

The science of perpetual change

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Introduction

WHEN James Mackenzie was in practice, few effective forms of treatment were available although he made a fundamental contribution to the better understanding of the use of digitalis.¹ In the 70 years since his death there has been an impressive growth of knowledge about clinically effective interventions which has gathered pace in recent years. Currently there are over 20 000 medical journals and two million articles are published each year. If they were stacked on top of each other they would be 500 m high.² It has been suggested that general physicians would need to digest 19 original articles daily in order to keep up to date.³ Even enthusiastic clinical teachers only undertake a median of two hours' professional reading a week.³ It is therefore impossible to keep up to date with all medical advances and the difficulties are particularly marked in the case of general practice where competence across a wide range of clinical areas is required. It is not only the volume of publications which presents difficulties in the assimilation of new knowledge but also variability in quality. Good quality review articles are therefore important because they represent the distillation of information available on a given subject. Unfortunately many review articles are inadequate because they quote selectively from the literature and do not critically appraise the quality of the studies included.^{4,5} Experts in a given field of medicine have, in the past, rarely possessed the skills to search for and analyse research evidence in a rigorous fashion.

Analysis of evidence from research

There are a growing number of texts for those who wish to learn how to appraise critically the medical literature⁶⁻¹⁵ and there are increasing professional incentives to develop critical appraisal skills, including the paper on this topic in the membership examination for the Royal College of General Practitioners.

When undertaken with methodological rigour, randomized controlled trials are a powerful means of reducing bias in the evaluation of specific interventions. However, a number of problems in design and execution are still prevalent and methodologically flawed trials lead to larger estimates of treatment effects than

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do those of high quality.¹⁶ Trials that show positive results are more likely to be published than those that fail to show a difference. All too often only a small proportion of those apparently eligible for a trial are actually entered into the study and the reader is then left to wonder about the general applicability of the results. Some studies that purport not to show a difference have inadequate statistical power to detect clinically significant differences and if considered in isolation may lead to an erroneous conclusion that a particular treatment is ineffective. Systematic reviews and meta-analyses attempt to overcome some of the deficiencies of individual studies, although they too can give misleading results if potential sources of bias are not taken into account in the review process¹⁷ or if sources of heterogeneity are not investigated.¹⁸ The use of individual patient data may lead to lower estimates of benefit than pooling summary data from published articles.¹⁹ Guidelines for undertaking systematic reviews are now available which, if followed, should minimize potential methodological errors.^{20,21}

The Cochrane Collaboration has become widely known for its international collaboration work undertaking reviews of randomized controlled trials on a range of research topics including methods of promoting effective professional practice and primary care.²² In view of the time-consuming nature of reviews and their need to be continually updated, membership of the Cochrane Collaboration review groups requires long-term commitment and an agreement to follow a standardized methodological approach. The National Health Service Centre for Reviews and Dissemination, based in York, works closely with the Cochrane Collaboration but differs from it in that reviews may be undertaken on a 'one-off' basis, rather than as part of an ongoing review, and the centre does not necessarily restrict itself to reviews of randomized controlled trials. The subjects for review are determined not by the interests of the reviewers, as in the Cochrane Collaboration, but by the perceived priorities of the NHS. Increasingly, good quality research-based information will be available in an aggregated form on the Cochrane Collaboration's database of reviews²³ and from other sources. These other sources include *Effectiveness Matters*, *Effective Health Care Bulletins* and *Effective Health Promotion* (publications produced by the NHS Centre for Reviews and Dissemination), the United States of America Agency for Health Care Policy and Research guidelines, the American College of Physicians journal club and the journal *Evidence Based Medicine*.

Gap between research and practice

There are many examples of the gap between research evidence and practice, for example the detection and management of asymptomatic hypertension,²⁴ the use of angiotensin converting enzyme (ACE) inhibitors in heart failure,²⁵ the eradication of *Helicobacter pylori* in patients with duodenal ulcer,²⁶ the use of tranexamic acid for menorrhagia,²⁷ and a number of obstetric interventions including the use of steroids in women in premature labour to enhance fetal lung maturation.²⁸ At the same time, inappropriate procedures may become part of professional practice, having been accepted without adequate evaluation. For example the postcoital test has been widely used in the investigation of infertility but is of poor predictive value.²⁹ The dilatation and curettage procedure has been widely used for menstrual disorders in young women but is ineffective both diagnostically and therapeutically.²⁷

Process of uptake of innovations

Lack of knowledge may be one reason for delayed implementation of research findings by clinicians or the premature introduction into practice of inappropriate procedures but this appears to be only part of the problem. There is a considerable body of work aimed at understanding the process by which new ideas become incorporated into everyday practice. Much of this has been based in fields other than medicine. According to Rogers,³⁰ the process of innovation comprises five steps: acquisition of knowledge, persuasion, decision, implementation and confirmation of use. Several other theoretical models also exist.³¹

Knowledge is necessary but not sufficient for change. Even if practitioners have theoretical knowledge of a new advance they may not apply this new advance to their patients. Characteristics of the innovation which may affect its uptake include its degree of complexity (whether the practitioner feels that the innovation is straightforward to implement), trialability (that is, whether the practitioner can try out the innovation before adopting it for routine practice) and observability (whether the practitioner can observe the results of the new treatment on the patients of other doctors).

In those parts of industry where innovation and implementation are seen as key attributes, there are well-defined management mechanisms for ensuring that they become part of company policy and practice,³² mechanisms that the NHS does not have.

Interventions to promote change in practice

The characteristics of the message (that is, the research finding) could influence its uptake. For example, the way in which a treatment effect is presented (as a relative risk reduction, an absolute risk reduction or its reciprocal, the number needed to treat, NNT) may influence practitioners' response.³³ Presentation of results as a relative risk reduction (which does not take into account the baseline risk) may be more likely to lead to practitioners adopting the treatment than the NNT which gives the number of patients needed to be treated for a defined period of time in order to prevent a death or a major event. It is the NNT which is more relevant to practitioners and their patients.³⁴

There are a number of key players who can influence the uptake of research findings or be influenced by others (Figure 1). Many of these key players are self evident but others, for example patients and user groups, are less obvious. The National Childbirth Trust has been helping its members to use the information arising from *Effective care in pregnancy and childbirth* so that they can make informed choices about their maternity care.³⁵

Individual health professionals and managers
Purchasing organizations
Provider organizations (trusts and health authorities, including non-executive directors)
Professional organizations (including royal colleges)
Industry, eg pharmaceutical
Education providers
Research information providers
Researchers
Public
Patients
User groups
Media
'Alliance' partners, eg local authorities
Policy makers

Figure 1. Key players who may influence the uptake of research findings or be influenced by others.

Patient-mediated interventions are still at a relatively early stage of development. For example, interactive video discs on a range of topics including benign prostatic hypertrophy, breast cancer, mild hypertension and hormone replacement therapy have been developed and are under evaluation.³⁶ Increasingly patients will also be able to obtain information about health care on the Internet,³⁷ although this information may be of variable quality. In the future the advent of 'video-on-demand' will make it possible for patients to access such information, based on the findings of research, in general practitioners' surgeries or, in the case of some topics which may be of general interest, from their own home.

Probably the best-studied interventions have been guidelines. A systematic review of the evidence from 91 studies documented the need to involve potential users in adapting guidelines for local conditions.³⁸ The incorporation of guidelines into educational programmes may also enhance their impact. Merely circulating them is likely to have little effect on professional practice.

A systematic review of 99 trials of continuing medical education emphasized the need to use predisposing and reinforcing strategies, for example outreach visits and reminders, in conjunction with educational programmes that are directed at the day-to-day practice of the recipients.³⁹ It found that combining audit and feedback with educational strategies was less effective in changing performance, and formal conferences alone had little impact. An earlier review suggested that audit and feedback may be an effective method of changing and reinforcing professional practice⁴⁰ but more research is clearly needed.

A recent study of feedback of patients' experience of their asthma to their general practitioners showed no effect on general practitioners' management of these patients; the authors suggest that primary care teams need to participate actively in the development of change processes if feedback from patients is to be effective.⁴¹

Computerized decision support systems show increasing promise. The number of controlled trials that have been undertaken to evaluate their impact is still relatively small: a recent review identified 28 of which only seven were of high quality.⁴² There is a need to ensure that those systems that are developed take into account the best evidence from research about the effectiveness of specific interventions, for example reminding general practitioners and patients of the need for regular fundoscopy to detect retinopathy in diabetic patients.

There is growing interest in the evaluation of social influence models of change. In the USA for example, there has been interest in using such strategies for the implementation of clinical practice guidelines. There are three main types of social influence settings — interpersonal, persuasion and the mass media.⁴³ These are targeted at individuals or small groups, moderate size groups and large groups, respectively. One example of a small-scale social influence strategy is academic detailing⁴⁴ which is the direct transmission of information from a trained individual to an individual or small group of professionals. It has considerable similarities to the role of the pharmaceutical representative. Although a number of trials have found both clinically and statistically significant improvements in prescribing practices following the use of a (non-commercial) academic detailing strategy, it has not always been an effective approach. One study which demonstrated no effect used brief educational visits with little interaction between the educator and the target professional and no prior knowledge of the educator by the target professional.⁴⁵

Social influence strategies for use in moderate size groups vary from those that rely on an individual, such as an opinion leader, to influence other members of the group to those that promote processes whereby group members influence each other. The evidence about the effectiveness of opinion leaders is

mixed⁴⁶ and this approach has not been adequately tested in the United Kingdom. Indeed, it seems unlikely that it would be an effective routine method in primary care because of the difficulty in regularly identifying local opinion leaders.

Social influence theory suggests that mass media campaigns could be designed to diffuse research-based information to a population. In the USA the Agency for Health Care Policy and Research clinical practice guideline dissemination programme, directed at health professionals, also used an extensive mass media campaign which was aimed at the wider public and has resulted in newspaper, television and radio coverage.⁴⁷ It seems unlikely that such a campaign would change practice by itself but may be effective if linked to local activities to promote the use of a specific guideline or recommendation.

Administrative and policy instruments could help provide incentives for change. Currently, some perverse incentives exist such as payment to providers per operation, irrespective of whether the operation is appropriate or not. Examples of incentives to promote change might include targeted payments, for example for the care of a specific group of patients using agreed guidelines. There are, however, many other factors which determine health policy and service development that are unrelated to evidence of effectiveness.⁴⁸ Many of the activities specified in the 1990 contract for general practitioners, such as health promotion clinics, were inadequately evaluated before being imposed.^{49,50} Policy makers and managers cannot expect to be credible promoters of clinical effectiveness if they do not apply similar criteria to their own decisions.

National programme to evaluate implementation strategies

The growing awareness both of the gap between research findings and practice and the lack of evidence about the effectiveness of different methods of promoting implementation led the NHS Central Research and Development Committee to set up an advisory group, which I chaired, to look at the priorities for evaluation in this field. The group was asked to consult widely about possible priorities and to deliver a report to the committee. Following the consultation exercise, the advisory group identified 20 priorities for evaluation (Figure 2); the ordering does not indicate relative importance.⁵¹ Qualitative and quantitative research methods are required. The priorities have been advertised through the NHS research and development programme and projects to address the priorities are being commissioned.

Implications for primary care of applying research findings to practice

The growth of evidence-based medicine has been, at least in part, a response to the growing awareness of the limitations of conventional medical education and of the pace of change in clinical practice. It has been defined as 'a process of life-long, problem-based learning in which caring for our own patients creates the need for evidence about diagnosis, prognosis, therapy and other clinical and health care issues'.⁵² It involves a five-step process of: formulating answerable questions; tracking down the best information to answer them with maximum efficiency; critically appraising the validity and applicability of the evidence; applying the results in practice; and evaluating performance.⁵²

It may be argued that general practice is not a suitable arena for an evidence-based approach because the problems encountered often defy classification or simple intervention and because it will lead to 'cookbook' medicine, with health professionals responding uncritically to proliferating guidelines. These are valid concerns but are not arguments against improving the translation of research findings into practice. The emphasis on

1. Influence of source and presentation of evidence on its uptake by health care professionals and others
2. Principal sources of information on health care effectiveness used by clinicians
3. Management of uncertainty and communication of risk by clinicians
4. Roles for health services users in implementing research findings
5. Why some clinicians but not others change their practice in response to research findings
6. Role of commissioning in securing change in clinical practice
7. Professional, managerial, organizational and commercial factors associated with securing change in clinical practice, with particular focus on trusts and primary care providers
8. Interventions directed at clinical and medical directors and directors of nursing in trusts to promote evidence-based care
9. Local research implementation and development projects
10. Effectiveness and cost-effectiveness of audit and feedback to promote implementation of research findings
11. Educational strategies for continuing professional development to promote the implementation of research findings
12. Effectiveness and cost-effectiveness of teaching critical appraisal skills to clinicians, patients/users, purchasers and providers to promote uptake of research findings
13. Role of undergraduate training in promoting the uptake of research findings
14. Impact of clinical practice guidelines in disciplines other than medicine
15. Effectiveness and cost-effectiveness of reminder and decision support systems to implement research findings
16. Role of the media in promoting uptake of research findings
17. Impact of professional and managerial change agents (including educational outreach visits and local opinion leaders) in implementing research findings
18. Effect on evidence-based practice of general health policy measures
19. Impact of national guidance to promote clinical effectiveness
20. Use of research-based evidence by policy makers

Figure 2. Priority areas for evaluation in the methods of implementation of the findings of research: recommendations of the advisory group to the NHS Central Research and Development Committee (source: Department of Health 1995).⁵¹

critical appraisal of evidence should counter any tendency towards uncritical development, dissemination or acceptance of guidelines or educational interventions. In general, most current research evidence is more appropriately applied to those whose problems are well defined and to that extent some caution is understandable. The estimate that 82% of admissions to a general hospital ward can be managed according to principles of evidence-based medicine is likely to be an overestimate for primary care.⁵³ Evidence-based medicine could also be perceived as insufficiently patient-focused. In discussing options for investigation and management it is important to integrate evidence from communication with patients and their families about their beliefs, attitudes and knowledge, with research evidence. There is also a need for work on the applications of decision analysis to primary care problems. Decision analysis is a method of analysing harms and benefits systematically to make trade-offs explicit; it incorporates the patient's view of the (dis)utility of

particular outcomes.⁵⁴

In a letter to his cousin, Mackenzie advocated the development of a panel epidemiological specialist who would study common diseases in general practice. Mackenzie was probably the first to apply the term epidemiology to non-infectious diseases. I am sure that he would have readily grasped the importance of the appropriate application of data from studies involving large groups to individual patients in practice. Mackenzie was instrumental in improving medical understanding of atrial fibrillation, a condition for which there have been recent advances in management (for example, the use of anticoagulants to prevent strokes). This condition illustrates some of the difficulties in trying to apply to general practice the results of trials mainly undertaken in secondary care, particularly when only between 3% and 40% of the population initially recruited are eventually randomized to take part in studies.^{55,56} This example demonstrates the need to undertake large, well-designed trials in primary care for conditions which are managed largely in the community. The UK is well placed to undertake such trials using the Medical Research Council general practitioner research framework and other research networks.

Research-based information can lead to changes in many aspects of care, including the care of individual patients, practice policies and guidelines, audit, continuing education, computerized decision support and primary care commissioning. Where there is good evidence for appropriate management of a given condition guidelines may be useful, particularly if they conform to defined standards derived from rigorous research.⁵⁷ In the case of primary care commissioning, the general practitioner may have the opportunity to influence hospital services in ways that promote clinical effectiveness. These include promoting the use of the Cochrane Collaboration database of systematic reviews or forms of organization of care such as stroke units or care attendants for elderly people on discharge from hospital.^{58,59}

In order to help busy practitioners to adapt to perpetual change, we need to develop relevant new information services which respond to specific clinical problems. Although the use of *MedLine* or other databases may be helpful for many clinical problems it is unlikely that general practitioners will have sufficient time to use them frequently while they are heavily engaged in clinical practice; the direct use of *MedLine* by general practitioners is currently infrequent.⁶⁰

Medical librarians have supported clinicians for many years. In 1967 at Washington Hospital Center in the USA a programme entitled 'literature attached to the chart' (LATCH) was initiated.⁶¹ This programme involved librarians responding to clinicians' requests for information by attaching relevant articles to the patient's medical record. Other programmes developed prepackaged information for routine delivery to a clinician or for attachment to a patient's records.⁶²

General practitioners could contact librarians for appropriate information to guide clinical decisions. In this way, the capacity of the general practitioner to deal with problems could be considerably improved without causing extra burdens on an already crowded workday. In order to make this possible, library services may need greater resources. Within practices or shared between practices, individual practitioners could take on responsibility for implementation, acting as change agents to promote new interventions. They could be the modern-day equivalent of the panel epidemiologist suggested by Mackenzie but with a role directed towards the implementation of research findings.

In order to use research-based information effectively, closer links must be developed between research and development, education and continuing professional development and clinical audit.⁶³ In the past these activities have had different cultures and different individuals participated in them with little exchange of

ideas.

Providers of continuing medical education need to take into account evidence from well-conducted research about ways of determining and addressing educational needs because practitioners may not be accurate in identifying their own educational needs. This is illustrated by a randomized trial of general practitioners in Canada in which the intervention group were given personalized instruction programmes on clinical topics they wished to learn about on condition that they also received educational programmes on topics they did not want to learn about.⁶⁴ The quality of care improved significantly only for the conditions they did not want to learn about compared with a control group — this implies that continuing education may be effective when it is not desired!

The research community needs to be more aware that use of NHS funds for research and development is likely to be questioned if the results are not implemented and this means giving resources to development as well as to research. Those engaged in clinical audit should aim to use guidelines and standards based on research evidence where it is available and should work closely with those who develop education programmes. Computerized decision support could have considerable benefits for the future.

Conclusion

Change cannot be wished away: it is an inevitable part of modern professional life. Whether individuals find the prospect challenging or threatening is likely to depend at least in part on whether they feel that they have some control over the process or whether instead they feel that change is being imposed upon them. In this respect the development of shared decision making within practices involving all the members of the primary care team is likely to be important.⁶⁵

Special attention must be paid to less developed practices to prevent the gap in the uptake of innovations between more and less well-developed practices becoming wider.⁶⁶

Much needs to be done to make better use of research findings but we already have a considerable understanding of the scientific principles underpinning the development of effective approaches to the perpetual change in knowledge which characterizes our age.

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