A significant research endeavor, coupled with stronger avenues for dissemination, is recommended to achieve the potential of new media in a timely manner. [Monogr Natl Cancer Inst 1999;25:134–9]

INTRODUCTION

The concept of perceived risk is central to most models of health behavior change and decision making (1–4). Public health campaigns designed to improve health-related behaviors or to stimulate awareness of a health issue at a population level often employ risk-based messages. However, disseminating risk messages to the general public in ways that are accurate, clear, and attention grabbing is a challenging task (5). Bottorff et al. (6) found that, although population-based information about risk factors for cancer is available, there are few opportunities for individuals to obtain accurate information that is personalized and based on individualized risk factors. Without knowledge of an individual’s actual risk, risk-based communication is easily disregarded by those at high risk, while taken too seriously by those at low risk.

As our understanding of risk factors and their interaction with individual susceptibility to disease improves, general messages designed to communicate risk seem increasingly ineffective and often misleading. The general public, by now, is inundated with the “risk factor of the week” and has grown weary of our attempts to generate media hype for these factors (7,8). The current “broadband” influx of health risk information may be likened to filling a water glass with a fire hose. Individuals may feel overwhelmed by the sheer number of “bad things” they need to improve. Mason et al. (9) state that “the very multiplicity of threats and the urgency with which they are presented make it difficult for most of us to sort out major from minor, proven from suspected, and most importantly, those that we as individuals can control from those we cannot.” Mass media fail to effectively convey the personal susceptibility to preventable diseases or the seriousness of these diseases; they provide messages that are easy to ignore (10). Often, the segments of the public who are the least informed about potential hazards are the very people who are likely to selectively ignore messages aimed at them (11).

Interactive multimedia have the potential to assist users in sorting out major from minor, proven from suspected, and controllable from uncontrollable risks. These new media systems allow us to reach the public more effectively with programs tailored to the needs and interests of individual users. Whereas the outward appearances of interactive multimedia are similar to those of mass media, interactive programs delivered through the Internet, CD-ROM, or computer kiosks offer the potential for vastly improved efficacy in communicating risk. Evaluations of computer-based health education programs in medical and educational settings suggest that these programs can be effective in changing behavioral intentions, influencing health behaviors, and improving the management of disease (13–16).

The purpose of this paper is to outline the potential uses of interactive multimedia within the traditional goals of risk communication. We hope that the discussion will stimulate new research and higher quality programs for the public. We begin with a discussion of the general advantages of interactive multimedia, followed by the potential for interactive multimedia in (a) presenting risk information in an accurate, understandable manner; (b) reducing inaccurate perceptions of personal risk; and (c) facilitating better informed health decisions. We close with a discussion of methods for reaching the public with these important programs.

WHY USE INTERACTIVE MULTIMEDIA?

There are several advantages to using interactive multimedia. Three notable advantages—interactivity, adaptiveness, and assessment—are relevant to the communication of risk information.

Interactivity

The systems we are considering in this paper require active, versus passive, involvement of the user. Active involvement with a message has been associated with a higher degree of active information processing (17). In one study of classroom use of educational technology (18), students who used computer-based instruction, in contrast to those who used more traditional curricular materials (i.e., textbooks), tended to have a higher percentage of “time on task” and were generally more involved in the process of learning.

It is likely that individuals vary in their preferences for sequencing, pacing, feedback, and review of interactive multimedia messages, although far more research is required in this area. Preferences for a rapidly paced multimedia experience among

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adolescent boys can readily be observed in any video arcade. The experience of our Health Media Research Laboratory with focus groups of middle school adolescents and of older adults using interactive multimedia programs suggests that adolescents prefer fast-paced interactivity than do the older adults. Tests of other sociodemographic groups, as well as the influence of pacing on relevant outcomes, should be conducted in the health area.

Adaptiveness

Another advantage of interactive multimedia is the ability to adapt, or tailor, information to relative characteristics of the user. By simply asking questions, interactive multimedia programs can generate an educational experience tailored to the user’s social and cultural milieu, sociodemographic characteristics, relevant life events, literacy level, concept recognition abilities and preferences, risk perceptions, physical and functional health status, health-related behaviors, health knowledge, perceived barriers to and benefits of health behavior changes, stage of health behavior change, self-efficacy, and attributions for previous failures, among a universe of possible variables. Never has the understanding and application of theories of individual health behavior been so relevant; we now have the potential to consistently apply these theories and their related concepts to improve the health of the public through individualized messages.

Assessment

Interactive multimedia programs are uniquely suited for comprehensive assessment. First, their interactivity allows significant shortening in the length of most questionnaire instruments. (If, on a health risk assessment, we find that the user does not eat meat, he or she no longer needs to be asked questions about meat.) While skip patterns can be employed in print-based questionnaires, computer-based questionnaires are less prone to respondent error (19). Interactive multimedia have the advantage of seamlessly constructing complex hierarchies, invisible to the user, that significantly shorten assessment forms. Second, the perceived anonymity of computer-based assessment programs has been shown to yield dramatic improvements in the quality of survey measurements, especially for surveys of sexual, drug, and other sensitive behaviors (20). Accurate estimation of epidemiologic risk, especially for sensitive behaviors, has been limited in the past by the need to report socially undesirable risk factors to others (21). When computers ask questions, respondents have reported that they believe their information will be kept confidential (22). Third, interactive multimedia programs can determine progress made. Most multimedia authoring tools readily support the collection, storage, and processing of all interactions made with an instructional computer program. Preintervention and postintervention assessments can therefore be created as a seamless part of the program itself.

Application to Traditional Goals of Risk Communication

Presenting Risk Information

Johnson and Slovic (23) found that, although people are unfamiliar with the concept of uncertainty, they are more likely to recognize uncertainty when it is presented simply and when meaningful graphics are used. In addition, uncertainty and probability may be difficult for the lay person to understand because they include the element of time. Genetic counselors, for example, are often faced with the task of explaining cumulative probabilities to patients. With static media, genetic counselors are limited in their ability to demonstrate how a patient’s risk for disease changes as he or she ages (24). Multimedia presentations may enhance a counselor’s ability to communicate this information to patients through the use of graphic animations that can allow clients to explore how risk and time interact. Animation can reinforce the concept that change in one’s estimated risk for disease over time is a gradually changing estimate. The interactive CD-ROM called “Counseling by Computer: Breast Cancer Risk and Genetic Testing” provides such an animation, showing how risk for cancer changes throughout life (25). In addition, this program also includes a valuable education component on the meaning of risk estimates by incorporating lessons using animated coin tosses to demonstrate chance and probability.

Risk ladders or other visual devices emphasize how the risk for one hazard compares with risks for other more commonly understood hazards (26,27). Although there are many pitfalls in comparing one hazard to another, even when it occurs at the same frequency risk (see (5), page 96, for discussion), interactive multimedia can present comparisons in a way that is less misleading. Features, such as animation, zooming in and out on graphics, and the provision of hyperlinks to meaningful explanations about the limitations of comparable data (28), can help alleviate some of the more common problems with risk comparisons. Multimedia can deliver integrated messages about lowering risk and the effect of actions on risk estimations. Interactive computer programs are able to compare estimated risk under current circumstances with potential future conditions. This instant “what if” comparison cannot be easily made when delivering risk information using other channels, including human interaction. “What if” comparisons are useful in presenting risk information aimed either at altering risky behaviors or at providing information for a decision under conditions of uncertainty (29).

Reducing Inaccurate Perceptions of Risk

Risk is often communicated for the purpose of educating individuals who are either unaware that they are at risk for a condition or who believe that they are at lower risk than their epidemiologic risk would indicate. Individuals frequently display an “optimistic bias” of their risk of being affected by a hazard (30,31). For example, Strecher et al. (32) found that, although most smokers accurately perceived their risks to be greater than nonsmokers for smoking-related illness, they were more likely to underestimate their risk and thus misunderstand the magnitude of smoking as a risk factor for disease. Related to unrealistic optimistic bias is overconfidence in one’s judgment of risk. Individuals are often sure that they “know” the odds; overconfidence reduces the perceived need for and the perceived importance of learning about risk (33).

Kreuter and Strecher (34) demonstrated that inaccurate perceptions of risk could be modified toward a more realistic view using computer-tailored printed messages by comparing their perceived risk with their actual estimated risk. Comparisons of perceived versus actual risk have been used successfully in multimedia as well. “Straight Talk About Breast Cancer” is a program designed to foster realistic perception of breast cancer risk among women (35). The program assesses women’s perceived risk and then calculates an immediate assessment of actual risk,
Facilitating Informed Decision Making

A primary objective of risk communication is to provide individuals with relevant information, enabling them to make informed medical decisions. The goal of risk communication, in this case, is not to persuade an individual to make a specific choice but to provide risk information in a “neutral” or nondirective manner so that the individual can then decide what is best. Typically, this form of risk communication occurs when an individual is faced with an important medical decision (e.g., whether to have hormone therapy) in which the obvious choice is not clear and satisfaction with the outcome of the decision depends on the values held by the patient.

Interactive multimedia programs can allow individuals to weigh their attitudes toward potential outcomes, informed by risk and their symptoms. One example of this approach is the “Shared Decision Making Program on Benign Prostatic Hyperplasia (BPH)” (42). This multimedia decision-making program shows personal case stories and probability information relevant to various BPH outcomes that are tailored to the individual. Risk is tailored on the basis of age, general health status, symptom level, and history of acute retention. Patients in this study were asked to rank the degree to which they were bothered by their symptoms and their attitudes about impotence. The relative importance of these factors was measured against the objective level of the patients’ actual symptoms in the decision to choose surgery or watchful waiting. The result was that symptom levels no longer predicted choice of treatment; instead, the shared decision program helped patients make a choice that reflected their attitudes about their symptoms and their concern about risks (42). “The Shared Decision Making Program on BPH” also uses interviews with patients who have had complications: one interview with a patient who chose watchful waiting and one who chose surgery, Wennberg states (42); page 118 that, by using an integrated decision-making tool such as “Shared Decision Making Program on BPH,” “patients become empowered to choose their own treatments.”

Tremendous opportunities for interactive multimedia programs exist in the area of informed decision making. Interactive multimedia programs have also been created for patients undergoing treatment for breast cancer and for human immunodeficiency virus (43,44). These programs include decision aids that help individuals clarify values, learn about options, and examine the consequences of their decisions. In addition, Internet-based programs have been created to assist individuals in making decisions about health care plans and professionals (45,46). In a broad array of illnesses and preventive health behaviors, complex decisions must be made on the basis of an analysis of medical and epidemiologic data linked to personal values and preferences. For example, in genetic screening and counseling, numerous informed decisions must be made regarding decisions to undergo genetic testing and other related medical decisions, such as prophylactic surgery (47,48). These decisions are no longer left simply to health providers or public health professionals; health consumers are likely to increasingly demand a stronger role in decision making accompanied by greater access to relevant health information (49–51).

REACHING THE PUBLIC WITH INTERACTIVE MULTIMEDIA

Consumers’ demand for health information is steadily increasing. McGinnis et al. (52) report that telephone inquiries to the Public Health Service’s health information clearinghouses more than doubled in the early 1990s and that mail inquiries grew by 43%. More than two thirds of consumers have questions about their personal health (52), yet a 1994 survey published by the Medical Library Association (53) found that nearly 70% of respondents reported problems in gaining access to relevant health information.

It is likely that, within the next 5–10 years, traditional mass communication channels, such as television and print media, will evolve into interactive television channels, creating oppor-
tunities to disseminate health programs that personalize messages to specific risk factors, stages of change, and health beliefs of users (54). In the June 1995 issue of the American Journal of Public Health, C. Everett Koop states that “cutting-edge technology, especially in communication and information transfer, will enable the greatest advances yet in public health... Eventually, personal home tele-medicine links could provide every home with access to health information 24 hours a day, 7 days a week, encouraging personal wellness and prevention and leading to better informed decisions about health care. A generation of children raised on video games will probably be more attuned to health messages coming from interactive videos than from lectures by the school nurse” (55).

The bridge to this future is the current interactive multimedia environment—increasingly through the Internet. According to a recent survey (56) conducted jointly by the Institute for the Future in Menlo Park, CA, and Princeton Survey Research Associates, nearly two thirds of the people who use the World Wide Web seek medical information and referrals. According to another survey (57) from the Pew Research Center for the People and the Press, in the absence of a big breaking story, 64% of those surveyed suggested that they go to the Internet to find news on science and health.

In the fall of 1995, the U.S. General Accounting Office conducted a survey (58) of 80 experts in the area of consumer health informatics to determine key issues as our society further develops advanced communications technologies in the consumer health area. This survey identified a number of significant barriers, requiring attention as consumer health informatics continues to develop. The most commonly cited barrier (reported by 79% of the experts) was lack of access. Access to and use of health information in general are directly tied to socioeconomic status. Moreover, individuals who use the kiosk are more likely to smoke cigarettes (approximately 37% of the kiosk users were cigarette smokers) than do nonusers. There is probably a higher proportion of smokers to nonsmokers than that found on the Internet (68), although there is a significant lack of data characterizing the health behaviors of Internet users. Because of the ethnic compositions where the kiosks are placed, over 50% of kiosk users are nonwhite. Satisfaction levels with the kiosks do not differ by ethnic status or by gender. These data suggest that interactive multimedia would be used by the public most in need of preventive services—those who do not have ready access to computers.

**SUMMARY**

Interactive multimedia systems, such as the Internet, CD-ROM, and kiosk programs, have the potential for reaching populations in need of risk communication messages. But it is clear that we must determine (a) how we can harness the power of new media to create the most efficacious programs and (b) how we can maximize the exposure, access, and reach of these programs.

The revolutionary advances in our ability to predict, at the level of the individual, health problems before they occur must be matched by our ability to effectively communicate risk at this level. The equally revolutionary advances in information technology allow us to do just that—to communicate risk to mass populations at the level of the individual. An area that requires particular research attention is the development of improved statistical models for the estimation of risk [e.g., (69)]. These models should include algorithms for estimating the interactions of multiple risk factors (70).

With increasingly powerful risk assessment tools, interactive multimedia technologies should address the difficulties many end users have in accurately comprehending and recalling risk factor information (71). Interactive multimedia allow us to develop programs tailored to the relevant learning styles of the user, including variations in pacing, in sequencing, and in type of feedback. This technology allows us to generate standardized methods for reviewing previously presented information, additional instruction, and skill building. The graphic capabilities of interactive multimedia allow greater vividness of risk-related questions and messages through digital video, animation, sound, and text.

In the future, interactive multimedia technologies will likely reach many individuals who would not normally purchase or use a computer. However, before the time that interactive multime-
dia channels become as ubiquitous as television, video cassette recorders, and telephones, significant effort will be required to make tailored and interactive health materials available to a broader spectrum of our society. Equitable access will require not only available technology but also content that is understandable, interesting, and relevant.

The degree to which we capitalize on the potential of interactive multimedia in communicating risk will depend largely on the quantity and quality of research in this area. To date, there are very few research groups dedicated to pursuing the many complex questions, challenges, and opportunities posed by the information revolution (72, 73). Lack of significant investment in a technology infrastructure and the integrated involvement of health behavior, epidemiologic, technical, and communications expertise has impeded rapid development of this research field. Although front-end costs to create this infrastructure are high, the resulting interventions can be inexpensively disseminated and broadly adopted at low cost. Heightened prioritization from federal and private research agencies is required to develop and to support this nascent field. Such support is likely to result in a payoff equal to or greater than any public health communications effort to date.

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