Sheldrick *et al* have shown that about one person out of every 1000 consults for refractive problems each year.[1] Currently most refractive problems are dealt with by optometric services. With corneal laser surgery, however, the treatment of myopia,[8] hyperopia, and astigmatism could become the responsibility of ophthalmologists.[9 10] When these new techniques have been perfected the NHS will have to decide whether to provide them for patients—at a cost of about £200 000 per machine.

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Audit and research

Research is concerned with discovering the right thing to do; audit with ensuring that it is done right

"If your research proposal is turned down then set your wordprocessor to change 'research' to 'audit' throughout and you might well get the project funded." This cynical but widespread view of how audit may grow out of research was repeated at a recent meeting in Newcastle upon Tyne on how the two relate. Another widely held view is that audit is a fashionable time waster that will soon pass into history with many other untested management notions. But when the government is spending some £42m a year on audit and working towards spending £350m a year on the NHS research initiative there are crucial questions to be asked on whether audit and research, particularly research into effectiveness, are the same activity carried out with different degrees of rigour and whether the two need to be better coordinated.

One common answer to the question of how audit and research are different is that research is concerned with discovering the right thing to do whereas audit is intended to make sure that the thing is done right. Audit, said Mike Peckham (director of research and development in the NHS), is usually ongoing, whereas research is a one off activity; and audit uses routine data, whereas research collects complex data. Another, almost philosophical difference, pointed out by Nick Black (head of the health services research unit at the London School of Hygiene and Tropical Medicine), is that those engaged in research do everything they can to control what happens in a project whereas the essence of audit is that the doctors or others included in the project find their own way to improve their practice. It is thus possible to generalise from research but not from audit studies.

But there are also similarities between research and audit. Both depend, said Raj Bhopal (professor of epidemiology and public health in Newcastle), on the spirit of inquiry, both are good for the brain, and both are trying to fill what he called "a black hole of ignorance." In addition, both must be "bottom up" to be fully effective: attempts to direct either audit or research are likely to backfire.

Another similarity between audit and research is that they use similar methods, but, warned Ian Russell (director of the health services research unit in Aberdeen), audit is often scientifically sloppy: the samples that are used are too small and collected by means of inadequate sampling methods, and analyses are unsound. Professor Russell believes that audit will be taken seriously and be effective in producing change only when its methods are just as solid as those of the best research. Doctors need to be trained in the methodologies of audit, and they need to be helped to design audits that are scientifically sound. Indeed, there was consensus at the meeting that too much of the money made available for audit had been spent on computers and too little on training. Effective audit can be conducted without computers, but computers cannot compensate for inadequate methods.

Researchers can bring benefits to those practising audit not only by sharing their methods but also by studying audit to develop better methods. The research studies that have been done on audit suggest that the participation of a clinical leader is crucial if audit is going to work; that concentrating on raising quality rather than reducing cost will produce better results; and that change is more likely if people have participated in the process rather than had it imposed on them. Researchers have also already applied themselves to asking whether audit is effective. Professor Russell said that the best designed studies support the effectiveness of audit and setting guidelines, but Dr Black was more cautious, pointing out that most studies of effectiveness have come from the United States and been primarily concerned with cost containment; that positive results are more likely to be published than negative ones; that the evaluations of effectiveness are often carried out by those who have done the audit; and that only a limited range of subjects has been covered by the studies so far published. Stephen Proctor (professor of haematological medicine in Newcastle) said that we must not expect too much of audit too early. The whole activity, he said, is "still in nappies": evidence of real benefit can hardly be expected yet.

But while research applies itself to audit, audit can also contribute to research. Its main contributions are to throw up questions that research must address and to provide a mass of data that researchers might use. Professor Proctor sees audit and research as intimately related, and he believes that they must operate together—only in series rather than in parallel. He used as an example the work of the Northern Regional Haematology Group, which includes all those in the region looking after patients with haematological malignancies. The group, which has a family atmosphere, meets weekly and has regular clinical, research, audit, business, and social meetings. Every patient from the region is included in a register, and the group conducts trials of new treatments that avoid the selection bias that limits the value of so many trials. But between research projects the group switches to audit to ensure that the best practice is being applied throughout the region. The group moves easily and naturally from one mode to the other.

With this example under its nose of research and audit fitting so neatly together the Northern region has decided to link its regional research and audit activities. As Professor Peckham conceded, there is still no link at national level, but the main message emerging from the meeting in Newcastle was that audit and research, although not the same thing, have much to contribute to each other and must be linked at every level. Regions take note.

RICHARD SMITH

Editor, *BMJ*

Low molecular weight heparin

Probably better than conventional heparin in orthopaedic practice but not in general surgical practice

Heparin has been in routine use for over 50 years, but the problems with conventional heparin are that it has to be given two or three times a day when used subcutaneously and that it sometimes causes bleeding.[1] Low molecular weight heparins have been developed in an attempt to overcome these problems: they persist longer in the body,[2,3] have better availability,[4] and have less effect on clotting times.[5,6] But are these new heparins better in practice than the much cheaper traditional heparin?

A meta-analysis on p 913 by Leizorovicz and others suggests that low molecular weight heparins are better than placebo at preventing deep vein thrombosis in orthopaedic and general surgical practice and better than dextran in orthopaedic practice.[7] The superiority over placebo was expected, but the superiority over dextran is important because dextran has to be given by intravenous infusion and potentially has more serious side effects than low molecular weight heparin—it may, for example, cause volume overload and acute hypersensitivity reactions.[8] Leizorovicz and others also conclude that low molecular weight heparins are better than conventional heparin in orthopaedic and general surgical practice. These findings contrast with the conclusions of Nurmohamed and others in another meta-analysis recently published in the *Lancet*: they found that low molecular weight heparins, although superior in orthopaedic practice, are not better in general surgical practice.[9]

Leizorovicz and others base their conclusions on 39 trials, including several reported only as abstracts. Although 25 of the trials were in general surgery, the risk of deep vein thrombosis was not significantly lower with low molecular weight heparins than with conventional heparin. The analysis of the 14 orthopaedic trials similarly did not show a significant benefit, but when all 39 trials were analysed together there was a significant benefit for low molecular weight heparins.

Nurmohamed and others began with 23 studies and also concluded that low molecular weight heparins were better than conventional heparin in preventing both deep vein thrombosis and pulmonary embolism in general surgical and orthopaedic practice. The authors then conducted an analysis of only those studies that satisfied more than six predetermined criteria of methodological strength and found different results: the superiority of low molecular weight heparins disappeared in the eight studies from general surgical practice and remained only for preventing deep vein thrombosis (but not pulmonary embolism) in the five studies from orthopaedic practice.

The criteria of methodological strength adopted by Nurmohamed and others are ones that many support. They include the need for the publication to be a full, peer reviewed paper; clearly specified inclusion and exclusion criteria; adequate description of the clinical characteristics of the study group; description of bleeding complications; accurate diagnosis of deep vein thrombosis, which means using phlebography in the orthopaedic studies; blinded assessment at the end point; and adequate description of patients who did not complete the study. The application of these strict criteria may mean that more confidence can be put in the results of Nurmohamed and others.

Nurmohamed and others had, even before considering the 23 studies in their paper, excluded eight studies in which the doses of heparins used were higher than those currently recommended and 12 in which an inadequate screening method was used to detect deep vein thrombosis. Yet six of the studies with high doses of heparin and seven of those with inadequate screening methods were included in the analysis by Leizorovicz and others. The difference in results may thus be partly explained by different inclusion criteria.

Neither overview (meta-analysis) showed any difference in the incidence of major bleeding between the two groups, which suggests that factors other than clotting time are important in determining the risk of bleeding.

The conclusion for now is that in orthopaedic practice—where thrombosis occurs in about one in five patients compared with one in 20 patients in general surgical practice—low molecular weight heparins are probably more effective than conventional heparin in preventing thromboembolic complications. They are certainly more convenient, as adjusted subcutaneous doses may be necessary to obtain optimal prophylaxis whereas low molecular weight heparins can be given in fixed dose once daily. However, in general surgical practice there is no clear evidence that low molecular weight heparins are superior and the convenience of their administration must be weighed against their much greater cost.

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