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# Getting a better grip on research: the comfort of opinion

*Too often we … enjoy the comfort of opinion without the discomfort of thought.*
John F. Kennedy
(1917–1963)

**In the 21st century, health care clinicians, managers and patients expect to see the findings of research incorporated into clinical practice, taking into account the needs and wishes of individual patients.**

**The GP curriculum**

Evidence-based practice is covered by Statement 3.5 of the GP Curriculum. All GPs should be able to

- Ask the 'right questions'
- Find the appropriate literature from the widest available sources
- Apply rigour in appraising the literature
- Place the answers in the appropriate context

GPs should have the ability to
- Demonstrate that they base their treatment and referral decisions on best available evidence
- Apply rigour to scientific research to decide whether evidence is applicable to the primary care setting and appropriate to the individual
- Demonstrate sufficient knowledge of the breadth of scientific evidence in order to provide the best information for the individual and his or her illness
- Use their knowledge of the 'best possible evidence' to inform a patient of the 'best possible' way to navigate the health care system
- Demonstrate that they base their treatment and referral decisions on best available evidence
- Demonstrate sufficient knowledge of the breadth of scientific evidence in order to provide the best information for the individual and his or her illness
- Demonstrate understanding that evidence needs to be gathered from the most appropriate, rather than the most readily available source. GPs should be able to determine whether evidence presented to them is sufficient and rigorous enough to be analysed in the context of a patient.

In this series, we examine why that happens—and often does not happen—and what clinicians and managers can do to improve the use of evidence in consultations. Papers 1 and 2 are based on comprehensive literature searches undertaken as part of a programme that started in 2002 by the National Prescribing Centre. These two papers outline the background to the science of evidence-based medicine (EBM) and consider the extent to which it informs practice. Paper 3 describes under-recognized but evidence-based, pragmatic approaches to enable high-quality research findings to be identified, considered and where appropriate incorporated more often and with less difficulty into routine clinical practice. It also contains details of materials for further study for generalists and especially GP registrars. Paper 4 is based on a published systematic review. It describes the characteristics and actions associated with more successful adoption of change and the implications for health care organizations such as hospital trusts, primary care trusts (PCTs) and practice-based commissioning (PBC) groups and their equivalents in other health systems. The final paper describes a clinician's progress on a journey to meet the real-world challenges of using evidence in medical practice, using a narrative approach. This is the second paper in the series of five, describing the use of evidence to support decisions made in clinical practice.

If you ask doctors, they say they need information in order to be able to manage a clinical problem about once a week. However, if you debrief them more intensively, they raise about two questions for every three patients. Answers to most questions are not immediately pursued. When they are, an average of less than 2 minutes is spent pursuing an answer, and readily available printed material or colleagues are the usual sources of information accessed (Covell *et al.*, 1985; Ely *et al.*, 1999). This leads to the uncomfortable conclusion that much clinical decision making is based on what is thought to be current best, or at least better, evidence—as opposed to the consultation being based on what is known to be the evidence. Assuming certainty about the knowledge underpinning health care treatment decisions made by individual clinicians may be largely illusory.

## Handling large volumes of complex information

The psychology of decision making has been extensively studied. It is a remarkable paradox that undergraduate and postgraduate programmes for health care professionals seek to produce excellent decision makers, yet learners are exposed a little or not at all to the evidence that describes how humans make decisions.

The processes involved in handling large volumes of complex information are the same, whatever the context or type of information—be it air traffic control, military operations or clinical decision making in health care (Sutherland, 1992). The human brain has a limit to the amount of information it is able to utilize in decision making. Various approaches are employed to enable a decision to be made in the face of large volumes of evidence, and these usually involve truncating the amount of information used in order to be able to make a 'good enough' decision, an approach termed satisfycing (Gigerenzer, 2008).

Think about the way you approached buying your current car. Most people will consider cost, unless they are lottery winners or have a significant personal fortune. Safety, size, running costs, colour, gadgets and so on are other factors to which most people pay some attention. So, from where is that information collected? You probably read one of the popular consumer motoring magazines and spoke to some people whose opinion you respected or who already had a car similar to the one you were considering. Brief reading and talking to other people are the tactics. Very few people would go to detailed motor engineering websites and try and digest hundreds of pages of technical information, and even if that was the case, that volume of information would hinder rather than help decision making.

That is the way human beings make decisions—any decision. A small number of variables are ascribed values based on brief reading and talking to other people, and a decision is made within the available time frame. And so, since most doctors were human the last time we checked, it is not surprising that doctors make their decisions in the same way. UK general practitioners, if consulted by a young woman with an uncomplicated urinary tract infection, are likely to prescribe trimethoprim. Where did the information come from on which that decision is based?

Undergraduate teaching, brief written summaries, seeing what other people do, talking to local colleagues and personal experience are the most likely sources of information (Gabbay and le May, 2004). Psychologists call this System 1 processing. Very few clinicians will actually have used 'System 2 processing', a logical and emotionally attractive method on which to base decision making. In this case, a System 2 approach might involve reading the systematic review comparing cure rates with different antimicrobials, perhaps reviewing and critically appraising the best of the primary research contributing to that review, and then coming to a conclusion about the optimal management. In most decision making, humans think they use System 2 approaches or at least they express a preference for that approach. However, the data often shows System 1 approaches are the norm.

System 1 and System 2 approaches apply in all areas of decision making and in medicine that means in both making a diagnosis and also in making decisions about clinical management plans. Both approaches have advantages and disadvantages. System 1, also termed pattern recognition, is above all fast. It would be impossible to practise as a doctor without using System 1 processing for both diagnosis and management given the pace of clinical practice. And in some circumstances, System 1 can be superior to System 2 and actually result in better decisions (Gigerenzer, 2008).

But what if new data emerges that will perhaps change the optimal approach? A clinician continuing to use System 1 approaches will only know about the new management strategy when his or her trusted colleagues are talking about the new approach or the new treatment appears in front of him or her in brief text. That does not sound too good when we are taking critical decisions involving getting the right treatment for the right patient. Would we be happy getting treatment for a cancer based on a System 1 approach to acquiring the best evidence? System 2 is inherently attractive to a modern society and the individuals within it. It is scientific, all encompassing and ensures we use the latest data to support decision making. We would expect people to use System 2. But do they and can they?

The development of medical expertise is described in Box 1. It involves sacrificing much of the basic science learning covered in the early years of all undergraduate health science degrees, while retaining more pertinent clinical features and especially patterns—of signs and symptoms for diagnosis and of management options. Both are then combined as illness scripts. These patterns are then refined as personal experience develops.

In the expert, the slow, logical and linear thinking of the beginner is usually replaced by the pattern recognition, with alternative System 2 approaches to making a diagnosis or recommending management employed when that approach fails. When asked how they made particular clinical decisions, such clinicians may construct *post hoc* a linear model, even though they used non-linear intuitive thinking to reach their diagnosis or management strategy. Experts therefore switch between System 1 and System 2. It might be argued that a measure of their expertise is knowing when to switch.

**Box 1. Handling large volumes of complex information**

**Causal networks**

The first stage in the development of clinical expertise is the development of elaborated causal networks. In medicine, this occurs during acquisition of the basic sciences, even though this may be contained within modern problem-based or clinical presentation-based curricula. Huge volumes of information—anatomy, physiology, biochemistry, pharmacology, clinical features, and epidemiology—are combined with details of clinical management options and consultation skills. At this stage, it is as difficult for an aspiring clinician to contemplate making an accurate diagnosis and carrying out safe and effective treatments as it is for a 17 years old sitting behind a driving wheel for the first time to contemplate driving in the rush hour.

**Abridged networks**

Learners start to form abridged networks when they become exposed to real patients. Basic knowledge is rewritten and automated into more simplified causal models that explain signs and symptoms, which then become associated with diagnostic labels. Diagnosing a first clinical case involves significant conscious mental effort involving extensive reasoning. However, subsequent cases require progressively less effort as mental short cuts, patterns and familiarity with the process of history taking and examination develop. It is no longer necessary to activate all possibly relevant knowledge in order to understand what is happening with the patient; only knowledge pertinent to understanding the case will be activated. With effort, practice, sensitive instruction and support, the young driver gradually is acquiring the skills to be able to handle a car.

**Illness scripts**

Following repeated experience with patients, clinicians develop illness scripts. These are sufficient to diagnose and treat diseases. Clinicians can readily access lists of features that characterize diseases, have information in hand about temporal features of disease and a specification of what to do and handle that information within the context of an individual patient. Although still an inexperienced driver, the driving test has been passed.

**Cases**

The final stage involves expertise being stored as cases. Experienced clinicians remember many individual patients and store that information as instance scripts. Each new patient has a different variant of the disease and new (or newly sick) patients are recognized as 'similar to Patient X' and treated as Patient X was treated. Experienced drivers avoid many pitfalls that may trap the less experienced, but does experience automatically default to expertise?

In progressing through the stages of acquiring diagnostic expertise, doctors change from using primarily one strategy to using primarily another (Elstein and Schwarz, 2002). The beginner's approach to diagnosis is System 2—logical, linear and largely hypothetico-deductive. Hypotheses are created and information is collected with the aim of proving or disproving them. As experience grows, a System 1 approach starts to characterize the method of diagnosis most often deployed and the pattern recognition develops. This uses the creation of mental models as a form of short cut to diagnosis. More advanced diagnosticians make the leap from, say, lower extremity oedema to heart failure without processing all the pathophysiology that links the two. They begin to know more, with less reliance on, or even awareness of, knowing how they know more.

In diagnosis, the pattern recognition works well when patients fit the pattern, but may mislead with potentially disastrous consequences when patients do not fit the established models (Dwivedi, 2006a; Dwivedi, 2006b; Dwivedi, 2006c). The old diagnostic adage is (for clinicians practising in the UK) 'if a bird flies over this building it's more likely to be a sparrow than a parrot'. But what if someone has left the gates to the local tropical aviary open without you knowing? Conceptually, hypothetico-deductive reasoning is an attractive approach which is grounded in the scientific method. However, it also has potential flaws. For example, there may be a failure to generate the correct hypothesis and the data may be collected thoroughly but the clinician may ignore, misunderstand or misinterpret it. In addition, the clinician may collect insufficient information to prove a hypothesis, interpret accurately what is available, but still produce an inaccurate or incomplete diagnosis.

In selecting management, we saw in Paper 1 the limitations of System 1 processing. Many thousands of patients received Cox II inhibitors on the basis of the pattern recognition, thereby increasing their cardiovascular risk. In the UK, many thousands continue to receive diclofenac, when System 2 processing indicates that ibuprofen or naproxen might offer similar efficacy, similar gastrointestinal safety (especially when combined with a proton pump inhibitor) and lower cardiovascular risk. The reality is that in most areas of therapeutics, it is possible to identify a difference between existing patterns of prescribing by UK general practitioners (based on System 1 processing) and what the System 2 approach based on the evidence would indicate is optimal (see www.npci.org.uk, data focussed commentaries).

One alternative System 2 approach to diagnostic problem solving is Bayesian decision making, which has some similarities with hypothetico-deductive reasoning (see Box 2). A Bayesian approach is a minority sport among clinicians—academic general practitioners on average use six clinical decision calculators based on a Bayesian approach to assess the probability of a diagnosis and even then not routinely (C. Henegan, personal communication). Of course, the Bayesian approach to diagnosis has many characteristics of System 2 and since human beings prefer to use System 1 most of the time, the limited use of Bayesian diagnostic calculators is not surprising. Yet, in a systematic review, in 4 out of 10 randomized controlled trials, a computer decision support for diagnosis was beneficial. Two of the four successful decision support tools were diagnostic systems for cardiac ischemia in the emergency department; these decreased the rate of unnecessary hospital or coronary care admissions by 15% ($P < 0.05$) and another improved the time to diagnosis of acute bowel obstruction (1 hour when computer was used versus 16 hours when diagnosis was made with contrast radiography; $P < 0.001$) (Garg *et al.*, 2005).

Essential Evidence Plus (www.essentialevidenceplus.com/) contains more than 3000 decision support calculators, diagnostic test calculators and history and physical test calculators. Switching occasionally from System 1 to System 2, when indicated, would reduce some uncertainty in diagnosis and perhaps avoid some serious, even fatal, diagnostic errors.

## In praise of experts

Neither hypothetico-deduction, pattern recognition nor Bayesian decision making are proof against error. But anyone

**Box 2. The Bayesian approach to diagnosis**

Named for the Rev Bayes, an 18th-century English mathematician and clergyman, this technique sounds exactly the opposite of natural human decision making. The approach is formal and mathematical, requiring high-quality research recording the results of signs, symptoms and diagnostic tests and their presence or absence in people with a specific diagnosis, as confirmed by a gold standard test. However, the use of sequential signs, symptoms and tests each with its own positive or negative result is quite natural to the experienced clinician. Each test on its own may not provide sufficient evidence confidently to rule in or rule out a diagnosis. However, by combining the results, a more firm (but not certain) conclusion can be drawn (Gill *et al.*, 2005).

An hypothesis is developed which is then confirmed or excluded using an estimate of the patient's pretest probability of the hypothesized condition and the likelihood ratio (LR) of the symptom, sign or test to produce a posttest probability. A positive LR (LR+) is the number of times more likely it is that a person with the condition would show a positive result. The pretest odds, multiplied by the LR+, gives us the posttest odds. We naturally think in terms of probabilities or rates (e.g. 2 in 10=0.20 or 20%). For rare events, these are similar to odds, but for more common things, odds and rates diverge: the odds of something happening 2 in 10 times is 2:8=0.25. Fortunately for us, clinical decision calculators usually convert between probabilities/rates and odds automatically.

For example, consider John, a 62-year-old male smoker with type 2 diabetes who presents with acute chest pain and sweating, who has had a myocardial infarction (MI) in the past. We might estimate that the pretest probability that he is experiencing an acute MI is quite high—say 10%. But of course, there might be other things going on. The LR+ for the presence of diaphoresis in such patients is 2.0 (Panju *et al.*, 1998). So the posttest probability that John is having an MI is now 18.2%. This posttest probability becomes the next pretest probability. His history of MI has an LR+ of 1.5–3, so the posttest probability is now 25–40%. An MI is looking increasingly likely. However, John's pain is sharp and stabbing (LR+ 0.3), which reduces the chances that he is having an MI—now down to 9–17%. His pain improves if John shifts his position (LR+ 0.2, probability now 2–4%) and can be reproduced by palpation (LR+ 0.2–0.4).

So now, we think the likelihood that John is having an MI is down to 1.6% or even 0.4%. Even the presence of ST elevation on electrocardiogram, with a LR of 11, would make the probability of John having an MI only 4–15%. So the possibility that he is having an MI is still an important differential diagnosis, but we might well be thinking about other possible causes of John's signs and symptoms. Would a pattern recognition approach have led us to consider them or would our mental short cuts have ignored the other clues?

suffering significant central chest pain would hope to be assessed by someone who has seen many people with similar symptoms. By the skilful taking of a history, careful examination and judicious assessment of the results of investigations, an acute MI can be separated from alternative and mostly less threatening diagnoses, and the outcome is better when the attending physician sees more people with MI (Tu *et al.*, 2001).

There is substantial evidence that expertise in procedures, as defined as performing a high volume, is also highly desirable (Halm *et al.*, 2002). Whether it is treating AIDS, performing surgery on pancreatic cancer, oesophageal cancer or abdominal aortic aneurysms or managing paediatric cardiac problems, there is a median of 3.3–13 excess deaths per 100 cases attributed to low volume. Coronary artery bypass surgery, coronary angioplasty, carotid endarterectomy, other cancer surgery and orthopaedic procedures also have a volume–outcome relationship, but of smaller magnitude. Experience and practice, if not making perfect, is what we all ought to look for in a clinician performing procedures.

The challenge here, and how that challenge is met, is the same as in diagnosis. There is a lot of complex information to acquire; this is followed by supervised practice, the development of short cuts and heuristics as competence develops, leading to unsupervised practice, which is increasingly required to be within the environment of audit, review and revalidation. System 1 approaches may not only be appropriate, they can be optimal if supported by an appropriate framework to ensure quality.

## Feeling comfortable with not knowing everything

When it comes to decision making about different clinical management options, the challenge is to check our System 1 processing against the evidence contained in a System 2 approach. But a System 2 approach involves acquiring, assessing and then applying large volumes of complex information. And what volumes of information! It is estimated that there are 1500 pages added to Medline each day. Even when this is distilled into accurate, fair, complete and balanced guidelines, it was recently estimated that for a single acute medical take of 18 patients with a total of 44 diagnoses, 'the guidelines that the on call physician should have read remembered and applied correctly for those conditions came to 3679 pages. This number included only NICE, the Royal Colleges and major societies from the last 3 years. If it takes 2 minutes to read each page, the physician on call will have to spend 122 hours reading to keep abreast of the guidelines' (Allen and Harkins, 2005).

The volume of information is the obvious challenge. But in tackling this, unless they are aware of how the information reaching them can be flawed, both specialists and generalists are dealt a difficult hand. Given the information overload, relying on brief reading of abstracts is tempting. However, a random sample of 44 articles and their abstracts from five mainstream international medical journals found 19% of abstracts contained statements that were inconsistent with the full article and 11% of abstracts contained statements that were not present in the full article (Pitkin *et al.*, 1999).

Many new research findings are first presented to specialists at large scientific meetings. Information obtained in this way may have a greater impact than reading the research in a journal. Yet, of the 148 randomised controlled trials that were presented at American College of Cardiology scientific meetings between 1999 and 2002, and subsequently published, 41% exhibited discrepancies between the efficacy estimate of the primary outcome reported in the meeting and reported in the full length report (Toma *et al.*, 2006).

New research rarely sets its results in the context of the rest of the evidence (Clarke and Chalmers, 1998; Clarke *et al.*, 2002).

Review articles often fail to mention important advances or exhibit delays in recommending effective preventive measures. And in some cases, treatments that have no effect on mortality or are potentially harmful continue to be recommended (Antman *et al.*, 1992; McCormack and Greenhalgh, 2000; Shaughnessy and Slawson, 2003). Even if the conscientious clinician finds and is able to adequately critically appraise a randomised controlled trial, he or she ought not to base automatically their practice only on that one trial. There might be others, perhaps many others, in the literature that provide a more accurate and perhaps different representation of 'the truth'.

As an example, let us look at the effect of exercise of the pain of knee osteoarthritis (see Fig. 1). Those clinicians who searched and found the Hopman-Rock trial in 2000 would tell their patients that exercise does not help. On the other hand, those clinicians who searched and found the Petrella paper, published coincidentally in the same year as the Hopman-Rock paper, would tell their patients that exercise helps the pain of osteoarthritis a lot. Both cannot be right. Fortunately, in this case, we have a systematic review which has examined all of the well-conducted trials on this subject and therefore has done the hard critical appraisal work for us. That review tells us that on avarage exercise overall helps a little with the pain of knee osteoarthritis (Roddy *et al.*, 2005).

Given the overwhelming volume, time requirements, technical complexities, limitations, contradictions and flaws in the published research, it is no wonder that many of those wishing to practice EBM as a System 2 approach give up and return to using System 1 approaches to decision making.

## Cognitive biases

System 1 has its problems too. Using short cuts, heuristics and mindlines is comfortable and helpful in human decision making. But cognitive biases affect the heuristics and mindlines involved in the rapid decision making required, whether it be for diagnosis or for management. Aside from

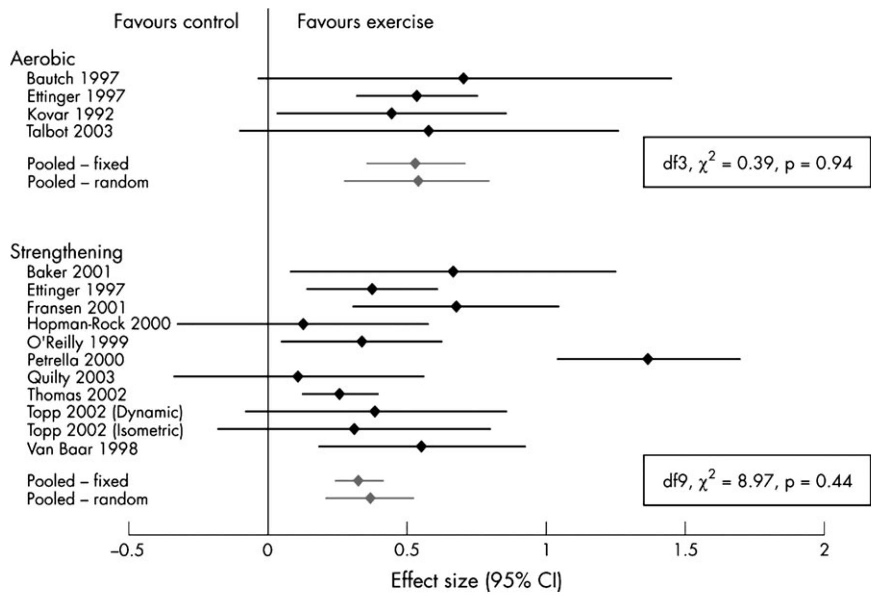


***Figure 1.*** *Results of a meta-analysis: exercise for knee osteoarthritis.*
*Reproduced from Roddy, E., Zhang, W., Doherty, M. Annals of the Rheumatic Diseases (2005) 64: p. 544–8, with permission from BMJ Publishing Group Ltd.*

the potential bias introduced because a subset of the total evidence is known and used, there are many well-described cognitive biases that affect clinical decision making. Probabilities may not be accurately weighted; decisions may reflect recent personal experience rather than evidence; knowledge may be over estimated; information that fits with existing expectations may be remembered, whereas information which contradicts those expectations may be ignored or dismissed as unimportant and causality may be perceived when in fact the relation between two events (often a specific treatment and recovery) is coincidental (Klein, 2005).

Networking with colleagues is the single most important way in which clinicians hear about new health technologies and incorporate them into their practice (Greenhalgh *et al.*, 2004). Local specialists are frequently viewed as 'trusted colleagues' and are asked for informal advice on clinical questions. In one discrete geographical area, 81 doctors consulted 23 'experts'; six of the experts received over 90% of the calls, about 90 each month (Weinberg *et al.*, 1981). Such networking may have a very powerful effect on clinical practice, yet it has been suggested that the doctors' 'answering' the questions may not necessarily be more knowledgeable than those seeking the answers (Smith, 1996). Possibly, the more important issue is that experts are also fallible to cognitive biases (Klein, 2005) and may misrepresent the true findings from primary research (McCormack and Greenhalgh, 2000; Shaughnessy and Slawson, 2003). What has worked in their own clinical practice or been the object of their own clinical research features disproportionately in their thinking and may blunt objectivity. Specialists have a different case mix and networks from generalists, and so have different heuristics and mindlines. The lens through which they view the world may be very different from that of generalists, coloured as it is by their experience in treating a different selection of patients, where 'parrots' might be as commonly encountered as 'sparrows'. It is not surprising that tensions can occur over some clinical decisions or policies made by one party when viewed by the other.

## Combining System 1 and System 2

So clinicians are faced with a problem. Initial training and subsequent expertise in diagnosis and management depend on the processing of large volumes of complex information by the use of short cuts and heuristics. These techniques often serve us well in meeting the challenges of diagnosis and management but are imperfect. When coupled with the information explosion and the poor quality of much published research, it leaves clinicians open to a wide range of influences that exploit cognitive biases.

Clinicians are busy people who want to do a good job, guided by the evidence applicable to their patients' particular situations. So, if we wish to set aside brief reading and advice from colleagues—'the comfort of opinion'—is there an alternative process in the hurly-burly of normal clinical practice?

System 1 clinical decision makings using a series of internal mindlines, based largely on brief reading and what colleagues have talked about, is the consequence of normal human psychology. Unless this is recognized, and individuals and organizations are supported to adopt a different approach, the technical and rational seeds of EBM may continue to fall on stony ground.

Instead of 'trying to know everything', we need a more systematic approach to knowing, or being able to find, the best available evidence on which to base practice. What trustworthy resources are there—local, national or international—which we can regularly access for unbiased summaries of evidence about the conditions we see commonly? And can we also quickly find unbiased summaries there which describe the best possible evidence for the less common conditions that present? Can we translate that information into terms our patients can understand within the context of a consultation that prioritizes fully informed decision making? We describe combining System 1 and System 2 approaches in Paper 3 in this series.

And clinicians are not independent of the health care system in which they work, whether they are employees or independent contractors. What do organizations have to do differently to support the best quality, patient-centred decision making? We describe this is in the fourth paper in this series.

## Key points

- The psychology of decision making has been extensively studied. Undergraduate and postgraduate programmes for health care professionals seek to produce excellent decision makers, yet learners are not exposed to the evidence that describes how humans make decisions.
- Various approaches are employed to enable a decision to be made in the face of large volumes of evidence. These usually involve truncating the amount of information used in order to be able to make a 'good enough' decision, an approach termed satisfying.
- In the expert, the slow, logical and linear thinking of the beginner is usually replaced by the pattern recognition, with alternative approaches to making a diagnosis or recommending management employed when that approach fails.
- Brief reading and talking to other people are the prime sources of information used by clinicians; this approach manages the information overload but the consequence is that the selection of high-quality, unbiased sources of information is crucial.

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