Different formats for communicating surgical risks to patients and the effect on choice of treatment

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Abstract
Effective communication of treatment risks is important to enable patients to make informed decisions. This study aimed to determine the effects of different risk formats on participants’ evaluation and interpretation of risk information and on their treatment choice. Participants (N = 44) were recruited among patients who had undergone surgery for an abdominal aneurysm and were asked to evaluate treatment risks (surgery or an observation policy) of two hypothetical cases presented in one of three risk formats (numbers, vertical bars or icons). Risk information presented in vertical bars was evaluated as the most difficult to comprehend, and the perceived threat of this information was evaluated as higher than that of the other risk formats. Risk information presented as icons was evaluated as more helpful for making a decision, but resulted in a lower percentage of participants choosing for surgery than when risks were presented in the other formats. In conclusion, this study showed that different risk formats have different effects on participants’ evaluation of the information and on their choice. Doctors should therefore be careful in choosing the format in which they present treatment risks.

Keywords: Risk communication; Risk formats; Patient decision making

1. Introduction
An active role of patients in the decision-making process with regard to their treatment is becoming increasingly important, and discussing the risks and benefits of treatment options is therefore an essential part of modern health care. Understanding the risks is considered to be crucial for appropriate decision-making [1]. Providing patients with objective (i.e. based on empirical evidence) and useful information in the most accessible manner is not easy. In particular, the communication of risks is a complex matter. It has been shown that patients find it difficult to adequately comprehend risk information [2,3].

While many studies focus on interventions concerning risk communication to optimize decision-making, fewer studies are concerned with comparing various formats for effective risk communication. Studies, in which relative and absolute risks were compared, showed that risks were considered to be greater when information was expressed as relative risks than when it was presented as incidence rates [4,5] and that more patients agreed to treatment than when the risks were presented as absolute differences [6]. Risks presented as frequencies were also perceived as higher than when the same risks were presented as percentages [7]. Although having the attraction that common words are used that seem to be generally understood, the use of verbal labels (e.g. “a great chance”) for communicating risks appears to be less effective in clearly explaining risks, because people differ greatly in their interpretation of verbal labels [8,9].

The visual presentation of risk information has also been explored. We know little about how (and even whether) graphical presentations are superior to other formats, such as numerical or verbal formats, in terms of effective risk communication. The findings of some empirical studies suggest that many patients prefer the simple bar charts to other formats such as icons (for example, showing how many people per 100 are affected), survival curves or pie charts [10]. In non-medical domains it has been shown that a combination of graphs and tables produced more accurate performance [11,12] and that subjects using simple bar graphs

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needed less time for making a judgment than when using pie charts [13, 14]. Elting et al. [15] showed that displaying the results of clinical trials in icons resulted in more accurate decision-making by physicians than displaying the results in tables, pie charts or bar graphs. Stone et al. [16] found that participants were less risk averse when the risks were presented with numbers than with any of the graphical formats, such as bar graphs or icons. They argue that a graphical presentation of risks increases the subjective estimate of the risk (either the perceived chances or the seriousness of adverse outcomes), because the visual salience facilitates the comparison of risks. Most of the experimental research that has been carried out suggests that combining graphics with numerical information does affect several outcomes, such as the perceived helpfulness of the information and the perceived threat of risks. There is still little experimental research testing whether people’s perception and understanding of risk vary by graphical format and whether the addition of graphical displays significantly improves comprehension compared to the numerical presentation of risks only.

As there is agreement that effective risk communication is necessary for the involvement of patients in the decision-making process, there is no agreement on what constitutes effective risk communication. One criterion of effectiveness is that risk communication should increase patients’ understanding of the risks in order to enable them to use this information in their decision-making. Cognitive outcomes are often used, such as an accurate recall of objective risk estimates, assuming this is related to an adequate comprehension of the information. A better understanding of risk information may thus lead to better decisions. Good decisions are often defined as decisions based on relevant empirical evidence and patient’s values, thereby maximizing patient’s expected utility [17, 18]. In addition to these aspects, attitudinal criteria (such as satisfaction with the decision), and more affective outcomes (such as threat induced by the information) are applied [19]. These aspects are assumed to reflect the quality of the information and the decision-making process [20]; i.e. effective risk communication should contribute to the satisfaction with and confidence in the decision that has been made, and the risk information should be evaluated as helpful in decision-making. Further, information presented in a risk format which induces less threat than when presented in other risk formats might be preferred. All in all, the effectiveness of risk communication can be evaluated on many dimensions. The evaluation which risk format is most effective therefore depends on the evaluation of the importance of the different aspects of effectiveness [19].

The findings of some studies suggest that the effectiveness of a format not only depends on the characteristics of the information (e.g. magnitude of the risks to be communicated), but also on user characteristics (e.g. cognitive style [10]). While patients in general have a great desire for information, this varies substantially among patients due to, for example, the level of education and age [21–23]. Sutherland et al. [21] showed that the desire for information is related to the desire for decision involvement. These individual differences in desire for decision involvement might be a moderating factor in the effectiveness of different formats for risk communication.

The objective of the present study was to investigate various effects of risk communication concerning a surgical treatment using three different formats. Numerical risk information only was compared with two graphical formats (vertical bars and icons) in addition to numerical information. Bars and icons are the most frequently used graphical formats for presenting risks in health care, and have been shown in a few studies to be superior to other graphical displays especially for comparing risks [14, 15]. The criteria we used to measure the effects of risk format are related to the risk information, i.e. comprehensibility of risk information, helpfulness for making the decision, and threat induced by the risk information (i.e. the described situation). The decisions of participants were further compared with the outcome of an empirically based decision analytic model [25, 26] and participants were asked to report their confidence in the decision.

In this study participants were asked to compare several mortality risks and to make a hypothetical treatment decision. Since the ultimate goal of our study was to select the appropriate format for information provision to aneurysm patients, we chose to use this group as participants in this experiment. The magnitude of the risk was varied in two hypothetical decision problems, because it was assumed that the effect of risk communication in a certain format interacts with the magnitude of the risks, in the sense that numbers would be better to quantitatively compare risks when differences between risks were small while graphs and icons would be better when differences between risks were larger. The following hypotheses were formulated. Based on the results of previous studies, it was assumed that numerical risk information would be evaluated as more complex, less helpful for decision-making, but as less threatening than graphical information, and in particular than risk information presented as icons. These effects may be moderated by factors such as desired decision involvement and level of education. Greater decision involvement might be related to smaller differences between formats in the evaluation of the risks. Participants with a higher level of education might have fewer problems in interpreting numerical risk information. With respect to the participants’ choice of treatment, it was expected that risks presented in a graphical format would lead to more risk-averse behavior (cf. Stone et al. [16]). In the present study it was expected that this would lead to more risk-averse behavior regarding the short-term risks, i.e. risks of surgery, as research results suggest that the attention of patients is more focused on the short term risk and they are more inclined to avoid this short term risk of surgery and thus to choose for the observation policy [24]. The visual salience of a graphical display would make especially...
the short-term risk of surgery more hazardous or threatening, and therefore fewer participants would choose this option.

2. Methods

Participants were confronted with two hypothetical cases of an asymptomatic abdominal aneurysm and asked to choose a treatment option. An abdominal aneurysm or dilation of the aorta is potentially life-threatening because of the risk of rupture, after which the patient will most likely bleed to death. For patients with an abdominal aneurysm there are basically two options available: surgery to replace the affected artery with a prosthesis, or watchful observation. Which option is preferable depends mainly on the mortality risks involved. Operative mortality is affected by the condition of the patient (e.g., cardiopulmonary risk, age, sex) and is on average 6% [25,26]. Mortality risk with the observation policy is mainly caused by rupture of the aneurysm, and is directly related to the size of the aneurysm. The generally accepted policy is that for large aneurysms prophylactic surgery is appropriate and for small aneurysms (up to a certain threshold) a more conservative approach is considered to be better.

A decision analytic model was developed in which the various risk aspects of this decision problem were incorporated [25,26]. The model is a Markov decision tree that simulates both the natural history of disease and the effects of watchful observation and surgery. The literature on the natural history and the treatment of abdominal aortic aneurysms was used to quantify the analysis. Data obtained from the literature were aggregated into several variables, such as patient characteristics (age, gender), aneurysm characteristics (measured diameter), and mortality rates of surgery and an observation policy. The model was used to calculate life expectancy of each option and the optimal strategy as calculated by maximized life expectancy was presented to participants. Patients’ preferences for outcomes were not included in the model, because our aim was to compare different formats of presenting risk information.

2.1. Participants

Participants in our study were 44 patients who already had undergone an operation for an abdominal aneurysm in the Leiden University Medical Center. These patients were asked to participate because they were familiar with the problem, but did not have to make an actual decision. We decided to ask these patients and not patients who had to make an actual decision for or against surgery because of ethical reasons. It was considered to be unacceptable to subject patients actually making a treatment decision to a psychological experiment in which different formats of information were provided, when it was expected that the decision would be influenced by the format of the information. The operations had taken place in a 4-year period (1992–1996). Although more patients had undergone an aneurysm operation during this period and were, in principle eligible for participation in our study, it was not possible to include more patients, because they either had died (as a result of the operation, from other illnesses or old age), or were mentally incompetent. Also, patients who initially received the observation policy could not be included, because most patients eventually were or could be operated later. A total of 39 men and 5 women participated; their average age was 72.

Their level of education was: primary school only or primary school and lower technical education (N = 22), professional or vocational training (N = 14), and college or university education (N = 8). All participants were invited to participate in the study in a letter signed by their surgeon. They were asked to come for an interview on their next visit to the hospital for a routine check-up. If this was not possible, they were interviewed at home (23 patients were interviewed at home). Four patients did not accept the invitation for an interview.

2.2. Independent variables

2.2.1. Risk information format

Three formats were used. In one format the mortality risks were presented numerically as percentages and frequencies. In order to prevent framing effects due to a positive (i.e. patients survived) or negative (i.e. patients died) presentation, information about the percentage of patients who survived was also given in addition to the percentage of patients who died. In another format, the risks were presented as stacked vertical bars. We used vertical bars because they have been shown to be superior to horizontal bars [14]. We used stacked bars instead of simple bars in order to avoid framing effects, because the proportion of patients who survived could also be clearly represented. The last format made use of icons, with white “human” figures representing patients who survived and black “human” figures representing patients who died. The icons were displayed in 10 rows of 10, and the icons representing the patients who died were randomly distributed in order to emphasize the randomness of patients who will die (i.e. it is unknown beforehand who will live and who will die). In order to communicate the exact size of the risks, and because graphical risk information is often used in practice in addition to numerical risk information, percentages were given in addition to the vertical bars and icons (see Appendix A for an example of the formats).

2.2.2. Type and size of risks

The treatment risks involved were the mortality risks of two options: surgery and an observation policy. The 1-year and 5-year mortality risks were presented for both surgery as well as the observation policy. The participants were presented with two hypothetical cases: the first case was a patient with low risks for both options, and the second case...
was a patient with high risks for both options. These hypothetical cases were constructed in such a way that there was no clear “best” option when considering the 1-year risks, i.e. the risk of surgery was about equal to the risk of the observation policy. The 5-year risks for surgery were lower than the 5-year risks for the observation policy for both options and thus resulted in an optimal option regarding life expectancy. Risks were calculated with the data-based decision analytic model [25]. The risks of mortality of surgery and the observation policy for 1 and 5 years of both hypothetical cases are presented in Table 1. Because the cases concerned elderly patients and the risk of dying from other causes is substantial, these risks were also presented. See Appendix B for a description of the case of the low-risk patient.

2.3. Design

The study was based on a between-subjects design. The three risk formats were varied between participants. The numerical format was presented to 14 participants, the stacked vertical bars were presented to 14 participants and, the icons were presented to 16 participants. All participants were confronted with both the low and high-risk patient case.

2.4. Procedure

The risks were presented on paper, supported by oral information. In a structured and standardized face-to-face interview the participants were asked several questions about their evaluation and comprehension of the risks and their preferred choice of treatment for the two hypothetical patients. The participants were first presented with information about the low-risk patient and the 1-year mortality risks of both treatment options in one of the three risk formats. After reading the risk information, the participants were asked to evaluate the information and to make a treatment decision (surgery or observation policy). After having answered these questions, the participants were presented with the 5-year risks of mortality for the same hypothetical patient, and were asked the same questions again. The participants were then presented with information about the second, high-risk hypothetical patient, and the same procedure was repeated.

2.5. Dependent variables

Effective risk communication was evaluated according to criteria related to the risk information and criteria related to the decision, including cognitive as well as attitudinal criteria. The participants were asked to evaluate the risk information with regard to the following dimensions: complexity of the information, helpfulness of the information for decision-making, and the threat conveyed by the information (i.e. the situation described) on a 7-point scale ranging from ‘1’ (not complex/not helpful/not threatening) to ‘7’ (very complex/very helpful/very threatening). To test their understanding of the risks, the participants were asked to compare the risk of surgery with the risk of the observation policy and to indicate whether the risk of surgery risk was greater than the risk of the observation policy (1: much greater to; 5: much smaller). This task tests whether participants understood the risks in the way needed to make a treatment decision, i.e. evaluation of the quantitative differences in magnitude between risks. Only clearly incorrect answers were scored as such, e.g. if surgery risk was smaller than the risk of the observation policy, then the answers equal, larger and much larger were incorrect.

The participants were asked which treatment they would prefer (surgery or an observation policy) and to indicate how confident they were about their decision on a scale ranging from ‘1’ (not confident at all) to ‘7’ (very confident). Because it was assumed that the treatment options would be evaluated differently when presented in different risk formats, participants were also asked to indicate which of the two treatment options was more terrifying given equal risks on a scale from ‘1’ (surgery much more terrifying than observation policy) to ‘5’ (observation policy much more terrifying than surgery). Finally, they were asked to indicate their preferred decision involvement on a 5-point scale (1: the doctor should decide; 2: the doctor should decide after discussion with the patient; 3: the doctor and the patient should make the decision together; 4: the patient should decide after discussion with the doctor; 5: the patient should decide).

3. Results

Two respondents were unable to complete the questions about both hypothetical cases, another four respondents about the second hypothetical case. A total of 38 respondents completed the interview. In order to determine whether the risk format affected their evaluations and decisions, an analysis of covariance with repeated measures was performed with risk format as a between-subjects variable, both types of risk (1-year and 5-year mortality risks) and size of risk (low-risk and high-risk patient) as within-subjects variables, and desired decision involvement and level of education as covariates. The results are reported for (a) the evaluation of the risk information and
Table 2. Perceived complexity, helpfulness and threat of the risk information, reported confidence in decision and perceived threat of treatment options for each risk format, type of risk and each patient case separately.

<table>
<thead>
<tr>
<th>Patient case</th>
<th>Risk format</th>
<th>1-year</th>
<th>5-year</th>
<th>1-year</th>
<th>5-year</th>
<th>1-year</th>
<th>5-year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Numbers</td>
<td>Bars</td>
<td>Icons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived complexity</td>
<td>Low-risk patient</td>
<td>1.8</td>
<td>1.9</td>
<td>2.2</td>
<td>2.2</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>High-risk patient</td>
<td>1.8</td>
<td>2.0</td>
<td>3.1</td>
<td>2.6</td>
<td>1.9</td>
<td>2.1</td>
</tr>
<tr>
<td>Perceived helpfulness</td>
<td>Low-risk patient</td>
<td>5.3</td>
<td>6.0</td>
<td>6.0</td>
<td>5.9</td>
<td>6.7</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>High-risk patient</td>
<td>4.5</td>
<td>4.7</td>
<td>6.2</td>
<td>6.2</td>
<td>6.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Perceived threat of information</td>
<td>Low-risk patient</td>
<td>3.8</td>
<td>4.1</td>
<td>4.7</td>
<td>5.3</td>
<td>3.8</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>High-risk patient</td>
<td>4.4</td>
<td>4.5</td>
<td>6.1</td>
<td>6.1</td>
<td>5.5</td>
<td>4.9</td>
</tr>
<tr>
<td>Reported confidence</td>
<td>Low-risk patient</td>
<td>6.4</td>
<td>6.9</td>
<td>6.5</td>
<td>6.7</td>
<td>6.0</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>High-risk patient</td>
<td>6.4</td>
<td>6.5</td>
<td>6.7</td>
<td>6.2</td>
<td>5.6</td>
<td>5.9</td>
</tr>
<tr>
<td>Perceived threat of treatment options</td>
<td>Low-risk patient</td>
<td>3.9</td>
<td>4.6</td>
<td>4.6</td>
<td>4.3</td>
<td>3.1</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>High-risk patient</td>
<td>3.1</td>
<td>3.5</td>
<td>3.4</td>
<td>2.8</td>
<td>2.6</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Responses were measured on a 7-point scale. Means with similar letters differ from each other at P ≤ 0.05.

(b) the respondents’ treatment choice and evaluation of the choice:

3.1. Evaluation of the risk information

3.1.1. Perceived complexity of the information

In general, the information was evaluated as not very complex (mean 2.1, S.D. 1.9). There was an almost significant effect for risk format (F(2, 34) = 2.8; P = 0.07). The risk information presented in bars was evaluated as more complex than the information presented in the other risk formats. Participants who indicated a desire to be more involved in the treatment decision evaluated the information as less complex than patients who had less desire to be involved (F(1, 34) = 16.0; P ≤ 0.001). No effects of educational level or other significant differences were found between the conditions.

3.1.2. Perceived helpfulness of the information in the decision-making process

In general, the information was evaluated as rather helpful for making a treatment decision (mean 5.9, S.D. 1.5) and more helpful for the low-risk than for the high-risk patient (F(1, 34) = 6.0; P ≤ 0.05). Icons were evaluated as more helpful than bars or numbers for decision-making concerning the low-risk patient (as shown by an almost significant two-way interaction effect of patient case and risk format F(2, 35) = 3.0; P = 0.06). Graphical information (bars and icons) was evaluated as more helpful than numerical information for decision-making, especially for the high-risk patient. Participants, who preferred to be more involved in decision-making, evaluated the information as more helpful for the decision-making process than participants who reported less desire for decision involvement (F(1, 34) = 5.2; P ≤ 0.05).

3.1.3. Perceived threat of information

The information was evaluated as rather threatening (mean 4.7, S.D. 1.5). Not surprisingly, the information about the high-risk patient was evaluated as more threatening than the risk information about the low-risk patient (F(1, 35) = 11.5; P ≤ 0.001). The risk information presented as bars was perceived as more threatening than the risk information presented in the other risk formats (F(2, 34) = 3.5; P ≤ 0.05). Participants who preferred to be more involved in the decision-making process perceived the information as less threatening (F(2, 34) = 3.4; P ≤ 0.05), especially the risk information concerning the high-risk patient (F(1, 34) = 7.1; P ≤ 0.01). Covariance analysis with educational level as covariate produced similar results, i.e. no significant effects for education.

3.2. Understanding of the information

Most participants were able to evaluate the differences between the risks in an adequate way. Although fewer correct answers were given when the risk information was presented as icons, the differences were not significant (see Table 3).

3.3. Treatment choice and evaluation of choice

3.3.1. Treatment choice

When presented with numerical 1-year risk information only, 100% of the participants chose surgery in the case of the low-risk patient. They did not change their opinion after receiving the 5-year risk information. When presented with the information in bars, 92% chose surgery at first, and 100% after receiving the 5-year risk information. When presented with the risk information in icons, 67% chose for surgery initially, and 87% after receiving the 5-year in-
The difference between the numerical format and the icons was significant for the 1-year risks ($\chi^2(2) = 7.2; P < 0.05$).

For the high-risk patient, the participants who were presented with the risk information in icons less often chose surgery (29 and 21% for 1-year and 5-year risk information, respectively) than participants who were presented with the information in numbers (46% for both 1-year and 5-year risk information) or bars (69 and 62% for 1-year and 5-year risk information, respectively). The percentages of participants choosing surgery differed significantly between the icons and the bars ($\chi^2(2) = 4.5; P \leq 0.05$ for both 1-year and 5-year risk information, see Table 3).

In the two hypothetical cases the 1-year risks of both surgery and the observation policy were approximately the same (not taking into account the small differences of 1 and 2% between the treatment options for the low-risk and the high-risk patient, respectively). Both treatment options may thus be considered to be approximately equal with respect to life expectancy for the 1-year risks. For both cases the 5-year risks of surgery, however, were much lower than the 5-year risks of the observation policy. When considering the option with the lowest risks as the optimal one (because resulting in the highest life expectancy), presenting the risks in icons led to the lowest percentage of optimal choices for the 5-year risks, while presenting the risks in bars led to the highest percentage of optimal choices.

### 3.3.2. Evaluation of choice

The participants were also asked how confident they were about their treatment decision. They were less confident about their decision after receiving risk information in icons compared to the other formats, especially the 1-year risks ($F(2, 34) = 4.6; P < 0.05$, see Table 2). Risk format also affected the perceived threat of both treatment options in relation to each other. Participants who were presented with the numerical risk format more often evaluated surgery as the least threatening treatment option than participants receiving the information in bars or icons ($F(2, 34) = 5.1; P < 0.05$, see Table 2).

When asked which of the two treatment options participants evaluated as most terrifying when risks would be equal, 45% ($N = 5$) of those participants who preferred that the patient (with the doctor) should decide, chose surgery while the other participants (who preferred that the patient should decide) chose the observation policy as most terrifying option ($\chi^2(2) = 15.5; P < 0.001$).

### 4. Conclusion and discussion

The objective of this study was to investigate the effects of various risk formats on the evaluation of the risk information and on the treatment decision made by the participants. The findings suggest that vertical bars as used in this study are a less suitable way to present risks, in the sense that risk information presented in this format was evaluated as more complex and more threatening than risk information presented in other formats. The presentation of risks as icons also seems to have some drawbacks, because information presented in this way resulted in a significantly lower percentage of participants choosing for the optimal option in terms of life expectancy (i.e., surgery) compared to participants who were presented with risk information in other formats. Analysis showed a relationship with a higher perceived threat of the surgery option and a lower percentage of patients choosing for surgery. Risks presented as icons, however, were evaluated as more helpful for decision-making as risks presented in other formats.

#### 4.1. Discussion

The finding that bars were evaluated as more complex is not in line with the literature, which assumes that graphical displays are the most accessible way to communicate risks. However, we used only one example of presenting information in bars (i.e., stacked bars), which might be more difficult for some people than simple bars, although simple bars as well as stacked bars are frequently used in the Dutch newspapers. Thus, we may assume that people are equally
familiar or unfamiliar with both formats. The finding that risk information presented as numbers was perceived to be less threatening is in line with the finding of Stone et al. [16]. The visual salience of risks might be higher when presented in a graphical format than when presented as numbers, and might therefore have more impact on patients’ risk perception and decision making and be more threatening.

A presentation of risk information that is less threatening, could be considered to be better, because one could argue that this helps patients to pay better attention to the decision itself and the actual differences between risks without being distracted by the manner in which risk information is presented. In contrast to Stone et al. [16], we found differences between the evaluation of the information presented in bars and the information presented in icons. One reason for this could be that the participants in our study (elderly patients with a variety of educational backgrounds) were less familiar with bars as a representation of risks than with icons or numbers than the student population of Stone et al.

It has been suggested [14] that graphical information leads to a higher accuracy in determining the relative quantitative differences between risks and that numbers are more accurate for determining the exact difference. The fact that we did not find significant differences between formats does not necessarily mean that risk format does not affect the understanding of a risk. The task in this study was rather simple, but adequate to test whether participants perceived the differences between the risks.

When the risks of surgery were presented as icons, a lower percentage of patients chose surgery. This option was also evaluated as more threatening than when the risks were presented in a numerical format. This finding suggests that the lower percentage of patients choosing surgery in the high-risk case is related to the greater perceived threat of surgery. Participants seemed to avoid the short-term risk of surgery. Earlier research [24] suggests that the attention of patients when having to decide between treatment options are more focused on the short-term risk and patients are more inclined to avoid this short-term risk of surgery than to avoid an (even higher) long term risk of another treatment. Especially for the 5-year risks, fewer patients chose surgery (i.e. the optimal option) suggesting that icons induced patients to make less optimal decisions. It needs to be noted that in our study we defined an optimal decision as a decision that resulted in the highest life expectancy according to a databased decision analytic model. However, patients may have different criteria for defining an optimal decision, i.e. preferences for an option, but these were not taken into account in this study. Furthermore, we used randomly distributed icons and not grouped icons, which might have a different impact on participants’ evaluation of risks and decision-making.

There was a strong interaction between desired decision involvement and the evaluation of risks, suggesting that patients who have a greater desire for decision involvement have a more positive attitude towards information, and might prefer to receive a different type of information than patients with less desire for decision involvement (in fact, 60% of the participants who prefer to make the treatment decision themselves (or with a doctor) reported that they would like to have received more information about their own operation, while only 20% of participants with less desire to be involved in the decision said so). We did not find a relationship between desired decision involvement and educational level, nor was there any effect of educational level on dependent variables. This might have been due to the small number of participants, whereas other studies found a relationship [22]. The sample in this experiment can be considered to be representative for a large group of surgery patients. Patients who undergo an operation for a serious condition, such as vascular diseases or cancer, are likely to be elderly and have a variety of educational backgrounds, which makes it even more difficult to find a good format for risk communication.

4.2. Practice implications

Different formats affect participants’ evaluation of the information and their treatment decisions in different ways. When a choice seems to be affected by the format in which risks are presented, this means that one should be careful in choosing a risk format. The numerical risk format, which is often evaluated as less suitable for communicating risks, turned out to be adequate and regarding some effect measures better than the other two formats for communicating surgical risks in this elderly study population. Vertical bars as used in this study are a less suitable way to present risks. The presentation of icons were evaluated as very helpful, but grouped icons might be better than randomly allocated icons because this makes it easier to compare risks. Patients with a higher desire to be involved in decision-making preferred more and more complex information than patients who wanted to be less involved in decision-making suggesting that the choice of a risk format might be more important for patients with less desire for decision involvement.

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Appendix A. Example of the risk formats: the 1-year mortality risks of the low-risk patient as presented, respectively, in the numerical format, as stacked vertical bars and as icons.
Appendix B. Hypothetical patient case

B.1. Low-risk patient

Mr. Blake is a pale looking man of 68 years old. He has a vascular disease. When his heart was examined because he suffered from chest pain, a dilated artery (aneurysm) was found with a diameter of 6.5 cm (about twice as large as normal). There are two possible treatment options:

1. Operation: The weak spot on the artery is replaced by a prothesis. There is a risk that the patient dies during the operation or by the effects of the operation.

2. Observation policy: Once a year the patient will be examined by the surgeon. The patient will not be operated upon, unless the aneurysm has grown as shown during yearly examination. In that case an operation is considered. If the patient will not be operated there is a risk that the patient dies because of ruptering of the artery. If the patient is operated upon, this has the usual risks.

In order to be able to make the right decision, the patient should consider several mortality risks. Could you imagine yourself in Mr. Blake’s position when considering the following risks:

References


