by 25% to 33% overall. Of more importance is that the proportion of children with extended illness—that is, those who do not experience signs of improvement until after the fourth day of illness—was reduced from 20% to 3% in placebo controlled clinical trials.^{1,3} In other words, those who need it most benefit most. What price tag can we attach to that?

D J Paynton's family probably did not experience the usual situation of secondary cases in the family being more severe than the index case. My family was less fortunate. One winter before oral acyclovir was available my three children had chickenpox one after the other in painfully slow succession. My son, the tertiary case, was nearly admitted to hospital because of central nervous system complications that were, in retrospect, due to a concomitant infection with influenza A virus.

The service implication of an additional treatment option is a valid concern. My suggestion would be to set up a triage system so that only questionable cases need be seen by a practitioner. In my experience, the parents or guardians are reliable at recognising chickenpox, especially after they have suffered through the index case.

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- 1 Balfour HH Jr, Kelly JM, Suarez CS, Heussner RC, Englund JA, Crane DC, et al. Acyclovir treatment of varicella in otherwise healthy children. *J Pediatr* 1990;116:633-9.
- 2 Dunkle LM, Arvin AM, Whitley RJ, Rotbart HA, Feder HM, Feldman S, et al. A controlled trial of acyclovir for chickenpox in normal children. *N Engl J Med* 1991;325:1539-44.
- 3 Balfour HH Jr, Rotbart HA, Feldman S, Dunkle LM, Feder HM Jr, Prober CG, et al. Acyclovir treatment of varicella in otherwise healthy adolescents. *J Pediatr* 1992;120:627-33.

Number needed to treat

Absolute risk reduction may be easier for patients to understand

EDITOR,—I strongly support the use of absolute risk rather than relative risk in clinical decision making¹ as the higher the patient's risk before treatment the greater the benefit of treatment. In New Zealand clinical guidelines for the management of mildly raised blood pressure,² the detection and management of dyslipidaemia,³ and the use of hormone replacement therapy⁴ have explicitly used the concept of absolute risk as a decision making tool. This concept, however, has been expressed as an absolute risk reduction rather than "numbers needed to treat." This absolute risk reduction is expressed in terms of the numbers of events prevented per 100 people treated.

If long term hormone replacement therapy is used as an example we can see how it is possible to weigh up the benefits and risks of treatment with this approach. For this example I have assumed from clinical trials that long term treatment with oestrogen alone reduces hip fractures by 25% and coronary heart disease by 35% and increases breast cancer by 25%.⁵ Giving hormone replacement therapy for 15 years to 100 New Zealand women from the age of 50 would be expected to prevent roughly two myocardial infarctions, cause about one case of breast cancer, and confer little or no benefit on hip fracture. After 25 years (to age 75) the net difference in events would increase: for every 100 women given hormone replacement therapy there would be six fewer myocardial infarctions, one fewer hip fracture, and one to two additional cases of breast cancer. Benefits for hip fracture become greater after 75 years of age, when the risk of hip fracture increases steeply. This model may be modified for patients at different baseline risk.

As a general practitioner, I helped to develop the

guidelines on hormone replacement therapy⁴ and have informally evaluated how useful general practitioners find the concepts of numbers needed to treat and absolute risk reduction. Twenty general practitioners were asked in a pilot study of future guidelines on the management of mildly raised blood pressure which approach they would prefer in clinical practice. All found tables of absolute risk reduction, expressed in terms of the number of events prevented per 100 people treated, more useful than numbers needed to treat.

The concept of numbers needed to treat is useful for clinicians, policymakers, and economists illustrating the clinical and resource implications of treating patients with different baseline risks. When weighing up the benefits and risks of treatments with individual patients I have found that patients are better able to personalise information about treatment when the concept of absolute risk reduction is used. To promote the understanding and use of absolute risk in the clinical setting I recommend the use of tables of absolute risk reduction.

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- 2 Jackson R, Barham P, Bills J, Birch T, McLennan L, MacMahon S, et al. Management of raised blood pressure in New Zealand: a discussion document. *BMJ* 1993;307:107-10.
- 3 Mann JI, Crooke M, Fear H, Hay DR, Jackson RT, Neutze JM, et al. Guidelines for detection and management of dyslipidaemia. *NZ Med J* 1993;106:133-41.
- 4 MacMahon S, North D. *Hormone replacement therapy. A consensus development conference report to the National Advisory Committee on Core Health and Disability Support Services*. Wellington: Core Services Committee, 1993.
- 5 Grady D, Rubin SM, Petitti DB, Fox CS, Black D, Ettinger B, et al. Hormone replacement therapy to prevent disease and prolong life in postmenopausal women. *Ann Intern Med* 1992;117:1016-37.

Risk measures expressed as frequencies may have a more rational response

EDITOR,—Richard J Cook and David L Sackett propose that the number needed to treat (to avoid an adverse event) should be used as a measure of the efficacy of treatment in reducing medical risks.¹ This measure has advantages over probability measures (for example, reduction in relative risk) as it conveys both statistical and clinical significance.

A treatment that reduces deaths by 50% sounds better than one that reduces deaths by 5%, yet the latter treatment might be more valuable than the former: reducing a tiny risk by 50% might be trivial relative to reducing a large risk by 5%. The number needed to treat reflects the incidence and is more relevant for medical decision making.

Studies of medical decision making support use of this measure. Several studies show that experts—including medical clinicians—have great difficulty reasoning with probabilities.² For instance, Eddy asked 100 physicians questions of the following type. The prevalence of breast cancer is 1% (in a specified population). The probability that the result of mammography is positive if a woman has breast cancer is 79% and 9.6% if she does not. What is the probability that a woman with a positive result actually has breast cancer?³

Eddy reports that 95 physicians estimated the probability P (cancer and positive result) to be about 75%; the correct probability is only about 8%. Dawes reports a surgeon in the United States performing preventive mastectomies on the basis of this faulty logic.⁴

Nevertheless, the same problems presented by use of frequencies rather than probabilities are

solved relatively easily. Gigerenzer reviewed several studies that show a dramatic improvement in reasoning with probabilities if they are converted into frequencies. For instance, we can change the example above as follows. Imagine 100 people (think of a 10×10 grid). We expect that one woman has cancer and a positive mammogram. Also we expect that there are 10 more women with positive mammograms but no cancer. Thus we expect 11 people with positive mammograms. How many women with positive mammograms will actually have cancer?

With frequencies you immediately "see" that only about one out of 11 women with a positive result will have cancer. Although staff of Harvard Medical School have difficulties with the probability version—most give wrong answers⁵—most undergraduates readily provide the correct answer to similar problems constructed with frequencies.⁶

Psychological research suggests that measures of risk communicated in terms of frequencies rather than probabilities will be more readily understood and rationally responded to.

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- 2 Ayton P. On the competence and incompetence of experts. In: Wright G, Bolger F, eds. *Expertise and decision support*. London: Plenum, 1992:77-105.
- 3 Eddy DM. Probabilistic reasoning in clinical medicine: problems and opportunities. In: Kahneman D, Slovic P, Tversky A, eds. *Judgement under uncertainty: heuristics and biases*. Cambridge: Cambridge University Press, 1982:249-67.
- 4 Dawes RM. *Rational choice in an uncertain world*. Cambridge: Cambridge University Press, 1988.
- 5 Gigerenzer G. Why the distinction between single event probabilities and frequencies is important for psychology (and vice-versa). In: Wright G, Ayton P, eds. *Subjective probability*. Chichester: Wiley, 1994:129-61.

Computer software that can calculate confidence intervals is now available

EDITOR,—Richard J Cook and David L Sackett usefully show applications of the number needed to treat statistic for clinical decision making.¹ Confidence intervals are an important aid to meaningful inference from this statistic.² Mention in the paper of the construction of confidence intervals for the number needed to treat is limited to their direct inverse relation with confidence intervals for the absolute risk reduction. In statistical terms, the absolute risk reduction is analogous to the comparison of unpaired proportions. A widely published formula for approximate confidence intervals for the difference between unpaired proportions is often used to calculate confidence intervals for absolute risk reduction and thence number needed to treat.³ With large numbers, such as those quoted by Cook and Sackett, this approximation is acceptable, but with smaller numbers it is unreliable.⁴

This problem can be overcome with computer software that uses robust iterative methods to construct these confidence intervals. Arcus Pro-Stat version 3.23 provides "near exact" confidence intervals for relative risk, relative risk reduction, absolute risk reduction, number needed to treat, and other statistics used in clinical epidemiology (Medical Computing, Aughton, Lancashire). Any reader who needs computer software for these calculations can obtain a royalty free copy of a limited version of Arcus Pro-Stat for IBM compatible computers by contacting me.

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- 2 Laupacis A, Sackett DL, Roberts RS. An assessment of clinically useful measures of the consequences of treatment. *N Engl J Med* 1988;318:1728-33.
- 3 Armitage P, Berry G. *Statistical methods in medical research*. 3rd ed. Oxford: Blackwell, 1994.
- 4 Anbar D. On estimating the difference between two probabilities, with special reference to clinical trials. *Biometrics* 1983;39: 257-62.

Number who benefit per unit of treatment may be a more appropriate measure

EDITOR,—Like Richard J Cook and David L Sackett¹ and many others,^{2,3} we are enthusiastic about the advantages of using the “number to treat” as a clinically useful measure of the effect of treatment. It is not, however, a universal panacea. In research into health services in which the unit of treatment or intervention and cost is a group or population (such as a regional trauma centre) rather than an individual, it surely remains more appropriate to report the number who benefit per unit of treatment rather than the number of treatments per unit of benefit.

Furthermore, since the number needed to treat is the reciprocal of a more traditional measure of effectiveness—absolute risk reduction—those who use it should be aware of the statistical tricks that reciprocals can play. Most importantly, the average of the reciprocals is not the same as the reciprocal of the average. For example, if two trials of identical size and quality are conducted, one of which shows an absolute risk reduction of 0.1 and therefore a number needed to treat of 10 and the other an absolute risk reduction of 0.025 and associated number needed to treat of 40, what is the best overall estimate of the number needed to treat? Averaging the figures gives an overall number needed to treat of 25, while averaging the absolute risk reduction and then taking the reciprocal gives a number needed to treat of 16. If the trials were identical and conducted in the same population the best estimate is obtained by pooling the results, yielding a number needed to treat of 16.

The lesson for combining trial results is that when taking an (appropriately weighted) arithmetic mean is the correct method for combining absolute risk reductions it is not the correct method for combining numbers needed to treat; these must be calculated by taking the reciprocal of the summary absolute risk reduction.

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- 1 Cook RJ, Sackett DL. The number needed to treat: a clinically useful measure of treatment effect. *BMJ* 1995;310:452-4. (18 February.)
- 2 Muir Gray JA. Is it worth doing? *Bandolier* 1995;2(1):1.
- 3 Guyatt GH, Cook DJ, Jaeschke R. How should clinicians use the results of randomised trials? *ACP Journal Club* 1995;122: A12-3.

Making routine data adequate to support clinical audit

EDITOR,—The message of our editorial on routine clinical data seems to have been misunderstood and may need restating.¹ We have no argument with J G Williams and Michael Joffe and colleagues when they note that data systems that are “owned” by clinical staff are likely to be of higher quality than those that are not.² Indeed, we said this in the editorial. The relevant point, which the authors of both letters have missed, is that the value of clinical

data, whether they are owned by clinicians, managers, or anyone else, is limited by differences in what the diagnostic codes actually represent. Unfortunately, doctors often disagree about diagnoses. As long ago as 1965 Geoffrey Rose showed that three cardiologists could agree about whether 57 men with chest pain had angina in only 75% of cases.³ More recently, Sackett *et al* have provided many other examples.⁴ Such disagreements arise at least partly because doctors use different diagnostic criteria and their decisions are subject to a variety of biases. While we are never likely to achieve universally agreed criteria for all diagnoses, we need at least to recognise that this is a problem and, when appropriate, to make a start at a local level with the commoner conditions so that those working in the same hospital or general practice speak the same language.

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- 1 McKee M, Dixon J, Chenet L. Making routine data adequate to support clinical audit. *BMJ* 1994;309:1246-7. (12 November.)
- 2 Making routine data adequate to support clinical audit [letters]. *BMJ* 1995;310:665-6. (11 March.)
- 3 Rose GA. Ischaemic heart disease. Chest pain questionnaire. *Millbank Mem Fund Q* 1965;43:32-9.
- 4 Sackett DL, Haynes RB, Guyatt GH, Tugwell P. *Clinical epidemiology: a basic science for clinical medicine*. Boston: Little, Brown, 1991:24-49.

Risk factors for breast cancer

EDITOR,—In their reply to my letter on risk factors for breast cancer¹ McPherson and colleagues entirely miss the crucial difference between natural progesterone and progestogens.² To quote from my original letter: “synthetic progestogens have very different effects on the body from progesterone itself.” As the administration of progestogens results in a lowering of serum progesterone concentrations I entirely agree that giving progestogens to women at high risk of breast cancer is potentially hazardous.

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- 1 Lewis PJ. Risk factors for breast cancer. *BMJ* 1994;309:1662. (17 December.)
- 2 McPherson K, Steel CM, Dixon JM, Miller WR. Risk factors for breast cancer. *BMJ* 1995;310:598. (4 March.)

Electoral reform of GMSC

EDITOR,—Many people may think that, in his quest for electoral reform of the General Medical Services Committee, David Roberts has followed a strange route, but that does not invalidate his arguments in favour of reform.¹ There is a real feeling at grass roots level in general practice that the GMSC is not truly representative of general practitioners' views, and whether this is true or false it is being used extensively as propaganda against the GMSC.

Evidence suggests that the present electoral college system of electing regional members to the committee throws up some odd results. To use the argument that local medical committees fund the GMSC and therefore have some sole right to elect its members is clearly fallacious as it is the constituents of the local medical committees whose funds are used for this purpose. As chairman of a local medical committee I would welcome open elections for the regional seats as I believe that—as

for the regional elections for the BMA's council—the process would be more transparently democratic.

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- 1 Roberts D. Electoral reform of GMSC. *BMJ* 1995;310:938. (8 April.)

Medical students fight increase in course fees

Will discriminate against less affluent applicants

EDITOR,—We were concerned to read about the expected rise in fees for medical students.¹ As recently qualified mature students, we are aware of the difficulty of raising money to fund a medical course, even with the fees at around £700 a year, as they were for us. An increase in the fees will make entry into medical school as a mature student possible only for those from affluent backgrounds.

The current exodus of disillusioned doctors from the profession must partly be due to many of those people having chosen their career at too early an age. At a time when there is a shortage of junior doctors, admission tutors would be well advised to consider sources of potential medical students other than the 18 year olds heading for high grades at A level. This might mean foraging among the ranks of graduates. As the General Medical Council has said, “opportunities should be afforded to those who decide on a career in medicine after gaining experience in other fields.”²

For this to be possible, fees should be kept to a minimum for those students financing themselves. In addition, more positive measures need to be taken to encourage a greater diversity of people to enter the profession—for example, the setting up of a central educational fund specifically aimed at mature medical students.

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Amended funding has forced college to this position

EDITOR,—Linda Beecham's item concerning increases in course fees for medical students who are pursuing their medical course as a second degree refers to a doubling of fees for the clinical course at King's College London.¹ I would like to clarify the situation. For a limited period in the early 1990s higher education institutions were provided with additional funds to allow them to compensate home students who were responsible for funding their own course (usually students doing a second degree course) who would be adversely affected by the introduction of new fee bands. The fee band rate for clinical subjects was considerably higher than the rate that had applied previously because funding from the Higher Education Funding Council for England was reduced commensurately.

In common with other institutions King's College undertook to protect students who were continuing to finance themselves from the impact of the introduction of the increased fees in the new bands. Also in common with other institutions, while funding was available we attempted to protect new entrants similarly, having in mind the great difficulties experienced by students who