ABC of Clinical Reasoning

SECOND EDITION

Edited by Nicola Cooper and John Frain

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2nd Edition

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Preface (Second Edition)

Excellence in clinical practice is not just about good knowledge, skills, and behaviours. As fellow author Pat Croskerry points out, how doctors think, reason, and make decisions is arguably their most critical skill. While medical schools and postgraduate training programmes teach and assess the knowledge and skills required to practice as a doctor, few currently offer comprehensive training in clinical reasoning and decision making. This matters because studies show that diagnostic error is common and results in significant harm to patients, and the majority of the root causes of diagnostic error involve errors in clinical reasoning.

Clinical reasoning is complex and takes years to learn. Most of the time it is learned implicitly and in an *ad hoc* fashion. In this book, we have made it explicit, broken down into its core components. This book is designed to be an introduction for individuals and also an up-to-date resource for teachers and curriculum planners. Each chapter describes a component of clinical reasoning and its applications for clinical practice, teaching, and learning. This second edition has been extensively re-written and updated, and key references and further resources have been included for readers who want to explore topics in more detail.

Clinical reasoning is relevant to every clinical specialty in every setting, and it is not confined to medical students and doctors – we have written this book with advanced clinical practitioners and other clinicians in mind as well. We hope you enjoy reading it as much as we enjoyed re-writing and editing it.

Nicola Cooper
John Frain

CHAPTER 1
Introduction to Clinical Reasoning

Nicola Cooper and John Frain

OVERVIEW

- Clinical reasoning describes the application of knowledge to collect and integrate information from various sources to arrive at a diagnosis and/or management plan
- A lack of clinical reasoning ability has been shown to be a major cause of diagnostic error
- Several components of clinical reasoning have been identified
- Expertise in clinical reasoning develops as a result of different types of knowledge plus some other important factors
- Clinical reasoning can be viewed from different perspectives that each give insights into how it can be taught and learned and why it goes wrong

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 practice 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 [1].

This book covers the core components of clinical decision-making – or clinical reasoning. It is designed for individuals but also for teachers and learners as part of a curriculum in clinical reasoning. Chapter 10 specifically covers teaching clinical reasoning in undergraduate and postgraduate settings. In this chapter we define clinical reasoning, explain why it is important, and introduce some of the different components of clinical reasoning that are explored in this book. We will consider how expertise in clinical reasoning develops, and also look at clinical reasoning through different lenses.

Definitions

Clinical reasoning describes the application of knowledge to collect and integrate information from various sources to arrive at a diagnosis and/or management plan for patients [2]. It is a complex cognitive process involving clinical skills, memory, problem-solving, and decision-making. A definition of clinical reasoning is given in Box 1.1.

Box 1.1 A definition of clinical reasoning

‘Clinical reasoning can be defined as a skill, process, or outcome wherein clinicians observe, collect, and interpret data to diagnose and treat patients. Clinical reasoning entails both conscious and unconscious cognitive operations interacting with contextual factors. Contextual factors include, but are not limited to, the patient’s unique circumstances and preferences and the characteristics of the practice environment. Multiple components of clinical reasoning can be identified: information gathering, hypothesis generation, forming a problem representation, generating a differential diagnosis, selecting a leading or working diagnosis, providing a diagnostic justification, and developing a management or treatment plan. A number of theories (e.g., script, dual process, and cognitive load theories) from diverse fields (e.g., cognitive psychology, sociology, education) inform research on clinical reasoning.’

From Daniel et al. (2019). Acad Med; 94(6): 902–12.

As the definition in Box 1.1 states, clinical reasoning can be defined as a skill, process, or outcome and multiple components of clinical reasoning have been identified. However, for teachers and learners, it can be useful to think of clinical reasoning as a *process* made up of different components, each of which requires specific knowledge, skills, and behaviours. The UK Clinical Reasoning in Medical Education group has defined five broad areas of clinical reasoning education [3]:

1. History and physical examination
2. Choosing and interpreting diagnostic tests

3. Problem identification and management
4. Shared decision-making
5. Clinical reasoning concepts

In this second edition, we have used this framework and explore each of these areas (see Figure 1.1) in more detail.

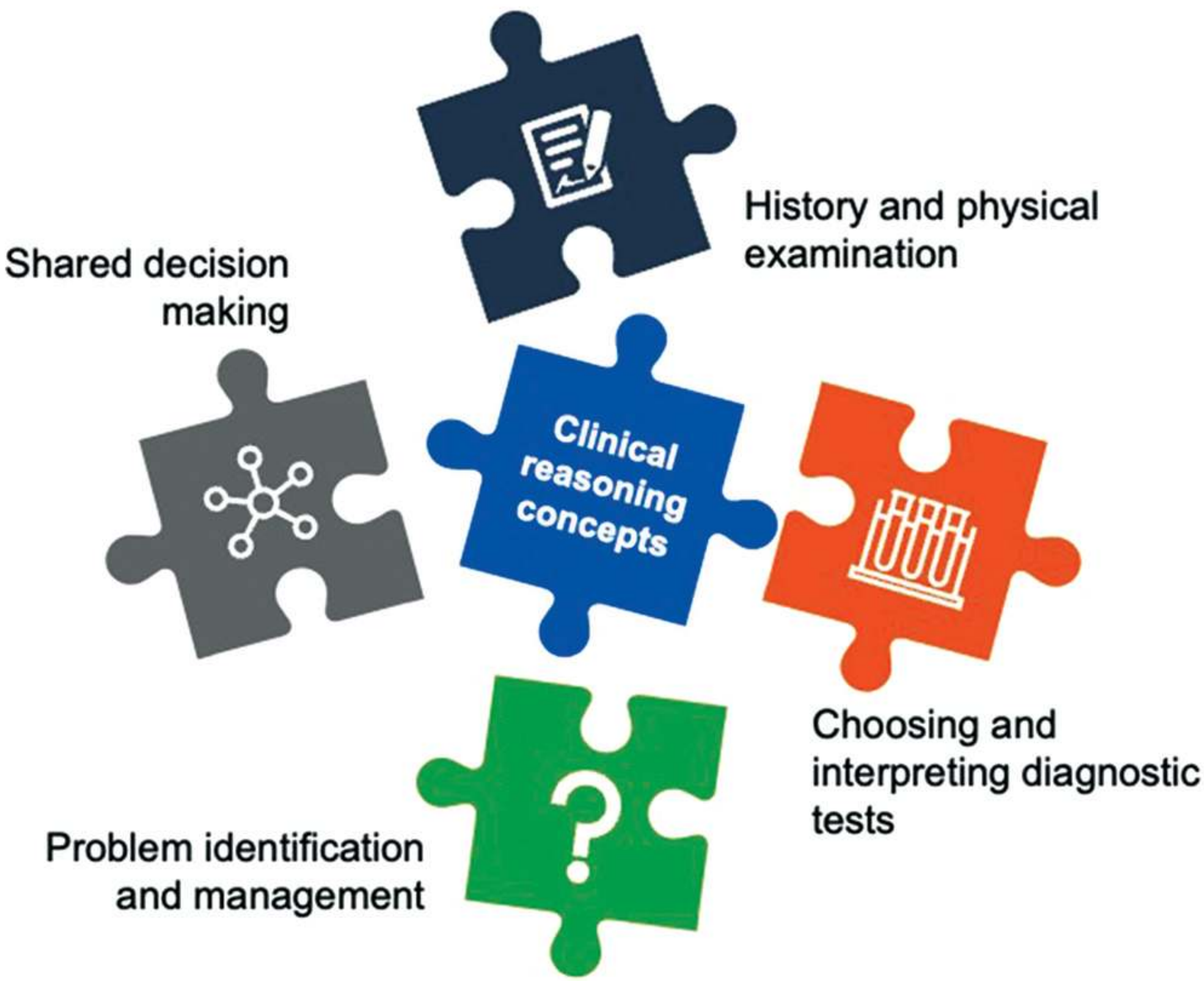

Figure 1.1 Five broad areas of clinical reasoning education. Clinical reasoning concepts include key theories (e.g., script, dual process), how clinical reasoning ability develops, the problem of diagnostic error, the role of clinical reasoning in safe and effective care for patients, cognitive errors, and other factors that may impair the clinical reasoning process or outcome.

Why Is Clinical Reasoning Important?

Diagnostic errors tend to occur in common diseases and are a significant cause of preventable harm to patients worldwide [4]. It has been estimated that diagnosis is wrong 10–15% of the time [5]. Post-mortem studies consistently find undiagnosed disease as the cause of death in 10–20% of patients, of which half could have been successfully treated [6]. Diagnostic error is by far the leading source of paid malpractice claims in the UK, and diagnostic error has been identified as a high-priority patient safety problem by the World Health Organization.

A lack of clinical reasoning ability has been shown to be a major cause of diagnostic errors which can result in unnecessary pain, treatments, or procedures, and increase the costs of healthcare [2]. There are many reasons why diagnostic errors occur. A comprehensive review of studies of misdiagnosis assigned three main categories, shown in Box 1.2. However, *faulty synthesis of the available information* was found to be the most common reason for diagnostic errors leading to death and serious harm [7]. In other words, the clinician had all the information to make the right diagnosis but made the wrong diagnosis. There is a growing consensus that medical schools and postgraduate training programmes need to do more to teach clinical reasoning in an explicit and systematic way. The National Academy of Medicine's report Improving Diagnosis in Health Care [8] found that diagnosis and diagnostic errors have been largely unappreciated in efforts to improve the quality and safety of healthcare and called for curricula to explicitly address teaching the diagnostic process, using educational approaches that are aligned with evidence from the learning sciences.

Box 1.2 Categories of misdiagnosis

Error category	Examples
No fault	Unusual presentation of a disease Missing information
System errors	Technical, e.g. unavailable tests/results Organisational, e.g. poor supervision of junior staff, error-prone processes, impossible workload
Human cognitive error	Faulty data gathering Inadequate reasoning
Adapted from Graber ML et al., 2005 [7].	

Diagnostic error definitely causes harm, but increasing attention is also being paid to another problem which can be caused by faulty clinical reasoning – the harm caused by unnecessary tests and overdiagnosis. A study of over one million Medicare patients in the USA looked at how often people received one of 26 tests or treatments deemed by scientific and professional organisations to be of no benefit [9]. 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 that at least 20% of healthcare spending is waste [10]. This waste has a huge impact on patients and the wider healthcare economy. 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 them is the increasing availability of increasingly sensitive tests.

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 caused harm
- 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.

The growing recognition of the problem of diagnostic error, unnecessary tests, and overdiagnosis is why clinical reasoning is of such interest to researchers, medical educators, and policy makers. Improving clinical reasoning outcomes is a patient safety and healthcare economy priority.

Components of Clinical Reasoning

Several components of clinical reasoning have been identified. A fundamental one is the application of knowledge to gather and interpret data in the patient's history and physical examination. The purpose is to establish the clinical probability of disease – a judgement based on the clinician's knowledge of epidemiology and what we call *evidence-based* history and physical examination, a topic which we explore in Chapter 2. The clinical probability of disease is a prerequisite for choosing and interpreting diagnostic tests. Interpreting diagnostic tests is something even qualified health professionals find difficult [11]. This is because tests lie; very often, tests give us test probabilities, not real probabilities, which is why test results have to be *interpreted* by knowledgeable clinicians, a topic which we explore in Chapter 3.

Problem representation is something that is neglected in traditional 'history–examination–differential diagnosis' teaching methods, but studies show that being able to represent the problem before attempting to solve it (i.e., think of a diagnosis) is a key step in problem-solving, and dramatically increases diagnostic accuracy, especially in more complex cases [12]. This is a skill that can be learned, and a topic which we explore in Chapter 4.

Clinical reasoning often takes place within teams. Clinicians also make use of guidelines, scores and decision aids, and co-produce decisions with patients and carers. The important topic of shared decision-making is explored further in Chapter 5.

Simply knowing about clinical reasoning concepts does not help people reason better. But it is important for clinicians, teachers, and learners to have a shared definition, vocabulary and understanding of clinical reasoning in order to facilitate meaningful discussion and learning. Models of clinical reasoning can be useful to help us understand the processes underpinning our decision-making – as clinicians, teachers, and learners. Chapter 6 explores dual process theories which are widely accepted as a framework with which to understand diagnostic reasoning and diagnostic error. Some common misunderstandings are identified, and we explore critical thinking, rationality, the different types of knowledge used by Type 1 and Type 2 processing, and thinking about one's own thinking (metacognition).

The topic of cognitive biases in clinical reasoning is controversial. This is partly because there are several key fallacies in the *received* view of dual process theories. There is definitely agreement that cognitive biases exist in medicine, but disagreement as to whether they are a significant source of diagnostic errors compared with knowledge deficits. Chapter 7 explores this topic further using a case history and analysis.

Clinical reasoning does not exist solely inside a clinician's organised cognitive structures but is entangled in the activity of providing care for the patient [13]. Chapter 8 explores 'situativity' and human factors (the science of the limitations of human performance). 'To err is human', therefore in order to minimise errors, we need to focus on improving processes, systems, and technology, as well as education and training in cognitive strategies. Pat Croskerry explores metacognition and cognitive strategies further in Chapter 9.

Finally, we look at teaching clinical reasoning in Chapter 10. There is no evidence that teaching clinical reasoning concepts alone, or short courses, improves clinical reasoning ability. The most effective way to teach clinical reasoning is to use strategies that build knowledge and understanding, and to practice with as many different cases as possible in as many different contexts as possible with coaching and feedback. We explore key concepts in teaching clinical reasoning, specific evidence-based strategies that teachers can use, and describe one approach to introducing a clinical reasoning curriculum at undergraduate level.

How Does Expertise in Clinical Reasoning Develop?

If how clinicians think, reason, and make decisions is arguably their most critical skill, it is useful to consider how expertise in clinical reasoning develops. In the 1970s, expertise in medicine was thought to be related to superior general thinking skills. However, when researchers observed experts and novices, they found there was no difference in the processes or thinking strategies used – both quickly came up with one or more diagnostic hypotheses which guided the search for further information. Experts were more accurate because they knew more, and because the knowledge of experts varied from case to case, their performance varied from case to case as well [14]. This led to researchers changing direction and examining the role of knowledge in medical expertise.

One of the next questions for researchers was, do experts have bigger, better memories? The answer was no – given unlimited time, novices can remember as much as experts about a clinical case on paper. But experts appear to acquire information more efficiently and pay attention to more critical information (you have probably seen this in action). In a series of well-known experiments, Chase and Simon showed chess players of varying strength – from master to novice – chessboards set up as if in the middle of a game for only 5 seconds and then asked them to reconstruct the position of 28 pieces on a blank chessboard immediately afterwards. What they found was the chess masters showed a remarkable ability to reconstruct the board almost perfectly, whereas the novices could only recall the position of four or five pieces. However, when the experiment was repeated with the chess pieces arranged randomly, chess masters performed no better than anyone else [15]. Chase and Simon concluded that chess masters had stored in memory a large number of recognisable 'chunks', or meaningful patterns (see Box 1.4). Similar results have been found in other fields – experts can reconstruct a briefly examined scene provided it portrays a realistic (as opposed to random or meaningless) pattern. But pattern recognition by itself does not explain expertise. Non-chess players can be trained to memorise chess patterns. Experts recognise patterns of *high significance* because of their formal as well as experiential knowledge of chess – in other words, they study [16].

Box 1.4 Chunking and automating: how we can think more complex thoughts

Human working memory can only process a limited number of elements at a time. But not all elements are created equal. The elements of information stored in our long-term memory increase in complexity over time, with smaller elements combining to form larger ones. This process is called ‘chunking’ and it is what allows us to think more complex thoughts.

For example, a child who has not yet learned the alphabet will see the letter ‘H’ as three straight lines. Reproducing these three straight lines correctly could be a cognitively demanding task. Over time, they will chunk and automate drawing the letter ‘H’ until it becomes effortless. Once they have mastered individual letters, whole words will still be new to them. The word ‘H, o, u, s, e’ will consist of five separate elements. But over time, this will be chunked as the word ‘House’ in long-term memory which can then be read and written effortlessly.

Chunking and automation is a result of learning. Experts store knowledge in long-term memory as rich chunks called schemas which allows them to overcome the limitations of working memory when solving problems. (See Chapter 10 for information on how teachers can facilitate the process of schema formation.)

Adapted from Lovell O. Sweller’s cognitive load theory in action. A John Catt Publication, 2020. pp. 20.

We know that knowledge is fundamental to expertise in clinical reasoning. (As we will see in Chapter 6, other things matter as well.) But by knowledge, we do not mean only facts. That is like saying the raw ingredients are the same as the cake. Figure 1.2 refers to different types of knowledge; all these types of knowledge matter in clinical reasoning.

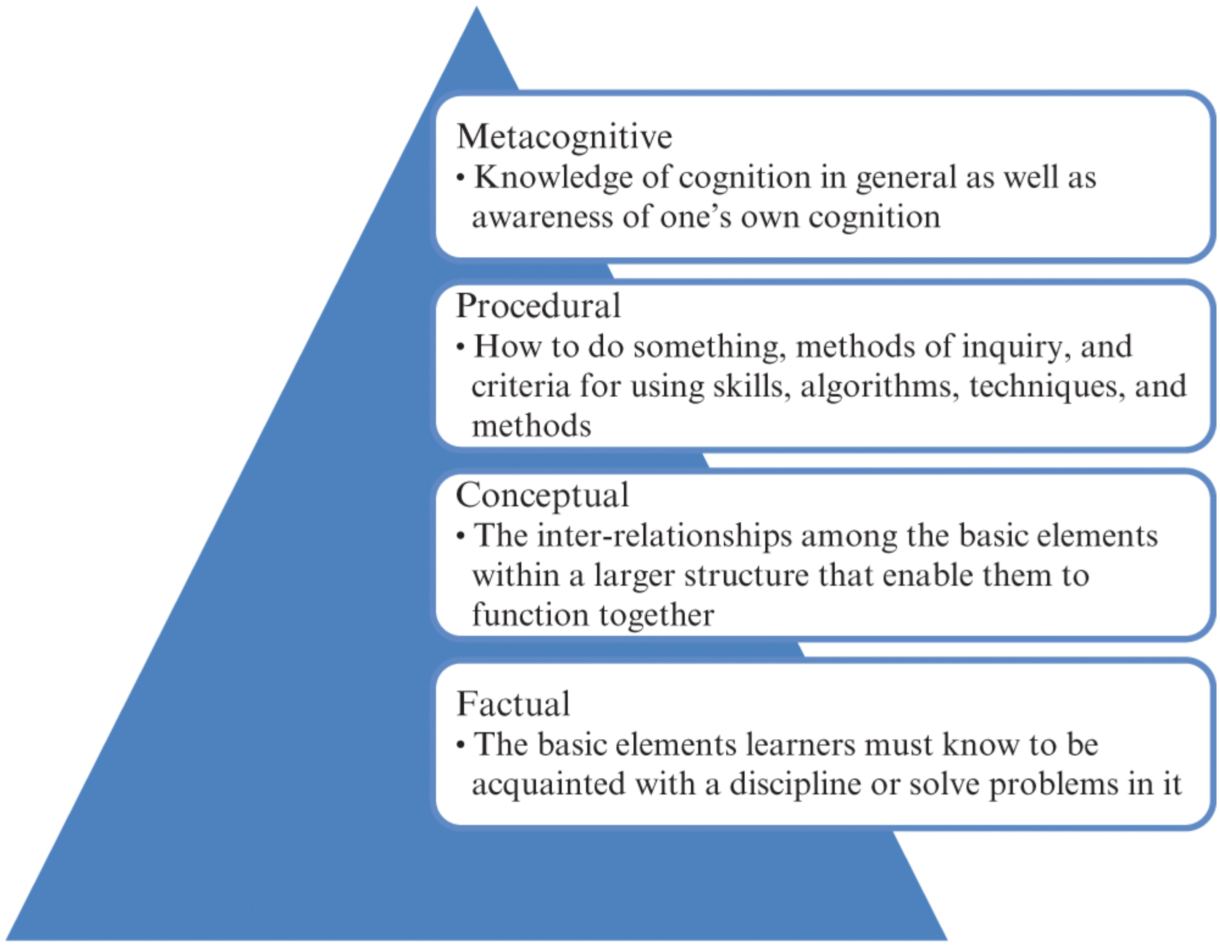

Figure 1.2 Different types of knowledge. Adapted from: A model of learning objectives–based on: a taxonomy for learning, teaching, and assessing: a revision of Bloom's Taxonomy of educational objectives by Rex Heer, Center for Excellence in Learning and Teaching, Iowa State University. https://www.celt.iastate.edu/teaching/effective-teaching-practices/revised-blooms-taxonomy (accessed April 2022).

With learning, the process of chunking and automating, as described in Box 1.4, frees up mental resources. The difference between normal learning and expert learning is what people do with those freed up resources. People who become experts reinvest their mental resources in further learning. They seek out more difficult problems. They tackle more complex representations of common problems. They continue to work at the edge of their competence [17].

In summary, we know that expertise in clinical reasoning is highly dependent on knowledge, but that is not the whole story. We will explore this further in Chapters 6 and 10.

Clinical Reasoning through Different Lenses

At its most basic level, clinical reasoning is to do with knowledge, how knowledge is organised in long-term memory as mental representations, and the cognitive processes responsible for storing, transforming, and retrieving these. This view of clinical reasoning is important for learners, who must have a) a deep foundation of factual knowledge, b) understand facts and ideas in a conceptual framework, and c) organise their knowledge in a way that facilitates retrieval and application. (The latter two points are why we need expert teachers.) However, clinical reasoning is also something that is ‘situated’ in the environment. Thinking and learning is context-dependent, the result of multiple dynamic interactions between individuals and the environment. Cognition is also distributed in team members and in non-humans (e.g., computers). It can be adversely affected by poorly designed technology and systems, as well as sleep deprivation, fatigue, and excessive workload. Understanding clinical reasoning through this lens is important too. But sometimes we need to be able to go beyond the ‘content’ and make sense of the patient’s illness (and our own response to it) and understand the practice of medicine in its wider socio-cultural context. This is what we sometimes call the ‘art’ of medicine, which involves crafting a wise and deliberate course of action appropriate for the circumstances and may not involve any technical decision-making at all. Clinical reasoning through this lens is often what postgraduates are able to start practicing once their mental resources are freed up from focusing on the technical aspects of medicine. Many studies demonstrate a correlation between effective clinician–patient communication and ‘whole person care’ with improved health outcomes. An example of this is given in Box 1.5.

Box 1.5 The importance of whole person care

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.

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 lead to better outcomes, greater compliance with recommended treatments, and less re-attendances.

Listen to Me; I Am Telling You My Diagnosis