Health Risk Appraisal from a Behavioral Perspective: Present and Future

Victor J. Strecher, PhD, MPH[1], and Matthew W. Kreuter, PhD, MPH[2]

[1]*Dr. Strecher is Associate Director of the University of Michigan Comprehensive Cancer Center and Director of the Health Media Research Laboratory. He is a behavioral scientist whose work has focused on developing and testing strategies for health behavior change. He has been, and is currently, principal investigator of numerous NIH-funded research studies. Recent studies have examined the impact of computer-tailored minimal-contact behavior change interventions for individuals in the areas of cigarette smoking, cancer screening, nutrition, and other health-related behaviors.*

[2]*Dr. Kreuter is the Director of the Health Communication Research Laboratory at the Saint Louis University School of Public Health. He has developed and evaluated computer-tailored interventions to promote smoking cessation, dietary changes, physical activity, weight management, cancer screening, childhood immunizations, women's health, medication compliance, injury prevention, and alcoholism recovery. He has worked with the Centers for Disease Control and Prevention, Agency for Health Care Policy and Research, Merck-Medco Managed Care, Monsanto, DuPont-Merck, Bristol Myers Squibb, and BASF Pharmaceutical. He teaches a graduate course in Health Communication, and has published a number of articles on health promotion interventions. Dr. Kreuter received his PhD and MPH from the University of North Carolina at Chapel Hill.*

Corresponding author: Victor Strecher, Director, Health Media Research Laboratory, School of Medicine, University of Michigan, 300 North Ingalls, Room 5D-04, Ann Arbor, MI 48104; phone: 734.763.6099; email: STRECHER@UMICH.EDU

Introduction

Health Risk Appraisal (HRA) is probably the most widely used health education strategy for promoting individual behavior change.[1,2] Millions of North Americans have participated in HRA or HRA-like programs in worksites, universities, community wellness programs, health fairs, and health care organizations.[3] A 1992 survey of worksites with 750 or more employees by the Office of Disease Prevention and Health Promotion (ODPHP) found the proportion of worksites using some form of health risk assessment increasing from slightly more than 65% in 1985 to over 90% in 1992. Although HRA was originally developed as a data gathering mechanism to direct physicians' preventive health care activities,[4] it is now more commonly used to enhance program planning and evaluation (see chapter "The Role of Health Assessment in Planning Health Promotion Programs"), to identify those in need of preventive screening procedures, to help recruit participants into health promotion programs, and to provide information directly to individuals to inform, motivate, and facilitate health-directed behavior change.[1,2,3]

With its appeal, relative low cost, adaptability, and pervasiveness, HRA would seem, on the surface, to be an important strategy for meeting many of the nation's health objectives. However, reviews of the research literature have found little evidence for HRA's efficacy in changing individual behavior.[4,5,6] In this chapter, we'll explore the reasons why HRA fails to have a significant effect on most behaviors, and how HRA might be enhanced to do a better job of effectively promoting health-related behavior change.

HRA Effectiveness: A Brief Review

Schoenbach[5] defined health risk appraisal as "a procedure for using epidemiologic and vital statistics data to provide individuals with projections of their personalized mortality risk and with recommendations for reducing that risk, for the purpose of promoting desirable changes in health behavior." Captured in this definition are the three essential elements of HRA: assessment, estimation, and education.[1] HRA *assesses* individuals' health status and practices, usually by way of self-administered questionnaires and in some cases biomedical measures. From this information, an HRA *estimates* individuals' risk of death or disease from each of several causes, and provides *educational messages* which indicate ways they can reduce their risk by changing specific behaviors. Most published research involving health risk appraisal has focused on the second function, risk estimation. When HRA use burgeoned in the late 1970s and early 1980s, there was considerable debate about the precision of HRA's risk estimates and their ability to predict individuals' future mortality.[6] Findings from more recent studies,

however, suggest that for at least some kinds of risk (e.g., coronary heart disease) HRA estimates are fairly accurate.[7,8] In fact, there seems to be general agreement that although its risk estimates may be imprecise, HRA is sufficiently accurate in distinguishing high from low risk as to justify further testing of its effectiveness as a health promotion tool.[3,6,9]

There has been less research evaluating the educational function of HRA (i.e., determining how effective its user feedback will be in promoting health-related behavior changes). What little research we have found provides only limited, if any, support for behavior change effects resulting from the receipt of HRA feedback. One early review of HRA effectiveness[6] concluded that most studies were methodologically weak, and characterized their findings as "equivocal." Among two of three randomized controlled studies reviewed in the paper, no HRA effect was found on risk factor reduction[10] or attitudes toward disease susceptibility.[11] The third study[12] found small, though inconsistent (across age-sex-risk groups) behavior changes, but suffered from high rates of attrition, a short follow-up period, and analytic flaws (unadjusted alpha for multiple outcome analyses). Five years after this initial review article, none of these studies had been published in the peer-reviewed scientific literature. Schoenbach and colleagues conducted a similar review,[3] and again found little evidence in support of HRA. Three new randomized controlled studies were reported on,[13,14,15] one of which (Blue Cross and Blue Shield of Michigan[14]) was not published in the scientific literature. Among these studies, none provided strong evidence for either psychosocial or behavioral changes resulting from HRA.

In 1990, Dunton and colleagues[16] examined the influence of HRA on seat belt use. In the study, each of six worksites was assigned to one of three conditions: HRA plus a group counseling session, HRA plus group counseling plus educational materials designed to facilitate habit change, or a no intervention control condition. There was no study condition in which employees received HRA feedback alone (i.e., without a group counseling session). Seat belt use was observed at all worksites at baseline, post-screening, post-counseling, and 2-3 months later. Findings showed the HRA plus group counseling programs were found to have a greater increase in observed seat belt use compared to the control worksites. Kellerman[17] studied the effects of HRA plus counseling and found 93% of employees reportedly making a health-related behavior change after receiving HRA and individual counseling from a nurse or health educator. These self-reported changes were in the areas of diet, seat belt use and cancer screening behaviors. However, a low follow-up rate (57%), lack of an HRA-only group, and lack of a control group severely limit the inferences that can be made from the results.

Analysis of HRA Feedback from a Behavioral Science Perspective

The appeal of completing an HRA is most likely related to the individualized estimates of health risk it can provide. Unlike most generic messages (e.g., "smoking is bad for you"), HRA can quantify just how deleterious a particular risk factor is, given your age, gender, health status, and other health-related practices. To do this, HRA collects epidemiologic risk factor information from its users, calculates their risks based on population mortality data, and provides feedback identifying these risk factors and the health benefit they can expect to gain (usually in years of prolonged life expectancy or some roughly equivalent metric) by modifying each risk factor. Therefore, implicit in the use of HRA to promote lifestyle changes is the belief that provision of *risk information alone* will help people modify unhealthy behaviors. But HRA's user feedback is derived from epidemiologic risk calculations, almost always uninformed by behavioral science. As Beery, et al,[4] have noted:

> *Unlike many behavioral and educational interventions, HRA has not developed out of any particular educational or psychological tradition; it therefore lacks the presumption of efficacy that a close connection with a body of theory and associated empirical evidence would bring.*[4]

This limitation of HRA led Becker and Janz[2] to conclude: "the provision of typical HRA feedback should not (on a theoretical basis) be expected to accomplish much beyond information transmission, belief or attitude change, and the induction of some level of motivation."

The Health Belief Model (HBM) is useful in examining why, from a theoretical perspective, the current application of HRA may not have behavioral, or even pre-behavioral effects on its users. The HBM

conceptualizes behavior change as a function of perceived threat of a negative health outcome and perceived benefits (minus perceived barriers) of taking a particular course of preventive action. The HBM has been demonstrated to predict a wide variety of health behavior change.[18,2] According to the model, an individual's readiness to engage in a given health behavior is determined by his or her perception of personal *susceptibility* to a specific disease, and by perceptions of the *severity* of the consequences of the disease. Combined, perceived susceptibility and severity comprise an individual's *perceived threat* of the disease. Assuming the individual perceives some threat or feels some readiness to change, the benefits of specific health behaviors in terms of reducing the threat are weighed against the costs, or barriers to taking action. A cue to action such as a symptom of illness or a media campaign message may also be necessary to trigger the desired behavior. Demographic, personality, and social factors are considered by this model to be modifying factors, affecting behavior only through their influence on other components of the model.[19] Figure 1 illustrates this model of behavior change.

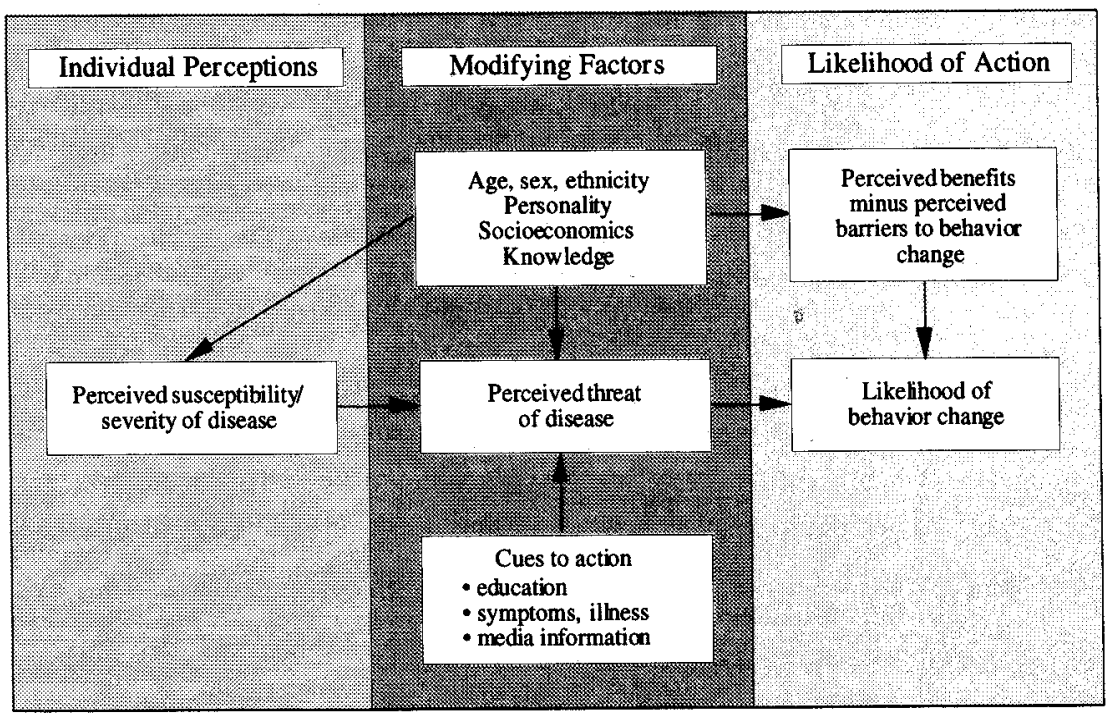
Viewed from an HBM perspective, typical HRA feedback would seem unlikely to stimulate much behavior change. First, consider the types of data gathered in the assessment function of HRA. Users provide information on a variety of risk factors, including behavioral (use of tobacco, non-use of seat belts, consumption of excessive amounts of dietary fat), demo-graphic (e.g., age and gender), and physical status (e.g., height, weight, blood pressure, cholesterol) variables. From these data, HRA feedback could only address perceived susceptibility, severity, and perhaps perceived benefits, and only in a limited way. For example, typical HRA feedback addresses perceived threat and perceived benefit in purely quantitative terms, usually as the projected number of years of life to be gained or lost by changing or not changing an unhealthy behavior. Yet longevity and being healthy are just two of many factors that might motivate behavior change, and arguably not always the most salient ones. Further, because HRA seldom collects data on individuals' motivations for, or concerns about changing their health habits, it has no means of addressing perceived barriers to behavior change, and does nothing to enhance self-efficacy or build skills necessary to make changes in complex behaviors.

The sections below discuss in greater detail each of the key components of HBM, and how HRA presently does and potentially could address each of them.

Perceived Susceptibility and Severity, and Perceived Threat: Nearly all information provided in typical HRA feedback is derived from epidemiologic risk estimates. HRA usually provides a risk estimate for all-cause mortality (e.g.,*"Your `risk age' is 57.4 years, your actual age is 49.6 years"*), and a breakdown of how specific risk factors contribute to that estimate (e.g., *"If you quit smoking, you can add 4.2 years to your present life expectancy"*). The message carries an implicit, though not an explicit, threat: "If you continue to smoke, you will cut an average of 4.2 years from your normal life expectancy." In addition, the risk information presented in most HRAs is conveyed in terms of *absolute*, rather than relative risk. From an epidemiologic standpoint, absolute risk is a less stable measure than is relative risk.[20] From an educational or communication standpoint, it may also be more difficult to understand.[21] In a study assessing the effects of feedback from four different HRAs on individuals' perceived risk of heart attack, Avis, et al,[22] found that the greatest impact on risk perception was achieved by the only HRA of the four that presented risk as relative, and specific to a particular outcome (heart attack).

Perceived Benefits Minus Barriers to Behavior Change: Most HRAs provide some feedback regarding the improvement in life expectancy associated with changing a particular behavioral risk factor. But, like HRA's threat messages, these "benefits" are described in purely quantitative terms, usually as the projected years of life to be gained or lost by changing or not changing an unhealthy behavior. Messages such as *"If you were to quit smoking this year, your life expectancy would increase by 4.2 years"* may have a positive impact. However, the Health Belief Model emphasizes the user's—not an epidemiologist's—perceived benefits. HRA does not typically ask the user why he or she would like to change a risk factor. If it did, added longevity to life would not always be a leading response. For example, in a study of physicians' preventive health care

Figure 1. The Health Belief Model



activities,[23] we ask patients expressing interest in making specific health-related behavior changes to give the main reason they wanted to make the change. Among patients interested in exercising more often (n=141), 40% wanted to do so in order to lose weight, while only 22% said they were interested in doing so to improve their health. While losing weight *may* improve their health, messages focusing on the health benefits of losing weight will, for much of this population, be less effective than messages emphasizing changes in physical appearance, increased physical capabilities, and self-image that can accompany weight loss. While some health-related behaviors might be done largely for health reasons, most influential benefits are probably related to a perceived improvement in quality of life.[24,25]

Given HRA's treatment of perceived benefits, the Health Belief Model would predict that recommended changes in health behavior would be attempted only if the user perceived the barriers to engaging in the recommended health action to be quite low. In other words, if a person would like to quit smoking, but perceives stress to be a major barrier to success, HRA alone would not facilitate behavior change. Typical HRAs do not collect barrier information. This rules out feedback directed toward a broad variety of factors impeding behavior change, from lack of self-efficacy,[26,27] to physical barriers such as lack of money or time, to lack of knowledge. For health behaviors that typically have few barriers (e.g., seat belt use), one might expect HRA feedback to be effective. However, for most lifestyle behaviors (e.g., smoking, excessive alcohol use, exercise, diet), HRA feedback would only heighten risk perception.

Cues to Action: According to the Health Belief Model, if perceived threat is high and perceived benefits

outweigh perceived barriers, a cue to action can prompt or trigger an individual to take a particular health action, stimulating the belief-action link. Cues to action may be internal (e.g., symptoms) or external (e.g., media information). For individuals already highly motivated to change a health behavior, the receipt of HRA feedback confirming their concerns may well serve as an external cue to action.[2] In some cases however, it seems possible that cues to action may be more effective if they are behavior specific and can be placed in a specific behavioral setting. For example, for relatively simple preventive health practices like wearing seat belts or regularly checking household smoke detectors, a cue to action like a dashboard magnet or calendar sticker would seem to be at least as effective in promoting change as the typical HRA message. HRA could easily provide behavior-specific cues to action as part of its feedback component.

Recommendations for Enhanced HRA Feedback

Considering the popularity and continuing dissemination of the HRA, particularly in worksite and medically-based health promotion programs, careful evaluation of potential improvements of HRA are warranted. From our analysis of the psychosocial and behavioral effects of HRA, we can make three recommendations for a new, more behaviorally-based HRA:

1. Provide feedback designed to correct users' inaccurate perceptions of their own risk.
2. Provide feedback that establishes behavior change priorities when multiple risk factors exist.
3. Provide feedback that enhances the user's ability to make recommended health behavior changes.

Each of these recommendations is discussed in detail below.

1. Provide Feedback Designed To Correct Users' Inaccurate Perceptions of Their Own Risk.

There is considerable evidence that people tend to underestimate their own health risk.[22,28–33] Weinstein[31] has termed this kind of unrealistic perception as an "optimistic bias." In Health Belief Model terms, people with an optimistic bias about a particular health risk (i.e., they perceive their risk to be low, but it is actually high) will have low perceived susceptibility and are probably unlikely to make behavioral changes. At the other extreme, some people will have a "pessimistic bias" about their health risks, believing their risk of some condition is high when it is actually low. People with this type of belief—the so-called "worried well"—may suffer necessary concern and anxiety, and may unnecessarily utilize health care resources. Ideally, HRA feedback should identify and address both types of bias, with the objective of moving users towards a more accurate perception of their own risk, whatever that may be.

To identify risk-related biases in an individual, one must first have an epidemiologic indication of the person's risk. This is done through the HRA tool itself. Second, one needs an indication of the individual's *perceived* risk. This can be accomplished through many existing measures of perceived risk. We generally use a variation of Weinstein's questions: "compared to others your same age and gender, would you say your risk of getting [x] is much less than average, less than average, about average, greater than average, or much greater than average." Using both measures together, one can identify biases in risk from identification of those in the diagonal cells (see Figure 2).

Figure 2. Optimistic, Pessimistic, and Realistic Perceptions of Risk

		Actual Risk		
		Low	Medium	High
Perceived Risk	Low	Realistic risk perception	Pessimistic risk perception	Pessimistic risk perception
	Medium	Optimistic risk perception	Realistic risk perception	Pessimistic risk perception
	High	Optimistic risk perception	Optimistic risk perception	Realistic risk perception

Because typical HRA feedback is focused primarily on providing risk information, we would expect it might be effective in altering inaccurate perceptions of individual risk. Findings from several well-designed studies have confirmed this expectation. For example, Avis and colleagues[22] conducted a large-scale study examining the influence of four

HRAs on risk perception biases related to heart attack risk. In the study, 732 men and women ages 25-65 were randomly selected from the greater Boston area. Subjects received home interviews to determine their perceived risk of having a heart attack within the next ten years, and biomedical assessments of cholesterol, blood pressure, and weight. Upon completion of the interview, subjects were administered one of four randomly assigned HRAs or did not receive any HRA. Comparing subjects' perceived risk with an epidemiologic measure of their coronary heart disease risk, 42% of participants were found to underestimate their risk, 18% overestimated their risk, and 40% accurately assessed their risk. Subjects were re-interviewed 7-12 weeks later. Of those who initially underestimated their risk (an optimistic bias) who received HRA feedback, 22% increased their perceived risk level, 66% did not change their perceived risk, and 12% decreased their perceived risk. HRA feedback did not influence users with a pessimistic bias. Risk perception among subjects with a pessimistic bias was as likely to increase as it was to decrease after receiving HRA feedback, suggesting there is room for improvement in HRA's treatment of this group.

In a second randomized study, Kreuter and Strecher[34] measured perceived and actual risks of heart attack, stroke, cancer, and motor vehicle crash mortality among 1,317 adult primary care patients, then randomly assigned each to receive computer-generated individualized risk feedback, risk feedback plus behavior change feedback, or no feedback. At a six-month follow-up, results showed that individualized risk feedback (with and without behavior change feedback) was effective in increasing perceived stroke risk among patients who had underestimated their stroke risk at baseline (i.e., optimists), and in reducing perceived risk of cancer among patients who had overestimated their cancer risk at baseline (i.e., pessimists). Individualized risk feedback did not alter patients' perception of their heart attack and motor vehicle crash risks.

Weinstein suggests that optimistic bias is in large part a function of cognitive errors. One error studied by Weinstein is egocentrism—the assumption that other people of similar age, sex, and general situation are not taking the same degree of precautionary action. In a study[32] testing the impact of information designed to counteract egocentrism by offering subjects information about the precautionary actions of others, optimistic bias was reduced. An unexpected finding of this study was that subjects in a group instructed to simply describe their own risk factors (with no feedback about others) had the greatest level of optimistic bias. It is possible that consideration of one's own risk factors (or lack of them) actually increases egocentrism, and therefore, optimistic bias.

HRA typically does not provide feedback regarding the health habits of others; rather its focus is on the individual user and his or her health habits. Based on the Weinstein[32] study, one wonders whether this focus might actually create unintended egocentrism. HRA users may pay particular attention to risk factors they did not have or ones they had never considered previously. For example, the HRA user may focus on the fact that he always buckles his seat belt and eats many vegetables, rather than the fact that he smokes cigarettes. If this is the case, many HRAs may be inviting egocentrism by presenting their mortality risk estimates in terms of absolute rather than relative risk. In other words, although population estimates provide the basis for HRA's risk estimates, most HRAs do not consider this information in the formulation of feedback messages for the user. Interestingly, of the four HRAs administered in the Avis[22] study, feedback from only one was found to have an effect on perceived risk—the Arizona Heart Institute HRA. This HRA specifically informs people that, compared to others, they are at above average, average, or below average risk for developing heart disease. This would support the hypothesis that optimistic bias is a function of egocentrism, which can, in turn, be counteracted by comparison with others.

Besides advocating for comparative risk information, Weinstein[33] has also recommended that risk perception biases might be counteracted by: 1) strongly emphasizing the link between behavior and susceptibility, and 2) providing specific behavioral objectives.

Even when HRA does influence risk perception, it may not affect health-related behavior. Avis and colleagues[22] found no evidence that changes in risk perception led to behavior changes to decrease heart attack risk (e.g., smoking, exercise, dietary control). This is not surprising. According to the Health Belief Model, we would not necessarily expect behavior change to occur. Only in cases where the behavior is

relatively free of significant psychological and physical barriers (e.g., wearing seat belts) would we expect changes in risk perception to affect changes in behavior. That said, although change in perceived risk may not be as attractive as behavioral change to those organizations thinking about implementing a HRA program, it is an important—and in some cases requisite—step in the change process.

2. Provide Feedback That Establishes Behavior Change Priorities When Multiple Risk Factors Exist.

For HRA users who have only a single modifiable behavioral risk, the course of preventive action is fairly clear—modify that behavior. But addressing multiple risk factors at the same time can burden and confuse users, and most individuals will be unable to make changes in multiple risk-related behaviors (e.g., quitting smoking, reducing dietary fat intake, exercising, reducing alcohol intake) simultaneously. Individuals with multiple risk behaviors may be confused about the relative importance of each risk behavior, or may feel overwhelmed by the sheer number of "bad things" they need to improve. Mason, et al,[35] 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."

Addressing multiple risk behaviors has tremendous public health significance while posing significant intellectual challenges. Many co-morbid behaviors are associated, and addressing one may facilitate change in another. When addressing multiple risk behaviors, individuals can learn about comparative risks and be encouraged to choose a behavior to change. This process of making choices may also increase individual participation and commitment. On the other hand, changing more than one habit may be extraordinarily difficult to do. Individuals who drink excessively, for example, may have a greater difficulty in quitting smoking. Moreover, individuals with multiple risks, particularly the ones addressed in this research, may have factors underlying these behaviors (e.g., depression) that inhibit success in changing any health practice.

From a behavioral perspective, habit breaking might best be accomplished when only focusing on a small set of habits at a time. Ornstein, et al,[36] examined adherence to preventive service reminders and found that some recipients felt "overwhelmed" when receiving multiple messages. Meichenbaum and Turk[37] state that "...informational and behavioral overloads are substantially greater when multiple different adherent behaviors are required." Similarly, Marlatt[38] suggests that "one problem to avoid at all costs" is recommending too much behavior change too quickly.

Knowing this, HRA feedback should prioritize among competing risks when multiple risk factors exist. We have identified five specific criteria that could be used to establish such a prioritization: epidemiologic risk, readiness to make behavioral changes, self-efficacy for behavioral changes, quality-adjusted life years, and gateways to behavioral change. Each is discussed in detail below.

Epidemiologic risk

HRA feedback has always done a good job of implicitly, if not explicity, prioritizing a user's risk by quantifying the contribution of specific risk factors and risk behaviors to a projected overall risk estimate like "risk age" or an equivalent metric. Some HRA feedback has gone the next step to describe how much "risk age" could be reduced by reducing the various risk factors that contribute to its elevation. Setting behavior change priorities based solely upon an epidemiologic criteria (e.g., attributable risk) would mean that HRA feedback would encourage the user to focus his or her efforts on whatever factors contributed most to his or her risk. If successful in getting people to change, this approach might yield the greatest reduction of user risk. However, if users are not interested in changing their "most important" risk factor, they are highly unlikely to do so in the short run and without specialized intervention efforts.[39,48]

Readiness to make behavioral changes

As first suggested in the research design of Kreuter and Strecher,[40] the type of behavioral feedback a user receives along with HRA-based risk feedback could be determined by the relative readiness to change each of the candidate behaviors. Rather than automatically selecting the user's greatest risk, this approach would select whichever behavior the user was most interested, or ready, to try changing. This should yield the greatest probability of change occurring because the interventions will be helping the patient make changes

he or she was already considering. For example, an HRA user might be a cigarette smoker, have high cholesterol, and consume excessive amounts of alcohol. If this user were thinking about reducing his dietary fat consumption (i.e., in the contemplation stage for this behavior) but not thinking about quitting or cutting down his tobacco and alcohol consumption (i.e., a "precontemplator" for these behaviors), HRA feedback would initially focus on helping him make the dietary changes he wants to make.

Self-efficacy for making behavioral changes

Efficacy expectations are beliefs individuals have about their ability to enact a particular behavior.[26,27] These expectations, or "self-efficacy," have been found to be strong predictors of a person's success in modifying a range of lifestyle behaviors.[41] Behavior-specific self-efficacy could be assessed in conjunction with HRA assessments, and used as a criteria for determining which among multiple risk factors would receive priority for intervention in HRA/behavioral feedback. For example, a user might be very confident she can begin to wear her seat belt more often, but not at all confident she will be able to give up a lifelong smoking habit. This example points out the greatest potential limitation of this approach. Failing to intervene upon her smoking and instead focusing on seat belt use may seem like shifting deck chairs on the Titanic. On the other hand, self-efficacy theory suggests that establishing early successes—even if they are not directly related to other behaviors—can enhance a person's self-efficacy for future prevention activities.[41]

Quality-adjusted life years

If a person is identified by a traditional HRA as being a cigarette smoker and having an alcohol problem, the HRA would most likely focus on the smoking habit. This is because cigarette smoking usually has a greater associated mortality risk than does an alcohol problem. Yet, most experts would probably recognize an alcohol problem as a greater influence on quality of life. While quality of life is a difficult concept to measure, attempts have been made to quantify the concept into quality-adjusted life years, or "QALYs."[24,25] Quality-adjusted life years have not been quantified for most health-related behaviors or conditions, though this area of research continues to accumulate more data relevant to prioritization. Using existing QALY data, combined with expert opinion, Strecher and his colleagues at the University of Michigan Health Media Research Laboratory have developed a Health Risk Assessment tool ("All About You") that incorporates quality of life in its prioritization algorithm.

Gateways to behavioral changes

Certain health-related behaviors, such as physical activity or stress reduction, may not have the largest influence on longevity relative to other risk factors such as cigarette smoking. Such behaviors, however, may positively influence one's ability to quit smoking, develop a better diet, reduce depression, or improve numerous other health-related behaviors. It therefore makes sense to us that HRA prioritization criteria include the degree to which changing a behavior can also influence changes in other relevant health behaviors.

Combinations of criteria

Naturally, these are not mutually exclusive criteria. Advanced computer technologies make it possible to consider multiple, or even all, of these criteria in a single prioritization algorithm or in a series of interactions with the user. From a behavioral science standpoint, the key evolutionary step this prioritization offers is movement away from solely risk-based criteria to a more systematic consideration of users' interests, beliefs, and general life circumstance.

3. Provide Feedback That Enhances The User's Ability To Make Recommended Health Behavior Changes.

Historically, HRA feedback has not demonstrated efficacy in helping people make the changes it recommends. Part of the reason for this is that the educational component of HRA feedback has been weak—simply telling users what behaviors they must changes with little if any assistance to actually enact those changes (see assessment in previous section). Just as an HRA currently collects information about health risk and develops feedback tailored to the user, additional components could collect information regarding characteristics of the targeted behavior, and behavior change messages tailored specifically to these characteristics. For example, collecting information regarding the individual's barriers to changing risk-related behaviors, then addressing these barriers in the feedback has been found to achieve greater levels of positive behavior change.[43_47]

Such feedback would assess not only an individual's risk factors, but also the behavioral and

psychosocial factors that influence the person's motivation or ability to make health-related behavior change. In a recent randomized intervention trial, Kreuter and Strecher[39] tested the effectiveness of enhanced HRA feedback, which provided not only risk information, but also individualized behavior change feedback. In the trial, this enhanced HRA feedback was compared to feedback generated from a standard HRA, and to a control group receiving no HRA feedback. Participants in the study were 1,316 adult patients from eight community-based family medicine offices in central North Carolina. The risk assessment and risk estimation algorithms were derived from "Healthier People," the health risk appraisal formerly administered by the Carter Center at Emory University. The behavioral assessment gathered more detailed information about cigarette smoking, cholesterol screening, dietary fat consumption, aerobic exercise, seat belt use, getting a mammogram, and getting a Pap smear. Feedback was computer-generated and mailed directly to patients at their homes. The feedback was not supplemented with counseling or interpretive services of any kind. Six months later, patients were sent a follow-up questionnaire. Overall, patients who received the enhanced HRA feedback were about 20% more likely to have made a needed behavioral change (i.e., one indicated by the presence of a risk factor) than were patients who received standard HRA feedback (O.R.=1.2, 95%; C.I. = 1.0-1.4).

Should HRA's effectiveness be judged on its own as an independent intervention rather than upon its use *together with* interpretive counseling? From a practical standpoint, although most HRAs recommend that their feedback be "interpreted" or reviewed by a health professional, this type of counseling is rarely administered. We believe that HRAs can be improved to the point of being effective in changing health-related behaviors, without interpretive feedback or follow-on group therapy programs.

Conclusions

The future of Health Risk Appraisal continues to be exciting, particularly with additions that strengthen its ability to improve health-related behaviors. HRA was the first health education tool that provided computer-tailored feedback to the user. The appeal of this feedback has always been strong. Applying behavioral theories of change to traditional HRA quickly identifies significant shortcomings. These shortcomings are borne out in evaluations of HRA efficacy. We believe that the appeal of feedback that allows individuals to better understand and prioritize their risk factors and to take steps toward actually changing their risks will be even stronger.

New communication channels, such as the Internet, are allowing users to engage in potentially more powerful HRA formats. New degrees of interactivity and longitudinal response allow users to iteratively identify risk factors, prioritize behaviors associated with their risk, develop a plan for changing selected behaviors, and receive feedback regarding their progress. Eventually, we envision the primary channel being in the user's home, on interactive television.

Physiological tests, such as blood pressure and cholesterol tests, have been used in the past to add to the accuracy of HRA. Future tests could include genetic tests (e.g., BRCA1, BRCA2 and P53 among an ever-increasing number of others) to identify increased susceptibility to particular diseases. Linking these powerful physical tests with behavioral assessment and feedback could provide us with the most exciting tools yet created in public health. Yet, unlike the previous two decades, we hope that research will take a leading role in future HRA development, assuring that new HRAs are more effective, user-friendly, accurate, and secure.

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