Technical appendix

The difference between absolute and relative risk

Many patients (and some health professionals) struggle to understand the difference between changes in absolute risk and changes in relative risk.

Relative reductions in risk of harm or relative increases in risk of side effects can sound impressive or worrying, respectively, but the **absolute** differences may actually be quite small. One way to explain this to patients is to use the analogy of buying lottery tickets. The chance of winning the National Lottery jackpot if I buy just one ticket is very small — of the order of 1 in 14 million. If I buy 10 tickets, my chance of winning would increase in **relative** terms 10-fold, or by 10-times, or by 1000%. But we can see that my **absolute** chance of winning has increased from 1 in 14 million to 10 in 14 million, that is, my chance of winning is now 1 in 1.4 million. It is still not very likely that I will win the lottery jackpot. Although the chance ('risk') of winning is increased by a large amount (by 10 times or 1000%) in relative terms, the absolute increase in the chance of me winning is still very small (it has increased by 9 in 14 million, or by about 0.00006%), because my baseline chance of winning was low.[†]

Compare that with, say, a raffle at a school fete that I attend, where only 250 tickets are sold. If I buy one raffle ticket, my chance of winning is 1 in 250. Buying 10 tickets increases my relative chance of winning 10 fold (1000%), as before, but in absolute terms my chance of winning increases from 1 in 250 to 10 in 250, or 1 in 25. The absolute increase in chance of winning is 9 in 250, or 3.6%. This is much greater, because the baseline chance of winning was much greater.

[†]This is simplified for the purposes of analogy. The mathematics of the real National Lottery are more complex. There are 13,983,816 possible combinations of numbers, but on average about 2.6 times more tickets than this are sold, so at least some combinations are chosen by more than one person. In addition, some combinations are more popular than others, and some may not be chosen at all. See http://understandinguncertainty.org/node/95

In both of these scenarios, when thinking about buying the tickets I would need to weigh up the value and importance to me of winning, the absolute chances of winning associated with buying 10 tickets instead of one, and the extra cost of buying 10 tickets instead of one. More information on the difference between absolute and relative risks and the concepts discussed here can be found on the *Information Mastery 2 – Skills* floor of NPCi (www.npci.org.uk). This example also illustrates how our perceptions can influence us — the National Lottery has been running for many years, and most weeks **someone** wins the lottery jackpot. It's quite possible that we have some kind of social connection (a 'friend of a friend') to someone who has won a lottery prize — if not the actual jackpot — so we might think that our chance of winning is greater than it actually is. In a similar way, in a health context, we might recall a person who experienced a rare, but memorable side effect or complication of treatment or as a result of not being treated. Events that are easier to recall are judged as more likely to happen (this is known as 'availability bias').

Taking into account the patient's particular baseline risk

As we can see from the previous section, it is important to take into account the patient's likely starting or baseline risk. The PDAs illustrate the absolute benefits and risks of interventions, assuming a particular baseline risk. Even though the relative risk is the same regardless of baseline risk, patients with a lower baseline risk than that illustrated will have a lower absolute chance of benefiting and a lower residual risk. Patients with a greater baseline risk than that illustrated will have a greater absolute chance of benefiting but also a greater residual risk.

PDAs usually give the relative risk reduction and this can be used to amend the PDA. For example, statins reduce the relative risk of cardiovascular (CV) events by about 27%. Consider someone with a 10-year risk of CV disease of 20%. Without treatment, on average, over the next 10 years, 20 people in every 100 like him will develop CV disease and 80 (that is, 100 – 20) will not. Statins will save approximately 20 x 27% = 20 x 0.27 = 5 people from developing CV disease. So, over 10 years, 80 people in the 100 will not develop CV disease just as would have happened if they had not taken a statin, 5 of the 100 people will be saved from developing CV disease because they take a statin, and 20 – 5 = 15 people will still develop CV disease, even though they take a statin.

Conversely, consider someone at a much lower 10-year risk of CV disease, say 4%. Without treatment, on average, over the next 10 years 4 people in every 100 like her will develop CV disease and 96 (that is, 100 – 4) will not. Statins will save approximately 4 x 27% = 4 x 0.27 = 1 person from developing CV disease. So, over 10 years, 96 people in the 100 will not develop CV disease just as would have happened if they had not taken a statin, 1 person in the 100 people will benefit from the statin, and 4 – 1 = 3 people will still develop CV disease, even though they take a statin.

Now consider someone at a much higher 10-year risk of CV disease, say 40%. Applying the same method as above, we can see that if 100 people at that degree of baseline risk all take a statin for 10 years, over that time 60 people in the 100 will not develop CV disease just as would have happened if they had not taken a statin, 11 people in the 100 people will benefit from the statin, and 29 people will still develop CV disease, even though they take a statin.

A similar method may be used in relation to adverse effects.

It is important to remember that the figures calculated are only a guide and indication of the likely possible size of benefits or harms. The data for relative risk and relative risk reduction used in the PDAs are taken from the best available evidence, but inevitably they are point estimates with a degree of imprecision; all have 95% confidence intervals. In addition, estimation of baseline risk cannot be precise, and some rounding is also necessary to allow representation in grids of 100 or 1000 faces.

Do patient decision aids make a difference to patients?

The message from the data that follows is that using decision aids does not consistently affect the decisions that are made; but patients are more comfortable with their choices. There are too few studies to determine the effects of decision aids on persistence with the chosen therapy, costs, or resource use. A problem with research in this area is the 'Hawthorne effect' — participation in the study may itself affect perceptions.

A Cochrane Review[1] of the literature up to 2006 (55 randomised controlled trials [RCTs]) concluded that decision aids performed better than usual care interventions in terms of:

- greater knowledge (mean difference [MD] 15.2 out of 100; 95%CI 11.7 to 18.7)
- lower decisional conflict related to feeling uninformed (MD –8.3 out of 100; 95%CI –11.9 to –4.8)
- lower decisional conflict related to feeling unclear about personal values (MD –6.4 out of 100; 95%CI –10.0 to –2.7)
- reduced proportion of people who were passive in decision-making (relative risk [RR] 0.6; 95%CI 0.5–0.8)
- reduced proportion of people who remained undecided post-intervention (RR 0.5; 95%CI 0.3–0.8).

Most of the decision aids were intended for use before counselling.[1] When simpler decision aids were compared to more detailed decision aids, the relative improvement was significant in knowledge (MD 4.6 out of 100; 95%CI 3.0–6.2) and there was some evidence of greater agreement between values and choice. Exposure to a decision aid with probabilities resulted in a higher proportion of people with accurate risk perceptions (RR 1.6; 95%CI 1.4–1.9). The effect was stronger when probabilities were measured quantitatively (RR 1.8; 95%CI 1.4–2.3) versus qualitatively (RR 1.3; 95%CI 1.1–1.5). Decision aids are no better than comparisons in affecting satisfaction with decision-making, anxiety, and health outcomes. The effects of decision aids on other outcomes (patient-practitioner communication, consultation length, continuance, resource use) were inconclusive.

More recently, a small RCT in patients with type 2 diabetes compared a PDA about statin treatment, which was very similar to the NPC statin PDA, with usual care (a general information booklet).[2] Patients who received the PDA had more knowledge (difference 2.4 of 9 points; 95%CI 1.5–3.3), had better idea of their estimated cardiovascular risk (odds ratio [OR] 22.4; 95%CI 5.9–85.6) and potential absolute risk reduction with statin drugs (OR 6.7; 95%CI 2.2–19.7), and had less decisional conflict (difference −10.6; 95%CI, −15.4 to −5.9 on a 100 point scale) than did patients in the control group (n=46).

A pragmatic study evaluated the effectiveness of teaching large groups of family doctors to use a similar PDA relating to statin choice. 44 doctors were

randomised to being instructed in using the PDA and they subsequently recruited 550 patients whose cholesterol had been measured. 47 doctors in the control arm similarly recruited 480 patients.[3] Intervention patients were significantly more satisfied with the process and result (Patient Participation Scale, difference 0.80; P<0.001). Decisional regret was significantly lower at follow-up (difference 3.39; P = 0.02). Cardiovascular disease risk decreased in both groups without a significant difference between study arms.

What is the best way to express risk?

Poor numeracy impairs understanding and communication of health risks and benefits. A randomised, cross-sectional survey of 500 female New England veterans found that 46% were unable to convert 1% to 10 in 1,000, 80% were unable to convert 1 in 1,000 to 0.1% and 46% were unable to correctly estimate how many times a coin would come up heads in 1,000 flips. Just 6% of women answering one of these questions correctly could correctly interpret the benefit of mammography after being presented with standard risk reduction information, whereas 40% of those answering all three questions correctly could accurately interpret the data.[4] In a study of 100 New Zealand patients presented with information about treatment benefits in cardiovascular disease in different ways, of those who expressed a preference, 57% preferred graphical representation (a stacked bar graph) to numerical representation.[5] There is some evidence from a small study in 40 women that bar graphs may be more popular than line graphs, thermometer graphs and plots of representative faces, but it is not clear which if any of these is more effective. However, participants consistently stated that they wanted graphical and textual explanations of absolute risks provided together.[6] More research is needed, and we would also welcome feedback on your experience of using the NPC PDAs. Please send comments and suggestions of how our PDAs might be improved to feedback@npci.org.uk.

References

1. O'Connor AM, Bennett CL, Stacey D, et al. Decision aids for people facing health treatment or screening decisions. Cochrane Database of Systematic Reviews 2009, Issue 3. Art. No.: CD001431. DOI: 10.1002/14651858.CD001431.pub2

2. Weymiller AJ, Montori VM, Jones LA, et al. Helping patients with type 2 diabetes mellitus make treatment decisions. Arch Intern Med 2007;167:1076–1078.

3. Krones T, Heidemarie K, Sönnichsen A, et al. Absolute cardiovascular disease risk and shared decision-making in primary care: a randomised controlled trial. Ann Fam Med 2008;6:218–227

4. Schwartz LM, Woloshin S, Black WC, et al. The role of numeracy in understanding the benefit of screening mammography. Ann Intern Med 1997;127:966–972

5. Goodyear-Smith F, Arroll B, Chan L, et al. Patients prefer pictures to numbers to express cardiovascular benefit from treatment. Ann Fam Med 2008;6:213–217

6. Fortin JM, Hirota LK, Bond BE, et al. Identifying patient preferences for communicating risk estimates: A descriptive pilot study: BMC Medical Informatics and Decision Making;2001;v1

Additional resources

Here are some websites which you may find useful.

Information mastery skills floor of NPCi
http://www.npci.org.uk/therapeutics/mastery/mast2/room_mast2.php

Covers the basic skills of evidence-based medicine, including relative and absolute risks.

Understanding uncertainty http://understandinguncertainty.org/

Produced by the Winton programme for the public understanding of risk *based in the Statistical Laboratory in the University of Cambridge. The stated aim is 'to help improve the way that uncertainty and risk are discussed in society, and show how probability and statistics can be both useful and entertaining!' See especially '2845 ways to spin the risk'*
http://understandinguncertainty.org/node/233

Dr Chris Cates' EBM Website www.nntonline.net

The site addresses many aspects of EBM, and is the home of Visual Rx, the program used to create the Cates Plots in many of the NPC PDAs.

Cochrane decision aid registry http://decisionaid.ohri.ca/cochinvent.php

*The Cochrane Inventory, a resource for researchers, is a registry of **all** the decision aids identified to date by the Cochrane Systematic Review Group. It includes decision aids that are still under development and those that have been evaluated in research studies but are no longer available. The A to Z Inventory, a resource for patients, is a registry of available decision aids that meet certain minimum inclusion criteria.*