When Diagnoses Fail

New Insights, Old Thinking

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Diagnostic errors are not uncommon in the emergency department (ED). The rate has been estimated at 1% to 12%[1,2] of all admitted patients, but the overall rate is certainly higher, as the majority of patients are diagnosed and discharged. Given the high denominator of patients seen in the ED, even the lower estimates would still indicate a problem of significant proportions. Importantly, while diagnostic errors are among the most devastating, they are also preventable.

Errors in diagnosis fall into three groups (Table 1).[3] No-fault errors are those in which information from the patient is misleading or absent. Systemic errors, in contrast, arise when conditions of the workplace predispose to error.[4] These are referred to as error producing conditions, which may be general or specific (Table 2). The third category, cognitive errors, are due to defaults in the physician's thinking. Cognitive errors may range from basic knowledge deficiencies to cognitive dispositions to respond (CDRs) to certain patients in predictable ways.[5] Cognitive errors may also result from idiosyncratic decision styles, and are referred to as violation producing behaviours.

Recently, compelling arguments have been made that CDRs have their origin in "cognitive modules." These

Jake's failed diagnosis

Jake, 35, presents to the emergency department (ED) of a community hospital complaining of headache and nausea. He describes the headache as similar to migraine attacks he suffered some time ago, but a little worse.

He is triaged as a "migraine headache" and is seen by the emergency physician. Vital signs are normal, and he has a normal neurologic exam.

Treatment is begun with 10 mg metoclopramide intravenously. Jake reports some relief of his nausea shortly after. The headache has ameliorated somewhat, but not gone completely. He appears stoical and is anxious to get home to relieve a neighbour who is looking after his 2-year-old child.

Jake feels that things will settle down if he goes home and rests. He is discharged home from the ED. However, the headache worsens and he calls his wife at work to ask her to come home. When she arrives, she finds him dead on the living room floor. Autopsy revealed that he had died of a subarachnoid hemorrhage.

Table 1
Diagnostic failure categories in the ED

No-fault error	Systemic error	Cognitive error
• Unreliable information from the patient	• EPCs	• CDRs
• Deliberate misrepresentation of illness (malingering)	• RACQITO	• VPBs
• Somatoform disorders	• Laboratory error	• Knowledge deficiencies
• Factitious disorder	• Inefficient followup of reports	• Incomplete data gathering
• Insufficient medical information available about a new disease	• Time delays	• Test misinterpretation
• Patient refusal of critical diagnostic tests/procedure/consultation		
• Silent presentation of comorbid illness		

EPC: Error-producing condition
CDR: Cognitive disposition to respond
RACQITO: Resource availability continuous quality improvement trade-off
VPB: Violation producing behaviour

Adapted from: Graber M, Gordon R, Franklin N: Reducing diagnostic errors in medicine: What's the goal? Acad Med. 2002; 77(10):981-92.

predictable patterns of responding have specific neuronal substrates that have undergone Darwinian selection in the course of evolution of the human brain.[6,7] They have their origin in the basic decisions that were required of our primitive ancestors made in the relatively simple environments of earlier times. While they were effective then, it is clear that they are increasingly maladaptive in the complex environment of modern medicine. However, we are not at the mercy of ancestral thinking. Numerous strategies are available to overcome CDRs (Table 3), and they can often be detected through a process of "cognitive autopsy."[8] Strategies involve assessing the misdiagnosed case as soon as possible after the error is realized, to determine which particular CDRs were made. The process requires a thorough working knowledge of their properties.

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CDRs

Returning to Jake's case, the specific CDRs that are identified are as follows (more CDRs are listed in Table 4):

1. **Triage cueing:** the triage nurse used a search satisficing strategy to enter "migraine headache," rather than recording the presenting complaint (headache not yet diagnosed).

2. **Anchoring:** the physician anchored to the patient's description of the pain as migrain-

Frequently Asked Questions

Questions:	Answers:
If I'm hard-wired for cognitive errors, doesn't it let me off the hook for making them?	No. It is imperative that physicians learn and understand the basic properties of the CDRs. Clear strategies exist to correct them and have been shown to be effective.
How do you know for sure that a CDR was made?	We can never be certain that a particular CDR did occur. We can never know all the information that the physician had, or didn't have, at the time the decision was made. Importantly, too, we often cannot reconstruct the ambient conditions that prevailed at the time.
What are the most common CDRs?	No direct work has yet been done on the respective rates of CDRs in the clinical setting, but unpublished work indicates that anchoring, search satisficing, and premature diagnostic closure are common.
Don't CDRs just represent the many short-cuts in decision making that we have learned to take?	Yes. This form of abbreviated decision making is referred to as heuristics. In many areas of medicine we could not get by without heuristic decision making. We learn to take short-cuts and use rules of thumb that can save a lot of time and effort. However, while they work some of the time, they do not work all of the time. When they fail, the outcome may be catastrophic.
Doesn't the evolutionary argument indicate that all health-care workers are vulnerable to these inherited thinking errors?	Yes. The physician's thinking is presently the main focus of scrutiny because they are usually the final vector for establishing the diagnosis. But all health care workers, including those at the blunt end of care, are equally disposed towards making these thinking errors.

Table 2
Characteristics of the ED and personnel that may lead to diagnostic error

Intrinsic	Systemic	VPBs
• High levels of diagnostic uncertainty	• High communication load	• Gender
• High decision density	• Overcrowding	• Risk-taking behaviour
• High cognitive load	• Production pressures	• Normalization of deviance
• Narrow time windows	• High-noise levels	• Maladaptive group pressures
• Multiple transitions of care	• Inadequate staffing	• Maladaptive copying behaviour
• Multiple interruptions/distractions	• Poor feedback	• Underconfidence
• Low signal to noise ratio	• Inexperience	• Overconfidence
• Surge phenomena	• Inadequate supervision	• Maladaptive decision styles
• Circadian dysynchronicity	• RACQITO	• Authority gradient effects
• Fatigue		• Likelihood of detection
• Novel or infreqently occurring conditions		

ED: Emergency department
RACQITO: Resource availability continuous quality improvement trade-off
VPB: Violation producing behaviour

Adapted from:
Croskerry P, Sinclair D: Emergency Medicine: A practice prone to error? CJEM 2001; 3:271-6. pp 19-162, 1992; New York: Oxford University Press.

Croskerry P, Wears RL: Safety errors in emergency medicine. In: Markovchick VJ and Pons PT (eds.) Emergency Medicine Secrets, 3rd Edn..; Hanley and Belfus: Philadelphia, PA, 2002: 29-37.

ous, and to the triage diagnosis.

3. **Premature diagnostic closure:** the diagnostic label attached to the patient at triage resulted in diagnosis momentum, and with apparent amelioration of symptoms with standard 'migraine' treatment (a not uncommon feature of subarachnoid hemorrhage presentation [SAH]), a final and erroneous diagnosis was made.

4. **Representativeness error:** the patient did not present in a classic fashion with sudden onset, intense pain, and possible loss of consciousness. Further, there were no neurological findings in this atypical presentation. Thus, the physician was restrained from giving a full consideration to SAH as the patient was not perceived as representative of the general class of SAH presentations. The patient's stoicism, the description of the pain as worse than his usual migraine, and the failure to get significant resolution of the headache should have forced other considerations.

Table 3
Cognitive de-biasing strategies to reduce diagnostic error

Strategy	Mechanism	Action
Develop insight and awareness	Provide detailed descriptions and thorough characterizations of CDRs.	Develop multiple clinical teaching examples of major CDRs, illustrating their adverse effects on decision-making and diagnosis formulation.
Consider alternatives	Establish forced consideration of alternative possibilities.	Reinforce the generation and working through of a differential diagnosis. Always ask "what else might this be?"
Metacognition	Train for a reflective approach to problem solving, step back from the immediate problem to examine and reflect on the thinking process.	Develop generic and specific cognitive forcing strategies for predictable diagnostic pitfalls.
Decrease reliance on memory	Improve the accuracy of judgements through cognitive aids.	Mnemonics, clinical practice guidelines, algorithms, charts, handheld computers.
Specific training	Identify specific flaws and biases in thinking, and provide directed training to overcome them.	Provide didactic instruction in fundamental rules of probability.
Simulation	Develop mental rehearsal, "cognitive walkthrough," strategies for specific CDRs.	Construct clinical training videos contrasting incorrect approaches with the correct one.
Make task easier	Provide more information about the specific problem to reduce task difficulty and ambiguity.	Make available rapid access to concise, clear, well-organized information.
Minimize time pressures	Provide adequate time for quality decision-making.	Ensure adequate staffing to avoid cognitive overload.
Accountability	Establish clear accountability and followup for decisions made.	Remove any ambiguity about who is responsible for a patient's care, especially at shift handover, and who is responsible for followup.
Feedback	Provide as rapid and reliable feedback as possible to decision makers so that errors are immediately appreciated, understood, and corrected, resulting in better calibration of decision makers.	Establish mechanisms to provide timely information on patient outcomes. Ensure discharge summaries are always provided to physicians involved in a patient's care.

Reproduced with permission: Table 1, the importance of cognitive errors in diagnosis and strategies to minimize them. Acad Med. 2003; 78:775-80.

5. Zebra retreat: a further constraint that may have prevailed in this case is that no computed tomography (CT) scanner was available. In theory, this should not have provided any impediment to obtaining a CT scan by transferring the patient to another facility, but in practice it often does. The unavailability of specialized imaging or tests may create some

Table 4

A catalogue of cognitive dispositions that may lead to diagnostic error

Aggregate bias: the belief that aggregated data do not apply to individual patients; this may lead to ordering X-rays or other tests when guidelines indicate none are required.

Ascertainment bias: stereotyping and gender bias are examples.

Availability: recent experience with a disease may inflate the likelihood of its being diagnosed. Conversely, if a disease has not been seen for a long time it may be under-diagnosed.

Base-rate neglect: the tendency to ignore the true prevalence of a disease, either inflating or reducing its base-rate, and distorting Bayesian reasoning.

Commission bias: results from the obligation towards beneficence, in that harm to the patient can only be prevented by active intervention.

Confirmation bias: is the tendency to look for confirming evidence to support a diagnosis rather than look for disconfirming evidence to refute it.

Diagnosis momentum: once diagnostic labels are attached to patients they tend to become stickier and stickier.

Feedback sanction: is a form of ignorance trap and time-delay trap CDR.

Framing effect: how you see things may be strongly influenced by the way in which the problem is framed.

Fundamental attribution error: the tendency to be judgmental and blame patients for their illnesses rather than examine the situational factors.

Gambler's fallacy: attributed to gamblers, an example would be a physician who sees a series of patients with chest pain, diagnoses all with an acute coronary syndrome, and assumes the sequence will not continue.

Gender bias: the tendency to believe that gender is a determining factor in the probability of diagnosis.

Hindsight bias: knowing the outcome may profoundly influence perception of past events, and prevent a realistic appraisal of what actually occurred.

Multiple alternatives bias: a multiplicity of options on a differential diagnosis may lead to significant conflict and uncertainty.

Omission bias: is the tendency towards inaction and rooted in the principle of non-maleficence.

Order effects: a tendency to remember the beginning part (primacy effect) or the end (recency effect). Care should be taken to give due consideration to all information, regardless of the order of presentation.

Outcome bias: the tendency to opt for diagnostic decisions that will lead to good outcomes, rather than those associated with bad outcomes.

Overconfidence bias: there is a universal tendency to believe we know more than we do.

Playing the odds: also known as frequency gambling, is the tendency in equivocal or ambiguous presentations to opt for a benign diagnosis on the basis that it is significantly more likely than a serious one.

Posterior probability error: occurs when a physician's estimate for the likelihood of disease is unduly influenced by what has gone before for a particular patient.

Psych-out error: Psychiatric patients appear to be particularly vulnerable to the CDRs described in this list, and to a variety of other errors in their management, some of which may exacerbate their condition.

Search satisficing: reflects the universal tendency to call off a search once something is found.

Sutton's slip: The slip occurs when possibilities other than the obvious are not given sufficient consideration.

Sunk costs: the more clinicians invest in a particular diagnosis, the less likely they may be to release it and consider alternatives.

Unpacking principle: failure to elicit all relevant information (unpacking) in establishing a differential diagnosis may result in significant possibilities being missed.

Vertical line failure: routine, repetitive tasks often lead to thinking in silos – predictable, orthodox styles that emphasize economy, efficacy and utility.

Visceral bias: the influence of affective sources of error on decision-making has been widely underestimated.

Yin-yang out: The yin-yang out is the tendency to believe that nothing further can be done to throw light on the dark place where, and if, any definitive diagnosis resides for the patient.

Adapted from: List 1 in the importance of cognitive errors in diagnosis and strategies to minimize them. Acad Med. 2003; 78:775-780. The terms used to describe the various CDRs above are those by which they are commonly known in the psychology and medicine literature, as well as colloquially. Some, such as feedback sanction, and hindsight bias, are indirect, reflecting more on processes that interfere with physician calibration. There is considerable overlap among CDRs, some being known by other synonyms. A detailed description of these CDRs has been published.[9]

Net Readings

1. OHSU.edu:
   www.ohsuhealth.com/patient_guide/tips.asp
2. Professional Development Resources:
   www.pdresources.org/readingroom/preventingmedicalerrors.htm

inertia in pursuing certain diagnoses. In essence, intrinsic pressures of the system may exert subtle restraining effects on physician's test-ordering behaviour and they retreat from more rare or esoteric diagnoses.

A common problem

Diagnostic error is common and often serious. Simply asking physicians to be more diligent, cautious, or thorough is unlikely to accomplish anything. The same pitfalls are repeated over and over in acute care. What is needed, instead, is a working knowledge of the CDRs that we have inherited in the course of the brain's evolution. In undergraduate and postgraduate training, more emphasis needs to be placed on critical thinking skills, and what we have learned in the last 30 years from cognitive science, to develop more realistic ways of approaching diagnostic uncertainty. Every effort should be made to establish acceptable working conditions, and emphasise the changes needed to accomplish the de-biasing strategies described here. CME

Take-home message

- The rate of diagnostic errors in the ED is estimated at 1% to 12% for admitted patients.
- Errors in diagnosis fall into three groups:
  - No-fault,
  - Systemic,
  - Cognitive
- Numerous strategies are available to overcome cognitive dispositions to respond (CDRs).

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