The results of primary research should be systematically reviewed to identify promising implementation techniques and areas where more research is required.[3] Undertaking reviews in this area is difficult because of the complexity inherent in the interventions, the variability in the methods used, and the difficulty of generalising study findings across healthcare settings. The Cochrane Effective Practices and Organisation of Care Review Group is helping to meet the need for systematic reviews of current best evidence on the effects of continuing medical education, quality assurance, and other interventions that affect professional practice. A growing number of these reviews are being published and updated in the *Cochrane Database of Systematic Reviews*.[4 31]

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Statistics Notes

Time to event (survival) data

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continued over

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In many medical studies an outcome of interest is the time to an event. Such events may be adverse, such as death or recurrence of a tumour; positive, such as conception or discharge from hospital; or neutral, such as cessation of breast feeding. It is conventional to talk about survival data and survival analysis, regardless of the nature of the event. Similar data also arise when measuring the time to complete a task, such as walking 50 metres.

The distinguishing feature of survival data is that at the end of the follow up period the event will probably not have occurred for all patients. For these patients the survival time is said to be censored, indicating that the observation period was cut off before the event occurred. We do not know when (or, indeed, whether) the patient will experience the event, only that he or she has not done so by the end of the observation period.

Censoring may also occur in other ways. Patients may be lost to follow up during the study, or they may experience a "competing" event which makes further follow up impossible. For example, patients being followed to a cardiac event may die from some other disease or in an accident.

In most survival studies patients are recruited over a period and followed up to a fixed date beyond the end of recruitment. Thus the last patients recruited will be observed for a shorter period than those recruited first and will be less likely to experience the event. An important assumption, therefore, is that patients' survival prospects (prognosis) stay the same throughout the study (although this will not matter too much in a randomised trial). We also assume that patients lost to follow up have the same prognosis as those remaining in the study.

Table 1 shows the survival times of 44 patients in a randomised trial. Several patients in each group were still alive at the end of the study, while one was lost to follow up. In such a study we wish to compare the survival times of the two groups of patients. Statistical methods such as *t* tests cannot cope with the uncertainty in the data caused by censoring. Patients with censored data contribute valuable information and they should not be omitted from the analysis. It would also be wrong to treat the observed time (at censoring) as the survival time. We cannot tell, for example, whether the patient in the control group who was still alive at 127 months would have lived longer than the patient in the prednisolone group who died after 143 months. Rather we need recourse to a specialised set of statistical methods that have been developed for handling such data. We shall consider methods for graphical display and analysis of survival data in subsequent Statistics Notes.

Implicit in the preceding discussion is that survival should be evaluated in a cohort of patients followed forwards in time from a particular time point, such as diagnosis or randomisation, even if the cohort is identified retrospectively. An alternative, and potentially highly misleading, approach is to take a group of people experiencing the event of interest, perhaps in a certain time interval, and ascertain the elapsed time since the start of the relevant preceding time span. For example, we might take all newly diagnosed diabetics and find out when they first experienced certain symptoms. Similarly we might take birth as the start of the time period of interest for a group of individuals who have died and investigate associations between age at death and other variables.

Analyses of such data can cause serious problems. A good example is the highly dubious finding that left handed people die on average seven years younger than right handed people.[2] In this study those dying at old ages were survivors from a cohort born 70 or more years ago while those dying young may have been born at any time, and so on average will have been born later. Such studies make strong implicit assumptions—in essence that the prevalence of the risk factor(s), the characteristics of the population at risk, and the survival (prognosis) remain unchanged over many decades.[3] These assumptions will usually be untenable and may also be untestable. Using this study design we would certainly find that people who use electric guitars or even personal computers die much younger than those who do not. The differing longevity in relation to handedness[2] would have arisen if the prevalence of left handedness had increased over the past 80 years. Proper prospective studies have found no evidence of an effect of handedness on lifespan.[4,5]

The same design was used in a study of long term survival in prostate cancer. All patients dying in a three year period who had been treated with palliative intent were "followed from death to diagnosis,"[6] a period of up to 30 years. The authors reported that the proportion of deaths due to cancer increased with length of survival. This finding cannot be trusted because of the problems noted above, which are common to all such studies.[3] Subjects with long survival times must have been diagnosed decades ago, whereas those with short survival times may include some patients diagnosed recently. The observed association could be a spurious consequence of improved treatment, earlier diagnosis, or some other change over time. The same error was seen recently in the *BMJ*.[7]

Retrospective studies can be valuable, but this design should be avoided when studying survival times. Whenever possible times to an event of interest should be studied in a definable cohort of individuals followed forwards in time.

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Endpiece

Hopefully, the last word

Since at least the 17th century, certain adverbs in -ly have acquired the ability to qualify a predication or assertion as a whole. Such adverbs are elliptical uses of somewhat longer phrases.... In the 20th century there has been a swift and immoderate increase in the currency of [such] adverbs [which] include actually, basically, frankly, hopefully, regretfully, strictly, and thankfully. Suddenly, round about the end of the 1960s, and with unprecedented venom, a dunce's cap was placed on the head of anyone who used just one of them—hopefully—as a sentence adverb.... Conservative speakers, taken unawares by the sudden expansion of an unrecognised type of construction, have exploded with resentment that is unlikely to fade away before at least the end of the 20th century.

Robert Burchfield,
The New Fowler's Modern English Usage
(Oxford: Clarendon Press, 1996)

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Table 1 Survival times (months) of 44 patients with chronic active hepatitis randomised to receive prednisolone or no treatment[1]

Prednisolone (n=22)	Control (n=22)
2	2
6	3
12	4
54	7
56†	10
68	22
89	28
96	29
96	32
125*	37
128*	40
131*	41
140*	54
141*	61
143	63
145*	71
146	127*
148*	140*
162*	146*
168	158*
173*	167*
181*	182*

*Still alive at time of analysis.
†Lost to follow up.