Most family physicians report communicating the risks of adverse drug reactions in words (vs. numbers)

Marie Juanchich[1] and Miroslav Sirota[1]

[1] University of Essex, Department of Psychology

Word count (including introduction and discussion only): 2450

*Corresponding author at: Marie Juanchich. Address: Department of Psychology, University of Essex, Wivenhoe Park, CO4 3SQ, Colchester, UK. Email: m.juanchich@essex.ac.uk or marie.juanchich@gmail.com

The authors do not have any conflict of interests regarding the publication of the present manuscript.

Abstract

Family physicians can communicate the risk of adverse drug reactions to patients using words or numbers, and this format selection has important implications for patients' risk perception and their ability to make informed decisions. The present study (i) assessed which formats family physicians preferred to communicate the risk of a given side effect, (ii) tested whether the severity of this adverse drug reaction affected this preference and (iii) investigated the types of verbal or numerical quantifier family physicians preferred to use in general (e.g., ratios, percentages). In a sample of 131 family physicians, most reported that they use words to communicate the risk of mild and severe adverse drug reactions to patients in a format selection task, but the verbal preference was weaker for severe adverse drug reactions. A quantifier selection task showed consistently, that the most common quantifiers family physicians reported to use were verbal frequencies and verbal probabilities. Family physicians and patients should be aware of the implications of this verbal preference.

Keywords: risk communication; adverse drug reaction; side effect; severity; risk quantifier format; family medicine

Most family physicians report communicating the risks of adverse drug reactions in words, but less so for severe ones.

Introduction

The principle of autonomy in medical ethics places patients at the centre of their decisions. Therefore, family physicians are expected to explain the risks and benefits associated with treatments to help patients reach informed decisions (General Medical Council, 2008; Hugman, 2006; NICE, 2009). Adverse effects are a key risk associated with taking a drug (World Health Organization, 1972) and are one of the reasons why patients refuse treatment or do not adhere to it (Frenkel, 2013; Verdú & Castelló, 2004; Waters, Weinstein, Colditz, & Emmons, 2009), which has negative health and economic consequences (Brown & Bussell, 2011). The perceived risk of suffering from drug adverse effects is also positively related to their actual occurrence - a phenomenon called the nocebo (Barsky, Saintfort, Rogers, & Borus, 2002; Colloca & Finniss, 2012). Despite the importance of the risks of adverse drug reactions on health decisions and even health itself, the way in which family physicians communicate that risk is not regulated, nor is it well understood. Family physicians can communicate the risk of adverse drug reactions to patients using words or numbers (e.g., a small chance vs. a 20% chance), and while we know the advantages and drawbacks of those formats, we are currently unaware of which format is most often used. To bridge this gap, we investigated the format that family physicians report using to communicate the risk that patients would experience a drug's adverse effect.

The characteristics of verbal and numerical risk communication formats

Verbal quantifiers are believed to be more natural and easier to process than numerical ones (Zimmer, 1983) and have been found to be more effective in guiding

recipients towards a specific decision (Hilton, 2008; Moxey, 2006; Teigen & Brun, 1999). Furthermore, because their meaning is flexible (Budescu & Wallsten, 1995), verbal quantifiers can be used effectively to downplay an undesirable fact, while not appearing to be untruthful (Bonnefon & Villejoubert, 2006; Bonnefon, Feeney, & De Neys, 2011; Juanchich & Sirota, 2013; Juanchich, Sirota, & Butler, 2012; Olson & Budescu, 1997; Sirota & Juanchich, 2015).

However, there are three reasons why using verbal quantifiers may not be judicious. First, the flexibility of meaning of verbal quantifiers can be seen as a weakness because patients often do not understand those quantifiers as expected by practitioners (Brun & Teigen, 1988). Verbal quantifiers used to describe drug adverse effects in leaflets in Europe (see Table 1, European Commission (1998)), consistently lead to an overestimation of the risks (Berry, Raynor, & Knapp, 2003; Knapp, Gardner, Carrigan, Raynor, & Woolf, 2009; Knapp, Gardner, Raynor, Woolf, & McMillan, 2010a; Knapp, Gardner, & Woolf, 2016; Peters, Hart, Tusler, & Fraenkel, 2014; Webster, Weinman, & Rubin, 2017; Young & Oppenheimer, 2006). For example, the verbal frequency “common” is used to mean a 1-10% probability, but it is psychologically perceived by patients as meaning a 45% probability (Berry, Holden, & Bersellini, 2004). Patients feel that an adverse effect that is “common” is actually “very likely” (Webster et al., 2017) and this over-estimation made people less willing to take a recommended treatment (Peters et al., 2014). The vagueness of verbal quantifiers also makes them vulnerable to contextual biases (e.g., severity: Harris & Corner, 2011; base rate: Villejoubert, Almond, & Alison, 2008; Wallsten, Fillenbaum, & Cox, 1986; and on both severity and base rate: Weber & Hilton, 1990). Finally, people perceive physicians quantifying risk in words as less trustworthy than those using both words and numbers and this was particularly the case for less numerate individuals (Gurmankin, Baron, & Armstrong, 2004b).

Table 1.

Verbal frequency guidelines of the European Commission to communicate adverse drug reaction risk along with their numerical expected meaning (1998).

Verbal descriptor	**Assigned frequency**
Very common	> 10%
Common	1-10%
Uncommon	0.1-1%
Rare	0.01-0.1%
Very rare	< 0.01%

Verbal vs. numerical format preference

Prior research has shown that "lay" people prefer to communicate their uncertainty verbally rather than numerically (Du et al., 2013; Erev & Cohen, 1990; Juanchich & Sirota, 2019; Xu, Ye, & Li, 2009) although the opposite pattern has sometimes been documented too (Du et al., 2013; Olson & Budescu, 1997). Little data exists from health professionals, but it consistently indicates a preference for verbal risk quantification. Of 66 Norwegian physicians, 50 believed that physicians should convey the chances of treatment effectiveness in words and only 6 believed numbers should be used (Brun & Teigen, 1988). In another study investigating the content of 70 recorded cardiovascular visits, the data showed that a numerical estimate was provided in only 11% of the visits (Neuner-Jehle, Senn, Wegwarth, Rosemann, & Steurer, 2011). Evidence therefore suggests that family physicians will prefer the verbal format to talk about adverse effects, but so far there are no data directly supporting this. In fact, there are reasons why family physicians should prefer to communicate using numbers.

Based on the cooperative principle from the maxims of conversation (Grice, 1975) we could expect that physicians would use the most precise information available. Given that most drug leaflets feature the numerical probabilities of different adverse drug reactions (Study 3, Sirota et al., 2018b), we could expect that family physicians would use them. While in general people prefer to communicate risk with words, they also report that they would actually use a numerical estimate if such a precise estimate is available or can be easily computed (Juanchich & Sirota, 2019; Olson & Budescu, 1997; Wallsten, Budescu, Zwick, & Kemp, 1993). For example, most people produced a numerical prediction to describe events for which a precise probability could be computed (e.g., the probability of selecting a red card from a deck of card), whereas people favoured words for events where uncertainty stemmed from a lack of knowledge (e.g., whether Reynes is a village in France; Juanchich & Sirota, 2019).

The importance of the communication of adverse drug reactions could reinforce the need to follow the maxims of conversation and to provide the most accurate information available (i.e., numerical estimates). Past work on format preference has shown that numbers are used more often when describing important events but not so much when describing events of less importance (Wallsten et al., 1993). For example, people who reported that they usually preferred to use verbal probabilities said that they would switch their preference to numerical estimates if the issue at hand was important, and people who reported that they preferred numbers said that they would switch their preference to words if the issue at hand was unimportant (Wallsten et al., 1993). Given that physicians do believe that communicating risk is important for patients (Brun & Teigen, 1988), we could expect that they would resort more often to numerical quantifiers.

However, the work of family physicians is not set in a social vacuum and the (perceived) needs of patients can affect how family physicians interact with them. According to the Politeness theory, given that talking about adverse drug reactions might upset patients, physicians may also be tempted to trade precision for vagueness to space the patients' feeling (Brown & Levinson, 1987). Due to their vague meaning, verbal probabilities are convenient devices to hedge negative information while being truthful (Bonnefon & Villejoubert, 2006; Juanchich & Sirota, 2013; Sirota & Juanchich, 2015). For example, some participants believed that the verbal risk quantifier "possible" served a face-management purpose rather than a likelihood-communication device when it described a severe prognosis (Bonnefon & Villejoubert, 2006). In line with this argument, when physicians use only words (vs. numbers), patients tend to perceive this as a means of minimising the risk so that they will not worry (Gurmankin, Baron, & Armstrong, 2004a).

In sum, drawing from the maxim of conversation and the Politeness theory, we can draw opposite predictions. In accordance with the maxim of conversation (Grice, 1975), we can expect physicians to provide the most precise and relevant information available to patients – the numerical quantification of the risk – whereas, in accordance with the Politeness theory, we can expect that they might resort to using a vaguer format to hedge the risks. The general preference for numerical or verbal quantifiers may therefore be taken as an indicator of the goal that physicians pursue: a preference for numbers indicates that physicians aim to be informative, whereas a preference for words indicates that physicians aim to hedge information.

Investigating the effect of the adverse drug reaction severity on format preference

To further test the two accounts, we propose to manipulate a situational factor expected to have an opposite effect on format preference. We propose to manipulate the

importance of the communication by means of the severity of the adverse drug reaction and assess whether it increases or decreases the reliance on the verbal format. According to the maxim of conversation, an increased importance will magnify the need to be informative (and to provide numerical estimates) whereas according to the Politeness theory it will increase the need to soften bad news (and to provide verbal quantifiers).

Which Quantifiers Do Family Physicians Prefer?

The format (verbal vs. numerical) is a generic attribute of risk quantification; it is a category that actually captures many different types of quantifiers. The verbal format includes, for example, existential quantifiers (e.g., a few), verbal frequencies (e.g., rare), verbal probabilities (e.g., a small chance) and modals (e.g., can, may). The numerical format, on the other hand, includes numerical percentages (e.g., a 10% chance), ratios (e.g., a 1 in 10 chance) or frequencies (10% of the patients, 1 patient out of 10).

Assessing the quantifiers used by family physicians is important for two reasons. First, within a same format, quantifier types have implications for the recipients' probability perceptions (Koehler, 2001; Monahan et al., 2002; Slovic, Monahan, & MacGregor, 2000). For example, the frequent use of verbal frequencies could be problematic as this particular quantifier is perceived as conveying risks that are largely superior to what they should convey according to the EU commission guidelines (Berry, Knapp, & Raynor, 2002; Berry et al., 2003; Knapp et al., 2009; Knapp, Gardner, Raynor, Woolf, & McMillan, 2010b; Knapp, Raynor, & C, 2004; Webster et al., 2017). Numerical formats are not immune to discrepancies either. For example, numerical frequencies (e.g., one patient out of 10) trigger higher risk perceptions than equivalent numerical percentages (Slovic et al., 2000). Second, different quantifiers may elicit different biases. For example, the use of ratios (e.g., a 1 in 10 chance) is associated with specific biases that do not affect quantifiers with normalised

denominators (10%). For example, a 1 in 2 ratio is perceived as meaning a higher probability than a 10 in 20 ratio (Pighin, Savadori, Barilli, & Bonnefon, 2011; Sirota, Juanchich, & Bonnefon, 2018a; Sirota, Juanchich, Kostopoulou, & Hanak, 2014). The extent to which family physicians use a specific quantifier therefore indicates the sorts of biases that may exist in patients' responses to adverse drug reaction information.

The Present Study

The present study had three goals. First, we aimed to identify which format physicians prefer to use: verbal or numerical? Second, we wanted to gain a better understanding of the dynamics behind format preference. We tested whether severity had an effect on this format preference to assess whether family physicians favour conversational maxims (increased numerical preference) or politeness considerations (increased verbal preference). The final goal was to identify which types of quantifier family physicians prefer to use for communicating adverse side effects in general.

Method

Participants

A total of 131 family physicians practising in the UK took part in the study. They were contacted by a panel company to take part in this research that sent 490 invitation emails (participation agreement: 27%). Of this figure, 39% were women, 24% practised in a rural location and 76% practised in an urban area. Their experience in family practice ranged from 1 to 35 years (*Mdn* = 12, *IQR* = 14 years of experience). The sample size could be used to detect a small-to-medium effect size difference of $w = 0.24$, assuming goodness-of-fit test and $\alpha = 0.05$, $\beta = 0.80$ and $df = 1$.

Design

In a between-subjects design, participants were randomly allocated to the minor adverse drug reactions (n = 64) or the severe adverse drug reactions condition (n = 67). For each level of severity, two adverse drug reaction examples were provided: dry mouth and irregular periods in the minor adverse drug reaction condition and heart failure and stroke in the severe adverse drug reaction condition.

Materials and Procedure

After consenting to take part in the study, participants completed a series of tasks, not reported here: in the first task, they diagnosed and managed patient cases described in a vignette (Sirota, Round, Samaranayaka, & Kostopoulou, 2017), in the second task, they communicated to an hypothetical patient the chance of having a medical condition by selecting a numerical quantifier from a list of numerical options (Sirota et al., 2018b) and in the third task they communicated to a different hypothetical patient the chance that his treatment would be effective by choosing a verbal quantifier from a list of verbal options. The study was approved by the Ethics Committee of the University of Essex. The authors have no conflict of interest.

Format selection task for a minor or severe adverse drug reaction. We assessed the way participants prefer to communicate the risk of adverse effects via two tasks: a format selection task and a quantifier selection task. We examined the role of severity in the format selection task only. In this task, participants decided whether they usually preferred to describe to their patients the possible occurrence of a minor (or severe) side effect caused by a treatment, in words or in numbers. Participants read two examples of adverse effects corresponding to the severity condition: dry mouth and irregular periods for minor adverse

drug reactions and heart failure and stroke for severe ones. Participants answered by selecting one of two options associated with a sentence example, as shown below:

- Words only (e.g., this side effect is rare).
- Words and numbers (e.g., this side effect affects around 1 in 1,000 people).

Quantifier selection task. In the quantifier selection task, participants selected the type of risk quantifier they usually used to communicate the side effects of drugs in general. The quantifier preference task did not focus on a particular type of adverse drug reaction, but the example provided with each quantifier focused on a minor adverse drug reaction: experiencing dry mouth. We chose to pair our options with a sentence example describing a low probability of a minor adverse drug reaction because these are more common. Participants selected a single option among the following eight quantifiers and their respective examples (a random order was used for each participant):

- An existential quantifier (e.g., a few patients experience dry mouth)
- A verbal probability (e.g., there is a small chance that patients experience dry mouth)
- A modal (e.g., patients can experience dry mouth)
- A verbal frequency (e.g., it is rare that patients experience dry mouth)
- A numerical frequency (e.g., 1 patient in 10 experiences dry mouth)
- A ratio probability (e.g., patients have a 1 in 10 chance of experiencing dry mouth)
- A percentage probability (e.g., 10% of the patients experience dry mouth)
- Other, please specify …

The list of options included four verbal quantifiers and three numerical ones complemented by an “other” option for which participants could specify the quantifier of

their choice. Only two participants chose the "other" quantifier option: one provided a modal answer, which was coded as "modal", and the other responded with "it depends to whom I talk", which was counted as an invalid answer. The materials and data are available on the Open Science Framework:

https://osf.io/m5qk9/?view_only=3224b70df95140999aecf07e24d4574d

Results

Format Preference

As shown in the left panel of Figure 1, almost 70% of the family physicians reported that they usually communicate the risk of adverse drug reactions in words. A binomial test showed that the preference for the verbal format was significantly over 50%, $p < .001$.

Effect of Severity on Format Preference

As shown in Figure 1, the severity of the adverse drug reactions had an impact on format preference: the more severe adverse drug reactions increased the rate of selection of numerical risk quantifiers by 19 percentage points, $\chi^2(1) = 5.00$, $p = .025$ (2-sided), $\varphi = -.20$. In fact, in the severe adverse drug reaction condition, the verbal format was no longer "preferred" in the sense that it was not chosen by a proportion of participants above 50% according to a binomial test, $p = .222$. In contrast, a larger majority selected the verbal format in the minor adverse drug reaction condition with almost 8 family physician in 10 selecting it, $p < .001$. In an exploratory analysis we tested whether experience, gender and practice location (rural vs. city) of family physicians predicted the format preference in a multiple logistic regression model. We found that, individually, those factors did not predict the format preference, B = -0.04, $p = .067$, B = -0.08, $p = .845$ and B = 0.049, $p = .101$, although the overall model featuring all three predictors accounted for a statistically significant amount of variance, $\chi2(1) = 4.46$, $p = .035$, *Cox and Snell R* = 0.05.

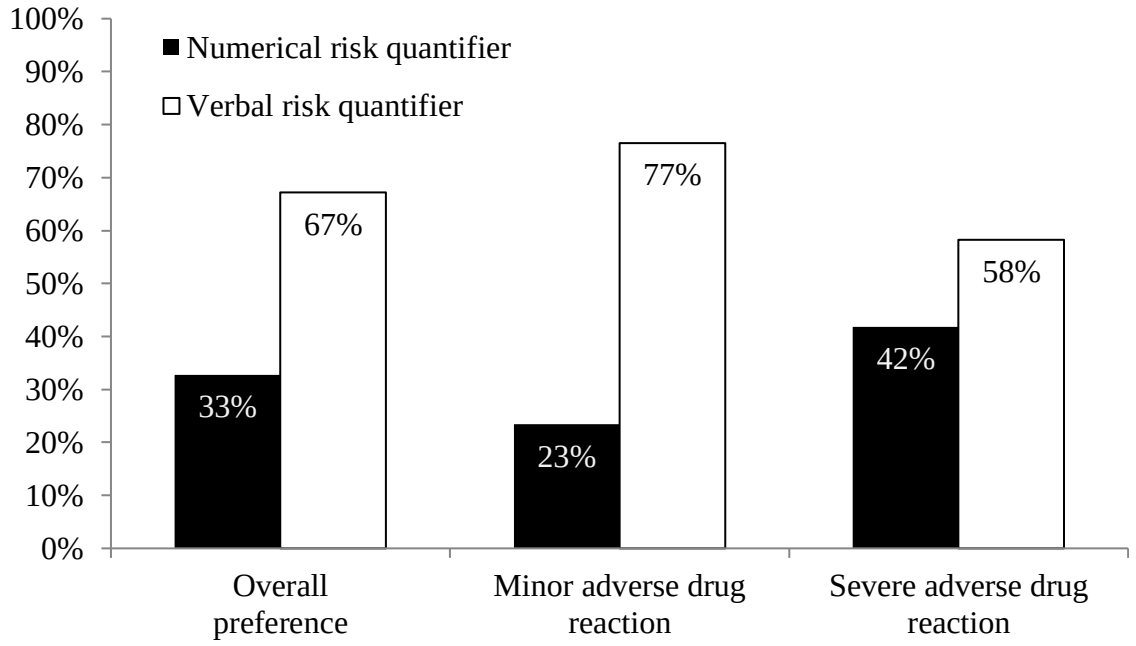

Figure 1. Format preference for communicating a minor or severe adverse drug reaction to patients (e.g., dry mouth vs. heart attack; $N = 131$).

Quantifier preference. Family physicians selected the quantifier they usually used to describe adverse drug reactions. The severity of the adverse drug reaction was not specified in the question but each response option available came with an example of communication regarding a minor adverse drug reaction: experiencing dry mouth. As shown in Table 2, all of the seven quantifiers were selected more than once, with the three most common being verbal: verbal quantifiers, verbal probabilities and modals. When summed together, the rate of verbal quantifier added up to 82%, which was close to the rate of selection of the verbal option in the format selection task for the minor adverse drug reaction.

Table 2.

Quantifiers used by family physicians to communicate adverse drug reactions in general.

Quantifier type	% selection
Verbal expressions	29%
Verbal quantifier (e.g., a few patients experience dry mouth)	
Verbal probability (e.g., there is a small chance that patients experience dry mouth)	25%
Modal (e.g., patients can experience dry mouth)	18%
Verbal frequency (e.g., it is rare that patients experience dry mouth)	10%
Total verbal	**82%**
	10%
Numerical expressions	
Numerical frequency (e.g., 1 patient in 10 experiences dry mouth)	
Ratio probability (e.g., patients have a 1 in 10 chance of experiencing dry mouth)	6%
Percentage (e.g., 10% of the patients experience dry mouth)	2%
Total numerical	**18%**

Discussion

Our research has shown that family physicians – the most trusted source of information for medical advice (Oberg & Frank, 2009) – reported that they usually describe the risks of adverse drug reactions verbally (vs. numerically) and that the severity of this adverse reaction reduced (but did not eliminate) the preference for words.

General format preference

In the communication trade-off between being precise (and blunt and accountable) or vague (and tactful and less accountable), the second option was more attractive for the majority of the physicians to communicate the risk of adverse drug reactions to patients. The family physicians' preference for words is consistent with most of the literature on format preference (Du et al., 2013; Gonzalez-Vallejo, Erev, & Wallsten, 1994; Olson & Budescu, 1997; Wallsten et al., 1993) but is at odd with findings showing that events that have a precise probability (as that provided in drug leaflets) are more often communicated in numbers (Juanchich & Sirota, 2019). Because of the vagueness and proneness of verbal quantifiers to

interpretation biases, their frequent usage may pose a threat to the ability of patients to provide informed consent. The issue is especially important for severe adverse effects.

Role of adverse effect severity in format preference

Family physicians chose less verbal quantifiers to communicate the risk of severe adverse drug reactions than to communicate the risk of minor adverse drug reactions. In theory, "a small probability" is "a small probability", whether it qualifies the chance of winning a million dollars or the probability of having cancer (Samuelson, 1952). We know, however, that this is not the case as, for example, the severity of an adverse drug reaction has been shown to be negatively associated with likelihood (when the base rate is not controlled for; Fischer & Jungerman, 1996) or with a higher likelihood when the base rate was also manipulated (Weber & Hilton, 1990; see also Harris, Corner, & Hahn, 2009, for similar findings in a non-medical context) . Here we demonstrate yet another phenomenon that connects the value of an outcome and its probability in risk communication: the value of an outcome shapes the format one chooses to communicate it. We knew that people leverage the vagueness of words to downplay the probability of the occurrence of severe outcomes (Bonnefon & Villejoubert, 2006; Juanchich et al., 2012), but our current findings show that speakers may also be less likely to use words when the information is severe, hence reducing the practical challenges associated with verbal risk communication. Furthermore, the effect of the value of an outcome on the format preference points out the possibility that the benefits of medications could be communicated in different ways compared to their possible negative consequences.

There is surprisingly little research on how to present the probabilities of positive medical events, such as the probability of a treatment being effective (Berry, 2006). Most research regarding how to best communicate medical probabilities focuses on some forms of

negative events (e.g., the probability of having cancer, the probability of a treatment not working or having adverse side effects; e.g., Bonnefon & Villejoubert, 2006; Knapp et al., 2004; Weber & Hilton, 1990). While the European Commission requires the risk of adverse drug reactions to be listed in drug leaflets, there is no requirement to provide such information regarding the benefits. Benefits are therefore often absent from drug leaflets (Chrisler, 2008). Further research on uncertainty regarding benefits in addition to harm is urgently needed (Politi, Han, & Col, 2007) as both harm and benefits are believed to be essential in the decision process that patients make (Chrisler, 2008; Mahalik et al., 2005).

Theoretical implications

The overall verbal preference to communicate mild and more severe drugs adverse side effects is seen as an indication that family physicians tend to prefer to couch the negative information in vague words in line with our expectations derived from the Politeness theory. We assumed that the usage of words is assumed to enhance the social interaction between the family physician and their patient. This could happen through different possible pathways. For examples, words allow providing an optimistic estimate to patients without being deceitful (e.g., saying “likely” instead of “possible” for a 50% probability). Patients do indeed believe that doctors provide optimistic risks estimates and adjust their perceptions accordingly (Bonnefon & Villejoubert, 2006; Gurmankin et al., 2004a; Juanchich et al., 2012). Physicians using words may be perceived as less trustworthy than those using numbers (Gurmankin et al., 2004a), but in the long run, those using words may be perceived as more trustworthy, because words are harder to prove wrong.

However, our findings that the severity of the adverse drug reactions increased the use of the numerical format, indicate that when the information becomes more critical, physicians may trade the social utility of words for the informative precision of numbers, in line with the conversational Gricean maxims of quantity and quality (provide the most instructive and

truthful information). This echoes findings showing that people who report describing their uncertainty in words could switch to numbers based on the importance of the message (Erev & Cohen, 1990).

Quantifier type preference

We also investigated the nature of the verbal or numerical quantifiers that physicians reported to prefer. This analysis showed that around 1 in 4 reported preferring existential verbal quantifiers (e.g., a few, some) or verbal probabilities (e.g., there is a small chance), 1 in 5 preferred modals (e.g., can, may) and 1 in 10 some verbal frequencies (e.g., it is rare). The reliance on those verbal quantifiers could be problematic because of their vagueness and the absence of word-number guidelines, which means that different practitioners could use them as meaning different probabilities and different patients will perceive them as meaning different probabilities too. Past research has shown that physicians tend to under-estimate the level of vagueness of verbal probabilities (Brun & Teigen, 1988). In addition to the issue of vagueness, some verbal probabilities and modals are used to indicate the position of a continuous outcome within a range of possible values in ways that are not obvious to recipients (Juanchich, Teigen, & Gourdon, 2013; Teigen, Juanchich, & Filkuková, 2014; Teigen, Juanchich, & Riege, 2013). For example, “possible” is often used to characterised to worst case scenario when describing quantities (e.g., It is possible that the drug will take 10 days to be effective). The issue with this extremity preference is that extreme outcomes are rare but are not perceived as such by recipients (Exp 4, Teigen et al., 2014); in contrast “possible” events are perceived as having a 50% chance of occurring (Juanchich & Sirota, 2017).

Although verbal frequencies are the types of quantifiers currently recommended by the European Commission to quantify the risk of adverse drug reactions in drug leaflets (together with numerical percentages), they were only selected by a minority of physicians.

The fact that only one physician in ten used verbal frequencies may nevertheless be too many, given that patient do not interpret them as expected by information providers (e.g., "common" is intended to mean a 1-10% probability but is perceived as meaning a 45% probability) (Berry et al., 2002). It is possible that family physicians do not follow the European commission guidelines regarding how verbal frequencies should be used (using 'common' for a 5% frequent adverse drug reaction) and use them instead in a more intuitive way that would be more in line with patients' interpretations (e.g., "common as meaning 40-50%). This would have the advantage of reducing miscommunication between physicians and patients but would have the drawback of not being standardised across practitioners.

The most common numerical quantifier was a frequentist ratio format (e.g., 1 in 12 patients). Although they are precise, numerical ratios can lead to biased perceptions as well. For example, numerical frequencies lead to risk perception overestimation compared to percentages (Monahan et al., 2002). Also, ratios that have 1 as a numerator (e.g., 1 in 10) lead to higher risk perceptions than mathematically equivalent ratios starting with any other number (e.g., 2 in 20; Pighin et al., 2011; Sirota et al., 2018a; Sirota et al., 2014) and this "1-in-X" effect translates into ill-informed health decisions (Sirota & Juanchich, 2019).

Alternative interpretation of the results

We found that the severity of the adverse drug reaction increased the reliance on numerical format, but the effect may be explained by other factors than severity per se: factors that are associated with the severity of adverse side effects. The severity of an event is often negatively correlated with its frequency (e.g., Weber & Hilton, 1990), meaning that severe events are also unlikely events, thereby creating a confound between probability magnitude and severity. Thanks to drug development regulations and pharmaceutical quality control procedures, minor drug adverse side effects are more common than severe ones.

Hence, participants may have felt that the severe adverse drug reaction was less likely than the mild one, and the preference for numerical risk quantification may have been driven by the lower subjective probability of the adverse effect rather than by its severity. To our knowledge, there is no evidence that the format could change as a function of the probability conveyed, but this was not formally tested. Family physicians might prefer not to turn to verbal quantities for very low probabilities because the drug leaflet lexicon for describing those may seem inappropriate (e.g., common is perceived as meaning a 42-48% risk instead of a 1-10% risk; Berry et al., 2004). Further research should aim to disentangle the role of severity and probability perception on format preference.

A final cautionary note is that in our work, we have assumed that the numerical frequencies provided in drug leaflets are precise and accurate. However, this may not be the case. One could also posit that precise estimates are not warranted in medicine, because information about harms and benefits is surrounded by uncertainty (Peters, Hibbard, Slovic, & Dieckmann, 2007). According to this view, providing numerical risk quantifiers could actually be misleading because they provide an illusion of precision (Wallsten et al., 1993). The source of the risk information provided in drug leaflets is not transparent either, it does not always come from randomised control trials, and can also, for example, come from reports from practitioners or patients (Edwards & Aronson, 2000). Hence, risks presented in drug leaflets may not be perceived as precise, nor 100% reliable and may not necessarily match the probability that a particular patient would suffer from this side effect. Possibly, physicians prefer to use words because they assume one cannot know precisely the probability that a patient will experience a given adverse side effect. This would explain the verbal preference consistently with the congruency principle that posits that people try to choose the format that allows the most precise information warranted by available evidence (Budescu & Wallsten, 1995). Further research on how family physicians expect frequencies

to translate into actual probabilities for individual patients should shed more light on the processes underpinning the preference for the verbal format in the presence of precise information.

Limitations

The main limitation of our study is that our findings are based on self-reported preferences and may not reflect the way family physicians talk in practice. Our findings correspond to previous observations in medical practice (Clark, 1990)(Neuner-Jehle et al., 2011) but more analyses focusing on real conversations with patients would bring evidence with more ecological validity. It is also important to note that our quantifier selection task did not allow participants to select two quantifiers. Physicians could only select the quantifier that they use most often but, in practice, they may actually use more than one quantifier at a time. For example, based on our data we cannot exclude the possibility that family physician would use a combination of verbal and numerical quantifiers, along the line of what is recommended by the public health department of the European Commission. This point being noted, participants also had the possibility to provide their own personal answer if the ones prelisted for them were not satisfactory.

Conclusion

Preferring to use words rather than numbers may be a "risky" strategy given that verbal formats appear to have drawbacks in the medical context. Although recipients tend to like this format in medical risk communication (Waters, Weinstein, Colditz, & Emmons, 2006), the verbal risk information fosters less trust than numerical information, especially in less numerate individuals (Gurmankin et al., 2004b) and the verbal vagueness is underestimated by both family physicians and patients (Brun & Teigen, 1988). Hence the

preference for the verbal format of risk communication may be considered as a threat to the provision of informed consent.

References

Barsky, A. J., Saintfort, R., Rogers, M. P., & Borus, J. F. J. J. (2002). Nonspecific medication side effects and the nocebo phenomenon. *287*, 622-627.

Berry, D. C., Holden, W., & Bersellini, E. (2004). Interpretation of recommended risk terms: Differences between doctors and lay people. *International Journal of Pharmacy Practice, 12*, 117-124. doi: 10.1211/0022357044120

Berry, D. C., Knapp, P. R., & Raynor, T. (2002). Is 15 per cent very common? Informing people about the risks of medication side effects. *International Journal of Pharmacy Practice, 10*, 145–151. doi: 10.1111/j.2042-7174.2002.tb00602.x

Berry, D. C., Raynor, D. K., & Knapp, P. (2003). Communicating risk of medication side effects: An empirical evaluation of eu recommended terminology. *Psychology, Health and Medicine, 8*, 251-263. doi: http://dx.doi.org/10.1080/1354850031000135704

Bonnefon, J.-F., & Villejoubert, G. (2006). Tactful, or doubtful? Expectations of politeness explain the severity bias in the interpretation of probability phrases. *Psychological Science, 17*, 747-751. doi: http://dx.doi.org/10.1111/j.1467-9280.2006.01776.x

Bonnefon, J. F., Feeney, A., & De Neys, W. (2011). The risk of polite misunderstandings. *Current Directions in Psychological Science., 20*, 321-324. doi: http://dx.doi.org/10.1177/0963721411418472

Brown, M. T., & Bussell, J. K. (2011). Medication adherence: Who cares? *Mayo Clinic Proceedings, 86*, 304-314. doi: 10.4065/mcp.2010.0575

Brown, P., & Levinson, S. (1987). *Politeness: Some universals in language usage*: Cambridge, England: Cambridge University Press.

Brun, W., & Teigen, K. H. (1988). Verbal probabilities: Ambiguous, context dependent, or both? *Organizational Behavior and Human Decision Processes, 41*, 390-404. doi: http://dx.doi.org/10.1016/0749-5978(88)90036-2

Budescu, D. V., & Wallsten, T. S. (1995). Processing linguistic probabilities: General principles and empirical evidence. In R. H. J.R. Busemeyer & D. Medin (Eds.), *Psychology of learning and motivation* (pp. 275-318): Amsterdam: Academic Press.

Clark, D. A. (1990). Verbal uncertainty expression : A critical review of two decades of research. *Current psychology: Research and reviews, 9*, 203-235. doi: http://dx.doi.org/10.1007/BF02686861

Colloca, L., & Finniss, D. J. J. (2012). Nocebo effects, patient-clinician communication, and therapeutic outcomes. *307*, 567-568.

Du, X.-L., Liu, S.-H., Xu, J.-H., Rao, L.-L., Jiang, C.-M., & Li, S. (2013). When uncertainty meets life: The effect of animacy on probability expression. *Judgment and Decision Making, 8*, 425–438.

Edwards, I. R., & Aronson, J. K. (2000). Adverse drug reactions: Definitions, diagnosis, and management. *The Lancet, 356*, 1255-1259. doi: https://doi.org/10.1016/S0140-6736(00)02799-9

Erev, I., & Cohen, B. L. (1990). Verbal versus numerical probabilities: Efficiency, biases, and the preference paradox. *Organizational Behavior and Human Decision Processes, 45*, 1-18. doi: http://dx.doi.org/10.1016/0749-5978(90)90002-Q

European Commission. (1998). *A guideline on the readability of the label and package leaflet of medicinal products for human use.*

Fischer, K., & Jungerman, H. (1996). Rarely occurring headaches and rarely occuring blindness: Is rarely-rarely? *Journal of Behavioral Decision Making, 9*, 153-172.

Frenkel, M. (2013). Refusing treatment. *The Oncologist, 18*, 634-636. doi: 10.1634/theoncologist.2012-0436

General Medical Council. (2008). Consent guidance: Discussing side effects, complications and other risks.

Grice, H. P. (1975). Logic and conversation. In P. Cole & J. Morgan (Eds.), (Vol. 3): New York: Academic Press.

Gurmankin, A. D., Baron, J., & Armstrong, K. (2004a). The effect of numerical statements of risk on trust and comfort with hypothetical physician risk communication. *Medical Decision Making, 24*, 265-271. doi: 10.1177/0272989x04265482

Gurmankin, A. D., Baron, J., & Armstrong, K. (2004b). The effect of numerical statements of risk on trust and comfort with hypothetical physician risk communication. *Medical Decision Making, 24*, 265-271. doi: 10.1177/0272989X04265482

Harris, A., Corner, A., & Hahn, U. (2009). Estimating the probability of negative events. *Cognition, 110*, 51-64. doi: http://dx.doi.org/10.1016/j.cognition.2008.10.006

Harris, A. J. L., & Corner, A. (2011). Communicating environmental risks: Clarifying the severity effect in interpretations of verbal probability expressions. *Journal of Experimental Psychology: Learning, Memory, and Cognition., 37*, 1571-1578. doi: http://dx.doi.org/10.1037/a0024195

Hilton, D. J. (2008). Emotional tone and argumentation in risk communication. *Judgment and Decision Making, 3*, 100-110.

Hugman, B. (2006). The erice declaration : The critical role of communication in drug safety. *Drug Saf, 29*, 91-93.

Juanchich, M., & Sirota, M. (2013). Do people really say it is "likely" when they believe it is only "possible"? Effect of politeness on risk communication. *Quarterly Journal of Experimental Psychology, 66*, 1268-1275. doi: http://dx.doi.org/10.1080/17470218.2013.804582

Juanchich, M., & Sirota, M. (2017). Improving climate change risk communication: The effect of format on prediction calibration, probability perception and decision making. *Journal of experimental Psychology: Applied*.

Juanchich, M., & Sirota, M. (2019). Do people really prefer verbal probabilities? *Psychological research*. doi: 10.1007/s00426-019-01207-0

Juanchich, M., Sirota, M., & Butler, C. L. (2012). The perceived functions of linguistic risk quantifiers and their effect on risk, negativity perception and decision making. *Organizational Behavior and Human Decision Processes, 118*, 72-81. doi: http://dx.doi.org/10.1016/j.obhdp.2012.01.002

Juanchich, M., Teigen, K. H., & Gourdon, A. (2013). Top scores are possible, bottom scores are certain (and middle scores are not worth mentioning): A pragmatic view of verbal probabilities. *Judgment and Decision Making, 8*, 345-364.

Knapp, P., Gardner, P. H., Carrigan, N., Raynor, D. K., & Woolf, E. (2009). Perceived risk of medicine side effects in users of a patient information website: A study of the use of verbal descriptors, percentages and natural frequencies. *British Journal of Health Psychology*.

Knapp, P., Gardner, P. H., Raynor, D. K., Woolf, E., & McMillan, B. (2010a). Perceived risk of tamoxifen side effects: A study of the use of absolute frequencies or frequency bands, with or without verbal descriptors. *Patient Education and Counseling, 79*, 267-271. doi: http://dx.doi.org/DOI: 10.1016/j.pec.2009.10.002

Knapp, P., Gardner, P. H., Raynor, D. K., Woolf, E., & McMillan, B. (2010b). Perceived risk of tamoxifen side effects: A study of the use of absolute frequencies or frequency bands, with or without verbal descriptors. *Patient Education and Counseling, 79*, 267-271. doi: 10.1016/j.pec.2009.10.002

Knapp, P., Gardner, P. H., & Woolf, E. (2016). Combined verbal and numerical expressions increase perceived risk of medicine side-effects: A randomized controlled trial of ema recommendations. *Health Expectations, 19*, 264-274. doi: 10.1111/hex.12344

Knapp, P., Raynor, D. K., & C, B. D. (2004). Comparison of two methods of presenting risk information to patients about the side effects of medicines. *Quality and Safety in Health Care, 13*, 176-180. doi: http://dx.doi.org/10.1136/qshc.2003.009076

Koehler, J. J. (2001). When are people persuaded by DNA match statistics? *Law and Human Behavior, 25*, 493-513.

Monahan, J., Heilbrun, K., Silver, E., Nabors, E., Bone, J., & Slovic, P. (2002). Communicating violence risk: Frequency formats, vivid outcomes, and forensic settings. *International Journal of Forensic Mental Health, 1*, 121-126.

Moxey, L. M. (2006). Effects of what is expected on the focussing properties of quantifiers: A test of the presupposition-denial account. *Journal of Memory and Language, 55*, 422-439. doi: http://dx.doi.org/10.1016/j.jml.2006.05.006

Neuner-Jehle, S., Senn, O., Wegwarth, O., Rosemann, T., & Steurer, J. (2011). How do family physicians communicate about cardiovascular risk? Frequencies and determinants of different communication formats. *BMC Family Practice 2011, 12:15, 12*. doi: http://dx.doi.org/10.1186 /1471-2296-12- 15

NICE. (2009). *Nice guideline [cg76] medicines adherence: Involving patients in decisions about prescribed medicines and supporting adherence*. Retrieved from https://www.nice.org.uk/guidance/CG76.

Oberg, E. B., & Frank, E. (2009). Physicians' health practices strongly influence patient health practices. *The journal of the Royal College of Physicians of Edinburgh, 39*, 290-291. doi: 10.4997/JRCPE.2009.422

Olson, M. J., & Budescu, D. V. (1997). Patterns of preference for numerical and verbal probabilities. *Journal of Behavioral Decision Making, 10*, 117-131.

Peters, E., Hart, P. S., Tusler, M., & Fraenkel, L. (2014). Numbers matter to informed patient choices: A randomized design across age and numeracy levels. *Med Decis Making, 34*, 430-430. doi: http://dx.doi.org/10.1177/0272989X13511705

Peters, E., Hibbard, J., Slovic, P., & Dieckmann, N. (2007). Numeracy skill and the communication, comprehension, and use of risk-benefit information. *Health Affairs, 26*, 741-748. doi: http://dx.doi.org/10.1377/hlthaff.26.3.741

Pighin, S., Savadori, L., Barilli, E., & Bonnefon, J.-F. (2011). The '1 in x' effect on the subjective assessment of medical probabilities. *Medical decision making, 31*, 721-729.

Samuelson, P. A. (1952). Probability, utility, and the independence axiom. *Econometrica, 20*, 670-678. doi: 10.2307/1907649

Sirota, M., & Juanchich, M. (2015). A direct and comprehensive test of two postulates of politeness theory applied to uncertainty communication. *Judgment and Decision Making, 10*, 232–240-232–240.

Sirota, M., & Juanchich, M. (2019). Ratio format shapes health decisions: The practical significance of the "1-in-x" effect. *Medical Decision Making, 39*, 32-40. doi: 10.1177/0272989x18814256

Sirota, M., Juanchich, M., & Bonnefon, J. F. (2018a). "1-in-x" bias: "1-in-x" format causes overestimation of health-related risks. *Journal of Experimental Psychology: Applied*. doi: 10.1037/xap0000190

Sirota, M., Juanchich, M., Kostopoulou, O., & Hanak, R. (2014). Decisive evidence on a smaller-than-you-think phenomenon: Revisiting the "1-in-x" effect on subjective medical probabilities. *Medical Decision Making, 34*, 419-429. doi: http://dx.doi.org/10.1177/0272989X13514776

Sirota, M., Juanchich, M., Petrova, D., Garcia-Retamero, R., Walasek, L., & Bhatia, S. (2018b). Health professionals prefer to communicate risk-related numerical information using "1-in-x" ratios. *Medical Decision Making*.

Sirota, M., Round, T., Samaranayaka, S., & Kostopoulou, O. (2017). Expectations for antibiotics increase their prescribing: Causal evidence about localized impact. *Health Psychology, 36*, 402-409.

Slovic, P., Monahan, J., & MacGregor, D. G. (2000). Violence risk assessment and risk communication: The effects of using actual cases, providing instruction, and employing probability versus frequency formatss. *Law and human behavior, 24*, 271-296.

Teigen, K. H., & Brun, W. (1999). The directionality of verbal probability expressions: Effects on decisions, predictions, and probabilistic reasoning. *Organizational Behavior and Human Decision Processes, 80*, 155-190. doi: http://dx.doi.org/10.1006/obhd.1999.2857

Teigen, K. H., Juanchich, M., & Filkuková, P. (2014). Verbal probabilities: An alternative approach. *Quarterly Journal of Experimental Psychology*. doi: http://dx.doi.org/10.1080/17470218.2013.793731

Teigen, K. H., Juanchich, M., & Riege, A. (2013). Improbable outcomes: Infrequent or extraordinary? *Cognition, 127*, 119-139. doi: http://dx.doi.org/10.1016/j.cognition.2012.12.005

Verdú, F., & Castelló, A. (2004). Non-compliance: A side effect of drug information leaflets. *Journal of Medical Ethics, 30*, 608-609. doi: 10.1136/jme.2003.003806

Villejoubert, G., Almond, L., & Alison, L. (2008). Interpreting claims in offender profiles: The role of probability phrases, base-rates and perceived dangerousness. *Applied Cognitive Psychology, 22*, 1-19. doi: http://dx.doi.org/10.1002/acp.1438

Wallsten, T. S., Budescu, D. V., Zwick, R., & Kemp, S. M. (1993). Preferences and reasons for communicating probabilistic information in verbal or numerical terms. *Bulletin of the Psychonomic Society, 31*, 135-138. doi: 10.3758/BF03334162

Wallsten, T. S., Fillenbaum, S., & Cox, J. A. (1986). Base rate effects on the interpretation of probability and frequency expressions. *Journal of Memory and Language, 25*, 571-587. doi: http://dx.doi.org/10.1016/0749-596X(86)90012-4

Waters, E. A., Weinstein, N. D., Colditz, G. A., & Emmons, K. (2006). Formats for improving risk communication in medical tradeoff decisions. *Journal of Health Communication, 11*, 167-182. doi: 10.1080/10810730500526695

Waters, E. A., Weinstein, N. D., Colditz, G. A., & Emmons, K. (2009). Explanations for side effect aversion in preventive medical treatment decisions. *Health psychology, 28*, 201-209. doi: 10.1037/a0013608

Weber, E. U., & Hilton, D. J. (1990). Contextual effects in the interpretations of probability words: Perceived base rate and severity of events. *Journal of Experimental Psychology: Human Perception and Performance, 16*, 781-789. doi: http://dx.doi.org/10.1037/0096-1523.16.4.781

Webster, R. K., Weinman, J., & Rubin, G. J. (2017). People's understanding of verbal risk descriptors in patient information leaflets: A cross-sectional national survey of 18- to 65-year-olds in england. *Drug Safety*. doi: 10.1007/s40264-017-0542-1

World Health Organization. (1972). International drug monitoring: The role of national centres. *Technical report series*.

Xu, J.-H., Ye, X.-B., & Li, S. H. U. (2009). Communication mode preference paradox among native chinese speakers. *The Journal of Social Psychology, 149*, 128-129. doi: 10.3200/SOCP.149.1

Young, S. D., & Oppenheimer, D. M. (2006). Percentages matter: Framing risk information can affect fear of side effects and medication compliance. *Clinical Therapeutics, 28,* 129-139.

Zimmer, A. C. (1983). Verbal versus numerical processing of subjective probabilities. *Advances in Psychology Research*, 159-182. doi: 10.1016/S0166-4115(08)62198-6

Table 1.

Verbal frequency guidelines of the European Commission to communicate side effect risk along with their numerical expected meaning (1998).

Verbal descriptor	**Assigned frequency**
Very common	> 10%
Common	1-10%
Uncommon	0.1-1%
Rare	0.01-0.1%
Very rare	< 0.01

Table 2.

Quantifiers used by family physicians to communicate side effects.

Quantifier type	% selection
A verbal quantifier (e.g., a few patients experience dry mouth)	29%
A verbal probability (e.g., there is a small chance that patients experience dry mouth)	25%
A modal (e.g., patients can experience dry mouth)	18%
A verbal frequency (e.g., it is rare that patients experience dry mouth)	10%
Total verbal	**82%**
A numerical frequency (e.g., 1 patient in 10 experiences dry mouth)	10%
A ratio probability (e.g., patients have a 1 in 10 chance of experiencing dry mouth)	6%
A percentage probability (e.g., 10% of the patients experience dry mouth)	2%
Total numerical	**18%**

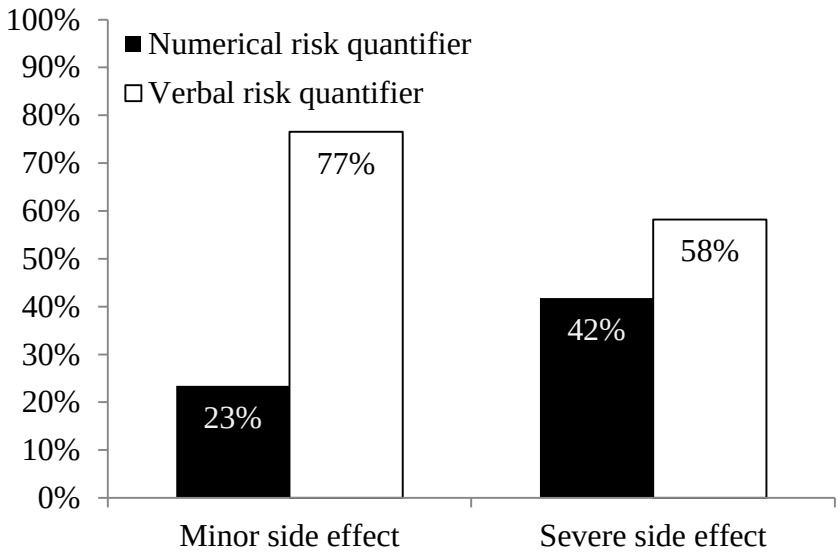

Figure 1. Format preference for communicating a minor or a severe side effect to patients (*N* = 131).