Commentary

Veterinary clinical decision-making: cognitive biases, external constraints, and strategies for improvement

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Making decisions is the central task of clinical veterinary practice. Performing surgery and other manual skills and communicating with colleagues and clients are important, but there is nothing we do as often or that is ultimately as central to clinical medicine as making decisions. However, veterinarians and veterinary students receive little, if any, formal training in decision making, and there is little explicit discussion in the veterinary literature about this critical activity.

When evaluating a patient, we need to characterize the clinical situation on at least three levels. First, we need to interpret the clinical problem in terms of its relationship to the functions and services we provide. That is, we must make a diagnosis, identifying the nature and cause of the clinical signs within the medical model we use. This allows us to then identify what diagnostic or therapeutic steps, if any, are indicated.

Second, we must determine the meaning of the clinical situation from the perspective of the client, so we can effectively address the client's needs and concerns. That is, in addition to making an accurate diagnosis and choosing an effective treatment, we must understand the goals and values of the client and make our interventions compatible with those goals and values.

Third, we should attempt to consider the problem from the perspective of the patient. It is widely believed that veterinarians have a role in identifying and representing the interests of our patients.[1] Because these interests cannot be directly communicated to us by our patients and may not be accurately or fairly understood or represented by their owners, one goal of veterinary clinical decision making is to identify and act on behalf of the needs and interests of our patients.

Each of these three tasks requires a different combination of knowledge and skills. Identifying and responding appropriately to a clinical problem requires mastering an enormous body of medical knowledge. This includes knowledge about the mechanisms of health and disease and about the strengths and weaknesses of the diagnostic and treatment options available. Such information must be accurate, reliable, and accessible. It is in regard to this aspect of clinical decision making that the tools and techniques of EBM are especially valuable.

To gather the information needed to understand the clinical problem as well as to understand the client's goals and values, we need strong communication skills. There has been increasing recognition of the importance of client education and client communication in veterinary medicine in recent years, and there is a growing body of information and research on improving client communication.[2,3]

Abbreviation

EBM	Evidence-based medicine

Additionally, fulfilling our clients' needs and making our interventions acceptable to them requires a degree of empathy.[4] Clients cannot be effective partners in caring for patients if we are unable to establish trust and a sense of shared goals or if they feel our recommendations are in conflict with their values. Of course, as guardians of the interests of our patients as well, we are often forced to negotiate apparent conflicts between the goals and values of our clients and what we believe is best for our patients. These are areas in which so-called soft skills, behavioral competencies such as building trust and rapport, and communicating clearly, are most important.

All of the tasks involved in veterinary clinical decision making must be accomplished within various constraints arising from the context of clinical practice. Perhaps the most challenging for veterinarians are the time limitations that are imposed. Office visits in private practice typically last from 10 to 30 minutes, which is inadequate for the use of many formal reasoning and decision-making strategies. Financial resources, for owners to pay for care and for veterinarians to pay for training, equipment, and staff, also constrain our clinical decision making.

Sources of error inherent in the nature of decision making are also important and are potentially more easily remedied than are resource constraints imposed by the economic context in which veterinarians practice. Our brains have evolved to process information and generate responses through certain mechanisms that have intrinsic limitations and weaknesses. These sources of error are rarely discussed in veterinary medicine, yet they have a powerful influence on the efficacy of our clinical decision making.

It behooves us to understand how we make decisions in practice, where the errors and pitfalls in this process lie, and how we can make the most accurate and effective decisions possible within the constraints under which we function. Improving the quality of our decision making can improve the care we provide our

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patients and the services we provide our clients and can reduce the stress and frustration of the process for us. Fortunately, there is a rich literature on medical decision making from which we can draw to understand how we can improve.

Decision-Making Theory

Although veterinarians have extensive specialized knowledge and skills resulting from training and experience, these are used in the context of a decision-making apparatus that is the same as that used by all other human beings. There is a growing understanding of the basic structure and functions of this apparatus as well as many of its weaknesses. This understanding has been explicitly applied to the improvement of clinical decision making in human medicine, but little attention has yet been given to investigating how veterinarians in particular make decisions or how general principles of how human beings gather and process information and use it to make decisions can help improve veterinary clinical decision making.

The currently dominant model for how people make decisions is dual process theory.[5,6] This model identifies two complementary systems by which people process information and make decisions, often called system 1 and system 2 (**Appendix 1**). These are not simply concepts but also processes with identifiably distinct anatomic and physiologic substrates in the cerebral cortex.

In brief, system 1 is a rapid, unconscious process by which information is gathered, evaluated, and used to make judgments on the basis of heuristics (ie, mental shortcuts that enable us to make decisions rapidly and with limited information). This system involves processes that are generally not directly observable or accessible to consciousness.

System 1 corresponds loosely to what clinicians often think of as intuition, an ability to focus on salient information, match patterns on the basis of experience, and identify a problem or make a diagnosis quickly without going through a formal, explicit reasoning process.

The advantages to this system are that it works quickly, copes well with limited information, requires no deliberate effort, and generates an emotional sense of certainty or confidence in its output that is satisfying to the clinician and reassuring to the client.

The disadvantages of system 1 are that it is only accurate under predictable and stable circumstances. Heuristics gain efficiency at the cost of accuracy, leading to many errors. And the emotional sense of certainty that comes with system 1 judgments impedes our ability to identify and accept our own errors.

System 2 is a deliberate, explicit process for evaluating information and generating decisions. It is the part of the decision-making process we are consciously aware of; however, it inevitably lags behind system 1. System 2 has been likened to a presidential approval or veto of complex legislation that has been drafted by a variety of committees whose processes and agendas are completely hidden. Often, unfortunately, system 2 is used to rationalize and defend the decisions made unconsciously by system 1 rather than to critically evaluate them.

System 2 uses learned decision-making techniques, such as constructing lists of differential diagnoses and invoking mnemonic devices or diagnostic algorithms. System 2 is prone to fewer errors than system 1 and can identify and correct errors generated by system 1. It is also more dispassionate than system 1 and so less likely to make mistakes on the basis of overconfidence or other emotional influences.

The primary disadvantage of system 2 is that it is slow and requires more effort than system 1. It is also less likely to gloss over uncertainty, which can feel like a disadvantage because it deprives us of some degree of confidence in our judgments. However, an accurate and honest understanding of the degree of uncertainty is critical for effective decision making.

Finally, system 2 is dependent on the information available to construct and guide formalized decision making and is less useful when such information is limited in quantity and quality, as is often the case in veterinary medicine.

Cognitive Biases in Clinical Decision Making

Most mistakes made by clinicians do not arise from a lack of knowledge but from cognitive biases inherent in our decision-making mechanisms.[7,8] These errors arise from faults in our memory, from quirks in how we direct our attention, and from the influence of our beliefs, desires, and expectations on what we observe. Most of these errors are embedded in system 1 processes.

Cognitive errors are an important source of medical mistakes. Surveys of physicians and patients report medical errors leading to serious harm in 35% to 42% of cases.[9] This is consistent with autopsy studies, which have consistently shown a 20% to 40% discrepancy rate between antemortem and postmortem diagnoses, with an estimated 33% of autopsies taking place only because the correct diagnosis was not identified antemortem.[7,10] Other studies[11,12] have found lower error rates (from < 5% in perceptual disciplines, such as radiology, up to 15% in specialties involving more cognitive processing, such as internal medicine), but it is still estimated that 50% to 96% of medical mistakes are due to decision errors. Although there are few relevant data, there is no reason to believe the frequency or importance of such errors would be lower in veterinary medicine.

Research in psychology has uncovered an enormous number of such cognitive biases, and comprehensive lists of those that most commonly influence medical decision making[5,13] are available (**Appendix 2**). Some of these biases drive decision making in conflicting directions (eg, commission bias and omission bias). The influence of individual biases in specific situations is dependent on many factors, including the temperament and habits of the clinician and the influence of other constraints in a given situation.

It is important to recognize that acting on these biases can often lead to a correct decision. The problem is not that these biases inevitably lead to error, but that they significantly increase the error rate when efforts are not made to compensate for them. Biases are neutral to the truth of a clinical problem. They drive decision making in a given direction irrespective of what is most likely to lead to an accurate diagnosis and effective treatment. So, even though we can all think of examples in which acting on these biases led to a correct diagnosis and successful outcome, this does not alter the fact that avoiding them is the best way to reduce errors and optimize decision making.

Cognitive biases are ubiquitous errors that are quite literally built into our brains by evolution. They cannot be avoided through pure willpower or extensive medical training. They do not correlate with intelligence or clinical experience. No clinician is immune to such errors regardless of his or her level of training, experience, intelligence, or good intentions. However, errors resulting from these biases can be minimized by the application of system 2 processes.[14,15]

External Constraints on Clinical Decision Making

Apart from inevitable cognitive errors, the primary limitations on the effectiveness of veterinary clinical decision making are the constraints imposed by the context of clinical practice. The two most prominent external constraints are time and money. Limitations in other resources, such as the quantity, quality, and accessibility of information and the training and skills to make clinical decisions effectively and efficiently, are also important constraints.

Veterinarians in clinical practice feel great pressure to make decisions and recommendations quickly and confidently.[16,a] This pressure comes both from the economic conditions that require consultations to be generally no more than 15 to 30 minutes long and from the perception that clients expect immediate and decisive action. Veterinarians often begin limiting the diagnostic and therapeutic options they consider within the first few minutes of a consultation on the basis of impressions regarding the client's attitude and goals or limitations they might place on diagnostic evaluation or treatment. This necessarily favors system 1 processes at this stage.

Financial constraints are also a factor veterinarians consider in guiding their own decision-making processes.[17,18] Clinicians may not be able to afford the equipment and facilities, the personnel, or the training to offer certain diagnostic and therapeutic options. Or clients may often not be able or willing to pay for such services, which over time will make veterinarians less likely to consider or offer these.

Finally, veterinarians are often forced to make decisions with inadequate information and high levels of uncertainty. High-quality scientific research is often unavailable to guide decision making, and even when it exists, it may not be possible for clinicians to access or use it effectively, owing to insufficient tools, resources, training, or motivation.[19,20] And veterinarians often suffer from a phenomenon known in the human medical literature as feedback sanction.[21] There are rarely mechanisms in place for veterinarians to obtain timely and accurate feedback about patient outcomes or their own errors. Formal outcome assessment and clinical audit mechanisms are rare, and few of us have any detailed or specific understanding of our own error rates.

Veterinary Clinical Decision Making

There has been little published research on veterinary clinical decision making. However, the studies that have been done illustrate the use of system 1 and system 2 processes, the opportunities for cognitive biases, and the impact of external constraints on the decision-making process.

One survey of veterinarians identified several characteristic steps in the process of making clinical decisions[16]:

- Rapid initial decision.
- Immediate communication of decision to client and initial action.
- Evaluation of initial decision through feedback on patient progress and client perceptions over minutes to days.
- New decision and action, if necessary.
- Justification of initial action, if unsuccessful, and communication of rationale for new action to client.

Another study[a] of general practice veterinarians found similar patterns, with clinicians initially making rapid decisions on the basis of spot diagnoses and pattern recognition, repeatedly reevaluating these decisions over minutes to days in an iterative process in which the client is deeply involved, and making use of more formal decision making only in the face of an unsatisfactory response to the initial action.

That study[a] also revealed that subjects were inclined to develop more rapid, simplified, and intuitive rather than formal decision-making processes in response to time constraints, perceptions about the desire of clients for quick and clear decision making, and concerns about the cost and efficiency of extensive, systematic diagnostic procedures. This was especially true in general practice and less so in specialty and referral practices, where clinicians used a more formal reasoning approach.

Both studies[16,a] also found that veterinarians placed a high value on the opinions of trusted colleagues and experts and made frequent use of this resource to guide their decision making. However, these clinicians did not appear to find published scientific research or formal EBM techniques attractive or useful. Commonly, veterinarians complained that there was insufficient time to make use of these resources and procedures or that they were impractical and difficult to access.

These limited studies[16,a] suggest that system 1 processes predominate in veterinary clinical decision making, particularly in first-opinion practice. The constraints of time and money, the deep involvement of the client in setting the agenda, and the limits of the clinical consultation all favor a system 1 approach. Veterinarians in both studies[16,a] recognized this as a departure from the formal decision-making model that is generally taught and used in academia and specialty practice. However, they were mixed in their opinions of this, with some seeing it as a compromise that led to a lower standard of care and others seeing it as more pragmatic and realistic than an academic approach. Veterinarians in both groups reported feeling inadequately trained in decision-making skills and limited in their ability to use system 2 processes by the constraints of private practice.

Although system 1 has the advantages of being rapid and efficient in the face of limited information and resources, it has the disadvantage of relying heavily on heuristics and cognitive biases, which makes it highly prone to error. Some biases influence the initial clinical assessment and arise from preexisting beliefs (eg, anchoring, ascertainment bias, availability bias, framing, the gambler's fallacy, overconfidence bias, and representative heuristic). Subsequent evaluation of the initial decision without reference to formal

and explicit diagnostic processes and high-level evidence is prone to other biases associated with the evaluation of initial hypotheses (eg, confirmation bias, commission and omission bias, diagnostic momentum, premature closure and search satisfaction, and vertical line failure).

Strategies for Reducing Error and Coping with Constraints

Many system 2 techniques are available to compensate for the cognitive errors hidden in the workings of system 1. A variety of specific strategies for addressing particular biases can be effective.[14,22,23] In reality, most of the features of formal, controlled scientific research and the tools of EBM exist for precisely this purpose. The more often we can rely on these, the less our innate cognitive limitations will taint our decisions. This requires an understanding of the sources of error, an awareness of how research and EBM techniques compensate for these, and the humility to acknowledge our individual limitations and disregard the potent but unreliable feelings of certainty that often accompany system 1 judgments.

Metacognition (ie, awareness of cognitive biases and other sources of error in our decision making and thinking about the decision-making process) is a prerequisite for reducing our error rate.[15] Once we understand the sources of error in clinical decision making, we can identify and use appropriate strategies to mitigate them. Training veterinary students and practicing veterinarians in clinical reasoning and the relevant areas of cognitive psychology is necessary to generate an awareness of cognitive biases and the acceptance of a need for formalized, compensatory processes.

Such processes can often be quite simple and inexpensive. There is strong evidence, for example, that simple checklists can dramatically reduce errors in both diagnostic and treatment practices, with a substantial impact on morbidity and mortality rates associated with missed diagnoses and medical errors.[24,25] Many errors of omission and commission generated by various cognitive biases could be avoided if clinicians were forced to follow methodical decision-making processes through the use of such checklists.

There is also good evidence that properly developed, evidence-based practice guidelines can both simplify decision making and reduce errors.[26,27] Veterinarians often welcome such guidelines and use them as a way of improving care, reducing stress and uncertainty, and justifying their practices to clients. The recently published RECOVER guidelines for small animal CPR are an excellent example of a transparent, evidence-based process for developing practical clinical guidelines.[28]

Both veterinarians and physicians have been less accepting of diagnostic and treatment algorithms and resist the idea that following algorithms will improve care or reduce errors. However, there is abundant, consistent evidence accumulated over decades that such algorithms consistently perform as well or better than clinical experts do, with lower cost and lower risk of error.[29,30] It is often believed that such rule-based decision making is less effective than a more flexible and intuitive approach because it is less able to account for the unique characteristics of each patient and situation. However, there is clear evidence that when we use such characteristics as justification for disregarding the conclusions of a formalized, rule-based system, we are most often introducing error and making our decisions less reliable.

For clinical practice guidelines and diagnostic or treatment algorithms to be effective at improving outcomes, they must of course be based on reliable information. Recognized EBM standards for conducting, reporting, and evaluating clinical research must be used to generate such guidelines for us to have confidence in the results. Similarly, for clinicians to use formal system 2 processes to improve their decision making, they must have access to accurate, relevant information. Evidence-based medicine is also concerned with providing this type of information by supporting the development of more and better-quality research evidence and the tools to efficiently and affordably make critically appraised evidence available to clinicians when and where it is needed.

The external constraints of private clinical practice on the use of system 2 methods cannot be completely eliminated, but they can be mitigated. For example, an accurate understanding of our clients' goals and perspective can reduce the pressure generated by mistaken perceptions of what clients expect of us. Veterinarians who feel clients expect rapid and confident decision making may be reluctant to use system 2 processes, which could slow down the consultation process or make the veterinarian appear insufficiently certain or knowledgeable. However, there is some evidence that client confidence is not as strongly affected by veterinarians' expression of uncertainty as we may believe and that clients might welcome explicit attempts to improve accuracy and reduce error in the diagnosis and treatment of their animals.[31]

Limited time is often cited as a reason for not making use of formal decision-making strategies or external research evidence. More efficient and available decision-support tools that deliver appropriate information to clinicians in a practical, timely manner could help reduce this barrier to the use of EBM and other formal reasoning processes.[32]

It may also be possible to reduce the time and money constraints placed by clients on our decision making if we can demonstrate better outcomes and fewer errors. It is possible, albeit not certain, that veterinary clients might be willing to bear the higher costs associated with longer consultations and more deliberative decision-making practices if the clients can be convinced that the additional costs and time resulted in better care and fewer mistakes. This will require a concerted effort to determine error rates and evaluate the impact of efforts to reduce them.

In any case, although we cannot make the private practice setting perfect in terms of minimizing medical errors attributable to clinical decision making, the perfect should not be the enemy of the good. We certainly can improve our practices with a more explicit, thorough understanding of the sources of error. Recognizing and understanding the limitations we must overcome and educating our clients about the risks of excessively constrained decision making and the benefits of explicit, formal, adequately informed decision-making processes is the first step. Informed by an understanding of the errors we are prone to and the constraints imposed by the context of clinical practice, EBM can help us make better decisions and more effectively meet the needs of our patients and clients while reducing the stress of clinical practice.

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Appendix 1

Characteristics of system 1 and system 2 decision-making processes (corresponding to intuition and learned decision-making techniques, respectively) in the dual process theory for how people make decisions.

Cognitive style	System 1	System 2
Computation principle	Associative	Rule-based
Responsiveness	Passive	Active
Capacity	High	Limited
Conscious awareness and control	Low	High
Automaticity	High	Low
Rate	Fast	Slow
Reliability	Low	High
Errors	Common	Less common
Effort	Low	High
Emotional attachment	High	Low
Scientific rigor	Low	High

(Adapted from Croskerry P. A universal model of diagnostic reasoning. *Acad Med* 2009;84:1022–1028.)

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Appendix 2

Common cognitive biases influencing veterinary clinical decision making.

Error	Description	Example
Aggregate bias	Believing population data, such as evidence-based clinical guidelines, do not apply to specific patients	Assuming that even though the best evidence suggest treatment X is useless for disease Y, this case is different
Anchoring	Fixing on an initial hypothesis and ignoring or not seeking subsequent salient data	Not obtaining radiographs for a dog with a cough typical of that for collapsing trachea and, therefore, overlooking a pulmonary tumor
Ascertainment bias	Allowing perception and judgment to be strongly influenced by expectations	Assuming that a pruritic retriever has allergies because these types of dogs always do
Availability bias	Judging the probability of a diagnosis on the basis of the ease with which it comes to mind	Making a diagnosis of yeast otitis because it is common and may be diagnosed and treated, without a thorough search for an aural foreign body (eg, foxtail)
Commission bias	Acting on the need to do something without adequate evidence or a rationale for specific action	Giving antimicrobials to an animal with a likely viral infection to satisfy the client or just in case
Confirmation bias	Seeking evidence to confirm a hypothesis rather than disprove it; ignoring disconfirming data	Assuming that because the patient got better, the diagnosis must have been correct and the treatment effective
Omission bias	Excessively applying the "first do no harm" principle to the point of eschewing appropriate and necessary interventions	Not pursuing dental treatment, even when it is warranted, because of unjustified concerns about anesthetic risk
Overconfidence bias	Believing we are smarter, more knowledgeable, and more accurate than we are and overrelying on intuition	Making a diagnosis of intervertebral disk disease in a toy-breed dog with signs of back pain without diagnostic testing to confirm or refute the diagnosis
Representative heuristic	Relying too much on prototypical clinical manifestations to guide diagnosis and, thereby, missing less common variants	Missing a diagnosis of hemangiosarcoma in a Golden Retriever with lameness by assuming this condition only causes splenic bleeding
Search satisfaction	Ceasing diagnostic efforts once a diagnosis is made and, thereby, overlooking comorbid disorders	Overlooking concurrent neoplasia in a geriatric cat with weight loss once a diagnosis of hyperthyroidism is confirmed