Debate & Analysis

Medical decision making and the importance of baseline risk

INTRODUCTION

There is general consensus that individual medical decisions should be made through a shared process between a patient and their clinician(s) with the goal of reaching a choice consistent with the patient's wishes.¹ The process asks clinicians to translate, in an understandable manner, the available knowledge that may affect a patient's decision.² Our message is that the baseline risk (BR) for the outcome of primary interest is necessary information for any treatment decision, yet often ignored in discussions regarding medical decision making.

Foreachpotentialtreatmentandoutcome, the patient needs to understand the severity, the time frame, and a measurement scale to compare treatment choices. A variety of summary effect measures have been established to help patients compare treatment choices, for example, relative measures, such as relative risk (RR) and relative risk reduction (RRR), and absolute measures, such as absolute risk reduction (ARR), also known as risk difference (RD). Similar information given in different forms may result in different decisions.³ Relative measures can be difficult to interpret,⁴ partly because patients need to know both the BR and the relative comparison, plus make the necessary multiplicative calculation to combine the two numbers. In 1988, Laupacis, Sackett, and Roberts recommended that clinicians translate risk contrasts to patients with a single, absolute number, that would incorporate 'both baseline risk without treatment and relative risk with treatment,' entitled, the 'number needed to treat' ($NNT = 1/RD$).⁵ The argument that NNT incorporates the BR is based on an assumption that the RR is constant across baseline risks for a particular disease and treatment. If RR were constant, then $RD = BR \times \text{constant}$. Thus NNT appears directly correlated with the BR, implying that the BR provides no further important information for patient decision making.⁶ The purpose of this essay is to demonstrate that BR may affect the value that patients associate with any summary measure of effect. Consequently, BR must be provided to make an informed medical decision.

HYPOTHETICAL SCENARIO

Imagine that you were diagnosed with cancer. You could either let the condition

Table 1. Five-year risk of death due to an illness with and without treatment, expressed as risk difference and number needed to treat

Scenario	5-year risk of death without treatment, ^a %	5-year risk of death with treatment, %	RD, %	NNT
A Outcome (death) likely	95	85	10	10
B Outcome (death) unlikely	15	5	10	10

^aBaseline risk. NNT = number needed to treat. RD = risk difference.

take its natural course or receive surgical treatment with the expected 5-year survival increasing by an absolute 10%. The surgery is 6-hours long, causes pain for 2-weeks, requires a 3-day hospital stay, and a 6-week convalescence. Assume no additional side effects. If absolute risk reduction (either RD or NNT) was the optimal measure for knowledge translation, then the patient would have the information needed for decision making: the outcome is serious (death), the effects (both desirable and undesirable) of the intervention are known, and NNT is 10.

Would a difference in BR alter one's treatment decision? Gyrð-Hansen *et al*⁷ queried 411 subjects about an example where $RD = 10\%$ and everything else was equal, 42% were more likely to take treatment when the BR was low (20/100) and 29% were more likely to take treatment when the BR was high (80/100). Of importance, only 28% were

either indifferent or did not know.⁷ In real-life one would normally only compare treatments for the same BR. The purpose of considering treatment decisions with different BR is to illustrate the importance of BR when making medical decisions.

Table 1 shows the calculations for a treatment that results in an NNT of 10 when the untreated 5-year risk of death is high (95%, scenario A) or low (15%, scenario B). If NNT (and/or RD) could be interpreted independently of BR, then it would be irrational to prefer treatment in one scenario more than in the other scenario. The value one would be willing to pay for treatment (a common method of assessing preferences in research on decision making) would be the same in each scenario (Figure 1). Any difference in treatment choice between scenarios A and B would seem illogical and has been categorised as a cognitive bias.⁸ The remainder of this commentary outlines

Figure 1. Value willing to pay if absolute risk difference had meaning independent of baseline risk.

several rational reasons why, given identical NNT and/or RD, individuals may make different choices due to differences in BR.

RATIONALE FOR THE NEED TO KNOW BASELINE RISK

The added value of zero-risk

Consider a situation where you may develop two different diseases independently of each other that affect your quality of life in similar ways. You have the option of either improving your disease-free probability from 50% to 60% for one disease, or improving your disease-free probability from 90% to 100% for a second disease. In both cases, the RD is 10%. Individuals who are prone to anxiety may gain extra value when uncertainty is eliminated with a zero-risk (as in the second disease).⁹ For these patients, it may even be in their best interest to prefer improving disease-free probability from 90% to 100% compared with a larger RD; for example, from 50% to 65%.

Starting point

In some contexts, it may also be considered rational to prefer a choice that does not lead to zero-risk. Imagine a scenario of Russian roulette using a gun with six chambers, but differing numbers of starting bullets.¹⁰ Is the value associated with removing a bullet the same if (1) the gun started with one bullet versus (2) the gun started with four bullets? If zero-risk is important, one may pay more if there were only one bullet. However, according to the classic economic theory of diminishing marginal value, it is rational to pay more when there are four bullets.¹¹ The value of money is lower if there is a higher probability of death (starting with four bullets) compared to a lower probability of death (starting with one bullet). Although each bullet reduces the probability of death by an absolute 17% (that is, $1/6 = 0.17$), dead subjects cannot spend money.

As a clinical example, what if the treatment needed to obtain the decrease of 10% in absolute risk of death shown in Table 1 would cost the patient a dollar amount equivalent to their entire financial savings? And, that these savings were about to go toward the patient's dream of starting a business. It may be rationale for a person facing scenario A (high risk for death) to sacrifice their business dream as the dream depends on them living beyond 5 years. Conversely, a person facing scenario B (low risk for death) may be more likely to take the gamble that the condition will not lead to death and use the money for the business. The decrease of 10% in

absolute risk of death is a relatively greater value when the baseline risk is higher.

Context of uncertainty

Clinicians aim to know the expected average outcome for the patient of interest. We anticipate that patients will generally choose the option that predicts their best outcome, on average. However, medical decisions are made in the context of probability for a one-time event, that is, in the face of uncertainty. What would be irrational in the context of two certain choices could be rational in the context of uncertainty. This is most clearly shown using a gambling analogy. Given a choice between either losing \$3200 or losing \$3000, one would undoubtedly choose the latter. Yet, in one study, 92% of individuals chose an 80% chance of losing \$4000 (20% chance of losing nothing, that is an average loss of \$3200) over certainty at losing \$3000.¹⁰ Losing the average is not an option for the individual in the context of a one-time gamble. If a loss of \$3000 would put a person into bankruptcy, then the rational choice is to hope for the 20% chance at not losing any money.

In clinical terms, some would likely opt for treatments that are certain to improve their quality of life by 20% over treatments that would improve their quality of life by 30% on average, but that may have no effect at all.

Asymmetry of values

When the same subjects in the previous financial example (dealing with loss) were provided with a choice of certain gain versus possibility of gain, the results were reversed. When dealing with gain, the vast majority chose a certain gain of \$3000 over an 80% chance of gaining \$4000 (that is, an average gain of \$3200).¹⁰ Clinically, the asymmetry of values for losses and gains means one should not simply add up the absolute differences across risks and benefits of treatment as proposed by some.⁶

Consideration of definite losses

Surgical treatment entails definite losses that people try to avoid. Surgery is a complex intervention that includes not only the surgery itself, but also a hospital stay, pain, and a scar. These additional components are part of the intervention, yet not generally considered side effects in studies or systematic reviews. These components should be taken into account when discussing medical decisions because they carry value. A person at lower risk for an outcome may be more likely than a

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person at higher risk to accept the gamble of no treatment in order to avoid these treatment associated inconveniences, that is, the value is BR dependent.

CONCLUSION

The process of shared medical decision making requires that decisions be made with consideration of the patient's wishes. The clinician, to the best of their ability, must translate knowledge about the expected differences in treatment options. This knowledge appears in the medical literature in the form of summary effect measures, such as RR, RRR, RD, or NNT. This essay discussed several rational reasons why differences in BR may affect the value of any singular comparison between treatment options and is therefore essential in patient care discussions. Since BR is necessary for a patient to make an informed medical decision, we believe that the simplest method for risk comparison is to present the risk at baseline and the risk under treatment. All other summary effect measures should be considered adjunct information.

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