given for early communication is that information leaking out during the long lead time to full publication could be distorted and cause much confusion.

If one accepts that very occasionally there are grounds for phased release of results, how should the early announcement be made? Brief statements are unsatisfactory. The latest guidelines from the International Committee of Medical Journal Editors[5] should remove fears that early release under any circumstances would preclude publication in a peer-reviewed journal. The announcement should contain adequate detail for clinical workers to assess the results for themselves. Some groups (the Oxford Clinical Trialists Group, for example) choose to make their findings public at scientific meetings at which they distribute detailed preliminary information to attenders and brief the press carefully. The arguments for this mode of release are that, when properly briefed, journalists can produce accurate, balanced reports; that many clinicians do not read peer-reviewed journals; and that dissemination of the results of important trials through the media may accelerate their otherwise slow translation[6] into clinical practice. Our view is that the preliminary information should be given in a medical journal that is readily accessible world wide.

Preliminary announcements can generate needless alarm, undue optimism, or mere confusion. Who bears the responsibility? At worst, as happened with the Concorde report, different parties to the trial may offer different interpretations. These things are best planned in advance, before the data emerge; and, as with a formal paper, the authors, having agreed the wording, must present a united front. Theirs is the responsibility.

The Lancet

1 Aboulker J-P, Swart AM. Preliminary analysis of the Concorde trial. *Lancet* 1993; 341: 889–90.
2 Volberding PA, Lagakos SW, Koch MA, et al. Zidovudine in asymptomatic human immunodeficiency virus infection: a controlled trial in persons with fewer than 500 CD4-positive cells per cubic millimeter. *N Engl J Med* 1990; 332: 941–49.
3 Thompson DF. Understanding financial conflicts of interest. *N Engl J Med* 1993; 329: 573–76.
4 Freestone DS, Mitchell H. Inappropriate publication of trial results and potential for allegation of illegal share dealing. *BMJ* 1993; 306: 1110–24.
5 International Committee of Medical Journal Editors. Uniform requirements for manuscripts submitted to biomedical journals. Philadelphia: URM Secretariat Office, 1993.
6 Fletcher A, Spiegelhalter D, Staessen, Thijs L, Bulpitt C. Implications for trials in progress of publication of positive results. *Lancet* 1993; 342: 653–57.

On practise, practice, and praxis

Practice makes perfect. Or is it practise? Or perhaps praxis? Without our worrying about the etymological differentiation of Middle English *practyse*, mediaeval Latin *practizare*, and Greek *praxis* (πρᾶξις), the distinctions between the words emphasise important questions about the psychological mechanisms by which technical and professional expertise originates in and is maintained by practitioners. Doctors have many complex skills—mechanical, intellectual, and social—which they use to *practise* (*Oxford English Dictionary*: "To exercise, pursue [an occupation, profession or art]"). Those skills are not inborn but arose because of extended *practice* ("Exercise . . . for the purpose of attaining proficiency") during undergraduate and postgraduate training. And the skills are partly maintained by the daily activities, the *praxis* ("action"), of the doctor's routine work. Is it practice or praxis that best improves practise?

Ericsson and colleagues[1] lately conducted an extensive review of the role of practice in improving skilled performance. The studies of Bryan and Harter[2,3] in the 1890s into the performance of morse code key operators showed that skilled performance often reaches suboptimum plateaus, despite extensive daily use of the skill, but that specific training can further improve performance. Ericsson et al, studying musicians, distinguish deliberate practice—"activities that have been specially designed to improve the current level of performance"—from other everyday activities, including "public performance, competitions, services rendered for pay, and other activities directly motivated by external rewards", in which learning is only an indirect result. They describe how professional violinists and pianists average about 30 hours of deliberate practice each week, so that even by age 20 they have accumulated over 10 000 hours of practice, by comparison with only 3 or 4 hours per week in talented amateurs, who by age 20 had totalled about 1500 hours. Similarly, top tennis players, swimmers, and athletes practise about 20 hours per week and, not surprisingly, the best predictor of performance in athletic competitions and marathons is frequency of training. The study of expertise is a serious business,[4,5] and research shows that 10 000 hours are required to produce an expert at anything—from chess playing[6] to juggling. A quick calculation reveals that a medical undergraduate studying 40 hours a week 50 weeks a year for 5 years to become proficient in the generic expertise[7] of medicine, should have put

in 10 000 hours of work; and 10 years of postgraduate study, at 20 hours a week, will give the additional 10 000 hours necessary for producing a specialist.

Ericsson et al argue that only deliberate practice can improve skilled performance; routine praxis has no effect beyond a certain level. Why is deliberate practice so important? Motivation is part of the explanation. But more important is that deliberate practice allows complex skills to be dissected apart, and their components practised in isolation; it allows a reflective contemplation of strategy and a trying out of novel and different approaches. Most important, particularly if carried out with a skilled trainer, practice not only provides specific feedback on the separate parts of a task but also insight into the relations between the components, thereby allowing development of intellectual schemas for predicting the consequences of changes in those components. Experts are often remarkably bad at knowing how they do something, at knowing when and why they do it well, and at knowing how to improve it.[8] Sports coaches and music teachers provide precisely those skills to their students, even if, paradoxically, their students are performing at a far higher level than the teachers could themselves attain or have ever attained. Good teachers generate motivation, provide feedback, break down complex tasks into separable components, and provide cognitive maps of the task.

Medicine has never espoused practice for practice's sake. Perhaps it could and should. Imagine the 1996 Medical Olympiad. Top-quality physicians from a host of countries parade around the stadium before testing their skills against one another in the clinical pentathlon. Physicians step forward in turn to the podium and are presented with their standardised patients; the judges raise their score boards as they rate speed, efficiency, elegance, skill, and compassion in each of the five events: history taking, investigation, diagnosis, counselling, and treatment. In the UK newspapers the next morning the tabloid headline says it all: "Brit docs flop". The team has always proudly proclaimed the gentlemanly virtues of amateurism and apprenticeship over professionalism, of gentle uncritical peer review and audit, and of the occasional well-fortified evening training session at the College. Now there is a national outcry, particularly when it is learnt that none of the entrants had practised for the event, most coming straight from outpatient clinics: "Dear boy, I don't need training, I've been seeing patients for twenty years, and besides I'm far too busy", says one, who is pilloried by the media. The national reputation is at stake and a Minister for Medical Sports is appointed. A crash training programme is instituted for competitors, with individual coaches to videotape them as they go about their work and identify weaknesses. One day a week competitors stop practising and deliberately start their practice—two hours of working through presentations of acute pancreatitis, four hours of trying different ways of telling a simulated patient that he needs to lose weight, three hours of inserting catheters, over and over again. And so on. Four years later, at the millennial games, the rewards are apparent: a sheaf of gold medals. But the true rewards had been apparent long before that: reflective, professional practitioners whose performance had improved and was still improving on all components as they practised every day. And it was not only the gold medallists who won; just as the skills practised today by international level athletes trickle down to tomorrow's club and school level players, so doctors benefited from the effects of the training, as did their patients. Everyone won.

The Lancet

1 Ericsson KA, Krampe RTh, Tesch-Römer C. The role of deliberate practice in the acquisition of expert performance. *Psychol Rev* 1993; 100: 363–06.
2 Bryan WL, Harter N. Studies in the physiology and psychology of the telegraphic language. *Psychol Rev* 1987; 4: 27–53.
3 Bryan WL, Harter N. Studies on the telegraphic language: the acquisition of a hierarchy of habits. *Psychol Rev* 1899; 6: 345–75.
4 Ericsson KA, Smith J. Toward a general theory of expertise. Cambridge: Cambridge University Press, 1991.
5 Chi MTH, Glaser R, Farr MJ. The nature of expertise. Hillsdale, NJ: Lawrence Erlbaum, 1988.
6 Chase WG, Simon HA. Perception in chess. *Cognitive Psychol* 1973; 4: 55–81.
7 Patel VL, Groen GJ. The general and specific nature of medical expertise: a critical look. In: Ericsson KA, Smith J, eds. Toward a general theory of expertise. Cambridge: Cambridge University Press, 1991: 93–125.
8 Camerer CF, Johnson EJ. The process-performance paradox in expert judgment: how can experts know so much and predict so badly? In: Ericsson KA, Smith J, eds. Towards a general theory of expertise. Cambridge: Cambridge University Press, 1991: 195–217.

COMMENTARY

Medicine in a warmer world

See page 1027

The extension of schistosomiasis in Africa into the cavernous, previously pristine, Lake Malawi[1] marks a redistribution of disease to higher (austral) latitudes. The redistribution of old diseases and the emergence of new ones depend on host factors and agents—and on the environment, both local and global. The environment must be "right" for the persistence and amplification of vectors, reservoirs, and pathogens. Climate change—alterations in temperature, rainfall, and the pattern of extreme weather events—has an important role in the distribution and impact of disease. The world's ecosystems—terrestrial, marine, aquatic, even atmospheric—have proved remarkably robust over millennia. Can that last as one species, a consumer, energy waster, overpopulator, and polluter, does its best to upset those delicate balances? For many years persons of "green" or Gaia-esque persuasion have answered No. Now climate scientists are joining them. And physicians also, as the health implications of global climate change become more apparent.[2,3] Reluctantly and nervously, politicians too.