Three approaches to defining knowledge

Both knowledge and learning can be examined from two perspectives, the individual and the social. These can be considered as analogous to the particle and wave theories of light. An individual perspective on knowledge and learning enables us to explore both differences in what and how people learn and differences in how they interpret what they learn. A social perspective draws attention to the social construction of knowledge and of contexts for learning, and to the wide range of cultural practices and products that provide knowledge resources for learning. This situation is further complicated by disputes about what counts as knowledge. There are now three distinct definitions of knowledge in common use, each of them in a state of constant evolution.

The medical profession has usually defined knowledge in terms of codified knowledge, which until fairly recently has been defined by publication in books and journals; but the term ‘expertise’, which has wider connotations, also includes aspects of personal knowledge that are developed from experience and outside the codified knowledge system. Codified knowledge is subject to quality control by editors, peer review and debate; and given status by incorporation into educational programmes, examinations and qualifications. The guardians of the codified knowledge system are the universities and publicly funded research councils and organisations, even though an increasing number of publications of medically related scientific knowledge now come from other organisations (Gibbons et al 1994). Quite how this system will survive the increasing use of electronic publication and communications that disseminate knowledge prior to publication remains to be seen. Even in its current form, however, the codified knowledge system is far more complex than usually recognised. For example, in addition to academic publications, there are policy documents, publications by a plethora of user groups, medical statistics, local audit reports and a variety of patient records.

The main foci of the codified knowledge perspective are acceptance and truth. Each publication outlet of status has editors and referees controlling acceptance, using criteria of originality and, in journals of a more scientific nature, truth according to the parameters of the community from which the publication draws its readership. Some people regard these criteria as unproblematic, at least in theory; others see the acceptance of publications as socio-politically problematic and the accompanying truth claims as epistemologically problematic. While it would be unlikely for knowledge systems to be developed with a postmodernist perspective, the issues of inclusion or exclusion according to espoused judgements of reliability and credibility are central to any codified knowledge system.

Cultural knowledge that has not been codified, plays a key role in most work-based practices and activities. There is considerable debate about the extent to which such knowledge can be made explicit or represented in any textual form; and the evidence gathered so far suggests that its amenability to codification has been greatly exaggerated (Eraut 2000). What does appear to be generally acknowledged is that
much uncodified cultural knowledge is acquired informally through participation in social activities; and much is often so “taken for granted” that people are unaware of its influence on their behaviour. This phenomenon is much broader in scope than the implicit learning normally associated with the concept of socialisation. In addition to the cultural practices and discourses of different medical specialties and a wide range of other health professions, one has to consider the cultural knowledge of healthy and illness that permeate the beliefs and behaviours of patients from different cultural backgrounds.

**Personal Knowledge** is the individual centred counterpart to cultural knowledge, which Eraut (1997) defines as what individual persons bring to situations that enables them to think, interact and perform. The rationale for this definition is that its defining feature is the use of the knowledge, not its truth. This allows one to investigate the effects of personal knowledge without necessarily being able to represent that knowledge in codified form, thus incorporating aspects of personal expertise, practical wisdom and tacit knowledge. For example, it includes not only personalised versions of public codified knowledge, the understandings which affect how it is used, but also everyday knowledge of people and situations, know-how in the form of skills and practices, memories of cases and episodic events. It could also include various aspects of self-knowledge, attitudes and emotions. The evidence of personal knowledge comes mainly from observations of performance, and this implies a holistic rather than fragmented approach to knowledge; because, unless one stops to deliberate, the knowledge one uses is already available in an integrated form and ready for action.

Skills can be considered as both a form of cultural knowledge and a form of personal knowledge, according to the focus of attention. The term also tends to be used at two levels. One level is used to describe actions believed to be based on procedural memory alone, although the knowledge needed to decide when to use that skill will include situational understanding, which is not a skill. Such skills are likely to be either classified as technical or treated as taken for granted cultural attributes. While there is a body of codified knowledge about such skills, one cannot perform the skill by simply “learning the words”; it could even be a hindrance. The other level of usage relates to processes, which are constructed from a mixture of procedural knowledge and other forms of knowledge, for example teamwork, leadership or problem solving. There is a danger that labelling these capabilities as ‘skills’ will implicitly deny both their complexity and their possible dependence on personal expertise.

Teamwork and group problem solving introduce the issue of the knowledge constructed by teams, which makes their combined capability greater than that of all their members acting individually. This will include mutually developed understandings that permeate their discourse, mutual adaptation and collaboration in rapid response situations, mutual awareness of differences of perspective and expertise that broaden and deepen their problem solving capability, and agreed processes for making decisions. While no doubt drawing on cultural resources, their new knowledge is likely to be too situated and too team-specific to merit description as cultural knowledge; nor could it be described as purely personal. It is certainly not codified and probably largely tacit; so it cannot be adequately covered by any of the three definitions. No doubt other exceptions will also emerge when this analysis is further pursued.
Finally it is useful to discuss the role of codified knowledge that does not become public, because this features quite strongly in many knowledge management systems. Typical examples are records of patients, personnel files and a range of internal documents. Security will usually be high in order to maintain an appropriate level of confidentiality or to protect sensitive information. It is arguable whether it should be described as information rather than knowledge; but its organisation is likely to involve some thinking about its use, so there is a case for counting it as knowledge. It becomes cultural knowledge if linked to other cultural knowledge present in the organisation; or personal knowledge if, for example, it forms just part of a family doctor’s knowledge of patient. It could be regarded as codified if it became an unidentifiable part of some publicly available statistic.

The role of theory

A profession is better understood as an applied field rather than a discipline, because its rationale derives from its social purpose and not from any distinctive form of knowledge. Typically, it uses theories from a range of formal disciplines, appropriating and resituating them in its own professional contexts; in medicine these disciplines are collectively referred to as biomedical science, and their appropriation is justified only in as far as it advances the social purpose of the profession. Professions, however, are not wholly dependent on imported theories; they also create their own theories both in the academy and in their professional practices. These theories may be based on empirical research and conceptual frameworks peculiar to the applied field, and in healthcare are collectively referred to as clinical science. The relationship between biomedical science and clinical science is not at all clear, in spite of its significance for the design of medical school curricula. What is known is that clinicians rarely use basic science in explaining cases, whereas medical researchers prefer detailed, basic science explanations, without developing clinical descriptions (Patel et al., 1989).

Patel and Kaufman (2000) offer the following analysis:

“*It is our view that the results of research into medical clinical reasoning are consistent with the idea that clinical medicine and the biomedical sciences constitute two distinct and not completely compatible worlds, with distinct modes of reasoning and quite different ways of structuring knowledge* (Patel et al., 1989). *Clinical knowledge is based on a complex taxonomy, which relates disease symptoms to underlying pathology. In contrast, the biomedical sciences are based on general principles defining chains of causal mechanisms. Thus, learning to explain how a set of symptoms is consistent with a diagnosis may be very different from learning how to explain what causes a disease.*”

There are two schools of thought on how to proceed. Schmidt and Boshuizen (1992) at Maastricht suggest a theory of encapsulation, whereby biomedical propositions and concepts are subsumed into a small number of high level clinical propositions; and this is supported by the finding that, with increasing clinical experience, student doctors decrease the number of separate concepts they use to describe a single case. However Patel et al (2000) at McGill also highlight evidence that when, as in Problem Based Learning courses, students learn basic science in a context of clinical problems,
they cannot decontextualise that science for use in other contexts. They then proceed to argue that:

“Basic science does not provide the axioms, the analogies or the abstractions required to support clinical problem solving. Rather, it provides the principles that make it possible to organise observations that defy ready clinical classification and analysis. We also contend that, because clinical reasoning demands the coordination of multiple tasks and goals, the ability to organise and communicate observations is an absolute prerequisite for medical expertise.”

This becomes particularly important when one considers the increasing prevalence of multi-condition patients in an aging population.

Their recommendation for medical education is described in terms of Salomon and Perkins’ (1998) distinction between forward-reaching and backward-reaching kinds of transfer:

“Forward-reaching transfer occurs when one abstracts basic elements... conceptual understanding in anticipation of later application. This type of transfer would be expected when one is acquiring basic science knowledge in a classroom setting. Backward-reaching transfer is required when one faces a new situation and deliberately searches for relevant knowledge already acquired. This kind of transfer is exemplified in situations when one is engaged in a clinical reasoning task and needs to abstract particular principles to explain a complex problem. The challenge for medical schools is to present concepts in diverse contexts and make the relationships between the specific and general aspects explicit. This entails striking the right balance between presenting information in applied contexts (e.g. as illustrated by a clinical problem) and allowing students to derive the appropriate abstractions and generalisations to further develop their models of conceptual understanding.”

Theories, however, are not only derived from empirical evidence. Their other role is to help practitioners to explain, understand, and critique occupational practices and the arguments used to justify them; and to appreciate new thinking about the role of the profession and proposed new forms of practice. Theories related to the ideology of a profession are particularly important in discussions of its goals and purposes, and modes of interaction with clients. Most doctors have a preferred view of their profession, i.e. an ideology or theoretical justification of its purposes and practices in terms of moral principles, views of society and occupational beliefs about the effectiveness of various practices. This plays an important part in sustaining professional identity and derives partly from ethical principles articulated by philosophers and partly from the cultural assumptions about the role of that profession that prevailed (or used to prevail) in that particular society. But this identity is both changing and diversifying in response to new challenges and expectations: public accountability, a wider ethnic range of patients, patient organisations and expertise, litigation and the decline of trust, and new ethical issues raised by rapid advances in treatment. Doctors need to be far more aware of the different expectations and preferences of different patients, which can only be addressed by learning more cultural knowledge and culturally responsive communication skills.
At the theoretical level the discourse of professional ethics requires that attention be given to the meanings of concepts embedded in the discourse of different cultural groups; and the ways in which these meanings affect people's understandings and actions. If one considers, for example, concepts such as 'fairness', 'rights', 'competence', 'quality', 'responsiveness', 'consultation' or 'informed consent', the significance of understanding different cultural interpretations is readily apparent. Moreover, cultural theories of illness, disease and well-being, which have a profound effect on people's actions, have usually been excluded from the cannon of codified knowledge under the rather dismissive label of 'lay theories'. Both doctors and patients have personal concepts and theories, which draw heavily on cultural knowledge, including codified knowledge, but also acquire personal meanings through individual use and experience, often undergoing significant transformation in the process.

Although this sounds eminently sensible, we need to be aware of a strong tendency in inter-personal professions to construct theories of practice, which are ideologically attractive but almost impossible to implement. The main problem is that the professionals concerned are urged to adopt practices that involve much greater levels of time and effort than service users and/or the public purse can possibly finance. Hence, there is a significant gap between the theories of practice taught by 'enlightened' former practitioners, based on how they would have liked to have practiced, and the activities performed by current practitioners. This contrasts with a common workplace stance, in which current practice is uncritically accepted as an inevitable reality. Neither ideology nor compliance provide an adequate basis for a professional service; but this situation can only be addressed by negotiating changes in both expectations of, and arrangements for, healthcare services – a problem that most politicians assiduously avoid.

Three types of evidence
Information generated by oneself or others is treated as evidence when it is cited either as evidence of the validity of an analysis or diagnosis or as evidence for or against an argument, conclusion or decision option. But it will only be publicly accepted as evidence if it is believed to be true, or to have a reasonable probability of being true. Hence attention is given to its provenance and reliability and its consistency with other evidence. Three kinds of evidence are commonly used in medicine, each dependent on a different kind of credibility:

1) **Research-based evidence** from published research that satisfies the critical reviews of that area of research;

2) **Other scientific evidence** generated by a process involving scientific procedures with a proven record of producing valid and reliable results; and

3) **Practice-based evidence** from professional practices recognised by the relevant profession, and performed in accordance with the criteria expected by the relevant experts within that profession.

Practice-based evidence is always used in making decisions about an individual patient; and in health care this may be provided by several members of a multi-professional team. Recognised professional practices whose evidence is accepted unless contravened include a doctor's clinical examination and history taking procedures. These processes are learned through apprenticeship and personal
experience, whose nature we discuss below. Other scientific evidence may be gathered either by doctors and nurses or by specialists such as biomedical scientists and radiographers. Expertise in interpreting such evidence is varies with its complexity and the applicability of common norms; and some doctors may overestimate their competence or have insufficient time to consult the scientists who provided the evidence. Research based evidence differs from the other two types in four respects:

- It is based on populations rather than individual patients
- It is generated by researchers whom clinicians rarely meet
- It is expensive to create
- It can be difficult to locate and assess.

Thus a great deal of attention is given to its quality and its use.

The origins of what is now called evidence-based medicine lie in research on decision-making, aimed at improving rather than understanding human capability by amassing greater amounts of information, expanding the coverage of research and making increasing use of computers to organise, process and access relevant information. The term originally adopted was clinical decision analysis (Weinstein and Fineberg 1980). Its first main area of application was in drug testing where the use of randomised controlled trials (RCTs) moved from rarity in 1960 to mandatory by 1990. Since then this method has been increasingly applied to surgical therapies and diagnostic tests. At the same time principles of epidemiology, whose concern is with estimating the probable occurrence and distribution of illnesses and diseases, have been increasingly applied to mainstream clinical practice.

The term ‘Evidence-Based Medicine’ was given a considerable boost by a publication with this title in the Journal of the American Medical Association (1992) by the Evidence-Based Medicine Working Group at McMaster University in Ontario, whose radical new medical school had introduced problem-based learning some twenty years previously. Its opening sentence declared that a new paradigm for medical practice was emerging, and five years later a fuller presentation of this paradigm was provided by a pocket-sized handbook *Evidence-Based Medicine: How to practice and teach EBM* (Sackett et al, 1997), authored by two leading members of the McMaster Group - David Sackett, now Director of the NHS R&D Centre for Evidence-Based Medicine in Oxford, and Brian Haynes, Head of the Health Information Research Unit at McMaster - and two professors of medicine. The intended readership of this handbook is practitioners rather than researchers and it provides guidance on precisely when and how practitioners should be seeking to use evidence available from research. It also explains how the use of research evidence is integrated with much patient-specific evidence and informed by doctors’ previous experience.

The 1992 McMaster paper also emphasised that, while the new paradigm was of critical importance, its implementation still relied on the old knowledge:

“Clinical experience and the development of clinical instincts (particularly with respect to diagnosis) are a crucial and necessary part of becoming a competent physician. Many aspects of clinical practice cannot, or will not, ever be adequately tested. Clinical experience and its lessons are particularly important in these
situations. At the same time, systematic attempts to record observations in a reproducible and unbiased fashion markedly increase the confidence one can have in knowledge about patient prognosis, the value of diagnostic tests, and the efficacy of treatment.

The paper also warned against placing too much reliance on either doctors’ personal knowledge or biomedical science.

“In the absence of systematic observation one must be cautious in the interpretation of information derived from clinical experience and intuition, for it may at times be misleading.”

“The study and understanding of basic mechanisms of disease are necessary but insufficient guides for clinical practice. The rationales for diagnosis and treatment, which follow from basic pathophysiologic principles, may in fact be incorrect, leading to inaccurate predictions about the performance of diagnostic tests and efficacy of treatments.” (McMaster, 1992, p 2421)

The key conclusion to be drawn from these authoritative sources and is that Evidence-Based Medicine is founded not only on research based evidence and other scientific evidence but also on practice-based evidence. For practitioners and those who train them one of the most critical issues appears to be the balance between the two.

However, the huge world-wide investment in pharmacological and other medical research has given EBM a much higher political profile. Hence much of the current advocacy of evidence-based practice proceeds on the assumption that there is enough research evidence available to largely determine, not just inform, a large proportion of practitioner decisions. There has also been significant public investment in knowledge management systems designed to make the results of that research available not only to policy makers but also to individual physicians. This has been accompanied by increasing pressure to use this growing body of codified knowledge to maximum effect.

The “gold standard” of medical research is the randomised control trial of a health care intervention, and its Fort Knox is the Cochrane Database of Systematic Reviews, an electronic resource with quarterly updates prepared, maintained and disseminated by the Cochrane Collaboration, an international organisation. According to Sackett et al (1997) the Cochrane database sets “a newer higher standard for finding, rating, summarising and reporting evidence from trials”. But they also note that it will take many years to reach the stage where the “Cochrane Collaboration succeeds in summarising all randomised control trials of health care interventions in any field.” Some knowledge retrieval pathways may be paved with gold, but others will remain less easy to find and less firm underfoot. During the course of a recent review of research in postgraduate medical education, I consulted a number of medical consultants about the proportion of medical decisions for which relevant “gold standard” evidence was available, whether summarised by Cochrane or not. Nobody suggested a figure above 20%, but all agreed that the figure was rising. However, opinions about the speed of that rise and when it would begin to plateau varied widely.
The practice of meta-analysis associated with Cochrane reviews involves first the exclusion of all research other than RCTs, then the careful differentiation of the included research studies according to their population (especially the nature and severity of the patient’s condition), the effect size and other contingent conditions such as contextual variables and side effects. The reason for this focus on double blind randomised control trials (RCTs) is to avoid the unintended influence by researchers or participating workers by the use of double blind randomised control trials and to enable the more robust attribution of outcomes to the specified intervention rather than to other factors.

When other types of research are included, more research becomes available but its value is usually lower because alternative interpretations of the data are more plausible. The process moves closer to that of a traditional research review, which at its best gives considerable attention to alternative interpretations to those offered by the authors of published studies. Hence their output is more likely to take the form of carefully considered judgements based on evidence, argument and warnings against over-reliance on the research. Such reviews may still contribute to the probability of making a better decision but their use requires even greater expertise from the doctor.

We must also note that this “gold standard” research applies almost exclusively to treatment and even that requires fine-tuning to the characteristics of individual patients. It assumes the diagnosis is correct and will normally not apply to patients with multiple conditions, although such conditions are increasingly likely as patients get older. Diagnostic decisions usually rely on a wide range of practice-based evidence; and the diagnostic process is best described in terms of a doctor recognising the pattern created by piecing together several disparate types of information, derived from patient history (obtained by questioning), physical examination, routine tests and, if appropriate, x-ray or other forms of image, microbiological or other more sophisticated tests – all of which need interpretation by doctors and often by other health professionals as well. Some of this practice-based evidence is collected at the beginning and some, if needed, at later stages in the diagnostic process. When patients are acutely ill, stabilisation and treatment of life endangering symptoms may precede the collection of diagnostic evidence that cannot be quickly obtained; and the patient’s response to such emergency measures may provide some of the most important evidence. Some diagnostic tests are mainly used for differential diagnosis after possible diagnoses compatible with the early evidence have been short-listed.

Research-based evidence may contribute to this diagnosis process in a number of ways. First, these are the results of epidemiological research that measures the probability of various medical conditions in particular populations. Populations in the medical context can be defined by a large number of variables, including: gender, ethnicity, age, family, occupation, locality of home and work, lifestyle (e.g. smoking, diet, exercise, travel) height, weight and medical history of self and family. Such data allows early assignment of probabilities to possible diagnoses. Second, research has provided statistical evidence of how test results may vary with many of these population variables, thus enabling estimates of the abnormality of a test result by comparing it with data from ‘similar’ patients. Together with research or local audit evidence on the accuracy of such evidence, these provide an essential framework for judging its significance. Then, thirdly, research may provide evidence on the discriminating power of various diagnostic tests and procedures. What is the
probability that a particular test will confirm a particular diagnosis? Will it significantly improve the choice of diagnosis; and what are the most likely errors to arise from its use?

The nature of expertise

The powerful attraction of research based evidence has tended to divert attention from the expertise of individual physicians, which includes the important issue of how they use research based evidence, something that cannot be taken for granted and often requires considerable professional judgement. Thus, even in the most researched areas there is always a balance between research-based knowledge, the cultural knowledge found within the specialties and personal knowledge constructed from a doctor’s own experience. However, it is now recognised that these boundaries are not at all clear. In the UK the main response has been to set up specialty committees of recognised experts to construct guidelines for the main conditions treated by their specialty. Typically, these committees consult their colleagues, write draft versions, consult again, then finally publish a monograph of a hundred or more pages. The advice in these guidelines is graded from A to E according to the strength of the supporting research. Thus the decisive conclusions of a meta-analysis of several RCTs would be given an A rating, less comprehensive or conclusive reviews of research would be rated B or C, and the collective wisdom of the group would be given only an E if it had no research backing. Such guidelines cover both diagnostic and treatment decisions; but the physician, with or without consultation with colleagues, still has to locate each individual case within the landscape of possible conditions within the specialty, and decide whether there may also be conditions present which are located outside the specialty.

This case based experience still plays an essential role in medicine; and there is evidence that the accumulation of case experience is not a purely rational process, in which the features of each case are consciously and rationally added to a store of similar information from other cases. This would be an enormous cognitive overload. Memories of cases are aggregated unconsciously and activated intuitively when apparently similar cases are encountered (Kolodner 1993). One plausible hypothesis based on schema theory is that this accumulated experience is represented in the mind by an ‘illness script’ or narrative account of a typical case, in which causal models of the condition are embedded in the sequence from assumed conditions, through diagnosis and treatment, to short term outcomes. A key advantage is the illness scripts are activated as a whole.

“This means that once an illness script has been activated, the other elements of the script are also activated, immediately and automatically. People whose knowledge is organised in illness scripts therefore have an advantage over those who have only semantic networks at their disposal. A physician who solves a problem activates one or a few illness scripts. Information provide by a patient is matched to the illness script elements (Enabling Conditions and Consequences). Furthermore, illness scripts generate expectations about other signs and symptoms the patient might have, Hence, activated illness scripts provide a list of phenomena to look for when taking the patient’s history and during physical examination. In the course of this process a script may become further instantiated, i.e. expected values are substituted by real findings. On the other hand, when findings do not match, the script becomes
Thus scripts are very efficient tools for storing case based expertise. However, they do not provide a complete picture of a physician’s expertise. The expert doctor may have a mental portfolio of scripts, but still encounter some cases, for which none of these scripts are appropriate. These cases are stored in memory as archetype cases, which are activated as single cases when the doctor encounters apparently similar cases in the future.

Eraut and Du Boulay (2000) argue that key features of this research are:

“**The importance of case-based experience, the rapid retrieval of information from memory attributable to its superior organisation, the development of standard patterns of reasoning and problem-solving, quick recognition of which approach to use and when, awareness of bias and fallibility; and the ability to track down, evaluate and use evidence from research and case-specific data.**” (p99)

Moreover, “understanding the nature of expertise is important for self-monitoring one’s use of heuristics and possible bias, sharing knowledge with others and supporting other people’s learning. It is also critical for understanding the respective roles of clinical experience and research-based guidelines”. (p99)

“Those responsible for developing, disseminating, evaluating and modifying guidelines, decision aids, information systems and communications aids within teams and across teams need to match their procedures and modes of representation to the way doctors’ minds work” (ibid, p99).

To this I would add that it is not only doctors’ minds but also the prevailing conditions in their practice contexts that have a huge effect on their use of guidelines. This problem is increasingly recognised in primary care (Lipman & Price 2000), but not in secondary care, where changes in service delivery have significant implications for the acquisition of case based expertise. Apart from the lack of time to consult guidelines or colleagues in pressured hospital environments, the introduction of shift working is changing the very nature of a new doctor’s experience. Previously each case contributing to case based expertise comprised a set of linked episodes spanning a patient’s stay in hospital and covered history taking, examination, diagnosis, treatment and short term outcomes; and included cases where initial diagnoses were uncertain or turned out to be wrong. Now the case could include just a single encounter with a patient, and fail to link diagnosis or treatment decisions with outcomes, because the patient was never seen again. Such single episode fragments of cases are insufficient raw material for constructing an experientially based illness script; so the unconscious aggregations of cases that enable doctors to develop expertise and good judgement will no longer take place. They will either practice more slowly ‘by the book’ or gain speed by using maxims or recipes that are far less grounded in case experience and therefore less reliable.

My brief mention of uncertain and wrong diagnoses raises another very important issue. Evidence based medicine is constructed on the assumption that diagnostic and
treatment decisions conform to the parameters of classical decision theory, which has been criticised by Beach and Lipshitz (1993) as:

“an abstract system of propositions that is designed to describe the choices of an ideal hypothetical decision maker - omniscient, computationally omnipotent Economic Man.”

However, research has shown that “real life” decision-makers rarely behave in this way. Researchers into what has come to be called Naturalistic Decision Making (NDM) argue that contexts are rarely as simple as those envisioned by either classical decision theory or the stronger versions of evidence-based practice, because real settings have many of the following characteristics:

- Problems are ill-structured
- Information is incomplete, ambiguous, or changing
- Goals are shifting, ill-defined or competing
- Decisions occur in multiple event-feedback loops
- Time constraints exist
- Stakes are high
- Many participants contribute to the decisions
- The decision-maker must balance personal choice with organisational norms and goals (Orasanu and Connolly 1993, pp19-20).

The findings of NDM research correspond quite closely with those from observation based studies of medical diagnosis:

- Experts frequently generate and evaluate a single option rather than analyse multiple options concurrently
- Experts are distinguished from novices mainly by their situation assessment abilities, not their general reasoning skills
- Because most naturalistic decision problems are ill-structured, decision makers choose an option that is good enough, though not necessarily the best (ibid p20).
- Reasoning and acting are interleaved, rather than segregated (Weick 1983).
- Instead of analysing all facets of a situation, making a decision, and then acting, it appears that in complex realistic situations people think a little, act a little, and then evaluate the outcomes and think and act some more (Connolly and Wagner 1988) (ibid p19).

The research also demonstrates that reasoning is “schema-driven” rather than algorithmic, as assumed by the EBM model of decision analysis in the classical mode.

“Even for problems with many novel elements (typical of NDM situations), decision makers use their knowledge to organise the problem, to interpret the situation, and to define what information is valuable for solution. Some information may be selected or distorted to fit the existing schema, a potential source of error. But it also enables speedy assessment, search, selection, and interpretation of relevant information, a definite advantage when faced with information overload and time pressure. A critical
feature of the schema-driven approach is that people create causal models of the situation. They try to understand the significance of events and information by inferring causal relations” (ibid p 18).

The implications of this research are that (1) the relationship between knowledge and decision-making is rarely simple, (2) good decision-making is critically dependent on how the decision is framed by the decision-makers in the light of their situational understanding and therefore (3) the balance is tilted more towards the personal knowledge of the decision-maker and less towards a codified knowledge management system than might be implied by classical decision-making theory. If there is very little time or several competing decisions, any consultation of the knowledge management system would be brief and only undertaken if there was a high expectation of getting a valuable pay-off almost immediately. Most of the research evidence has to be embedded in normal practice, if it is to be used on a regular basis.

When we move outside the hospital to community or even outpatient settings, other kinds of expertise become more prominent. Consultations, in particular, may involve treatment, even therapy, as well as diagnosis. Most of the conditions will be less severe or not yet sufficiently clear to diagnose, and the psychological element may be given greater attention. Some authors (e.g. Balint 1957) have argued that there is a psychological element in most consultations, and that it is the most significant aspect of at least a quarter of consultations in community settings. This gives a very different perspective on the kind of knowledge needed by family doctors.

A rather different psychological issue is associated with what the user-unfriendly literature describes as the problem of compliance. Whatever the merits of a doctor’s diagnosis and advice, research indicates that a large proportion of patients do not follow it. This does not apply only to “hard to change” unhealthy lifestyles but also to taking medication. A study by Tuckett et al (1985) of doctor-patient communication in general practice found that in “as many as one in every two consultations patients could not recall all the key points... could not make correct sense of them, or were not committed to them” (pp 167-178).

“Because doctors did not know the details of what patients were thinking, the information they did give could not relate, in any precise or considered way, to the ideas patients themselves possessed. In short, doctors could have no way of knowing whether the information they offered was being understood ‘correctly’ or not. Equally, patients could have no way of knowing whether their understanding of what doctors said was ‘correct’.” (p205)

At a more general level, and particularly in community settings and clinics, it is important for the doctor to find out what is worrying the patient and why they have come for a consultation in order to frame the health problem in an appropriate way for progressing the situation. The doctor’s problem may not be the same as that of the patient. I doubt if knowledge of how to conduct more effective consultations often appears in teaching sessions on prescribing medication. This analysis of professional-client interaction could apply to many other professions. It is not only the professionals who try to construct causal models of the situation!
Understanding Practice

The significance of this research on professional expertise becomes clearer when we look more critically at the nature of practice, and the contexts and conditions in which it takes place. The nature of medical expertise is largely determined by how doctors have to think on-the-job in the midst of a busy shift. Under these conditions deliberative problem-solving is a default strategy, because doctors’ expertise is constructed to enable them to short circuit time such consuming responses. Figure 1 below shows the interaction between time and mode of cognition for four key aspects of professional practice in action:

1) Assessing patients and situations (sometimes briefly, sometimes involving a long process of investigation) and continuing to monitor their condition;

2) Deciding what, if any, action to take, both immediately and over a longer period (either on one’s own or as a leader or member of a team);

3) Pursuing an agreed course of action, modifying, consulting and reassessing as and when necessary;

4) Metacognitive monitoring of oneself, patients receiving or needing attention and other participants in the immediate situation.

These activities can take many different forms according to the speed and context and the types of technical and personal expertise being deployed. Although analytically distinct, they may be combined into an integrated performance that does not follow a simple sequence of assessment, decision and then action. For example, as suggested

<table>
<thead>
<tr>
<th>Type of Process</th>
<th>Mode of Cognition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instant/Reflex</td>
</tr>
<tr>
<td>Reading of the situation</td>
<td>Pattern recognition</td>
</tr>
<tr>
<td>Decision-making</td>
<td>Instant response</td>
</tr>
<tr>
<td>Overt activity</td>
<td>Routinised action</td>
</tr>
<tr>
<td>Metacognitive</td>
<td>Situational awareness</td>
</tr>
</tbody>
</table>

in our discussion of naturalistic decision making, there may be several assessments, decisions and actions within a single period of consultation and treatment. The chosen pathway may depend not only on the conditions and constraints on the performer, but
also on what the doctor has learned to do, with or without stopping to think. Thus the model assumes that time is the variable that most affects mode of cognition and divides the time-continuum into three sections, headed Instant, Rapid and Deliberative. These terms attempt to describe how the time-scale is perceived by the performer, and are interpreted differently according to the orientations of performers and the nature of their work. For example, in one context rapid might refer to any period less than a minute, while in another context it might include periods of up to ten minutes or even half an hour. The critical feature is that the performer has little time to think in an analytic mode.

The instant/reflex column describes routinised behaviour that, at most, is semi-conscious. The rapid/intuitive column indicates greater awareness of what one is doing, and is often characterised by rapid decision-making within a period of continuous, semi-routinised action. Typically it involves recognition of situations by comparison with similar situations previously encountered; then responding to them with already learned procedures. The time available affects the degree of mismatch that is tolerated, because rejection of action based on precedent leads to deliberative, problem-solving and hence to a more time-consuming approach. The deliberative / analytic column is characterised by explicit thinking about one’s actions in the past, present or future, possibly accompanied by consultation with others. It involves the conscious use of prior knowledge, sometimes in accustomed ways, sometimes in novel ways or in a more critical manner.

The interesting question arises as to whether performers are aware of the knowledge embedded in their practice when it is not explicitly used at the time. Four very different circumstances may pertain:

1) The practice was modelled on that of other doctors without understanding the reason for it or being aware of any underpinning knowledge.

2) The practice was developed with awareness of its rationale and underpinning theory, but that awareness dissipated over time and with it the ability to explain or justify it.

3) The practice can still be justified by citing underpinning knowledge, but cannot withstand any challenge because there has been no critical evaluation of the practice since it was first adopted.

4) The practice can be justified and withstand criticism, because it has been periodically re-evaluated and remains under the doctor’s critical control.

Two problems are likely when the use of underpinning knowledge is not under critical control. First, conflicts may arise in problematic cases between competing responses based on different practical principles – these cannot be resolved unless the underlying reasons for these principles are understood. Second, there is a danger that “scientific” knowledge will be replaced by unscientific knowledge – that which falls within the domain of a discipline but is regarded by leading professionals as either incorrect or alarmingly incomplete. The normal assumption is that being a competent doctor implies keeping one’s practice under critical control; and therefore keeping up to date with relevant areas of theory and research. Reviews of practice may arise
either from individual reflection and consultation or, more officially, from the work of an appointed group at local or national level, which reviews the rationale for the practice, the evidence for its effectiveness, alternative approaches and recent research findings.

The embedded nature of much professional knowledge makes it hard to keep under critical control, and also has many implications for transferring it from one context to another. In the complex situations encountered by most professional workers, the transfer process typically involves five inter-related stages:

1) The extraction of potentially relevant knowledge from the context(s) of its acquisition and previous use;
2) Understanding the new situation, a process that often depends on acquiring information from other people;
3) Recognising what knowledge and skills are relevant;
4) Transforming them to fit the new situation;
5) Integrating them with other knowledge and skills in order to think / act / communicate in the new situation.

The complexity of the learning processes required for transfer, both between clinical contexts and from education to practice contexts is rarely recognised by medical educators, thus encouraging doctors to become sceptical of the relevance of much scientific knowledge, including much that is likely to influence future practice.

References


Eraut M. Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology*. 2000;70,113-136.


