good health and actively try to prevent disease; most value health information, but don't enjoy searching for it and some may lack skills to do so.
- Doctor Dependent Actives (20%): Older, low SES adults, many of them African-American, who value health and prevention but experience more health problems; they are actively seeking health information and capable of finding it, but may have difficulty interpreting it.

Together, these audience segments comprise over two-thirds of the adult population. This is an audience segmentation approach that may merit further investigation.

Major gaps in the research literature on the audience for health information include:

- Any discussion of the role of other psychographic variables beyond health information-seeking, such as culture or optimism, that may motivate people to search for health prevention information;
- Any detailed multi-variate analyses that examine the contribution of gender and socio-economic characteristics with racial/ethnic identity to determine the relative contribution of each.

Question 2: Available Prevention Information

The second research question addressed by this literature review is: "In what ways and to what extent is currently available prevention information responsive to patterns of prevention information seeking and processing among audiences?" To answer this question, this review considered the types of media used in health prevention interventions, the theoretical foundations and methods used in designing communication interventions, and the outcomes of interventions on specific prevention topics.

Types of Media Used in Interventions

In the last two decades, a greater number of interventions focused on changing health behaviors incorporate a variety of media modalities such as television campaigns (i.e., public service announcements, paid advertisements, videotapes); computer based programs (i.e., multimedia CD-ROM, web television); interactive forms of media (i.e., the Internet, email, kiosks, automated telephone counseling); portable devices (i.e., mobile phones, personal digital assistant) and written materials (i.e. pamphlets, letters, tailored messages, self-help books) (Owen et al., 2002). These forms of media have been used to disseminate information, increase knowledge, assess perceived risks, and deliver targeted health promotion and prevention information (Di Noia et al , 2003; Connell, 2003; Kreuter, 1995; Strecher et al., 1999).

Increasingly, interactive forms of media are being used in health promotion campaigns. For example, kiosks have been used to educate the public about Alzheimer's disease or provide individually tailored feedback to reduce smoking (Connell et al., 2003; Strecher et al., 1999). Not only does the Internet disseminate information, but it also is being used as a form of communication in which to counsel and deliver individualized health information. For example, one study used email to communicate directly with people at risk for diabetes in order to help them lose weight (Tate, 2003). Interactive media components have demonstrated significant changes in measured outcomes (Tate, 2003; Tate 2001). Positive outcomes were also documented when utilizing chat rooms on the Internet to encourage smoking cessation among teens (Woodruff, 2001). The use of personal digital assistants (PDA) and palmtop computers is a new development in media health interventions and at this point, empirical evidence evaluating the effects of using these devices in health interventions is limited (Owen et al., 2002). However, preliminary data suggest that the devices are acceptable to users in obesity and panic disorder studies, and that these users were adherent to self-monitoring recommendations (Newman et al., 1997; Agras et al., 1990).

Similar to other interventions, media-based health interventions are targeted to different levels of potential impact. Interventions have been developed for individuals, organizations, communities, and mass society (Finnegan and Viswanath, 2002). Traditionally most media health interventions were developed at the individual level and emphasized motivation, cognition, attitudes, and behaviors (Finnegan and Viswanath, 2002). In addition to interventions directed at individuals, media plays a role in community level health campaigns to achieve social norm change or policy change (Siegel, 2000; McAlister, 2004; Niederdeppe, 2004). Several community level media campaigns have shown to reduce teen smoking rates (Niderdeppe, 2004; Siegel, 2000). These larger campaigns often incorporate television, radio, and billboards, as well as individual level materials created for clinics or health providers' offices (McAlister, 2004). Some studies have demonstrated greater change in

outcomes when media campaigns use materials at both the community and individual level, as compared to only the community alone or no media campaigns (McAlister, 2004; Renger, 2002).

A range of study designs and methods are being used to evaluate the effects of media interventions on health outcomes, with many researchers using rigorous designs such as randomized control trials, or experimental and control group conditions. Both quantitative and qualitative methods have been employed to measure outcomes. For example, sophisticated longitudinal analyses have been conducted in addition to focus groups, case studies, interviews, as well as review of health materials. Moreover, populations recruited to participate in these interventions are diverse: urban African Americans, adolescents, Vietnamese immigrants, inactive adults, and low-income Latino women. A review of the different media types indicates that using media to change health behavior is effective in the short term, and that interventions using different forms of media are effective across diverse types of public health priorities such as injury prevention, drug abuse, and obesity to name a few (Schnike, 2004; Roberto, 2000; Delichatsios, 2001).

Theory-Based Approaches

Theory, models and findings from evidence-based research have been used to a great extent in the design of interactive media and health interventions. A number of theories from the behavioral health sciences and communications research have been used to assess the design of health media, how these media are used, and how effective they are with various audience segments. Some of the more widely utilized theories and models that guide the development of media based interventions include Social Learning Theory, Health Belief Model, Stages of Change (Transtheoretical Model), Theory of Reasoned Action (theories used in both health behavior and education sciences, as well as communication science) and the Elaboration Likelihood Model, and Extended Parallel Process Model (examples from communications and media research studies, rarely used in health behavior and education sciences).

Social Learning Theory posits that behavior, personal factors, and the environment interact together in a reciprocal way to affect behavior change (Baranowski et al., 2002). Self-efficacy, the belief that one is able to perform a specific behavior successfully, is a central component in social learning theory and a main outcome measure in many health media interventions. When self-efficacy is high, there is a greater likelihood that a person will carry out a prevention or self-care behavior once she learns that it can benefit her health (Bandura, 1997). The Health Belief Model is a value-expectancy theory based on a person's desire to avoid illness or get well (value) and the belief that a health behavior (expectancy) will lead to the desired outcome (Janz et al., 2002). The Transtheoretical Model uses the stages of change processes and posits that behavior change occurs over time through a series of stages (Prochaska et al., 2002). The Theory of Reasoned Action and the Theory of Planned Behavior focus on individual determinants that result in behavior change (Montano and Kasprzyk, 2002).

The Elaboration Likelihood Model (ELM) is a persuasion theory that focuses on the information-processing strategies underlying people's changes in health behavior in response to media messages, rather than using characteristics of the source, message or population to predict behavior change without explaining why that change occurs (Booth-Butterfield and Welborne, 2002). (For a further discussion of the application of ELM to the online environment, see page 31.) This model proposes that behavior change occurs through either the central route (i.e., careful and thoughtful processing of the message argument) or the peripheral route (less thoughtful processing and more reliance on the clues unrelated to the message such as an attractive source) (Booth-Butterfield and Welborne, 2002). The model has implications for the design of online content, as described later in this paper. The

Extended Parallel Process Model addresses risk communication, noting that such messages evoke two cognitive assessments, one of the threat and the other of the efficacy of the recommended response. When efficacy is high and the individual believes the threat can be contained by action, the message is accepted; when the perceived threat dominates and too much fear in invoked, the individual seeks to control their fear by avoidance or denial of the message (Witte, Meyer and Martell, 2001).

In *Speaking of Health*, the Committee on Communication for Behavior Change in the 21st Century reported the following:

> In its limited review of cases, the committee found great variation in the use of theory as an underpinning to implementation decisions. Some programs saw themselves as implementing certain theoretical principles and did so using theoretical constructs to guide intervention development; some made reference to theory as a justification for their implementation decisions, but outside observers found it difficult to match theory and implementation; and some programs made no theoretical claims at all. [3]

This finding is consistent with the present review of the literature. Twenty-three of the 50 articles about specific prevention-oriented interventions reviewed below failed to identify which, if any, theory guided the development and/or implementation of the intervention. These studies, summarized in Appendix 4, were most likely to have used the Elaboration Likelihood Model (ELM) or the Transtheoretical Model. ELM is most closely associated with tailoring of health messages; the frequency with which this theory is cited reflects the high interest in tailoring that is apparent in these studies. The Transtheoretical Model is often cited because it has provided a useful framework for segmenting the audience by the individual's readiness to change health behaviors.

Targeting and Tailoring Messages

Researchers continue to investigate the benefits of using targeted and tailored materials as ways to influence healthy behaviors within the context of various theoretical approaches described above. Targeting refers to the presentation of content or an intervention aimed at a specific group, whereas tailored messages are specific to individuals (Kreuter and Strecher, 2000). Both targeting and tailoring methods have been shown empirically to change behaviors (Kreuter et al., 2000; Oenema et al., 2001). Examples of targeting or tailoring of information using media forms include written materials such as letters, computer kiosks, interactive computer programs, Internet chat rooms, emails, and telephone calls (Brug et al., 2003; Strecter et al., 2000; Ryan et al., 2001; Oenema et al., 2001). In one study, individuals receiving computer-tailored nutrition education indicated intentions to change eating patterns compared to the control group (Oenema et al., 2001). The advantages of tailoring in interactive content is discussed later in this paper.

One widely recognized component of targeting or tailoring interventions is the use of culturally appropriate materials. Developing information based on feedback from focus groups or professionals that focus on specific cultural needs of different segments of the population is critical to successful health interventions, including those using media. For example, one study with African-American women revealed that religiosity, racial pride, and perception of time were important concerns that may not always be met in conventional health messages (Kreuter et al., 2002). For Hispanics/Latinos,

[3] Institute of Medicine (2002). *Speaking of Health: Assessing Health Communication Strategies for Diverse Populations*, Washington DC, page 261

language barriers are another important concern but should not be confused with inability to acquire and process new information (Kreuter, 2003).

An example of targeting a specific subset of the population is the work that pertains to adolescents and sensation-seeking in the substance abuse area (Palmgreen et al., 2001). "Sensation-seeking" is the extent to which an individual enjoys arousing and risky activities; it is hypothesized that youth react differently to health promotion messages based on personality traits, such as sensation-seeking (Palmgreen et al., 2001). Adolescents who rate high on the sensation-seeking dimension prefer and respond to media presentations that emphasize risk, compared to those who rate low on this personality trait. Successful interventions would need to develop and direct media messages at youth in the appropriate risk categories (Stephenson et al., 2003, Palmgreen et al., 2001). Another example of targeting aimed at the adolescent population is the use of perceived realism, which is very effective as a strategy for stimulating adolescents' reception and recall of public service announcements (Andsager et al., 2001). These results suggest that in order to capture the attention of youth and impact their behavior, logic-based PSA's may not be as effective as other enjoyable ads (Andsager et al., 2001).

Health Literacy Issues

Health literacy is "the degree to which individuals can obtain, process, and understand basic health information" (IOM, 2004). Although health literacy is a more comprehensive concept that simple literacy, readability of materials is an important contributing factor to whether people can understand concepts presented in print. Literacy rates are low among older adults and persons of lower socieo-economic status. (Davis et al., 2002). Literacy capabilities affect people who speak English as well as other languages; may impede communication of health prevention messages; and diminish the ability to participate in interventions (Davis et al., 2002). Research suggests that many Internet sites and media materials are created at higher reading levels than the public can comprehend (Berland et al., 2001; Zarcadoolas et al., 2002; Slaten et al 1999; Graber, 1999). In one study, a review of 24 health websites found that the average reading level was grade 13 for English and grade 10 for Spanish, and studies have shown that these levels are not acceptable (Berland et al., 2002; Graber et al., 1999).

Two studies examining health issues with low-literate adults focus on the need for further research in developing health interventions in this population (Rosal, et al 2004; Zarcadoolas et al. 2002). Both studies highlight that health interventions for low-literate adults should focus on learning styles or methods and not intelligence or education. Rosal, et al conducted focus groups with Latinos regarding views on diabetes and found that written information may not be the best method to educate this population (2004). Instead a communication strategy that includes graphic images and discussions held in a group format may be more effective. For example, modeling or live demonstrations are better received and emphasize the same content delivered in a different format. The preference for small group format among Latinos has been documented elsewhere and adult learning theories support the finding that low-literate adults may be better served with active interaction rather than passive information (Moreno et al., 1997; Rosal et al., 2004; Cheatham, 1993; Knowles, 1973).

Levels of literacy also affect how people use the Internet, particularly for underserved populations (Zarcadoolas et al., 2002). In addition to access issues, the ability to use the Internet is an important consideration in developing online information or interventions. An exploratory study found navigational and content barriers for low-literate adults using the Internet: how links function; using the scroll bar; manipulation of arrows and web site addresses; spelling of names when searching; and searching within a site (Zarcadoolas et al., 2002). Unless low literate individuals are given more

training and information about how to navigate the Internet, they may be more likely to conduct inadequate searches, which ultimately result in incomplete information.

Research by Freimuth and Mettger (1990) reviews misconceptions associated with hard-to-reach populations, such as low literacy audiences, and the authors conclude that to capture low SES, different ethnic groups, and low-literacy adults requires more sophisticated audience segmentation techniques that involve the target audience in interactive roles. Flay and Burton (1990) support this view and highlight four key factors to attract target audiences: education level, salience of issue, involvement of the issue, and access to the media channels being used.

Prevention Content

This section summarizes the research on interventions in the eight prevention content areas of concern to ODPHP. Fifty studies were identified that have been published between 1999-2004. There are relatively few articles reported within each topic area; in some cases, only one or two studies were found. During this period, nutrition, physical activity, obesity and overweight, tobacco, youth risk-taking and preventive screenings were the topics on which research was most often published. These topics represent areas of substantial public investment during this time period.

Appendix 4 contains a table that summarizes each of the articles discussed below. The two approaches to the communication of health prevention information most often reported during the time period studied were tailoring (18 studies) and mass media campaigns (including both paid campaigns and those that used Public Service Announcements (12 studies). In five studies, Internet web sites were the intervention studied; three reported on CD-ROM/multimedia programs; and two addressed kiosk-based interactive computer-based programs. The remainder examined a variety of miscellaneous approaches.

Preventive Screenings

Interventions that encourage healthy behaviors and preventive screenings have been used to promote a variety of programs, with many focusing on cancer screenings and health promotion campaigns. In a review of the cancer prevention and screening literature, one common factor used to promote health behavior was identified: tailored messages (Campbell et al., 2002; Skinner et al., 1994; Kreuter et al., 2003). In each of the studies, theory was also used to inform the intervention and the tailored messages were tested through health kiosks, magazines, and letters (Campbell et al., 2002; Skinner et al., 1994). In each population of women, tailored messages were found to be more effective than the control (either a standardized version of a letter or a delayed intervention) in changing certain health behaviors, seeking mammography screenings, and increasing knowledge.

Research in the area of preventive screenings has also focused on the tailored versus targeted messages (Ryan et al., 2001; Kreuter et al., 2002). In one study, the effects of cultural tailoring on improving mammography rates among African American women was examined using four areas of emphasis: religiosity, collectivism, racial pride and perception of time (Kreuter et al., 2002). While the effectiveness of tailoring with culturally appropriate messages remains an area that needs further investigation, this study is one of the few that address the need to respond to differences among segments in the population through their cultural beliefs. Other forms of media have also been used in cancer communication research and include multimedia programs, brochures, and the Internet (Davis et al., 2002; Slaten et al., 1999; and Bader and Strickman-Stein, 2003). One limitation with using print

materials and more sophisticated multimedia programs is the lack of literacy among segments of the population that need the information (Davis et al., 2002). Older patients, persons of low socioeconomic status, and low health literacy rates are less likely to be screened for cancer, present with more advanced stages of cancer when diagnosed, and suffer from higher mortality rates, and these groups are also less likely to use the Internet or comprehend health education materials (Davis et al., 2002).

Healthy Eating

The use of the Internet and computers to deliver nutrition counseling appears promising (Campbell et al., 1994; Campbell et al., 1999a; Campbell et al., 1999b; Buller et al., 2001; Frenn et al., 2003). One formative study used focus groups within a multi-ethnic population to develop a website that promotes increased intake of fruits and vegetables (Buller et al., 2001). The Internet and computer based programs with tailored messages have been effective in increasing knowledge about diets and reducing the amount of fat consumed (Campbell et al., 1994; Campbell et al., 1999b; Frenn et al., 2003). Moreover, these interventions were well-received (Campbell et al., 1994) and conducted with segments of the population most at risk for obesity, low income groups and individuals from different ethnic and racial groups (Campbell et al., 1994; Campbell et al., 1999a; Campbell et a., 1999b; Frenn et al., 2003).

Physical Activity

Several studies have examined the effect of using media to increase or change physical activity levels among adults (Green et al., 2002; Reger et al., 2002; Kreuter et al., 1999; Bull et al., 1999, Pinto et al., 2002) and children (Levin, 2002). Interventions have relied on telephone support systems; television, newspaper, and radio advertisements; and computer generated tailored messages and brochures (Green et al., 2002; Reger et al., 2002; Kreuter et al., 1999; Bull et al., 1999; Pinto et al., 2002). The studies that used mass media and telephone systems developed interventions using theoretical models to guide the content (Reger et al., 2002; Green et al., 2002; Pinto et al., 2002). Results showed marked improvement in walking in the community campaign (Reger et al, 2002); significant changes in mean level of physical activity for individuals who received motivational counseling by telephone (Green et al., 2002); and increased levels of activity for persons receiving automated telephone therapy (Pinto et al., 2002). However, in the study by Pinto et al., results were only sustained in the short-term (3 months) and while no effect was seen at 6 months, one explanation for short-term results may be the decreased use in the automated telephone system over time (2002).

Two studies used tailored messages to promote increased physical activity (Kreuter et al 1999; Bull et al 1999). Participants in these studies reported more positive thoughts about the materials (Kreuter et al., 1999) and in one study, individuals in the tailored group were more likely to increase physical activity as compared to the control group (Bull et al., 1999). One study examined the effect of a video to promote knowledge, self-efficacy, and positive attitudes about physical activity in children (Levin et al., 2002). In a quasi-experimental design, children watched a 15-minute video that showed health educational themes (Levin, et al 2002). Children in the intervention group had more knowledge and higher self-efficacy scores at post-test than those in the comparison group (Levin et al., 2002).

Overweight and Obesity

In addition to the research on nutrition and physical activity using overweight or obesity as an outcome, many of the health intervention studies have concentrated on overweight and obesity as a primary study objective. Studies on overweight persons and obesity have focused on tailoring

messages and using the media. Three studies looked at the effects of tailored messages on adult overweight individuals (Kreuter et al., 1999; Kreuter et al., 2000; Holt et al., 2000). In one study, results showed that tailored materials were just as well received as non-tailored materials (Kreuter et al., 2000). A second study found that study individuals received tailored materials more positively than the non-tailored materials, and concludes that tailored materials may improve the chances of behavioral intentions (Kreuter et al., 1999). The third study used locus of control and the effect of tailored and non-tailored materials (Holt et al., 2000). Individuals with an external weight locus of control (i.e., who attributed weight loss to something outside themselves, such as luck or powerful others) were more likely to respond to tailored messages that addressed their own lifestyle and perceived competence to carry out the behaviors needed to lose weight with counter arguments that negated the weight loss message (Holt et al., 2000). These results suggest that locus of control is a useful variable for impacting the design of weight loss messages for overweight individuals.

Weight loss programs utilizing the Internet and television have been used to deliver health interventions (Tate et al., 2001; Tate et al., 2003; Gans et al., 2003). Two studies used the Internet to deliver weight loss interventions (Tate et al., 2001; Tate et al., 2003). In each of these studies, email was added to the basic Internet program and provided individualized contact and feedback. Both studies found significant results when the Internet and email component was used as compared to either basic Internet program, or persons given links to educational websites. A third study used a theoretical framework and formative research with audience members to create a culturally appropriate weight loss intervention for African American women, SisterTalk, on cable TV (Gans et al., 2003).

Tobacco Use

One of the most widely researched health areas is tobacco use. Different forms of media and behavior change interventions have been researched with the goal to prevent smoking or promote smoking cessation programs (Glasgow et al., 2000; Manfredi et al., 2000; Strecher et al., 2002; Boyd et al., 1998; Orleans et al., 1998; Jenkins et al., 1997). Research in tobacco has been diverse in terms of the populations recruited to participate in behavior change studies and includes persons of different age groups (adolescent and adult), income levels, and racial and ethnic groups. The interventions have also been innovative in the environments in which they have been implemented. For example, smoking cessation interventions have occurred in prenatal clinics, public health clinics, and communities (Strecher et al., 2002; Manfredi et al., 2000; Glasgow et al., 2000; Orleans et al., 1998; Boyd et al., 1998). While results from these studies have not been conclusive in determining how many people have stopped smoking, the interventions were effective in reaching underserved populations; showed better short term outcomes; resulted in a better understanding of risk behaviors; suggest that paid advertising is effective to reduce smoking; and suggest that tailored messages can play an important role in smoking cessation (Glasgow et al; 2000; Strecher et al 2002; Boyd et al 1998; Orleans et al 1998). One study that used a community-based campaign involving mass media, health education materials, and activities aimed at physicians and businesses showed modest results in smoking cessation program aimed at Vietnamese men (Jenkins et al., 1997), i.e., the audience segments were those intermediaries in a position to influence the behavior of the intended audience.

The Centers for Disease Control and Prevention's *Task Force on Community Preventive Services* conducted a systematic review of published research and found that mass media campaigns are effective at reducing tobacco use initiation and increase cessation when combined with some other action (CDC, 2003). Furthermore, this task force recommends the use of mass media as a strategy to tobacco control and prevention based on the strong evidence (CDC, 2003). One study evaluated the effects of the American Legacy Foundation's "truth" countermarketing advertisement campaign

against Phillip Morris's "Think, Don't Smoke" campaign and found that youth who watched the "truth" commercials reported increased anti-tobacco attitudes and beliefs, whereas the Phillip Morris advertisements were associated with positive attitudes and beliefs towards smoking (Farrelly et al., 2002). A follow-up study to the "truth" campaign showed lower rates of teen smoking in teens with higher "truth" campaign awareness (Niererdeppe et al., 2004). Mass media campaigns combined with other activities to reduce prevent adult tobacco use and cessation were also effective and resulted in reduced smoking rates compared to areas that didn't receive the campaign or received media campaigns alone. (McAlister et al., 2004).

Substance Abuse

The majority of research studies using different forms of media to deliver health prevention interventions are aimed at youth – these are discussed under the Youth-Risk Taking section. Two studies that examined computer-based prevention programs for alcohol and substance abuse for adults were identified (Matano et al., 2000; Epstein et al., 1999). Matano and his colleagues described the development of an interactive Internet alcohol prevention program to deliver primary, secondary, and tertiary prevention to employees of several companies; no evaluation of the program was reported. The second study (Epstein et al., 1999) explored the impact of a kiosk-based interactive multimedia program about substance abuse; results indicated that individuals used the program for more than twice as long as had originally been expected and then demonstrated a significant improvement in their attitudes toward substance abuse research and treatment.

Injury Prevention

In a study aiming to promote injury prevention among children, tailored messages were found to be more effective than generic information in adopting home and car safety behaviors (Nansel et al., 2002). The study population was primarily comprised of African American children and their parents and the intervention took place in primary care offices. More research is recommended to fully explore and understand the use of tailored messages in primary care settings and offered by physicians (Nansel et al., 2002). In another study, radio, television and newspaper advertising was combined with police checkpoints and traffic citations to increase seatbelt use in North Carolina (Williams, Wells and Reinfurt, 2002).

Youth-Risk Taking

Youth risk taking as a topic of health intervention media includes tobacco use, alcohol and substance abuse, and injury prevention. In its series of First Look Reports, The American Legacy Foundation examined the effects of mass media on tobacco use. Adolescents are highly aware of tobacco advertisements on the Internet, in print advertising, and from other sources (Niederdeppe et al., 2003). Moreover, youth who perceive these advertisements as receptive are more likely to initiate smoking in the future (Niederdeppe et al., 2003).

Media interventions seeking to prevent or stop substance abuse have focused for the most part on adolescent populations and tend to concentrate on marijuana (Yzer et al., 2003; Stephenson et al., 2001; Di Noia et al., 2003; Duncan et al., 2000; Schnike et al., 2004; Palmgreen et al., 2001). Two additional studies looked specifically at the effects of alcohol education (Reis et al., 2000; Andsager et al., 2001). Research on media and substance abuse can be divided into two categories: (1) analyzing targeted content of media messages and, (2) the effects of media interventions on the outcome of interest. Media messages with theoretically based content have been analyzed to measure the effect on intended populations. Results

show that targeted messages aimed at youth may not reach all youth in the same manner. In the case of marijuana, for example, it is has been hypothesized that adolescents who rate high in sensation seeking compared to those who rate low will react differently to media content (Stephenson et al., 2001; Palmgreen et al., 2001). Those adolescents in the high sensation seeking group (i.e., youth categorized as more adventurous and therefore at greater risk for substance abuse), were more likely to watch the public service announcements that were targeted to this group on TV than individuals in the low sensation seeking group. (Stephenson, 2001). In examining media advertisements for the gateway belief in marijuana (i.e., hypothesis that marijuana will lead to other stronger drugs), researchers found an unintended effect: that messages with explicit gateway references may actually boomerang as measured by attitudes and beliefs among adolescents (Yzer et al., 2003). A similar phenomenon was identified in public service announcements analyzing themes of perceived realism among youth (Andsager et al., 2001). Adolescents recalled unrealistic but more enjoyable ads about alcohol use compared to the more realistic persuasive public service announcements (Andsager et al., 2001).

Five studies looked at the use of interactive media, mass media, or a combination of different media modalities on preventing substance abuse (Schinke et al., 2004; Duncan, 2000; Stephenson et al., 2003; Di Noia et al., 2003; Reis et al., 2000). All studies concluded that all forms of media – television, CD-ROM, the Internet, interactive software – were effective in preventing drug abuse, increased self-efficacy, and educating adolescents about substance abuse (Schinke et al., 2004; Duncan et al., 2000; Stephenson, 2003; Di Noia et al., 2003; Reis et al., 2000).

Immunization

Only one study addressing immunization in children was identified. Tailored messages to increase immunization among children are a novel method to increase rates (Kreuter et al., 2004). Parents of children received tailored calendars (generated by a computer program) reminding them of dates that children need to receive immunizations. Results showed that immunization rates increased for those in the intervention, and the effect was stronger the younger a child was at enrollment (Kreuter et al., 2004).

One study addressing immunization in adults was identified. In this study (Zimmerman et al., 2003), health center staffs implemented proven tailored interventions that included patient, provider and system-oriented strategies. Strategies for patients included posters, mailed reminders, and/or free or low-costs vaccines to the indigent. Results found that evidence-based tailored interventions can improve immunization rates (Zimmerman et al., 2003).

Question 2: Summary of Findings

The evidence related to the second research question--In what ways and to what extent is currently available prevention information responsive to these patterns?—suggests that there has been little research that takes people's health information-seeking or other psychographic variables into account when designing health communication interventions. Exceptions to this statement from the studies reported above include the role of sensation-seeking in designing anti-drug messages for youth and the role of religion and spirituality in targeting preventive screening messages to African-American women. For the most part, however, demographic variables such as age, gender and race/ethnicity are the most commonly reported means by which health communicators have targeted audiences and then designed messages to be responsive to those target groups. There are, however, an insufficient number of studies published on the design of effective communication interventions for specific

demographic targets that contain guidelines on how best to present information to each target audience, based on the current level of evidence.

Moreover, there has been relatively little research published in some of the eight prevention content areas identified as priorities by ODPHP. Immunization, injury prevention and adult substance abuse are three areas in which substantial gaps in knowledge about effective communication exist.

Researchers in several of the studies that used computer-based technologies directly with consumers (e.g., kiosks) reported frustrating technical difficulties in implementing their interventions. Most of the researchers noted that their findings are limited to the specific study populations they examined and called for more research on hard-to-reach populations, such as low-income ethnic minorities; thus, the generalizability of results across multiple populations is unknown. More research is also needed to identify the major components of culture and other psychographic variables so that health communication materials that are responsive to cultural issues may be developed. Currently, the leading work in this area has been conducted by Kreuter and his colleagues (2002 and 2003); substantially more work is needed in this area.

The strong interest in tailoring that emerged from this literature review raises some questions about tailoring as an approach. First, the generalizability of findings on the effectiveness of tailoring across prevention behaviors requires further exploration. Bull et al (1999), for example, noted that physical activity may be less amenable to change by computer-tailored materials than other health behaviors are; this is a hypothesis that needs further testing. Finally, despite the promise of tailoring, Kreuter (2000) points out the need for further evaluation of the circumstances under which tailoring is most optimal; he notes that "good-fitting" non-tailored materials can be effective and are less expensive to develop and disseminate than tailored materials.

Question 3: Audience Segmentation

The third question addressed in this literature review--Is prevention information that is targeted in content, design, and delivery to different audience segments based on characteristics such as information-seeking or health literacy better received and more likely to lead to preventive decisions and actions than information that is not targeted on these characteristics?—focuses on the value of audience segmentation. The evidence on this topic is reviewed below.

Audience Segmentation Strategies

The goal of audience segmentation in health communication is to identify and describe population sub-groups that are homogeneous in ways that are relevant to some desired behavior or outcome (Slater, 1996). When such groups are identified and well-understood, different communication strategies can be developed to reach different sub-groups (Slater, 1995). These group-specific, or *targeted,* strategies should enhance the effectiveness of health communication by increasing its relevance to a given audience (Kreuter and Wray, 2003).

Effective strategic message design and targeting depend largely on meaningful audience segmentation. The concept of audience segmentation originated in the field of marketing, and is now regarded by most health communication scholars and public health practitioners as a prerequisite to effective health communication campaign efforts (Slater, 1996). Audience segmentation is conducted based on the assumption that "different groups of audience members possess different characteristics that make them more or less likely to pay attention to, process, and be influenced by different messages" (Rimal & Adkins, 2003, p. 498). As such, audience members within a given segment can be reached using the same message and message design through similar interpersonal and media channels (Slater, 1995).

Although audience segmentation is recognized as a best practice in health communication, its application in many public health efforts has been relatively unsophisticated (Maibach, Maxfield, Ladin, & Slater, 1996). Early audience segmentation research relied on demographic variables as the common criteria for dividing the population into sub-groups. Slater (1995) contends that this approach is only useful when factors such as race, gender, ethnicity, income, or age are correlated with antecedent variables of the behavior of interest. Antecedent variables such as knowledge, motivation, and self-efficacy may be more useful segmentation variables because they are stronger and better predictors of health-related behaviors than are demographic variables. Segmentation strategies based on multi-variable approaches have been found to be more effective in creating messages that are responsive to the unique needs, concerns, and perspectives of different sub-groups.

In a CDC-funded intervention trial, Boslaugh and colleagues (Boslaugh, Kreuter, Nicholson, & Naleid, manuscript under review) discovered that segmentation strategies that rely solely on demographic variables provided little improvement over no segmentation in identifying groups that were homogeneous on physical activity. However, when segmentation strategies based on psychosocial or health status variables were used, or combined with demographic information, more homogeneous sub-groups were identified with a greater range of variability between sub-groups on level of physical activity.

Audience sub-groups identified through more sophisticated multi variable approaches to segmentation have been found in other studies to be associated with health behavior and health behavior change. In their analyses of the Stanford Five City Project (FCP), Slater and Flora (1991) considered 10 cognitive/attitudinal variables, three social influence variables, five behavioral variables, and seven demographic variables in an audience segmentation strategy that led to the identification of seven lifestyle clusters – healthful adults, unhealthful adults, worried older adults, healthful talkers, healthful young adults, unhealthful young adults, and young athletes. The unhealthful adults, unhealthful young adults and worried older adults were found to require more immediate health education efforts compared to the other four remaining clusters. (For a detailed description of each cluster, see Slater and Flora, 1991). Using data from Hispanic participants in the FCP study, Williams and Flora (1995) identified six segments which differed on the basis of demographic variables, health knowledge of cardiovascular disease (CVD) and the discussion of CVD and its risk factors, exposure to prevention strategies for CVD, newspaper readership, prescription medication use and consumption of prepared meals at home. The analyses revealed that Hispanics, a minority population within the U.S., are heterogeneous in reference to health related behaviors and health outcomes.

In an effort to examine prescription drug information seeking by the elderly, Morris, Tabak and Olins (1992) identified four clusters of older adults who differed along several background, knowledge and information search characteristics – ambivalent learners, uncertain patients, risk avoiders, and the assertively self-reliant. Analyses revealed that each segment had distinctively different motives for wanting and avoiding prescription drug information. For example, the ambivalent learners tend to see themselves as unhealthy, have low perceived knowledge, have greater desire for additional prescriptive drug information and continued reassurance that their medicines are effective in controlling their respective health conditions. (For a detailed description of each segment, see Morris et al., 1992).

Laughrey, Basiotis, Zizza and Dinkines (2001) used national market research survey data to segment 491 women into three nutrition-related market segments—*better eaters, fair eaters and poor eaters*--based on the Healthy Eating Index. *Better eaters* ate a diet that most closely followed the USDA Food Guide Pyramid; they were more likely to be better educated, White and to have no children than the other audience segments. *Fair eaters* were somewhat less likely to adhere to the recommendations of the Food Guide Pyramid, but still valued healthy eating. Convenience and taste, however, were more important considerations for this group than for the better eaters. *Poor eaters* were less likely to believe that it was important to eat a healthful diet and more likely to report that eating healthfully was too complicated and confusing. Based on the profiles of the three groups, Laughrey et al. suggested alternative strategies for meeting the information needs of each segment, e.g., offering new tips to *better eaters* that can be added to their current actions for eating healthfully or inserting frequent environmental cues emphasizing taste and convenience of healthy eating into messages for *fair eaters*. These recommendations, however, have not been implemented nor evaluated.

For audience segmentation research to have both practical and utility values, Slater (1995) posits that a health communication researcher will have to: (a) identify what and which antecedent variables are most crucial in influencing the behavior of interest, (b) determine how these antecedent variables are distributed in the larger population, (c) ascertain what antecedent variables are correlated with one another and in what direction (positive vs. negative), (d) ascertain what demographic variables are associated with these antecedent variables, (e) determine what demographic variables are associated with the behavior of interest, (f) develop segment profiles based on the distinctive patterns of determinants that emerged, (g) develop messages or interventions based on each segment's perspectives, needs, and concerns, and lastly, (h) test the message or intervention with representative members of each audience segments.

In addition, a good segmentation strategy will have at least four key characteristics. First, it will identify distinct sub-groups that are truly different with respect to the outcomes of interest. Second, these sub-groups will be large enough in size or population proportion to justify allocation of resources to reach its members. Third, in order to assure that these groups can be reached with targeted communication, methods of identifying members of different audience segments should exist, be fast and easy-to-use, and reliable. Finally, the unique characteristics of each audience segment should provide clear opportunities and directions for targeting health information content and/or delivery channels.

Question 3: Summary of Findings

"Is prevention information that is targeted in content, design, and delivery to different audience segments based on these characteristics better received and more likely to lead to preventive decisions and actions than information that is not targeted on these characteristics?" Because there are few examples of research on prevention information interventions that are based on variables other than demographic ones, it is not possible to answer this question definitively. However, the evidence presented above on various segmentation studies, coupled with the evidence about tailoring presented in the previous section, suggest that 1) the audience is often more heterogeneous than simple demographic segmenting would suggest; and 2) health information that is targeted in response to information known about specific audience segments has been demonstrated to be effective.

A major gap in the evidence on effective presentation of prevention information is the paucity of research using health information-seeking and other psychographic variables among adults as an evaluated audience segmentation strategy.

Question 4: Design and Implementation of Online Health Information

The fourth question—How can prevention information be presented effectively online?—is addressed in this section. A growing body of theory-based research is providing evidence that can guide the design and implementation of online health information. Drawing from the fields of communication, public health, psychology, education, and human-computer interaction, this section focuses on five areas:

1. Perceived credibility and usefulness of health messages
2. Motivation and engagement
3. Interactivity
4. Interpersonal communication via the web
5. Learning, decision-making, and behavior change

The five sections each conclude with a set of recommendations, drawn from the literature, to help ODPHP and other designers of online health content enhance user interest, engagement with the content, satisfaction, learning, and behavior.

Perceived credibility and usefulness of health messages

This section presents research that identifies health consumers' assessments of the credibility and usefulness of online health messages. It is generally agreed that a health web site should contain accurate and unbiased health information and it should enable users to assess the credibility and usefulness of its content. A site's producers can, for example, list the authors of the content and their affiliations, and the date of the most recent update.

As of 1999, more than two dozen rating systems had been developed with criteria for assessing health web sites. An analysis of these systems (Kim et al., 1999) found that the most frequently cited criteria dealt with content quality; design and aesthetics of site; disclosure of authors, sponsors, or developers; currency of information (such as frequency of updates, freshness and maintenance of the site); authority of the source; ease of use; and accessibility and availability.

A study was conducted (Eysenbach et al., 2002) to determine how users assess health web site quality. A total of 79 studies were reviewed, evaluating 5941 health web sites and 1329 health web pages. The most frequently used quality criteria reported in these studies were accuracy, completeness, readability, design, disclosures, and references provided. Fifty-five of the 79 studies concluded that the uneven quality of health information is a problem on the web. The authors call for a standard set of operational definitions of quality, both to guide future health web content development and to help consumers evaluate the health content they find online.

Protection of privacy and consumer rights

U.S. healthcare providers maintain high levels of confidentiality and privacy of their patients' medical records. This is considered a fundamental right of health consumers, including those who seek health information online (Harris, 1995). To address privacy issues, the American Medical Association has published guidelines that set standards for the development and posting of health information on the web, govern online advertising and sponsorship, ensure users' rights to privacy and confidentiality, and provide effective and secure means of e-commerce (Winker et al., 2000). Without safeguards such as those articulated in the AMA guidelines, health consumers will be reluctant to enter personal medical information into a networked system or to share it with peers or experts online. Health web sites that adhere to strict privacy standards should let users know specifically how their personal information will be protected.

Research on web credibility yields guidelines applicable to health content

Users of online health information form impressions of the credibility of the web site, and this helps determine whether they trust the information. One qualitative study (Eysenbach & Kohler, 2002) found that people look for the following characteristics when they assess the credibility of a health information site:

- Authority and credentials of the source
- Layout and appearance
- Absence of advertising
- Readability of the content at the layperson's level
- Evidence that the site is updated often
- Third-party endorsements from trusted federal agencies or medical organizations.

Other studies have found that when consumers evaluate online health information, the most important two criteria for assessing quality are completeness of content and credibility of content (Dutta-Bergman, 2004; Eysenbach et al., 2002).

A series of studies involving more than 4,500 people (Fogg, 2002) has tested and developed ten guidelines to enhance web credibility. The authors conclude that an organization creating a web site should:

- Make it easy to verify the accuracy of information on the site, through citations, references, and links to supporting research material
- Show that there is a real organization behind the site, by including the organization's street address and background information
- Highlight the expertise of the organization and its key members, including the credentials of its experts
- Show that honest and trustworthy people stand behind the site, and include photos and biographical information that provide evidence of their sincerity, trustworthiness, and accomplishments

- Make it easy to contact the organization, by listing the phone number, physical mailing address, and e-mail address
- Design the site so it looks professional, or appropriate for its purpose, through layout, typography, images, consistency, and other design elements
- Make the site easy to use and useful, without wasting the user's time or effort
- Update the site's content often and show the date of the most recent review or revision
- Avoid displaying ads or any biased promotional content, but if advertising will be included the site should distinguish clearly between advertising content and the information provided by the organization; avoid pop-up ads; and use a writing style that is clear, direct, and sincere
- Avoid typographical errors and broken links, and keep the site up and running at all times.

Another study by some of the same researchers identified the credibility features of web sites, including some features listed in the ten guidelines above, that people tend to notice and care about the most, depending on the type of web site (Fogg et al., 2002). Ten types of web sites were evaluated, among them consumer health, financial, e-commerce, travel, non-profit, and others. To evaluate credibility features of health web sites, the following sites were included in the study:

- Dr. Koop http://www.drkoop.com
- Dr. Weil http://www.drweil.com
- Health Bulletin http://www.healthbulletin.org
- HealthWorld Online http://www.healthy.net
- Intelihealth http://www.intelihealth.com
- Mayo Clinic.com http://www.mayohealth.org
- MDChoice http://www.mdchoice.com
- National Institutes of Health http://www.nih.gov
- Oxygen.com Health and Fitness http://www.oxygen.com/health
- WebMD http://www.webmd.com

The research was done with 2,684 online participants Their average age was 39.9 years, 58 percent of them were female, and their average reported web use was 19.6 hours per week. About ten percent of the participants were randomly assigned to assess the credibility of health sites, and each participant in that group was assigned to look at two of the health sites in the list of ten. The study found that the design and visual appeal of a site was an important indicator of its credibility, across all ten topic categories. However, those who evaluated health sites cared most about the focus and usefulness of the health information presented on the site, as an indicator of the site's credibility. They considered the site to be more credible if they thought its information was personally useful. Health sites that carried advertising lost credibility, and this occurred to a greater extent in health sites than in sites about topics other than health. Also, study participants were not as concerned about the presence or absence of customer service on health web sites, compared to other types of sites included in the study.

A related study asked health experts and financial experts to rate the credibility of web sites in their field and this was compared to the ratings consumers gave to the same sites (Stanford et al., 2002). Compared to consumers, the health experts were much less concerned about the visual appeal of a health web site as a marker of credibility. The experts were more concerned than consumers were about the quality of a site's information, whether it came from a reputable source, and whether it cited the names and credentials of authors for each published article. In open-ended unprompted responses about the features they notice in a health site when they judge its credibility, the health experts most often mentioned the site's name reputation, its operator and affiliates, the source of the information provided on the site, and the apparent motive of the organization behind the site (e.g., whether or not there is a commercial motive).

In a study of web credibility and consumers, based on a telephone survey of 1,500 U.S. Internet users, fewer than one third (29 percent) said they trust web sites that sell products or services, and only 33 percent said they trust sites that provide advice about such products or services (Princeton Survey Research Associates, 2002). These numbers are low compared to the 58 percent of Internet-using respondents who said they trust newspapers and the 47 percent who said they trust the Federal government. The majority said they want web sites to provide easy-to-find and clearly stated information that will help them judge the site's credibility, such as who runs the site, how to reach those people if there's a problem, how to find the privacy policy, and how the site deals with mistakes. More than half of the study participants (60 percent) were not aware that some of the most popular search engines receive payments for listing some sites more prominently than others and, when questioned about this, 80 percent of participants said they want search engines to disclose these business deals in their search results or in an easy-to-find page on the site.

Importance of evidence-based design and rigorous evaluation

There are many types of interactive health communication (e.g., information, education, campaign, support group) on various media (e.g., interactive TV, web, games, telephone). To identify medical and health issues arising from the use of communication technology for health communication, the Office of Disease Prevention and Health Promotion of the U.S. Department of Health and Human Services organized the Science Panel on Interactive Communication and Health (SciPICH) (Robinson et al., 1998). Their charter was to identify how technology could improve health or cause harm, and to help health professionals ensure the quality, safety, and effectiveness of interactive health communication applications.

The panel identified six ways interactive media could support health communication, including

- Tailor information to the individual
- Match the presentation of media (text, visuals, audio) to the purposes of the intervention or the learning styles of users
- Provide anonymity that could increase people's willingness to engage in frank discussions about health concerns
- Increase access to information and support on demand
- Provide more opportunities to interact with health professionals or to find support from people who share common health problems
- Increase ability to disseminate content widely and to keep it current.

The panel also identified six desirable functions of interactive technology pertinent to health communication:

- Relaying health information in a general or individualized way
- Enabling informed decision-making
- Promoting healthful behaviors
- Promoting peer information exchange and emotional support
- Promoting selfcare
- Managing demand for health services

Also identified were potentially harmful impacts of poorly designed applications that could lead to inappropriate treatment or delays in seeking necessary medical care:

- False or deceptive advertising claims
- Proliferation of inaccurate information via online support groups
- Reduction of people's trust in their health providers and treatments
- Misuse of an individual's private and confidential personal information.

To ensure design quality and to obtain desirable health outcomes, the panel proposed an Evaluation Reporting Template for Interactive Health Communication Applications (provided in Robinson et al., 1998) that potential users and purchasers of an application could use to judge the quality and appropriateness of an interactive health communication application. The panel also called for an evidence-based approach to the development and dissemination of interactive health communication and the use of rigorous evaluation designs, such as randomized controlled trials.

Recommendations

To make it possible for users to assess the credibility of online health content, every section of content should display the name of the author(s) and the author's credentials, title, and organizational affiliation, along with the date of the latest update. Users should have convenient access to information about the organization or agency that is providing the web site. When available, research evidence should be cited to support any conclusions or recommendations provided in the health content; this can be done via links to bibliographic information or to a list of references at the end of a page. There should also be a prominent link to a list of the quality standards that guide the design of the content and of the site in general, as well as a link to a description of the privacy and confidentiality standards the web site follows to ensure that there will be no misuse of personal information.

While many people understand that a government health web site has no commercial sponsors, research (e.g., Benigeri & Pluye, 2003) has found that some web site users have difficulty determining whether health information is unbiased or biased. Therefore, we recommend that government health web sites state explicitly—for instance in the section listing the site's quality standards—that the site has no commercial sponsors and the authors of the content have no conflicts of interest that would cause them to provide biased information.

Aesthetics and usability serve important functions in any web site. When they are excellent, they make the site more appealing, useful, and efficient to use. Additionally, and this is especially important in a health web site, these features engender trust in the content itself. Even though Stanford et al. (2002) found that health *experts* are not highly concerned about the visual appeal of a health web site as a mark of credibility, many studies consistently indicate that health *consumers* do take note of a site's visual appeal and it does influence their assessments of value and credibility. Designers of health web sites should pay attention to aesthetics and functionality, and ensure that target users give high ratings to such features as layout, appearance, writing quality, graphics, interface, navigation, interactivity, and other aspects of visual design and interaction design, because excellence in these areas can enhance the user's sense that the information itself has been created with competence and expertise.

Motivation and engagement

Public demand for better access to health information, social support, and medical experts has been increasing (Rice, 2001; Rice Peterson, & Christine, 2001; Street, 2003). However, as mentioned earlier in this report, many health consumers lack the health literacy they would need in order to understand and process certain health messages and others are not interested enough to seek health information or attend to it thoughtfully. This section provides some of the successful strategies that have been used to improve people's interest in learning about health topics and their willingness to pay close attention to health information and think about it carefully.

Serving the underserved while offering advanced interactive features

Commercial sites display advertisements, so they have the incentive to use techniques that will attract users to the site and keep them there, especially the more educated and affluent users who are most likely to buy advertised products. Those users prefer sophisticated features such as interactive tools and in-depth content (Rice & Katz, 2001).

Government health web sites (.gov) tend to be less complex than commercial health web sites (.com), in many cases in order to encourage use by underserved people such as those with less advanced technology, lower literacy skills, and less willingness to devote significant amounts of time to exploring a health topic (Rice, Peterson, & Christine, 2001; Stout, Villegas, & Kim, 2001). For example, a multi-method evaluation of the "Wellness" section intended for the general public, on the Medicare web site http://www.medicare.gov, concluded that the site was lacking in content and did not provide enough links to additional web resources on preventive medicine (Schneider et al., 2001). The study also found that the site used too much jargon for the average health consumer, and even though there was too narrow a range of wellness topics, those that were presented in the site offered too much text, forcing users to read through a great deal of material before they found the information they wanted.

Variations in users' health literacy

Patient counseling and patient education, which is delivered face-to-face and via print, electronic, and interactive media and networks, are key interventions for the prevention of dozens of the most common health problems and diseases (McGinnis, Deering, & Patrick, 1995). Yet almost half of all

adults in the U.S. have difficulty understanding and using the health information provided in these venues, and this negatively impacts health and quality of life and costs billions of dollars in avoidable medical costs (Institute of Medicine, 2004). Health web sites can be designed to meet the needs of people who have low health literacy, through appropriate reading level, avoiding jargon and technical terms when possible, providing explanations and illustrations of medical terms that need to be used, and presenting graphics and narration to provide modalities that are not based on text (Eng, 2001; Eng et al., 1998).

A study of the web skills of 24 low-literate adults found that they were enthusiastic about the Internet (Zarcadoolas et al., 2002). Prior to the study 10 participants owned a computer and 15 said they had obtained access to the Internet. After using the Internet during the study, all but one of the participants said they expected to access the Internet in the future. When asked what types of information they would access on the web, health information was the most frequently mentioned use, followed by school/homework, child care/parenting, job search, news, my home country/other countries, entertainment, and chat/e-mail. The study found that participants were able to learn web navigation skills easily, and they could discover how to use interactive features such as active graphics and pull-down menus when the instructions were simple, direct, and noticeable. On the basis of their research, the authors provide the following recommendations:

- Links should be clearly labeled and functional
- Active graphics should be accompanied by clear, simple instructions
- Keep all information on one screen so that no scrolling is required, or inform users that more information appears below the displayed page
- Anticipate misspellings in search engines and other areas where users input information. An approximation system can take a misspelled word and ask the user, "Did you mean ___?"
- Provide multiple means of entering pages
- Include a table of contents, links to the side of the page, and links at the bottom and top of each page
- Give the user guidelines and helpful tips to explain and demonstrate how to use the web site
- Display the user's path history on each page, as an easy way to retrace steps after an unsuccessful search

Variation in users' level of interest in health information

Online behavior has been categorized into two distinct navigation styles: goal-directed searching and experiential surfing (Dutta-Bergman, 2004; Rice & Katz, 2001). Searchers know what they are looking for and they have specific interests and clear goals. Surfers, on the other hand, are in a more playful, browsing mode and their web use is exploratory with no particular goal. The same individual, at different times, can be a searcher or a surfer, depending on mood, current needs, and the content of a particular site. Searchers may become surfers if, during a search, they are sidetracked by an interesting, yet off-topic, link they decide to pursue.

The two navigation styles are analogous to the cognitive processing styles of two types of recipients of persuasive messages—involved and uninvolved—described in the Elaboration Likelihood Model (ELM) of persuasion (Petty & Cacciopo, 1986, 1990). Involved individuals are interested in learning

about the topic and they engage in deep, or central, processing of messages. They seek information about a topic of interest, think about it carefully, and elaborate on it by scrutinizing the evidence and comparing it to related information sources and to their own previous experience. Uninvolved individuals engage in fleeting, peripheral processing of a persuasive message, noticing only the very salient or eye-catching aspects of the message and using heuristics, or mental shortcuts, to draw conclusions. For example, they are likely to be persuaded by the number of arguments presented and not the content or quality of those arguments. Also, the attractiveness or credibility of a spokesperson will sway them inordinately because they have not deeply processed the logic, evidence, and arguments of the message itself.

The Elaboration Likelihood model can help health information web site designers reach users who are have high involvement (searching) or low involvement (surfing) for any particular topic or at any particular moment. Highly involved individuals are actively looking for information and are motivated to learn from it, while those who are relatively uninvolved are more likely to follow headlines and links that catch their attention even though they did not have an information seeking goal in mind.

Ideally, online health content would include a variety of features so that some of the content will appeal to people with high involvement in the topic and some will appeal to those with low involvement. For example, we might expect highly involved users to appreciate a health web site home page that offers a powerful search engine and a list of health topics as a straightforward alphabetical index of terms. A no-nonsense approach may be most desirable for them and easiest to use because they know what they are looking for. Conversely, low-involvement users may respond more enthusiastically to home page health content that is presented like a magazine, with catchy headlines, health and beauty tips, photos of attractive people, and links to games and quizzes. It would not be difficult to offer users a choice of home page formats, so they could easily toggle between the index display and the magazine display depending on their needs and interests at the time. This approach follows the recommendations of usability experts (e.g., Nielsen, 2000) and health researchers (e.g., Dede & Fontana, 1995; Dutta-Bergman, 2004) who find that web users prefer to have a great deal of user control over the format and the content of the material they are viewing.

Another way to serve both highly involved and uninvolved people would be to provide a relatively small amount of text on the introductory, opening page(s) for every topic, with short bullet lists when possible instead of dense paragraphs, along with vivid illustrations and photos on each page, so that people with low involvement would be more easily drawn in by the images and would be able to read the text without much effort. To serve the people who are highly involved in the topic, the screen could also display links to more in-depth material on the topic. In fact, this format for presenting information is recommended by usability specialists who advocate simplicity, brevity, liberal use of white space, and the use of links to additional content instead of a reliance on scrolling down the page, to make the page more inviting and readable (Nielsen, 2000)

Anonymity in health information searching

Online health searches provide a powerful and convenient way for health consumers to find current, reliable health information, and to maintain their anonymity in the process. Anonymity may be a highly motivating and appealing feature that would lead certain people to go online for health information when they would not seek it from any human source. In a study of adolescents, those who were engaging in risky behaviors, such as alcohol and drug use, looked up information about these topics on a private, anonymous computer system, yet they were not very likely to seek

information or assistance from other non-anonymous sources such as parents, counselors, or healthcare providers (Bosworth, Gustafson, & Hawkins, 1994). This demonstrates a unique function of the web, in that it provides timely and useful information and interactive tools in private, without the awareness or participation of a third party.

For certain people, the web may be their primary source of health information outside the clinic. Several researchers (e.g., Borzekowski & Rickert, 2001; Lieberman, 2001b) also note the attractiveness of anonymous online information seeking, especially when the health problem is embarrassing or stigmatized, or the individual is engaging in a risky health behavior that is illegal.

Avoiding health information

The study of health information management focuses mainly on information seeking, but recent research finds that information avoiding is also part of the process. People who believe they are at risk for a disease, or are already ill, may avoid information when it is distressing or when it conflicts with established beliefs that give them comfort. They may avoid diagnostic information and information about common warning signs (such as warning signs for cancer or heart disease) that would help them understand and interpret their symptoms. And, they may avoid health risk awareness messages to avoid anxiety, especially if they feel healthy and have no signs or symptoms of illness. The research on health information avoiding has documented a variety of circumstances like this, where people avoid information because they prefer not to know (see Brashers, Goldsmith, & Hsieh, 2002, for a review of this literature). In cases where people avoid health information, mediated sources of information may be more successful than face-to-face communication because today's media are relatively convenient to use, have asynchronous capabilities, and enable people to develop social networks while maintaining a certain amount of anonymity and control (Street, Gold, & Manning, 1997).

Information management

Information management consists of communicative and cognitive activities—such as seeking, avoiding, providing, appraising, and interpreting stimuli from the environment—that contribute to a person's knowledge or beliefs (Brashers, Goldsmith, & Hsieh, 2002). The web offers certain advantages over other information sources because the user can both acquire information and manage it conveniently.

For example, the web supports the accumulation, storage, and dissemination of prevention and selfcare information and it enables online communication and support, via listservs, newsgroups, bulletin boards, chat rooms, and moderated online support groups (Borzekowski & Rickert, 2001). Designers of prevention information for the web can take advantage of the strengths of online information management, such as the information provider's ability to send messages targeted to an audience segment, send information tailored to individuals, and update information continuously. Users can manage information online with the ability to search for desired topics, download and save information, and engage in two-way communication for information sharing and emotional support (Brashers, Goldsmith, & Hsieh, 2002). This combination of information acquisition and management is another motivating feature of the web.

Following usability guidelines

Online health information should be designed to be easy to find, relevant, and easy to use, especially for people with a low level of health literacy (Benigeri & Pluye, 2003; Nielsen, 2000). People are more motivated to use web sites that empower them find what they want conveniently and are easy to use. Health information web sites should apply usability standards that have been tested and validated. For example, users need to know where they have been in a site (with visited links appearing in a different color than unvisited links), where they can go (with menus and links displayed clearly on the page), and how they can search the site (see Nielsen, 2000, for many evidence-based guidelines for web usability, and also see an extensive set of research-based usability guidelines for health content developed by the National Cancer Institute http://usability.gov/guidelines/).

User control

Involved users, who by definition are goal-oriented in their health topic searching, are much more effective in their searching and satisfied with the results when they have access to health information sites that provide a great deal of user control (Rimal & Flora, 1997). Both involved and uninvolved users experience higher levels of enjoyment, increased learning, and more desirable health behaviors when they perceive that they have high user control (Dede & Fontana, 1995; Dutta-Bergman, 2004). Designers can increase the appeal and utility of health web sites by enabling users to control the selection and management of health content, with few constraints on the pathways they can choose to take through the content.

Recommendations

We recommend that government health web sites continue to offer content that is written clearly and simply, to accommodate people who have low health literacy skills, and that they also incorporate the attractive and motivating features found more often in commercial health sites. Interactive tools can support learning and self-assessment, and search engines empower users to find the content they want. Health content can now be targeted to specific segments, tailored to individuals, and customized by individuals, so it is possible to offer on one site a variety of presentation modes and levels of choice and complexity, to suit each user's abilities and preferences.

Research is indicating that people with novice-level technology skills can easily and enthusiastically learn basic web navigation skills (e.g., Zarcadoolas et al., 2002). Therefore, all web content—even the content designed for people with low health literacy—can be formatted into a standard web interface that calls on the user to use menus, links, and mouse clicks to navigate through the content. Novices need more guidance to navigate the web, but if it is provided online they are able to succeed.

Health web site designers can use theory and research from the field of persuasion to develop content that will appeal to two kinds of web users: those who are involved in a particular topic and are motivated to learn about it (sometimes called "searchers"), and those who are hardly involved or completely uninvolved ("surfers"). It is important to serve the needs of both, by offering a mix of content, some geared to involved people who want detailed information on a topic and some geared to people with low involvement who may be drawn to content that is highly appealing, fun, and easy to grasp even when attention is fleeting.

Anonymity can be very appealing and motivating to people who seek information and interactive feedback, yet do not want to share their health questions with other people. For example, people who engage in high-risk behaviors may not want to share that information with peers or counselors, and people who tend to avoid health information about certain topics, due to cultural norms or upbringing, are more likely to seek information when it is useful to them and they can obtain it anonymously. Health web sites may attract more users and more participation by their users if they do not require registration, sign-in, or any other process that asks the user to provide their name or contact information, which could be perceived as a threat to anonymity and privacy.

People are more highly motivated to search for health information online when a web site offers tools for information management. In addition to offering excellent information, health web sites can provide management capabilities, for example with search tools, bookmarks, logbooks and other forms of record-keeping, and opportunities to communicate and share information with others both asynchronously and in real-time.

Web users want ease of use and user control, the ability to forge their own pathway through online content and interactive tools. Health web sites will be more attractive, useful, compelling, and motivating if the user experience is satisfying and productive.

Interactivity

Interactivity has been defined as responses—between two people or between a person and a computer-based system—that take into account some or all of the previous messages exchanged between user and computer, in much the same way people respond to each other when engaging in conversation (Rafaeli, 1988). Many studies have found that people respond to interactive media messages in very social and natural ways, and they have more favorable attitudes and emotions when media messages conform to their expectations of politeness, teamwork, cooperation, personality, gender, and conversational style (Reeves & Nass, 1996). An experiment comparing web content presented with low or high interactivity found that users in the high interactivity condition reported greater satisfaction, effectiveness, efficiency, and value, and held more positive attitudes towards the web site (Teo, Liu, & Wei, 2003).

Interactive tools can attract users to a health site

Interactive navigational features and tools have the potential to bring users to a health site and hold them there, and to instill positive emotions that may enhance the processing and retention of health content (Fogg, 2002; Lieberman, 1992; Schwitzer, 2002; Witherspoon, 2001). Examples of interactive navigational features include:

- Search engines
- Personalized front page (or home page) on a health web site
- FAQs (Frequently Asked Questions about health, and their answers)
- Newsletters and other "push media" sent to the individual via e-mail
- Online shopping
- Putting one's own health data, or children's health data, into a personal medical record
- Logbooks for recording food eaten or daily exercise

- Chat rooms focusing on a health topic
- Asynchronous messaging: bulletin boards, message boards, listservs, asynchronous chat
- Calendars
- Tutorials
- Quizzes to test one's health knowledge or to assess one's health behaviors
- Surveys to gather information from a group and then share findings with the group
- Interactive games
- Health risk appraisals
- Calculators that provide the odds of a health problem occurring for the individual user
- Videos of physicians, videos of patients who have experienced certain treatments, tests, or changes in health behavior

However, a study of the 30 most widely cited and recommended health web sites (10 each of commercial, organizational, and government sites – .com, .org, and .gov) found that only a few interactive tools appeared in the majority of the sites (Stout, Villegas, & Kim, 2001). More than three quarters of the sites provided (in descending order) links to other sites, links within the site, e-mail, a search engine, or a site map. One half to three quarters of the sites included pull-down menus, an advanced search engine, FAQs, links to additional software, or a newsletter. One quarter to one half of the sites offered surveys, cross-promotions, online orders, inputting personal health data, information about classes, message boards, audio, quizzes, special offers, or chat. Less than one quarter of the sites contained video, personalized front page, text-only version, games played versus the computer, sweepstakes, e-postcards, personalized messages, push media, virtual reality, calendars, or recruitment of participants for medical research.

The commercial sites were most likely to provide interactive tools and the organizational sites were the least likely to provide them, of the three types of sites. The authors did not investigate the prevalence of specific types of e-tools, such as BMI calculators, calorie counters, exercise logs, calculations of calories expended, and health risk appraisals—tools that are becoming increasingly available on health web sites.

Logbooks and decision support

Web content can be designed to influence and enable decision-making, such as by displaying attitude-reinforcing reminders and cues at strategic places and times or providing pop-up windows that require a thoughtful decision (Fogg et al., 2002). Health information web sites, for example, could remind people about their attitudes about the importance of diet, exercise, or immunizations, if they are keeping a logbook and it indicates that the user has not met nutrition, exercise, or immunization goals. In sites where users can take action, such as purchasing a product that will help them meet their prevention or selfcare goals, or joining an online support group, the site can be designed to make the purchase or sign-up very easy to do.

Studies of computer systems that are integrated with exercise equipment to provide a logbook with feedback on the user's progress have found that the record-keeping function can motivate users so that they improve their attendance at the gym and their adherence to their exercise goals (Annesi,

1998). While not as convenient as keeping a record on site at the gym, a web site could offer similar kinds of logbooks to support health behavior such as exercise, healthy eating, and stress management.

Tailored content can be highly motivating and effective

Because the web is a two-way interactive medium, health web sites can be designed to select and present messages for an individual based on his or her characteristics, which the system has obtained from an external source, from results of a test or other online task, or directly from the individual via an online questionnaire about behaviors, beliefs, culture, health status, or personal preferences, for example. The system may infer certain characteristics based on demographic and other data, and it may also make inferences based on the individual's current online information choices. (See the next section on recommendation systems for more on inferences about the user.)

Health information that is tailored according to information about the individual offers a variety of benefits. Many studies have documented the advantages of tailored over non-tailored health information and have found that tailored messages are read more often, are attended to more closely, are better remembered, are perceived as more credible, and usually result in more health behavior change (Kreuter et al., 2000; Kreuter & Stretcher, 1996; Kreuter & Wray, 2003; Rimal & Adkins, 2003). Tailoring was discussed earlier in this report, but it is mentioned here because it is an important example of the effective use of interactivity to improve health information seeking and processing, and to improve health behavior change.

Here's an example of how tailoring could be done. For health messages aimed at changing people's health behavior (e.g., smoking cessation, safety precautions, diagnostic screening), tailoring could be based on a person's stage of health behavior change, or readiness to change behavior. Stage of change could be one of many dimensions (e.g., cultural, psychosocial, and/or demographic variables) used in the tailoring of a health message. Research in this area has shown that people have different information needs depending on their stage of change, and health messages accounting for stage of change should help move people from their current stage to the next stage in the progression (see Prochaska, DiClemente, & Norcross, 1992 and Witte, Meyer, & Martell, 2001, for further discussion). The five stages are:

- Precontemplation—unaware of risks or solutions
- Contemplation—begin to think about risks and possible solutions
- Preparation—make a commitment to change and learn more about the new behavior
- Action—perform the new behavior consistently
- Maintenance—maintain new behavior, avoid relapse

People in the precontemplation stage are best served by messages that identify a health risk and recommend a feasible and effective response. In the contemplation stage they should receive motivational messages. When in the preparation stage, motivational messages are also effective and so is specific information about what to do and what to expect when the behavior is actually changed. People in the fourth stage, action, benefit from information and from messages that help improve their self-efficacy (belief that they can successfully carry out the activities involved in the new health behavior) and response efficacy (belief that the new behaviors will really make a difference in one's own health), and they also need to learn how to remove the barriers that make it difficult to carry out

the new behavior. Information needs in the maintenance stage are similar to the action stage, but there should be more emphasis on long-term strategies for continuing the desirable health behavior.

Games can motivate learning and teach content and skills

Interactive games can bring users to a web site and can help improve health behaviors even if users are not motivated to seek information about a particular health topic (Lieberman, 1997). Research has found that well designed health games can improve players' knowledge, skills, self-esteem, self-efficacy, communication and social support, health behaviors, adherence to a prescribed regimen, and health outcomes (Lieberman, 1997, 2001a; Thomas, Cahill, & Santilli, 1997)

Games require a certain amount of attention and response; and some are extremely demanding. Players actively participate in a game—applying knowledge, making decisions, using skills, and seeing the outcomes. Interactive games engage players in what has been called "productive play," the learning that occurs through the activities in a game, such as building virtual worlds, manipulating simulations, and solving problems (Rieber, 1996). It has also been called "serious play" (Rieber, 1998) and "hard fun" (Papert, 1993, 1996). People who tend to be uninspired by more traditional modes of teaching and learning are often happy to be engaged by the hard fun of interactive games (Betz, 1995; Ermi, Helio, & Mayra, 2004; Papert, 1993).

Participation in a challenging activity bounded by rules often brings a sense of pure concentration and immersion, or "flow" (Csikszentmihalyi, 1990, 2000). It is a state of pleasure, well-being, and increased cognitive efficiency that occurs during an absorbing task. People experience flow when they are challenged enough to do their best, yet not challenged beyond their abilities. Flow is a characteristic of optimal experience and can occur whenever an activity involves intense focus and a sense of control—during work, creative endeavors, sports, or play. People in a state of flow often lose their sense of time and place while they are completely absorbed in the concentrated effort. Children and adults enjoy being in a state of flow when playing a challenging yet achievable interactive game.

Collaborative filtering

Web sites can be designed to select and present information specifically for the individual, automating the process of "word-of-mouth" by which people recommend products or services to one another. When people, such as health information seekers, have a variety of choices with which they have very little experience, they will often rely on the opinions and behaviors of others who do have experience in that area. However, when there are thousands of options, as in the web, it becomes practically impossible for an individual to locate reliable experts to give them advice about each of the options. Shifting from an individual to a collective method of recommendation makes the problem much more manageable.

Collaborative filtering is being used increasingly in electronic commerce, which leverages the interests of entire communities to provide targeted, personalized recommendations of interesting products or resources to individuals. Amazon.com uses this method, for example, to recommend books to the individual user, based on the user's previous book purchases and on book purchases by consumers who share some characteristics or buying habits with the user.

This process of generating individualized recommendations by analyzing the choices of many like-minded people has been given various names, such as recommendation agents (Ariely, 2004),

recommender systems (Burke, 2002), personalized information (Cawsey, Jones, & Pearson, 2000), user-adaptive systems (Alpert et al., 2003), collaborative filtering (Recker, Walker, & Lawless, 2003), and automatic filtering (Waern, 2004). They are all similar in that the system produces recommendations and/or guides the user in a personalized way to interesting or useful content. This process can be especially valuable in an environment, such as a health information system, where the amount of available information vastly outstrips any individual's capacity to peruse it.

Following is the way many collaborative filtering and recommender systems work:

- The system records the stated preferences or online choices of a large group of people.
- A similarity metric identifies people with similar patterns of interest, or shared characteristics, and they are categorized into audience segments.
- A (sometimes weighted) average of the preferences of each segment is calculated
- The system recommends options, based on the preferences of the entire segment, that have a high probability of meeting the individual's needs.

Four types of recommender systems are described by Burke (2002), as follows:

- **Collaborative recommender systems** aggregate users' ratings or recommendations, recognize commonalities between users on the basis of their ratings, and generate new recommendations based on inter-user comparisons. Demographic recommender systems aim to categorize the user based on personal attributes and make recommendations based on demographic classes. A content-based recommender learns a profile of the user's interests based on the features present in objects the user has rated.
- **Utility-based and knowledge-based recommenders** do not attempt to build long-term generalizations about their users, but rather base their advice on an evaluation of the match between a user's current need and the set of options available. Utility-based recommenders make suggestions based on a computation of the utility of each object for the user. A key problem is figuring out how to create a utility function for each user.
- **Knowledge-based approaches** have functional knowledge about how a particular item meets a particular user need, and can therefore reason about the relationship between a need and a possible recommendation.
- **Hybrid recommender systems** combine two or more recommendation techniques to gain better performance with fewer of the drawbacks of any individual one.

A study compared a personalized vs. nonpersonalized information system for patients with cancer (Cawsey, Jones, & Pearson, 2000). The personalized version of the system generated web pages that explained diseases, treatments, measurements, and other information related to the patient's condition, using information in the patient's medical record as the basis for selecting appropriate information. A controlled trial found that participants preferred the personalized system, rated the information as more relevant, reported higher satisfaction with the system, and felt they learned something new.

A system that matched lessons with the learner's preferred way of learning was more effective than a non-adaptive system, in a recent study. Learners were more likely to accomplish their learning goals with learner-matched lessons (Papanikolaou et al., 2003).

A series of studies of a collaborative filtering system was conducted in educational settings (Recker, Walker, & Lawless, 2003). The system successfully helped users find useful resources for learning, and it brought together people with similar interests and beliefs, which also has the potential to improve learning.

The aim in information filtering is to provide users with a personalized selection of information, based on their interest profile. In adaptive information filtering, this profile is partially or completely acquired automatically. A study (Waern, 2004) found that it was possible to modify users' interest profiles both automatically and by allowing the user to modify the logic of the filter directly.

Another study (Alpert et al., 2003) found that users wanted control of adaptive systems and they found it hard to believe that these systems can accurately infer their needs, goals, or interests. Study participants expressed a strong desire to know the site's rationale for displaying particular content.

Recommendations

Many health web sites are failing to use interactivity effectively to motivate and support health information seeking and health behavior change. Several examples of interactive tools are listed above and have the potential to enhance a health web site. For example, logbooks that enable users to save information about their daily exercise or food intake could be combined with an e-mail reminder system that would note when the user did or did not achieve specific goals. The reminder system could point out the user's the successes and failures, providing congratulations or words of encouragement. Health web site designers should integrate appropriate and well-designed interactive tools into their web sites, both to attract users and to support their learning and health behavior change.

Message tailoring is an example of interactivity; tailored messages are selected by the system to most closely address the needs and characteristics of each individual user. Research has demonstrated a variety of ways that message tailoring can influence health attitudes, knowledge, and behaviors more effectively than nontailored messages can. We recommend the use of message tailoring, based on a careful and systematic program of research conducted with the site's intended users.

Interactivity is an inherent characteristic of electronic games, which can be provided on health web sites. Not only would one or more games attract uninvolved people to a health web site, if well designed they would also provide valuable experiential learning, where users would be able to explore health questions, learn and rehearse prevention and selfcare skills virtually, and improve their health self-efficacy.

Collaborative filtering systems offer another promising way to use interactivity in health web sites. By compiling the choices and preferences of other users who are similar to the individual user, the system can suggest content the user is very likely to appreciate and use. Health web site designers should provide on the site a list of the criteria used to conduct collaborative filtering, so users can decide for themselves whether the recommendations are likely to be personally relevant and worthwhile.

Interpersonal communication via the web

In addition to being a medium of communication, the web is a channel for interpersonal communication. Message boards, e-mail, online chat, and online support groups are a few of the contexts in which people can communicate synchronously or asynchronously (Rice, Peterson, & Christine, 2001; White & Dorman, 2001).

Online support groups

For people with health problems, online support groups provide information, support, and a sense of belonging and acceptance (Preece & Ghozati, 2001; Sharf, 1997; Winzelberg et al., 2003). These groups may be the only viable form of support for people who are homebound; or who have stigmatized illnesses or contagious diseases and find it difficult to attend a face-to-face group meeting; or who have unusual problems so they don't know anyone in their geographical vicinity with the same concerns (Davison, Pennebaker, & Dickinson, 2000).

Several studies (Rice, Peterson, & Christine, 2001; White & Dorman, 2001) identified benefits and drawbacks of online support groups. For example, members of the groups develop supportive relationships with peers and caregivers and they appreciate the opportunity to give and get social support. There is a great deal of sharing of information, insights, and experiences online, and individuals feel they have plenty of opportunity to request and receive information from others. Participants also note that online support groups help them make health decisions. On the other hand, groups can spread misinformation, which is especially problematic when the topic is prevention and treatment of health conditions.

Online games

Games were discussed in the previous section on Interactivity, but online games are worth mentioning here because they can facilitate interpersonal communication. Multiplayer games provide a social context, and designers should consider ways to use game-related social interaction and communication to enhance learning. When people, especially those with health problems, have opportunities to talk about their health with others they are likely to receive more social support, and this can leads to better selfcare, health, and more effective coping when problems arise (Peterson & Stunkard, 1989).

A health game could be a springboard for conversation about health. Imagine, for example, an online multiplayer game about asthma. If the game requires players to keep an asthmatic character healthy through proper self-care, they may discuss strategies for helping that character avoid environmental triggers that set off asthma attacks, and choices of medications and activities. This is what happened with a Nintendo game for asthma (Lieberman, 2001b), although it was not a networked game. Two players could play the game together in the same room.

Recommendations

Health web site designers should consider offering asynchronous and real-time communication channels to users online. Not only does discussion have the potential to offer information and social support, it can also motivate people to look up more information online for personal use and to share with the group. Online games draw users to the site, have the potential to teach health skills, and facilitate interpersonal communication about health.

Learning, decision-making, and behavior change

The web has the potential to support learning, build users' awareness and knowledge about their own health, present an array of prevention and treatment choices, support decision-making, and move each individual through the decision-making process (Baur, Deering, & Hsu, 2001; Rice, Peterson, & Christine, 2001).

Multimodality

Web sites can employ multiple modes of presentation, including text, sound, narration, language, pictures, graphs, diagrams, animation, video, and simulated virtual environments, and can allow users to select the mode(s) they prefer to use to acquire health information. Users can also be given the option to make adjustments within a particular mode, such as changing the size of text, selecting the language, or pausing or slowing down a video segment (Rimal & Flora, 1997). Some studies have demonstrated the effectiveness of combining two or three modalities (Mayer & Moreno, 2002; Riegeluth & Squire, 1998).

Learning styles

Because people vary in their learning style, health information can be presented with a variety of styles, to make use of each individual's own set of "multiple intelligences," such as verbal, numerical, or kinesthetic intelligence, so that users can select the presentation formats or modalities that suit their own learning style (Gardner, 1993). For example, visually oriented learners may prefer to see illustrations while numerically oriented learners may gain the most if they can see data displayed in charts and graphs.

Interactive characters and agents

Animated characters and helpers are beginning to appear on web sites, and they can serve as effective pedagogical agents to support learning, using rich conversational styles, providing specific performance feedback, and establishing an interactive relationship with the user (Amory et al., 1999; Hayes-Roth et al., 1999; Jayakanthan, 2002). One study found that college students who received lessons in biology by interacting with an animated pedagogical agent were more interested in the lesson and were better able to transfer the skills they learned in the lesson, compared to students who did not interact with an agent (Moreno et al., 2001). Also, they learned biology concepts more deeply and thoroughly from an interactive simulation game when an on-screen agent spoke to them in a personalized style (saying "I" and "you") rather than a nonpersonalized (third-person monologue) language style (Moreno & Mayer, 2004).

Strategies for using interactive media for health learning and behavior change

An analysis of the research literature on interactive media, learning, and health promotion yielded a set of overarching recommendations for the design of interactive media for health campaigns targeted to children and adolescents (Lieberman, 2001b). Research conducted with adults and cited in the review confirms that the some of the recommendations are pertinent to all ages, and those recommendations include:

- Use the target audience's preferred media and genres, to reduce psychological distance and increase attention and perceived personal relevance
- Use characters that appeal to the age group, so that they serve as attractive role models, enhance observational learning, increase perceived personal relevance, and increase self-esteem
- Support information searching, through high levels of user control, easy access to content, and the use of games that can encourage information seeking
- Incorporate challenges and goals, to motivate users to learn and to increase user involvement and engagement in the content
- Use learning-by-doing, so that users vicariously experience prevention and selfcare behaviors, and applied decision-making, and develop self-efficacy in the process; in an environment that provides repetition and rehearsal of skills, rule-based outcomes, individualized feedback, and counterarguing against commercial messages
- Create functional learning environments, with personally meaningful activities, goal-driven activities, applying one's knowledge to real-world problems, sharing ideas and activities with others, and telling personal success stories
- Facilitate social interaction, so that users can share social support, discuss campaign topics, communicate with experts, and participate in interactive stories
- Allow user anonymity when appropriate, especially when a topic is sensitive, to encourage honest and candid participation
- Involve users in product design and testing, because their ideas and feedback will help develop content and formats that their target user group will be more likely to enjoy and use.

A review of the literature on the effectiveness of online learning (Coomey & Stephenson, 2001) identified four major features that, when well designed, can lead to better learning outcomes on the web:

- Learner control over the selection of content, processes of learning, pacing, and management of information
- Interpersonal communication via the web
- Learner support and help, from teachers and from interactive feedback provided by the system
- Direct involvement in learning tasks and collaboration with others

Computer-tailored nutrition education can motivate people to make healthy dietary changes. One system (Brug, Oenema & Campbell, 2003) provided respondents with individualized feedback about their dietary behaviors, motivations, attitudes, norms, and skills and it emulated the process of "person-to-person" dietary counseling. The research found that computer-tailored nutrition education was more effective in motivating people to make dietary changes (especially reduction of fat) than was general, non-tailored nutrition information. The effectiveness of computer tailoring has been attributed to the fact that individualized feedback commands greater attention, is processed more

intensively, contains less redundant information, and is appreciated better than more general intervention materials.

Interactive learning

Hundreds of studies demonstrate that people learn information, skills, and higher-order thinking strategies when they use appropriately designed interactive media for learning (see Fletcher-Finn, 1995; Jayakanthan, 2002; Kozma, 1994; Kulik & Kulik, 1991; Mayer & Moreno, 2002; Subrahmanyam et al., 2001; Wartella & Jennings, 2000). Learning is especially well supported when learners proceed at their own ability level and pace, receive individualized and constructive performance feedback, and review material until they understand it thoroughly (Jonassen & Land, 2000; Riegeluth & Squire, 1998). These features can be built into interactive health content, progressing from easy to difficult levels of challenge, responding immediately to the player's input, providing remedial help when needed, and offering unlimited opportunities to rehearse and retry.

When interactive online learning programs challenge users to reach a goal, they have the chance to apply important skills in a realistic setting with realistic consequences. To succeed in the situation, they become especially mindful of the content they need to know and the skills they must apply, and they use effortful and strategic processes of thinking (Lieberman & Linn, 1991; Potter, 1999). Their close attention and mental effort lead to deeper understanding, learning, and retention of the material (Choi & Hannafin, 1995).

A simulation is a representation of a physical or social system that lets the user change its parameters and observe its dynamics (Aldrich, 2003; Heinich et al., 1996). It is an algorithm-based artificial world that has some properties of the real world. For example, there are simulations that enable users to learn how ecosystems work, how to lead a country and deal with international conflict, how chemicals interact, how to live daily life in an ancient civilization, how to fly an airplane, how to use food and insulin to keep a diabetic character's blood glucose in the normal range, how to manage a city, how to build a business, how to diagnose and treat a patient, how to keep a family happy and thriving, and so on. Simulations can simplify a view of a system by eliminating some of the variables; they can speed up or slow down time so that processes and outcomes are easier to observe; they allow the user to manipulate variables that are not alterable in the real world (such as raising the earth's temperature to observe the impact of global warming); and they are safe because any dangerous outcomes, such as death, war, a chemical explosion, a plane crash, hypoglycemia, a nuclear accident, or melting of the polar ice caps are depicted but not physically experienced.

Recommendations

Beyond displaying information, health web sites can offer interactive learning experiences, using building blocks such as simulations, interactive tools, multiple modalities, learning styles, interactive agents, and personalized feedback. We recommend that health web site designers find ways to integrate interactive learning into their sites, perhaps at first by introducing some interactive tools to enhance existing health content, and then, with more resources and experience, acquiring or designing lessons and learning environments such as simulations.

Interactive media such as the web can stimulate learning by enabling users to test hypotheses in simulated worlds, see knowledge represented via multiple representations, work collaboratively in person or online, and receive individualized instruction and feedback.

Question 4: Summary of Findings

Question 4 asked, "How can prevention information be presented effectively online?" The research reviewed in this section identified characteristics of online media that contribute to users' trust, engagement and learning from these new technologies. The evidence suggests that highly interactive features within the online environment that are tailored to the learning styles and motivation of individual users can effectively engage those individuals and contribute to improved learning. It should be noted, however, that many of the features discussed here are costly to develop and therefore may not be immediately applicable to government agencies that are working within significant resource constraints. These agencies may need to rely more heavily on text as a mode of presentation than on non-text modes. Unfortunately, one significant research gap emerged from the present review: there is little published research that tests the design and implementation of expository text about health to support the development of text-based modes of presentation that enhance engagement, comprehension, learning, decision-making and behavior change. This is an important area in which considerably more research is needed.

Conclusion and Recommendations

This paper set out to examine the recent research literature to assess the evidence for answering four key questions:

- Which audience characteristics are the strongest determinants of homogeneity in terms of needs and abilities for seeking, using, and processing prevention information?
- In what ways and to what extent is currently available prevention information responsive to these patterns?
- Is prevention information that is targeted in content, design, and delivery to different audience segments based on these characteristics better received and more likely to lead to preventive decisions and actions than information that is not targeted on these characteristics?
- How can prevention information be presented effectively online?

One overall limitation is the fact that the literature review was confined primarily to research published within the past five years. Although this is appropriate for much of the information describing online communication, the search may have missed some useful findings about effective health communication to diverse populations that was published prior to 1999.

Most of the research that has been conducted on people's needs and abilities for seeking, using and processing prevention information has focused on health information-seeking. This research has looked primarily at the impact of gender, age, education and income on health information-seeking behaviors. The evidence is clear that affluent, well-educated women are the most active health information seekers; this pattern is independent of race/ethnicity. While race/ethnicity influences access to the Internet, differential levels of access are rapidly changing. Further, the research is clear that most Americans do not search for health information on a frequent basis.

Relatively few studies have examined how people use or process health information. The research generally supports the finding that tailored and targeted materials that respond to some characteristics of the individual, such as readiness to change a behavior or their religiosity, can be effective in engaging their interest and leading to health behavior change. There are only a handful of studies that examine health information behaviors among ethnic minority populations and/or low literate populations; those addressing the latter group have been primarily exploratory in nature. More information is needed, particularly more information on the health information-seeking, using and processing of persons with low health literacy.

Given the lack of evidence for the first question, it is impossible to adequately address the following two questions since both require a better understanding of audience homogeneity around health information-seeking dimensions. There has been relatively little research conducted about mediated interventions in several key prevention topics; what research has been conducted has not addressed issues about how to successfully segment the audience. Further

research on topics such as immunization, injury prevention and adult substance abuse prevention is clearly needed.

The strongest evidence base exists in support of the fourth question about the effectiveness of online information, particularly in the area of games, user control and interactivity. Although this information has been developed in regard to health web sites rather than specifically in regard to prevention content, much of the learnings can be applied to the presentation of prevention content online. Nonetheless, many of these questions are supported by only a handful of studies and further research about the effective presentation of online health prevention information is strongly recommended, particularly in the effective presentation of prevention information using text as the primary mode of presentation.

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Appendix 1. Search Terms

In conducting the literature review, the following search terms were used:

- Health promotion
- Health promotion + interactive media
- Health promotion + comprehension
- Health education
- Health literacy
- Literacy
- Consumer health
- Internet
- Internet use
- Marketing research + audience segmentation
- Audience
- Culture
- Social marketing
- Audience segments + internet use
- Health promotion campaigns + good nutrition
- Health promotion campaigns + physical activity
- Health promotion campaigns + overweight
- Health promotion campaigns + tobacco use
- Health promotion campaigns + substance abuse
- Health promotion campaigns + injury prevention
- Health promotion campaigns + youth risk-taking
- Health promotion campaigns + immunization
- Health promotion campaigns + preventive screenings
- search and health information
- search engine and health information
- web navigation and health information
- Internet navigation and health information
- information seeking and health
- online navigation and health information
- push, web, and health information
- push, Internet, and health information
- push, online, and health information
- health literacy and Internet
- health literacy and web
- health literacy and online
- cognitive involvement and health information
- emotional involvement and health information
- persuasion and health information
- health web site design
- interface design for online health
- health information design
- images and health information
- visual and health information
- multimodal health information
- online health information and learning
- online health information and behavior change
- online health information and attitude change
- online health information and motivation
- Targeting
- Tailoring
- Behavior
- Health
- Information
- Communication
- Interventions
- Media
- Computer
- Network
- Web
- Online
- Kiosk
- Wireless
- Handheld
- Information

- Information seek
- Information search
- Health search
- Health topic search
- Credibility
- Perceived quality
- Perceived usefulness
- Attention
- Interest
- Satisfaction
- Engage
- Involve
- Mental effort
- Motivation
- Process
- Decision
- Decision making
- Decision support
- Behavior
- Health behavior
- Behavior change
- Intent
- Learn
- Educat
- Know
- Understand
- Teach
- Pedagog
- Skill
- Usability
- Web usability
- Internet usability
- Online usability
- User test
- Web page
- Web site
- Web design
- Web feature
- Interact
- Responsive media
- Game
- Simulation
- E-tool
- E-health
- Interactive tool
- Feedback
- Support group
- Chat
- Bulletin board
- Human-computer interaction
- HCI
- Personaliz
- User preference
- User control
- Target
- Tailor
- Segment
- Comprehension
- Ability
- Access
- Filtering
- Collaborative filtering
- Automatic filtering
- Adaptive filtering
- Recommendation system
- Theory
- Model
- Outcome
- Methodology
- Research method
- Experiment
- Survey
- Clinical trial

Appendix 2. Mass Media Use Characteristics

Demographic	Findings
Age	
Toddlers and Preschoolers[a]	• Almost all homes (95%) with children zero to six have at least one VCR or DVD player. • A high proportion of very young children are using new digital media, including 50% of four-to-six –year-olds who have played video games and 70% who have used computers; • Those who use a computer spend an average of just over one hour at the keyboard. • More than half (56%) have used a computer by themselves (without sitting in a parent's lap); • Many children under six direct their own media use, such as turning on the TV by themselves (77%), using the computer by themselves (33%), loading their own CD-ROMs (23%), and asking for specific websites while surfing the Internet (12%). • Among four to six-year-olds, about one in six (16%) plays a video game on a typical day, averaging a little over an hour at the controls. Boys (24%) are more likely to play video games than girls (8%).
Adolescents[b]	• Male adolescents between 12 and 17 spend about 16% of the time they spend with media each day on the Internet and 15% of their time with video games. • 70% of youths have a radio in their room, 64% have a tape player, 53% have a TV, and 51% have a CD player. • 21% of children 8 and older have computers in their rooms. • 20% of teens recommend marketers use the Internet to communicate with them; 24% recommend broadcast TV. • Only 12 % of teens say they pay the most attention to Internet advertising and advertising on cable TV, magazines, and radio is perceived as more effective • 95% of all 15-17 year olds have gone online with 83% having Internet access from their home, and 29% have Internet access from their bedroom.
Young Adults [c]	• 80% of 18 to 34 year olds in the New York City metro area get their information from the Internet, 55% get information from a daily newspaper, and 79% get information from the TV • 34% of all Internet users are 18-34. These 18-34 year olds also account for 38% of total minutes spent online and 40 percent of all pages
Adults [d]	• 16 million 55-64 year olds use the Internet. Approximately 40 million (the largest segment by age) 35-49 year olds use the Internet • 45.5% of 35 to 44 year olds, 43.8% of 45 to 54 year olds, and 30.5% of 55-64 year olds have access to and use the Internet at home

Older Adults [e]	• Older adults pay the least amount of attention to health topics on the internet, as compared to similar topics on TV to which they pay the most amount of attention.
Race/Ethnicity	
Whites [f]	• White adults watch approximately 14.1 hours of television in a week. • White adults spend 8.2 hours per week listening to the radio. • White adults spend less than 5 hours per week reading a book or magazine. • White adults spend .9 hours per week playing video games.
African Americans [g]	• African Americans spend 17 hours per week watching television. • African Americans spend 10.2 hours per week listening to the radio. • African Americans spend 6.8 hours per week reading books or magazines. • African Americans spend .9 hours per week playing video games.
Latinos[h]	• Hispanic audiences are more likely to get healthcare new from television news (60%) than from the Internet (17%) or newspapers (12%) • The reliance on television as a source of healthcare news is more pronounced among those who rely on Spanish language media (80%) than those who consume English-language news (41%). • Among Hispanics who get their news in English, 30% use the Internet for this purpose, compared to 2% of those who get their news in Spanish.

[a] Henry J. Kaiser Foundation conducted a study of electronic media in the lives of children from infancy through age 6 (Rideout and others, 2003).

[b] (Mandese, 2004), (from Review of Literature and Secondary Research on Generation Y, 2000, footnote 112: "Kids Use Media Nearly 40 hours a Week," *Advertising Age*, November 29, 1999, (from Review of Literature and Secondary Research on Generation Y, 2000, footnote 113: "Kids and Media," *Kaiser Family Foundation*, November, 1999), (from Review of Literature and Secondary Research on Generation Y, 2000, footnote 119: Zollo, Peter, "Wise Up To Teens: Insights Into Marketing and Advertising to Teenagers," *New Strategist Publications*, 1999), ("Generation Rx.com: How Young People Use the Internet for Health Information", Kaiser Family Foundation, December, 2001)

[c] (Madore, James T., "Why Won't Johnny Read?: If you're 18 to 34 and reading this, your secret's safe with us. Many young adults are rejecting the traditional news media." *Newsday*, Feb 3, 2003), viewed (Greenspan, Robin, "Report: 18 to 34 Year Olds Are Well-Connected," ClickZ News, March 29, 2004).

[d] (Coombes, Andrea, "Retired, and more wired: Older Americans ramp up Internet use; site designers have yet to catch up," CBSMarketWatch.com, November 23, 2003), ("Home Computers and Internet Use in the United States: August 2000," U.S. Census Bureau, September, 2001).

[e] (from The Health Information National Trends Survey, National Cancer Institute)

[f] (Cole, Jeffrey, "Internet Use, Mass Media and Other Activity in the UCLA Data," IT & Society, Fall 2002)

g (Cole, Jeffrey, "Internet Use, Mass Media and Other Activity in the UCLA Data," IT & Society, Fall 2002)

[h](Hispanic Media Survey, Pew Hispanic Center, 2004)

Appendix 3. Online Use Characteristics

Age	
Children and Adolescents[a]	• About 8.4 million 13-18 year olds were Internet users in 1998. By 2003, 27% of Internet users will be under 18 years old and 72 percent of all teens will be online • Children ages 12-14 spend 6 hours per week on the Internet, and children ages 15-17 spend 7 hours per week on the Internet • 52% of adolescents use the Internet at school and 95% use computers. By 2002, 20.2 million students will have Internet access in the classroom. In 2000, 90% of public schools had Internet access. 50% of adolescents use the Internet when doing their homework; 90% use the Internet "to learn" • 49% of teens find online advertising "annoying and uninformative" and 86% of teens pay less attention to ads on the Internet than to ads in other media • 90% of all 15-24 year olds have gone online and 68% have gotten health information online. 24% have gotten "a lot" of health information from the Internet. Of the 90% who have gone online, 75% have used the Internet at least once for health information, and 50% have used the Internet to look up information on a specific disease • 74% of all 15-24 year olds have Internet access from their home. Of the 90% who have ever gone online, 49% go online at least once a day, and 78% go online at least a few times a week • 60% of 15-24 year olds searching for health information on the Internet started their search with a search engine - 23% came across the information while surfing the web and 16% went directly to a particular site. • 77% of 18-29 year-olds currently go online, as do 75% of adults 30-49, 58% of adults between 50-64, and just 22% of adults 65 and older
Adults[b]	• Computer use is around 70% among adults 26-55 and evenly distributed across this age range. Internet use among this age group varies between 60-70%. • Women from approximately age 20 to 50 are more likely to be Internet users than men in this same age range.
Older Adults[c]	• Most seniors do not use the Internet, know few people who use email or surf the Web, and are uninterested in learning how to use a computer. Seniors are also more likely than other age groups to have a disability or chronic disease, which could hinder their ability to use the Internet or to access computer training. • The Pew Internet and American Life Project surveyed older adults about their Internet use Their study found that 22% of Americans age 65 or older use the Internet; this is an increase of 47% between 2000 and 2004, making this one of the most rapidly growing segments of the online population. Men and women are equally represented among online seniors.

Race/Ethnicity	
African Americans [d]	• Thirty-six percent of all African-American adults—about 7.5 million people—now have Internet access. This represents an almost 100% increase over the preceding year. Women account for the growth of this population and they (56%) outnumber African-American men (44%) with Internet access. Parents are also a large part of this population; about 53% of online African Americans have a child under the age of 18 at home, compared to 42% of online whites. • Compared to whites with Internet access, the online African American population is proportionally more composed of women, of people with modest incomes, and of people who do not have college degrees. Further, the online African-American population is fairly young, with 56% under the age of 34. In contrast, about 46% of online whites are between 35 and 54 and 14% are over 54. • African Americans with access to the Internet (36%) do not go online as often as whites (56%) on a typical day. • Online African Americans are proportionally more likely than online whites to have searched for information about major life issues, such as researching new jobs and finding places to live. They also more likely than online whites to say the Internet helps them get health care information (45% vs. 35%) and pursue their hobbies. African American women are much more likely to have searched for health information, job information and religious information than men. They are also more likely to have sought entertainment online through music, video and audio clips, and instant messaging. Younger users are considerably more likely than older users to have done so. • Online African Americans are 65% more likely to have searched for religious or spiritual information than White users. In fact, this is the most striking difference between how African Americans and whites use the Internet with 33% of African Americans seeking religious or spiritual information compared to 20% of whites.
Asian Americans [e]	• Asian Americans are the Internet's most active users, with fully 75% of English-speaking Asian-American adults having used the Internet. (In contrast, 58% of white adults, 43% of African Americans, and 50% of English-speaking Hispanics are online.) They are also more likely to be veteran users; 80% have been online for two or more years. Furthermore, Asian Americans are most likely than others to use the Internet on a daily basis: 70% go online daily, compared to 58% of white Internet users, 48% of Hispanics and 39% of African Americans. About 40% of Asian Americans users spend two or more hours a day on the Web, and 15% spend four or more hours online each day. • High rates of Internet use among Asian Americans is consistent with studies that report that higher levels of education and income correlate with Internet access. English-speaking Asian American households tend to have higher incomes and higher levels of education than other ethnic groups. • The Asian-American Internet population is one of the most youthful on

	the Web, with almost two-thirds (63%) of Asian American users between the age of 18 and 34. Asian American baby boomers and elders are less likely than their counterparts in other racial/ethnic groups to use the Internet. • In contrast to other demographic groups, Asian American men (58%) are more likely to be Internet users than are Asian American women (42%). Asian American men also engage in online activities at a higher rate than Asian-American women. The men are more likely to use the Internet to get information, such as financial information, travel information and political news. Women are more likely to search for information on hobbies, to listen to music and to get sports information. • Although Asian Americans are enthusiastic Internet users, they are less likely that other racial/ethnic groups to search for health information on the Internet. Under one-half (47%) have searched the Internet for health or medical information, compared to 57% of online whites, 47% of African Americans and 51% of Hispanics.
Latinos [f]	• Half of Latinos who are 18 and older had used the Internet in 2001. In comparison, 58% of white adults have been online, as have 43% of African Americans. Internet access is evenly split between Hispanic men and women. The online Hispanic population is youthful: 61% are 34 and under. A high proportion is also a parent of children under age 18. • Half of online Hispanics live in households with less than $40,000 annual incomes. Most do not have college degrees, partly because some are not old enough yet to have finished college. • The greatest percentage of Hispanic Internet users (44%) go online only from their homes; 14% do so only from work, and 33% have access at both home and work. The remainder have access at community facilities and friends' homes. • Six out of ten Hispanic users (61%) are online on any given day. More than three-quarters (78%) say they go online at least three to five times a week. While their use of the Internet mirrors that of other racial and ethnic groups, Hispanics users are more likely than online whites to have browsed the Web for fun, listened to music online, downloaded music, played online games, looked for information about books and movies, and sampled audio and video clips. These differences are very likely a reflection of the youthful nature of the online Hispanic community, rather than a statement of cultural differences. • Half (51%) of Hispanics have used the Web to get health and medical information. Hispanic women are more likely than Hispanic men to search for health information. Online Hispanics 30 and older are more likely than younger Hispanics to have sought health information and to have visited government web sites. Four out of ten Hispanics (41%) and almost one-half (49%) of Hispanic women say the Internet has improved their ability to get health and medical information.

[a] (Review of Literature and Secondary Research on Generation Y, 2000, footnote 120: Gates, Suzi, "Digital Kids: Marketing to the Postmodern Kid," *Report from the Jupiter Digital Kids Forum*, June 7-8, 1999); Review of Literature and Secondary Research on Generation Y, 2000, footnote 130:

"Top Ten 'Junior Wired' Cities in America," *Business Wire*, August 17, 1999; Review of Literature and Secondary Research on Generation Y, 2000, footnote 125: Thompson, Bob, "The Selling of the Clikerati," *The Washington Post*, October 24, 1999); (Review of Literature and Secondary Research on Generation Y, 2000); (from Review of Literature and Secondary Research on Generation Y, 2000, footnote 153: "Teens and the Future of the Internet," Cheskin Research, August 1999); ("Generation Rx.com: How Young People Use the Internet for Health Information", Kaiser Family Foundation, December, 2001); ("Generation Rx.com: How Young People Use the Internet for Health Information", Kaiser Family Foundation, December, 2001); ("Generation Rx.com: How Young People Use the Internet for Health Information", Kaiser Family Foundation, December, 2001); (Pew, March 2004);

[b]NTIA, a Nation Online, February 2002.

[c] (Fox, 2004).

[d] (Spooner and Rainie, 2000)

[e] (Spooner, 2001).

[f] (Spooner and Rainie, 2001).

Appendix 4. Summary of Prevention Intervention Literature 1999-2004

Summary of Prevention Intervention Literature 1999-2004					
Author and Title	**Medium**	**Theory**	**Audience**	**Approach**	**Outcome**
PREVENTIVE SCREENING					
Bader and Strickman-Stein, 2003. Evaluation of new multimedia formats for cancer communications.	Print, and Multi-media	None mentioned	Cancer patients and families	Comparisons of print, web, audio, and flash.	Users overwhelmingly preferred the flash formats to the other four formats. Learning occurred equally in all formats.
Campbell et al., 2002. Effects of a tailored health promotion program for female blue-collar workers: health works for women.	Print	Ecological Model of Change	538 rural female blue-collar employees	Computer tailored magazines coupled with a natural helpers program (female volunteers within the community) within the workplace.	Intervention group significantly increased fruit and vegetable consumption, reduced fat intake, and demonstrated improvements in strengthening and flexibility exercises.
Kreuter et al., 2002. The role of culture and health communication.	Various	McGuire's Communication/ Persuasion Model	Primarily African American	Tailoring	Literature Review Article.
Kreuter et al., 2002. Achieving cultural appropriateness in health promotion programs: targeted and tailored approaches.	Print	None specified	African American women	Tailoring	None Reported.
Ryan et al., 2001. Examining the boundaries of tailoring: the utility of tailoring versus targeting mammography interventions for two distinct populations.	Print	Elaboration Likelihood Model	501 women 51 and older	Tailoring	More than 80% of the population received a unique tailored intervention; in 60% of these cases the intervention was a "good" mesh.

Summary of Prevention Intervention Literature 1999-2004					
Author and Title	**Medium**	**Theory**	**Audience**	**Approach**	**Outcome**
Skinner et al.,1994. Physicians' recommendations for mammography: do tailored messages make a difference?	Print	Health Belief Model	435 women	Tailoring	Tailored letter recipients were more likely to read more of their letters than the standard version recipients. Tailoring may be important for low socio-economic status women.
Slaten et al.,1999. Readability of skin cancer prevention brochures targeting parents of young children.	Print	None cited	N/A	Literacy level of skin cancer prevention brochures	Reading levels of available brochures range from 8 to 12.8; most brochures required reading comprehension higher than the average adult.
Valdez et al.,2002. A multimedia breast cancer education intervention for low-income Latinas.	Multi-media	Social learning Theory	1197 Latino women	Kiosk	Intervention increased information seeking among women who had never been screened for breast cancer and those that had not been recently screened. There were significant differences in knowledge and intention to ask a doctor about getting a mammogram.
HEALTHY EATING					
Buller et al., 2001. Formative research activities to provide Web-based nutrition education to adults in the Upper Rio Grande Valley.	Internet	None cited	200 adults Anglo, Hispanic and Native American	Nutrition education website to promote fruit and vegtable intake. Public access computers sites.	Formative research.
Campbell et al., 1994. Improving dietary behavior: the effectiveness of tailored messages in primary care settings.	Computer	Stages of Change	Adult patients from family practices	Tailored nutrition messages	Tailored intervention produced significant decreases in total and saturated fat compared to control group. Recall was twice as high for tailored messages than for non-tailored messages.
Campbell et al., 1999. A tailored multimedia nutrition education pilot program for low-income women receiving food assistance.	Computer based	Social cog theory and Trans-theoretical model	378 low income women enrolled in food stamp program	Tailored soap opera and interactive infomercial providing individualized feedback on dietary fat	Intervention significantly improved knowledge, stage of change and certain eating behaviors.

Summary of Prevention Intervention Literature 1999-2004					
Author and Title	**Medium**	**Theory**	**Audience**	**Approach**	**Outcome**
Frenn et al., 2003. Addressing health disparities in middle school students' nutrition and exercise.	Internet and video	Trans Theoretical Model and health promotion Models	341 Middle school students	Tailoring to participant stage of change: school based	Percentage of dietary fat in the food consumed was reduced significantly among girls.
PHYSICAL ACTIVITY					
Bull et al., 1999. Effects of tailored, personalized and general health messages on physical activity.	Print	None specifically mentioned	272 adults primary care patients	Tailoring	Inconclusive regarding tailoring affects on physical activity behaviors. Patients tailored were more likely than the standard to increase levels of preferred physical activity but not increase leisure time or total.
Green et al., 2002 Effectiveness of telephone support in increasing physical activity levels in primary care patients.	Telephone	None cited	Primary care patients 316 adults	Three sessions of phone motivational counseling	Significantly higher level of self-reported exercise at six-month follow-up.
Kreuter et al., 1999 Understanding how people process health information: a comparison of tailored and non-tailored weight-loss materials.	Print	Elaboration Likelihood Model	198 overweight participants	Tailoring	Participants who received tailored materials had more positive thoughts, personal connections to materials, positive self-assessment thoughts and positive behavioral intentions to lose weight.
Levin et al., 2002 Assessment of a pilot video's effect on physical activity and heart health for young children.	Video	None cited	Children k-2 208 ethnically diverse students	School based	Intervention group had greater gains in knowledge and self-efficacy.
Pinto et al., 2002 Effects of a computer-based, telephone-counseling system on physical activity.	Telephone	Social Cognitive and Trans-theoretical Model	298 sedentary adults	Physical activity counseling system	Participants that completed study expended more calories on a daily basis. Results not maintained at six months.

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Reger et al., 2002 Wheeling Walks: a community campaign using paid media to encourage walking among sedentary older adults.	Newspaper, TV, radio, Website	Elaboration Likelihood Model and Theory of planned behavior.	Sedentary 50-65 year olds.	Paid media, Public Relations and public health advertisements	There was a 23% increase in the number of walkers in intervention community compared to no change in comparison community; 32% of sedentary population met the surgeon general's recommendation for physical activity.
OVERWEIGHT AND OBESITY					
Gans et al., 2003 The development of SisterTalk: a cable TV-delivered weight control program for black women.	Cable TV	Social Action Theory	African American women	Weight control program; one-hour live TV show. Cultural African inspired art, African American and West Indian dishes, demonstrations of African dance and funk aerobics	None reported.
Holt et al., 2000 Does locus of control moderate the effects of tailored health education materials?	Print	Elaboration Likelihood Model and Locus of Control and Social Learning Theory	198 overweight adults	Tailored booklets of Health Education Materials	Revealed some support for hypothesis that internal weight locus individuals would respond more favorably to tailor and that external locus of control to non-tailored.
Kreuter et al., 1999 Understanding how people process health information: a comparison of tailored and non-tailored weight-loss materials.	Print	Elaboration Likelihood Model	198 overweight participants	Tailoring	Participants who received tailored materials had more positive thoughts, personal connections to materials, positive self-assessment thoughts and positive behavioral intentions to lose weight.
Kreuter et al., 2000 Are tailored health education materials always more effective than non-tailored materials?	Print	Elaboration Likelihood Model	198 overweight adults	Tailoring	Good fitting (responsive to participant needs) non-tailored material performed well or better than tailored materials for a variety of affective, cognitive and behavioral outcomes.

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Tate et al., 2001 Using Internet technology to deliver a behavioral weight loss program.	Internet	No theory cited	91 healthy overweight adults: hospital employees	Internet education or internet behavior therapy: email, self-monitoring diaries and online bulletin board	Therapy group lost more weight than education group.
Tate et al., 2003 Effects of Internet behavioral counseling on weight loss in adults at risk for type 2 diabetes: a randomized trial.	Internet	No theory cited	92 overweight adults	E-counseling versus basic internet. Weekly email counseling.	Educational counseling group lost more weight than the basic internet group.
TOBACCO USE					
Boyd et al., 1998. Quit Today! A targeted communications campaign to increase use of the cancer information service by African American smokers.	Radio, TV, videotape	None Specified	565 African American adults	Paid Advertising Campaign	Call volume in African American smokers significantly increased in the experimental group than in the control group. Calls for smoking cessation information was higher in the treatment communities. Paid radio was the single most powerful component of the campaign.
CDC, 2003 Effectiveness of mass media campaigns to reduce initiation of tobacco use and increase cessation.	Mass media	None cited	Smokers	Mass media	A systematic review on published studies of mass media campaigns found that they were effective in reducing tobacco use and increasing cessation among smokers.
Farrelly et al., 2002 Getting to the truth: evaluating national tobacco counter marketing campaigns.	Mass Media	None cited	12- to 17-year-olds	Mass media	Exposure to "truth" counter marketing advertisements was consistently associated with an increase in anti-tobacco attitudes and beliefs, whereas exposure to Philip Morris advertisements generally was not. In addition, those exposed to Philip Morris advertisements were more likely to be open to the idea of smoking.

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Glasgow et al., 2000 A brief smoking cessation intervention for women in low-income planned parenthood clinics.	Print, video, counseling and telephone	RE-AIM (Reach Efficacy Adoption Implementation and Maintenance)	1154 female smoking attending planned parenthood clinic	Multi-component clinic based intervention. Video, behavioral counseling, follow-up telephone calls and provider advice	Short-term significant effect in terms of self-report abstinence from cigarette and a more ambiguous long-term effect.
Jenkins et al., 1997 The effectiveness of a media-led intervention to reduce smoking among Vietnamese-American men.	Media, and Print	None Cited	Physicians	Multi-faceted campaign	Significant decreases in smoke prevalence and significant increase in cessation in men of the Vietnamese community.
Manfredi et al., 2000 The effect of a structured smoking cessation program, independent of exposure to existing interventions.	Print and video	None cited	2261 smoking Patients in clinic	Interpersonal booklet; video; and provider letter and motivational telephone call smoking cessation	Greater exposure to intervention components improves smoking outcomes.
McAlister et al., 2004 Media and community campaign effects on adult tobacco use in Texas.	TV, radio, newspaper and billboard advertisements		622 Daily smokers	Adult media campaign	Showed greater exposure to radio and TV messages in areas where highlight level media was combined with communities' cessation activities. Exposure to media messages was related to process of change and quitting.
Niederdeppe et al., 2003 First Look Report 12: Exposure to Pro-Tobacco Messages among Teens and Young Adults: Results from Three National Surveys	Mass Media	None cited	7400+ Teens between 12 and 17 years of age	Mass Media Campaign	Smoking rates were sub lower among Florida teens following exposures to the campaign.

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Orleans et al., 1998 A self-help intervention for African American smokers: tailoring cancer information service counseling for a special population.	Print	None cited	1422 AA smokers	Tailoring	Significantly more quit attempts and greater use of pre-quitting strategies among tailored subjects but no difference in self-reported one-week abstinence. At one year there was a significantly higher quit rate for tailored subjects.
Strecher et al., 2002 Tailored interventions for multiple risk behaviors.	Print and Computer	Trans-theoretical model, health belief and self-efficacy	255 patients in health care system	Tailored print and Tailored tele-counseling by counselors	No results at present.
SUBSTANCE ABUSE					
Epstein et al., 1999 ATOD-TV: evaluation of a multimedia program designed to educate the public about substance abuse.	Interactive multi-media	None cited	General Public 276 adults	Public Kiosks	Significant improvement in attitudes toward substance abuse research and treatment.
Matano et al., 2000 The Employee Stress and Alcohol Project: the development of a computer-based alcohol abuse prevention program for employees.	Website	None cited	Employees	Interactive, computer based Internet Personalized feedback, recommendation, mini-workshops, drinking journal, interactive forum for participant to participant communication	None reported.
INJURY PREVENTION					
Nansel et al., 2002 Baby, Be Safe: the effect of tailored communications for pediatric injury prevention provided in a primary care setting	Computer program	None cited	213 AA parents of children 6 to 20 months	Tailored educational materials on computers	Parents who receive tailored information reported greater adoption of home and car safety behaviors than those receiving generic information.

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YOUTH RISK TAKING					
Andsager et al.,(2001). Questioning the value of realism: young adults' processing of messages in alcohol-related public service announcements and advertising.	TV and Print	Message interpretation process (MIP) model	246 college student	Public Service Announcements and advertisements	Finds that: (1) perceived realism and themes that students could identify with are important factors in increasing the salience and persuasiveness of alcohol-related public service announcements (Public Service Announcements) among undergraduate students; (2) realistic but logic-based Public Service Announcements were not as effective as unrealistic but enjoyable advertisements; and (3) low production quality, though noticed, was not related to the persuasive value of Public Service Announcements.
Di Noia et al., 2003 The relative efficacy of pamphlets, CD-ROM, and the Internet for disseminating adolescent drug abuse prevention programs: an exploratory study	Print, CD ROM, Internet	None cited	188 Professionals	Dissemination using internet and CD ROM	Participants exposed to dissemination via CD ROM and internet had the greatest short and long-term gain on accessibility, self-efficacy and behavioral intention.
Duncan et al., 2000 Development and evaluation of an interactive CD-ROM refusal skills program to prevent youth substance use: "refuse to use"	Computer	None cited	74 high school students	Interactive CD ROM Program to reduce	Sid changes in personal efficacy to refuse marijuana intention to refuse marijuana and perceptions of the social norms associated with marijuana.
Niederdeppe et al., 2003 First Look Report 12: Exposure to Pro-Tobacco Messages among Teens and Young Adults: Results from Three National Surveys.	Mass Media	None cited	7400+ Teens between 12 and 17 years of age	Mass Media Campaign	Smoking rates were substantially lower among Florida teens following exposures to the campaign.

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Author and Title	**Medium**	**Theory**	**Audience**	**Approach**	**Outcome**
Palmgreen et al., 2001 Television campaigns and adolescent marijuana use: tests of sensation seeking targeting.	TV	SENTAR:	200 adolescents grades 7 to 10	Public Service Announcements	TV campaigns resulted in significant reductions in marijuana use in high sensation-seeking adolescents.
Reis et al., 2000 Interactive multimedia preventive alcohol education: a technology application in higher education.	Interactive CD Rom	Integrated Theory of Behavior Change	643 Undergraduate students	Multi-media software program	Students using CD ROM were more favorable to the alcohol related lessons than were students in an alternative alcohol group.
Schnike et al., 2004 Computer-mediated intervention to prevent drug abuse and violence among high-risk youth.	Computer	Unspecified "salient" theory	189 low-income youth	Interactive computer	Youth assigned to computer or conventional health education improved on how they regarded people who used drugs, strategies to avoid trouble and ways to control their temper.
Stephenson et al., 2001 Predictors of exposure from an anti-marijuana media campaign: outcome research assessing sensation seeking targeting.	TV only	SENTAR: Sensation-seeking targeting prevention strategy and framework	Adolescents	Public service announcements	High sensation-seekers users were more likely to be exposed to Public Service Announcements about marijuana than low sensation-seekers.
Stephenson et al., 2003 Mass media strategies targeting high sensation seekers: what works and why.	Mass Media	SEN-TAR	7 to 10th graders	Public Service Announcements	High and low sensation seekers processed anti-drug advertisements differently.
Yzer et al., 2003 The effectiveness of gateway communications in anti-marijuana campaigns.	Video and advertisements	Integrative Model (Health Belief, Social Cognitive, and Theory of Reasoned Action)	418 Middle and high school students	Public Service Announcements	Did not support the use of the gateway belief in marijuana interventions.

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IMMUNIZATION					
Kreuter et al., 2004 Effectiveness of individually tailored calendars in promoting childhood immunization in urban public health centers.	Print Calendars	Social Marketing and Exchange	321 parents of babies from birth to one year of age: predominantly AA	Tailoring	Higher proportion of intervention than control babies were up-to date on their immunizations at the end of 9 and 24 months. The younger the babies age at enrollment, the greater the effect.