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PATIENT SAFETY NETWORK

Anchoring Bias With Critical Implications

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Case Objectives

- Appreciate that diagnostic errors are common in primary and ambulatory care.
- Define premature closure.
- Define anchoring bias.
- List some of the cognitive biases that contribute to anchoring.
- Describe steps to improve cognitive awareness of diagnostic errors.
- Review system-based interventions that can help reduce diagnostic errors.

The Case

A 61-year-old man with a history of stroke initially presented to his primary care physician (PCP) complaining of burning pain and numbness in his left foot for one month. The exam was notable for loss of sensation to his knee and a foot drop secondary to his prior stroke, but his pulses were intact with no other abnormalities noted. The PCP attributed the patient's pain and numbness to a peripheral neuropathy and referred him to podiatry.

The patient presented four more times to his PCP and twice to urgent care with a similar complaint of left foot pain. Each time he was referred to podiatry, but he never went to any podiatry appointments. During these visits, a complete extremity exam was not performed or documented, and the complaint was repeatedly attributed to his prior diagnosis of peripheral neuropathy.

After multiple visits to his PCP and urgent care over a 2-month period, the patient presented to the emergency department with worsening symptoms. On exam his left lower leg was dusky in color with extreme tenderness to palpation and his pulses could not be palpated. A computed tomography angiogram revealed complete occlusion of the left superficial femoral artery secondary to atherosclerotic peripheral arterial disease. The patient required emergent bypass surgery of the left leg by vascular surgery. Unfortunately, due to ischemia (lack of blood flow from the arterial disease) of his leg, he developed multiple infections postoperatively and ultimately required an above-the-knee amputation.

The vascular surgeons who cared for the patient believed the patient's chronic burning pain was likely due to progressive peripheral arterial disease and not to a peripheral neuropathy.

The Commentary

In this case, despite repeated encounters with health care providers, the patient's severe peripheral arterial disease was misdiagnosed, and this cognitive error led to a serious adverse event. The case provides an opportunity to discuss diagnostic reasoning and heuristics and, in particular, to focus on interventions that can be taken to prevent diagnostic errors.

Diagnostic errors in primary and ambulatory care

Diagnostic errors in primary care are common. According to one retrospective review, for every 1000 primary care visits, there are approximately 20 diagnostic errors, from which 1 patient will seek unplanned medical help within 2 weeks.(1) Approximately 27,000 hospital admissions per year in the United States are due to missed or delayed diagnoses in the ambulatory care setting (2), and annually 150,000 or more patients experience diagnosis-related harm.(3) Moreover, adverse events related to misdiagnosis are more likely to be judged preventable (80%) than other types of adverse events such as medication errors (25%–50%).(4)

Cognitive errors and their frequency

About 75% of diagnostic errors have a cognitive component.(5) The two overarching cognitive components are: (i) the tendency to seek only as much information as necessary to form an initial clinical impression, and (ii) the tendency to stick with the initial impression even as new information becomes available.

Premature closure is the failure to consider alternative diagnoses after the initial impression is formed (often based on pattern recognition alone). In this case, the first diagnostic misstep was failure to include peripheral arterial insufficiency within the initial diagnostic impression. To combat premature closure, clinicians can ask themselves, "What else could it be?" Knowledge of the baseline prevalence of disease (i.e., the base rate) can be particularly useful. In cohorts of primary care patients with foot pain, 15% had peripheral arterial insufficiency, so this diagnosis should be considered in every patient with this clinical presentation.(6) Premature closure has been discussed in detail in a previous AHRQ WebM&M case.(7)

Premature closure is exacerbated by *anchoring*, the tendency for clinicians to stick with the initial impression even as new information becomes available. Anchoring appears to have been particularly strong in this case, where the patient presented 6 times over 2 months with worsening symptoms, yet the diagnostic impression did not change and the management plan was simply repeated. Progressive severe unilateral foot pain should have launched an exploration of other possibilities such as mononeuropathy, arthritis, or vascular insufficiency, because most neuropathy pain is bilateral.

Multiple cognitive biases contribute to anchoring. The first is *confirmation bias*, the tendency to selectively seek information that supports initial impressions. In a study of medical students presented with hypothetical patients, the students overwhelmingly sought nondiagnostic data that fit their initial

impressions, while only 17% of students correctly looked for further information that could distinguish between major diagnostic possibilities.(8) In the patient with unilateral foot pain, confirmation bias might lead the clinician to ask about tingling or burning in the same foot, even though such symptoms have little value in discriminating neuropathy from arterial insufficiency.

Confirmation bias can be reduced by actively seeking information that could lead away from the initial or current impression. In this case, a disconfirming clinician might ask "Is the other foot painful and numb?" Peripheral neuropathy is typically symmetrical, so a negative answer should open the mind to other possible diagnoses. Additional information from the history or physical examination that would point to a competing alternative diagnosis could also be useful. We are told that the pulses are intact in the initial examination, but this observation provides little diagnostic guidance. Important additional findings would be a left femoral bruit or reduced left posterior tibial or dorsalis pedis pulse (when compared to the right foot). These findings would significantly raise the possibility of left superficial femoral artery disease.(9)

A second bias is the tendency to overvalue irrelevant information if it has been deliberately sought by the clinician. In one controlled study, if extra effort was expended to obtain clinically irrelevant information, 11%–25% of clinical decisions changed.(10) This bias compounds confirmation bias, because the clinician first seeks irrelevant information, then systematically overvalues this irrelevant information when it is obtained.

A third bias is the inadequate adjustment of probabilities as new disconfirming information becomes available. This bias is classically called *anchoring bias* (11), but it is only one contributor to the overall tendency to anchor. This natural human bias may explain why patients persist in the belief that their arthritis symptoms correlate with weather, even when no such correlation exists.(12) In this case, the probability of peripheral neuropathy was not adjusted downwards, despite progressive unilateral symptoms, which are highly atypical for peripheral neuropathy. This bias can be minimized both by explicit consideration of base rates (prior probability of diagnosis), and application of Bayes' theorem using the sensitivity and specificity of new clinical information.

Fourth, clinicians tend to stick with initial impressions as the number of new possible alternative diagnoses increases; this can be referred to as *status quo bias*. In a controlled study, clinicians were 19% more likely to stick with an initial management plan if confronted by three options instead of two options.(13) In this case, unilateral foot pain has a broad differential diagnosis requiring assessment of the nervous system, the musculoskeletal system, and the vascular system. When the patient repeatedly returned to care without improvement, the case became more complex and the possible causes expanded; this complexity may have paradoxically increased the clinicians' anchoring to peripheral neuropathy.

Finally, *framing effects* can significantly influence diagnostic thinking when forming or revising diagnostic impressions. The framing effect is the tendency to be affected by how information is framed or presented. For example, in a randomized trial, physicians were 10% more likely to list coronary heart disease as their initial impression for a chest pain scenario when the scenario was framed by the statement that another doctor thought that the patient might have coronary heart disease.(14) In a different study, medical residents made 25% more errors in electrocardiographic diagnoses when the electrocardiograms were framed by irrelevant clinical information.(15) Framing difficult cases without diagnostic labels and with

appropriate uncertainty could reduce anchoring. In this case, the frame "return visit for peripheral neuropathy, not attending podiatry appointments" would promote anchoring, whereas the frame "unexplained progressive left foot pain" might combat it.

Interventions to reduce diagnostic errors

Given the prevalence of diagnostic errors, numerous studies have explored interventions to prevent such errors. A recent systematic review described 109 different studies that addressed one or more interventions.(16) Overall, the evidence base is comprised of studies that are small, of low to intermediate quality, and with heterogeneous methods, so no overarching recommendations could be made. Despite these limitations, a number of cognitive- and system-based interventions hold some promise.

Cognitive awareness

Many have proposed that awareness of cognitive biases and their contribution to diagnostic errors might help clinicians avoid such errors. Awareness could begin with focused efforts to teach trainees and practicing clinicians about the diagnostic thinking process and methods to improve it. The Society to Improve Diagnosis in Medicine has compiled key online resources, and experts in the field have proposed optimal methods for teaching clinical reasoning.(17)

Cognitive awareness may also be improved through teamwork and case discussions. While clinicians are limited in their ability to self-monitor their thought processes, their colleagues might be willing and able to do so. An effective case discussion—where clinicians come together to talk about cases should highlight the clinician's thought processes, share uncertainty, and avoid words that frame the case narrowly—might help.(18) In this case, if there were such a conference with other providers, the clinician might have started the case discussion by saying "I have a patient with unexplained severe progressive left foot pain, which I think is due to a peripheral neuropathy."

System-based improvements

Several system-based improvements might have improved things in this case. First, structured diagnostic assessments for common clinical scenarios (e.g., chest pain, fever in an infant) can ensure that relevant findings are elicited and common conditions considered. Such diagnostic assessments can improve detection of traumatic injury, mental illness, and geriatric-related illness.(16) For example, a structured tertiary trauma survey identified missed injuries in 9% of major trauma patients who had already received a primary and second survey.(19) In this case, a structured lower limb pain assessment that includes the musculoskeletal and vascular system may have increased the likelihood of establishing the correct diagnosis.

Structured diagnostic assessments can be augmented by decision support; that is, by systems that advise or provide guidance about a particular clinical decision at the point of care. Manual or automated decision support could help clinicians avoid pitfalls in diagnoses. For example, such systems could ensure that base rates of disease are considered and that sensitivity and specificity of common diagnostic tests or maneuvers are available and accurately applied.(16) Diagnostic decision support can improve diagnostic accuracy in the assessment of abdominal pain (20), geriatric health (21), and chest pain.(22) In this case, decision support might have actively provided the base rate of 15% to help the clinician maintain arterial

disease as a consideration or displayed the evidence to ensure the correct interpretation of the peripheral arterial examination.

Computer–assisted diagnostic expert systems may also help to avoid diagnostic errors. Such systems are intended to provide support for a broad spectrum of complaints and conditions. These expert systems can help clinicians identify relevant competing alternatives early, revise the diagnostic possibilities as new information becomes available, and maintain awareness of rare but treatable conditions. There is some evidence supporting the ability of expert diagnostic systems to help in diagnostic evaluations. One system correctly identified the correct diagnosis for 96% (n=50) of case records published in the *New England Journal of Medicine* when key words from the case were selected by an internist. The system was correct for 76% of cases when the entire case record text was simply cut and pasted, with data entry requiring less than a minute.(23) For this case, I entered the following terms into a widely available commercial computer–assisted diagnosis program: "pain left foot, numbness left foot, foot drop, loss of sensation left leg." The program offered the following top five diagnostic possibilities: compartment syndrome, tarsal tunnel syndrome, thromboangiitis obliterans, POEMS syndrome, and diabetic neuropathy. Clinicians could use these systems for unusual or complex diagnostic challenges, and when patients return with unexplained or progressive symptoms. In our spotlight case, the clinician might have been prompted to consider vascular causes of the patient's symptoms after seeing thromboangiitis obliterans on the computer-generated list.

In this case, multiple providers succumbed to common cognitive biases that led to premature closure as well as anchoring on the diagnosis of peripheral neuropathy. More formal education, case conferences, real-time decision support, or application of a computerized diagnostic aid might have prevented this error and the subsequent adverse event.

Take-Home Points

- Anchoring is the tendency to stick with initial impressions even as new information becomes available.
- Anchoring could be reduced if clinicians:
    - Explicitly consider base rates (prior probabilities), sensitivity, and specificity of diagnostic tests and maneuvers when diagnosing common clinical conditions.
    - Actively seek information that could refute the current provisional diagnosis.
    - Frame their diagnostic thinking to avoid premature diagnostic labeling and share uncertainty.
    - Use system-based interventions including structured diagnostic assessments, diagnostic decision support, or computerized expert diagnostic systems.

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