The Framing Effect of Relative and Absolute Risk

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Objective: To test whether a patient's perception of benefit is influenced by whether the benefit is presented in relative or absolute terms.

Design: Questionnaire-based study.

Setting: A general medicine outpatient clinic at a rural tertiary care center associated with a medical school.

Patients: 470 of 511 consecutive patients who agreed to answer a questionnaire while waiting for their clinic visit. Mean age was 49.1 years, 62.1% were female, and 51.9% had at least one year of education beyond high school.

Main outcome measures: Patient response to the choice of two equally efficacious medications for the management of a hypothetical serious disease. The benefit of one medication was stated in relative terms, the other in absolute terms. Patients could choose either medication alone, indicate indifference to the choice of medication, or choose not to answer.

Main results: 56.8% of the patients chose the medication whose benefit was in relative terms. 14.7% chose the medication whose benefit was in absolute terms. Only 15.5% were indifferent to the choice of medication. The patients preferred the medication whose benefit was in relative terms across a wide range of ages and educational levels. Further questioning suggested that the patients thought benefit was greater when expressed in relative terms because they ignored the underlying risk of disease and assumed it was one.

Conclusions: The "framing" of benefit (or risk) in relative versus absolute terms may have a major influence on patient preference.

Key words: framing; risk; patient preferences; benefit; decision making.

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IT IS WELL KNOWN that common expressions of probability have different meanings to different people,[1] and that even quantitative expressions can be interpreted differently.[2] This difficulty in communicating is compounded by "framing," the influence on decision making of the descriptions of acts, contingencies, and outcomes.[3] For example, McNeil et al. found that patients, students, and physicians were more likely to choose surgery over radiation therapy for treating patients who have lung cancer when the outcome of treatment was framed as the probability of surviving rather than as the probability of dying.[4]

In medical decision making, concerns with framing have been largely confined to the description of outcomes.[4-7] One aspect of framing that has not been well investigated is the impact of different measures of risk. In clinical situations, risk may be summarized using two different measures: relative risk (RR) or absolute (sometimes called attributable) risk (AR). When describing the effect of a risk factor, such as a high level of serum cholesterol in relation to coronary heart disease (CHD), RR is the ratio of the risk of disease in one group (i.e., CHD among those with high serum cholesterol) to that in another (i.e., CHD in those with low serum cholesterol); AR is the difference between the risks of disease in the two populations and defines the absolute magnitude of the risk. We[8] and others [9, 10] have argued that in clinical decision making AR is a much more meaningful measure of risk. However, RR is preferred in etiologic research, is more frequently reported in medical literature as well as in the popular press and is commonly used in clinical encounters.

If the underlying risk of disease is known, RR can be converted to AR.[8, 9, 11] The two measures are logically equivalent and, in this sense, presentation of either should lead to the same decision (if information about the underlying risk of disease is presented). However, the literature on perception of risks suggests this might not be true.[12, 13] When treatment efficacy is expressed in relative terms, larger percentages result than when the same treatment is discussed in absolute terms. For example, suppose a medication reduces the risk of an adverse outcome from 0.05 to 0.025. In relative terms it reduces the risk by 50%, while in absolute terms it reduces the risk by 2.5%. Thus, the presentation of RR may magnify the perception of efficacy.

To evaluate this question we conducted a questionnaire-based study to establish whether patients perceptions of risk were influenced by the presentation of risk in relative versus absolute terms. We hypothesized that patients would misinterpret RR and not account for underlying risk of disease when comparing it with a measure of AR.

METHODS

Study Population

Patients were recruited from the outpatient practice of an academic general internal medicine group in rural New Hampshire. The group is part of a large multispecialty practice and at the time of this study consisted of 12 internists and four nurse practitioners or physician's assistants seeing a mix of scheduled and unscheduled (walk-in-clinic) patients.

During August–September 1989 one of the investigators spent eight half-days in the designated general

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medicine waiting room recruiting subjects. All scheduled and unscheduled patients who registered were asked to complete a three-page questionnaire. Only patients who could not read English, were visually impaired, or had physical disability that limited their ability to read or write were excluded. A written informed consent was not required, though a cover letter approved by the institutional review board for the protection of human subjects was attached to each questionnaire stating the intent of the study, that participation was voluntary, and that no unique patient identifier would be obtained.

Questionnaire

The self-administered questionnaire consisted of eight items requesting demographic information and two hypothetical situations, each with an accompanying multiple-choice question. The demographic information included data describing gender, age, level of education, a measure of self-reported overall health, and whether subjects were under medical treatment for hypertension and/or hypercholesterolemia. We collected the latter information because we hypothesized that patients being treated for a cardiac risk factor may have had an explicit discussion about risks and benefits and might be more attuned to different measures of risk than would patients not being so treated. In the hypothetical situations, the patients were asked to imagine they had a disease and to answer a question about their preferences for treatment. The disease was described as serious, with one-year mortality that was clearly specified numerically. One year was chosen as the time frame to minimize the effect of patients' attitudes toward length of life.[14]

The first situation (Appendix A) was designed to test the effect of risk presentation. The patients were asked to make a choice between taking one of two medications for the treatment of their life-threatening disease. "Medication A" and "Medication B" were described as costing the same and having almost no side effect. The efficacies of the drugs were actually equivalent. However, the benefit of Medication A was presented in relative terms while the benefit of Medication B was presented in absolute terms. We asked the patients to choose to take Medication A, Medication B, either Medication A or B, or not to answer. The second situation (Appendix A) was designed to test patients' understanding of the relationship between RR and AR. The patients were told there was only one medication to treat a disease. They were told the benefit of this medication in relative terms and then asked to indicate this benefit in absolute terms. The one-year mortality associated with the disease was again clearly specified. They were given a choice of five possible answers, including one that was the product of the RR and the population size (the "expected mistake"), one that was the product of the RR and the baseline risk (the correct answer), and one indication they could not decide.

Four versions of the questionnaire were administered to provide in the first situation all combinations of an underlying risk of death (10 or 80%) and a treatment benefit (10 or 80%). The questionnaires were ordered to ensure that equal numbers of patients would receive each version throughout the period of study.

TABLE 1

Patient Characteristics ($n = 470$)

Age—median (years)	49.1 (range 15–89)
Gender (%)	
Female	62.1
Male	37.9
Education (%)	
≤ 12 grade	48.1
≥ 13 grade	51.9
Medical history (%)	
Hypertension	22.8
Medically treated	14.2
Hypercholesterolemia	20.5
Medically treated	2.6
Overall health (%)	
Poor–fair	17.7
Good–very good	65.1
Excellent	17.2

TABLE 2

Percentage of Respondents ($n = 470$) Choosing Each Possible Answer for Situation One

Answer	Percentage
Medication A (relative benefit)	56.8
Medication B (absolute benefit)	14.7
Medication A or B	15.5
Can't decide	13.0

$\chi^2 = 254.3$ with 3 df.

Data Entry and Analysis

All data were entered using SAS/FSP with error trapping. Standard chi-squared contingency-table methods were used to test for associations between categorical variables. Odds ratios (ORs) with 95% confidence intervals (95% CIs) were calculated as described by Hosmer and Lemeshow[15] using parameter estimates and standard errors from the appropriate logistic regression analysis (SAS Proc Logist[16]).

RESULTS

During the study period 511 patients registered to be seen as outpatients in the Section of General Medicine; 96.3% (492) returned a questionnaire. Of these, 4.5% (22) provided no answer for the first hypothetical situation. These patients were more likely to be over the

age of 70 years and less likely to have any high school education than were those who provided an answer. Because we were primarily interested in patients' choices in this first hypothetical situation, those patients not choosing an answer were eliminated from further analysis. The characteristics of the remaining 470 patients who constituted our study population are shown in Table 1. There was no difference in patient characteristics among those who responded to the different versions of the form (data not shown).

When asked in the first hypothetical situation to choose a medication to treat their disease, 56.8% of the subjects chose the medication with benefit presented in relative terms, 14.7% chose the medication with benefit presented in absolute terms, 15.5% were willing to be treated with either medication, and 13.0% could not decide (Table 2). This result was not expected by chance alone ($\chi^2 = 254.3$ with 3 df). Subjects were most likely to choose the medication whose benefit was presented in relative terms regardless of age, gender, level of education, self-reported health, experience with medical treatment for hypertension or high serum cholesterol (Table 3), or questionnaire version (data not shown). In a logistic regression model that included all patient characteristics as independent variables, subjects with at least some college education and those being medically treated for hypertension or hypercholestrolemia were significantly more likely to select the medication with benefit presented in relative terms than were those with less education or not taking medications. There was no statistical evidence of interaction between these variables in predicting who would choose the medication with benefit expressed in relative terms.

The subjects were asked to specify in free-text why they chose their answer. Two hundred thirty-one (86.5%) patients who chose the medication with benefit in relative terms responded. Twenty-eight (12.1%) compared the benefit of Medication A (expressed as a relative benefit) with that of Medication B (expressed as an absolute benefit) without accounting for the underlying risk of dying. Other respondents thought Medication A offered more benefit but were not specific as to why. Sixty-five (89.0%) of the patients who were indifferent to the choice of medication responded. Thirty-four (52.3%) clearly indicated that they knew the benefits of the medications were equivalent.

In the second hypothetical situation the subjects were given the underlying risk of dying and the benefit of medication in relative terms and asked to specify the benefit of this medication in absolute terms. Most subjects (47.7%, Table 4) apparently multiplied the relative benefit by the size of the population to produce the treatment effect that would be expected if the probability of dying from the disease were 1.0 (the expected mistake); 28.2% correctly identified the expected benefit and apparently were able to convert relative into absolute benefit. Some patient characteristics were as-

TABLE 3

Percentage of Respondents ($n = 470$) Preferring the Medication Expressed as a Relative Benefit (Medication A) or the Medications Expressed as Relative or Absolute Benefits (Medications A and B, respectively) and Odds Ratio for Selecting the Medication Expressed as a Relative Benefit, by Patient Characteristic, for Situation One

		Percentage Preferring Medication Expressed as:		Odds Ratio* of Preferring Medication Expressed as Relative Benefit (A)
	n	Relative Benefit (A)	Relative or Absolute Benefit (A or B)	
Age				
≤ 39 years	171	49.1	22.2	1.00†
40–59 years	152	63.2	12.5	1.44 (0.90, 2.30)‡
≥ 60 years	147	59.2	10.9	1.21 (0.73, 1.99)
Gender				
Female	287	54.7	17.1	1.00
Male	175	61.1	12.6	1.20 (0.80, 1.78)
Education				
≤ 12 grade	226	49.1	14.2	1.00
≥ 13 grade	244	63.9	16.8	1.68 (1.12, 2.51)
Health				
≤ Fair	82	51.2	12.2	1.00
Good	302	57.6	15.6	1.27 (0.75, 2.15)
Excellent	80	60.0	20.0	1.37 (0.69, 2.70)
Treated for high blood pressure and/or cholesterol				
No	392	54.9	17.6	1.00
Yes	68	72.1	4.4	2.21 (1.19, 4.12)

*As calculated from the coefficients of a logistic regression model that included all listed patient characteristics as independent variables.
†Reference category.
‡95% confidence intervals.

TABLE 4

Percentage of Respondents ($n = 470$) Choosing Each Possible Answer for Situation Two

Answer	Percentage
25 deaths can be prevented (correct answer)	28.2
50 deaths can be prevented (expected mistake)	47.7
Other choices	5.3
Don't know	18.8

$\chi^2 = 329.4$ with 4 df.

sociated with choosing the correct answer. Men, patients with at least one year of college education (≥ 13 grade), and patients in "excellent" health were all more likely than their comparison groups to successfully convert relative into absolute benefit (Table 5). Despite this, these subjects were almost as likely as others to make the expected mistake. Interestingly, they were less likely than those in their comparison groups to indicate they could not answer the question. Patients who were able to equate relative benefit with absolute benefit in the second hypothetical situation were more likely to be indifferent to the choice of medication in the first situation (OR = 1.84, 95% CI 1.01,3.35). However, like other subjects, more than half of them (58.1%) still preferred the medication with benefit expressed in relative terms in the first hypothetical situation.

CONCLUSIONS

The central finding of this study is that the majority of patients faced with choosing between two treatments, one expressed in terms of its relative benefit and the other in terms of its absolute benefit, chose the one framed in relative terms. This was true even when adequate information (about the underlying risk of death) was provided so that the relative benefit could be converted to absolute benefit. Of course, this required multiplying the risk of death by the relative benefit of treatment to determine the absolute benefit. Therefore, it might be expected that patient characteristics, especially level of education, would be associated with the ability to equate relative benefit with absolute benefit. To a degree, this was the case. In the second hypothetical scenario, when the subjects were specifically asked to convert relative to absolute benefit, those with a ≥13 grade education were more than twice as likely as those with a ≤ 12 grade education to correctly perform this task. Men and patients in "excellent" health were also more likely than their comparison groups to answer correctly, while those aged ≥ 60 years were less likely. However, even in the first hypothetical situation when all the information necessary to convert relative to absolute benefit was available, subjects with at least some college education were *more likely* to prefer the medication with the benefit expressed in relative terms than were subjects with less education. The same was true for patients undergoing medical treatment for hypertension or a high serum cholesterol level. Thus, most patients, even well-educated ones, may be influenced by the framing of risk.

Our results may be a special case of the "pseudocertainty" effect described by Tversky and Kahneman[12] in the framing of contingencies. This phenomenon can occur when a decision problem necessitates conditional evaluation. In our example, sequential processing was required to equate relative benefit with absolute benefit. It appears that a "conditional frame" was generated in which the underlying risk of death was eliminated from consideration. The majority of patients may simply have compared the relative benefit (i.e., it will decrease your risk of dying by 80%) with the absolute benefit (i.e., 8 deaths prevented per 100 treated, or 8%) in choosing their answers. The sense of certainty associated with this choice is illusory, however, because the benefit of the medication presented in relative terms is conditional on the underlying risk of dying.

Other possibilities exist to explain why most patients chose the medication whose benefit was presented in relative terms. Our descriptions of relative and absolute benefits might have presented patients with different framings of outcomes, not just of probabilities. The description of relative benefit read "If you take this

TABLE 5

Percentage of Respondents ($n = 470$) Answering "50 Deaths Can Be Prevented" (the Expected Mistake) or "25 Deaths Can Be Prevented" (the Correct Answer) and Odds Ratio of Selecting "25 Deaths Can Be Prevented," by Patient Characteristic, for Situation Two

		Percentage Answering:		Odds Ratio* of Answering "25 Deaths Can Be Prevented"
	n	50	25	
Age				
≤ 39 years	165	37.6	33.9	1.00†
40–59 years	149	53.7	30.9	0.77 (0.46, 1.29)‡
≥ 60 years	143	53.2	18.9	0.40 (0.21, 0.74)
Gender				
Female	281	51.6	20.3	1.00
Male	168	42.3	42.3	2.74 (1.76, 4.26)
Education				
≤ 12 grade	216	47.7	19.4	1.00
≥ 13 grade	241	47.7	36.1	2.21 (1.38, 3.54)
Health				
≤ Fair	79	44.3	15.2	1.00
Good	292	50.0	28.4	1.96 (0.97, 3.95)
Excellent	80	42.5	42.5	2.56 (1.13, 5.82)
Treated for high blood pressure and/or cholesterol				
No	381	48.0	29.9	1.00
Yes	66	47.0	21.2	1.07 (0.53, 2.19)

*As calculated from the coefficients of a logistic regression model that included all listed patient characteristics as independent variables.
†Reference category.
‡95% confidence intervals.

medication it will decrease your risk of dying. . . ." It is clear that the benefit of medication is directly applicable to the patient. The description of absolute benefit read "If 100 people with the disease, like you, take this medication. . . ." Here, it may have been less clear that the benefit of the medication would apply to the patient. The comments of at least one respondent suggested this interpretation. Another possibility is that patients could have known that both medications were equally effective and simply chosen the first one presented as being as reasonable a choice as any other. The order of answers was not varied to test this hypothesis. However, this possibility was not reflected in the comments of any respondent.

The high response rate and consistency of findings across subgroups in our study indicate that our results are very likely valid for the population we studied: a socioeconomically mixed patient group of (almost entirely white) patients in a semirural part of the Northeast. Of course, generalization to other patient groups may be hazardous, but we know of no reason to suspect that the results do not apply for other groups of culturally similar patients. Similarly, while it could be argued that our scenarios are artificial, we mimicked the language clinicians use in explaining risk to patients. Thus, we successfully explored risk communication as commonly practiced in this medical center. Of course, it is true that language distinct from ours might be perceived differently by patients and lead to different conclusions.

The effect of framing on the perception of risks and benefits is not limited to patient populations. Forrow et al.[17] presented data to physicians from published studies of the benefits of treating patients who have hypertension and hypercholesterolemia. Each study was presented in two different ways, once in terms of relative and once in terms of absolute benefit. When asked how the information would influence their decisions to treat, 46% of the physicians gave different responses to the same results presented in different ways and most indicated a stronger preference to treat after reading of the relative benefit. Though the authors did not include the underlying risk of disease in their description of relative benefit, their findings are clearly consistent with ours. Physicians, as well as patients, are influenced by the framing of risks and benefits, and the frame will have an influence on clinical decision making.

Our study demonstrates the difficulty introduced by attempts to express measures of risk for patients. Compelling information published in terms of relative risk alone are commonplace and may have the effect of blinding the clinician and patient to the absolute benefit. For example, at a baseline risk of 10%, and a relative risk reduction of a treatment of 50%, the absolute risk reduction would be 5%, while with a baseline risk of 1.0%, it would be 0.05%. In the former case therapy might be attractive, while in the latter it might be ignored, even though the relative risk reductions are equal. The implications of these findings are critical to the way in which clinicians discuss potential risks and benefits with their patients. Expressions that magnify the benefit because they are in relative terms might tend to be more compelling both to clinician and to patient, and might even be coercive in their effect. Expressions of absolute risk reduction should give patients a greater ability to be informed and to choose treatment preferences rationally.

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(The appendix follows)

Appendix A

Situation One

Suppose you have a serious disease that needs to be treated with medication. Your risk of dying over the next year is 10% if you don't receive treatment.

There are only 2 possible medications for the disease: Medication A and Medication B: They cost about the same and have almost no side effects.

Your doctor provides you with the following information about these medications:

Medication A: If you take this medication it will decrease your risk of dying by *80% (four fifths)* over the next year.

Medication B: If 100 people with the disease, like you, take this medication *8* deaths can be prevented over the next year.

Question: Which medication do you want? (Circle your answer.)

(1) Medication A
(2) Medication B
(3) Either Medication A or B
(4) Can't decide

Situation Two

The situation is now a little different. Suppose you have a serious disease that needs to be treated with medication. Your risk of dying over the next year is 50% if you don't receive treatment.

There is only one medication for the disease.

Your doctor provides you with the following information:

Medication A: If you take this medication it will decrease your risk of dying by 50% (by half) over the next year.

Question: If 100 people with the disease, like you, were treated with Medication A, how many deaths could be prevented over the next year? (Circle your answer.)

(1) 5 deaths can be prevented
(2) 10 deaths can be prevented
(3) 25 deaths can be prevented
(4) 50 deaths can be prevented
(5) Don't know