Is There a Use for Tailored Print Communications in Cancer Risk Communication?

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The manner of presentation of cancer risk information is critical to its understanding and acceptance by the individual recipient. Optimal communication of cancer risk information must effectively translate the technical meaning and subtleties of risk and its associated factors to a conceptual level understandable by the recipient. Tailored print communications (TPCs) may be an appropriate medium for cancer risk communication (CRC). TPCs are more refined than targeted communication materials. They are print materials created especially for an individual on the basis of knowledge about that person. The goal is to provide individually relevant and appropriate information. This review examines the nature of TPCs, assesses the use and potential of TPCs for the purpose of CRC, and highlights new directions in CRC. Articles dealing with TPCs were located by searching the MEDLINE® and PsychInfo® databases and seeking in-press articles. TPCs were identified for several areas of CRC, including dietary change, smoking cessation, mammography use, hormone replacement therapy, health risk appraisal, and genetic susceptibility to cancer. Although TPCs have been used in a number of different behavioral areas, they have not yet achieved their potential for CRC. The use of TPCs in the communication of cancer risk shows great promise, however, particularly as knowledge evolves regarding both the nature of risk and the most effective tailoring of health communication messages. [Monogr Natl Cancer Inst 1999;25:140–8]

METHODS

We conducted MEDLINE® and PsychInfo® searches of the literature and identified fewer than 30 relevant articles on tailored print communications (TPCs). Here, we focus primarily on in-press or published articles that reported randomized studies of TPCs. We noted any mention of cancer risks as a tailoring or measurement variable in the study and examined study outcomes, especially related cancer risk variables. Because the focus of most of these articles was not on manipulation of cancer risks or on risk perceptions, the information that can be gleaned is often suggestive and is based on inferential rather than direct evidence, yet, in a larger sense, all these articles deal with cancer risk communication (CRC) because they focus primarily on reducing the chances of getting cancer or dying of it by changing cancer-related behaviors or engaging in cancer-protective behaviors.

TPCs were identified in several main areas of CRC: dietary change, smoking cessation, mammography use, hormone replacement therapy (HRT), and health risk appraisal (HRA). In addition, the amount of literature on genetic risk for cancer susceptibility is increasing and relevant as well because the communication is inherently individualized, personalized, and about risk.

Previous reviews by Strecher (1) and Skinner et al. (2) examined the first 12 studies published on TPCs. They concluded that, compared with their nontailored counterparts, TPCs have been consistently better remembered, read, and perceived as relevant, credible, or both. Evidence also exists that they are more effective for influencing health behaviors. Not all the studies showed main effects; in general, however, those that did not have main effects found important interactions. This article is not intended as a comprehensive review of TPCs, given the recent reviews. Rather, we were interested in identifying the more recent literature and examining the lessons learned and the research needed to advance the science of CRC. We sought evidence that the authors had tailored on risk or on risk perceptions or had discussed reactions to the TPCs in terms of altered risk perceptions, perceived susceptibility, or the like. Because of the great variability in populations, outcomes, and strategies and of our primary interest in the risk aspects of TPCs, we did not attempt a meta-analysis.

BACKGROUND

The scientific calculation of risk is inherently statistical. For individuals, risk is personal. CRC has been defined as an interactive process of exchange that includes multiple messages about the nature of cancer and related risks (3). To be effective, CRC must traverse a great conceptual distance—from probabilities, based on mathematics derived from populations, to the calculation of individual risk, and then to the accurate perception of personal risk by individuals. Individuals’ perceptions about risk are influenced by many forces known only imperfectly by scientists. Ultimately, perception of risk should translate into knowledge or action. Stated more concretely, the chance that “a woman” will get cancer is far less salient than the likelihood that “I” will get cancer. This discrepancy may help to account for optimistic biases, the tendency for some people to discount their personal chances of either getting a disease or experiencing something else that is undesirable (4).

A real potential exists to improve health in the correct understanding of personal risk. It can increase knowledge, facilitate decision making, motivate new behaviors, and change existing behaviors (5). Patients would benefit from health professionals who understand personal risk and have the time to communicate it to the patient on a one-on-one level.

A skilled, human risk advisor would take into account the host of individual factors that affect how people perceive risks and respond to risk communications, as well as age, cultural, and
risk-appropriate recommendations. In contrast, mass-produced materials on health education can provide information about general cancer risks, but they cannot take optimal advantage of the opportunity to communicate with individuals. They fail to recognize, as Maibach and Holtgrave (6) stressed, that the audience is not one undifferentiated group.

Whereas the personal relevance and accuracy of a risk estimate are important, so is the way it is presented. The manner in which cancer risk information is presented and how risk estimates are expressed may influence recipients’ interpretations (5). People need more than accurate, personal risk estimates (7). They also must know how they, as individuals, can reduce their risks (8).

CRCs should include, where appropriate, objective, absolute risks—for example, of getting cancer, dying of cancer, or having a mutation—and the objective risk reduction associated with recommendations for behavior changes. At present, only a small number of validated cancer risk models are available. Although these models yield apparently objective and quantitative risk estimates, tailoring carries both the opportunity and the obligation to help the individual reader understand the evidence underlying the model, as well as how a model-based estimate applies and does not apply to him or her. Any discussion must convey the confidence interval around the estimate. Such communications also should respond to people’s subjective risk perceptions (9) and attempt to correct misperceptions. A person’s subjective risk may be more important than his or her objective risk in determining better health behavior. On the one hand, a need exists for highly specific information about risk, presented in a way that takes into account the relevant characteristics that influence the understanding and use of the information. On the other hand, traditional booklets and brochures are limited in their capacity to individualize risk communication.

To resolve this dilemma, health communicators have begun to use TPCs. TPCs can accomplish this multilevel communication because individualized strategies are appropriate when the information must be individualized to be meaningful. Thus, cancer risk information can include other, individually appropriate content as well as specific quantitative estimates. Probability estimates can be accompanied by both an explanation of how the risk estimate was derived and what it means. It can include information about how to reduce the risk (10,11). CRC also must reflect the fact that some people do not want to receive quantitative probability estimates. Ideally, risk communication involves truly interactive communication and shared decision making about recommended risk management strategies (6).

TPCs are print materials that are created especially for an individual. They are based on information about that person (2) and provide individually relevant and appropriate information (12). The information can come from many sources (e.g., self-administered or interviewer-administered questionnaires, medical records, and encounter data) (13). The diffusion of TPCs has been facilitated by advances in computer technology and a growing number of software programs that can be used to create TPCs. In addition, the genetics revolution is providing us with the tools to provide better estimates of genetic risks.

Everywhere we look, the concept of mass customization is being applied (14). Increasingly, the consumer expects to be treated as an individual. Mass marketing has become more and more individualized, and the evidence suggests consumer acceptance of tailored products. TPCs are part of a global information revolution. Robinson et al. (15) recently highlighted the potential advantages of the “new media” for improving health, in part, by tailoring information to the needs of users. Tailored communications may be particularly important in helping consumers make personal decisions about health care choices. This ability is especially important in an era when the profusion of choices and the complexity of treatments may leave consumers at a disadvantage (16).

TPCs are suited ideally to communicating cancer risks. We provide an overview of TPCs, with a focus on their potential for CRC. We briefly will review the studies conducted to date, with a focus on their utility for CRC. We also will highlight new directions in CRC and the potential of TPCs for use in CRC. Another review in this monograph focuses on interactive health communications (17).

**HOW TAILORING IS DONE**

Tailored materials are more refined than targeted materials. The latter may segment the population into high-risk groups—for example, on the basis of race, a health condition, or age—and then create materials especially for the group. Evidence suggests that targeted materials are effective (17). But the messages are not individualized as they are for tailored materials. Researchers have hypothesized that greater effect could be achieved through tailoring.

Tailoring should be informed by theory and what is known about the determinants of the behavior (18). For example, to create a TPC about smoking cessation, the creator would need at least the following data: patient’s name, sex, current smoking status and intentions, responses to items about the pros and cons of change, and responses to the processes of change items (19). Ideally, level of addiction, confidence in ability to quit, and related variables also would be assessed. The selection of tailoring variables should be grounded in theory and understanding of the behavior. Some tailoring algorithms have used variables such as risk perceptions, motivations to change, quantitative risk estimates, and self-efficacy. This tailoring is especially appropriate when models such as Precaution Adoption are used.

To accurately assess risk and risk perceptions in TPCs, researchers should use qualitative and quantitative measures of risk as recommended by Weinstein et al. (20). These measures should include how likely one is to get breast cancer, for example. One would want to ask this question, using both qualitative descriptors, such as “How likely are you to get breast cancer?” and “On a scale from 1 to 100, what is the chance you will get breast cancer?” In addition, both objective and subjective risks should be assessed. The assessment should be specific to a particular risk or hazard, and the appropriate reference group should be used.

Tailoring of print materials may be done quite simply, using a few variables such as race and previous health behavior. Or it may be done by using complex combinations of variables that result in millions or billions of possible combinations.

TPCs come in many forms. The first reported TPCs were variants on tailored, personalized letters and feedback reports (21–23). More recent studies (most in press or ongoing) are using a wider array of approaches, including tailored calendars (24), tailored birthday cards and newsletters (25), tailored brochures (13), tailored tip sheets in combination with feedback reports (26), and combinations of personalized feedback reports and stage-matched manuals (19). Investigators have used different approaches when programming the tailored communications.
algorithms, including combinations of spreadsheets, databases, Microsoft Word, and Pascal. Unfortunately, at present, no “off the shelf” packages are available for producing tailored communications.

Briefly, print message tailoring is accomplished by programming a computer application, such as a word processor, to select and combine message elements into a printed message. The message elements are part of a message library that contains all possible responses for different conditions. The basis for the selection is the variables and their values in an individual’s data record, using information drawn from such sources as interviews, medical or pharmacy records, and observations. Message elements are usually sentences and paragraphs, as well as images such as drawings and graphs. Empirically based decision rules for selecting the appropriate message from a library of options are a feature of the expert-like systems that are used to produce TPCs. Tailored risk communication might be seen as simply a subset of TPCs, i.e., those communications dealing with risk, but this statement would oversimplify the range and complexity of tailoring opportunities associated with risk.

HOW TAILORING WORKS

It is not known exactly how tailoring exerts its effect. Data show that tailored materials are more likely to be read, retained, remembered, and rated more highly in comparison with nontailored materials. Under Petty and Cacioppo’s (27) Elaboration Likelihood Model, the increased attention and retention might lead to better processing of the information and, thereby, to better outcomes. Such outcomes are consistent with Rothman and Schwartz’s (28) observations about the importance of the accessibility of risk information. Features of both the person and the environment affect accessibility. The effect of TPCs also is consistent with the Transtheoretical Model (29) as the guiding theory; many tailored materials address issues pertinent to a particular stage of change without extraneous information. They are perceived as more relevant and are more attended to by the recipient and, ultimately, facilitate more behavior change. In the case of CRC, following the Precaution Adoption Model of Weinstein et al. (20), the effect may be achieved because the TPCs are directed at a person’s position along a behavioral continuum that reflects response to a hazard and overcomes barriers. Or messages might be designed to increase perceived susceptibility consistent with the Health Belief Model (30).

Because the reported studies have used several different theories, variables, and formats and generally have not used factorial designs, it is not possible to answer some of the most interesting and important questions about how tailored materials exert their effect, much less the role of risk communication in producing the effect. Moreover, most TPC research reported to date has relied on theories, such as the Stages of Change Model, in which risk is not a major construct. Several of the TPC studies currently in the field are using theories, such as the Precaution Adoption Model, in which risk is central. Thus, much more information should be available in the future about the utility of TPCs for CRC.

OVERVIEW OF RESEARCH RESULTS

In the next sections, we review research results from the TPC literature. Because two recent reviews (1,2) have focused on many of the articles reviewed here, our summary is brief. In

| Table 1. Evidence for the effectiveness of tailored print communications (TPCs) |
|---------------------------------|----------|----------|
| Characteristic                  | Significant impact* |
| TPCs are more likely to be read, recalled, and rated more highly. | |
| TPCs have a significant effect on decreasing dietary fat intake. | |
| TPCs have a significant effect on fruit and vegetable intake. | |
| TPCs have a significant main effect or subgroup effect on smoking cessation. | |
| TPCs have a significant main effect or subgroup effect on use of mammography. | |
| TPCs improve woman’s decisions about hormone replacement therapy. | |
| TPCs can improve behavior change in response to a health risk appraisal. | |
| Brinberg and Axelson (31) | Yes |
| Campbell et al. (32) | Yes |
| Brug et al. (22) | Yes |
| Lipkus et al. (33) | Yes |
| Rimer et al. (25) | Yes |
| Bowen et al. (34) | Yes |
| Brinberg and Axelson (31) | Yes |
| Campbell et al. (32) | Yes |
| Brug et al. (22) | Yes |
| Brug et al. (23) | Yes |
| Strecher et al. (35) | Yes |
| Lipkus et al. (33) | Yes |
| Dijkstra et al. (36) | Yes |
| Skinner et al. (21) | Yes |
| Rakowski et al. (26) | Yes |
| Rimer et al. (25) | Yes |
| Drossaert et al. (39) | Yes |
| Meldrum et al. (40) | Yes |
| O’Connor et al. (41) | Yes |
| Kreuter and Strecher (42) | Yes |

*Investigators and reference numbers are listed in columns.

Tables 1 and 2, we highlight the study outcomes and the role of risk in those studies.

Dietary Change

To date, more TPC studies have been conducted in the area of dietary change than in any other area. However, assessment of risk perceptions and tailoring on the basis of risk played only a minor role in these studies. Campbell et al. (32) measured perceived susceptibility to diet-related diseases but did not report findings. One of the assumptions of Brug et al. (22) was that TPCs would heighten recipients’ awareness of cancer risks and lead to other changes that would result in dietary behavior changes. Thus, feedback about dietary practices was designed accordingly. Nevertheless, the results have been impressive—significant effects on decreasing dietary fat intake in studies by Brinberg and Axelson (31), Bowen et al. (34), Campbell et al. (32), and Brug et al. (22,23). These outcomes were achieved with a variety of TPCs, including brochures (31), personalized feedback (34), and a tailored nutrition packet (32). The results for increasing fruit and vegetable consumption with the same interventions were mixed—one study (23) found significant effects, while two other studies (22,32) did not.

As a group, these studies have demonstrated that tailored letters can change dietary behavior, although the results were more consistent for dietary fat than for fruit and vegetable consumption (see Tables 1 and 2). The authors also found that TPCs, compared with generic materials, were more likely to be read, were rated higher, and resulted in greater information re-
variable, and messages included the perceived threat of smoking cessation interventions, but not all studies were tailored on outcome data were presented.

Strecher et al. (35) Risk for smoking-related diseases was a tailoring variable.
Dijkstra et al. (38,43) Smoking cessation was tailored on outcome and efficacy expectations; perceived health consequences were not affected.
Lipkus et al. (33) As a facilitator for quitting smoking, improved health was a tailoring variable but was not related to quitting.
Curry et al. (37) Health concern was a tailoring variable, but no outcome data were presented.
Scriber et al. (35) Risk for smoking-related diseases was a tailoring variable.

Table 2. Use of risk messages and/or assessment of risk outcomes in TPCs*

<table>
<thead>
<tr>
<th>Authors (reference No.)</th>
<th>Risk message and/or impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campbell et al. (32)</td>
<td>Beliefs about perceived susceptibility to diet-related diseases were measured but not reported.</td>
</tr>
<tr>
<td>Bowen et al. (34)</td>
<td>TPCs heightened awareness of cancer risks as related to diet, but no risk-related outcomes were presented.</td>
</tr>
<tr>
<td>Brug et al. (22)</td>
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<tr>
<td>O'Conner et al. (41)</td>
<td>Women who received tailored decision aids were more likely to be aware of the risks and benefits of HRT.</td>
</tr>
<tr>
<td>Kreuter and Strecher (42)</td>
<td>Enhanced HRA§ feedback included risk information and individually tailored behavior change information. Patients who received enhanced HRA feedback were 18% more likely to change at least one risk behavior. Patients who overestimated their cancer risks became more accurate.</td>
</tr>
</tbody>
</table>

*TPCs = tailored print communications.
†HRT = hormone replacement therapy.
‡HRA = health risk appraisal.

The amount of literature on the use of TPCs to increase smoking cessation is increasing. The smoking studies generally have used the Stages of Change Model as the theoretical foundation, but they have varied greatly in how tailoring was done as well as in style, format, number of tailoring variables, and other elements. As in the area of dietary change, it is difficult for the reviewer to judge the quality of the TPC. Tables 1 and 2 show that the effect of TPCs on smoking cessation has been mixed, with positive findings in three studies (33,35,36) and negative findings in two studies (37,38).

Risk communication could be a strong component of smoking cessation interventions, but not all studies were tailored on risk perception variables or even measured such variables. Studies by Strecher et al. and Dijkstra et al. are exceptions. Strecher et al. (35) used risk for smoking-related diseases as a tailoring variable, and messages included the perceived threat of smoking-related diseases. No data were reported with regard to changes in perceived risk. Dijkstra et al. (36,38,44) assessed different questions related to the effect of TPCs on smoking cessation. Of particular relevance to risk communication is a study that focused on using computer-tailored feedback to change cognitive determinants of smoking among smokers who said they were planning to quit in 6 months. The authors compared computer-generated letters on the outcomes of smoking cessation with computer-generated letters, using efficacy information versus control conditions (38). They focused on social learning variables, such as self-efficacy and outcome expectancies. Although some variables, such as perceptions about environmental and social consequences, were changed as a result of the computer letters, perceived health consequences—a dimension of risk perception—were not affected.

Lipkus et al. (33) assessed the effect of iteratively tailored birthday cards and newsletters among low-income, primarily African-American smokers. They tailored the cards and newsletters on the basis of variables from the Stages of Change Model as well as barriers to quitting and other variables. Three intervention groups were identified: provider prompting only, tailored print, and tailored print and telephone counseling. A highly significant quitting effect was seen for the TPC group: 33% of those who received TPCs quit smoking compared with 13% in the prompting only group and with 19% who received telephone counseling as well as the TPC. The effect was especially strong for contemplators and black men. Although improved health was a motivator for quitting and therefore a tailoring variable, risk perceptions were a minor part of both the intervention and evaluation and did not seem to affect quitting behavior.

Thus, several TPC studies have focused on smoking cessation. Several different kinds of TPCs were used in these studies, including personalized feedback (37,43), a tailored letter (35,38,44), and tailored birthday cards and newsletters (33). Some investigators used pro or con measures and measures of risk perception and then tailored on these variables. Although risk perceptions, health concerns, or both were tailoring variables in some studies, they did not appear to be a major focus, and it is not possible to determine how risk tailoring affected the outcomes. Two of the studies had main effects on longer term abstinence. An additional study showed significant interactions (see Tables 1 and 2). However, the variations in smoker characteristics make comparisons difficult.

Mammography Use

In several studies, TPCs were used as part of a strategy to increase mammography use. In most of these studies, risk was not a major variable, although, in some cases, the TPC was designed to reduce women’s unrealistic perceptions of cancer risk. Skinner et al. (21) conducted one of the first studies in this area and found no main effects on mammography use but significant interactions, with special benefits for black women and those with incomes less than $26 000. The tailored letter did not result in differences in perceived susceptibility, Skinner’s risk perception variable (21).

Two European studies (39,40) used tailored leaflets and invitation letters to increase participation in mammography. Neither study found an improvement in participation among women who received the tailored letters and leaflets. But mammography rates were uniformly high and these were very minimal TPCs.

In the United States, Rakowski et al. (26) combined stage
matching and tailoring to create tip sheets and tailored letters to increase mammography use among 1864 women in a health maintenance organization (HMO). Stage-matched, tailored materials significantly outperformed a no-materials group and a standard intervention group: 63.6% of the women in the stage-matched group received mammograms compared with 54.9% in the no-materials group and with 58.5% in the standard intervention group. Tailoring was not based on risk perceptions or communication of actual risks.

In a study in which TPCs were used in a low-income, primarily African-American population, Rimer et al. (25) found an effect of tailored birthday cards and tailored newsletters for Pap tests and overall cancer screening but not for mammography. However, mammography use was already well above the national average in all study groups, so there was little room for improvement.

The mammography-related TPCs are promising in spite of inconsistent results. This area might benefit from more inclusion of and tailoring on risk variables, as there are quantitative models of breast cancer risk. Some current studies are doing just that. For example, in an ongoing study using TPCs to improve women’s decision making about mammography, Rimer and colleagues (13) are giving women their Gail Model scores with additional information to shift their risk perceptions, if appropriate. Balance sheets are used to help women examine the pros and cons of mammography. Women are informed of the factors that contributed to their Gail Model scores. This approach is consistent with Rothman and Kiviniemi’s (7) recommendation that risk communicators provide information on probabilities and also on causes and consequences.

**Hormone Replacement Therapy**

Few areas of medicine exist in which risk communication is more challenging than HRT. Providers must communicate, and women must understand the trade-offs of risks and benefits for multiple diseases as they consider a lifelong HRT regimen. O’Connor et al. (41) applied the exciting technology of decision aids in helping women to make personal decisions about HRT use. In a randomized clinical trial, the authors compared the efficacy of a general educational pamphlet with a tailored decision aid. Women who received the decision aids showed significant improvements in a number of areas, including realistic personal expectations of the risks and benefits of HRT. Women who received the decision aids were more likely to know HRT benefits and risks, to be aware of the importance of the risks, and to say they made an informed choice (see Tables 1 and 2).

**Health Risk Appraisal**

Kreuter and Strecher (42) conducted a randomized trial to compare the effects of typical HRA feedback with enhanced HRA feedback. The enhanced feedback was individually tailored on the basis of the Health Belief Model and Stages of Change Model. The feedback included two components: risk information and individually tailored behavior change information. Overall, patients who received enhanced HRA feedback were 18% more likely to change at least one risk behavior than the patients who received typical HRA feedback. The enhanced feedback promoted changes in some behaviors but not in others, as determined by a baseline assessment and a 6-month follow-up. Moreover, the enhanced HRA was effective in changing perceived risks. Patients who had underestimated their stroke risks and those who had overestimated their cancer risks both became more accurate (45). This is one of the few studies to demonstrate a causal link between risk perceptions and behavior. Smokers who had accurate perceptions of stroke risk at baseline were significantly more likely to have quit smoking at follow-up than were those with optimistic biases. These results suggest that tailored communications may be effective for some behaviors when based on risk information and behavior change information.

**Genetic Susceptibility to Cancer**

One of the areas of CRC that provides the greatest challenges is cancer genetics. Genetic risk is inherently probabilistic, and, as Wroe et al. (46) showed, perceived risk may be a more important variable for genetic testing than for cancer screening and other health screening. Lloyd et al. (47) pointed out that the effectiveness of genetic counseling depends on attenders’ comprehension of risk communication. They also suggested that attention should be given to factors that facilitate comprehension and recall of risk estimations. In the literature related to genetic susceptibility for cancer, a number of authors have assessed people’s perceptions about their cancer risks, in addition to other measures (48). Most of these authors have found that people overestimate the chances of having a mutation and of getting cancer. Moreover, when faced with the possibility of being tested for genetic susceptibility, most people likewise focus on the benefits rather than on the risks or limitations. Thus, this area might benefit from the use of individualized educational strategies such as TPCs.

Few investigators have attempted to experimentally control the risk communication or even to assess people’s reactions to risk estimates. We will focus here on this aspect of genetic risk studies because they share a common core with TPC studies—the communication of individualized risk estimates. Although these studies are not strictly TPC studies, they offer lessons to those interested in considering the appropriateness of TPCs for communicating cancer risks in the area of genetics.

In one of the few experimental studies, Lerman et al. (49) conducted a randomized trial in which high-risk relatives of patients with breast cancer were assigned to either a general health education intervention or one in which they received individualized Gail Model scores and related information. Women who received risk counseling and printed risk estimates were significantly more likely to improve their risk comprehension. However, women in both groups continued to overestimate their lifetime risk of breast cancer. Women with high levels of baseline anxiety were least likely to benefit from the intervention. Lloyd et al. (47) and Watson et al. (50) studied women who attended genetics clinics versus general practice clinics to assess the effect of personalized risk estimates. They found that most women overestimated their breast cancer risk; 66% could not accurately recall their own risk even after being provided printed estimates.

The difficulty in recalling risk estimates may result from how information is presented. Hallowell et al. (51) studied preferences for risk information and found that 73% of women wanted quantitative risk estimates; however, in over 40% of cases, the risk information was not presented in the counselee’s desired format. In generic health education materials, it is not possible to respond to format preferences. TPCs offer the potential to tailor on both the risk estimate and the manner in which it is presented.
In a study being conducted at Duke University Medical Center through the Breast Specialized Program of Research Excellence (SPORE), women were asked whether they wanted a qualitative risk estimate, a quantitative risk estimate, or both. Baseline data indicate that the majority of women wanted both estimates (8). However, some women want only qualitative estimates, and this estimate is what they are given until their counseling session. A real mismatch could occur if women wanted qualitative estimates and were provided with numbers. The ability to respond to the needs, readiness, and preferences of individuals is an inherent benefit of TPCs. Fig. 1 shows an example of a woman who received a quantitative estimate of risk.

Together, these studies show that most people want quantitative risk estimates, but these estimates are not enough to encourage accurate recall. Moreover, the uncertainties associated with the results of genetic testing are especially challenging. Welch and Burke (52) gave the example of a physician who needed to communicate the concept: “You have a 75% risk of developing colon cancer.” TPCs may be a good vehicle for communicating genetic risks because they can provide individualized estimates in a format that is acceptable to individuals.

**DISCUSSION**

We have reviewed reports of 21 published or in-press studies in which the first TPCs were evaluated in randomized trials. As we discussed, TPCs have been used in a number of different behavioral areas, including primary and secondary cancer prevention as well as in cancer genetics, HRA, and decision making. Because the studies were so different from one another, with very different outcomes, we did not attempt a meta-analysis. Nevertheless, we can offer several conclusions.

First, as shown in Table 2, with reference to the theme of this review, TPCs have not achieved their potential in CRC. Whereas all the topics covered by TPCs can be considered CRC, at least broadly, little investigation has been done of how risk mediates the outcomes achieved. Even when authors said they were using a model that incorporated risk perception or objective risk measures, they rarely presented results specific to these variables.

Two studies provide reason to be optimistic about the potential role of TPCs in CRC. Kreuter and Strecher (42) demonstrated that patients who received enhanced HRA feedback in comparison with standard feedback became more accurate in their estimates of cancer risks. O’Connor et al. (41) showed that decision aids about HRT resulted in patients who were more aware of the risks and benefits of HRT.

Clearly, TPCs are rated more highly than their generic counterparts. This finding is important, and other investigators should use process measures as part of their evaluations. All the TPC studies conducted on dietary fat have found significant effects, whereas the results for fruit and vegetable consumption have been equivocal. However, in several of the studies, the investigators were attempting to affect multiple behaviors. Thus, it is not clear whether the lack of effect is a result of behavioral overload or if fruit and vegetable consumption is a more difficult behavior to influence through TPCs. The two smoking cessation studies that used well-developed TPCs without auxiliary print materials and did not self-select particularly difficult populations (33, 35) found significant main effects or interactions. This finding is especially important given the difficulty of influencing smoking behavior. The results on mammography also are equivocal, but the studies may have suffered from ceiling effects. Finally, in the areas of HRT and HRA, the results were positive.

In the studies reported in this review, it was not possible to determine whether, and to what extent, quality differences in the construction of the TPCs might have affected study outcome. While a rose is a rose is a rose, to paraphrase Gertrude Stein, the same cannot be said for TPCs. It is possible that negative results are a result of inadequacies in the TPC itself.

The TPCs reviewed here varied greatly in design, format, length, and execution. Some may have been executed better than others. No reason exists to believe that a letter with a few tailored elements would be as effective as a brochure with information and graphics tailored to the reader.

Thus, on balance, more positive than null results were found. This finding is true especially if one focuses on the more recent studies. The studies that are now in the field will be poised to answer many of the important questions about tailoring. Overall, the results of the studies reviewed here give us reason for both optimism and caution. The results are generally balanced; certainly no evidence of harm is found. However, more work is needed to determine how best to tailor and assess what problems and populations are most appropriate for tailoring interventions.

To advance the science of both tailoring and CRC, scientists should agree on the most pressing questions, develop a core set of common terms and measures, and put their codes, like genetic sequences, into a researcher-accessible website. TPC researchers can do a better job of describing what they do and of making their tailoring algorithms and formats available for examination. Science is built through iterative discoveries as well as giant leaps. Major advances in this field are likely to come from a concerted effort by scientists to collaborate to raise and answer the important questions.

![Fig. 1. Communicating personal risk information.](image-url)
In the next sections, we summarize some of the lessons learned about TPCs for health practitioners and suggest several areas of research that should be pursued to answer important questions about TPCs.

**WHAT CAN PRACTITIONERS DO TODAY WITH TAILORED RISK COMMUNICATION?**

Several reviews have highlighted the value of personalized letters and reminders (53). The previous discussion shows, on balance, a favorable effect of TPCs. The collective experience generally has been with tailored letters, booklets, newsletters, and even birthday cards. To date, it is not clear how much tailoring is needed. In many cases, less may be more. Even a Post-it note with an individualized message can increase the salience of health messages. Wherever possible, physicians’ offices, health departments, and other organizations should use personalized letters rather than, for example, “Dear Patient” letters. Any word processor is capable of producing a personalized letter of advice or a cover letter for a standard brochure that is addressed to the patient by name. A more intensive level of tailoring might be to use the data about a patient to insert a paragraph or sentence in the cover letter that points to a particular section of the brochure (“Be sure to read the section beginning on page x of the enclosed booklet”).

Another approach would be a risk-specific insert for the front of a generic booklet. The practitioner would create inserts for, say, three levels of risk and insert one by hand before giving or mailing the booklet to the individual. The insert could include areas to hand write details such as laboratory values and risk categories. New products, such as National Cancer Institute’s “Risk Disk,” provide ways to calculate an individual’s probability of being diagnosed with breast cancer. More such products will be available in the future as risk algorithms become more commonplace. At the very least, tailored letters will be needed to highlight or reinforce such information.

**Strategy Choices**

Practitioners should look to theory and to evidence-based scientific literature to guide strategy choices based on evidence. The literature now testifies to the benefits of targeted and tailored materials over generic ones. At this stage, parsimonious approaches to tailoring, such as letters, cards, and newsletters, are supported by the literature (53) in a number of areas. Some evidence shows that multiple tailored communications are more effective than single communications.

Practitioners should apply what is already known about risk communication in developing printed materials. Paring down the information to what people need should be a fundamental step in CRC. Fischhoff (54) has stressed the importance of understanding what is really relevant to a behavior or decision. Finally, wherever possible, researchers should evaluate what they do in tailoring. By doing so, they will improve their own work and advance both the state of the science and the state of the art.

**A Research Agenda for Tailored Print Communications**

The TPCs currently being tested are more advanced in terms of theory, format, and tailoring strategy than some of those reported here. Moreover, researchers are applying the strategy of tailored communication to areas about which there has been controversy, such as mammography for women in their 40s, colorectal cancer screening, HRT, and tamoxifen use for breast cancer risk reduction. In such cases, TPCs might serve an important role in the decision-making process not only by communicating critical information about risks and benefits but also by helping users to weigh their own perceptions of risks and benefits. In addition, researchers, such as those participating in the Cancer Information Service Research Consortium (CISRCC), are using appropriate designs to answer important questions (e.g., whether iterative tailoring is both effective and cost-effective). A number of important research questions about CRC could be examined using TPCs.

1) To advance CRC, TPC researchers should be encouraged to provide the following information consistently: theory used to inform the intervention and how the TPC is expected to exert its effect, as well as summary of risk measures, risk messages, and changes in risk variables as a result of exposure to TPCs. In addition, researchers should follow the recommendations put forward by Robinson et al. (15) for reporting studies of interactive communications. They provided detailed recommendations for process and outcome evaluation measures.

2) Researchers should be encouraged to assess people’s reactions to tailored risk communications and provide data about changes in variables such as perceived risk, susceptibility, and worry. The role of risk as an intervening variable affecting responses to TPCs should be investigated and then reported. Most current reports do not provide enough information to assess how changes in risk perceptions may have affected study outcomes.

3) As Weinstein and Sandman (55) advised, measures of risk comprehension should be obtained, and careful attention should be given to the criteria by which messages are to be evaluated. This process should be a part of the reporting for TPCs when risk is a major component.

4) TPCs should be tested in factorial designs or in smaller scale and more controlled laboratory studies to examine how to communicate risk estimates and other risk-related information. This testing is especially important as quantitative estimates of risk are increasingly available. Moreover, such designs could help to elucidate basic mechanisms. As de Vries and Brug (56) pointed out, we still do not know why tailored health education is more effective than general health education because no study was designed to answer this question. In this area, as in many other areas of CRC, we need to understand basic mechanisms.

5) TPCs can be used to improve the communication of cancer risk by refining messages so that they are appropriate for particular exposures and audiences. Such tailoring also could use increasingly available data on neighborhood exposures and behaviors.

6) More research is needed to assess the extent to which the efficacy of TPCs may be enhanced by combining them with other strategies such as companion materials for health providers or other adjuncts such as telephone counseling. The results to date have been inconsistent. For example, Rimer et al. (25) found a benefit of adding telephone counseling to TPCs for cancer screening. But Lipkus et al. (33) showed that TPCs outperformed the counseling condition for smoking cessation.

7) Future research should consider how factors such as cultural context, emotions, personality, and utilities can be incorporated into TPCs to enhance their relevance (46). Recently, the Institute of Medicine (57) made a series of recommendations about CRC in following up on an analysis of thyroid cancers related to iodine-131 exposure. Among other topics, the report called for research to determine how to communicate risk infor-
mation so it is perceived as personally relevant. Although the data suggest that TPCs are more likely than generic materials to be perceived as personally relevant, more research is needed to determine how to enhance perceived relevance. More understanding of people’s mental models may be helpful in this area (54).

8) More research is needed to refine the creation of tailored decision aids, especially those that are appropriate for people with a high school education or less as well as ethnic minorities.

9) A real need exists for statisticians to collaborate with behavioral scientists to develop more refined techniques to evaluate the effect of TPCs on the basis of every participant getting a unique intervention.

**The Future**

Chamberlain (58) argued that, instead of addressing mass audiences, tomorrow’s communicators need to learn how to send multiple messages through myriad channels, tailored in such a way that the content appears to be (or can evolve into) an individual message for the receiver. Risk communication research should be undertaken with the fundamental assumption that the resulting message is intimately tied to the individual—to age, interests, education, experience, health needs, and perceptual style. Such tailoring should accommodate preference for graphical information. This accommodation can be done with greater detail than a health professional talking one on one with a patient.

Is there benefit in telling a smoking security guard that for every one of his or her colleagues who will draw a gun in self-defense, one hundred will die of a smoking-related illness before reaching retirement?

Can an accomplished golfer be persuaded by comparing the chances of making a hole in one on a familiar golf course with the chances of getting skin cancer from playing without a hat?

Even at a less deeply detailed level, research questions and directions will be enriched by close interplay between understanding individuals’ perceptions of risk and pushing back the limits on how we can individually operationalize our understanding.

Some people seem to conceptualize space better; others seem to perceive best in terms of time. Weinstein et al. (20) suggested that describing different risks in terms of time intervals might be an effective way of communicating risk probabilities. This approach may be especially important when communicating population risks. Some people use rules of thumb and rough guidelines in decision making, while others go by the book. Some prefer statistical arguments; others prefer narrative and synecdoche. With tailoring, any combination of those attributes and others could be the basis for a communication. Tailoring research must become sufficiently multidimensional so that it can illuminate some of the more obscure links among personality, cognition, message characteristics, and action.

How to construct a parsimonious risk-perception profile that can drive state-of-the-art tailored communication methods is a question that needs to be asked, researched, and asked again. Both content and context will evolve along with our understanding of the biology of risk, with the psychobiology of risk perception, and with the technology of tailoring.

Researchers should examine the interrelationships between objective and subjective risks. For example, many women overestimated their subjective risk of breast cancer in comparison with their objective risk based on Gail Model scores (59). However, smokers may underestimate their risks for lung cancer. Providing tailored feedback on these mismatches could be a potential value of TPCs.

Like other new technologies, which are becoming increasingly available as a result of the communications revolution, TPCs are not a panacea. But the thoughtful use of theory-driven TPCs, built on a foundation of evidence from diverse fields (including the communication and behavioral sciences), could improve the art and science of CRC (60).

**References**
