CLINICAL REASONING IN SMALL ANIMAL PRACTICE

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Foreword

Although clinical reasoning and decision making are central to the veterinarian's (similar to the physician's) role, the process seems to be less well understood and associated with more erroneous statements about it in veterinary educational circles than any other of the skills we expect practitioners to possess. In an era that rightly prides itself on an evidence-based approach to medicine, it is surprising the way that increased repetition of statements such as ‘students should not engage in pattern recognition’, ‘scientific method is used to reach diagnosis’, ‘analytical approaches are more accurate than pattern recognition’ and ‘at least with objective data you do not get biased interpretation’ has led to them being accepted, even by those responsible for the education of the next generation of our profession.

In this book, Dr. Maddison and her colleagues aim to put the record straight through their clear description of their ‘Logical Approach to Clinical Problem Solving’ in the context of small animal practice. Their ideas have evolved from a combination of direct experience of the challenges of their different personal caseloads over many years and their reflections on how best to understand their expertise so that their methods could be explained to students in both the classroom and the clinic. However, with advances in our understanding of the way our brains work, we can increasingly link such insights to the approaches advocated in this book. We know that our processes of reasoning can be grouped into two categories (Evans 2003, 2012): type I (sometimes referred to as pattern recognition) and type II (analytical). Where possible in our lives, we try to use type I in making decisions, as it is rapid and efficient. It relies on

our memory of similar problems encountered in the past, and, if we correctly apply such patterns, it is at least as accurate as analytical reasoning. However, our impulse for speed and efficiency, particularly in our busy modern world, can easily trap us into ‘cognitive miserliness’ (Stanovich 2009) where we do not take note of any lack of fit of our repertoire of patterns. In such circumstances, faced with ‘high stakes’ decisions such as the life and well-being of a patient, it is vital we cross-check our initial conclusions with an analytical approach, as this book emphasises (Ark *et al*. 2007).

Many continue to suggest that the analytical approach to clinical reasoning is ‘scientific’, involving hypothesis testing, but this is misleading. Scientific method involves us creating and testing hypotheses by predicting data and, subsequently, following an experiment, making observations on whether our predictions are correct. This has been called ‘backwards reasoning’. It is extremely robust in the contexts in which it is relevant, but, particularly in primary care settings, where the number of possible diagnoses in an individual patient is large, such an approach quickly leads to cognitive overload. Even if a practitioner can persist in applying a hypothetico-deductive scientific approach, at this point, it is undermined by the very features that are meant to make it robust. The size of the potential data sets generated renders our decision making less accurate, and for novices, it can lead to ‘paralysis by analysis’, with a failure to act even when action is essential (Croskerry *et al.* 2014).

From observations of clinicians working with real and paper-based cases, clinical reasoning is an inductive process, working forward from data to diagnosis (Patel *et al.* 2005). This is the systematic approach adopted in this book, and it makes explicit for those starting to work with cases, and those who are more experienced, the

intervening steps. In contrast to a backwards approach, which tends to fail to develop pattern recognition, this repeated use of systematic forward reasoning also helps to lay down structured patterns for future use (Sweller 1988). At an early stage, it is important to contain the size of the data set, and this is achieved by clustering signs to clarify the organ system (or systems) involved and how it is affected (Auclair 2007). Only then should we start to think about provisional diagnoses, and then this list will be much shorter than the series of lists, based on consideration of each clinical sign separately, that advocates of a 'scientific approach' have promoted in the past.

William Osler wrote that medicine is the '*practice of an art which consists largely in balancing possibilities (Osler 1910)… It is a science of uncertainty and an art of probability… Absolute diagnoses are unsafe and made at the expense of conscience*' (quoted in Bean 1968). His insight from 100 years ago reminds us that our diagnoses frequently remain provisional, in the sense that they are based on likelihood and may need to be modified as new information comes to light. Our approach is Bayesian, in the sense that these provisional diagnoses provide a prior probability in advance of further tests that we may undertake. Such tests can then be chosen on the basis that their result may increase the probability of our provisional diagnosis being correct. As a result of limitations of sensitivity and specificity, used in 'screening' mode, these tests can fail to detect many cases as well as yielding many false positive results. However, following a good clinical work-up and used in 'diagnostic mode', well-chosen tests can make us more confident in our diagnosis and plan to manage a case, still recognising that even with all the technology we possess, 'absolute diagnoses are made at the expense of conscience'.

Donald Schön, in his seminal work ‘The Reflective Practitioner’, uses two memorable images. He talks about specialist (academic) practice as occupying ‘high, hard ground, overlooking a swamp’ where it may be possible to solve problems with scientific approaches, and ‘swampy lowland’ where problems often appear messy and unclear, and where traditional scientific methods cannot apply (Schon 1983, p. 42). This book is meant for, and highly recommended to, all those who practice in the swamps! Another image Schön uses is of the expert pianist who tells a student that they need to modify their playing but cannot immediately say how (Schön 1995). The pianist has to sit at the piano and play the section to recognise the fingering that is required. The difficulty of the expert unpicking the detail of thinking processes that have become automatic, to teach them to others, is well known and can lead to misinterpretation, based on incorrect rationalisations of the processes involved. Therefore, this book is also highly recommended for all experienced practitioners keen to understand how their minds work, in order to support the learning of others in an evidence-based and proven way.

Stephen May

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Chapter 1
Introduction to problem-based inductive clinical reasoning

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The aim of this book is to assist you to develop a structured and pathophysiologically sound approach to the diagnosis of common clinical problems in small animal practice. The development of a sound basis for clinical problem solving provides the veterinarian with the foundation and scaffold to allow them to potentially reach a diagnosis regardless of whether they have seen the disorder before. Furthermore, the method presented in this book will help you avoid being stuck trying to remember long differential lists and hence free your thinking skills to solve complex medical cases. The aim of the book is *not* to bombard you with details of different diseases – there are many excellent textbooks and other resources that can fulfil this need. What we want to provide you with is a framework by which you can solve clinical problems and place your veterinary knowledge into an appropriate problem-solving context.

We all remember our first driving lessons, which may have been quite challenging – for us and/or our instructors! We had to think actively about many factors to ensure we drove safely. The more experienced we became at driving, the more non-driving-associated tasks, such as talking to our passengers, listening to the radio and changing the radio channels, we were able to do while driving. If we had attempted any of these tasks at the beginning of our driver training, we might have had an accident. As we become

more experienced at a task, we need to think less about it, as we move to what is known as unconscious competence.

We see a similar process in clinical education. During the progression from veterinary student to experienced clinician, knowledge and skills are initially learnt in a conscious and structured way. Veterinary undergraduate education in most universities is therefore based on systems teaching, species teaching or a mixture of both. These are excellent approaches to help develop a thorough knowledge base and understanding of disease processes and treatments. However, when an animal or group of animals becomes unwell, the clinical signs they exhibit can be caused by a number of disorders of a range of different body systems – the list may seem endless. They do not present to the veterinarian with labels on their heads stating the disease they have (more's the pity!). Therefore, for the veterinarian to fully access their knowledge bank, they need to have a robust method of clinical reasoning they can rely on. This method allows them to consolidate and relate their knowledge to the clinical case and progress to a rational assessment of the likely differential diagnoses. This makes it easier to determine appropriate diagnostic and/or management options for the patient. Because you have a clear path, communication with the client becomes easier.

The next part of the journey of becoming an experienced clinician is that clinical judgement and decision-making processes become unconscious or intuitive. The rapid, unconscious process of clinical decision-making by experienced clinicians is referred to in medical literature as intuition or the ‘art’ of medicine. The conscious thinking process is often referred to as ‘science’ (evidence-based) or analytic. Intuition is context-sensitive, influenced by the level of the clinician's experience, context-dependent and has no obvious cause-and-effect logic. Why is this

important? We have all thought – ‘I just know that the animal has …’ The unconscious mind will pretend to the conscious mind that the clinical decision was based on logical assumptions or causal relationships. This is not a problem as long the intuition or ‘pattern recognition’ has resulted in a correct diagnosis. However, when it does not, we need to understand why it failed and have a system in place to rationally progress our clinical decision-making. This book will provide you with the tools and thinking framework needed to unravel any clinical riddle, unleashing the potential of your unconscious mind rather than blocking your working memory as you try to recall all the facts you may have once known.

Why are some cases frustrating instead of fun?

Reflect on a medical case that you have recently dealt with that frustrated you or seemed difficult to diagnose and manage. Can you identify why the case was difficult?

There can be a multitude of reasons why complex medical cases are frustrating instead of fun.

- Was it due to the client (e.g. having unreal expectations that you could fix the problem at no cost to themselves? Unwilling or unable to pay for the diagnostic tests needed to reach a diagnosis? Unable to give a coherent history?)
- Was the case complex and didn't seem to fit any recognisable pattern?
- Were you unable to recall all the facts about a disease and this biased your thinking?

- Did the signalment, especially breed and age, cloud your clinical decision-making resulting in an incorrect differential list?
- Did the case seem to fit a pattern but subsequent testing proved your initial diagnosis wrong?
- Did you seem to spend a lot of the client's money on tests that weren't particularly illuminating?

Can you add any other factors that have contributed to frustrations and difficulties you may have experienced with medical cases?

Apart from the client issues (and as discussed later, we may be able to help a little bit here as well), we hope that by the end of this book, we will have gone some way towards removing the common barriers to correct, quick and efficient diagnosis of medical cases and have made unravelling medical riddles fun.

Solving clinical cases

When a patient presents with one or more clinical problems, there are various methods we can use to solve the case and formulate a list of differential diagnoses. One method involves pattern recognition – looking at the pattern of clinical signs and trying to match that pattern to known diagnoses. This is also referred to as developing an illness script. Another method can involve relying on blood tests to tell us what is wrong with the patient – also referred to as the minimum database. Or we can use problem-based clinical reasoning. Often, we may use all three methods.

Pattern recognition

Pattern recognition involves trying to remember all diseases that fit the ‘pattern’ of clinical signs/pathological abnormalities that the animal presents with. This may be relatively simple (but can also lead to errors of omission) and works best:

- For common disorders with typical presentations
- If a disorder has a unique pattern of clinical signs
- When all clinical signs have been recognised and considered, and the differential list is not just based on one cardinal clinical sign and the signalment of the patient presented
- If there are only a few diagnostic possibilities that are

  easily remembered or

  can easily be ruled in or out by routine tests
- If the vet has extensive experience, is well read and up-to-date, reflects on all of the diagnoses they make regularly and critically and has an excellent memory.

Pattern recognition works well for many common disorders and has the advantage of being quick and cost effective, provided the diagnosis is correct. The vet looks good to the client because they have acted decisively and confidently … provided the diagnosis is correct.

However, pattern recognition can be flawed and unsatisfactory when the clinician is inexperienced (and therefore has seen very few patterns) or only considers or recognises a small number of factors (and is not aware that this process is mainly driven by unconscious processes that might need to be reflected upon if they fail). Or even if the clinician is experienced, it can be flawed for uncommon diseases or common diseases presenting atypically, when the patient is exhibiting multiple clinical signs that are not

immediately recognisable as a specific disease, or if the pattern of clinical signs is suggestive of certain disorders but not specific for them. In addition, for the experienced clinician, the success of pattern recognition relies on a correct diagnosis for the pattern observed previously being reached *and* not assuming that similar patterns must equal the same diagnosis. Pattern recognition can lead to dangerous tunnel vision where the clinician pursues his/her initial diagnostic hunch based on pattern spotting to the exclusion of other diagnostic possibilities. They may then interpret all subsequent data as favourable to their initial diagnosis, including ignoring data that doesn't ‘fit’ their preferred diagnosis. This phenomenon is described in psychological literature as confirmation bias – defined as a tendency for people to favour information that confirms their beliefs or hypotheses. And finally, the disadvantage of relying entirely on pattern recognition to solve clinical problems means that should the clinician realise subsequently that their pattern recognition was incorrect, they have no logical intellectual framework to help them reassess the patient. Thus, pattern-based assessment of clinical cases can result at best in a speedy, correct, ‘good value’ diagnosis but at worst in wasted time, money and, sometimes, endangers the life of the patient.

I'll do bloods!

Routine diagnostic tests such as haematology, biochemistry and urinalysis can be enormously useful in progressing the understanding of a patient's clinical condition. However, relying on blood tests (often called a minimum database) to give us more information about the patient before we form *any* assessment of possible diagnoses can be useful for disorders of some body systems but totally unhelpful for others. Serious, even life-threatening, disorders of the gut, brain, nerves, muscles, pancreas (in cats) and heart, for

example, rarely cause significant changes in haematological and biochemical parameters that are measured on routine tests performed in practice. Over-reliance on blood tests to steer us in the right clinical direction can also be problematical when the results do not clearly confirm a diagnosis. The veterinarian can waste much time and the client's money searching without much direction for clues as to what is wrong with the patient. And of course, the financial implications of non-discriminatory blood testing can be considerable, and many clients are unable or unwilling to pay for comprehensive testing. Using blood testing to ‘screen’ for diagnoses can be misleading, as the sensitivity and specificity of any test are very much influenced by the prevalence of a disorder in the population.

For experienced veterinarians, pattern recognition combined with ‘fishing expeditions’ (i.e. ‘I have no idea what's going on so I'll just do bloods and hopefully something will come up!’) can result in a successful diagnostic or therapeutic outcome in many medical cases in first opinion practice. However, there are always cases that do not yield their secrets so readily using these approaches, and it is these cases that frustrate veterinarians, prolong animal suffering, impair communication, damage the trust relationship with clients and on the whole make veterinary practice less pleasant than it should be. You also have to know about *and* remember lots of diagnoses for this approach to be effective. This is problematical if the veterinarian does not recognise or remember potential diagnoses or if, as discussed previously, the pattern of clinical signs doesn't suggest a relatively limited number of differentials. It is also less useful for inexperienced veterinarians or veterinarians returning to practice after a career break or changing their area of practice.

It is for all of these reasons that we hope this book will enhance your problem-solving skills as well as build your knowledge base about key pathophysiological principles. We want to assist you to develop a framework for a structured approach to clinical problems that is easy to remember, robust and can be applied in principle to a wide range of clinical problems. The formal term for this is problem-based inductive clinical reasoning.

Problem-based inductive clinical reasoning

In problem-based inductive clinical reasoning, each significant clinicopathological problem is assessed in a structured way before being related to the other problems that the patient may present with. Using this approach, the pathophysiological basis and leading questions (see the following sections) for the most specific clinical signs the patient is exhibiting are considered before a pattern is sought. This ensures that one's mind remains more open to other diagnostic possibilities than what might appear to be initially the most obvious and thus helps prevent pattern-based tunnel vision. If there are multiple clinical signs, for example vomiting, polydipsia and a pulse deficit, each problem is considered separately and then in relation to the other problems to determine if there is a disorder (or disorders) that could explain all the clinical signs present. In this way, the clinician should be able to easily assess the potential differentials for each problem and then relate them rather than trying to remember every disease process that could cause that pattern of particular signs. It is important that the signalment of the patient is seen as a risk factor but should not blind the clinician to potential diagnoses beyond what is common for that age, breed and sex.

Thus, we *do* look for patterns but not until we have put in place an intellectual framework that helps prevent tunnel

vision too early in the diagnostic process.

Essential components of problem-based clinical reasoning

Step 1 – the problem list

Construct a problem list

The initial step in logical clinical problem solving is to clarify and articulate the clinical problems the patient has presented with. This is best achieved by constructing a problem list – either in your head or in more complex cases, on paper or the computer.

Why is constructing a problem list helpful?

- It helps make the clinical signs explicit to our current level of understanding
- It transforms the vague to the more specific
- It helps the clinician determine which are the key clinical problems (‘hard findings’) and which are the ‘background noise’ (‘soft findings’)
- And most importantly, it helps prevent overlooking less obvious but nevertheless crucial clinical signs.

Identify the problems and ‘prioritise’

Having identified the presenting problems, you then need to assign them some sort of priority on the basis of their specific nature.

For example, anorexia, depression and lethargy are all fairly non-specific clinical problems that do not suggest involvement of any particular body system and can be clinical signs associated with a vast number of disease

processes. However, clinical signs such as vomiting, polydipsia/polyuria, seizures, jaundice, diarrhoea, pale mucous membranes, weakness, bleeding, coughing and dyspnoea are more specific clinical signs that give the clinician a ‘diagnostic hook’ they can use as a basis for the case assessment. As the clinician increases their understanding of the clinical status of the patient, the overall aim is to seek information that allows them to define each problem more specifically (i.e. narrow down the diagnostic options) until a specific diagnosis is finally arrived at.

Specificity is relative!

The relative specificity of a problem will, however, vary depending on the context. For example, for a dog that presents with intermittent vomiting and lethargy, vomiting is the most specific problem, as in all likelihood the cause or consequences of the vomiting will also explain the lethargy. In contrast, for the dog that presents with intermittent vomiting and lethargy *and* is found to be jaundiced on physical examination, jaundice is the most specific clinical problem. The majority of causes of jaundice can also cause vomiting but the reverse is not true, that is there are many causes of vomiting that do not cause jaundice. Thus, there is little value in assessing the vomiting as the ‘diagnostic hook’, as it will mean that many unlikely diagnoses are considered and time and diagnostic resources may be wasted. In this case, assessment of jaundice will lead more quickly to a diagnosis than that of vomiting, as the diagnostic options for jaundice are more limited than those for vomiting.

In other words, although you identify and consider each problem to a certain degree, you try to focus your diagnostic or therapeutic plans on the most specific problem (the ‘diagnostic hook’) if (and this is important)

you are comfortable that the other clinical signs are most likely related. If you are not convinced that they are all related to a single diagnosis, then you need to keep your problems separate and assess them thoroughly as separate entities, which may or may not be related. There are reasons that might make one surmise that the clinical signs are related to more than one problem including the following:

1. The chronology of clinical signs is very different, raising the possibility that there is more than one disorder present.
2. The problems don't fit together easily, for example different body systems appear to be involved in an unrecognisable pattern.
3. Other clues that may be relevant to the case, for example some clinical signs resolved with symptomatic treatment but others didn't.

How do I decide what problems are specific?

As indicated previously, specificity is a relative term and will vary with each patient. There are a few clues that you can look for when trying to decide the most specific problems the animal has:

Is there a clearly defined diagnostic pathway for the problem with a limited number of systems or differential diagnoses that could be involved?

For example: vomiting vs. inappetance

- The problem of vomiting has a very clearly defined diagnostic pathway (discussed in Chapter 2), whereas there is almost an endless set of diagnostic possibilities for causes of inappetance, and there is no well-defined diagnostic approach (Chapter 4). Hence, vomiting is a

more specific and appropriate ‘diagnostic hook’ than inappetance.

Could one problem be explained by all the other problems but not vice versa or does the differential diagnosis list for one problem include many diagnoses that would explain the other problems but not vice versa?

For example: vomiting vs. jaundice

- As mentioned earlier, jaundice is the more specific problem because most causes of jaundice could also conceivably cause vomiting, but there are many causes of vomiting that do not cause jaundice.
- Hence, the diagnostic pathway for jaundice is more clearly defined (discussed in Chapter 10), and there are a more limited number of possible diagnoses.

But don't forget to relate each problem to the whole animal

Once you have narrowed down your diagnostic options for the most specific problems, you use these to direct your diagnostic or therapeutic plans, but don't forget to consider the less specific problems in relation to your differential diagnosis.

For example, your *specific problem* may be polyuria/polydipsia (PU/PD) associated with a urine specific gravity of 1.002 (hyposthenuria), and your non-specific problem may be anorexia. Hence, when considering the potential differential diagnoses for PU/PD associated with hyposthenuria, those diagnoses for which anorexia is *not* usually a feature, for example psychogenic polydipsia, diabetes insipidus and hyperadrenocorticism, are much less likely than those diagnoses where anorexia is common such

as hypercalcaemia, pyometra and liver disease. It is not always necessary to ‘rule out’ the former diagnoses, but they have a lower priority in your investigation than the latter group.

Thus, the thinking goes: ‘*the causes of hyposthenuria are ……. (Chapter 12) and in this patient the most likely causes are ……. (because of the other clinical signs or clinical pathology present).*” In other words, you use the non-specific problems to refine the assessment of the specific problems. One could claim that this is pattern recognition, and indeed it is to a certain extent. However, the step of clarifying the problem list (and thus not overlooking minor signs) and assessing the specific problems in this manner allows the clinician's mind to be receptive to differentials other than the supposedly blindingly obvious one that uncritical pattern recognition may suggest (such as thinking every cat with PU/PD must have renal failure). And as we discuss later in this chapter, the particular steps you take in assessing the specific problems also decrease the risk of pattern-based tunnel vision and confirmation bias.

How likely is a diagnosis?

Priority is also influenced by the relative likelihood of a diagnosis. Common things occur commonly. Therefore, although you shouldn't dismiss the possibility of an unusual diagnosis by any means, the *priority* for the assessment is usually to consider the most likely diagnoses first, provided they are consistent with the data available.

Step 2 – Does this make sense?

Always ask yourself, particularly when assessing clinical pathology or results of other diagnostic procedures in light of particular problems – ‘*does this make sense – does this*