Teaching clinical medicine: the key principals

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Summary

Background: Many studies analyse the diagnostic process, diagnostic errors and diagnostic excellence but few provide a broad, yet practical view of this complex and highly context-dependent challenge.

Methods: A personal, experience- and research-based selection of the principles of data collection, processing and clinical reasoning found to be most useful in achieving an efficient, timely and patient-centered diagnosis.

Results: Twenty-four principles were identified and each one is presented followed by a brief commentary.

Conclusions: No single strategy can provide a solution for all diagnostic problems. However, the 24 principles have proven validity and can be applied for solving diagnostic problems in varied settings and as a scaffold in teaching diagnosis at all levels of medical education.

Diagnosis is the vital engine that carries forward not only the train of treatment but also health outcomes. Acquiring the science and art of clinical diagnosis is central to medical education, but there is no consensus on how it should be taught. Diagnostic problem solving is highly context dependent. The absence of a single, universal problem-solving process common to all cases and all physicians increases the challenge facing practitioners and educators. Diagnosis is often taught by clinician educators demonstrating on current patients, but this is usually done without attention to its general principles. Moreover, role model clinicians teaching diagnosis at the bedside have been pronounced ‘endangered species’ and are hard to come by. CPCs, clinical problem solving, clinical images and other published ‘exercises’ in diagnosis provide enlightening examples of clinical reasoning but are often selective and present unusual patients. Learning from diagnostic errors can be beneficial, whether identified by autopsy studies, malpractice claims, chart review, or self-reported. However, these were studied in retrospect and apply to groups only. Studies of the cognitive aspects of diagnostic decisions based on actual or standardized patients transformed our insight on mechanisms of bias and diagnostic failure, but their practical implications are uncertain. Other studies try to decipher the key to being superior diagnosticians or the essence of medical expertise. However, not many studies address the diagnostic process as a whole, starting from the patient encounter and data gathering, through analysis and the basic principles of decision making. Although some excellent books have been devoted to diagnosis, these lengthy texts are not very practical. For example, the advocated use of Bayesian approach requires complex time-consuming mathematics that most clinicians had rather avoid. We present an experience- and research-based overview of the major practical principles...
covering all stages of the diagnostic process that can be used as a framework in teaching as well as by residents and clinicians in all settings.

Methods

The author has been serving as head of a large (400 admissions/month) academic department of medicine for 24 years. Diagnostic principles were derived from a long personal experience in practicing, researching and teaching diagnostic methods to medical students, interns and residents. Commitment to medical education has mandated ongoing follow-up of the literature on decision making, clinical reasoning and diagnostic errors—an additional important influence on the choice of principles. The author’s research in related areas such as the intrinsic value of the history and examination,\textsuperscript{16, 17} the non-biological aspects of disease,\textsuperscript{18} the patient–physician relationship,\textsuperscript{19} clinical excellence\textsuperscript{20} and non-clinical influences on decision making\textsuperscript{21} have also been incorporated. Several principles have been included after they proved highly useful in deciphering some intriguing problems in the past.\textsuperscript{22-28}

Results

Twenty-four principles central to clinical reasoning and diagnosis were identified. Each is briefly described, followed by a comment.

I. The ABCD rule—Achieve the most from the Basic Clinical Data

Methodical, personal, curiosity-driven gathering of the patient’s narrative (all history elements, all potential sources), followed by a systematic (yet problem-directed) examination, often also incorporating electrocardiogram, chest X-ray and basic laboratory tests will likely diagnose correctly four of five patients\textsuperscript{16, 17} or suggest appropriate investigations. A sound base of knowledge and skills is a prerequisite.\textsuperscript{10, 29} Attention to the timeframe\textsuperscript{28} and to detail, ‘the Δ rule’ (A. Schattner, submitted for publication), and awareness of the operating characteristics (strengths and limitations - sensitivity, specificity, likelihood ratio) of common history and examination elements\textsuperscript{15, 30} are particularly useful. The history (and especially the reason for presentation) remains the most rewarding single source of diagnostic information.\textsuperscript{21} Simple or recurrent problems are often amenable to a much shorter, focused approach.

*Thoroughness in data collection does not guarantee accuracy in interpretation and diagnosis, but remains a strong starting point.\textsuperscript{31} In addition, the more patients are seen, the more ‘illness scripts’ are mastered,\textsuperscript{32} and the more efficient would the next encounter be. Although shunned by some,\textsuperscript{14} the technique can be applied after some experience within a framework of minutes, retaining its inherent power.

II. Record and arrange key findings using a ‘problem list’

After recording the findings, review the data, identifying meaningful ‘clusters’ and ‘key phrases’ and arranging them in a laconic (<\sim 100 words), comprehensive (all types of problems, biologic and other), dynamic (constantly changing with new information or insight) problem list.\textsuperscript{33} *Although this step seems to slow you down, it has a high yield for the provider ensuring a concise summary of all salient facts, a view of the whole picture and an excellent departure for problem solving, test selection, presentations and consultations.\textsuperscript{34} Here, a first attempt to grasp the gist of patient symptoms and their meaningful connections can be made.\textsuperscript{35}

III. Cherchez Les ‘red flags’

Screen your problem list giving early consideration to potential ‘red flags’! Any high impact/high treatability possible diagnoses identified, require urgent intensive attention.\textsuperscript{26, 27} *This is similar to the rule-out worst-case scenario (‘ROWS’) principle.\textsuperscript{36}

IV. Does ‘pattern recognition’ apply?—if so, verify

Intuitive, ‘augenblick’ (‘at the blink of the eye’) diagnosis suspected by its overall appearance and ‘Gestalt’ based on reflexive recognition of resemblance to previously seen cases, is often rapid (seconds), efficient (effortless) and accurate.\textsuperscript{37} However, it is also highly prone to bias and errors.\textsuperscript{38}

*Pattern recognition (PR) should be always be tried first but mandates confirmation: a quick verification stage is suggested wherein the provider mentally compares the degree of match between disease characteristics and mental model of the essentials of the suspected diagnosis,\textsuperscript{32} as if written on two overlapping transparencies. Any significant inconsistency may signify error and makes re-evaluation necessary. Reliance on non-analytical reasoning
V. Identify & analyse specific features germane to the case

Having failed PR, look for ‘specific’ features that are both central to the case and unique. These idiosyncratic clues often allow a shortlist of just a few differential diagnoses. \(^{40}\) Conditions appearing under two or more columns of ‘specific’ features are especially promising diagnostic possibilities and should be critically evaluated by selecting appropriate tests. \(^{24}\)

*This variant of the usual analytical (‘hypothetico-deductive’) (HD) method that names the main etiologies for the patient’s presentation (usually, 4 ± 1) following a conscious deliberate search and slowly constructs a workup to rule out/rule in hypotheses\(^ {1}\) may be more effective.

VI. The rule of reflexive consultation

‘Look it up’ as a habit, as early and as often as possible using PubMed (even Google), UpToDate, Textbooks, as well as expert colleagues. Main conclusions had better be added to the patient’s chart. Such attitude not only ensures a broad comprehensive view but also informed test selection and interpretation\(^ {22}\); a learning opportunity\(^ {17}\) and fostering an attitude of humility and maximal care—as opposed to overconfidence.\(^ {41}\)

*This habit also establishes the art of diagnosis as a lifetime learning endeavor\(^ {10}\) and is in line with Graber’s ‘get help’ category of interventions likely to reduce diagnostic errors.\(^ {42}\)

VII. ‘Milk’ the pretest probability

The diagnosis is often pathogenetically related to the patient’s past predisposing factors and susceptibilities (genetic, past illnesses, iatrogenic, occupational, lifestyle and other easily ascertainable risk factors and exposures). These predispositions constitute the ‘pretest probability,’ also defined as the expected prevalence of the suspected condition in similar patients.

*This relationship may be true even when it does not initially seem so. Unfortunately, errors of omission in obtaining these history elements prevail and they may ‘surface’ only after a long circuitous and costly detour. Thus, a quick but comprehensive survey of predispositions (which may be unapparent at first) had better be given priority and carefully considered\(^ {21,28}\) before ‘unrelated’ conditions arising de novo.

VIII. Could it be iatrogenic?

Take a moment to consider the possibility that the patient’s medications (possibly ‘over the counter’ or ‘natural’ preparations) or past medical interventions underlie the current symptoms, signs or abnormal laboratory tests.

*This particular brand of ‘pretest probability’ is particularly common, comprising the main diagnosis in up to 19% of hospital admissions\(^ {43}\) and a similarly significant proportion of primary care consultations.

IX. Try ‘Occam’s razor’—the law of parsimony

Consider the possibility of a single unifying diagnosis that may account for all (or most) clinical findings, before resorting to multiple concurrent different explanations (so-called Saint’s triad).\(^ {44}\)

*Today’s elderly patients with multimorbidity and polypharmacy may easily have more than one operative problem, but still, Occam’s law often applies.\(^ {25}\)

X. The ‘law of imperfection’: prevalent ‘partial’ presentations

Do not expect to find a perfect set of symptoms, signs and tests characterizing a given condition in order to make a diagnosis. Any combination may occur and sometimes even a single symptom and sign may suggest the correct diagnosis.

*Complete presentations are most commonly found in textbooks and are not necessary for diagnosis.

XI. Is there a tenable alternative?

Finding (or being unable to find) a tenable alternative diagnosis is of paramount importance in the diagnostic considerations.

*Any ‘Key’ symptom or sign must be explainable by the diagnosis. A potential alternative explanation detracts, whereas its absence may strongly support it even in the absence of a typical confirmatory test (few tests are 100% sensitive).

XII. The dog that did not bark in the night . . .

We are all tuned primarily toward positive findings and preoccupied with their importance. However, what is not found is often as important—useful in
ruling out diagnoses (by absent key findings) or, even more significant, in drawing attention to an expected but absent feature as a potential specific diagnostic clue.

*Do not look only at the half-full glass. The empty half may be as revealing.

**XIII. What is it?—Or what it is not!**

Sometimes it is sufficient (and much more useful) to determine that a given presentation is not one of several significant and ominous possibilities. To be able to state its exact cause is occasionally a hard and not cost-effective task (e.g. syncope, headache, low back pain, etc.).

*Uncertainty is the ‘bread and butter’ of the diagnostic process and a degree of tolerance had better be adopted. This is true provided ‘red flags’ are effectively excluded. Under such circumstances, time may be a powerful, safe and frugal diagnostic tool (strategy of ‘watchful waiting’ or the ‘test of time’): patients may either get well spontaneously or the diagnosis will become more obvious.*

**XIV. Be aware of common biases leading to diagnostic errors**

Several common cognitive biases need recognition and attention, since they precipitate pitfalls in diagnosis, especially when using the intuitive PR mode. Dozens of biases have been identified, including: considering recent, memorable, easily recalled diagnoses or those in your field of expertise as more likely ('Availability bias', 'Recall bias'); preferring data that support it, excluding contradictory material ('Confirmation Bias'; 'Anchoring'); tendency to stop considering alternatives and sticking to your diagnosis ('Premature closure'); tendency to rule out a common disease presenting without its prototypical features ('Representativeness bias'); pursuing rare but more exotic diagnoses ('Base rate neglect bias'); letting emotion influence your reasoning ('affective bias'); and endless testing to exclude even highly unlikely possibilities ('Uncertainty angst').

*Unfortunately, there is no good evidence that awareness may prevent diagnostic mistakes due to common biases.*

**XV. Mind interfering context factors**

Contextual factors (such as language barrier, emotional volatility, bias vs. patient characteristics, effect of the encounter setting) are common and may require additional attention so that diagnosis will not be adversely affected.

*Situation-related factors which tend to influence and may skew clinical reasoning process must be recognized and acknowledged.

**XVI. Maintain fluidity in clinical reasoning**

For complex problems, remember to examine, reconstruct and reformulate hypotheses as data are obtained and the case evolves.

*Premature closure’ remains one of the most common and unyielding errors in diagnosis.*

**XVII. Think of ‘robbins’**

Once any past diagnosis is encountered, think in terms of the renown pathology textbook: Backwards—What caused it? Forward—What does it cause? And Present—How is it being treated? Can it be linked to the present illness?

Think of the complex patient in terms of which anatomical systems are involved (e.g. gastrointestinal tract [GIT], peripheral nervous system [PNS], myocard) and what pathogenetic mechanisms might apply (e.g. infectious, inflammatory, neoplastic).

*This type of evaluation is much better than erratic ‘name dropping’ of many different possible diseases… Both anatomical systems and pathogenetic mechanisms can be further subclassified (e.g. GIT—small bowel; PNS—autonomic; myocard—diastolic dysfunction; or: Infectious—viral, bacterial, protozoal, etc.). Maintain healthy skepticism: do not take prior diagnoses for granted but take time to briefly check their ‘solidity’ (validity).

**XVIII. Invest time!**

Some diagnostic problems require more effort and are inherently time consuming. Unless urgent, slow down, consult, reflect, schedule another appointment if necessary.

*Discern as quickly as possible between the straightforward and the complex. The latter will not be deciphered without appropriate time allocation. Complex diagnostic problems are more likely to represent atypical presentation of the more common diseases that should be considered before rare ones.

**XIX. Consider using the ‘test of treatment’**

Failure to respond to treatment as expected may be a clue to diagnostic error. More often, a probable but uncertain single diagnosis may be resolved by
‘test of treatment’ (e.g. edrophonium in myasthenia; low-dose corticosteroids in polymyalgia rheumatica). Also, clinical deterioration after discontinuation of an empiric treatment may suggest its appropriateness.

*Provided it is used sparingly and interpreted vs. a predetermined objective measurement, the ‘test of treatment’ may be a useful adjunct to diagnosis in selected cases.48

XX. Back to Step 1?

In case the diagnosis remains obscure despite prolonged and extensive workup, personally repeating the complete patient’s history and examination may point the clinician in the right direction and resolve the difficulty.

*Rather than repeating sophisticated imaging studies that have already proved non-contributory, going back to the basics with a fresh mind may be more rewarding.23–25

XXI. If unwell...

In a ‘bad’ day (of feeling unwell, fatigued, or burn-out)—take extra care or preferably step aside (if you can), for recreation and ‘recharge’.49

*Persisting despite temporary incapacity is a recipe for mistakes.50

XXII. Ensure ‘tracking’ & feedback

Make a habit of regularly obtaining feedback on your diagnostic performance by comparing your findings and thoughts with test results and ‘tracking’ your patients’ subsequent course. Retain continuous mindfulness and reflection on your performance.

*Providers often overrate their performance.41,51,52 A habit of tracking and feedback ensures that no abnormal results are disregarded7 and that mistakes are recognized, encouraging a continuous learning curve, improvement of performance12 and decrease in future diagnostic errors.53

XXIII. Avoid ‘tunnel vision’—be holistic

Commitment to diagnosis does not end with the patient’s primary complaint: heed any potential problem that may affect the patient’s health in the future.16 Also, diagnosis does not end with biological disease: attention to prevalent emotional factors (such as depression, anxiety, stress) may reveal important risk factors and further active diagnoses.17

*Relating to one major condition at the expense of others is a common form of neglect54–56 and so is disregard of the patient’s psychological status, an inseparable and influential feature of illness.37

XXIV. Respect, show empathy, share, support

The diagnostic process may occasionally be prolonged and creates an ordeal for the patient too. Throughout, be truthful to your patient, even when in doubt or in need to consult a colleague or information source. Once the diagnosis is established and verified, communicate it to the patient/family without delay, providing information, answering questions—but stressing positive aspects and maintaining hope.19

*Sharing and support are essential components of the diagnostic journey and of patient-centered care.57

Discussion

Accurate, comprehensive and timely diagnosis is central to patient care and a major determinant of health outcomes. However, cases of delayed, missed and erroneous diagnosis are common with an incidence of 10–20%.4,37,58 This significant rate of diagnostic failures is confirmed by surveys59 and research60 and remains disappointingly persistent despite all advances in medicine.

Many factors appear to be responsible, including the complexity of the diagnostic process1; time constraints61; susceptibility of even the most sophisticated tests to false (positive or negative) results62 that is underappreciated by physicians4; prevalent bias and cognitive errors63; context variability and shortcomings in teaching. Findings from research on physicians’ diagnostic reasoning have not yet been sufficient to determine how clinical diagnosis should be taught.64

Most of the literature on diagnosis focuses on the performance of the analytic (HD) method vs. the intuitive, subconscious, non-analytic (PR) method (‘dual processing’) and the merits of their combined use which is strongly advocated.37,39,65 Another centrepiece is the cognitive aspects of clinical reasoning and contribution of bias to diagnostic errors. Other texts provide a mathematical basis for the informed use of history elements, physical findings and test results.14 However, providers have paucity of data and a limited capacity for detailed numerical analysis.15 Few have addressed the diagnostic process as a whole continuous process, providing advice on its general, widely applicable principles. We have made a personal, experience- and research-based selection of 24 basic principles of the
diagnostic process (Table 1) that may be used in teaching this science and art as well as in practice.

Table 1. The 24 practical principles of clinical diagnosis

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Principles IV and V refer to the two basic (reflexive vs. analytical) methods of reasoning. Principles I, VI and XXIII are of prime importance, whereas XXII and XXIV highlight an essential commitment toward the patient and family that is inseparable from the diagnostic process.

Not all of the 24 principles discussed were created equal. Except for the two basic methods, the most crucial techniques in our experience are ABCD—Achieving the most from the Basic Clinical Data (I); Reflexive Consultation and learning (V); and assuming Holistic commitment for comprehensive patient care (XXII). These three quintessential principles ensure the numerous benefits of a clinically based approach; a whole, patient-centered view of the patient’s health; and an attitude of humility, optimal care and lifelong learning, as opposed to overconfidence. Other principles reinforce the weight of the patient’s pre-existing risk factors and susceptibilities in the pathogenesis of a new diagnosis (VII and VIII) and underline the value of more reflection and introspection (XIV, XV and XX) and of regular follow-up and feedback (XXII).

Both approaches are essential not only for reducing diagnostic error but also for continued improvement and learning. Adopting a systematic, methodical modus operandi is an additional theme with myriad benefits that we believe and translate into improved diagnostic skills (I, II and VII). Further principles stress the inherent values in diagnosis of selected practical logic laws (IX–XIII); consider unique, personal patient-related factors (XV and XXIV); as well as providers’ factors (XXI). Other principles highlight the element of time as both a valuable diagnostic clue by itself, a diagnostic policy in non-urgent problems and an obligatory investment in complex ones (I, XIII and XVIII). Quite a few of the principles can be particularly useful for patients who present a major diagnostic challenge (V, X, XIII and XVII–XX).

Thus, the 24 principles have the potential to become useful in teaching and as a reminder to practicing clinicians in hospitals and primary care. Interestingly, they conform to the SOAPS mnemonic summarizing the essential ingredients of excellent clinicians: being Systematic and orderly; using Observation and listening as the basic skills; Accessing databases; being ‘Personal’; and providing Shared decision making and patient-centered care.

The strength of the study is in the derivation of the principles from both long-term personal experience, research and the current literature. Their usefulness for solving diagnostic problems has been repeatedly demonstrated in bedside teaching rounds and consultations, and has occasionally been published. They can be easily applied to daily patient care, providing practical guidance on information gathering, processing and diagnostic decision making. Limitations include the entire subjective selection process and lack of validation in controlled studies. Diagnostic errors, although little discussed in the
renown Institute of Medicine report, continue to pose a significant danger to patient safety and the quality of care. Teaching and practice of the 24 principles may facilitate timely, high-quality clinical reasoning and diagnosis. Their potential to reduce diagnostic error remains to be examined in future research.

Conflict of interest: None declared.

References
39. Ark TK, Brooks LR, Eva KW. Giving learners the best of both worlds: do clinical teachers need to guard against...