The Effects of Information Framing on the Practices of Physicians

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OBJECTIVE: **The presentation format of clinical trial results, or the "frame," may influence perceptions about the worth of a treatment. The extent and consistency of that influence are unclear. We undertook a systematic review of the published literature on the effects of information framing on the practices of physicians.**

DESIGN: **Relevant articles were retrieved using bibliographic and electronic searches. Information was extracted from each in relation to study design, frame type, parameter assessed, assessment scale, clinical setting, intervention, results, and factors modifying the frame effect.**

MAIN RESULTS: **Twelve articles reported randomized trials investigating the effect of framing on doctors' opinions or intended practices. Methodological shortcomings were numerous. Seven papers investigated the effect of presenting clinical trial results in terms of relative risk reduction, or absolute risk reductions or the number needing to be treated; gain/loss (positive/negative) terms were used in four papers; verbal/numeric terms in one. In simple clinical scenarios, results expressed in relative risk reduction or gain terms were viewed most positively by doctors. Factors that reduced the impact of framing included the risk of causing harm, preexisting prejudices about treatments, the type of decision, the therapeutic yield, clinical experience, and costs. No study investigated the effect of framing on actual clinical practice.**

CONCLUSIONS: **While a framing effect may exist, particularly when results are presented in terms of proportional or absolute measures of gain or loss, it appears highly susceptible to modification, and even neutralization, by other factors that influence doctors' decision making. Its effects on actual clinical practice are unknown.**

KEY WORDS: **information framing; systematic review; presentation format; absolute risk; relative risk; number needed to treat.**

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In this era of evidence-based medicine, medical decisions are frequently based on data that estimate, in numeric terms, the expected benefits and harms of certain clinical interventions. Psychological analyses of decision making, however, have found that the interpretation of numeric data may vary depending on the presentation format or the "frame."[1,2] Similarly, in the medical literature, it has been found that under certain circumstances, the frame used to present the results of clinical trials may influence perceptions about the worth of treatments.[3–5] It appears that when the benefits of therapy, estimated from the results of large-scale clinical trials, are presented as relative risk reductions (RRR), enthusiasm for an intervention is higher than when the same data are presented as absolute risk reductions (ARR), or as the number needing to be treated in order to prevent a single event (NNT). For example, in a study that has been widely quoted to illustrate the framing effect, Forrow et al. found that physicians' judgments about treating patients with hypertension and hyperlipidemia differed depending on whether the results of trials were presented in RRR or ARR terms.[3] Doctors were significantly more inclined to treat patients when mortality outcomes were framed as RRR rather than ARR. Similarly, Naylor et al. found that reporting the outcomes of the Helsinki Heart Trial as NNT led to much lower ratings by physicians of treatment effectiveness than the same outcomes framed in terms of either RRR or ARR.[4]

Potentially, these observations are of great importance when attempts are made to align clinical practice with the best evidence from clinical trials. The objective of this study was to undertake a systematic review of the published literature on the effects of information framing on the practices of physicians.

METHODS

Search Strategy

We aimed to retrieve articles that investigated the impact of different forms of framing of clinical trial data on the practices of physicians. A preliminary collection of papers, obtained through bibliographic and electronic searches (MEDLINE, PSYCLIT, CINAHL, CANCERLIT, Cochrane Library), was examined for medical subject heading (MeSH) terms and key words to formulate a comprehensive search strategy. The strategy was refined by assimilation of additional key words from new citations in an iterative process. We were aware of the diffuse nature of this literature and could not rely on key words and MeSH headings alone. We therefore performed searches using as search terms the names of known researchers in this area, hand searched journals in which several articles relevant to this review were published (*Medical Decision Making, British*

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Table 1. Study Details*

Article	Subjects	Scenario Presented	Choice Alternatives and Frames	Methodological Comment
Forrow et al. (1992)[3]	Hospital physicians at educational conferences or faculty/ fellows. Varying experience. 235 respondents.	Six statements, based on mainly unspecified published studies,† summarizing outcomes of treatment for either hypertension or hypercholesterolemia	Five statements described outcomes of hypertension *or* hypercholesterolemia treatment in RRR terms. Mortality outcome in each case was also presented in ARR terms.	No controls. Within-subject comparison between ARR and RRR. No differences between comparison groups in experience, specialty, gender.
Naylor et al. (1992)[4]	Hospital housestaff/ faculty physicians. Varying experience. 100 respondents.	Helsinki Heart Study outcomes: Fatal MI Any MI All-cause mortality	All 3 outcomes presented in either RRR or ARR terms; in each case, "any MI" outcome was also presented in NNT terms.	No controls. Effect on response of seniority/knowledge not assessed. Within-subject comparison with NNT. No differences between comparison groups in experience, specialty, time spent reading journals.
Bucher et al. (1994)[6]	Random sample of 802 hospital and primary care physicians from Swiss Medical Register. Varying experience. 499 respondents.	Helsinki Heart Study outcomes: Fatal MI Any MI All-cause mortality	All 3 outcomes presented in either RRR or ARR terms; in each case, "any MI" outcome was also presented in NNT terms.	No controls. Effect on response of seniority/knowledge not assessed. Within-subject comparison with NNT. No differences between comparison groups in experience, specialty. Time spent reading journals.
Bobbio et al. (1994)[7]	Recruited from 5 refresher courses run by the Italian Society for General Medicine. Varying experience. 148 respondents.	Helsinki Heart Study outcomes: Any cardiac event Any cardiac event + TM	Any cardiac event outcome reported in RRR, ARR, NNT, EFP terms. RRR (any cardiac event) and TM were also presented simultaneously.	No controls. Within-subject comparison, all frames. No differences between comparison groups in experience, specialty, gender.
Cranney & Walley (1996)[8]	GPs attending a CME refresher course. Varying experience. 73 respondents.	MRC trial of treatment of hypertension in the elderly: Risk of stroke and "coronaries"	Risks for each event presented in RRR, ARR, NNT, EFP terms.	No controls. Within-subject comparison, all frames. No differences between comparison groups in experience, specialty, gender.
Nikolajevic-Suranac et al. (1999)[9]	Random sample of 398 GPs in a single health area. Varying experience. 243 respondents.	HRT prescribing for subjects with differing levels of risk: 7 clinical scenarios used	All subjects given the same 7 scenario questionnaire on 2 occasions. On the first, no benefit/risk data were given. On the second, two groups also received benefit/risk data in RRR *or* NNT terms. One group (control) got questionnaire only.	Used control group. Effect on response of seniority/ knowledge not assessed. No differences between comparison groups in experience, specialty, gender.
Ward et al. (1999)[10]	All cardiologists and cardiothoracic surgeons in New South Wales, Australia. All consultant level.	Resource allocation for unidentified cardiac rehabilitation programs	All subjects received mortality reduction data, presented in ARR, RRR, and NNT terms.	No controls. Within-subject comparison, all frames. Private consultants differed from public specialists.
McNeil et al. (1982)[11]	Radiologists on postgraduate education courses. Varying experience. 424 respondents.	Lung cancer treatment options: surgery or radiotherapy—these options were either identified or unidentified and referred to as therapy A and therapy B	Identified or unidentified lung cancer treatment options with outcomes presented in *both* cumulative probability and life-expectancy terms as probability of *either* living or dying.	No controls. Effect on response of seniority/knowledge not assessed. No indication the subject groups were the same. Within-subject comparison between life expectancy and cumulative probability.
Marteau (1989)[12]	End-of-second-year University of London undergraduates. 74 respondents.	Three clinical scenarios involving decisions to undergo: Surgery in terminal liver disease Amniocentesis for diagnosing spina bifida Termination for possible hemophilia	Outcomes presented in gain/ positive or loss/negative frames from either "patient" or "doctor" perspective. Three levels of risk presented in each case: i.e., dying/surviving × 3 risk levels, normal/abnormal fetus × 3 risk levels, affected/ unaffected fetus × 3 risk levels.	No controls. Crossover effect of risk levels not controlled for. No indication the comparison groups were the same. Within-subject comparison across risk levels.
Christensen et al. (1991)[13]	47 University of Illinois year 3 medical students. 34 residents from 3 Chicago teaching hospitals. 25 internists recruited from CME courses.	Twelve clinical treatment scenarios in three general areas: surgical vs medical treatment for cancer and for cardiovascular disease, and preventive therapies.	Choice of two therapy options for each scenario; outcomes presented as either gain in all cases (e.g., chance of survival) or as loss in all cases (e.g., chance of death).	No controls. No indication comparison groups were the same.

(Continued)

Table 1. (Continued)

Article	Subjects	Scenario Presented	Choice Alternatives and Frames	Methodological Comment
Hux et al (1994)[14]	Random sample of 330 physicians of fellowship level in 2 Canadian academic centers; 231 respondents.	Four unidentified hypothetical preventive interventions relating to drug treatment in cardiovascular disease.	Outcomes expressed as either averaged or stratified gains in life expectancy, from either individual patient or societal viewpoint. Both costs and gains in each scenario were varied to high and low levels.	No controls. No indication the comparison groups were the same. Effect on response of seniority/knowledge not assessed. Within-subject comparison for gain level and costs.
Timmermans (1994)[15]	University Hospital in Leiden; 25 interns, 22 residents (12 medicine, 10 surgery), 16 internists, 15 surgeons.	1. Assignment of numeric probability values to context-free‡ and context-specific§ verbal probability terms. 2. Treatment decisions in respect of appendicitis, angina, and an imaginary disease.	In the clinical scenarios, outcomes and risks were presented first in verbal probability terms and some weeks later in numeric terms.	No controls. Within-subject verbal/numeric comparison.

**ARR indicates absolute risk reduction; RRR, relative risk reduction; NNT, number needed to treat; EFP, event-free patients; TM, total mortality; MI, myocardial infarction; GP, general practitioner; CME, continuing medical education; MRC, medical research council; HRT, hormone replacement therapy.*

†*Examples of only one hypertension and one hypercholesterolemia statement were included in the paper, and the original publication in each case was indicated.*

‡*Context-free verbal probability terms: subjects were first presented with 18 verbal probability terms (e.g., likely, rarely) without a specific clinical context, and were asked to assign numerical meanings to these terms.*

§*The 3 clinical cases were then presented using similar verbal probability terms (i.e., context-specific terms) and subjects were asked to estimate in percentage terms the probability of disease (refer to text for detail).*

Journal of Social Psychology, Academic Medicine), and undertook bibliographic searches.

It was our intention to combine compatible data sets using meta analytic techniques, but this proved impractical because of interstudy variability in the parameters assessed and in the methods of analyzing and reporting the outcomes.

Preliminary Review of Papers

Articles appearing relevant to medical information framing were distributed among a multidisciplinary reading group comprising the investigators and research assistants. Specialty areas included medicine, pharmacology, biostatistics, and psychology. A coversheet was developed that included a brief methodologic description and commentary for each article. This was completed and presented to the group before final categorization and relevance to the review were determined using a consensus approach. Articles were categorized as follows: reports of studies undertaken to assess the effect of framing on physician practices; relevant background information relating to the theory of information framing; discussions of framing methods (e.g., ARR, RRR); reports on other factors that influence decision making; and reports that were not relevant to the review.

Information was extracted from articles reporting the outcomes of trials (parallel group or crossover) designed to assess the effect of framing on physician practices. This included the study design, the type of frame used, the parameter assessed, the assessment scale, the clinical setting, the intervention, the results, and the factors that were shown to modify the frame effect.

RESULTS

Results of the Literature Search

Our searches identified 3,691 potentially relevant articles. On review of the abstracts, most were eliminated from further consideration. In the majority of cases, this was because application of the search terms individually was insufficiently specific to identify articles relating to the effect of framing on physician practices. A number of articles addressed the effect of framing on patient preferences and decision making.

From the review of titles and abstracts, 192 articles were considered to merit further assessment. These were discussed by the reading group, and 44 papers were judged to be relevant. However, only 12 reported trials that investigated the effect of information framing on doctors' opinions or practices.[3,4,6–15] These studies form the basis of this review.

Of the remaining 32 papers, 5 discussed framing in the context of decision theory,[1,2,22–24] and 15 reported the influence on decision making of factors other than information framing.[25–40] These papers are considered further in the Discussion section. Twelve papers discussed the type of framing method used, such as NNT, RRR, ARR, and risk differences, but did not include any intervention designed to investigate the impact on physician practice.[41–52] These papers are not considered further in the review.

Study Characteristics

Details about the subjects, the scenarios and frame types presented, and methodologic comments on each study are summarized in Table 1. Table 2 presents a summary of the study designs in terms of frame types, randomization,

Table 2. Summary of Study Designs*

Article	Comparisons: Frames	Randomized?	Design
Forrow et al. (1992)[3]	ARR vs RRR	N	X
Naylor et al. (1992)[4]	ARR vs RRR	Y	P
	ARR/RRR vs NNT	N	X
Bucher et al. (1994)[6]	ARR vs RRR	Y	P
	ARR/RRR vs NNT	N	X
Bobbio et al. (1994)[7]	ARR vs RRR vs EFP vs NNT vs RRR+TM	Y	X
Cranney & Walley (1996)[8]	ARR vs RRR vs EFP vs NNT	Y	X
Nikolajevic-Suranac et al. (1999)[9]	RRR vs NNT vs No intervention	Y	P
Ward et al. (1999)[10]	ARR vs RRR vs NNT	N	X
McNeil et al. (1982)[11]	Survival vs Mortality	U	P
	Identified vs Unidentified		
	Cumulative probability vs Life expectancy	N	X
Marteau (1989)[12]	Survival vs Mortality	Y	P
	Doctor vs Patient		
	Levels of risk	N	X
Christensen et al. (1991)[13]	Gain vs Loss	U	P
Hux et al. (1994)[14]	Stratified vs Averaged life expectancy	Y	P
	High cost vs Low cost		
	Individual patient vs. Society	N	X
Timmermans (1994)[15]	Numeric vs Verbal	N	X

**ARR indicates absolute risk reduction; RRR, relative risk reduction; NNT, number needed to treat; EFP, event-free patients; TM, total mortality; Y, yes; N, no; U, uncertain; P, parallel groups; X, crossover.*

and design. Table 3 presents the results of the individual studies.

Seven of the 12 papers investigated the effect of presenting the results of published clinical trials in terms of RRR, ARR, or NNT (Table 1)[3,4,6–10] Of these, three assessed subjects' intention to treat patients,[6–8] two compared subjects' ratings of the effectiveness of treatment,[4,6] two reported change in intention to treat,[3,9] and one determined willingness to fund a rehabilitation program.[10] All but one study[9] used data from trials of cardiovascular interventions. Subjects in the Forrow et al. study[3] received either the all-cause mortality data from the Hypertension Detection and Follow-up Program[16] or the cardiac mortality data from the Lipids Research Clinics Coronary Primary Prevention Trial.[17] The diseases, but not the drugs, were identified. Outcomes of fatal infarction, any infarction and all-cause mortality from the Helsinki Heart Trial[18] were presented by both Naylor et al.[4] and Bucher et al.[6] This trial found that infarction risks in patients with hypercholesterolemia were reduced with gemfibrozil treatment, but all-cause (total) mortality was increased. Naylor et al. did not identify either the treatment or the disorder. Bucher et al. referred to "a cholesterol lowering drug treatment." Bobbio et al.[7] used the Helsinki Heart Trial data on any cardiac event for the comparisons of RRR, ARR NNT, and percentage of event-free patients, and to determine the effect of "completeness of information," they presented a fifth comparison wherein the cardiac RRR and total mortality outcomes were presented simultaneously. Neither the drug nor the disorder was identified. The rates of strokes and "coronaries" among subjects in the Medical Research Council trial of treatment of hypertension[19] were presented in the Cranney and Walley study.[8] The drug treatments were not identified. Ward et al.[10] based their estimates of reduction in cardiac mortality on data contained in a review of cardiac rehabilitation.[20] Nikolajevic-Suranac et al.[9] assessed change from baseline in subjects' intentions to prescribe hormone replacement therapy when presented with data on the risks of hip fracture (reduced risk), myocardial infarction (reduced), and breast cancer (increased). The risk levels, determined from a meta-analysis of published studies, were presented to one group in RRR terms, to the second as NNT, with the third group acting as a control group and receiving no information.

Gain and loss (or positive and negative) terms were used to frame outcomes in four papers.[11–14] McNeil et al.[11] framed survival after radiotherapy or surgery for lung cancer in terms of the probability of living or dying, and varied both the nature of the data (cumulative probability of survival or death, or life expectancy) and its form (treatment identified, or referred to as treatment A or B). Marteau[12] used three clinical scenarios (possible surgery for a terminal liver disease, amniocentesis for diagnosing spina bifida, and termination of pregnancy in which the fetus was at risk of hemophilia) and presented outcomes in either "positive" (chance of survival or of a normal pregnancy) or "negative" (chance of dying or abnormal fetus) frames, each with varying levels of risk for the outcome in question. Christensen et al.[13] presented a series of 12 problems (e.g. *L*-thyroxine or surgery for a thyroid nodule, chemotherapy or surgery for gastric carcinoma) to doctors with varying clinical experience. Each problem had a choice of two treatment options and was presented to half the participants in a "loss" frame

(chance of death or treatment failure) and to half in a "gain" frame (survival or treatment success). Hux et al.[14] framed life expectancy after various unidentified primary preventive treatments for cardiac disease in terms of averaged or stratified gains. The gains, and also the costs of treatment, were varied to high and low levels.

Timmermans explored the effects of framing information in verbal and numeric terms.[15] Subjects from different specialties were first asked to assign numeric (percentage) probabilities to a list of 18 verbal probability terms (for example, "more/less/highly/un- likely, commonly, frequently, rarely") (defined as "context-free" terms). Next, they were asked to read three clinical cases in which the probabilities of various diagnoses and outcomes were expressed in similar verbal terms (defined as "context-specific" terms). They then estimated the probability of the disease being present and indicated whether they would treat the patient. Some weeks later, the subjects were given the same clinical scenarios with the verbal terms replaced by percentage probability terms and asked to repeat the exercise.

Clinical Complexity

Of the six studies incorporating clinical scenarios, two used relatively simple presentations,[8,13] while four sought to introduce some of the complexities that might be encountered in practice.[9,12,14,15]

No study assessed the effects of framing on actual clinical practice.

Methodological Aspects of the Framing Studies

Study Design. Only two studies were of parallel group design,[9,13] while five were of combined parallel group and crossover design,[4,6,11,12,14] and five were crossover studies.[3,7,8,10,15]

Randomization. Randomization was considered in terms of both allocation to parallel groups and the order in which the data were presented (in the same subjects) (Table 2).

Of the seven studies that assigned subjects to parallel groups[4,6,9,11–14] (Table 2), it was unclear in two if subjects were actually randomized.[11,13] Three stated that the questionnaires were distributed randomly but gave no details of the method,[6,12,14] and two reported details.[4,9] Of the latter, in one study, the questionnaires were simply mixed together and distributed in the order they were drawn,[4] and the other described an adequate method,[9] using block randomization to assign general practices to an intervention or control group. Five of these studies also involved crossover comparisons within subjects,[4,6,11,12,14] presenting different frames (for example, ARR or RRR and NNT) to the same physicians. The concern here is that the response to one frame may be conditioned by recent exposure to the other (response conditioning).

Of the ten studies that presented each subject with more than one frame type,[3,4,6–8,10–12,14,15] only two randomized the order of frame presentation,[7,8] and one study reversed the sequence of questions in half the questionnaires (Table 2). Five studies presented each subject with multiple clinical scenarios,[9,12–15] but only one varied the presentation sequence.[13] In both cases, response conditioning is of concern, but generally authors did not speculate on the extent to which this might have influenced subjects' responses.

Of particular concern were issues relating to lack of a control group, comparability of the comparison groups, and subject selection.

Controls. Only one study incorporated a nonintervention control group.[9] The investigators, who also sought to introduce some of the complexities of "real life" decision-making, found a much weaker frame effect than was observed in the studies that did not have a control or "no information" group, suggesting it was not that framing of information in relative terms increases enthusiasm for an intervention, but rather that framing in absolute terms reduces enthusiasm, particularly when therapeutic gains are small.

As the remaining 11 studies failed to assess subjects' baseline opinions or intentions, the degree to which the frame increased or diminished preexisting enthusiasm for a practice or treatment could not be determined.

Comparability of Comparison Groups. Of the seven studies in which subjects were assigned to one of two or more groups,[4,6,9,11–14] four failed to report on baseline characteristics such as subjects' age, sex, practice type, experience, or specialty.[4,11–13] In these cases, the extent to which such factors might have contributed to the observed differences in outcomes could not be assessed.

Subject Selection. With the exception of three studies,[7,9,10] participants tended to represent samples of convenience among various populations of doctors. The possibility that this might have introduced selection bias was not explored in any paper.

Limitations Acknowledged by Authors. Some authors acknowledged limitations in the conclusions that may be drawn from their studies. For example, Forrow et al.[3] pointed out that the magnitude of the problem, its effects on patient care, or the appropriate strategies for correction, had not been established. Marteau[12] emphasized that the findings represented probable, as opposed to actual, practice. Similarly, Bucher et al.[6] cautioned about drawing inferences on whether the observed differences in the ratings of effectiveness reflected an important difference in the initiation of treatment. Christensen[13] suggested that more clinical cases, and a larger, more representative group of experienced physicians was necessary, before educational

Table 3. Results of the Framing Studies*

Article	Comparison Groups	Assessed	Scale	Topic	Results	*p* Value	Effect Modifiers
Forrow et al.[3]	RRR vs ARR	Change in intention to treat	7-point Likert	Hypertension: reduction in total mortality	% Subjects changing treatment decision		No effect of training level, specialty, practice type, gender.
			1 = more, 7 = less likely to treat	Hypercholesterolemia: reduction in cardiac mortality	RRR vs ARR		
					49.2 4.1	<.0001	
				(*Various published studies*)	32.7 5.3	<.0001	
Naylor et al.[4]	RRR vs ARR	Rating of treatment efficacy/ effectiveness	11-point Likert	Lipids/cardiovascular (*Helsinki Heart Study*)	Mean effectiveness ratings (SE)		Subjects' risk aversion in respect of causing harm to patients.
					RRR vs ARR		
			+5 = beneficial 0 = no effect −5 = harmful	Fatal MI (reduced risk)	0.56 (0.21) 0.36 (0.09)	>.2	
				All-cause mortality (increased risk)	−0.84 (0.16) −0.22 (0.11)	.004	
				Any MI (reduced risk)	3.36 (0.15) 2.84 (0.15)	.008	
					Controlling for end point, RRR vs ARR	.001	
				NNT: Any MI	1.06 (0.21) 1.04 (0.21)	>.2	
Bucher et al.[6]	RRR vs ARR	1. Rating of treatment effectiveness	11-point Likert	Lipids/cardiovascular (*Helsinki Heart Study*)	1. Mean effectiveness ratings (SE)		None commented upon.
					RRR vs ARR		
		2. Likelihood of treating	+5 = beneficial 0 = no effect −5 = harmful	Fatal MI (reduced risk)	1.07 (0.09) −0.08 (0.09)	<.001	
				All-cause mortality (increased risk)	−0.72 (0.09) −0.53 (0.10)	.17	
				Any MI (reduced risk)	2.53 (0.09) 2.08 (0.09)	<.001	
				NNT: Any MI	1.24 (0.11) 1.38 (0.11)	.39	
					2. Mean treatment likelihood (SE)		
					RRR vs ARR		
				Fatal MI	3.39 (0.11) 2.45 (0.11)	<.001	
				All-cause mortality	2.55 (0.10) 2.39 (0.10)	.25	
				Any MI	4.36 (0.12) 3.82 (0.11)	<.001	
				NNT: Any MI	3.41 (0.11) 3.47 (0.11)	.72	
Bobbio et al.[7]	RRR vs ARR, also NNT, EFP, RRR + TM	Likelihood of treating	0–100 visual analogue scale	Lipids/cardiovascular (*Helsinki Heart Study*)	Mean % score (SD), treatment likelihood	<.001 for RRR vs all the others	No effect of practice type, years qualified, gender. Completeness of reporting (RRR+TM) reduced intention to treat.
			0 = would not, 100 = would prescribe	Any cardiac event (reduced risk)	RRR vs ARR vs NNT vs EFP vs RRR+TM		
				Any cardiac event + TM (TM: increased risk)	77 (28) 24 (28) 34 (34) 37 (37) 23 (28)		
Cranney & Walley[8]	RRR vs ARR also NNT, EFP	Likelihood of treating	0–100 visual analogue scale 0 = would not, 100 = would prescribe	Hypertension (*Medical Research Council Hypertension Trial*)	Mean score (95% CI), treatment likelihood	<.001 for RRR vs all the others	No effect of training level, practice type, years qualified, gender.
					RRR vs ARR vs NNT vs EFP		
				Risk of stroke and "coronaries" (both reduced risk)	69 (66, 72) 54 (51, 57†) 44 (40, 47) 48 (45, 52)		
Nikolajevic-Suranac et al.[9]	RRR vs NNT	Change in intention to treat	7-point Likert	HRT 7 scenarios (*various published studies)*	Mean change (SD) from baseline in intention to treat	For 3-way comparison	Risk type.
					Control‡ vs RRR vs NNT		
			Definitely would not . . . Definitely would treat	No risk factors	0.25 (1.15) 0.26 (1.49) −0.34 (1.43)	.007	Level of risk.
				High hip fracture risk	0.35 (1.13) 0.34 (1.10) −0.03 (1.05)	.10	
				Mod hip fracture risk	0.18 (0.87) 0.24 (1.24) −0.30 (1.21)	.0001	
				High risk MI	0.18 (1.43) 0.63 (1.37) −0.14 (1.46)	.002	
				Mod risk MI	0.04 (1.26) 0.56 (1.30) −0.23 (1.42)	.0007	
				High hip, moderate breast cancer risk	0.27 (1.52) 0.36 (1.66) −0.03 (1.44)	.32	
				High hip, high breast cancer risk	−0.07 (1.74) −0.19 (1.97) −0.52 (1.96)	.46	
Ward et al.[10]	RRR vs ARR vs NNT	Willingness to fund the program	11-point Likert	Cardiac rehabilitation effects on mortality (*based on published review*[20])	Mean score (95% CI), willingness to fund	RRR vs ARR	Public hospital consultants more likely than private to rate the programs equally.
			Do not support...		RRR vs ARR vs NNT	.001	
			Strongly support funding		7.59 6.60 6.93	RRR vs NNT	
					(7.09, 8.08) (6.05, 7.15) (6.39, 7.47)	.03	

(continued)

Table 3. (Continued)

Article	Comparison Groups	Assessed	Scale	Topic	Results	*p* Value	Effect Modifiers
McNeil et al.[11]	Gain vs loss	Treatment preference (Radiotx vs Sx; i.e., treatment identified *or* Tx A vs Tx B; i.e., treatment unidentified)	None	Lung cancer treatment	% Choosing Radiotherapy over Surgery 1. Results expressed in life-expectancy terms Gain (n) vs Loss (n) Tx id (87) vs Tx unid (122) | Tx id (80) vs Tx unid (135) 29 41 28 39 2. Results expressed in cumulative probability terms Gain (n) vs Loss (n) Tx id (87) vs Tx unid (122) | Tx id (80) vs Tx unid (135) 16 51 50 62	<.001 for all independent variables in both condition 1 and 2	Preexisting beliefs about treatments. Format: Surgery more attractive expressed in life-expectancy than in cumulative probability terms.
Marteau[12]	Gain vs loss Risks, expressed in % terms, varied in each scenario	Treatment preference (from either "doctor" or "patient" perspective)	None	1. Treatment in liver disease—chance of living/dying	1. "Doctors": favored surgery in gain frame @ 10% survival level. "Patients": favored surgery in gain frame @ 40% survival level.	<.05 <.02	Level of risk.
				2. Amniocentesis—spina bifida risk	2. "Doctors": tended to favor amniocentesis in loss frame at all risk levels "Patients": similar trend, significant frame difference at highest risk of abnormality (20% risk spina bifida vs 80% chance normal child)	NS <.05 @ 20% level	Type of health decision.
				3. Termination—hemophilia risk	3. Neither "doctors" nor "patients" exhibited any frame effect at any risk level	NS	
Christensen et al.[13]	Gain (living) vs loss (dying)	Treatment preference	None	Twelve identified clinical scenarios	Medical students exhibited no frame effect Residents exhibited frame effect in 5/12 scenarios Physicians exhibited frame effect in 1/12 scenarios	NS <.05 in each <.05	Level of experience.
Hux et al.[14]	Gain vs loss expressed as stratified or averaged life expectancy	Treatment preference (individual patient and societal perspectives)	Visual analogue scale: −5 = oppose treatment; +5 = favor treatment	Four unidentified scenarios:	Stratified life expectancy: Median / Mean (SE); Averaged life expectancy: Median / Mean (SE)		Drug costs.
				1. High yield, low cost	1. 3.0 / 2.74 (0.19) / 3.0 / 2.68 (0.22)	NS	
				2. High yield, high cost	2. 1.0 / 0.37 (0.25) / 0.0 / 0.10 (0.27)	NS	
				3. Low yield, low cost	3. 0.9 / 0.72 (0.23) / −1.0 / −0.94 (0.26)	<.0001	
				4. Low yield, high cost	4. −2.0 / −1.63 (0.24) / −4.0 / −2.97 (0.22)	<.0001	
					Preferences were not affected by perspective adopted		
Timmermans[15]	Interpretation of verbal probability terms Verbal vs numeric (percentage) expression of probability	Likelihood disease present Likelihood of treating	None	Appendicitis Angina Imaginary disease	Verbal probability terms: mean % difference from the 50% probability level for: Context-free terms§ / Context-specific terms‖ 29.9 / 31.8	<.0001	Subjects' experience in the area.
					Overall, subjects were more likely to correctly estimate the presence of disease when numeric terms were used	<.0001	
					Experienced clinicians were more likely than inexperienced to make correct decisions with both verbal and numeric terms	<.05	
					Subjects were more likely to agree on treatment when numeric probability terms were used	<.001	

**ARR indicates absolute risk reduction; RRR, relative risk reduction; NNT, number needed to treat; EFP, event-free patients; TM, total mortality; MI, myocardial infarction; SE, standard error; CI, confidence interval; HRT, hormone replacement therapy; Radiotx, radiotherapy; Sx, surgery; Tx, treatment; Tx id, treatment identified; Tx unid, treatment unidentified; NS, not significant.*

†*Published report listed 95% CI of 51 to 66, which appears to have been an error.*

‡*Controls received no outcomes information.*

§*Context-free verbal probability terms: subjects were first presented with 18 verbal probability terms (e.g., likely, rarely) without a specific clinical context, and were asked to assign numerical meanings to these terms.*

‖*The 3 clinical cases were then presented using similar verbal probability terms (i.e., context-specific terms) and subjects were asked to estimate in percentage terms the probability of disease (refer to text for detail).*

recommendations based on understanding of framing could be formulated.

Results of the Framing Studies

The Frame Effect and Modifying Factors. In six of the seven papers comparing subjects' opinions on treatment outcomes expressed in relative and absolute terms,[3,4,6,7,8,10] a framing effect was observed. When presented as RRR, rather than ARR or NNT, results describing treatment benefits were significantly more likely to elicit a "treat" response, to be rated as effective, or to cause respondents to change their decision on whether to treat (Table 3). Similarly, in the case of adverse treatment effects (e.g., the higher all-cause mortality associated with treatment in the Helsinki Heart Trial), results expressed in relative terms tended to be viewed more negatively than the same results expressed in absolute terms.

In the case of three studies,[3,7,8] the impact on responses of subjects' training level, specialty, practice type, and years of experience was assessed, but none of these was found to modify the impact of information framing. Ward et al.,[10] however, found private consultants were more likely than public hospital consultants to be influenced by the frame. "Risk aversion" was identified as a possible modifying factor in two studies.[4,9] Naylor et al.[4] had hypothesized that the difference between absolute and relative measures would be greatest when a statistically significant benefit from treatment was described. However, a definite difference was shown for the all-cause mortality outcome (increased with treatment), even though the risk increases were described as not significant. It was speculated that this occurred because subjects were risk averse and viewed treatments associated with increased mortality negatively, irrespective of how the information was framed. Bobbio et al.[7] investigated the effect of both different frames and the "completeness of information" on physicians' opinions of a treatment. It was found that when results were framed in RRR terms, physicians were significantly more likely to express an intention to prescribe than when other frames were used. Risk aversion, though not termed as such, was also evident in this study, as, when RRR was combined with the total mortality outcome (increased in the Helsinki Heart trial), the effect of the RRR frame was lost (Table 3). Nikolajevic-Sarunac et al.[9] specifically investigated the influence of concomitant beneficial and adverse risks of hormone replacement therapy, and found that subjects' risk aversion could neutralize the framing influence (Table 3). Risk aversion might similarly account for the variability in response across outcomes that was evident in the study by Bucher et al.[6] (Table 3).

The four papers employing gain/loss-type frames[11–14] also found that framing influenced subjects' opinions and choices. Procedures or treatments were more likely to be viewed favorably when the outcomes were presented in terms of gain. Factors that modified the effect were also identified (Table 3). These included the nature of the data presented (survival gain vs probability of death), preexisting prejudices or beliefs about treatment modalities (e.g., surgery vs radiotherapy), the level of risk, the type of decision required, the experience of the subject, the therapeutic yield, and the costs of the intervention.

The numeric/verbal frames used by Timmermans[15] were not directly comparable with either of the other broad categories of frame type. This study found that interpretation of clinical information and subsequent treatment decisions were more likely to concur across specialties when data were presented in numeric, as opposed to verbal, terms. Subjects' experience modified the impact of the data format.

DISCUSSION

The concept of frame influence on medical practice is intriguing. Its importance, however, is difficult to establish.

Conclusions of the Review

We found that the literature investigating the effect of information framing on physicians' practices is small and generally of poor quality. Methodologic shortcomings in the published studies—most notably, the absence of nonintervention controls, suboptimal techniques for allocating subjects to comparison groups, and within-subject comparisons—greatly limited the capacity of the review to quantify the extent of the framing influence. As the existing literature is confined entirely to examination of physicians' opinions or their intended clinical practice, the effect of framing on actual clinical practice is undeterminable.

Notwithstanding these criticisms, the review has two findings of interest to physicians. It appears that information framing may influence their decisionmaking, particularly when the outcomes of interventions are presented in terms of proportional or absolute measures of gain or loss. It is notable that pharmaceutical company promotions and media reports show a preference for reporting beneficial outcomes of clinical trials in terms of RRR. While absolute risk estimates or NNT data are generally included in the original publications, these data may receive considerably less exposure than relative risk estimates; hence, the latter may exert a disproportionate effect on physicians' perceptions of treatment benefits.

The review has also found, however, that the effects of information framing are unstable, having been reported in the studies reviewed to be modified, or even nullified, by factors including risk aversion, physician experience, level and type of risk, the clinical situation, beliefs about treatment efficacy, and costs of treatment. The relative impacts of each of these factors could not, however, be estimated.

Strengths and Weaknesses of the Review

This review incorporated a comprehensive literature search and retrieval of papers relating to the effects of

information framing on physicians' practices. It appears to be the first review of this body of literature as our searches revealed no others. In excluding non-English papers, it is possible that some relevant studies were omitted, though given the paucity of relevant studies in English, this is unlikely. The papers were assessed by a multidisciplinary team with backgrounds in medicine, psychology, and statistics. The initial intention was to provide a quantitative summary of the effects of information framing on physicians' practice, but the small size, variability, and poor quality overall of the literature rendered this impossible.

Framing in the Psychological Literature

The psychological literature has explored the issue of framing in the context of decision making. The major theory of decision making under risk is the "expected utility" model, wherein a rational decision maker, when faced with a choice, will prefer the option that offers the highest expected utility or gain.[1,2] In practice, however, patterns of preference are exhibited that appear incompatible with this theory and are better described by "prospect theory."[2,22] This recognizes that decisions are influenced not only by probability and the value of possible outcomes, but also by the manner, or frame, in which these probabilities are presented. It also proposes a value function which asserts that people avoid risks when considering gains (risk aversion), but prefer risks when considering losses (risk seeking).

The generalizations of prospect theory were refined to some extent by later investigators who found that although framing exerted some influence on decision making, the effect was weak and unstable, and could not be characterized in terms of tendencies toward risk aversion or risk seeking.[23] Subjects were found to be consistent in their preferences when options were framed as gains, but inconsistent when the same options were presented as losses. It was hypothesized that in drawing attention to the negative consequences of a decision, negative frames heightened subjects' awareness of the presence of conflicting goals that cannot be satisfied regardless of which option is selected. Positive frames, in focusing attention on desirable outcomes, may obscure the presence of conflicting goals and, as a result, reduce the perceived need to make difficult trade-offs. It has also been argued that the original experiments by Kahneman and Tversky describing the framing effect failed to provide subjects with sufficient information about implied losses in the gain frame, and implied gains in the loss frame.[24] Framing effects could be reduced or eliminated by providing information on the reciprocal relation between the gains and losses. These caveats on the effects of information framing have not made their way into the medical literature, even that which is recent.[25] However, in the present review, their applicability was well illustrated in the papers by Bobbio et al.,[7] Marteau,[12] and Nikolajevic-Sarunac et al.,[9] wherein subjects had to consider simultaneously the benefits and risks of interventions.

Other Influences on Decision Making

Factors other than information framing have been reported to affect the ways in which data are used in clinical decision making.[25–40] In particular, choices are influenced by physicians' knowledge, pharmaceutical advertising, and the views of opinion leaders, patients, and peers.[26,27] Data from randomized controlled trials have been shown to have a measurable impact on practice,[26] but this is highly variable. The ability of physicians to understand and interpret the type of quantitative information that is often presented in trial reports may affect the veracity of the conclusions drawn from such data.[28,29] The amount and detail of data presented in relation to any single choice option may also affect preferences.[30,31]

Practitioners' level of knowledge influences perceptions of treatment value; for example, many generalists have inflated perceptions both of cardiovascular risk without treatment, and of the benefits of risk-modifying medical therapy.[32,33] Patient desires, physician training, treatment guidelines, and whether physicians must personally undertake an intervention, as opposed to referring the patient or writing a prescription, have all been found to determine actual clinical practice.[34] The diverse interests and characteristics of individual patients are recognized to particularly affect physicians' implementation of the findings of research in the individual situation,[25,35,36] and discrepancy may exist between medical decisions made for individuals and those that will affect groups of patients.[37] The role of judgment in medicine is recognized and, with it, the conflict that may arise when statistical approaches are used in an attempt to standardize decision making.[38,39] Community values and views on the trade-offs involved in treating different groups of patients are also relevant,[40] and may influence medical decisions.

Framing is a well-exploited marketing tool. It is not surprising, then, that physicians, like the rest of humanity, may be susceptible to its influence. The extent to which that influence affects actual, as opposed to reported, clinical practice, and its place relative to the other factors affecting clinical decision making, remain to be determined. These questions would be best answered if a future research agenda were to include a field study in a realistic clinical setting that required the simultaneous consideration of the benefits and harms of an intervention. In design terms, such a study would be randomized, of parallel group design, and include a nonintervention control group.

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