

## ENDGAMES

## STATISTICAL QUESTION

## Absolute and relative risks

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Researchers evaluated the effectiveness of a single application of topical chloramphenicol ointment in preventing wound infection after minor dermatological surgery. A randomised placebo controlled, double blind, multicentre trial was performed. Placebo was a single application of paraffin ointment. A total of 972 minor surgery patients with high risk sutured wounds were recruited and randomised to a single topical dose of chloramphenicol ointment (n=488) or placebo (n=484). The primary outcome measure was incidence of infection on the agreed day of removal of sutures or sooner if the patient re-presented with a perceived infection.<sup>1</sup>

The researchers reported that the percentage of participants with an infection was significantly lower in the chloramphenicol group than in the placebo group (6.6% versus 11%; P=0.01). The relative risk of wound infection for chloramphenicol compared with placebo was 0.6 (95% confidence interval 0.39 to 0.91). The number needed to treat was 22.8.

Which of the following statements, if any, are true?

- Each treatment group estimated the population at risk.
- The intervention resulted in an absolute risk reduction of 0.044 compared with placebo.
- The intervention resulted in a relative risk reduction of 0.4 compared with placebo.

## Answers

Statements *a*, *b*, and *c* are all true.

In medicine, absolute risk is a term often used to describe the probability that a disease or outcome will occur. Sometimes absolute risk, often referred to simply as risk, is expressed as a percentage. In the above example the absolute risk of infection in the chloramphenicol group was 0.066 (or 6.6%), compared with 0.11 (or 11%) for placebo. For each treatment group the risk of infection represented the incidence, because it was derived as the ratio of patients who developed an infection to all those who could have developed an infection during the study period.

It was assumed that the patients recruited to the study were a representative sample from the population of minor dermatological surgery patients with high risk sutured wounds.

After randomisation to treatment, each group of patients would have been similar to the other group and to the combined sample. Therefore, each treatment group would have been representative of the population. The trial was a prospective study, and all patients were at risk of developing an infection. Therefore, the risk of infection for each group would have estimated the population risk if the entire population had been treated with chloramphenicol or placebo. Hence each treatment group is said to estimate the population at risk (*a* is true).

The percentage infected was 11% in the placebo group and 6.6% in the topical chloramphenicol group. This represented an absolute reduction in risk of infection of 0.044 (or 4.4%), referred to as the absolute risk difference or absolute risk reduction (*b* is true). Therefore, treatment with chloramphenicol was beneficial. A measure of the benefit of treatment is provided by the statistic the number needed to treat, described in a previous question.<sup>2</sup> The number needed to treat is derived as the reciprocal of the absolute risk reduction; in the example above it is equal to  $1 \div 0.044 = 22.73$ . Hence, for every 23 patients treated with chloramphenicol there would be one fewer patient with an infection than if those same patients had been treated with placebo.

The relative risk was derived to compare the risk of infection between treatment groups. Relative risk, described in a previous question,<sup>3</sup> is the ratio of two absolute risks. In the example above, the relative risk was calculated as the ratio of risk of infection if patients were treated with chloramphenicol to the risk if they were treated with placebo. Patients treated with chloramphenicol had a risk 0.6 times that of those treated with placebo—that is, their risk was reduced by 40% relative to those treated with placebo. This represents a relative risk reduction of 0.4 or 40% (*c* is true).

When reporting the benefits of topical chloramphenicol ointment in reducing the rate of infection in minor surgery patients with high risk sutured wounds, it was essential that the absolute risks of infection were presented in addition to the relative risk. The number needed to treat is also a useful measure of clinical significance that should always be given. Presenting all measures of risk facilitates informed decision making regarding the effectiveness of treatment. Clinical decision making will

obviously also take into account the severity of infection and potential consequences of not treating, together with consideration of any side effects and the cost of treatment.

The presented absolute risks permitted an evaluation of the severity of disease without treatment, as measured by administration of placebo, and the effectiveness of treatment with chloramphenicol. Often studies report only relative risks, and this may make treatments seem more effective than they actually are. In the above example, treatment resulted in a 40% reduction in risk of infection compared with placebo. This may sound impressive; but when viewed alongside the absolute risk reduction of 4.4% (from 11% to 6.6%), the benefit of treatment may seem small and not considered cost effective or worthwhile. Indeed, the researchers commented that the absolute reduction in infection rate was statistically but not clinically significant.

The above example illustrates the importance of presenting absolute risks in addition to relative risk. A large reduction in relative risk represented a relatively small absolute change in

risks as a result of treatment. To illustrate this point further, consider the fictitious example of a similar relative risk reduction being observed with a treatment for another disease or outcome. If the absolute risk without treatment was very small to start with—for example, 0.001—then a 40% relative risk reduction would probably be of little consequence, although the importance of treatment would be part of the informed clinical decision making process described above.

Competing interests: None declared.

- 1 Heal CF, Buettner PG, Cruickshank R, Graham D, Browning S, Pendergast J, et al. Does single application of topical chloramphenicol to high risk sutured wounds reduce incidence of wound infection after minor surgery? Prospective randomised placebo controlled double blind trial. *BMJ* 2009;338:a2812.
- 2 Sedgwick P. Number needed to treat I. *BMJ* 2011;342:d2463.
- 3 Sedgwick P, Marston L. Relative risks. *BMJ* 2010;341:c3983.

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