Never mind solutions: what are the issues? Lessons of industrial technology transfer for quality in health care

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It is now accepted as a truism that quality in health care would substantially improve if only some way could be found to secure more comprehensive and systematic uptake of the findings of biomedical research and development through implementation in everyday clinical practice. The relationship between the communities of clinical practitioners and scientific researchers is at best, integrated; more usually, distant; and at worst, non-existent. Each community can easily stereotype the other and use this as a justification for maintaining distance. Members of the medical research community can dismiss misguided practitioners who do not immediately acknowledge, let alone act on, what they see as the most persuasive of proven findings, which show how to improve the outcome of clinical interventions. In contrast, members of the clinical community, particularly when they are geographically or culturally far removed from postgraduate research centres, can dismiss the scientists for their “ivory tower” approach, which pays little attention to things which are really important to those at the front line of health provision. Clinicians are preoccupied with doing their clinical work in “tried and tested,” “good enough” ways, which reflect the principles of their own education and training and the norms of practice for many of their respected colleagues. Practitioners are frequently unaware of the results of research and development and even if they are aware they are often sceptical about the feasibility of general application. Many reasons can be cited why it is impractical or unwise to seek to secure widespread applications of particular findings.

The distant relationship between groups of practitioners and researchers has recently become the focus for attention of a third group, the commentators and researchers who focus on the relation between medical research and clinical practice. The endeavours of this third group have been given special impetus through the development of the National Health Service (NHS) research and development programme. This group’s concern is to seek ways in which the gulf between practitioners and researchers can be bridged, yet there is a danger that in their approach they accept one, if not both, of the stereotypes. Although widespread concern about the relation of research to clinical practice in the health service is only comparatively recent, this is a concern which has been strongly evident in other scientifically based sectors of the economy for at least 30 years. A wealth of research commentary and action in managing innovation and technology transfer could usefully be taken as a basis for determining fruitful avenues for developing the relation between research and practice in the health sector.

The aim of this paper is threefold: firstly, to summarise a review of the relation between research and practice undertaken for the then North West Thames region in spring 1994; secondly, to summarise some of the lessons from research and practice of technology transfer outside the health service; and, thirdly, to suggest ways of developing the agenda for research and action in implementation in health.

Influencing clinical practice through implementing results of research and development

A small scale study was undertaken in spring 1994 to identify ways in which clinical practice was influenced by findings of research and development. A particular focus was to examine whether the commissioning/contracting process was, at that time, being used as a lever to secure the implementation of research and development results. The study was in three parts: a literature review, a telephone survey of some 30 people working as practitioners or academics in research and development and health commissioning throughout the United Kingdom, and an examination of draft contracts followed by interviews with 18 people, including two chief executives, six directors of commissioning, and four directors of public health, as well as some of their staff, in six of the district health authorities in the (then) North West Thames region. The main findings of the study are summarised here.

Definitions of what constitutes clinical practice can be very widely drawn. The focus of this study was the relation between biomedical research and development and the practices of clinical diagnosis and treatment, which were taken to include any clinical interventions, use of equipment, and prescription of drugs and other treatments, which impact on the patient’s health status. It did not focus on issues of clinical organisation, skill mix, or meeting quality indicators in the patient’s charter, even though such things as the length of wait for triage in an accident and emergency department or the availability of a specially trained asthma nurse in general practice may well have an impact on clinical outcomes.
The review and the interviews confirmed that not only was there a substantial body of information detailing research and development results indicating that improvements in health outcomes would result if clinical practitioners were to implement the suggestions/guidance flowing from that research and development but that this was generally acknowledged among commissioners of health care. Furthermore, there was considerable support among the interviewees for the view that recognition of, or action on, the results of research and development by practitioners is very patchy. Less published evidence, despite increasing research, was found detailing attempts at translating research and development results into practice. In particular, there was a lack of evidence that one implementation technique was superior to others.

LITERATURE REVIEW

In a systematic review of 102 interventions, including educational material, conferences, outreach visits, local opinion leaders, patient mediated interventions, audit and feedback, reminders, marketing, multifaceted interventions, local consensus processes, Oxman concluded: “There are no magic bullets for improving the quality of care but there is a wide range of interventions that, if used appropriately, can lead to substantial improvements in the application of research.” An integrated approach to implementation, including evidence based guidelines, encouraging and supporting opinion leaders, and developing computer based decision support systems was proposed by Haines and Jones, who emphasised that key players are “professional associations, purchasers, users, and policy makers.” Grol emphasised the importance of direct personal contact and showed how it can be applied to general practice. The importance of medical peers in the local community, of local product champions to break into closed medical communities, and of peer acceptance and the way behaviour reflects socially accepted norms of appropriateness and habit have all been emphasised. The personal motivation of individual clinicians must also be considered.

Both in the United Kingdom and United States the potential of medical informatics has been emphasised in providing accessible, user friendly, responsive information systems to encourage clinicians to note and act on research findings. In facilitating the development of new ways of working and learning, medical informatics may also be important in creating a culture receptive to new ideas and willing to change. Similarly, in the United States there has been considerable interest in developing quality programmes which lead to changes in organisational arrangements which inhibit the dissemination and implementation of evidence of “good practice.”

Appropriate use of intervention within an appropriate context and the references to changing culture and organisation are important in implementation. There is now considerable evidence that in seeking to change clinical practice the social and organisational contexts in which clinicians practise are as important as the nature of the findings and the nature of the intervention which seeks to secure their dissemination. This point may be illustrated by the following example on the design and implementation of clinical guidelines. In the United Kingdom the use of guidelines has given added impetus by an executive letter issued in 1993 by the NHS Management Executive, which started the process of setting national guidelines, in which the importance of local involvement was emphasised: “Changes will always need to be negotiated between purchasers and providers and in all cases must secure the support of the clinicians involved, whose freedom to determine the treatment of individual patients must be preserved.”

An extensive review of experience with clinical guidelines concluded that they can make a significant difference to clinical practice; that they must be rigorously evaluated; and that it is important to have in place strategies for their development, dissemination, and implementation. These three strategies are, of course, interdependent, but they each need to be the subject of focused investment. The most effective guidelines were (a) developed locally and nationally, with the cooperation of those who will use them, (b) disseminated through specific focused educational interventions, and (c) those whose implementation was secured through issuing patient specific reminders at the time of consultation. In contrast, guidelines initiatives which were least likely to be effective in influencing clinical practice were (a) developed externally and nationally, (b) disseminated through journal publications and (c) whose implementation was brought about through general reminders to clinicians. The importance of local involvement and the resource intensity of developing and implementing guidelines is illustrated in work being undertaken in the Hackney collaborative clinical guidelines project (L Southgate, unpublished data).

Even with local involvement and investment in specific dissemination and implementation, adoption of guidelines requires additional support in the form of incentives or removal of disincentives. The importance of a multifaceted approach, including personal contact, was supported by Paterson-Brown et al, who examined the responses to the first systematic review of evidence based practice in the United Kingdom, in obstetrics. Access was made widely available to the Oxford Database on Perinatal Trials for four years and yet the database was neither widely disseminated nor widely used.

INTERVIEWS

The interview component of the small scale study with 18 people involved in implementation throughout the United Kingdom showed a widespread but fairly superficial knowledge of a variety of different approaches. For example, work in Oxford (GRIP) was frequently cited, as was the work of the
development and evaluation committee in Wessex region, the Hackney guidelines project, and work being undertaken by Greater Glasgow Health Board. Most of the views canvassed in the interviews emphasised the importance of bottom up local involvement and multidisciplinary involvement in developing and implementing guidelines, often coupled with a regional role in getting things started. Service strategy reviews by commissioning agencies were also thought to be useful in identifying the areas and types of intervention which are likely to be fruitful in securing implementation. There was also considerable discussion about the role of medical and clinical audit, with emphasis on the importance of clinicians being involved and committed to change if audit was to lead successfully to changes in clinical practice, views supported in the literature.38-41

One focus of this study was to examine the extent to which the newly created internal market in the United Kingdom provides leverage to support changes in clinical practice. Considerable caution was expressed by purchasers on the use of contracts as levers to change clinical practice. Contracts were seen as a means of influencing but not of imposing change in clinical practice. This reflected a strong commitment from public health physicians and commissioning managers to work in a non-prescriptive way and to establish trust and a spirit of collaboration with providers. Most contracts embodied general exhortations – for example, providers “will be aware of relevant developments in technical and clinical practice and be active in considering the implications of their own services.” Occasionally, more specific references were made – for example, one contract for maternity services required that account be taken of the “effective care in pregnancy and childbirth” meta-analysis. However, this was the exception rather than the rule.

Contracts were seen as important in creating an environment conducive to change and as sealing agreements for change which had already been negotiated. The interviewees acknowledged that providers would be threatened by suggestions of major shifts in service provision, but purchasers said mainly that they were interested in working with their providers rather than ceasing to trade with them. Financial incentives were considered of limited value, in that they would not necessarily allow purchasers to target particular individuals and clinical teams, and in any case the sums available for “additional” incentives were not thought likely to be large. Rather than using the mechanism of contracting as a direct means of requiring changes in clinical practice, purchasers were undertaking comparative service reviews involving several providers, seeking to identify cost effective service provision and direct or indirect means of influencing providers to alter their practices accordingly. Senior purchasing managers were also funding evaluation studies of various innovations and putting pressure on the NHS research and development organisation to ensure that evaluation was built into service innovations.

Overall, the 18 interviews showed purchasers to be concerned to find ways to ensure that clinical practice reflected the findings of research and development but to see contracting as an inappropriate avenue for its achievement. Two further points emerged. Firstly, that purchasers shared some of the reported concerns and even scepticism of clinicians about the applicability and feasibility of adopting some research and development findings. Secondly, as well as being committed to the principle of developing more evidence based practice, purchasers were also strongly committed to finding ways to ascertain and champion the patients’ views of clinical practice, and they were aware that patients’ views do not always accord with recommendations which may flow directly from research and development.

**DISINCENTIVES TO INCORPORATE KNOWLEDGE INTO PRACTICE**

During this study five groups of reasons were advanced to explain why clinicians may not rush to incorporate new scientific knowledge into their practice.

### Possible reasons for clinicians’ reluctance to change their practice according to new scientific knowledge

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**Nature and meaning of available scientific knowledge**

A great deal of uncertainty and, to an extent, scepticism exist about the strength of some of the research findings. Although there are a few celebrated examples of evidence of clinical effectiveness – for example, the use of steroids in preterm delivery or dilatation and curettage in women aged under 40 – much research is seen as less compelling and robust in its indication for changes in practice. Doubts also exist whether the research scientists are interested in the same performance indicators as practitioners. Busy clinicians want help in separating the gold from the dross in the plethora of published work. Medical practitioners deal mostly with grey areas, “where they are unsure of what to do and where they consider the research findings are less than conclusive in their advice.”

**Access to scientific information**

Recent investment in the Centre for Reviews and Dissemination at the University of York and in the Cochrane Centre, which provides meta-analysis of research findings in selected areas, should facilitate easier access to a more informative database. Hitherto, user friendly
access to the results of research and development has been a major problem.

Skills and competence of clinicians
In the small scale study there was considerable discussion about a lack of confidence and skill in the clinical community in evaluating research findings and so making judgements about the applicability and strength of findings. Furthermore, innovations in clinical practice may require clinicians to learn new procedures, or use unfamiliar equipment, or develop different ways of working with clinical colleagues. Fear and insecurity about personal competence may disincline some to change.

Lack of commitment to sell or market research findings
Ten years ago Stocking wrote about the dynamic nature of diffusion of innovation and the importance of research findings being perceived as relevant and applicable by clinicians if they were to have a hope of being translated into practice. She and others have shown that to attract the attention of practitioners, there should be concentration on broadness rather than narrowness of application, compatibility with current practice, the ability to perform trials so that an innovation can be tried and discarded if necessary, and the extent to which clinicians can observe whether expected results are being achieved. More recently Dickinson has described how research results may be marketed.

Institutional and financial arrangements
The patterns and practices of resource allocation usually support the status quo. If an innovation implies a more cost-effective practice, requiring fewer resources per case than an existing one, there may be a reluctance to change, particularly if this is not accompanied by an increase in the number of cases. For example, the organisational and financial arrangements in the NHS in the 1980s damped the general diffusion of technology. A change in incentives or disincentives as well as a general “bandwagon” is often needed to encourage serious shifts in practice. For example, a coalition of clinical and managerial incentives produced a climate in the internal market in which adopting day surgery was much more supported than before the internal market.

Changes indicated by research may lead to a reluctance to change either because fewer resources are required and therefore empires may be threatened or because more resources are required and therefore already over-stretched budgets for purchasing health care may be stretched beyond their limits. Conditions previously untreatable may become treatable, new investment in equipment may be required, and the drugs bill may escalate. In the former scenario participants in the study suggested that providers would be reluctant to change; in the latter resistance was thought to be more likely among purchasers.

From published evidence and among participants in the study, there is considerable awareness that the cycle of low uptake of research findings will not be broken unless we look beyond individual actors, the nature of findings, and communication channels to explore the organisational, social, and cultural contexts of both research and clinical work.

Sharing knowledge in other sectors
The relation between biomedical research and development and clinical practice is an issue akin to technology transfer in industrial sectors. Technology is most obviously embodied in artefacts and materials but it also includes the knowledge through which it was created and on which its use depends. Technology transfer has been defined as “information that is put to use,” although it is more often described in terms of “moving ideas from the laboratory to the market place.” Williams and Gibson showed how different phases of research on technology transfer were based on different models of where barriers or inhibitors to the free flow of knowledge arose. They described four models in the following terms: appropriability, dissemination, knowledge utilisation, and communications and feedback (box).

What is needed for good technology transfer?

Appropriability model
Effective technology transfer requires:
- Good, sound ideas
- Clarity on “what technology can do”
- Clear communication channels

This is achieved through:
- Scientific rigour
- Standardised procedures for education and communication

Dissemination model
You need all the above and the following:
- Committed and supported gatekeepers
- Strong networks and project teams

This is achieved through:
- Supportive human resource management, reflected in reward systems, appraisal, selection, promotion, training, effective operational management
- Integrative mechanisms to overcome discipline, team, and geographical barriers

Knowledge utilisation model
You need all the above and the following:
- Group problem solving
- Complex participation from the users as well as the generators of knowledge in the transfer process
- Market pull as well as technology push

This is achieved through:
- Even better message transfer
- Even better leadership and human resource management to overcome cultural barriers

Communication and feedback model
You need all the above and the following:
- An appreciation that different participants attach different meaning to problems and solutions
- An appreciation of users’ problems and preoccupations from their viewpoint
- An engagement with users’ problems in the process of defining problems as well as selling solutions
The appropriability model was predicated on a view that if the information was good enough and the channels for its communication were clear, practitioners would be queuing up to use it. Technology transfer thus entailed a linear sequence of orderly steps between idea generation and full implementation. It was a perspective embedded in a research and development view of research and development; it discounted the role of the user, other than as a willing recipient of ideas. It therefore emphasised the scientific validation of findings and the procedures for communication.

The focus of the second model was dissemination. It, too, emphasised the channels of communication but acknowledged that they formed complex networks in which the role of gatekeepers at strategic nodes in the network was very important. Gatekeepers operated “at the boundaries” and translated between two or more worlds. Gatekeepers had different roles at different stages of innovation. At the stage of idea generation they were important in communicating between markets, users, and scientists; at the problem solving time, in communicating between research and development laboratories and different research groups; and then at implementation in communicating with users again. The more sources of uncertainty, the more gatekeepers were needed. The role of the “champions” of specific innovations, the critical importance of “technical discussion networks” and of informal relations between colleagues were all also very important in the diffusion of scientific information. However, the evidence to support informal social contact was less strong than that relating to work group membership and structure, in which cross functional and cross level teams were much emphasised. The barriers which arose from physical distance and the increasing insularity of project teams over the life cycle of a project were also emphasised. The receptiveness of a team to critical information was thought to be reduced once the project team was established and worked.

Notwithstanding the significant role for gatekeepers and champions and the importance of networks, the dissemination model is still one which assumed a linear one way flow of information from research to user. Improvements were still directed largely towards improving the fidelity of the message and the chances of the user understanding the sender’s (that is, the scientist’s) message. “Once linkages are established, the new technology will flow from the expert to the non-expert much like water through a pipe.” The practical applications of this approach were that the message must be made clear and the channels more carefully defined and supported through various human resource strategies – for example, appraisal, reward systems, training, and career planning, including secondment between research teams and between research and operations. However, even this investment is insufficient for effective technology transfer, and an emphasis on organisational context and structure grew. More concern was devoted to developing matrix structures, liaison roles, and flatter hierarchies as means of facilitating greater integration of functions. We can see a shift from “people” and “mechanics” of communication to the whole organisation and culture. However, even with this elaboration, the dissemination model still assumed that the take up of innovation could be dealt with by facilitating the process of “technology push.”

The third approach to technology transfer redressed this imbalance to some extent and focused on knowledge utilisation – “market pull.” It had a greater focus on issues of application and sought to build in feedback between functional groups and project teams to overcome cultural and functional obstacles to integration. The emphasis shifted to group problem solving with overlapping roles and frequent personal interaction, free flowing information, and wide participation. Yet, still the dissemination model was in a single direction, from research and development to user, but with more complex participation and a strong acknowledgement that the user’s involvement was critical. Thus the problems inhibiting technology transfer were still couched in terms of inadequate staffing in operations, unwillingness or inability of scientists to communicate in lay terms, users’ perceptions of technology as too fragile or complex, and users’ preoccupation with other problems and the need to maintain present operational and budgetary constraints, and perceptual problems were still overcome with more user involvement, face to face communication, and even better message transfer.

The fourth, and latest, communications based approach moves away from a linear bias to acknowledge that each player gives different meaning to issues, problems, and solutions, that they “make sense” of innovations in different ways. Thus as well as looking at boundary spanning roles, improved channels and enhanced networks, there also needs to be continuous feedback and scope for redefinition of problems as well as solutions.

To look at how different meaning systems arise and how they influence the generation and use of knowledge, one needs to be aware that social structures and meaning systems are locally constructed and context specific. Actors are guided in their behaviour by beliefs and accepted rules. New meanings are created as work progresses and thereby situations are redefined. Organisational culture develops from, and in turn shapes, shared meaning. This approach has been applied to generating scientific knowledge, which is shown to be contextually specific, locally constructed, and the subject of negotiation between generations of creators and users.

Implications for improving quality of health care

What lessons can be drawn from this brief review of present practices and views in the health sector and experiences in other sectors? Simple linear models of technology transfer which are either “knowledge driven” or
oriented to specific solutions do not adequately explain the processes involved in successfully "putting knowledge to use." Rather than merely seeking to identify the barriers to delivering knowledge to end users, it is now acknowledged that more emphasis on joint problem solving is essential among all parties involved in the developing, adapting, and using scientific knowledge.

It has taken industry and scholars of technology transfer over a generation to learn that the problems of sharing knowledge can often not be solved by developing a clear view of what technology or knowledge can do; indeed, that often evolves with the knowledge itself. Nor is it enough simply to try to improve communication channels. Although these are important, there is a further hurdle, which is to appreciate the strength and diversity of the view points of all involved and identify the benefits to participants and how they will be achieved. Activities involving joint working, or at least excellent communication, on defining problems for exploration and developing a shared commitment to learn and implement lessons, become almost more important that investment in newer and better ways to "find or sell solutions." Hence the need to understand the issues before rushing to invest in solutions. The two are, of course, related; the solutions will be more easily adopted if they are seen to deal with problems important to the user. Furthermore, if an innovation based culture is to be developed, all those involved have to identify a willingness to invest in new ventures and a culture which permits failure as well as success, since innovation and change embody risk and therefore the possibility of failure.

There is now a strong view in industry and among management theorists that a notion of technology push is incomplete as an account of the innovation process; it has at least to be coupled with a "market" or "user" pull. In health care this means that practitioners are not eagerly awaiting to take up any new knowledge which passes by. They do not have an active "wish list" of new innovation. They face problems to which they want pragmatic solutions. For example, problems in commercial industry may be identified as falling market share, poor morale, decreasing quality of performance, even tighter margins. In health care, the issues may also mirror these commercial concerns but they may be manifest in oversubscribed, overstretched, outpatient clinics; bed blocking by elderly patients; revolving door patients with chronic conditions; and patient advocacy for change.

It is therefore insufficient to conceptualise clinical practice in primary and secondary care as being passively at the centre of a bombardment of influences, consciously designed to secure particular forms of clinical behaviour for example, continuing medical education, consensus processes, or new protocols. These are important but can be only partially successful in that they concentrate on "pushing out" messages rather than taking the perspective of the practitioner. Many other influences at work arise, often unintentionally, from routine contacts with clinical colleagues, patients, the media, and health service managers. Clinical behaviour is influenced by the opinion leaders to whom doctors talk, those whom they see as trustworthy and legitimate role models, or those whom they see as trusted personal considerations of future career or present comfort. The immediate and medium term demands on clinicians may create a climate in which there are many more pressing considerations than giving time and energy to learning how to do things differently in accordance with research findings. For example, in the United Kingdom patients are becoming more demanding and their views on what is appropriate are influenced by accepted local customs, media, pressure groups, the pharmaceutical industry, and public pronouncement of a few celebrated professionals. Only a small unpredictable part of their views are formed from the context of what research findings suggest.

In developing an agenda for research and action in implementing research we need to consider where clinicians are, to deal with their concerns, and to appreciate the patterns of work and organisation in which they are embedded, as a basis for tackling issues of implementation. This is now the focus of a research project which I and my colleagues are just beginning.

It is unreasonable to expect either all practitioners or all members of the scientific community to assume responsibility for implementing research findings. However, those researchers who are operating at the more applied end could usefully be encouraged to think about the processes entailed in transferring knowledge and to work together with clinicians on definitions of problems as well as on generating solutions. Beyond this there needs to be considerable investment in an implementation infrastructure within health which embodies the reality of the situation in the NHS and all the behavioural, structural, and cultural aspects needed for good technology transfer. On this basis this paper urges considering the processes involved in effective implementation as a necessary prerequisite to generating solutions.

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