

# Informing People about the Risks and Benefits of Medicines: Implications for the Safe and Effective Use of Medicinal Products

Dianne C. Berry\*

University of Reading, UK

**Abstract:** Providing effective information about drug risks and benefits has become a major challenge for health professionals, as many people are ill equipped to understand, retain and use the information effectively. This paper reviews the growing evidence that people's understanding (and health behaviour) is not only affected by the content of medicines information, but also by the particular way in which it is presented. Such presentational factors include whether information is presented verbally or numerically, framed positively or negatively, whether risk reductions are described in relative or absolute terms (and baseline information included), and whether information is personalized or tailored in any way. It also looks at how understanding is affected by the order in which information is presented, and the way in which it is processed. The paper concludes by making a number of recommendations for providers of medicines information, about both the content and presentation of such information, that should enhance safe and effective medicines usage.

**Keywords:** Medicines information, risk communication, medicine benefits, probability descriptors, framing, message tailoring.

## INTRODUCTION

Over the last two decades there has been increasing recognition that people both want and need to be given accurate and understandable information about their medicines [e.g. 1-3]. In particular, they need to be told about the risks and benefits of their drugs in order to make informed decisions about medicine taking and to use drugs safely and effectively [4,5]. This is a cornerstone of the philosophy of concordance in medicine taking [e.g. 6], and is a key element in current healthcare policy in the UK, US and many other countries. As noted in a recent Department of Health report in the UK [7], "information is fundamental to choice and making informed decisions. Without information there is no choice. Information helps knowledge and understanding." (p.2). In line with this, there is evidence that the provision of appropriate and understandable information about illnesses and treatments, including medicines, can have beneficial effects on patient satisfaction and on important health outcomes [e.g. 8,9].

Unfortunately, however, it has also become apparent that, in practice, provision of medicines information does not always have such beneficial effects, and may even have unwanted or harmful effects on health [e.g. 1,10,11]. In particular, informing people about the risks and benefits of possible treatments has become a major challenge for healthcare providers and producers of medicines information. This is because the information is often complex, in that it can be ambiguous, incomplete, uncertain, and unstable. For example, drug companies are often required to specify possible adverse reactions on medicine information leaflets before their precise risk is known. Furthermore, the information necessary to protect against

legal liability is not always the same as that needed for effective risk communication, and companies have understandably put more emphasis on the former. In addition, people in general are not well equipped, either cognitively or emotionally, to understand, retain and use risk information effectively [12]. Many people have difficulties interpreting numerical information, and virtually all of us are subject to cognitive biases and are influenced by the particular way in which information is presented [e.g. 1,13].

## THE CONTENT OF MEDICINES INFORMATION

The interpretation of risk (and benefit) information is affected both by the content of the message and the way that it is presented. Until relatively recently, the majority of attention has focused on determining what the content of messages should be, such as which particular risks to convey, whether or not to include information about their likelihood, and so on. Clearly this is essential, as we need to determine what information should be conveyed to patients so that they can make appropriately informed decisions. As far as medicines information is concerned, the International Medicine Benefit Risk Foundation [14] recommended that the minimum information patients should be given should cover the medicine's name and dose, its purpose and benefit, how it should be taken, and any special precautions and adverse effects. These topics are very similar to those specified in the European Commission's (EC) Directive on the content of Patient Package Inserts [15] and the Food and Drug Administration's (FDA) recent draft guidance on written consumer medicines information [16]. As noted in the draft guidance, it is important that the information is based on up-to-date scientific evidence and is fair and balanced. In addition, it should come from a trusted source, and take account of both the patient's needs and the healthcare provider's goals [1].

Although there is general recognition of the importance of informing people about both the risks and benefits of their treatments, considerably more attention has been focused on

\*Address correspondence to this author at the Pro-Vice-Chancellor's Office, University of Reading, Whiteknights House, Whiteknights, Reading RG6 6AH, UK; Tel: +44 118 378 7113; Fax: +44 118 378 7424; E-mail: D.C.Berry@Reading.ac.uk

the former than the latter. Thus, the current EC regulations require medicine information leaflets to include relatively detailed information about a drug's side effects, including their frequency of occurrence [15,17]. However, the regulations do not specify anything in relation to the inclusion of information on the beneficial effects of the medicine. Similarly, the proposed FDA format for medicines information in the US includes presentation of information about possible adverse effects, as well as contraindications and other warnings, but does not include any reference to information about benefits [18]. As Amery [19] has pointed out, this can result in an unbalanced focus on side effects, which in turn can lead to a 'relatively negative information overload' (p.122). Similarly, Vander Stichele, Vandierendonck, DeVooght *et al.* [20] have stressed that an imbalance between risk and benefit messages in patient leaflets may jeopardise their impact [see also 21].

Only a small number of empirical studies has looked specifically at the effects of providing people with information about the benefits of their treatments [20,22,23]. The preliminary evidence suggests, however, that the inclusion of such information can have significant beneficial effects. Vander Stichele, *et al.* [20], for example, reported that inclusion of a relatively short (around 60 words) benefit message in a patient information leaflet significantly improved both patient knowledge and judgments of subjective benefit / risk perception. More recently, Bersellini and Berry [23] showed that the provision of benefit information in a simplified Patient Information Leaflet increased patient satisfaction and resulted in significantly lower ratings of perceived risk to health and significantly higher ratings of intention to take the medicine.

Clearly, it is important that information about drug risks and benefits is presented in a fair and balanced way. One of the main arguments against Direct to Consumer drug advertising (which is now allowed only in the US) is that it can leave many people with an exaggerated perception of the medicine's benefits [24]. A line has to be drawn between the provision of factually based efficacy information and promotional claims.

## PRESENTATIONAL FACTORS

In recent years it has become increasingly apparent that there is far more to effective risk (and benefit) communication than getting the content 'right'. There is growing evidence from both everyday experience and empirical studies, that people's interpretations of risk messages are also significantly influenced by the particular way in which the information is presented [see 1 for a recent overview]. The wording of some currently approved medicines information has been shown to lead to serious misunderstandings [11,25]. The next sections of this paper review the current evidence in relation to six key presentational factors. These are whether probability information is presented verbally or numerically, whether it is framed positively or negatively, whether risk reductions are described in relative or absolute terms (and baseline information included), whether the information is personalized or tailored in any way, and how understanding is affected by the order in which information is presented and the particular way in which it is processed.

## Verbal and Numerical Expressions of Probability Information

The two most common ways of presenting risk probabilities have involved using verbal labels, such as 'likely' or 'rare', or numerical terms, such as '10%' or '1 in a 100'. In terms of the former, there is a good deal of evidence to show that people vary considerably in their interpretation of the terms that are commonly used to describe risk probability, even in relatively restricted contexts [e.g. 26-29]. In an early study Bryant and Norman [27] found that physicians' interpretations of the term 'likely' ranged from 25% to 75%. Similarly, Timmermans [29] reported that interpretations of the term 'very likely' ranged from 30% to 90%, even when presented in a restricted medical context.

Such variability is a particular concern as far as medicines information is concerned, because verbal labels are often used to describe the probability of adverse side effects occurring. In fact, the European Commission (EC) specifically recommended the use of five such descriptors in Patient Information Leaflets ('very common, common, uncommon, rare, and very rare') [17]. Unfortunately their recommendations were not based on sound empirical evidence, nor were they systematically evaluated prior to publication of the guidelines. Berry, Raynor and Knapp have recently carried out a number of studies with members of the general population, patients, and doctors, to evaluate the interpretation of these descriptors, and have found that the use of these terms in Patient Information Leaflets typically leads to considerable over-estimation of risk [e.g. 4,30-34]. It has been consistently shown, for example, that the term 'common' (which the EC recommend should be used to describe possible adverse reactions that occur in between 1% and 10% of people who take a medicine) is generally interpreted as meaning between 45% and 50% by lay people and around 25% by experienced physicians.

Problems with the interpretation of verbal labels have led some researchers and practitioners to argue that risks should be conveyed using only numerical information. However, there is also considerable evidence that many people have difficulty interpreting such information [e.g. 35,36,37,38]. Schwartz, Woloshin, Black *et al.* [35], for example, found that only 16 percent of 500 women were able to answer three simple numeracy questions (such as converting percentages into proportions and vice-versa) correctly. Such difficulties are not just limited to members of the general population with poorer educational backgrounds. Sheridan and Pignone [38] found similar difficulties in a sample of medical students.

The use of percentages has been shown to give rise to particular difficulties. Gigerenzer [39] reported a recent German study showing that over a third of a sample of 1000 Germans were unable to interpret the term '40 percent' correctly, mistakenly believing that it meant one in four or every fortieth person. He and colleagues have advocated that many of the difficulties go away if probabilities are presented using natural frequencies, such as '1 in 100', rather than percentages [e.g. 40,41; see also 42,43]. Hoffrage, Lindsey, Hertwig and Gigerenzer [41], for instance, found that medical students were significantly more correct on a

series of medical diagnosis problems when the statistics were communicated as frequencies.

The use of frequency information can cause problems, however, particularly when providing comparative information. People can be misled by the size of the denominator, for example mistakenly believing that '1 in 10,000' is a larger risk than '1 in 100' [44,45]. One solution is to keep the size of the denominator, rather than numerator, constant when making comparisons between different risk levels (e.g. '1 in 10,000' and '100 in 10,000').

Given the limitations associated with both verbal and numerical forms of presenting probability information, the safest strategy is to present both verbal descriptors and the corresponding frequency information [see also 46].

### **Framing of Information**

A key way in which the form of presentation can affect the interpretation of probability information concerns whether a message is framed positively or negatively. It is now well established that people are more likely to choose particular treatments if the information is framed positively (e.g. there is a 95 percent chance of survival) rather than negatively (e.g. there is a 5% risk of dying). Gurm and Litaker [47], for example, found that patients were more likely to opt for angioplasty treatment when told that it was 99 percent safe, compared with there being a 1 percent likelihood of a serious complication. Positive framing not only affects people's treatment preferences, but has also been shown to improve their understanding of the information presented [e.g. 48].

A number of factors have been found to moderate the size and direction of such framing effects, however. Thus, Maheswaren and Meyers-Levy [49] reported that positively framed messages were more persuasive than negatively framed messages, only for people who showed low levels of involvement in the situation. Similarly, Broemer [50] found that positive framing was beneficial for 'highly ambivalent' participants but not for those who were low in ambivalence.

### **Relative and Absolute Forms of Presentation**

Another way in which judgments can be affected by the particular way in which medicines information is presented, and one that has received increasing attention in recent years, is whether risk levels are described in relative or absolute terms. The two most commonly used methods for reporting risk reductions or increases are 'absolute risk formats' and 'relative risk formats'. Thus, a risk reduction from 4 percent to 2 percent can be described as an absolute risk reduction of 2 percent or, in relative terms, as the risk having halved or being reduced by 50 percent. A large number of studies has shown that relative risk formats can have more influence on judgments, and be more likely to lead to the uptake of particular behaviours, than absolute presentation formats. Malenka, Baron, Johansen, *et al.* [51], for instance, found that nearly 80 percent of study participants opted for a medicine that was presented with information about relative risk benefits, compared with 20 percent for the medicine whose benefits were described in absolute terms.

Recent experiments have shown that such biasing effects can be avoided, however, if people are informed about the baseline level of risk. Natter and Berry [52] found that any 'advantage' of relative risk formats disappears if people are given information about the baseline level of risk.

### **Tailoring Messages to Individuals or Particular Populations**

In terms of medicines information, the majority of materials that are currently available are not tailored to individuals or to particular sub-groups of the population. In recent years, however, a number of researchers have argued in favour of such tailoring [e.g. 53-56]. Individually tailored communications use data gathered about individual characteristics to design and present personalized health messages to individuals that match each person's unique background and orientation [57]. As Kreuter, Strecher and Glassman [58] pointed out, however, full tailoring of even a relatively short communication to individuals could result in hundreds of thousands of possible different messages being needed, which is not feasible. Although computer generation of materials will help to some extent, a key issue that remains to be addressed is, how much tailoring is needed to produce a significant benefit? In this context, Berry, Michas and Bersellini [59] found beneficial effects on people's satisfaction, perceived risk, and intention to take a medicine from the use of personal terms, such as 'your symptoms' and 'you should take' in a Patient Information Leaflet, as opposed to impersonal descriptions, such as 'the symptoms' and 'should be taken'. Similarly, Campbell and Califf [11] proposed that risk communication letters to healthcare professionals might be more effective if addressed to them personally. Berry [60] has further suggested that a potential compromise between the two extreme forms of communication (generic as opposed to individually tailored messages) might be to produce leaflets for particular sub-groups of the population, such as elderly patients, carers, or those who suffer from particular illnesses.

### **The Order in which Information is Presented**

Consideration also needs to be given to the order in which information is presented, as this can impact on how well it is processed and remembered. Berry, Michas and DeRosis [61] found that, in order to be remembered, information about drug administration (e.g. details of dosage and how to take the medicine) had to be given near to the beginning of an information leaflet, whereas information about adverse side effects was remembered well irrespective of its relative position in the text. It is likely that this 'order effect' is related to the perceived importance of the information. Subjective ratings showed that information about side effects was rated as being much more important than information about drug administration [see also 62]. Healthcare providers and designers of medicines information should therefore put information that is important, but that patients do not necessarily perceive to be important, near to the start of any medicines information that is given to patients. The recommended order for medicines information in the current European Commission and draft FDA guidelines is not in line with this recommendation [16,17].

### Active Processing of Information

Finally, it is not only necessary to consider what information to give to people, how to present it, and in what order, but one also needs to take account of how it is processed. In this context, Natter and Berry [63] presented study participants with a simplified medicines information leaflet, and required half of them to answer a simple reflective question about the given level of risk of adverse side effects (converting from the stated percentage risk level to a natural frequency), or marking the risk level on a blank graph. In two experiments, they found that active processing of the key risk information significantly improved both the accuracy of risk estimates and satisfaction with the information. This benefit of active processing is in line with a number of studies in the cognitive psychology literature, using other tasks and materials [e.g. 64-66]. Thus, where practical, patients should be encouraged to process key medicines information in some active way; for example, by the inclusion of a few simple questions at the end of the medicines information.

### Additional Presentational Considerations and Other Guidance

In addition to considering the above six presentation factors, providers of medicines information also need to ensure that the 'level of language' is appropriate and that any printed information is designed appropriately. Thus, where possible, technical terms should be replaced by everyday counterparts, non-essential information should be eliminated, word and sentence length should be reduced, language structures should be simplified, and information should be ordered to enhance coherence [1]. In line with this, Kenny, Wilson, Purves *et al.* [67] recommended that all new patient information materials should declare an objective score of readability using a standard formula. In addition, any printed materials must be designed in line with current best practice in terms of factors such as layout, print size, and the use of diagrams and colour. This should be tailored to suit the particular needs of intended recipients, such as using large print or Braille for the visually impaired.

An increasing number of guides to providing effective medicines information are being published by regulatory authorities and other independent organizations. Examples include the ATSDR (Agency for Toxic Substances and Disease Regulation) Primer on Health Risk Communication Principles and Practices [68], the medicines guides provided by Medicines.org.uk, and recent draft guidance produced by the FDA in the US [16] and the Medicines Healthcare Products Regulatory Agency in the UK.

### The Importance of User Testing and Evaluation

Finally, it is essential that any new medicines information is subjected to systematic evaluation and user testing, particularly in the case of printed materials. This involves more than just asking the views of a few colleagues to see if they like it or find it helpful. One reason for this is that people may 'like' leaflets that do not actually lead to good understanding or retention [e.g. 69].

Wright [70] stressed that it is essential to carry out a thorough evaluation of any materials that are produced, and

that the process must be intimately involved with the development of the materials (rather than a separate process that is tagged on at the end). She recommended that performance-based criteria are needed when carrying out such evaluation. In terms of medicine information leaflets, some specific criteria could be that a certain percentage of people (e.g. 80 percent) can locate relevant dosage information within a specified time (e.g. 20 seconds) and that, say, 90 percent of people can identify the circumstances in which the medicine should be taken.

This issue of user testing is particularly timely in the UK and other European Union countries at present, as the Commission is introducing new legislation that requires user testing to be carried out to demonstrate the readability and usefulness of new Patient Information Leaflets to patients. Specifically, the requirements state, "the package leaflet shall reflect the results of consultations with target patient groups to ensure that it is legible, clear and easy to use" [71].

### RECOMMENDATIONS

If medicines are to be used safely and effectively then patients must be given appropriate information about the risks and benefits of the medicines, in a form that they can understand and apply to their own circumstances. As far as the content of the information is concerned, this should include details about what the medicine is for, how it should be taken, important contraindications and other warnings, and possible adverse effects. In addition, it should be based on current scientific evidence, is be fair and balanced, come from a trusted source, and take account of both patient's needs and the healthcare provider's goals. Information about medicine risks should be balanced with information about medicine benefits.

In terms of the presentation of the information, the following recommendations can be made:

- Probability information should be presented using both verbal terms and numerical equivalents
- Natural frequencies should be used rather than percentages. Care should be taken when drawing comparisons between two or more values
- Healthcare providers should present information using both positive and negative framing, particularly when consumers of the information may have low involvement or be high in ambivalence
- Relative forms of presentation format should not be used for presenting changes in risk levels, unless baseline information is also provided.
- Providers of medicines information should assess whether some degree of tailoring of the information is practical. This may be as simple as using personal terms such as 'you' and 'yours', rather than impersonal terms
- Information that is important, but that patients might not believe to be important, should be placed near to the beginning of health messages
- Patients should be encouraged to process the information actively where practical

- Medicines information should be designed (in terms of legibility and readability) in line with current best practice
- Printed medicines information should be subjected to systematic evaluation / user testing before being disseminated

Adhering to these recommendations clearly will not guarantee the safe and effective use of all medicines. However, it should prevent many of the common misunderstandings that currently occur, and could help patients to understand the key information that they need to make appropriately informed choices and to use their drugs in the intended manner.

REFERENCES

[1] Berry DC. Risk, Communication and Health Psychology, Maidenhead, UK, Open University Press. 2004.

[2] Coulter A, Gilbert D, Entwistle V. Sharing decisions with patients: Is the information good enough? *Br Med J* 1999; 318: 318-22.

[3] Stevenson FA, Wallace G, Rivers P, Gerrett D. It's the best of two evils: A study of patients' perceived information needs about oral steroids for asthma. *Health Expectations* 1999; 2: 185-94.

[4] Knapp PR, Raynor DK, Berry DC. Comparison of two methods of presenting risk information to patients about side effects of medicines. *Qual Saf Health Care* 2004; 13: 176-80.

[5] Mottram DR, Reed C. Comparative evaluation of patient information leaflets by pharmacists, doctors and the general public. *J Clin Pharmacy Therapy* 1997; 22: 127-34.

[6] Pharmaceutical Society of Great Britain and Merck, Sharp & Dohme, 1997. From Compliance to Concordance: Achieving shared goals in medicine taking. London: Royal

[7] Department of Health. Better Information, Better Choices, Better Health: Putting Information at the Centre of Care. London Department of Health. December 2004.

[8] Bishop P, Kirwan J, Windsor K. The ARC Patient Literature Evaluation Project. Chesterfield: The Arthritis Rheumatism Council 1996.

[9] Macfarlane JT, Holmes WF, Macfarlane RM. Reducing reconsultations for acute lower respiratory tract illness with an information leaflet; a randomized controlled study of patients in primary care. *Br J Gen Pract* 1997; 47: 719-22.

[10] Calman KC. Cancer: Science and society and the communication of risk. *BMJ* 1996; 313: 799-02.

[11] Campbell WH, Califf RM. Improving communication of drug trials to prevent patient injury: proceedings of a workshop. *Pharmacoepidemiol Drug Saf* 2003; 12: 183-94.

[12] Doyal L. Informed consent: moral necessity or illusion? *Qual Health Care* 2001; 10: 29-33.

[13] Kahneman D, Tversky A. Choices, values and frames. *Am Psychologist* 1984; 39: 341-50.

[14] International Medicine Benefit Risk Foundation. Improving Patient Information and Education on Medicines. Geneva, IMBRF. 1993.

[15] European Commission. EEC Directive 92/27EEC on labeling of medicinal products for human use and on package leaflets (OJ No L113 of 30 April 1992).

[16] FDA. US Food and Drug Administration. Guidance on useful written consumer medication information 2005. <http://www.fda.gov/cder/guidance/6520dft.htm>.

[17] European Commission. A guideline on the readability of the label package leaflet of medicinal products for human use. EC Pharmaceuticals Committee 1998.

[18] Marwick C. MedGuide: at last a long sought opportunity for patient education about prescribed drugs. *J Am Med Assoc* 1997; 277: 949-50.

[19] Amery WK. Coming full circle in pharmacovigilance: communicating safety information to patients through patient package inserts. *Pharmacoepidemiol Drug Saf* 1999; 8: 121-9.

[20] Vander Stiele RH, Vandierenonck A, DeVooght G, Reynvoet B, Lammerlyn J. Impact of benefit messages in patient package inserts on subjective drug perception. *Drug Inform J* 2002; 36: 201-8.

[21] Breckenridge A. For the good of the patient: risks and benefits of medicines. *Pharmacoepidemiol Drug Saf* 2003; 12: 145-50.

[22] Berry DC, Michas IC, Bersellini E. Communicating information about medication side effects: effects on satisfaction, perceived risk to health and intention to comply. *Psychol Health* 2002; 17: 247-67.

[23] Bersellini E, Berry DC. Communicating information about medicines: the benefit of a benefit statement. *Proceedings of the Br Psychological Soc* 2004; 12: 35.

[24] Mansfield PR, Mintzes B, Richards D, Troop L. Direct to consumer advertising: is at the crossroads of competing pressures from industry and health needs. *BMJ* 2005; 330: 5-6.

[25] Berry DC, Raynor DK, Knapp PR, Bersellini E. Official warnings on thromboembolism risk with oral contraceptives fail to inform users adequately. *Contraception* 2002; 66: 305-7.

[26] Toogood JH. What do you mean by 'usually'? *The Lancet* 1980; 1: 1094.

[27] Bryant GD, Norman GR. Expressions of probability: words and numbers. *N E J Med* 1980; 302: 411.

[28] Mazur DJ, Merz JF. Patients' interpretations of verbal expressions of probability; implications for securing informed consent to medical interventions. *Behav Sci Law* 1994; 12: 417-26.

[29] Timmermans D. The roles of experience and domain of expertise in using numerical and verbal probability terms in medical decisions. *Med Decision Making* 1994; 14: 146-56.

[30] Berry DC, Knapp PR, Raynor DK. Provision of information about drug side effects to patients. *The Lancet* 2002; 359: 853-4.

[31] Berry DC, Raynor DK, Knapp PR. Is 15% Very Common? Informing people about the risks of medicine side effects. *Intl J Pharmacy Practice* 2002; 10: 145-51.

[32] Berry DC, Raynor DK, Knapp PR. Communicating risk of medicine side effects: an empirical evaluation of EU recommended terminology. *Psychol Health Med* 2003; 8: 251-63.

[33] Berry DC, Raynor DK, Knapp PR, Bersellini E. Patient understanding of risk: impact of EU guidelines and other risk scales for consumer medicines information. *Drug Safety* 2003; 26: 1-11.

[34] Berry DC, Holden W, Bersellini E. Interpretation of recommended risk terms: differences between doctors and lay people. *Intl J Pharmacy Practice* 2004; 12: 117-24.

[35] Schwartz LM, Woloshin S, Black WC, Welch HG. The role of numeracy in understanding the benefit of screening mammography. *Ann Int Med* 1997; 127: 966-72.

[36] Bynner J, Parsons S. It doesn't get any better: the impact of poor basic skills on the lives of 37-year-olds. London: The Basic Skills Agency 1997.

[37] Lipkus IM, Samsa G, Rimer BK. General performance on a numeracy scale among highly educated samples. *Med Dec Mak* 2001; 21: 37-44.

[38] Sheridan SL, Pignone M. Numeracy and the medical student's ability to interpret data. *Effect Clin Practice* 2002; 5: 35-40.

[39] Gigerenzer G. *Reckoning With Risk*. London: Penguin. 2002.

[40] Hoffrage U, Gigerenzer G. Using natural frequencies to improve diagnostic inferences. *Acad Med* 1998; 73: 538-40.

[41] Hoffrage U, Lindsey S, Hertwig R, Gigerenzer G. *Medicine: Communicating statistical information*. Science 2000; 290: 2261-2.

[42] Cosmides L, Tooby J. Are humans good intuitive statisticians after all? Rethinking some conclusions from the literature on judgement under uncertainty. *Cognition* 1996; 58: 1-7.

[43] Hanoch Y. Improving doctor-patient understanding of probability in communicating cancer screening test findings. *J Health Commun* 2004; 9: 327-335.

[44] Paling J. Strategies to help patients understand risks. *Br Med J* 2003; 327: 745-8.

[45] Grimes DA, Snively, GR. Patients' understanding of medicine risks: Implications for genetic counseling. *Obstetr Gynaecol* 1999; 93: 910-4.

[46] Weber EU, Hilton DJ. Contextual effects in the interpretations of probability words – perceived base rate and severity of events. *Journal of Experimental Psychology: Hum Percept Perform* 1990; 16: 781-9.

[47] Gurm HS, Litaker DG. Framing procedural risks to patients: is 99% safe the same as a risk of 1 in 100? *Acad Med* 2000; 75: 840-2.

[48] Armstrong K, Schwartz JS, Fitzgerald G, Putt M, Ubel PA. Effect of framing as gain versus loss on understanding and hypothetical treatment choices: survival and mortality curves. *Med Dec Mak* 2002; 22: 76-83.

- [49] Maheswaren D, Meyers-Levy L. The influence of message framing and issue involvement. *J Mark Res* 1990; 27: 361-7.
- [50] Broemer P. Relative effectiveness of differently framed health messages; the influence of ambivalence. *Eur J Soc Psychol* 2002; 32: 685-703.
- [51] Malenka DJ, Baron JA, Johansen S, Wahrenberger JW, Ross JM. The framing effect of relative and absolute risk. *J Gen Int Med* 1993; 8: 543-8.
- [52] Natter HM, Berry DC. Effects of presenting the baseline risk when communicating absolute and relative risk reductions. *Psychol Health Med In Press*.
- [53] Skinner CS, Campbell MK, Rimer BK, Curry S, Prochaska JO. How effective is tailored print communication? *Annals of Behavioral Medicine* 1999; 21: 290-8.
- [54] Kreuter MW, Holt CL. How do people process health information? Applications in an age of individualized communication. *Curr Directions Psychologic Sci* 2001; 10: 206-9.
- [55] Strauss SE. Individualizing treatment decisions – the likelihood of being helped or harmed. *Eval Health Professions* 2002; 25: 210-4.
- [56] Kreuter MW, Wray RJ. Tailored and targeted health communication: strategies for enhancing information relevance. *Am J Health Beh* 2003; 3: 227-32.
- [57] Rimer B, Glassman B. Tailored communication for cancer prevention in managed care settings. *Outlook* 1997; 4: 5.
- [58] Kreuter MW, Strecher VJ, Glassman B. One size does not fit all; the case for tailoring print materials. *Annals of Behavioral Medicine: A Publication of the Society of Behavioral Medicine* 1999; 21: 276-83.
- [59] Berry DC, Michas IC, Bersellini E. Communicating information about medicine: the benefits of making it personal. *Psychol Health* 2003; 18: 127-39.
- [60] Berry DC. Interpreting information about medication side effects: differences in risk perception and intention to comply when medicines are prescribed for adults or young children. *Psychol Health Med* 2004; 9: 226-34.
- [61] Berry DC, Michas IC, DeRosis F. Evaluating explanations about drug prescriptions; effects of varying the nature of information about side-effects and its relative position in explanations. *Psychol Health* 1998; 13: 767-84.
- [62] Bergus GR, Levin IP, Elstein AS. Presenting risks and benefits to patients – the effect of information order on decision making. *J Gen Internal Med* 2002; 17: 612-7.
- [63] Natter HM, Berry DC. Effects of active information processing on the understanding of risk information. *Appl Cogn Psychol* 2005; 19: 123-35.
- [64] Cosmides L, Tooby J. Are humans good intuitive statisticians after all? Rethinking some conclusions from the literature on judgment under uncertainty. *Cognition* 1996; 58: 1-73.
- [65] Lee AY, Hutchinson L. Improving learning from examples through reflection. *J Exp Psychol: Applied* 1998; 4: 187-210.
- [66] Stern E, Aprea C, Ebner HG. Improving cross-content transfer in text processing by means of active graphical representation. *Learn Instruct* 2003; 13: 191-203.
- [67] Kenny T, Wilson RG, Purves IN, *et al.* A PIL for every ill? Patient information leaflets (PILs): a review of past, present, and future use. *Family Practice* 1998; 15: 471-9.
- [68] ATSDR. Agency for Toxic Substances and Disease Registry. A primer on health risk communication principles and practices. <http://www.atsdr.cdc.gov/HEC/primer.html>.
- [69] Livingstone J, Axton RA, Mennie M, Gilfallan A, Brock DJ. A preliminary trial of couples screening for cystic fibrosis: designing an appropriate information leaflet. *Clin Genet* 1993; 57-62.
- [70] Wright P. Designing healthcare advice for the public. In F. Durso (ed.) *Handbook of Applied Cognition*. Chichester: Wiley. 1998.
- [71] European Commission. Directive 2004/27/EC of the European Parliament and Council of 31 March 2004 amending Directive 2001/83/EC on the Community Code relating to medicinal products for human use. March 2004.