

## CHAPTER 1

# Clinical Reasoning: An Overview

Nicola Cooper<sup>1,2</sup> and John Frain<sup>2</sup>

<sup>1</sup>Derby Teaching Hospitals NHS Foundation Trust, UK

<sup>2</sup>University of Nottingham, UK

### OVERVIEW

- Clinical reasoning describes the thinking and decision-making processes associated with clinical practice
- The core elements of clinical reasoning include: evidence-based clinical skills, use and interpretation of diagnostic tests, understanding cognitive biases, human factors, metacognition (thinking about thinking), and patient-centred evidence-based medicine
- Diagnostic error is common and causes significant harm to patients. Errors in reasoning play a significant role in diagnostic error
- Sound clinical reasoning is directly linked to patient safety and quality of care

### Introduction

Fellow author, Pat Croskerry, argues that although there are several qualities we would look for in a good clinician, the two absolute basic requirements for someone who is going to give you the best chance of being correctly diagnosed and appropriately managed are these: someone who is both knowledgeable and a good decision-maker. At the time of writing, medical schools and postgraduate training programmes teach and assess the knowledge and skills required to practise as a doctor, but few offer a comprehensive curriculum in decision-making. This is a problem because how doctors think, reason and make decisions is arguably their most critical skill.

This book covers the core elements of clinical decision-making – or clinical reasoning. It is designed not only for individuals but also as an introductory text for a course or as part of a curriculum in clinical reasoning. Chapter 9 specifically covers teaching clinical reasoning in undergraduate and postgraduate settings. In this chapter we define clinical reasoning, explain why it is important, and provide an overview of the different elements involved.

### What is clinical reasoning?

Clinical reasoning describes the thinking and decision-making processes associated with clinical practice. According to Schön, it involves the ‘naming and framing of problems’ based on a personal understanding of the patient or client’s situation. It is a clinician’s ability to make decisions, often with others, based on the available clinical information, which includes history (sometimes from multiple sources), clinical examination findings and test results – against a backdrop of clinical uncertainty. Clinical reasoning also includes choosing appropriate treatments (or no treatment at all) and decision-making with patients and/or their carers. Box 1.1 gives a definition of clinical reasoning.

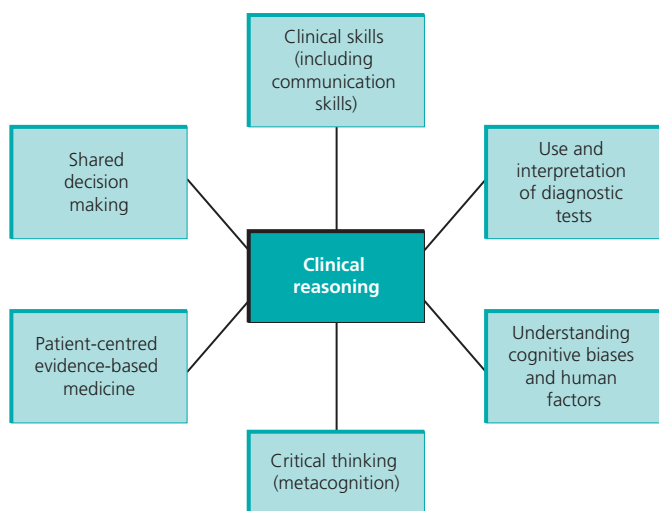
Figure 1.1 shows the different elements involved in clinical reasoning covered in this book, underpinned by a knowledge of basic and clinical sciences. Good clinical skills – in particular communication skills – are vital because the heart of the clinical reasoning process is often the patient’s history and physical examination. Another element in clinical reasoning is understanding how to use and interpret diagnostic tests, something that is surprisingly rarely taught in a systematic way. Other elements include an understanding of cognitive psychology – how the human brain works with regards to decision-making – and human factors. We are unaware of the subconscious cognitive biases and errors to which we are prone in our everyday thinking and actions. Metacognition – thinking about thinking – is a critical skill that can be both learned and nurtured. It starts with an understanding of *how* we think, how our thinking and decision-making can be flawed, and how to mitigate this. Finally, reasoning does not end with a diagnosis. Patient-centred evidence-based medicine and shared decision-making (explored in Chapter 8) are also elements of clinical reasoning.

Clinical reasoning is a complex process that is not fully understood. It is only in recent years that doctors have begun to focus on their thinking processes, helped by advances in cognitive psychology that have given us models of decision-making that were

### Box 1.1 A definition of clinical reasoning

'Clinical reasoning comprises the set of reasoning strategies that permit us to combine and synthesise diverse data in to one or more diagnostic hypotheses, make the complex trade-offs between the benefits and risks of tests and treatments, and formulate plans for patient management. Tasks such as generating diagnostic hypotheses, gathering and assessing clinical data, deciding on the appropriateness of diagnostic tests, assessing test results, assembling a coherent working diagnosis, and weighing the value of therapeutic approaches are a few of the components. Teaching these cognitive skills is a difficult matter even for outstanding clinician-teachers.'

From Kassirer JP and Kopelman RI. *Learning clinical reasoning*, 1st edn. Williams & Wilkins, 1991.



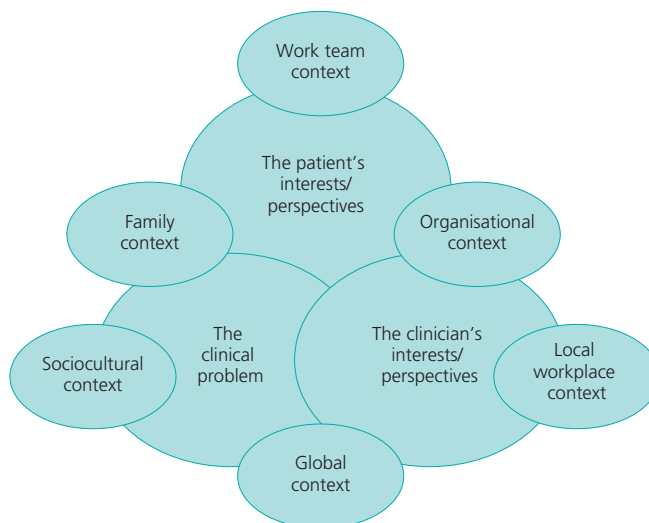
**Figure 1.1** The elements involved in clinical reasoning, underpinned by a knowledge of basic and clinical sciences.

not available before. In addition, while clinical reasoning is often conducted individually, it is often done in a team and also occurs in context – or ‘problem spaces’ as illustrated in Figure 1.2. These different contexts or *points of view* impact on our reasoning in ways we often do not realise.

## Why is clinical reasoning important?

Clinical reasoning is important because a wide variety of studies suggest that diagnostic error is common. Using various methods it is estimated that diagnosis is wrong 10–15% of the time, highest in the ‘undifferentiated’ specialties of emergency medicine, internal medicine and general practice. Diagnostic error causes significant harm – in the Harvard Medical Practice Study, which looked at adverse events, diagnostic error was much more likely to lead to serious disability than other types of error. In the USA, misdiagnosis now rivals surgical accidents as the leading cause of medico-legal claims.

There are many reasons why diagnostic error occurs. A comprehensive review of studies of misdiagnosis assigned three main categories, shown in Table 1.1. However, it has been estimated



**Figure 1.2** Clinical reasoning in multiple problem spaces: factors influencing clinical decision-making. Source: Higgs J and Jones MA. Clinical decision making and multiple problem spaces. In: Higgs J, Jones MA, Loftus S, Christensen N (eds), *Clinical Reasoning in the Health Professions*, 3rd edn. Elsevier, 2008. Reproduced with permission of Elsevier.

**Table 1.1** Root causes of diagnostic error.

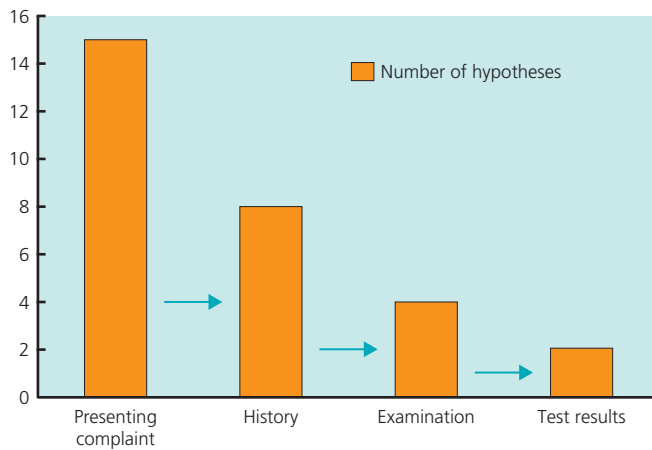
| Error category        | Examples                                                                                                                                       |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| No fault              | Unusual presentation of a disease<br>Missing information                                                                                       |
| System errors         | Technical, e.g. unavailable tests/results<br>Organisational, e.g. poor supervision of junior staff, error-prone processes, impossible workload |
| Human cognitive error | Faulty data gathering<br>Inadequate reasoning                                                                                                  |

that roughly two-thirds of the root causes of diagnostic error involve errors in reasoning, most commonly when the available data are not synthesised correctly. This means that sound clinical reasoning is directly linked to patient safety and quality of care, and teaching it should be a priority.

## History and examination

Clinical reasoning in medicine usually starts with a presenting complaint. We then listen to the patient's story – which could be from the patient or carers or eyewitnesses. During this process the clinician starts to generate different hypotheses as to what the problem might be. The history generates the most hypotheses. Clinical examination and in some cases tests narrow these down, as illustrated in Figure 1.3. For example, in breathlessness there is a wide differential. Experienced clinicians generate hypotheses early and are able to ask specific questions during the history in order to explore these hypotheses further. During the clinical examination the list of differentials becomes smaller if some findings are present or absent, and test results narrow things down even more – although as Chapter 3 explains, not in the way we might think.

Although students are taught history and examination skills there may be little emphasis on the evidence-base or context of



**Figure 1.3** Number of diagnostic hypotheses during the steps in making a diagnosis. Source: Sox HC, Higgins MC, Owens DK. *Medical Decision Making*. Wiley-Blackwell, Oxford, 2013. Reproduced with permission of John Wiley & Sons, Ltd.

these vital skills. We make many assumptions about history and examination – a topic that is explored further in Chapter 2.

## Probability and diagnostic tests

Information gathering can happen in seconds, as in the resuscitation room of an emergency department, or over a longer period of time, as in a clinic setting. After gathering information the clinician has to decide whether to treat, gather more information, or wait and see. Lots of factors come into play at this point: probability/odds, risks versus benefits, what is available, patient wishes and so on. Probability/odds (or to put it another way ‘uncertainty quantified’) is a key element in clinical reasoning and is present from start (history) to finish (discussing the pros and cons of a particular treatment). A definition of probability and odds is shown in Box 1.2.

Sox and colleagues (see ‘Further reading/resources’) state that the most fundamental principle in clinical decision-making is that *the interpretation of new information depends on what you believed beforehand*. In other words, the interpretation of a test result depends on the clinical probability of the disease before the test is performed. They go as far to say, ‘Once you accept this principle, your life will never be the same again.’ This principle again reinforces the importance of clinical skills – being able to elicit the patient’s story and physical examination findings.

Tests are commonly misused by clinicians. We do not understand probabilities or the information we receive from tests. Tests change the probability of a particular disease being present or absent, but rarely in a binary yes/no fashion. More commonly a test will increase or decrease the likelihood of a disease being present by less than we think.

For example, CT angiography to diagnose ischaemic bowel is a good test – it is 94% specific and 93% sensitive. This combination of high sensitivity and high specificity is rare. But even with such a good test, if we are highly suspicious of ischaemic bowel (say a pre-test probability of 80%) then a negative test reduces the chance of ischaemic bowel to 20%. This is far from zero.

### Box 1.2 A definition of probability

Probability is a number between 0 and 1 that quantifies the likelihood that something exists or will exist in the future.

- If we are certain it exists then the probability is 1.0
- If we are certain it does not exist then the probability is 0.

Certainty is rare in medicine. In real life the probability that something exists or will happen lies somewhere between 1.0 and 0.

Another way to talk about probability is ‘odds’ – this is the ratio of the probability that something exists over the probability that it does not exist:

$$\text{Odds} = \frac{p}{1-p}$$

If the probability of something is 0.67 then the odds are 0.67/0.33 or ‘2 to 1’.

Spirometry testing in the community for chronic obstructive pulmonary disease (COPD) is common. The sensitivity of this test is 92% and the specificity 84%. If we believe a heavy smoker with persistent wheeze has COPD (say we think the pre-test probability is 90%) then a negative test still leaves a 46% chance the patient has COPD. If we are not sure about the diagnosis (say a 50% pre-test probability) a positive test changes the probability to 85% and a negative test to 9%.

In other words, the interpretation of new information depends on what you believed beforehand. The concepts of sensitivity, specificity, pre- and post-test probabilities, and so forth are explored in more detail in Chapter 3.

## Clinicians are human too

Even if we had the best knowledge and clinical skills our reasoning would still be flawed by virtue of the fact that we are human. Chapters 4, 5 and 6 explore this further. It is not a matter of intelligence or memory – the human brain is *wired* to miss things that are obvious, see patterns that do not exist, and jump to conclusions. We are also very poor at estimating probability. Clinicians are not exempt from these human characteristics. In his book *Human Error* (Cambridge University Press, 1990), psychologist James Reason argues that, ‘Our propensity for certain types of error is the price we pay for the brain’s remarkable ability to think and act intuitively – to sift quickly through the sensory information that constantly bombards us without wasting time trying to work through every situation anew.’

Humans have a fast, pattern recognising way of decision-making, and a slower more deliberate method of decision-making – often referred to as intuitive and analytical. Psychology and other disciplines have explored this ‘two minds hypothesis’, or dual process theory, which is explained further in Chapter 4.

Thinking itself is prone to error. This affects everyone. Also, error is not randomly distributed – we systematically err in the same direction, which makes our mistakes predictable, but only to a degree. Even highly intelligent people fall into the same cognitive traps or cognitive biases. Croskerry has termed these *cognitive dispositions to respond* in certain ways in particular situations. Cognitive biases are explored further in Chapter 5.

Human factors approaches this problem from a systems point of view. Research shows that errors are predictable and tend to repeat themselves in patterns. The systems in which we work, the processes that are in place, and how we communicate within teams can either adapt for this to make error less likely, or they can in fact create accidents waiting to happen. Unnecessarily complicated processes, fatigue and cognitive overload all impact on human performance. These 'affective biases' and the discipline of human factors is explained further in Chapter 6.

What can we do about our human tendency to err? Metacognition (thinking about thinking) and cognitive debiasing is explored in Chapter 7. Using guidelines, scores and decision aids – an area of increasing interest in an attempt to improve decision-making and patient safety – is explored in Chapter 8. Finally, the very important matter of how we can start to teach clinical reasoning in medical schools and in postgraduate training programmes is explored in Chapter 9.

## Clinical reasoning matters to patients

Diagnostic error definitely causes harm, but increasing attention is being paid to another problem in developed countries – the harm caused by unnecessary tests and *overdiagnosis*. Overdiagnosis occurs when people without relevant symptoms are diagnosed with a disease that ultimately will not cause them to experience symptoms or early death. There are many factors contributing to overdiagnosis (see Box 1.3), but one of the main ones is the increasing availability of increasingly sensitive tests.

A study of over one million Medicare patients looked at how often people received one of 26 tests or treatments deemed by scientific and professional organisations to be of no benefit (Shwarz A, Landon B, Elshaug A et al. Measuring low value care in Medicare. *JAMA Intern Med* 2014; 174:1067–76). These included things like brain imaging in syncope, screening for carotid artery disease in asymptomatic patients, and imaging of

the spine in low back pain with no red flags. In one year at least 25% of patients received at least one of these tests or treatments. It has been estimated elsewhere that at least 20% of healthcare spending is waste (see 'Further reading/resources'). This waste has a huge impact on patients and the wider healthcare economy.

While some of the content of this book is 'technical' it is important to state in this first chapter that there is another vital element of clinical reasoning – *understanding people*. People are not machines, they present with individual narratives and context. They have a psychological, social and spiritual element to them that significantly impacts on illness and well-being, which clinicians need to understand. Figure 1.2 illustrated how clinical reasoning occurs in context. An example of context is the tendency of doctors and society to 'medicalise' people's problems. Research shows that labelling people with a diagnosis when in fact they are experiencing the normal trauma, anxiety and low mood that all humans experience can actually create illness. An example of this is given in Box 1.4. Medicine is often called an art as well as a science because it can be a very human and intuitive practice. Many studies demonstrate a correlation between effective clinician-patient communication (or 'whole person care') and improved health outcomes.

## Summary

It takes years to develop effective clinical reasoning skills. This is partly because clinical knowledge is a fundamental requirement for successful clinical reasoning and this takes years to acquire. However, as Chapter 9 ('Teaching Clinical Reasoning')

### Box 1.3 Factors contributing to overdiagnosis

- Screening programmes that detect 'pseudodisease' – disease in a person without symptoms in a form that will never cause symptoms or early death
- Increasingly sensitive tests
- Greater access to scanning – diagnostic scanning of the head and body reveals incidental findings in up to 40% of those being scanned for other reasons, often leading to anxiety and further testing for an abnormality that would never have harmed them
- Widening definitions of disease and lower treatment thresholds, for example:
  - Chronic kidney disease
  - High cholesterol
  - Attention deficit hyperactivity disorder
- Cultural considerations – medicalisation, commission bias (better to do something than nothing), fear of litigation
- Individual clinicians' lack of understanding of statistics relevant to the disease, diagnostic test and intervention in question

Adapted from Moynihan R. Preventing overdiagnosis: how to stop harming the healthy. *BMJ* 2012; 344:e3502.

### Box 1.4 The tendency of doctors and society to 'medicalise' patients' problems

Two patients had similar symptoms. They were experiencing transient numbness of different parts of the body – one side of the face or the other, sometimes the arm or hand. These symptoms were causing a great deal of anxiety. The patients went to see two different physicians who had different training, interests and perspectives (see Figure 1.2), so the outcome for the two patients was very different.

The first patient told his story. At the end of the consultation the physician said, 'Well you've either got migraine or multiple sclerosis so we'll do an MRI scan and I'll let you know the results.' He was not given a further appointment. While waiting for his MRI scan, his anxiety and symptoms increased significantly.

The second patient told her story. Recognising that these symptoms are common in stress and did not fit any neurological pattern, the physician said, 'I see lots of people with these symptoms and very often it's because they are working too hard, not sleeping, or under stress. Even though they might not realise they are stressed, their body is telling them they're stressed. Tell me about your schedule and what's going on in your life.' The patient's husband looked at her knowingly and sure enough there were lots of stressors related to work and home that had been an issue. An MRI scan was arranged, but the patient was advised to make changes to her lifestyle and her symptoms resolved.

Both patients had normal MRI scans.

Explanation and good communication leads to better outcomes, greater compliance with recommended treatment, and less re-attendances.

will explain, there are some other key ingredients that are required to develop expertise – for example coaching, deliberate practice and feedback. If we can start with an understanding of what clinical reasoning is, why it is important, what its key elements are and how to teach it, we can create clinicians who are better decision-makers and who ultimately provide better patient care.

### Further reading/resources

Berwick D and Hackbarth A. Eliminating waste in US healthcare. *JAMA* 2012; **307**(14):1513–6.

Graber ML. The incidence of diagnostic error in medicine. *BMJ Qual Saf* 2013; **22**:ii21–ii27.

Leape LL, Brennan TA, Laird NM et al. The nature of adverse events in hospitalized patients: results of the Harvard Medical Practice Study II. *N Engl J Med* 1991; **324**:377–84.

Neale G, Hogan H, Sevdalis N. Misdiagnosis: analysis based on case record review with proposals aimed to improve diagnostic processes. *Clin Med* 2011; **11**(4):317–21.

Schön DA. *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Books, 1983.

Sox HC, Higgins MC, Owens DK. *Medical Decision Making*, 2nd edn. Oxford: Wiley-Blackwell, 2013.