Cognitive Errors In Anesthesiology: 
Making Mistakes Even When We "Know" Better

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"I never make stupid mistakes. Only very, very clever ones." ~John Peel

Introduction

What does it feel like to be wrong? How can we know when are making a mistake? We cannot, of course, because being wrong feels exactly like being right. We are oblivious to our errors at the time that we commit them. There is only the experience of realizing that we have been wrong. This idea of error-blindness, put forth by Kathryn Schulz, is summarized by her as: "we can be wrong, or we can know it, but we can't do both at the same time."

Naturally, erroneous thinking can be due to lack of information. However, this course focuses on cognitive errors - mistakes rooted in faulty subconscious thought processes. They are distinct from knowledge gaps because the thinker possesses adequate information and understanding of the subject matter to arrive at the correct conclusion. Simply put, cognitive errors are mistakes that are made despite "knowing better."

Why are cognitive errors important?

In the early 1990s, medical errors were exposed for the enormous problem that they are. Few physicians need a reminder that medical errors have been estimated to account for up to 98,000 deaths annually in the United States at a cost to the US healthcare system of $24 billion per year. According to Brennan et al, 1.5 jumbo jets would need to crash every day for an equivalent death rate, making "medical errors" the fifth leading cause of death in the United States (ahead of motor vehicle accidents, diabetes, kidney disease, breast cancer, and influenza).

While it is easy to agree that medical errors must be reduced, significant challenges remain regarding error reporting, management, and prevention. Recent studies suggest that cognitive errors, a subset of medical errors involving faulty thought processes and subconscious biases, are important contributors to missed diagnoses and patient injury. Indeed, according to Jerome Groopman, "technical errors account for only a small fraction of incorrect diagnoses and treatments. Most errors are mistakes in thinking." He goes on to say that these thinking mistakes are caused in part by subconscious processes, such as biases we may not even recognize, and certainly not admit. In the 1990s, early pioneers of the "crisis resource management" paradigms at Harvard and Stanford introduced this topic by including fixation error, or "tunnel-vision", in their curricula. This is indeed a cognitive error, and likely a very common one. Today, the psychology of decision-making is becoming ever more appreciated, as more vast descriptions of a variety of cognitive errors have now been described in safety culture industries, such as nuclear power and aviation, and many medical specialties including internal medicine, emergency medicine, family practice, radiology, neurology, and even pathology.

"Be not ashamed of mistakes and thus make them crimes." ~Confucius

Historically, there has been a notion that making a mistake is shameful, diminishing a person's worth and undermining their expertise. However, fallibility is not equivalent to stupidity. In fact, Pulitzer winner Joseph Hallinan, an expert on human perception pitfalls, asserts that the same qualities that make us efficient (rapid pattern recognition in lieu of detail scrutiny, for example) also make us error prone; thus the mechanisms by which we perceive, process, and remember actually set us up to make mistakes. As well, he asserts, humans have significant capacity for self-deception and/or delusion. We are prone to bias, and are poorly calibrated, meaning that our
perception of our performance rarely approximates our actual performance. We tend to hold fast to old strategies that work poorly in new situations, and rely upon memories that are much less accurate than we realize. Any reader now thinking, “This subject may be interesting, but it doesn't actually apply to me,” is in fact committing a cognitive error right now! Study after study consistently shows that people, including doctors, tend to overestimate their capabilities and remain very certain of decisions even in the face of irrefutable evidence to the contrary. We attribute favorable personal characteristics (talent, intelligence, dexterity) to our successes, yet blame circumstances for our failures. Whether or not we are personally prepared to be open to our own fallibility factors prominently in our potential abilities to avoid and manage these kinds of thought process errors.

What exactly are cognitive errors?

Cognitive errors are thought process traps that are ubiquitous human experiences, usually linked to failed biases or heuristics. It is worth repeating that they are distinct from knowledge gaps. It is noteworthy that heuristics and biases are frequently useful in clinical medicine; they allow experts to arrive at decisions quickly and (usually) accurately. However, cognitive error arises when these subconscious processes and mental shortcuts are relied upon too heavily, or under the wrong circumstances.

Because cognitive errors are rooted in subconscious processes, we are often unaware of their influence. According to Thomas Kida, humans believe strongly in anecdotes, demonstrating a powerful preference for stories over statistics and a tendency to ignore the concepts of chance and coincidence. The human brain subconsciously reshapes and enhances memories as time goes by, and then we rely on these faulty memories to shape future decisions. People seek to confirm what they already believe and gloss over contradictory evidence. We tend to oversimplify or misinterpret complex situations. While there is a plethora of science and documentation of evidence to these points, we humans continue to repeat the same errors of thinking.

"Experience is that marvelous thing that enables you to recognize a mistake when you make it again."
~ Franklin P. Jones

How do cognitive errors manifest in anesthesiology?

Experts rely heavily on cognitive shortcuts and intuitive processes, especially when making high-stakes decisions under time pressure; this thinking environment may be particularly prone to cognitive error. In anesthesiology, it is easy to describe examples of particular cognitive errors that may arise in routine practice and during emergency situations.

The following is a brief introduction to just a few specific examples (which may be known by other synonymous terms). It is true that the mere provision of a vignette example may bias the reader's interpretation of the error. While considering these illustrations, focus on the thought process problem being described, rather than the medical situation in which it is depicted. Refrain from judging the error as careless or stupid, and keep an open mind to the fallibility of human nature, even among experts. Think about the process being described, and you'll find examples in your own experience of the same mechanisms.

Premature Closure

"No problem can withstand the assault of sustained thinking." ~Voltaire

Premature closure describes the cognitive error of accepting the first plausible diagnosis before it has been fully verified. For example, if a patient is hypotensive after induction, the tendency may be to attribute this to the effect of
deep anesthesia without adequate stimulation, and not investigate further. (A different physician may select anaphylaxis just as readily, or myocardial infarction, etc – and not consider other key items on the differential diagnosis). The error lies not in the nature of the preliminary diagnosis, but in the premature cessation of investigation. Putting premature closure in the context of useful heuristics is important, for patients often do have a decrease in blood pressure after induction, particularly in the period prior to surgical stimulation. This experience shapes the expert mind to expect this result, and does not require an exhaustive differential diagnosis at every occurrence. Playing the odds, this premature conclusion will be correct a good percentage of the time. It becomes a cognitive error on the more rare occasions when these shortcuts lead us astray.

Feedback Bias

"The greatest of faults is to be conscious of none" -Thomas Carlyle

Feedback bias is another cognitive error that may be particularly pertinent to anesthesiology. This describes the process that occurs when significant time elapses between actions and consequences, or outcome data is never reported back to the practitioner. When important information does not return to the decision maker, it is impossible to shape future decisions based upon that information. As such, the absence of feedback is subconsciously noted as positive feedback.

Confirmation Bias

"I will look at any additional evidence to confirm the opinion to which I have already come" --Lord Molson

Believing is seeing: confirmation bias is an error characterized by seeking confirming evidence to support a diagnosis while discounting disconfirming evidence, despite the latter often being more definitive. Sometimes this will manifest by "cherry-picking", or trying to force data to fit a desired or suspected diagnosis. A simple example in anesthesiology might be the repeating of blood pressure measurements, changing cuff sizes and locations, in an effort to get a reassuring reading, instead of recognizing the hypotension as real. The same could be said for nearly any monitoring device or interpretation of labs or other studies.

Availability Bias

"Nothing fixes a thing so intensely in the memory as the wish to forget it.” ~Michel de Montaigne

Availability bias is an error in diagnosis due to an emotionally memorable past experience. These are the experiences by which physicians sometimes say they’ve "been burned", and these memories make the diagnosis readily available at the forefront of the mind. When this error occurs, the physician may subconsciously ignore important differences between the current presentation and that prior experience.

Omission Bias

"The man who makes no mistakes does not usually make anything." ~Edward Phelps

Omission Bias is the tendency toward inaction rather than action, out of fear of failure or being wrong. This may be especially likely when a significant authority gradient is perceived (as with a less experienced anesthesiologists and very senior surgeon) or is real (as may be the case with a surgeon directly supervising a nurse anesthetist, without an anesthesiologist). However, this hesitation to act can occur even when there is no such authority gradient, particularly with dramatic situations, and may be rooted in fear of causing harm. An example is hesitation to request or perform a surgical airway, even though that maneuver is clearly life-saving in the case of "can't intubate/can't
ventilate". Some may still hesitate for fear of causing bleeding or not performing an aesthetically appealing procedure, which are secondary considerations.

There are many more cognitive errors, which will be addressed in more detail in the lecture. They are very briefly described below:

**Commission Bias**

"You will do foolish things, but do them with enthusiasm." ~ Sidonie-Gabrielle Colette

This describes the tendency towards action rather than inaction, even when those actions are unindicated or founded on desperation.

**Sunk Costs**

"Insanity is doing the same thing over and over again and expecting different results." ~ Albert Einstein

Sunk costs describes the phenomenon during which the more effort and commitment invested towards a plan, the harder it may become psychologically to abandon or revise that plan, because it has been established as the "right" plan. Continued unsuccessful perseveration may result in patient harm.

**Fixation**

"If you can see the light at the end of the tunnel, you are looking the wrong way." ~ Barry Commoner

"He who has a one-track mind, his train of thought often becomes derailed" ~ Arthur Blank

Fixation is focusing on one feature or problem exclusively, at the expense of comprehensive situation awareness. This may lead to misdiagnosis of a single problem by failing to understand all of its facets, or missing concurrent diagnoses by focusing on just one.

**Framing Effect/Unpacking Principle**

"An error does not become truth by reason of multiplied propagation" ~ Gandhi

These describe the mistake of allowing early presenting features to unduly influence decisions. This may be related to the way a patient history is presented by others, or to our own filters as we review information. Related to this concept is that of the "Sticky Diagnosis," in which an erroneous diagnosis is recorded in the chart (Latex allergy, for example) and is never removed despite its discovery by many subsequent caregivers.

**Overconfidence/Denial**

"Thinking you know when in fact you don't is a fatal mistake" ~ Bertrand Russell

The labels "Overconfidence" and "Denial" need no explanation, but it may be puzzling as to why these are so heavily represented in adverse outcome anecdotes, cases resulting is legal action or quality committee reviews, and autopsy studies.11
What can be done to prevent cognitive errors?

Cognitive errors are considerably less tangible than procedural or factual errors. They are described as "low-visibility", rarely witnessed or recorded, usually with low awareness on the part of the thinker, not conducive to root-cause analysis, yet potentially highly preventable. Before we can do anything to prevent errors, we need to understand why we make them. Reducing cognitive errors depends upon a few distinct but related factors: self-awareness, metacognition, and cognitive de-biasing.

Increased self-awareness is imperative. Studies of unconscious mental influences demonstrate that increased self-awareness leads to better management of these cognitive distortions. How can we increase our self-awareness about our own errors? Although error-blindness presents an inherent challenge, one strategy is the systematic and deliberate reflection upon one's thoughts, forecasts, and predictions to reveal inherent biases. A self-guided "debriefing" at the conclusion of each case or each day is one way to accomplish this, though it requires routinely challenging one's own decisions and rationale with a good deal of skepticism.

Second, because no single strategy of decision making is appropriate for every situation, selection of thought strategy must be deliberate, and less automatic. Our brains are pluralist: we can either carefully analyze and reason through options, and we can make intuitive "gut instinct" decisions. A crucial step towards avoiding error is figuring out which brain system is best for a given circumstance. Should we trust our intuitions or calculate the probabilities? Have we considered the true base-rate, or are we allowing anecdotes to inflate or deflate the prevalence of a particular problem? We must be thinking about how we think, and considering the specific environment in which we are thinking. This process is called metacognition.

Third, we must employ de-biasing strategies in our metacognitive practice, which have been shown to reduce the impact of subconscious tendencies on decision making. Some strategies are as simple as active contrarianism, and others as challenging as truly cultivating an open mind and mental flexibility. Basic features of metacognitive practice include recognition of limitations of memory, ability to mentally "step back" and appreciate a broader perspective, good capacity for self-critique and harnessing overconfidence, and the ability to select specific strategies for best decision making. Engage in deliberate self-checks, asking: "Am I using the best decision-making strategy right now?" and "Am I relying too heavily on pattern-recognition or bias?" Routinely force yourself to be less certain, and treat predictions as provisional works-in-progress at all times.

The prior behaviors can be considered "generic" strategies, as they may be ubiquitously useful practices. Still to be developed in our specialty are context-specific strategies. As an example borrowed from radiology, "systemic deconstruction" is a specific strategy used to combat confirmation bias. The radiologist reads every chest film in the exact same systematic way, reporting on all structures and findings, whether positive or negative, regardless of the study indication or clinical question asked. Further work is needed in anesthesiology to develop these situation-specific strategies to manage cognitive errors in pitfall-prone contexts.

"An expert is a man who has made all the mistakes which can be made in a very narrow field."
~Niels Bohr
Selected References:
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