

**AGGREGATION, RATIONALITY, AND RISK COMMUNICATION :THREE
CURRENT DEBATES IN MEDICAL DECISION MAKING**

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Decision analysis prescribes a systematic way of decision making under uncertainty based on probability theory and utility theory. It is often used to solve complex medical decision problems, such as the following. "A 70 years old male who is a heavy smoker, has for over 10 years complained of chest pain indicative for angina pectoris. The nitroglycerine his physician prescribed relieved the pain immediately, but the pain returned occasionally over the past few weeks. His physician thinks the diagnosis of a progressive angina pectoris is very likely. This is the reason why this patient is eligible for a coronary bypass operation. There is a reasonably large chance that this operation will lead to a relief of the pain. A very small percentage of the patients dies during the operation. However, this patient has an increased mortality risk, because he suffers from hemophilia A. An angiogram shows that the angina pectoris is rather serious. There is a low chance that the result is a false positive."

The workshop addressed the following tree dilemmas in medical and other applications of decision analysis : individual versus aggregate analysis, deviations from EU theory, and the communication and the perception of risks.

DILEMMA 1: The individual versus the aggregate level

Aggregated empirical data play an important role in medical decision analysis. These data lead to probability and utility estimates for specific groups, and help to provide guidelines for how to deal with groups of patients. The use of such estimates has raised many questions. For instance, should we consider patients comparable and divisible into subgroups, and therefore most efficiently managed with aggregate guidelines, or are patients unique? Who, for instance, should have the greatest role in deciding whether the patient should undergo a coronary artery bypass operation: the patient, who takes a concrete individual view, or the doctor, who takes a more abstract aggregate view for similar patients, or third parties like hospitals or insurers, who balance aggregate costs and benefits in allocating resources?

In the first presentation Peter Politser (MIT) presented some data showing that lay people rely on different factors when making decisions than doctors. The former focus more on welfare conditions, while the latter focus more on the uncertainties in the decision. In the discussion Jim Shanteau (Kansas State University) emphasized that lay people and experts take different factors into account when making decisions which might cause miscommunications between patients and physicians.

The second issue was equity in health care. How do we adequately consider the equity of resource allocation in health care? Which methods do we need to assess preferences for the distribution of resources? Is it fair that the patient from the opening example with his age and history of smoking is eligible for a coronary bypass operation, while there is a long waiting list with patients who are younger and did not smoke? In the second presentation Rakesh Sarin (UCLA) discussed the issue of equity from individual, group and social viewpoints. Generally, people believe that good but also bad things should more or less be equally divided among people. In relation to health care, it is assumed undesirable that some privileged groups benefit more from health care than others. When formalizing equity issues, different divisions of people into specific groups may lead to differences in the equity of health benefits. When dividing people, for instance, into men and women health policies might seem fair, while a

division into blacks and whites of the same group of people seems unfair. Equity in health care is thus related to how one defines groups. Martin Weber (University of Mannheim) emphasized this in his discussion of the paper. He also drew the attention to different kinds of risks. Things are different for voluntary and involuntary risks. Surely, people are free to endure the risks they want (such as mountain climbing), but should they have the same rights to health care as people who do not take these risks? What is the criterion of fairness in relation to health risks such as infant mortality: should one measure it against infant mortality in earlier days or against the risk of the group with the lowest infant mortality? What is the reference point? Most physicians, however, refuse to make decisions on other than medical grounds. Equity is not an useful criterion for them, because what is equitable is difficult to determine. It is simply not possible to find out who is most "guilty" of his/her disease. In their view, the patient with angina pectoris can only be refused treatment, if his chances to survive the operation are much lower than those of a non-smoker.

The general discussion continued by emphasizing the complexity of the equity issue which can be viewed from different perspectives. This leaves also ample room for manipulation by policy makers. A conclusion was that more research is needed about the different roles of patients and physicians in medical decisions, and that the issue of equity in relation to health care is becoming more important.

DILEMMA 2: Deviations from EU theory

People do not always make decisions according to EU theory. They may overweigh small probabilities and do not always revise probabilities adequately after receiving new information. In treatment problems, they may judge unfavorable outcomes attributed to doctors' actions as more serious than those caused by inaction. In diagnostic problems they may do the opposite. How should we deal with decision makers' deviations from the EU model? Is it sensible that the physician, when deciding what to do, takes into account the regret she might feel when the patient from the opening example, who is in a bad shape, dies during the operation and the angina turns out not to have

been very serious? Should we include factors such as responsibility and anticipated regret in a normative model?

Jane Beattie (University of Sussex) discussed the notion of decision aversion, which might be caused by the anticipated regret involved in making a decision. There is a trend in medicine to increase patients' involvement in treatment decisions. Although this involvement yields many benefits, there are also some costs. If a pregnant woman, for instance, has a choice whether or not to do prenatal screening, this may lead to stress. Because these tests induce a risk for the unborn baby, the woman has to trade-off the risk of having a handicapped baby (when no screening is done) against having a spontaneous abortion due to the tests. Data show that some women are very averse to making this kind of decisions.

George Wu (Harvard University), in his discussion of the paper, mentioned that regret can be reduced by a proper framing of decisions, and discussed whether regret should be modelled as an attribute of utility. Important in this context is how much one might want to pay (in terms of a reduction in expected utility) for taking into account the anticipated regret. Furthermore, participants of the workshop felt that the regret patients would feel, should play a role in decisions. Physicians, however, should not let their personal emotions influence the optimal decision for the patient.

Another issue which was discussed, is how physicians assess probabilities, e.g. the probability that the angina pectoris is progressive after learning about the result of the angiogram, and how physicians process probabilities in general. John Fox (Imperial Cancer Research Fund) argued that decision analysis is inadequate for medical practice, because it leaves out the important step of recognizing that there is a problem and how to structure that decision problem. Instead of a Bayesian reasoning model to establish the most probable disease on the basis of symptoms and test results, he proposed a model that makes use of argumentations. Argumentations for or against a certain disease increase or decrease the probability of disease. Embedded in a formal mathematical framework, a set of argumentations leads to a decision network or argumentation structure suggesting the most plausible outcome. This approach is assumed to be more natural for physicians

to use than Bayesian reasoning, and is part of a general decision technology that has been developed by Fox and his colleagues to achieve maximal flexibility.

Patrick Bossuyt (University of Amsterdam), in his discussion of the paper, pointed out that decision technologies should not only be flexible, but should also satisfy optimality criteria. The advantage of using decision analysis in medicine compared with AI applications, is that decision analysis provides objective criteria to compare clinical strategies, and can thus justify clinical practice. He also called attention to the growing role of decision analysis in medical practice. He argued that, contrary to some years ago, decision analysis is widely accepted as an approach to solve medical problems, even to the extent that people accept decision analytic solutions without critically examining the model or the data used in the model. In the general discussion, some participants argued that a decision analytic framework may very well be used in medical practice and that an argumentation based decision model should be considered as an additional tool for, e.g., the generation of alternatives.

DILEMMA 3: Communication and perception of risks

Legal doctrine often allows medical interventions once the patient is informed of the risks, and approves. Often risks are communicated in verbal terms. The question is how the physician should communicate the risks of surgery versus continuation of medication to the patient. Is the description in the opening example sufficient or should the physician provide numerical information? Would percentages enable the patient to make a rational trade-off of the different risks? Many researchers have tried to explain why people use verbal terms to communicate risks. Ido Erev (Technion Haifa) disagreed with the view that verbal terms are used because people can communicate risks more efficiently in verbal terms than in percentages. He argued that we should adapt a game theoretical approach. Communication could be seen as a game, in which people have different goals they want to achieve. A hypothetical example is the following. Although physicians want to choose the best treatment for the specific patient, they might also want to introduce some vagueness

in the communication of the different risks. This vagueness of risks involved induces a variability in the treatment preferred by different patients. Not all patients prefer the same treatment. This in turn might provide physicians with a wider experience in treatments. Processes like this may play a role in patient-physician communications and could be studied from a game theoretical perspective. More attention should be given to the functions, other than conveying the truth, that verbal probability terms play in communication.

Karl Teigen (Tromsø University), in his discussion of the paper, elaborated on this. To create behavioral variability is just one of the possible functions. Whether a person prefers to use verbal or numerical probabilities may depend on the different aims in a communicative setting. Does a person want to be maximally informative or simply to sound convincing? Is the aim to create agreement or to be encouraging? Or is the primary aim not to be blamed if proven wrong? Or does a person have several (maybe contradictory) goals, he/she wants to achieve? Different needs may lead to different preferences for the sender and receiver of the communication. In the general discussion it was argued that in a medical setting the vagueness of verbal terms make risks more acceptable to patients.

People's interpretation of these verbal terms may differ and may also depend on context. It is possible that patients and physicians differ in the appraisal of the several risks involved, i.e., the risk of surgery and a possible increased risk of an heart attack when continuing the medication. What are the factors that influence the acceptability of medical risks? How do people handle these risks? How much impact on risk perception do the following factors have: whether the risk is controllable, ambiguous, and whether it is caused by action or inaction? Willem Albert Wagenaar (University of Leiden) presented some data about framing experiments (cf. Asian disease problem) in which subjects were asked to give verbal terms to percentages. Results show that subjects, by means of giving labels, construct a dominance structure of the decision problem which is no longer a dilemma, because one alternative is clearly dominant. However, subjects turned out to give different interpretations to percentages depending on the outcomes, e.g. if there are human lives at stake or "only" butterflies etc.

Ilana Ritov (Ben Gurion University), in her discussion of the paper, called attention to other factors which might affect patients' perception of risks, such as whether the risk is caused by action or inaction, and the ambiguity of risks which might change people's perception of the risk. The general discussion further dealt with what should be the best way to communicate risks to patients. Verbal terms have the advantage of vagueness, but percentages are more exact. However, if patients do not interpret percentages in an exact way, but attach verbal labels to them, are percentages still preferable? The general discussion led to the conclusion that more research is needed on the communication of risks, especially between patients and physicians in relation to how patients handle these risks.

In conclusion: the papers and the discussions in this workshop all referred to three dilemmas related to the prescriptive role of EU theory, which are:

(1) *Equity: the individual versus the group.* How should we give health care to people in a fair way when budgets are shrinking? Who should decide whether or not a certain treatment for a specific patient is appropriate?

(2) *Rationality: normative versus descriptive models.* How should we model violations of EU theory such as regret? What should we do with deviations from Bayesian reasoning?

(3) *Ambiguity: verbal versus numerical risks.* Is ambiguity in the communication between physicians and patients by using verbal risk terms good or bad? How do patients perceive risks?

The workshop and several other presentations at the conference, showed an increasing interest in the study of medical decisions from a psychological point of view. It also showed that the themes discussed in the workshop are of interest to (psychological) researchers as well as practitioners in the field of medical decision making.