INFORMATION POINT:

Type I and Type II errors

When we carry out a statistical test we are making a decision between two statements, one called the null hypothesis (H_0) and the other called the alternative hypothesis (H_1). The null hypothesis will generally be a statement of no change or no difference or no association, whilst the alternative is some other statement of interest. For example, in the article above the null hypothesis would be that a nurse-initiated Telephone Reassurance Programme would have no influence on post-discharge problems reported by recently discharged ophthalmic patients. A more detailed explanation of hypotheses, including examples, is given in Crichton (1998). In the light of the evidence we have – our data – we assess the plausibility of the null hypothesis, and if it seems implausible we will reject H_0 in favour of H_1. If the data seem consistent with the null hypothesis then we do not reject H_0. The difficulty is that we might make a mistake, that is the data might suggest H_0 is untrue when in fact it is correct, or the data might suggest we keep H_0 when in fact H_1 is correct.

A Type I error occurs when we incorrectly reject H_0, that is we reject H_0 when in fact it is true. A Type II error occurs when we incorrectly retain H_0. Ideally we would like the probability of making both types of error to be small. Unfortunately if we try to reduce the Type I error then this will increase the Type II error. The only way of simultaneously reducing the Type I and Type II error is to increase the size of the study. That is we get more evidence on which to base our decision, so we should be more certain of making the correct decision.

The probability of a Type I error is often referred to as the level of significance, commonly identified as α and often set at 0.05 or 5%. The Type II error is commonly identified as β, but usually studies discuss power, which is $1-\beta$ rather than Type II error. Power is a measure of how likely a study is to produce a statistically significant difference of a given magnitude. Selecting an appropriate level of Type I and Type II error is an important component of the calculation of appropriate study size. This is discussed further in Crichton (1998) and Altman (1991).

Further reading

Altman D.G. (1991) *Practical statistics for medical research*. Chapman and Hall, London.

Crichton N.J. (1998) Statistical considerations in design and analysis. In *Research and development in clinical nursing practice* (Roe B. & Webb C., eds). Whurr, London.

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