Clinical Reasoning Unveiled: Demystifying Heuristics and Hermeneutics in Neurological Clinical Practice

Raciocínio clínico desvendado: desmistificando heurística e hermenêutica na prática clínica neurológica

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ABSTRACT

Introduction: Medical practice, particularly in Neurology, is often influenced by cognitive biases that can compromise diagnostic and therapeutic accuracy, leading to significant patient consequences. Clinical reasoning strategies are fundamental, yet the complexity of these processes is frequently underestimated. Understanding these strategies is crucial to ensure accurate diagnoses and effective treatments, thereby reducing clinical errors and optimizing patient outcomes. Despite extensive literature on cognitive biases, there is a need for a systematic synthesis addressing the peculiarities of neurological clinical reasoning, considering heuristics (mental shortcuts or rules of thumb that simplify decision-making) and hermeneutics (the theory and methodology of interpretation, especially of textual and symbolic content).
Objectives: To review and systematize the main clinical reasoning strategies in Neurology, highlighting common biases and proposing methods to improve diagnostic and therapeutic accuracy. **Methodology:** A comprehensive literature review focusing on familiarity biases, Dual Process Theory, and heuristics (anchoring, availability, and representativeness). Additionally, the application of hermeneutics in hypothesis formulation and the importance of understanding the patient as a complex system were analyzed. **Results:** Specialized neurologists often rely on heuristics, which means a cognitive shortcut. Recognizing this process can mitigate anchoring and availability biases. The hermeneutic approach, on the other hand, is essential for interpreting variables in the patient's context, integrating historical and social aspects.
Conclusion: Understanding clinical reasoning processes and systematically teaching these strategies are crucial to enhancing the efficiency and effectiveness of clinical decision-making, reducing diagnostic errors, and improving patient outcomes.

Keywords: Medical philosophy; Clinical decision-making

RESUMO

Introdução: A prática médica, particularmente em Neurologia, é frequentemente influenciada por vieses cognitivos que podem comprometer a precisão diagnóstica e a terapêutica, resultando em consequências significativas para o paciente. Estratégias de raciocínio clínico são fundamentais, mas a complexidade desses processos é subestimada. Compreendê-las é crucial para garantir diagnósticos precisos e tratamentos eficazes, reduzindo erros e otimizando resultados. Apesar da extensa literatura sobre vieses cognitivos, necessita-se sintetizar sistematicamente uma abordagem das peculiaridades do raciocínio neurológico, considerando heurísticas (atalhos mentais ou regras práticas que simplificam a tomada de decisão) e a hermenêutica (a teoria e metodologia de interpretação, especialmente de conteúdo textual e simbólico).
Objetivos: Revisar e sistematizar as principais estratégias de raciocínio clínico em Neurologia, destacando os vieses comuns e propondo métodos para melhorar a precisão diagnóstica e terapêutica.
Metodologia: Uma revisão abrangente da literatura focando em vieses de familiaridade, Teoria do Processo Dual e heurísticas (ancoragem, disponibilidade e representatividade). Além disso, a aplicação da hermenêutica na formulação de hipóteses e a importância de entender o paciente como um sistema complexo foram analisadas.
Resultados: Neurologistas especializados frequentemente dependem de heurísticas, que são atalhos cognitivos. Reconhecer esse processo pode mitigar os vieses de ancoragem e disponibilidade. A abordagem hermenêutica é essencial para interpretar variáveis no contexto do paciente, integrando aspectos históricos e sociais.
Conclusão: Compreender os processos de raciocínio clínico e ensinar sistematicamente essas estratégias é crucial para aumentar a eficiência e eficácia da tomada de decisões, reduzindo erros e melhorando os resultados dos pacientes.

Palavras-chave: Filosofia médica; Tomada de decisão clínica

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INTRODUCTION

Medical practice is a complex field where clinical reasoning plays a crucial role in decision-making. However, it is undeniable that highly specialized neurologists, like other specialized physicians, are susceptible to biases that can compromise diagnostic and therapeutic accuracy. From medical school, we learn strategies that should help us identify likely diagnoses and propose the best course of action for the patient. As we progress through our education and into practice, we continue to refine these strategies, relying on mnemonics, flowcharts, clinical experience, although often with limitations.

It must be considered that interpretation and its application are intimately related[1]. The potential interpretations of any phenomenon - whether an experience, speech, or text - are numerous and varied. Different aspects of this phenomenon may have varying relevance to different agents. The question of the 'best' interpretation cannot be resolved solely through methodological considerations; it depends on the purposes to which this understanding is applied [1,2] .

Ignorance of the complexity of these processes, their advantages, and limitations can lead to professional biases, resulting in suboptimal accuracy. In this context, this review discusses and proposes a synthesis and systematization of the main clinical reasoning strategies based on a comprehensive literature review. Therefore we expect to enable physicians to recognize clinical reasoning peculiarities, benefits, and pitfalls.

In the next sessions, this article addresses familiarity biases in the clinical reasoning of specialized neurologists, discussing the “Dual Process Theory” and the influence of cognitive systems on clinical decision-making. It then explores the effects of heuristics, such as anchoring and availability heuristics, on clinical reasoning, highlighting their advantages and pitfalls. Then, the application of hermeneutics in hypothesis formulation is analyzed, emphasizing the importance of the patient's historical and social context.

These cognitive features are summarized on the Tables 1-5. The article also discusses the necessity of understanding the patient as a complex system, integrating variables within a broader context. Finally, it summarizes the importance of systematic teaching of clinical reasoning in medicine, aiming to enhance the effectiveness and efficiency of clinical decision-making.

Clinical Reasoning and Familiarity Bias

Clinical reasoning, while essential, can be influenced by various cognitive biases, especially when a physician specializes heavily in a specific area like Neurology. Highly specialized neurologists tend to initially consider diseases they are most familiar with, often overlooking other possible conditions that may present similar symptoms[3].

The Dual Process Theory and the Influence of Cognitive Systems

Clinical reasoning is how doctors figure out what's wrong with a patient by recognizing patterns in their symptoms, like strength, pain, or tremors. This involves two types of thinking, often called System 1 and System 2.

System 1 is fast and based on intuition and experience. It's like doctors having a "gut feeling" about a diagnosis because they've seen similar cases many times before. This quick thinking happens mostly in the subconscious and uses little mental energy, making it efficient for experienced doctors.

System 2 is slower and more analytical. It involves carefully examining all the symptoms and information before making a decision. New doctors and medical students rely more on this method because they haven't yet built up enough experience to trust their intuition. This process takes more time and effort but helps in making accurate diagnoses.

Both systems are important and are used together in everyday medical practice. Even experienced doctors switch to System 2 when faced with a complex or unfamiliar case. Understanding how these systems work helps doctors avoid mistakes and provide better care for their patients. Recognizing the strengths and weaknesses of both types of thinking can lead to more accurate diagnoses and better patient outcomes. These characteristics are summarized on Table 1 [4,5] .

Tabela 1. Clinical Reasoning Strategies in Neurology.

Strategy	Description	Advantages	Disadvantages	Application Examples
Dual Process Theory	Combination of intuitive (System 1) and analytical (System 2) processes	Quick initial identification followed by detailed analysis	Can be slow in complex cases	Initial diagnosis with heuristics, followed by detailed analysis
Heuristics	Mental shortcuts used to simplify decision-making	Fast and efficient, based on experience	Susceptible to biases, can lead to errors	Common diagnoses, quick decisions in emergencies
Hermeneutics	Deep interpretation considering the patient as a complex and contextualized system	Holistic, individualized approach	Requires more time and detailed information	Complex cases, rare diseases
Bias Analysis	Identification and mitigation of cognitive biases that can affect diagnostic accuracy	Reduces diagnostic errors, improves accuracy	Requires awareness and continuous training	Diagnostic review, continuous medical education

Illustrative case: “A 54 years old male patient, former smoker, abstainer for 20 years, seeks care complaining of paresthesia and paresis in the feet that have begun 2 years ago, of an ascending and slowly progressive nature, now affecting the lower limbs up to the proximal third of the thighs. He evolved with the need for a wheelchair and weight loss of 20 kg during the period.”

Clinical reasoning according to System 1: a general physician would probably find it highly suggestive of an occult neoplasm, while an endocrinologist, a diabetic polyneuropathy. Both conditions would be considered at first also by a neurologist who would besides think of a chronic demyelinating polyneuropathy as well.

Clinical reasoning according to System 2: considering the number of possibilities, additional data would be essential. (to be continued)

Heuristics and Their Effects on Clinical Reasoning

Heuristics are mental shortcuts used to simplify decision-making. These characteristics are summarized on Table 1. It is a decision-making method that uses mental shortcuts or practical rules to solve problems quickly and efficiently. They comprise a set of rules for multivariable analysis aimed at reaching a conclusion. This process occurs automatically in our cognition, predominantly unconsciously[6].It operates as a type of cognitive shortcut, that 'aha' moment, that many experience. It involves an inclination towards a diagnostic hypothesis based not so much on statistically derived data evidenced by scientific studies but rather on a form of pattern recognition that is not yet fully understood.

In this way, the physician is able to interpret variables of the complex system (the patient) through a cognitive shortcut, as an emergent phenomenon, thus achieving greater efficiency with accuracy results similar to traditional probabilistic methods [7,8] . "[...] may sometimes seem simplistic or inadequate, but when compared to more complex and sophisticated methods, they yield similar results with much less effort." [9]. However, it is known that deception lies within this. Our complex, adaptive, and dynamic subconscious is capable of responding significantly differently to small details.

Even though the information conveyed is essentially the same, depending on how it is presented (using euphemisms, different graphs, etc.) [10-12] , individuals may interpret it differently, which can hinder the diagnostic process. This highlights the ambivalence of heuristics as a clinical method and underscores the importance of understanding this phenomenon to extract its best aspects while avoiding its pitfalls.

Frame Effect

This effect concerns how a case is presented or thought about (Table 2). It is known that not only the content but also the message's form influences the weighting of the values attributed to the variables. From this effect, the physician can summarize the most important variables together and build a pattern that makes sense and is quickly recognizable. On the other hand, depending on how the case is organized and conveyed, some important points may be downplayed, compromising the accuracy of clinical reasoning. Therefore, more important than separating the anamnesis into a Cartesian model of Current Disease History, Past Pathological History, Directed Anamnesis, etc., is understanding the patient's history chronologically, viewing all events as part of a single narrative [9,12] .

Table 2. Cognitive Biases in Neurological Practice.

Bias	Description	Impact on Clinical Practice	Example	Mitigation
Anchoring Bias	Excessive focus on the first information received	Can lead to neglect of other diagnostic hypotheses	Initial diagnosis based on a single symptom	Systematic review of all available information
Availability Bias	Ease of recalling recent or common diagnoses	Overestimation of rare diagnoses	Recall of a rare case seen recently	Review of epidemiological data and disease prevalence
Representativeness Bias	Judgment based on similarity to previous cases	Neglect of prevalent but atypical conditions	Diagnosis based on the classic appearance of a condition	Consideration of differential diagnoses
Framing Effect	Influence of how information is presented	Incorrect weighting of important variables	Different presentations of the same clinical case	Clear and structured presentation of information

Example of scenario:

A 55-year-old patient presents with complaints of progressive muscle weakness in the legs and difficulty walking. He describes the weakness as "feeling my legs heavy and sometimes stumbling without reason."

Presentation 1: The patient focuses on episodes of stumbling and the sensation of heaviness in the legs, mentioning that these episodes mainly occur after long periods of activity.

Physician's Interpretation: The physician may frame these symptoms as possible peripheral neuropathy, associating weakness and stumbling with muscle fatigue after exertion. This interpretation could lead to tests focused on neuropathies, such as electromyography (EMG) and nerve conduction studies.

Presentation 2: During the same consultation, the patient is asked more detailed questions about the timing and nature of the symptoms. He then mentions that in addition to weakness, he sometimes experiences muscle spasms in the legs and that the weakness seems to worsen in cold environments.

Physician's Interpretation: With this new presentation, the physician may reconsider the initial hypothesis and frame the symptoms as possible myotonia, a condition that can be exacerbated by cold and characterized by difficulty relaxing muscles after contraction. This could direct the evaluation towards specific genetic tests and laboratory examinations to identify myopathies.

The "Frame Effect" demonstrates how the presentation of symptoms influences the physician's interpretation, diagnosis, and treatment. Detailed descriptions and context provided by the patient are crucial to avoid diagnostic biases and ensure a comprehensive and accurate evaluation. This effect highlights the importance of thorough anamnesis and exploring all facets of the patient's symptoms.

Anchoring Heuristic

Even if initially, at an early stage of anamnesis or physical examination, the physician already has some diagnostic hypotheses in mind and has listed one as the most likely based on the analysis of the initial variables available (e.g., age, sex, ethnicity, pain pattern), they are able to change their reasoning and thus begin the active search for a series of variables that until then had a low power to modify a diagnostic hypothesis and so would have been little explored. In this context, it is said that the physician has "anchored" on information and from there, investigated other related information. See Table 2[9,12].

Take, for example, a male patient of 50 years old, poorly controlled hypertensive, smoker, drinker, overweight with precordial pain for a few months, not always associated with efforts. The hypothesis that quickly comes to mind is ischemic heart disease. At one point during the consultation, he mentions having a diaphragmatic hernia and having stopped taking "stomach medicine" because he "no longer felt burning".

At this point, the physician starts asking questions, such as "Have you ever had pneumonia? Do you feel unpleasant taste? Do you feel food coming back from your stomach? Is this pain worse if you lie down right after eating? Does this pain occur more easily if you eat a large volume of food? Before starting to take that stomach medicine, did you feel a pain similar to what you feel now?"

Example: Abnormal Postures of Hands and Feet

Anchoring Heuristic:

A physician may initially anchor on the hypothesis of dystonia when observing abnormal postures of the hands or feet, especially if specialized in movement disorders. However, these postures can also be caused by neuromuscular conditions such as myopathies or peripheral neuropathies, which require a more detailed examination and additional considerations.

Availability Heuristic

The availability heuristic (Table 2) is characterized by situations where the frequency of a class or the probability of an event is estimated by the ease with which cases or occurrences can be brought to mind. It becomes easier to suggest a diagnostic hypothesis similar to one that was seen recently in a similar case than to consider epidemiologically more likely hypotheses.

This is evident when medical students are trained in a predominantly quaternary environment and, at a certain point in their training, begin to work in primary care. Initially, their diagnostic reasoning tends to more easily consider serious and uncommon diagnoses because these are abundant in their repertoire. After some time in this new experience, they begin to reconsider this heuristic, as they come to know better epidemiological data, in addition to enriching their repertoire with a myriad of common presentations of common conditions, as well as uncommon presentations of common conditions[6,13].

The great trap of this heuristic lies in the physician already conducting their reasoning biased by recent memories of similar cases, causing them to lower their sensitivity to variables that could lead to differential diagnoses, as well as subjectively devaluing variables that oppose the initially considered diagnosis.

Example: Involuntary Eyelid Closure

Availability Heuristic:

A movement disorder specialist may interpret involuntary eyelid closure as blepharospasm, a condition they frequently encounter. However, the same symptom might be seen by a neuromuscular disorder specialist as ptosis, due to weakness of the eyelid elevators, common in conditions such as myasthenia gravis.

Representativeness Heuristic

This heuristic can be summed up as: "Does this case look like what?" It is the rapid recognition of a stereotyped pattern of a specific diagnosis, based on the perception of key variables (see Table 2). This heuristic has the downside of often providing the physician with too much certainty to the point of neglecting other diagnoses, even if they are not "classic" but are prevalent and likely[9,12].

One way to mitigate this tendency is to remember that, although the patient's variables represent a typical pattern of a rare disease, it is more plausible that they are affected by more common diseases, even if they do not fit the exact pattern of the condition being investigated but are presenting atypically.

Continued *Illustrative case:* On examination, the patient was alert and oriented, with severely reduced distal strength in the legs and hands. Symmetrical thermal-pain anesthesia in boots up to the knees and in gloves up to the distal third of the forearm. Preserved proprioception in all four limbs. Globally abolished deep tendon reflexes. Reduced tone distally in all four limbs. Indifferent plantar cutaneous reflex bilaterally. Without changes in cranial nerves. There was diffuse skin thickening with hyperpigmentation on the back, upper limbs and lower limbs; bilateral and symmetrical perimalleolar edema 1+/4+ with pitting; and lymph node enlargement in the anterior cervical chain, fibroelastic and mobile.

Representative heuristics - This clinical case presents a severe sensorimotor polyneuropathy with weight loss, skin lesions and adenomegaly. This pattern was instantly recognized by

the neurologist based on a previous clinical case from his experience diagnosed with a plasma cell disease. (to be continued)

Hermeneutics in Hypothesis Formulation

After anamnesis and physical examination, the physician begins to evaluate and interpret the variables together. The physician must master this art. It's characteristics are summarized on Table 1

One of the fundamental principles of phenomenological hermeneutics is that our interpretations are deeply influenced by the historical and social context in which we are immersed. Hermeneutics is the methodology of interpretation. It originated as a legal and theological method concerned with the correct interpretation of scriptures and laws. Over time, it has expanded to include a broader range of interpretative processes in various fields, such as philosophy and social sciences. Instead of simply receiving raw and undifferentiated sensory data, our perception of the world is mediated by specific objects and events.

Merleau-Ponty suggests that our experience is not limited to abstract sensations but is always directed towards specific elements of the world around us. Heidegger illustrates this idea by stating that we do not perceive just a cacophony of sensations such as tones and noises, but rather we hear distinct sounds, like the whistling of the storm in the chimney, the drone of the three-engine plane, or the bang of the door closing in a house[14].

Macro Context

To understand the patient and the value of the variables, i.e., what they represent, it is necessary to understand the context in which they are inserted and presented. What is the socioeconomic context in which this individual is embedded? Which other actors and phenomena influence negatively and positively on their life's evolutionary stage?

The patient must be considered as a complex, dynamic, adaptive, and open system. Being open means that they are influenced by the environment and also influence it. Attempting to interpret the patient in isolation from their surroundings is a practice that deviates greatly from reality and is mistaken. In this topic, one must also consider the size of their support network, from family members to more institutionalized support like community support groups or Family Clinics, etc. Understanding how this macro context is configured will be important for the individualized interpretation of variables, as well as for the best therapeutic approach, also individualized[15].

The social and economic conditions of patients are crucial determinants for health, access to medical care, and clinical outcomes. The lack of inquiries about the socioeconomic context in healthcare settings can compromise treatment effectiveness. Patients with low Socioeconomic Status (SES) often perceive that their socioeconomic condition negatively impacts the care they receive. These patients report difficulties in accessing care and less satisfactory interactions with healthcare providers. The SES of patients influences the clinical decisions of doctors. Changes in clinical management based on SES are implemented to improve patient outcomes, although they also create personal and financial challenges for doctors [15-17].

Example: an elderly diabetic patient with sensory polyneuropathy will be diagnosed with diabetic neuropathy, but taking into account his lower socioeconomic background, vitamin deficiency polyneuropathy would be much more relevant as a differential diagnosis.

Patient as a Complex System

The Cartesian model in health care is known for segregating phenomena that divides the individual into areas. This segmentation largely guides our medical training, so it is natural to classify the problems presented by the patient as "psychological," "social," "organic," or even to subclassify them as "cardiac," "endocrine," etc. The purpose of this segmentation is to seek a better understanding of the system's (individual's) functioning. The idea is to divide the system into segments, these into subsegments, study them, understand them, and then integrate them. This last part is often taught in a stumbling manner.

There is still too much difficulty in understanding the patient as a complex system. But what does this mean? It is a system because it is a set of elements that relate to each other to produce an effect together that is greater than the simple sum of its parts. Complex (com = together; plexus = network), because each element interacts and interrelates with the others as a network.

This system is open, as explained above, and dynamic and adaptive, meaning it can change, adapt to new internal and external stimuli to maintain its functions. In other words, it is an evolving system that transmutes over time. This has been noted for millennia by the Greeks, like Heraclitus, who observed that the same man never bathes in the same river twice, as both are in perpetual transformation. Armed with this information, it becomes clearer that the same variable in the same patient at different times can acquire different values, i.e., the same abnormal test result, the same semiological finding can have greater or lesser importance/gravity depending on the patient's evolutionary stage.

Finally, this system is also unique. Thus, the interaction of its elements produces unique effects, its socioeconomic, labor-related contexts, etc., also affect it uniquely, its repertoire of information, values, beliefs, fears, illness experience, reaction to drugs, everything in it is

unique. Therefore, the interpretation of their variables should be individualized and subsequently, the management proposals should also be individualized [18].

Variable per se and Variable in Contexts

Each variable embodies a value in itself. This means that its presence or absence, as well as its degree of intensity, relates to a pre-test probability of an outcome. This interpretation follows a predictive coding model. The acquisition of variables from an analyzed object passes through an interpretative model that confronts them with our idea of a known world model. Such a model aims to minimize disparities between the previously conceived idea and perception. When disparities are significant, i.e., the previous idea is insufficient to explain the perceived variables, this model encourages a revision of it or acts to modify the sensory input to make it consistent with internal predictions [2,19] .

continued *Illustrative case:* It is well known that edema of the lower limbs is an expected condition in patients restricted to a wheelchair. Just as a discrete, single lymph node enlargement in the cervical chain can, not infrequently, be found without relevant clinical implications. However, these "soft signs" become eloquent (become "hard signs") and begin to form the diagnostic puzzle.

Evaluator Assessment

The neurological crossovers and the subspecialty dilemma

A fundamental part of the hermeneutic process is the evaluation of the interpreter, i.e., the examining physician. The valuation of variables stems from a pre-configured state of the interpreter. Gadamer refers to this as 'prejudice,' and Ricoeur as 'prefiguration' [20]. This principle implies that our understanding of the world is not just a passive reaction to sensory stimuli but an active construction that reflects our cultural, historical, and personal contexts.

Beyond the socio-cultural understanding that the "physician is a product of the environment," it should be noted that we, by our human condition, are also a complex and mutable system and therefore susceptible to daily extrinsic factors. For example, a day with high patient demand, a heavier workload that week, a lack of sleep from the previous shift, or the patient's inflexible and assertive demand for procedures or treatments of questionable benefit. These stressors can modify our status and therefore our way of perceiving and interacting with the world. This means that we may be inclined to promptly devalue some variables with the intent, albeit unconscious, of accelerating the consultation and being able to eat as soon as possible; or we may insist excessively on an investigation without clear benefit to the patient if it brings back memories of a loved one.

Therefore, we must be aware of our own state when interpreting the patient's variables so that we can identify these biases and try to mitigate them, for example, by briefly postponing the diagnostic decision, of course, if the clinical scenario allows for this strategy. On the other hand, one could consider sharing the case with a more expert professional colleague and seeking their view, which could benefit from the distance between them and the patient[20].

continued *Illustrative case:* In a high demand care scenario with repeated diagnosed cases of diabetic polyneuropathy, the neurologist may assume that this is just another case and not proceed with the investigation. The chance of this occurring is even greater if the doctor is very tired. This can be mitigated as the physician realizes its actual mental condition at the moment. By acknowledging this fact, it should be able to create strategies for better time-management and stamina improvement, as a simple pause for a coffee.

Decision making

Finally, after collecting and interpreting variables comes the moment of decision, which must always be made, even if it is for an expectant management (see Tables 3 and 4). One must have in mind that this process is influenced by intrinsic and extrinsic factors [21,22] .

The first question to be asked at this stage is: is there enough information to make a decision? If not, what is the best way to obtain this information?

Would it be by repeating anamnesis/physical examination at another opportunity?

Would it be to monitor the evolution of this system and observe the best characterization of the variables?

Would it be to request complementary exams? How do you know which exam to request?

Or would it be better to perform a therapeutic test?

These and other questions are analyzed by cognitive processes similar to those discussed so far, but with their particularities. At this moment, it is worth remembering the great axiom of Medicine "primum non nocere," first, do no harm. This means that we must strive for safe conduct as much as possible and secondly, choose the most potentially beneficial ones [4,21].

It is paramount to exercise caution when applying heuristics and relying solely on intuitive judgments. In scenarios with ambiguous, incomplete, unknown, or complex patterns, System 2 should be prioritized as a strategy to avoid biased decisions.[22, 23].

The understanding that emotional states can influence decisions is crucial. There are strategies to mitigate these biases in decision-making. For example, a

known anxious physician might reconsider a watchful waiting approach initially or use a stepwise method instead of ordering multiple tests simultaneously. Another strategy is called "suppression," where negative emotions are silenced through techniques like deep breathing or mindfulness. An alternative is "cognitive reappraisal," which involves reinterpreting the variables to adopt a different perspective. [23].

People adapt their decision strategies to their environment and make efficient use of their limited cognitive resources. However, their strategy choices do not always fully exploit the environmental structure, leading to suboptimal decisions at times [24].

Table 3. Integration of Heuristics and Hermeneutics in Clinical Reasoning.

Step	Description	Objective	Methods
Initial Data Collection	Collection of information through history and physical examination	Obtain an initial overview of the patient	Structured history, detailed physical examination
Application of Heuristics	Use of known patterns and past experience for rapid hypothesis identification	Quick screening of possible diagnoses	Identification of key symptoms, comparison with previous cases
Critical Analysis (System 2)	Detailed and critical evaluation of initial hypotheses	Refine diagnostic hypotheses	Re-evaluation of symptoms, additional considerations
Hermeneutic Integration	Consideration of the patient's historical and social context	Holistic and individualized understanding of the patient	Discussion of social, economic, and family history
Decision Making	Choice of diagnosis and treatment plan	Define the best course of action	Decision based on collected data, review of options
Review and Adjustments	Continuous follow-up and adjustments as necessary	Ensure treatment effectiveness and adjust as necessary	Continuous monitoring, periodic reviews

Table 4. Components of Clinical Reasoning.

Component	Description	Importance in Clinical Practice	Implementation Example
Data Collection	Gathering information from the patient through history and physical examination	Basis for all subsequent stages of clinical reasoning	Complete history, systematic physical examination
Variable Identification	Determining relevant symptoms and signs for diagnosis	Focus on the most important information	List of symptoms, identification of key clinical signs
Application of Heuristics	Use of mental shortcuts and known patterns to make quick decisions	Efficiency in initial diagnosis	Diagnoses based on symptom patterns
Hermeneutic Analysis	Considering the patient as a whole, including their social and historical context	More personalized diagnoses and treatments	Discussion of the patient's social and economic history
Bias Mitigation	Identification and correction of cognitive biases that can affect diagnostic accuracy	Improvement in diagnostic accuracy	Continuous training in bias identification
Decision Making	Final choice of diagnosis and treatment plan	Definition of clinical course of action	Decision based on all collected and analyzed information
Continuous Review	Monitoring and adjusting treatment as necessary	Ensuring better patient outcomes	Regular follow-up, treatment adjustments

conclusion of *Illustrative case:* taken together, all of these evidences made the neurologist choose to further investigate the polyneuropathy considering the rare POEMS (polyneuropathy, organomegaly, endocrinopathy, M-protein and skin change) by performing a plasma immunoelectrophoresis.

CONCLUSION

It is evident that clinical reasoning is complex; it is a spectrum from intuition to analytical thinking. It must be studied to understand the advantages and disadvantages of each of its facets. Therefore, it is necessary to establish a systematic way of teaching this area to medical students at various times during their undergraduate studies in order to incorporate this reflective process into everyday practice.

Based on this review, several strategies are suggested to enhance medical education and clinical practice. First, integrating systematic teaching of clinical reasoning throughout medical education is paramount. This involves introducing students to both System 1 (intuitive) and System 2 (analytical) thinking processes early in their training and reinforcing these concepts with practical applications and case studies. (Table 5)

Table 5. Clinical Reasoning and Medical Education

Educational Component	Description	Importance in Medical Education	Teaching Methods
Heuristics Training	Education on mental shortcuts and their use in clinical practice	Development of quick diagnostic skills	Case studies, clinical simulations
Hermeneutics Teaching	Training on interpreting variables in the patient's context	Holistic and personalized understanding of the patient	Group discussions, case studies
Bias Identification	Training to recognize and mitigate cognitive biases	Reduction of diagnostic errors	Workshops, self-assessment
System Integration	Education on combining intuitive and analytical processing systems	Better clinical decision-making	Practical exercises, clinical simulations
Continuous Evaluation	Monitoring and continuous adjustment of clinical reasoning practices	Ensuring continuous improvement in medical practice	Regular feedback, performance review

Furthermore, incorporating regular training on cognitive biases, such as anchoring and availability heuristics, can help future physicians become aware of these pitfalls and learn strategies to mitigate their effects.

Simulated clinical scenarios that challenge students to identify and correct for biases can be particularly effective. Additionally, fostering an environment that encourages reflective practice and critical thinking can enable physicians to continually refine their clinical reasoning skills throughout their careers.

To build on the findings of this article, several avenues for future research are recommended. First of all, longitudinal studies tracking the development of clinical reasoning skills from medical school through residency and into practice can provide valuable insights into the effectiveness of different educational interventions. Understanding how and when these skills are best developed can inform curriculum design and teaching methodologies.

In conclusion, improving clinical reasoning through targeted education and ongoing research is essential for enhancing diagnostic accuracy and patient care. By addressing these areas, the medical community can work towards minimizing biases and errors, ultimately leading to better health outcomes for patients.

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