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# From Mindless to Mindful Practice — Cognitive Bias and Clinical Decision Making

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The two major products of clinical decision making are diagnoses and treatment plans. If the first is correct, the second has a greater chance of being correct too. Surprisingly, we don't make correct diagnoses as often as we think: the diagnostic failure rate is estimated to be 10 to 15%. The rate is highest among specialties in which patients are diagnostically undifferentiated, such as emergency medicine, family medicine, and internal medicine. Error in the visual specialties, such as radiology and pathology, is considerably lower, probably around 2%.[1]

Diagnostic error has multiple causes, but principal among them are cognitive errors. Usually, it's not a lack of knowledge that leads to failure, but problems with the clinician's thinking. Esoteric diagnoses are occasionally missed, but common illnesses are commonly misdiagnosed. For example, physicians know the pathophysiology of pulmonary embolus in excruciating detail, yet because its signs and symptoms are notoriously variable and overlap with those of numerous other diseases, this important diagnosis was missed a staggering 55% of the time in a series of fatal cases.[2]

Over the past 40 years, work by cognitive psychologists and others has pointed to the human mind's vulnerability to cognitive biases, logical fallacies, false assumptions, and other reasoning failures. It seems that much of our everyday thinking is flawed, and clinicians are not immune to the problem (see box). More than 100 biases affecting clinical decision making have been described, and many medical disciplines now acknowledge their pervasive influence on our thinking.

Cognitive failures are best understood in the context of how our brains manage and process information. The two principal modes, automatic and controlled, are colloquially referred to as "intuitive" and "analytic"; psychologists know them as Type 1 and Type 2 processes. Various conceptualizations of the reasoning process have been proposed, but most can be incorporated into this dual-process system. This system is more than a model: it is accepted that the two processes involve different cortical mechanisms with associated neurophysiologic and neuroanatomical

**Clinical Examples of Cognitive Failure**

**Case 1**

A 21-year-old man is brought to a trauma center by ambulance. He has been stabbed multiple times in the arms, chest, and head. He is in no significant distress. He is inebriated but cooperative. He has no dyspnea or shortness of breath; air entry is equal in both lungs; oxygen saturation, blood pressure, and pulse are all within normal limits.

The chest laceration over his left scapula is deep but on exploration does not appear to penetrate the chest cavity. Nevertheless, there is concern that the chest cavity and major vessels may have been penetrated. Ultrasonography shows no free fluid in the chest; a chest film appears normal, with no pneumothorax; and an abdominal series is normal, with no free air. There is considerable discussion between the resident and the attending physician regarding the management of posterior chest stab wounds, but eventually agreement is reached that computed tomography (CT) of the chest is not indicated. The remaining lacerations are cleaned and sutured, and the patient is discharged home in the company of his friend.

Five days later, he presents to a different hospital reporting vomiting, blurred vision, and difficulty concentrating. A CT of his head reveals the track of a knife wound penetrating the skull and several inches into the brain.

**Comment:** The cognitive failures identified here are "anchoring" and "search satisficing." The resident and attending staff both anchored onto the chest wound as the most significant injury. When they satisfied themselves that the chest wound was stable, the resident failed to conduct a sufficient search to rule out other significant injuries.

**Case 2**

An 18-year-old woman is referred by her family doctor to a psychiatric service for symptoms of severe anxiety and depression. She has been having frequent episodic dyspnea, associated with hyperventilation, carpopedal spasm, and loss of consciousness. The admitting psychiatrist wants to exclude the possibility of a respiratory problem and sends the patient to the emergency department (ED) with a request for a chest film to rule out pneumonia.

She is seen and assessed by an ED resident. The patient was not noted to be in any significant distress other than feeling breathless. She is obese, has a history of asthma, and smokes cigarettes. She is currently being treated with a benzodiazepine and anxiolytics and is taking a birth-control pill. Her chest and cardiovascular examination are normal. The resident orders routine blood work and a chest film. He reviews the film, reads it as normal, and believes the patient can be safely returned to the psychiatric facility. He attributes her respiratory problems to anxiety.

While she awaits transfer, she becomes very agitated and short of breath. Several nurses attempt to settle her, encouraging her to breathe into a paper bag. Shortly afterward, she loses consciousness. Her monitor shows pulseless electrical activity and then asystole. She cannot be resuscitated. At autopsy, she is found to have pelvic vein thrombosis extending from the femoral vein and saddle emboli in both lungs, as well as multiple clots of varying age.

**Comment:** Several cognitive failures probably influenced the outcome in this case. The patient's diagnosis of anxiety established "momentum" from her family doctor through to the ED, and although she might well have had hyperventilation due to anxiety, other possibilities were not ruled out earlier on in her care. Furthermore, bias regarding her psychiatric diagnosis probably influenced her care providers; psychiatric patients are more vulnerable to adverse events. "Framing" may also have been a problem, since the psychiatrist had specifically asked the ED to rule out an infective process and had not raised the possibility of pulmonary embolus, despite the patient's multiple risk factors. "Search satisficing" is again a problem, in that the resident called off the search for a cause for the patient's dyspnea after ruling out pneumonia.

substrates. Functional magnetic resonance imaging scans vividly reveal the changes in neuronal activity patterns as processes move from one system to the other during learning. Although the two processes are often construed as two different ways of reasoning, in fact very little (if any) reasoning occurs in Type 1 processing — it is largely reflexive and autonomous. The *Augenblick* diagnosis, made in the blink of an eye, is an impressive piece of medical showmanship and the stuff of television entertainment (and corridor consultations), but in real clinical life it is fraught with danger.

Descriptions of the operating characteristics of the dual processing system in clinical reasoning provide a useful starting point for learning about medical decision making.[3] Intuitive processes are generally either hard-wired or acquired through repeated experience. They are subconscious and fast and mostly serve us well, enabling us to conduct much of our daily business in all fields of human activity. We mostly get through life by moving from one of the intuitive mode's associations to the next in a succession of largely mindless, fixed-action patterns. These patterns are indispensable; however, they are also the primary source of cognitive failure. Most biases, fallacies, and thinking failures arise from the intuitive mode (see box). When primary care physicians trust their intuition that a patient's chest pain does not have a cardiac origin, they will usually be correct — but not always. The clinical gamble of trusting one's intuitions generally carries good odds, but inevitably those intuitions will fail some patients.

The issue is whether we can tolerate the current levels of failure — or is there room for improvement?

Analytic processes, by contrast, are conscious, deliberate, slower, and generally reliable. They follow the laws of science and logic and therefore are more likely to be rational. Despite the ubiquity and usefulness of intuitions, they are not reliable enough for us to use them to send a spaceship to Mars. By contrast, when a patient undergoes analytic assessment for chest pain in a cardiac clinic that culminates in angiography, the conclusion is invariably correct. Analytic failures can occur, but usually when the wrong rules are followed or other factors come into play, such as cognitive overload, fatigue, sleep deprivation, or emotional perturbations. The biggest downside of analytic reasoning is that it's resource-intensive. Although analytic reasoning can often be done quickly and effectively, in most fields of medicine, it would be impractical to deal with each clinical decision analytically.

Given the substantial impact of our evolving understanding of cognition over the past few decades, it is somewhat surprising that these major social science findings have not readily made their way into medicine. Although our awareness of research biases led to the development of the randomized, prospective, double-blind clinical trial, we remain unrealistic about the scale of everyday cognitive and affective biases and their effect on clinical reasoning. Cognitive psychology has not historically been considered within the remit of medicine, but I believe that we should embrace any work that helps us think about our thinking (metacognition) and that it would be beneficial both to include basic psychology courses in the medical school curriculum and to expand medicine's lexicon to incorporate terms from cognitive psychology.

If cognitive biases are so abundant and troublesome in clinical decision making, why not simply identify them and use a "debiasing" strategy to avoid them? Unfortunately, that's not as easy as it sounds. First, many decision makers are unaware of their biases, in part because our psychological defense mechanisms prevent us from examining our thinking, motivation, and desires too closely. Second, many clinicians are unaware of, or simply don't appreciate the effect of, such influences on their decision making.

Becoming alert to the influence of bias requires maintaining keen vigilance and mindfulness of one's own thinking. When a bias is identified by a decision maker, a deliberate decoupling from the intuitive mode is required so that corrective "mindware" can be engaged from the analytic mode. "Mindware" is defined as the "rules, knowledge, procedures, and strategies that a person can retrieve from memory in order to aid decision making and problem solving."[4] It includes knowledge about the properties of the particular bias and what strategies might eliminate or reduce it. This process appears to be uncommonly difficult, although there have been some successes. A variety of debiasing strategies have been proposed, and they lead to a few important conclusions: debiasing is not easy, no one strategy will work for all biases, some customization of strategies will be necessary, and debiasing will probably require multiple interventions and lifelong maintenance.

Cognitive failures like those described in the box can be addressed by educational strategies that embrace critical thinking — the "ability to engage in purposeful, self-regulatory judgement."[5] Regulating judgment requires training that can permit judicious interventions by the analytic mode when needed — specifically, in its capacity to override the intuitive mode. This critical step has been referred to as decoupling, metacognition, mind-

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fulness, and self-reflection. Most of us never reach our ceilings for critical thinking, and many people go through life unaware of their thinking limitations. We are not born critical thinkers. Like any other skill, however, critical thinking can be taught and cultivated, but even accomplished critical thinkers remain vulnerable to occasional undisciplined and irrational thought.

I believe that medical educators should promote critical thinking throughout undergraduate, postgraduate, and continuing medical education. One key element of training in critical thinking should be a review of the major cognitive and affective biases and the ways they affect thinking. Greater effort is needed to develop effective cognitive debiasing strategies in medicine. All clinicians should develop the habit of conducting regular and frequent surveillance of their intuitive behavior. To paraphrase Socrates, the unexamined thought is not worth thinking.

Disclosure forms provided by the author are available with the full text of this article at NEJM.org.

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1. Berner ES, Graber ML. Overconfidence as a cause of diagnostic error in medicine. Am J Med 2008;121:Suppl:S2-S23.
2. Pineda LA, Hathwar VS, Grand BJ. Clinical suspicion of fatal pulmonary embolism. Chest 2001;120:791-5.
3. Croskerry P. A universal model for diagnostic reasoning. Acad Med 2009;84:1022-8.
4. Stanovich KE. What intelligence tests miss: the psychology of rational thought. New Haven, CT: Yale University Press, 2010.
5. Abrami PC, Bernard RM, Borokhovski E, et al. Instructional interventions affecting critical thinking skills and dispositions: a stage 1 meta-analysis. Rev Educ Res 2008;78:1102-34.

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# Uncertainty — The Other Side of Prognosis

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Recently, there has been a resurgence of interest in prognosis. This interest has been driven by a recognition that prognosis plays a central role in medical decision making, from counseling outpatients about stopping cancer screening to making decisions with patients' surrogates about withdrawal of life support in intensive care units.[1,2] Patients say that understanding prognosis is important for making life choices, such as engaging in financial planning, arranging custodial care, and deciding when it's important for long-distance family members to visit.[2]

Despite a proliferation of data about prognosis and life expectancy, our best estimates still carry a high degree of uncertainty.[3] First, 95% confidence intervals indicate variation in the survival of people with similar health conditions and limitations in sample sizes. Second, most prognostic indexes have not been tested in heterogeneous clinical settings.[3] Third, in clinical practice, clinicians must extrapolate from population-level estimates to make judgments with or for individual patients. Even if a risk estimate is very precise — say, a 25% risk of death within 6 months — it is not clear whether the patient is 1 of the 25 out of 100 who will die or 1 of the 75 who will live.

Some people believe that the best approach to this problem is to generate and analyze more data so that we can know what the future will bring. Improving the accuracy of our prognostic estimates is indeed critically important — reducing uncertainty is helpful for clinicians and patients alike.[2] On the other hand, the quest for prognostic certainty has been described by our colleague Dr. Faith Fitzgerald as the "punctilious quantification of the amorphous." In other words, no matter what we do, there will always be some uncertainty in prognosis.

This uncertainty is difficult for patients and their families to deal with. For patients, not knowing what the future will bring is psychologically difficult. Worrying about the future may impede their ability to enjoy the present. They may be consumed by trying to figure out whether things are getting better and therefore become hyperaware of any physical changes that occur. Families may spend a great deal of time acquiring information in an effort to learn more about what the future will bring and may focus excessively on the medical details. For both patients and family members, anxiety may increase.