2.2.3 Presentation of frequencies

Introduction

The success of evidence-based praxis depends on the clear, effective communication of statistical information (1). The aim is for the information to be understood, the risks to be correctly estimated and, finally, for informed decisions to be made possible. The development process of the information comprises the selection of the content that should be communicated and the critical appraisal including the decision whether presentation of numerical data is adequate. In order to communicate frequencies correctly it is important to check the existing evidence on various presentation formats with regard to their efficacy and also to check for possible adverse effects.

To present statistical information (probabilities, quality of diagnostic tests as well as benefits, harm and side effects of medicinal measures) verbal descriptors are used. Verbal descriptors are more or less specific linguistic transcriptions of frequencies, e.g. *seldom, occasionally, frequent, certain* or *probable*.

However, studies have shown that the interpretations of linguistic descriptions and the resulting perception of risks differ significantly both inter-individually and between (medical) nonprofessionals and professionals (2). Verbal information concerning side effects leads to overestimating the probability of their occurrence (2).

A first attempt to standardize the verbal description of risks was made by the European Commission in 1998 (3). In the guideline on the readability of information on medical products, five verbal descriptors were each allocated with a defined numerical frequency or range of frequency (3). The Federal Institute for Drugs and Medical Devices (BfArM) also demands the use of fixed linguistic descriptions combined with a numerical indicator when making statements about the frequencies of side effects in product information leaflets (4). In a survey carried out in Germany, the participating physicians, pharmacists, and legal practitioners were unable to allocate the verbal probabilities for side effects correctly to the corresponding percentages (5).

There are various formats available for the numerical presentation: natural frequencies, percentages, absolute risk reduction (ARR), relative risk reduction (RRR), number needed to treat/screen/harm (NNT, NNS, NNH). The natural frequencies are given in differing reference parameters (denominators): 1 in 100, 1 in 1000, 1 in 10000. The effects of these formats have been investigated in several systematic reviews (1, 6-8), whereby Akl et al. for the first time included the outcome *persuasiveness* which is measured by means of hypothetical choices (1).

For a long time the use of natural frequencies was considered superior to percentages and was also strongly advocated in the context of evidence-based medicine (9). Several studies have investigated how often the positive predictive value of a test was correctly estimated when statements were made about the prevalence of a particular illness or about sensitivity and the false-positive rate (10-13). They found out that the number of correct answers was very low, even when the parameters were shown as natural frequencies. That is why positive predictive values and other test rating parameters should be shown directly, without the reader of the information having to carry out the corresponding calculations (11).

A possible adverse effect of presenting risks as natural frequencies can arise through the *denominator neglect*: Perception is focused on the number of observed incidents (numerators), no matter how small, and not on the reference parameters (denominators) (14). If the risks are compared – perhaps with or without a therapy – the perception is distorted even more if the chosen parameters are different (e.g. 80 of 800 vs. 20 of 100). The disadvantages of this presentation have long since been the subject of discussion. The use of different parameters makes it difficult to compare different statements and to estimate the level of risk correctly (15) which can lead to overestimating the risks (16).

Questions

1. What effects does the verbal presentation of risks, benefits and harm have in comparison to the numerical presentation?
2. What effect does the presentation of benefits and harm as absolute risk reduction (ARR) have in comparison to the relative risk reduction (RRR)?
3. What effects does the presentation in natural frequencies have in comparison to the presentation in percentages?
4. What effects does the presentation of number needed to treat/screen/harm (NNT, NNS, NNH) have in comparison to the presentation as ARR (percentage or natural frequencies)?
5. What effects does the presentation with constant reference parameters (e.g. x in 1000) have in comparison to presentation with differing parameters (e.g. 2 in 100; 5 in 1000)?

Recommendations

1. Verbal presentation

⇊	**Recommendation** **"The verbal presentation of risks, benefits and harm must not be applied exclusively."** Agreed: 14, Disagreed: 0, Abstentions: 1 **Quality of the evidence:** moderate quality

Comment on the recommendation:

The recommendation refers to the comparison of exclusively verbal with numerical presentation.

The studies show that the verbal presentation of risks, benefits and harm is inferior to the numerical presentation. In five out of six studies the numerical presentation enables a more realistic risk estimation / better understanding and in three out of four studies better knowledge. Regarding the outcome *understanding* there is no difference. All six studies show a higher *intention of performing the measure* concerned.

The efficacy of the affective outcomes (11 studies) is inconsistent.

Summary of the findings

Characteristics of the included studies

For this comparison, 15 studies with a total of 3,531 participants were included. The samples sizes were between 116 and 480, the ages ranged between 16 and 82 years. The studies were carried out in the USA (17-21), Great Britain (18, 22-28), Canada (29), Australia (30) and Singapore (31). The participants included pregnant women and mothers (27, 28), students of both sexes (21, 24), patients of both sexes (20, 25, 29-31), citizens of both sexes (17, 18, 22, 23, 26) and carers of both sexes (19).

The interventions consisted of scenarios concerning the side effects of antibiotics (23, 24), pain killers (18, 22, 31), statins (25), Tamoxifen (26) and cancer therapies

(17, 18, 20, 30), of scenarios relating to medical test results (27), the probabilities of certain incidents concerning babies (28), stroke risk (29) and to a fictitious discussion between a physician and relatives (19).

Results for the relevant outcomes

With regard to the outcomes *understanding*, *risk perception* and *knowledge*, positive effects were shown for the numerical presentation (18, 22-27, 29). No difference was found for the outcome *comprehensibility* (30). The results for the outcomes *acceptance*, *attractiveness* and *credibility* were not clear, but a positive tendency towards numerical presentation could be seen (17, 18, 20-25, 28, 30, 31). The *intention to perform a certain measure* is higher in numerical presentation (18, 22-26).

2. Absolute risk formats

⇑⇑	**Recommendation** **"Benefits and harm must be presented in absolute risk formats."** Agreed: 15, Disagreed: 0, Abstentions: 0 **Quality of the evidence:** moderate quality

Comment on the recommendation:

The recommendation refers to the comparison of the presentation as ARR with the exclusive presentation of RRR in health information.

Regarding the cognitive outcome *understanding / risk perception*, two out of three studies showed that, if details concerning the basic risk are missing, ARR enables more precise estimates to be made. In addition, ARR is usually superior to RRR, if the basic risks are given. However, RRR leads to an overestimation of the effects. No effects were shown in two studies with regard to the cognitive outcomes *knowledge* and *comprehensibility*.

The effects on affective outcomes (two studies) were inconsistent.

Summary of the findings

Characteristics of the included studies

For this comparison, five studies with a total of 4,314 participants were included. The sample sizes were between 209 and 2,978 participants and the age ranged between 18 and 74 years, depending on the target group. The studies had been carried out in Great Britain (32), the USA (33-36), Canada (33), Germany (33) and Norway (33). The participants included people from the general public (30, 34), women (34), patients (35) and people working in reservations and members of the First Nations (36). The interventions consisted of scenarios concerning influenza vaccinations (32), fictitious diseases (35, 36), the taking of statins for high cholesterol (33) and risk information for mammography screening (34).

Results for the relevant outcomes

With regard to the outcomes *understanding / risk perception* an effect was shown for ARR (32, 34). No differences could be seen for the outcomes *knowledge* and *comprehensibility / readability* (33, 36). For the outcomes *acceptance / attractiveness* the findings were inconsistent (32, 33).

3. Natural frequencies

⟺	**Recommendation** **"For probabilities >1%, presentation in percentages may be applied instead of presentation in natural frequencies"** Agreed: 14, Disagreed: 0, Abstentions: 0 **Quality of the evidence:** high quality

Comment on the recommendation:

The recommendation refers to the comparison of the presentation in percentages to that in natural frequencies in health information.

Regarding the outcome *understanding / risk perception* one study showed that for probabilities >1% the presentation in percentages was superior to that in natural frequencies.

No difference was shown for all other outcomes (*knowledge* – 2 studies; *comprehensibility / readability* – 2 studies; *acceptance / attractiveness* – 1 study).

Summary of the findings

Characteristics of the included studies

For this comparison, three studies with a total of 3,365 participants were included. The sample sizes were between 136 and 2,944, whereby the medium age was 39 to 61 years, depending on the target group. The studies were carried out in the USA (9, 18, 27) and England (19). Included were people from the general public (9), veterans (37) and visitors of both sexes to a web site (18).

The interventions consisted of scenarios concerning cholesterol reduction drugs and indigestion in drug facts boxes (9), cardiovascular risk (37), chemotherapy (18) and pain therapy (18).

Results for the relevant outcomes

With regard to the outcome *understanding / risk perception*, an effect for presentation in percentages was found in a high quality study (9). No differences could be seen for the outcomes knowledge, comprehensibility / readability, and acceptance / attractiveness (9, 18, 37).

4. Number Needed to Treat (NNS, NNH)

↓	**Recommendation** **"The presentation as number needed to treat (NNT), number needed to screen (NNS), number needed to harm (NNH) should not be used."** Agreed: 11, Disagreed: 0, Abstentions: 2 **Quality of the evidence:** moderate quality

Comment on the recommendation:

The recommendation refers to the comparison of the presentation as NNT (NNS, NNH) to the presentation as absolute risk reduction (ARR).

Studies concerning the outcome *understanding / risk perception* show that the presentation as NNT (NNS, NNH) is inferior to presentation as ARR. Particularly when no basic risks were given, the NNT led in two studies to the overestimation of the effect.

For all other outcomes (*comprehensibility / readability* – 1 study; *acceptance / attractiveness* – 2 studies) no differences could be seen.

Summary of the findings

Characteristics of the included studies

For this comparison, three studies with a total of 3,653 participants were included. The sample sizes were between 268 and 2,978, the ages ranged between 18 and over 60 years of age. The studies were carried out in the USA (33, 35), England (38), Canada (38), Germany (38) and Norway (38). The included participants were women passers-by in a town center (38), patients of both sexes (35) and people from the general public (33). The interventions consisted of scenarios concerning the anti-baby pill (38), fictitious diseases (35) and taking statins for high cholesterol (33).

Results for the relevant outcomes

For the outcome *understanding / risk perception* an effect for the presentation of ARR was shown (35, 38). No differences were shown for the outcomes *comprehensibility / readability* and *acceptance / attractiveness* (33, 38).

5. Reference parameters

↑	**Recommendation** **"In health information leaflets equivalent reference parameters should be used."** Agreed: 9, Disagreed: 0, Abstentions: 0 **Quality of the evidence:** high quality

Comment on the recommendation:

The recommendation refers to the comparison of presentations with the same reference parameters to those with differing parameters.

In one study, the presentation with the same reference parameters in drug facts boxes showed a positive effect on the outcome *understanding / risk perception*. In the same study no difference was shown for the outcome *comprehensibility / readability*. No findings are recorded for all the other outcomes.

Benefits and harm should as far as possible be presented with the same reference parameter. If there are deviations from this recommendation, these must be well-founded and the change must be portrayed transparently.

Summary of the findings

Characteristics of the included studies

For this comparison a single study was included with a total of 1,181 participants (9). The medium age was 47 years. The study was performed in the USA and included people from the general public. The interventions consisted of scenarios concerning cholesterol-reducing drugs and indigestion, each of which was presented in a drug facts box (9).

Results for the relevant outcomes

For the outcome *understanding*, a positive effect was shown for the presentation with the same parameters throughout (9). No difference was shown for the outcome *comprehensibility / readability* (9).

Evidence tables

Table 4: Evidence table „Verbal versus numerical presentation“

Certainty assessment						Summary of findings				
						No. of participants per group		Effect estimates		
Outcomes [No. of studies]	**Study design**	***Risk of bias***	**Inconsis-tency**	**Indirect-ness**	**Impreci-sion**	**Interven-tion**	**Control**	**Effects**	**Quality of evidence**	**Importance**
Verbal versus numerical presentation										
Understanding [n=1] Marteau (27)	RCT	serious (-1)	not serious	not serious	not serious	(verbal) N= 112	(numerical) N= 97	Effect for the numerical presentation immediately after the communication, no differences between groups after four months (27).	moderate	critical
Risk perception [n=5] Berry (study 2) (24) Berry (22) Berry (23) Lee Char (19) Man-Son-Hing (29)	RCT	very serious (-2)	not serious	not serious	not serious	N= 335 + N= 480 (allocation on intervention and control unclear)	N= 332	In 4 out of 5 studies effects for the numerical presentation (22-24, 29). Massive overestimation with the verbal presentation, less overestimation with numerical presentations. No effect in one study (19).	low	critical

Knowledge (recall) [n=4] Knapp (18) Knapp (25) Knapp (26) Man-Son-Hing (29)	RCT	serious (-1)	not serious	not serious	not serious	N= 324	N= 400	In three studies effects for the numerical presentation (18, 25, 26), in one study no effect (29).	moderate	critical
Comprehensibility [n=1] Hagerty (30)	Qualitative studies	no *Certainty assessment*				N= 126		Both presentations were perceived as equally comprehensible (30).	evidence from qualitative studies	important but not critical
Acceptance [n=4] Cheung (31) Mazur (20) Wallsten (21) Shaw 1990 (28)	Qualitative studies	no *Certainty assessment*				N= 991		All four studies showed a preference for the numerical presentation (20, 21, 28, 31).	evidence from qualitative studies	limited importance
Attractiveness [n=6] Berry (study 2) (24) Berry (22) Berry (23) Knapp (18) Knapp (scenario 1+2) (25) Hagerty (30)	RCT	very serious (-2)	serious (-1)	not serious	serious (-1)	N= 260 + N= 606 (allocation on intervention and control unclear)	N= 399	In three studies, significant higher satisfaction with the numerical presentation (22-24), in three studies no differences (18, 25, 30).	very low	limited importance

Credibility [n=1] Gurmankin (17)	Survey	no *Certainty assessment*				N= 115		Statistically significant but questionable relevant effect for the numerical presentation (17).	evidence from a survey	limited importance
Intention to perform a certain measure [n=6] Berry (Studie 2) (24) Berry (22) Berry (23) Knapp (18) Knapp (25) Knapp (26)	RCT	very serious (-2)	not serious	not serious	serious (-1)	N= 375	N= 451	In six studies higher intention to take medication with numerical presentation (18, 22-26).	very low	not defined

Table 5: Evidence table „Absolute versus relative risk formats“

Certainty assessment						Summary of findings				
						No. of participants per group		Effect estimates		
Outcomes [No. of studies]	**Study design**	***Risk of bias***	**Inconsis-tency**	**Indirect-ness**	**Impreci-sion**	**Interven-tion**	**Control**	**Effects**	**Quality of evidence**	**Importance**
Absolute versus relative risk formats										
Understanding / risk perception [n=3] Natter (32) Schwartz (34) Sheridan (35)	RCT	serious (-1)	not serious	not serious	not serious	(ARR) N=365	(RRR) N=347	Without providing the basic risk, in one study effect estimates were more precise with presenting ARR. Presenting RRR leads to overestimations. Presenting ARR with basic risks leads to significant more precise effect estimates (34). In the second study in 2 out of 4 groups an advantage for ARR was shown (32). In one study no effect (35).	moderate	critical
Knowledge [n=1] Sprague (36)	RCT	serious (-1)	not serious	not serious	not serious	N=46	N=54	In one study no effect (36).	moderate	critical

Comprehensibility / readability [n=1] Carling (33)	RCT,	not serious	not serious	not serious	not serious	N=505	N=508	In one study no effect (the outcome was self assessed by the participants, secondary outcome) (33).	high	important but not critical
Acceptance / attractiveness [n=2] Natter (32) Carling (33)	RCT	serious (-1)	not serious	not serious	not serious	N=615	N=618	With presentation of the basic risk, the absolute format was significantly preferred. Without basic risk, there were no differences between the groups (32). In one study no difference between groups (33).	moderate	limited importance

Table 6: Evidence table „Naturel frequencies versus percentage“

Certainty assessment						Summary of findings				
						No. of participants per group		Effect estimates		
Outcomes [No. of studies]	**Study design**	***Risk of bias***	**Inconsis-tency**	**Indirect-ness**	**Impreci-sion**	**Interven-tion**	**Control**	**Effects**	**Quality of evidence**	**Importance**
Naturel frequencies (NF) versus percentage										
Understanding / risk perception [n=1] Woloshin (9)	RCT	not serious	not serious	not serious	not serious	(NF) N=590	(percent) N=591	Positive effect for percentages, no differences with low probabilities (<1%) (9).	high	critical
Knowledge [n=2] Ruiz (37) Knapp (2 Experimente) (18)	RCT	serious (-1)	not serious	not serious	not serious	N=135	N=134	In two studies no effects (18, 37).	moderate	critical
Comprehensibility / readability [n=2] Woloshin (9) Ruiz (37)	RCT,	serious (-1)	not serious	not serious	not serious	N=630	N=631	In two studies no effects (9, 37).	moderate	important but not critical
Acceptance / attractiveness [n=1] Knapp (18)	RCT	serious (-1)	not serious	not serious	not serious	N=244	N=245	In one study no effect (18).	moderate	limited importance

Table 7: Evidence table „NNT / NNH versus ARR“

Certainty assessment						Summary of findings				
						No. of participants per group		Effect estimates		
Outcomes [No. of studies]	**Study design**	***Risk of bias***	**Inconsis-tency**	**Indirect-ness**	**Impreci-sion**	**Interven-tion**	**Control**	**Effects**	**Quality of evidence**	**Importance**
NNT / NNH versus ARR										
Understanding / risk perception [n=2] Berry (38) Sheridan (35)	RCT	serious (-1)	not serious	not serious	not serious	(NNT) N=192	(ARR) N=200	Effect for ARR (in %) without providing the basic risk. NNH leads to overestimation. With the presentation of basic risks no differences between groups (38). Effect for ARR in the second study (35).	moderate	critical
Comprehensibility / readability [n=1] Carling (33)	RCT	not serious	not serious	not serious	not serious	N=484	N=505	NNT and ARR (in %): no effect (33).	high	important but not critical
Acceptance / attractiveness (satisfaction, preference) [n=2] Berry (38) Carling (33)	RCT	serious (-1)	not serious	not serious	not serious	N=576	N=597	No effect, but higher satisfaction with presentation of basic risks in both groups (33, 38).	moderate	limited importance

Table 8: Evidence table „Equivalent versus differing reference parameters“

Certainty assessment						Summary of findings				
						No. of participants per group		Effect estimates		
Outcomes [No. of studies]	**Study design**	***Risk of bias***	**Inconsis-tency**	**Indirect-ness**	**Impreci-sion**	**Interven-tion**	**Control**	**Effects**	**Quality of evidence**	**Importance**
Equivalent versus differing reference parameters (x in 100; x in 1000; x in 10000)										
Understanding [n=1] Woloshin (9)	RCT	not serious	not serious	not serious	not serious	N=590	N=591	Effect for the presentation with equivalent reference parameters (x in 1000) in comparison to differing reference parameters within a drug facts box (9).	high	critical
Comprehensibility / readability [n=1] Woloshin (9)	RCT	not serious	not serious	not serious	not serious	N=590	N=591	In one study no effect (9).	high	important but not critical

References

1. Akl EA, Oxman AD, Herrin J, Vist GE, Terrenato I, Sperati F, et al. Using alternative statistical formats for presenting risks and risk reductions. The Cochrane database of systematic reviews. 2011(3):CD006776. Epub 2011/03/18.

2. Berry DC, Knapp P, Raynor DK. Provision of information about drug side-effects to patients. Lancet [Internet]. 2002; (9309):[853-4 pp.]. Available from: http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/036/CN-00558036/frame.html.

3. European Commission D-GI. A guideline on the readability of the label and package leaflet of medical products for human use. 1998.

4. Bundeministerium für Arzneimittel und Medizinprodukte. Wie sollen die Häufigkeiten für Nebenwirkungen in der Produktinformation angegeben werden? ; Available from: http://www.bfarm.de/SharedDocs/FAQs/DE/Arzneimittel/pal/ja-ampal-faq.html.

5. Ziegler A, Hadlak A, Mehlbeer S, Konig IR. Comprehension of the description of side effects in drug information leaflets: a survey of doctors, pharmacists and lawyers. Deutsches Arzteblatt international. 2013;110(40):669-73. Epub 2013/10/30.

6. Bunge M, Muhlhauser I, Steckelberg A. What constitutes evidence-based patient information? Overview of discussed criteria. Patient Educ Couns. 2010;78(3):316-28. Epub 2009/12/17.

7. Covey J. A Meta-analysis of the effects of presenting treatment benefits in different formats. [References]. Medical Decision Making Vol27(5), Sep-Oct 2007, pp 638-654. 2007.

8. Trevena LJ, Davey HM, Barratt A, Butow P, Caldwell P. A systematic review on communicating with patients about evidence. Journal of evaluation in clinical practice. 2006;12(1):13-23. Epub 2006/01/21.

9. Woloshin S, Schwartz LM. Communicating data about the benefits and harms of treatment: a randomized trial. Annals of internal medicine. 2011;155(2):87-96. Epub 2011/07/20.

10. Bramwell R, West H, Salmon P. Health professionals' and service users' interpretation of screening test results: experimental study. BMJ (Clinical research ed). 2006;333(7562):284. Epub 2006/07/15.

11. Galesic M, Gigerenzer G, Straubinger N. Natural frequencies help older adults and people with low numeracy to evaluate medical screening tests. Medical decision making : an international journal of the Society for Medical Decision Making. 2009;29(3):368-71. Epub 2009/01/09.

12. Garcia-Retamero R, Hoffrage U. Visual representation of statistical information improves diagnostic inferences in doctors and their patients. Social science & medicine (1982). 2013;83:27-33. Epub 2013/03/08.

13. Siegrist M, Keller C. Natural frequencies and Bayesian reasoning: The impact of formal education and problem context. [References]. Journal of Risk Research Vol14(9), Oct 2011, pp 1039-1055. 2011.

14. Reyna VF, Brainerd CJ. Numeracy, ratio bias, and denominator neglect in judgments of risk and probability. Learning and Individual Differences. 2008;18(1):89-107.

15. Zikmund-Fisher BJ. Time to retire the 1-in-X risk format. Medical Decision Making. 2011;31(5):703-4.

16. Pighin S, Savadori L, Barilli E, Cremonesi L, Ferrari M, Bonnefon J-F. The 1-in-X effect on the subjective assessment of medical probabilities. Medical Decision Making. 2011;31(5):721-9.

17. Gurmankin AD, Baron J, Armstrong K. The effect of numerical statements of risk on trust and comfort with hypothetical physician risk communication. Medical decision making : an international journal of the Society for Medical Decision Making. 2004;24(3):265-71. Epub 2004/05/25.

18. Knapp P, Gardner PH, Carrigan N, Raynor DK, Woolf E. 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. 2009;14(Pt 3):579-94. Epub 2008/11/11.

19. Lee Char SJ, Evans LR, Malvar GL, White DB. A randomized trial of two methods to disclose prognosis to surrogate decision makers in intensive care units. American journal of respiratory and critical care medicine. 2010;182(7):905-9. Epub 2010/06/12.

20. Mazur DJ, Hickam DH, Mazur MD. How patients' preferences for risk information influence treatment choice in a case of high risk and high therapeutic uncertainty: asymptomatic localized prostate cancer. Medical decision making : an international journal of the Society for Medical Decision Making. 1999;19(4):394-8. Epub 1999/10/16.

21. Wallsten TS, Budescu DV, Zwick R, Kemp SM. Preferences and reasons for communicating probabilistic information in verbal or numerical terms. Bulletin of the Psychonomic Society. 1993;31(2):135-8.

22. Berry D, Raynor T, Knapp P, Bersellini E. Over the counter medicines and the need for immediate action: a further evaluation of European Commission recommended wordings for communicating risk. Patient Educ Couns. 2004;53(2):129-34. Epub 2004/05/14.

23. Berry DC, Raynor DK, Knapp P. Communicating risk of medication side effects: an empirical evaluation of EU recommended terminology. [References]. Psychology, Health & Medicine. 2003;8(3):251-63.

24. D. Berry, T. Raynor, P. Knapp, E. Bersellini. Is 15 per cent very common? Informing people about the risks of medication side effects. International Journal of Pharmacy Practice. 2002;10(3):145-51.

25. Knapp P, Raynor DK, Berry DC. Comparison of two methods of presenting risk information to patients about the side effects of medicines. Quality & safety in health care. 2004;13(3):176-80. Epub 2004/06/04.

26. Knapp P, Raynor DK, Woolf E, Gardner PH, Carrigan N, McMillan B. Communicating the risk of side effects to patients: an evaluation of UK regulatory recommendations. Drug safety : an international journal of medical toxicology and drug experience. 2009;32(10):837-49. Epub 2009/09/03.

27. Marteau TM, Saidi G, Goodburn S, Lawton J, Michie S, Bobrow M. Numbers or words? A randomized controlled trial of presenting screen negative results to pregnant women. Prenatal diagnosis. 2000;20(9):714-8. Epub 2000/10/04.

28. Shaw NJ, Dear PR. How do parents of babies interpret qualitative expressions of probability? Archives of disease in childhood. 1990;65(5):520-3. Epub 1990/05/01.

29. Man-Son-Hing M, O'Connor AM, Drake E, Biggs J, Hum V, Laupacis A. The effect of qualitative vs. quantitative presentation of probability estimates on patient decision-making: a randomized trial. Health expectations : an international journal of public participation in health care and health policy. 2002;5(3):246-55. Epub 2002/08/30.

30. Hagerty RG, Butow PN, Ellis PA, Lobb EA, Pendlebury S, Leighl N, et al. Cancer patient preferences for communication of prognosis in the metastatic setting. Journal of Clinical Oncology. 2004;22(9):1721-30.

31. Cheung YB, Wee HL, Thumboo J, Goh C, Pietrobon R, Toh HC, et al. Risk communication in clinical trials: a cognitive experiment and a survey. BMC medical informatics and decision making. 2010;10:55. Epub 2010/09/28.

32. Natter HM, Berry DC. Effects of presenting the baseline risk when communicating absolute and relative risk reductions. Psychology, Health & Medicine 2005;10(4):326-34.

33. Carling CL, Kristoffersen DT, Montori VM, Herrin J, Schunemann HJ, Treweek S, et al. The effect of alternative summary statistics for communicating risk reduction on decisions about taking statins: a randomized trial. PLoS medicine. 2009;6(8):e1000134. Epub 2009/08/27.

34. Schwartz LM, Woloshin S, Black WC, Welch HG. The role of numeracy in understanding the benefit of screening mammography. Annals of internal medicine. 1997;127(11):966-72. Epub 1997/12/31.

35. Sheridan SL, Pignone MP, Lewis CL. A randomized comparison of patients' understanding of number needed to treat and other common risk reduction formats. Journal of general internal medicine. 2003;18(11):884-92. Epub 2003/12/23.

36. Sprague D, LaVallie DL, Wolf FM, Jacobsen C, Sayson K, Buchwald D. Influence of graphic format on comprehension of risk information among American Indians. [References]. Medical Decision Making Vol31(3), May-Jun 2011, pp 437-443. 2011.

37. Ruiz JG, Andrade AD, Garcia-Retamero R, Anam R, Rodriguez R, Sharit J. Communicating global cardiovascular risk: Are icon arrays better than numerical estimates in improving understanding, recall and perception of risk? Patient Educ Couns. 2013;93(3):394-402.

38. Berry DC, Knapp P, Raynor T. Expressing medicine side effects: assessing the effectiveness of absolute risk, relative risk, and number needed to harm, and the provision of baseline risk information. Patient Educ Couns. 2006;63(1-2):89-96. Epub 2005/10/26.