BIASES IN MEDICAL DECISION MAKING

Ece Marangoz
Uskudar American Academy, Istanbul, Turkey

ecemarangoz2026@gmail.com
Edoardo Gallo: edoardo.gallo@gmail.com

Abstract

The healthcare sector presents high-pressure, time-sensitive decision-making environments, where clinicians are often required to make swift judgments. Among the most prevalent are confirmation bias, the tendency to seek or prioritize information that supports pre-existing beliefs, and anchoring bias, the overreliance on initial information when forming diagnoses. Both can significantly distort judgment and compromise patient care. This literature review explores how these biases contribute to distortions in clinical judgment. Drawing on behavioral research and case-based examples, the literature review argues that longstanding issues in medical error and misdiagnosis may be better addressed by incorporating bias-awareness into health policy and clinical practice. Emerging bias-aware technologies that account for human cognitive limitations offer promising avenues for improving diagnostic accuracy and reducing errors in clinical settings.

Key Words: Confirmation Bias, Anchoring Bias, Diagnosis, Emergency, Systematic.

1. Introduction and Background

Traditional economic theory assumes decision-makers act rationally and with complete information. Behavioral economics, however, challenges this by recognizing the systematic cognitive biases and irrational tendencies that often influence real-world choices. The health sector offers a rich area for behavioral economic analysis, considering the complex choices involved, the urgency of decisions, and the significant reliance on expert guidance.Healthcare decisions often take place under stress, uncertainty, and a lack of balanced information between patients and providers. Moreover, healthcare often involves 'credence goods'—services whose quality is difficult to assess even after they've been used. This makes patients particularly reliant on a physician's judgment. Behavioral economics helps us understand these dynamics by showing how heuristics, framing effects, default options, and biases like confirmation and anchoring can distort medical decision-making. The consequences of such distortions are far from theoretical. A 2023 study published in *BMJ Quality & Safety* estimates that approximately 371,000 people die and another 424,000 are permanently disabled each year in the United States due to diagnostic errors—totaling nearly 800,000 people experiencing serious harm annually (Merelli, 2023). As David Newman-Toker, the lead author and director of the Center for Diagnostic Excellence at Johns Hopkins, notes, misdiagnosis may be the most common cause of death or disability from medical malpractice, though many cases go undetected and the true number could be even higher (2023,Newman-Toker). As emphasized in *Nudge* by Thaler and Sunstein (2008), health has long been a central domain for applying behavioral interventions like default options and planning prompts to improve public health outcomes. For example, behavioral tools such as 'nudges' have successfully improved public health outcomes, from

increasing vaccination rates through default appointments to enhancing medication adherence with automated reminders. These interventions utilize insights from concepts like loss aversion, status quo bias, and time-inconsistent preferences to guide individuals toward healthier behaviors. Despite these successes, many aspects of clinical decision-making are still underexplored from a behavioral economics perspective. This literature review aims to investigate how specific cognitive biases—confirmation bias and anchoring bias—influence medical decision-making, particularly in high-stakes clinical environments. In doing so, it contributes to a growing body of work that challenges the assumption of rationality in professional judgment and highlights the need for bias-aware frameworks in medical practice. In the following sections, this article first examines confirmation bias in clinical contexts, outlining its psychological underpinnings, and illustrates its impact through research examples such as emergency medicine case studies and Alzheimer's biomarker studies. It then analyzes anchoring bias, detailing empirical evidence and real-world diagnostic delays, with an emphasis on high-risk settings such as emergency departments. For each bias, it examines proposed mitigation strategies at both the individual and system levels, including metacognitive training, diagnostic timeout, and bias-aware decision support tools. The discussion concludes by integrating these findings into a broader framework for designing healthcare environments that reduce diagnostic error while respecting the role of clinical intuition.

1.1 The Unique Environment in Healthcare

Healthcare is a unique intersection of economics, psychology, and high-stakes decision-making. While most people imagine hospitals, doctors, and patients when thinking of healthcare, the system extends far beyond its physical components. Becoming a physician is a long, demanding journey: students first take rigorous coursework and the MCAT, then enter four years of medical school, followed by 3 to 7 years of residency training under intense clinical supervision. Even after residency, physicians must continue lifelong education to stay updated in their fields. Despite this extensive preparation, physicians remain vulnerable to cognitive errors. Medical professionals operate under constant pressure, navigating life-or-death decisions often with incomplete information, time constraints, and emotional intensity. The intensive care unit presents a setting where clinicians must make rapid judgments under uncertainty, frequently without clear guidelines and with significant consequences (Evans, 2021). These conditions create an environment highly open to cognitive errors. Even before entering clinical practice, medical students begin developing decision-making habits rooted in intuitive (System 1) and analytical (System 2) thinking, yet they often receive little structured guidance in managing these processes (Sanders & McHugh, 2021). This complex environment, worsened by information asymmetry between patients and providers, renders healthcare particularly susceptible to biases in both clinical and policy decisions. Understanding how behavioral economics principles apply in this context is crucial to improving health outcomes.

1.2 The Role of Cognitive Biases in Clinical Judgment

Throughout the entire treatment process, practitioners continually gather information and make informed decisions. Every client-worker relationship involves a complex process that includes gathering personal information, having conversations, and storing all of it. This information is then used for making comparisons, identifying correlations, and forming predictions. The

process relies heavily on cognitive activities, which are highly open to potential biases. As a result, there is a significant risk of error in these cognitive tasks.

When examining cognitive biases in clinical judgment, it is important to distinguish between implicit and explicit biases, both of which contribute to health and healthcare disparities. Explicit biases are conscious attitudes and assumptions that individuals can recognize and directly report; they often underlie discriminatory acts such as racism, sexism, and homophobia. In contrast, implicit biases are unconscious attitudes and beliefs about characteristics such as race, ethnicity, age, ability, and gender. These implicit biases operate outside of conscious awareness and can only be measured indirectly, but they subtly influence judgment and behavior in clinical settings.

Diagnostic errors are mistakes that occur due to missed or delayed diagnoses. These errors have been increasing rapidly and have drawn significant attention in recent years. Studies estimate that diagnostic errors occur in up to 15% of medical cases. No physician is entirely immune to such errors, regardless of their experience or expertise. Approximately 7.4% of physicians in the United States are involved in medical malpractice claims annually, with diagnostic errors being one of the leading causes of litigation. These errors often result from system breakdowns, such as communication failures or workflow issues, as well as from faulty clinical reasoning caused by cognitive biases. In many cases, both factors are involved.

A study by Graber and colleagues, which analyzed 100 diagnostic error cases, revealed that most errors had multiple contributing causes. Both system-related issues and cognitive biases were commonly present. These findings highlight the critical need to examine the role of cognitive biases in clinical judgment, as they significantly contribute to diagnostic errors and compromise the quality of care.

2. Confirmation bias

Psychologist Raymond Nickerson defines confirmation bias as “seeking or interpreting evidence in a way that is biased toward existing beliefs, expectations, or a given hypothesis.” (Nickerson, 1998, pp. 175). More simply, it is our tendency to seek, interpret, and recall information in ways that support what we already believe or expect. As Hahn and Harris (2014) explain, this bias can manifest in a variety of ways: selectively gathering evidence, resisting contradictory data, failing to consider alternatives, and overestimating the validity of our existing views. Confirmation bias can be motivated, meaning people are consciously or unconsciously driven to confirm a preferred outcome, or unmotivated, occurring even when people reinforce beliefs they do not want to be true (Nickerson, 1998; Steel, 2018). Although often associated with motivated reasoning (Kunda, 1990), confirmation bias often operates as an automatic and unconscious cognitive shortcut. As Klayman and Myers & DeWall note, people naturally favor information that supports their prior beliefs while ignoring or dismissing contradictory evidence.

This process is closely tied to System 1 thinking, the fast, intuitive, and low-effort way of thinking identified by Kahneman. In contrast, System 2 thinking is more deliberate and analytical, capable of overriding initial impulses but requiring more time and mental resources.

In the fast-paced, high-pressure environment of clinical practice, physicians often rely on System 1 out of necessity, making them particularly susceptible to confirmation bias.

One of the most well-known demonstrations of confirmation bias comes from a classic lab experiment by Peter Wason, who studied how individuals test hypotheses. Participants are shown a sequence of three numbers—2, 4, 6—and are told that these numbers follow a rule. Their goal was to discover the actual rule by proposing additional sequences, after which they would be told whether their new sequences conformed to the rule. Most participants assumed the rule was "increasing by twos" and suggested sequences like "8, 10, 12" or "20, 22, 24" that were confirmed to be true. What they failed to do, however, was test disconfirming examples like "2, 3, 4" or "10, 11, 13" that could potentially refute their hypotheses. In reality, the original rule was simply "any sequence that increases." Participants failed to discover the correct rule because they only sought evidence that confirmed their initial ideas and avoided generating sequences that could refute them. This experiment revealed a well-established cognitive bias: when forming beliefs or judgments, people are more likely to seek confirming evidence than to question their assumptions. Crucially, this process occurs even when individuals are explicitly told to scientifically test their hypotheses, highlighting that confirmation bias is not just a logical error but also an innate human flaw in information processing.

One area where the consequences of this bias become especially evident is in the diagnostic process. Diagnosis is typically made in two steps: first, doctors make a prediction based on the patient's initial symptoms; then they gather more information to confirm or refine that prediction. Ideally, this second step keeps doctors open to new information. However, confirmation bias often gets in the way. Instead of fairly considering all the evidence, doctors might unconsciously look for or put more weight on information that supports their first impression, while overlooking or downplaying anything that goes against it. This pattern, called premature closure, is a frequent result of confirmation bias. Once doctors settle on a diagnosis, they might stop exploring other possibilities too soon.

A particularly compelling example comes from Jesse Pines, who presents a case study of a 51-year-old patient, "Mr. W," who suffered from severe back pain and was misdiagnosed due to a series of cognitive and systemic errors stemming from confirmation bias. In scenario 1, the emergency physician (EP) was influenced by a colleague's prior diagnosis and a nurse's framing of the patient as someone seeking medication. Under pressure and cognitive overload, the EP reconfirmed the initial impression of musculoskeletal pain without performing a full examination or laboratory work and discharged the patient based on selective interpretation of the data.

Critically, this decision overlooked clinical red flags such as fever (100.5°F) and tachycardia (HR: 105), which were early signs of a serious underlying infection. This scenario reflects broader trends: diagnostic errors are the leading cause of malpractice claims in emergency departments, and one-third of malpractice cases in emergency departments are attributed to missed or delayed diagnoses (Pines, 2006). Furthermore, a 1993 multicenter study found that approximately 2% of patients with acute myocardial infarction were incorrectly discharged from the emergency department, demonstrating that initial diagnostic impressions—if left unchecked—can have life-threatening consequences.

The importance of slowing down cognitive shortcuts becomes even clearer in Scenario 2, where the same patient is thoroughly evaluated again and diagnosed with a spinal epidural abscess, a rare but potentially fatal condition. When properly examined, Mr. W had a higher fever (102.2°F), an elevated ESR (47 mm/hr), a WBC count of 11.8 x10^3/mm^3, and a recent history of intravenous drug use—all diagnostic clues that had been missed in the earlier encounter due to cognitive fixation and confirmatory thinking. The risk of missing such a diagnosis is not insignificant: spinal epidural abscesses have a mortality rate of 5–15%, and up to 45% of patients experience permanent neurological deficits if treatment is delayed. While this clinical report is not a randomized trial, it reflects the real-world consequences of cognitive bias under common emergency room conditions: fatigue, high patient volume, and fragmented communication.

Pines also cites a study of trauma patients in which judgment errors were observed in 100% of resuscitations, highlighting the extent of cognitive pitfalls when clinicians are forced to make rapid decisions. These data generally emphasize that confirmation bias is not a subtle or occasional problem but a common and important feature of diagnostic reasoning in emergency medicine. To mitigate these risks, Pines advocates for explicit training in metacognition and Bayesian reasoning, as well as structural reforms such as cognitive challenge strategies and protocol-based decision support tools that can help healthcare providers pause, reassess, and consider alternative diagnoses under pressure.

Confirmation bias doesn't just affect doctors during treatment—it also shows up in how scientific research is done, especially in the study of Alzheimer's disease (AD). For many years, most research has focused on what's called the "amyloid cascade hypothesis," which suggests that a protein called amyloid-beta (Aβ) causes brain damage that leads to Alzheimer's. Because this idea became so dominant, scientists have tended to focus on evidence that supports it and ignore studies that suggest other causes—a clear example of confirmation bias. As new technologies like brain scans and spinal fluid tests became available, researchers began diagnosing Alzheimer's based on these protein markers (amyloid and tau) even when patients didn't show memory loss or other symptoms. This shift has increased the risk of overdiagnosing people who have these biological signs but may never develop the disease. In this case, confirmation bias may have slowed progress by keeping science narrowly focused on one theory for too long.

A review by Souchet et al. (2023) highlights that amyloid-related tests exhibit variable sensitivity (64–100%) but generally low specificity (around 66.5%), meaning that approximately one-third of individuals without AD test positive and nearly 20% of those who develop AD test negative, complicating diagnosis and treatment. Autopsy studies reveal that many cognitively healthy older individuals harbor significant amyloid and tau pathology, calling into question their role as definitive disease indicators. Such evidence challenges the view that these biomarkers definitively indicate Alzheimer's. Longitudinal studies, including the A4 Study, show that many amyloid-positive but cognitively normal individuals do not develop dementia, suggesting these markers signal risk rather than certainty. Despite this, the prevailing focus on amyloid has created a self-reinforcing cycle, where positive test results are interpreted as proof of disease and contrary evidence is rationalized away or overlooked. As Souchet note, this persistence "It is

hypothesized that such a persistent focus [on amyloid biomarkers] might be influenced by confirmation bias in the field." (Souchet, 2023, p.9).

Longitudinal studies, such as the A4 Study, have found that only a minority of amyloid-positive but cognitively normal participants show cognitive decline over the years, suggesting that these markers signal risk but are not definitive of progression. This ingrained belief in the centrality of amyloid creates a self-reinforcing cycle in which positive tests are viewed as evidence of AD and opposing evidence is rationalized, exemplifying confirmation bias.

This has serious clinical implications: expensive anti-amyloid drugs like lekanemab, which can cause harmful side effects, may be overprescribed to patients who do not actually have Alzheimer's disease, leading to unnecessary risks and increased healthcare costs. Recognizing and addressing this bias is crucial to improving the accuracy and ethics of Alzheimer's diagnosis and treatment.

The consequences of unchecked confirmation bias are very extensive. Because confirmation bias continues to subtly influence clinical thinking, it leads to both under- and overdiagnosis, delays in care, and costly medical errors. Understanding how this bias manifests in real-world healthcare is an important first step toward creating systems that minimize its effects.

To effectively reduce confirmation bias in medical decision-making, a multifaceted and system-wide approach is essential. Because confirmation bias influences how clinicians seek, interpret, and recall information, solutions must target both individual cognition and the broader structures that shape clinical and scientific practice. Rather than relying solely on intuition or experience, clinicians can benefit from tools and habits that prompt reflective, evidence-based reasoning.

One proven strategy involves implementing structured pauses in the diagnostic process. These deliberate moments of reflection, known as diagnostic "timeouts," encourage clinicians to reassess initial impressions and actively seek disconfirming evidence. Graber et al. (2014) found that such cognitive challenge strategies increased diagnostic accuracy by 17–20% in emergency simulations.

Differential diagnosis checklists serve a similar function by expanding the diagnostic framework and preventing premature closure. Their use has been shown to reduce errors by 18% in complex cases (Sibbald et al., 2013), while electronic decision support tools integrated into health records have reduced diagnostic delays by 23% in high-risk scenarios (Schiff et al., 2015). These interventions create a cognitive buffer against bias by slowing automatic reasoning and injecting deliberate scrutiny into the decision-making process.

Equally important is the development of metacognitive awareness, the ability to monitor and review one's own thought processes. Rollwage and Fleming (2021) found in a large-scale decision simulation that individuals with high metacognitive efficiency were able to adaptively use confirmation bias, achieving higher accuracy when new evidence emerged after the initial

judgment. This finding suggests that the bias itself is not always harmful, but rather becomes problematic when not supported by reflection.

Training clinicians to adjust their confidence, recognize when they might be wrong, and remain open to corrective information transforms confirmation bias from a burden into a tool that can be managed and, in some cases, evaluated.

Beyond individual cognition, team-based practices offer powerful safeguards. Collaborative case reviews, structured handoffs, and interdisciplinary rounds can disrupt biased diagnostic momentum. O'Hare et al. (2018) reported a 36% reduction in significant diagnostic discrepancies in critical care settings when such practices were implemented.

Feedback mechanisms play a similar role: regular audits and diagnostic reviews help identify recurring error patterns; studies such as Haskel (2007) show a 25% reduction in recurring diagnostic errors following structured feedback. These collaborative and iterative processes broaden the perspective of individual clinicians and create a culture that values uncertainty and second opinions, an important antidote to cognitive fixation.

Confirmation bias also operates at the research and policy levels, particularly in how diseases are defined and studied. For example, in Alzheimer's research, the long-standing dominance of the amyloid cascade hypothesis has shaped both diagnostic criteria and drug development, despite growing evidence that amyloid positivity does not reliably predict cognitive decline.

This reflects a deeper pattern: as a theoretical model gains momentum, supporting evidence is emphasized, while conflicting data are minimized or rationalized. To address this, researchers should adopt practices that reduce circular reasoning and selective interpretation. Longitudinal cohort studies can help confirm whether biomarkers truly predict meaningful outcomes over time, rather than assuming their presence equates to disease.

Souchet et al. (2023) advocate for redefining Alzheimer's disease using outcome-predictive biomarkers instead of pathology-based ones, aiming to reduce the risk of overdiagnosis and inappropriate treatment. Pre-registering hypotheses and prioritizing independent replication trials reduces the risk of confirmation bias in scientific reporting. Preregistration involves publicly documenting a study's research questions, hypotheses, methods, and planned analyses before data collection begins. This process prevents researchers from retroactively adjusting their hypotheses to fit the results (a practice known as HARKing), which can distort scientific conclusions and falsely inflate the impression of support for a theory. By committing to a specific research area in advance, researchers are held accountable for objectively testing their original ideas, rather than interpreting uncertain results to confirm their expectations. Similarly, independent replication experiments serve as a safeguard against selective reporting or unintentional biases that might arise in original studies. When other research teams (ideally with no vested interest in the outcome) replicate the study using the same methods, they test whether the original findings are robust or simply the result of chance, methodological flaws, or confirmation bias. If a result can be consistently replicated by different groups, it becomes more reliable and less likely to be influenced by the original researchers' assumptions. Preregistration and replication together create a more transparent and self-correcting scientific process, helping

to distinguish truly valid findings from those influenced by cognitive biases or selective interpretation. Additionally cost-effectiveness analyses ensure that treatments, such as anti-amyloid drugs, are evaluated not only based on their biological targets but also on their actual patient benefits.

Together, these interventions represent a comprehensive strategy for managing confirmation bias in medicine. They do not, and should not be the goal, to eliminate bias entirely. Instead, they recognize that cognitive shortcuts are part of human reasoning and that their risks can be mitigated through reflection, transparency, and carefully designed systems.

When supported by metacognitive skills and institutional mechanisms, even a deep-seated bias like confirmation bias can be transformed from a source of error into an opportunity for improved accuracy, better outcomes, and more ethical care.

3 Anchoring Bias

Anchoring bias is a cognitive heuristic in which individuals disproportionately rely on initial information, the "anchor," when making judgments, even when subsequent evidence suggests they should have adjusted their judgments (Tversky & Kahneman, 1974). In one of their classic experiments, Tversky and Kahneman asked participants to spin a wheel of fortune set to stop at either 10 or 65. Participants were then asked whether the percentage of African countries in the United Nations was higher or lower than the number on the wheel and then asked to provide their own estimates. Strikingly, those who saw the wheel stop at 10 gave an average 25% estimate, while those who saw it stop at 65 gave an average 45% estimate. Despite knowing the number was random and irrelevant, participants' judgments were biased toward it. This simple but powerful experiment demonstrates how even arbitrary anchors can unconsciously shape decision-making.

This bias takes on even greater significance in medicine. Clinicians often form premature diagnostic impressions based on limited information (such as triage notes or initial symptoms), which can disproportionately influence subsequent testing and treatment decisions. Emotional states can exacerbate this effect; Bodenhausen et al. (2000) found that sadness reduces cognitive flexibility and increases reliance on anchors. These pressures are particularly important in high-risk, fast-paced environments such as emergency departments, where time constraints and stress can narrow the diagnostic focus and delay recognition of alternative conditions.

Ly et al. (2023) provide clear evidence of anchoring bias affecting clinical decision-making in emergency medicine through a large-scale cross-sectional analysis of 108,019 Veterans Affairs emergency department visits. The study focused on patients with congestive heart failure (CHF) presenting with shortness of breath (SOB), a common symptom in both CHF exacerbation and pulmonary embolism (PE). A key consideration was the "reason for visit" section documented by triage nurses prior to physician assessment. When CHF was explicitly mentioned in this initial documentation, it served as an anchor for subsequent clinical decisions. Anchoring bias occurs when decision-makers overrely on initial information and fail to adequately adjust their judgments with new data. Here, physicians who received triage notes emphasizing CHF tended to narrowly focus on CHF as the cause of symptoms and frequently neglected alternative

diagnoses such as PE. Consequently, when CHF was mentioned, physicians ordered significantly fewer PE diagnostic tests (8.8% vs. 13.4%; difference, −4.6 percentage points; 95% confidence interval [CI], −5.7 to −3.5) and delayed tests by an average of 15.5 minutes (90.4% vs. 74.9 minutes; 95% CI, 5.7 to 25.3). At the same time, testing for CHF exacerbation using B-type natriuretic peptide (BNP) increased by 6.9 percentage points (78.0% vs. 71.1%; 95% CI, 4.3 to 9.4). The mechanism is clear: the triage note served as an anchor that shaped physicians' initial expectations and led them to cognitively focus on CHF. This finding led to disproportionate testing for CHF, even when clinical symptoms warranted, and underassessment of PE—a hallmark of anchoring bias, which is typical of underadjustment from the initial anchor.

Although PE diagnoses were lower when CHF was noted during the emergency department visit (0.08% vs. 0.23%; difference, -0.15 percentage points; 95% CI, -0.23 to -0.08), 30-day PE diagnosis rates did not differ significantly (1.2% vs. 1.1%; difference, 0.06 percentage points; 95% CI, -0.23 to 0.36). This suggests that anchoring bias leads to delayed rather than missed PE diagnoses, potentially impacting timely patient care.

Delays in the diagnosis of pulmonary embolism (PE) due to anchoring bias are clinically significant because PE is a potentially life-threatening condition that requires prompt diagnosis and treatment. Studies show that early diagnosis and anticoagulant therapy can significantly reduce mortality rates. According to the American Heart Association, the estimated mortality rate for untreated PE is up to 30%, but with timely diagnosis and intervention, this rate decreases significantly, often to less than 10%. Delays in diagnosis increase the risk of complications such as right ventricular failure, recurrent embolism, and chronic thromboembolic pulmonary hypertension, all of which contribute to higher morbidity and healthcare costs.

A similar clinical scenario illustrating the detrimental effects of anchoring bias involves a 29-year-old man initially suspected of having a polysubstance overdose. The clinical team focused on this diagnosis due to the patient's presentation and positive drug screens, which delayed further investigations. After the patient's condition worsened, imaging revealed a large brain tumor that caused life-threatening complications. This case highlights how focusing on the initial diagnosis can overshadow potentially more serious alternative conditions, leading to delayed diagnosis and adverse outcomes. Such examples highlight the critical importance of clinicians remaining vigilant against cognitive biases to ensure timely and accurate diagnosis in high-risk medical conditions such as pulmonary embolism.

The case involves a 29-year-old man known for chronic headaches. He was brought to the emergency department (ED) under a police escort for suspected multiple substance overdose. He reported experiencing a suspected seizure and ingesting an unknown quantity of medications, including clonazepam, sumatriptan, and ibuprofen. However, he could not provide specific information about when or in what quantity the medication was ingested. During his initial examination in the ED, he experienced confusion, bradycardia, and hypertension. A urine drug screen was positive for amphetamines, benzodiazepines, and cannabinoids. Based on these findings and the context, the medical team focused on a diagnosis of drug overdose as the primary explanation for the patient's altered mental state.

Over the next several hours, the patient's condition worsened; he became increasingly drowsy and intermittently agitated, requiring soft restraints for safety. On his first day in the hospital, he was lethargic, unresponsive, and hypoxic on room air. A code blue was called, and the patient was intubated and transferred to the Intensive Care Unit (ICU). A neurological reexamination revealed fixed and dilated pupils, and an urgent CT scan of the head was performed. The imaging revealed a large, 10-cm hyperdense mass in the right frontal lobe, accompanied by severe swelling (vasogenic edema), uncal herniation, and hydrocephalus. These findings were highly suspicious for a meningioma or brain tumor.

A detailed history taken from the patient's mother revealed a distinct pattern of personality changes, bizarre behavior, memory loss, worsening headaches, and gait disturbances over the years. The mother initially assumed these symptoms were related to drug use, contributing to her diagnosis of overdose. She also confirmed that the number of pills remaining in the prescription bottles was consistent with the patient's statement and did not indicate an overdose. Consequently, the patient was referred to a tertiary hospital for neurosurgical intervention, but unfortunately, he died from complications related to the brain tumor and its associated herniation.

This tragic outcome highlights how fixating on an initial diagnosis of drug overdose can lead to a critical delay in recognizing the true underlying condition. By overlooking alternative explanations early on, the clinical team missed the opportunity for timely diagnosis and intervention, potentially altering the patient's prognosis. Thus, anchoring bias not only compromised the quality of care but also directly impacted patient survival, demonstrating the profound implications of cognitive biases in medical decision-making.

A similarly instructive scenario is described in Case 6 by Waldrop (2017), which exemplifies anchoring bias in pediatric emergency medicine. The case involved a 15-year-old female with known sickle cell disease (SCD) who presented with abdominal pain described as distinct from her typical vaso-occlusive episodes. Despite this clinically significant clue, the emergency department (ED) team made an early diagnosis of a routine pain crisis based on the patient's history of frequent ED visits and perceived drug-seeking behavior. Anchoring bias, reinforced by confirmation bias, led the team to discharge the patient after administering opioid analgesia without performing imaging or laboratory tests beyond the initial workup.

Within 24 hours, her condition worsened, and further evaluation revealed portal vein thrombosis, a life-threatening vascular complication. While Waldrop's report did not provide patient-specific mortality data, portal vein thrombosis has a reported mortality rate of 10–20% in untreated acute cases, and delayed diagnosis significantly increases the risk of bowel ischemia, liver failure, and long-term morbidity. This case quantifies the risk of anchoring bias: a 24-hour delay in diagnosis in a time-sensitive vascular emergency directly jeopardized the patient's survival. Clinically, this vignette illustrates how attachment to the past and reputation can override critical new information, narrow the diagnostic framework, and delay the recognition of emergencies. In high-pressure emergency situations where time constraints, cognitive load, and negative emotional bias combine, such attachment can have disastrous consequences. Waldrop (2017) emphasizes that mindfulness and diagnostic thinking, including explicit recognition of cognitive

dissonance and deliberate diagnostic pauses, are key strategies for neutralizing attachment, maintaining broad discrepancies, and reducing the risk of life-threatening delays.

A promising solution to address bias in medical decision-making involves the integration of bias-aware algorithmic support systems, as proposed by Ahsen et al. (2019). In their study of mammography decision-making processes, they showed that radiologists' interpretations were systematically influenced by prior clinical risk information, a clear indicator of bias-based assessment. To mitigate this, they developed an algorithmic prediction framework that explicitly accounts for human bias by modeling both the systematic variation caused by bias and the associated variability in decision-making processes.

By refactoring radiologists' assessments and incorporating unbiased clinical and imaging data, the algorithm produced more accurate cancer risk estimates and improved expected patient outcomes measured in life years. This approach offers a broader solution to anchoring bias: combining human expertise with algorithmic calibration to ensure that initial impressions do not disproportionately determine final diagnoses. In high-risk settings like emergency medicine, similar bias-sensitive decision-support tools can encourage clinicians to reassess early anchors, expand differential diagnoses, and reduce the risk of delayed or missed diagnoses.

Anchoring bias will always be a part of human cognition, but its consequences in clinical decision-making are not inevitable. Through conscious deliberation, team-based checks, and algorithmic calibration, clinicians can prevent early anchors from becoming fatal extremes. Combating anchoring bias is not about eliminating intuition; it's about ensuring that intuition is held accountable to the evidence.

4 Conclusion

This literature review examined how two specific cognitive biases—confirmation bias and anchoring bias—impact medical decision-making in both clinical and research contexts. By analyzing emergency medicine cases, Alzheimer’s research, and real-world diagnostic failures, the literature review showed how these biases shape physician judgment and contribute to missed or delayed diagnoses. It also evaluated concrete solutions, including decision support tools, diagnostic timeouts, and metacognitive training. Ultimately, the findings suggest that improving clinical outcomes depends not on eliminating intuitive thinking, but on designing systems that support reflective, evidence-based reasoning without ignoring human cognitive tendencies. A balanced approach that respects physician expertise while reducing cognitive error holds the greatest promise for safer, more accurate healthcare.

Many existing debiasing methods fail because they rely on assumptions that are incompatible with physicians' natural ways of thinking and making decisions. As Norman and Eva (2020) emphasize, physicians are often most vulnerable to diagnostic errors when they attempt to override intuitive System 1 thinking by overriding analytical System 2 processes. Successful diagnoses often rely on intuitive judgment rather than formal reasoning, making it difficult to challenge these ingrained cognitive habits. Therefore, effective debiasing approaches must adopt a broader perspective that integrates physicians' expertise and intuition rather than attempting to replace or override them. This requires developing conceptual models and technological tools

that are compatible with both the cognitive structures of the human mind and the practical demands of clinical work.

Future research should focus on creating healthcare technologies that facilitate productive interactions between clinicians and artificial expert systems, providing support at every stage of the medical decision-making process. Such tools should support the development of implicit knowledge and robust intuition, as well as analytical reasoning, and encourage the balanced use of System 1 and System 2 thinking. One promising area is the use of hybrid models, such as fuzzy cognitive maps, that combine human expertise with analytical algorithms. These techniques can increase physicians' awareness of diagnostic cognitive processes and encourage active participation and motivation in the decision-making process. Unlike current debiasing or fully automated data mining approaches, such balanced systems aim to reduce common errors such as premature closure and overconfidence by integrating cognitive knowledge with technological support.

Consequently, debiasing strategies and decision support systems must demonstrate scientific validity and personal relevance to be adopted in daily practice. Raising awareness of cognitive biases should be supported by training and tools that promote a cognitively focused diagnostic process. Clinician collaboration can enhance the effectiveness of decision support tools and foster intuitive diagnostic skills within evidence-based medicine frameworks. This balanced approach offers a path to reducing diagnostic errors and improving patient outcomes without undermining the valuable role of physician intuition.

References

Ahsen, Mehmet Eren, et al. “When Algorithmic Predictions Use Human-Generated Data: A Bias-Aware Classification Algorithm for Breast Cancer Diagnosis.” *Information Systems Research*, vol. 30, no. 1, 2019, pp. 97–116. JSTOR, https://www.jstor.org/stable/48758523.

Arkes, Hal R. “The Consequences of the Hindsight Bias in Medical Decision Making.” *Current Directions in Psychological Science*, vol. 22, no. 5, 2013, pp. 356–360. https://www.jstor.org/stable/41333450.

Bodenhausen, Galen V., et al. “Sadness and Susceptibility to Judgmental Bias: The Case of Anchoring.” *Psychological Science*, vol. 11, no. 4, 2000, pp. 320–23. JSTOR, http://www.jstor.org/stable/40063840.

Croskerry, Pat. “A Universal Model of Diagnostic Reasoning.” *Academic Medicine*, vol. __, no. __, __, pp. __. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2864081/.

---. “From Mindless to Mindful Practice—Cognitive Bias and Clinical Decision Making.” *New England Journal of Medicine*, vol. __, no. __, 2022, pp. __. https://www.nejm.org/doi/pdf/10.1056/NEJMp2201180.

---. “The Importance of Cognitive Errors in Diagnosis and Strategies to Minimize Them.” *Academic Medicine*, vol. __, no. __, __, pp. __. https://onlinelibrary.wiley.com/doi/epdf/10.1197/j.aem.2005.07.028.

Croskerry, Pat, et al. “Cognitive Debiasing 2: Impediments to and Strategies for Change.” *BMJ Quality & Safety*, vol. __, no. __, __, pp. __. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6110024/pdf/10.1177_1751143717746566.pdf.

FitzGerald, Chloë, and Samia Hurst. “Implicit Bias in Healthcare Professionals: A Systematic Review.” *BMC Medical Ethics*, vol. 18, 2017, p. 19. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5304800/.

Gonzalez, Chad M., et al. “Reducing Implicit Bias: Association of a Longitudinal Faculty Development Program with Perceptions of Bias.” *Journal of General Internal Medicine*, vol. __, no. __, __, pp. __. https://www.jstor.org/stable/48635302.

Graber, Mark L. “The Need for Cognitive Science in Diagnosis and Diagnostic Error Research.” *Academic Medicine*, vol. __, no. __, __, pp. __. https://www.jstor.org/stable/23483849.

Hall, William J., et al. “Implicit Racial/Ethnic Bias among Health Care Professionals and Its Influence on Health Care Outcomes: A Systematic Review.” *American Journal of Public Health*, vol. 105, no. 12, 2015, pp. e60–e76. https://www.ajpmonline.org/article/S0749-3797(16)00063-5/fulltext.

LeBlanc, Vicki R., et al. “The Impact of Emotional Stress on Clinical Reasoning Performance.” *Medical Education*, vol. __, no. __, __, pp. __. https://www.jstor.org/stable/26523588.

Ly, David P., Peter G. Shekelle, and Ziad Obermeyer. “Evidence for Anchoring Bias During Physician Decision-Making.” *JAMA Internal Medicine*, vol. 183, no. 8, 2023, pp. 818–823. https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2806464.

Ly, David P., Peter G. Shekelle, and Zirui Song. “Evidence for Anchoring Bias During Physician Decision-Making.” *JAMA Internal Medicine*, vol. 183, no. 8, 2023, pp. 818–823, doi:10.1001/jamainternmed.2023.2366.

Meyer, Andria N. D., et al. “Frequency of Diagnostic Errors in Outpatient Care: A Systematic Review.” *BMJ Quality & Safety*, vol. __, no. __, __, pp. __. https://www.jstor.org/stable/44318688.

Montgomery, Kathryn. “How Doctors Think: Clinical Judgment and the Practice of Medicine.” *The Journal of Medicine and Philosophy*, vol. __, no. __, __, pp. __. https://www.jstor.org/stable/3464683.

Norman, Geoff. “Dual Processing and Diagnostic Errors.” *Advances in Health Sciences Education*, vol. __, no. __, __, pp. __. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6110024/pdf/10.1177_1751143717746566.pdf.

Redelmeier, Donald A., and Amos Tversky. “Discrepancy between Medical Decisions for Individual Patients and for Groups.” *New England Journal of Medicine*, vol. __, no. __, __, pp. __. https://www.jstor.org/stable/27146390.

Rehana, Rita W., and Najia Huda. “A Common Heuristic in Medicine: Anchoring.” *Annals of Medical and Health Sciences Research*, vol. 11, no. 5, 2021, pp. 1461–1463. https://www.amhsr.org/articles/a-common-heuristic-in-medicine-anchoring.pdf.

Saposnik, Gustavo, et al. “Cognitive Biases Associated with Medical Decisions: A Systematic Review.” *BMC Medical Informatics and Decision Making*, vol. 16, 2016, p. 138. https://www.mdpi.com/2624-8611/5/4/71.

Shirley, Katherine, and Jonathan D. Derman. “Cognitive Bias in Dermatology: A Review.” *Journal of the American Academy of Dermatology*, vol. __, no. __, __, pp. __. https://www.jaad.org/article/S0190-9622(19)32285-6/fulltext.

Spencer, Steven J., et al. “The Role of Stereotyping in Medical Decision Making.” *Journal of Applied Social Psychology*, vol. __, no. __, __, pp. __. https://www.jstor.org/stable/25763860.

Stat News. “Misdiagnoses Cost the U.S. 800,000 Deaths and Serious Disabilities Every Year, Study Finds.” *Stat News*, 21 July 2023, https://www.statnews.com/2023/07/21/misdiagnoses-cost-the-u-s-800000-deaths-and-serious-disabilities-annually-study/.

Waldrop, Ron D. "Medical Decision-Making Errors Due to Faulty Heuristics in the Pediatric Emergency Department and the Use of Mindfulness." *Journal of Pediatrics & Neonatal Care*, vol. 7, no. 4, 2017, pp. 299. https://doi.org/10.15406/jpnc.2017.07.00299.

Wegwarth, Odette, et al. “Hindsight Bias in Medical Decision Making.” *Medical Decision Making*, vol. __, no. __, __, pp. __. https://www.jstor.org/stable/25763860.

Yap, Katie, et al. “The Role of Cognitive Biases in Clinical Judgment and Decision Making.” *Journal of Evaluation in Clinical Practice*, vol. __, no. __, __, pp. __. https://link.springer.com/article/10.1007/s10670-020-00252-1.

Zhang, Qian, et al. “Cognitive Biases in Clinical Diagnosis: A Review.” *International Journal of Molecular Sciences*, vol. 24, no. 24, 2023, p. 17544. https://www.mdpi.com/1422-0067/24/24/17544.