Diagnostic Error Web Meeting 5 Discussion Guide: Use Cases 3 and 4

Use Case 3: Cognitive Error – Information Overload

Information overload in complex or critically ill patients when the disease "signal" is too high

Overview/Clinical Context

Over the past two decades, there has been increasing complexity in both the content of clinical care (e.g., aging population, multiple chronic comorbidities, sicker hospitalized patients) and the delivery of that care (e.g., faster pace of care, more complex and disconnected teams, increased regulatory oversight, complicated electronic health records [EHR], novel technologies). This comes in the context of an exponential expansion in the volume of new medical science that must be applied in healthcare. Meanwhile, the ability of humans to process large volumes of data has remained constant. The sheer volume of information and how it is presented to clinicians can sometimes lead to medical errors, as clinician may have difficulty distinguishing important information from unimportant information.

One of the key underlying causes for these errors is excessive cognitive load on the clinician. Cognitive load can be separated into intrinsic and extraneous loads. Intrinsic loads involve the complexity of the information itself. For example, a clinician may experience high intrinsic load when caring for a multi-trauma victim in the ICU who is acutely hypotensive. Even if the information is presented to a clinician simply and succinctly, sorting through the problem commands substantial cognitive resources. Extraneous load, by contrast, is the mental load imposed by the structure, organization, or presentation of the information and the mental processing capacity (i.e., working memory) it takes to reach the intended cognitive task. For example, extraneous load is high when EHRs are designed without considering human factors, such that finding relevant information (e.g., a relevant radiographic test) requires searching in multiple locations. Alternatively, there may be no graphical presentation of lab value trends, requiring clinician to notice the trend from the numeric values alone. Humans have a finite ability to manage cognitive load, so burdening their working memory with extraneous load leaves less available for intrinsic load. Creating clinical contexts and tools that have high extraneous load risks wastes precious working memory on unnecessary tasks (e.g., navigating the EHR) at the expense of intrinsic, mission-critical tasks (e.g., considering the full differential diagnosis for acute hypotension).

Unnecessary tasks waste precious cognitive resources, but distractions and interruptions in the environment disrupt a clinician's focus, effectively shrinking the clinician's overall cognitive capacity to address both extraneous and intrinsic tasks. This too can leave insufficient resources for tasks critical to identifying an accurate diagnosis. A related phenomenon is alarm or alert fatigue – where clinicians receive so many warning signals or alarms (e.g., frequently beeping monitoring equipment or alert messages in the EHR) that they unconsciously or deliberately ignore them. For example, an alert for a true critical action lab value (e.g., a very high potassium level) might be ignored because there are similar alerts for all out-of-range lab results.

Use case 3 will focus on the types of errors that originate in situations where there is information overload. This includes high intrinsic load, high extrinsic load, excessive distraction, or a combination of all of these. The use case will address specific diagnostic challenges and causal factors that contribute to

information overload, and will consider global and granular solutions to prevent or mitigate errors resulting from information overload.

Question 1: Case Exemplars *(10 minutes)*

Identify a handful of specific clinical case exemplars that the Committee can use to "test run" ideas when working on the subsequent questions for use case 3. The clinical scenarios should demonstrate the error in practice, and the scenarios should be different enough from one another with respect to settings and clinical context. The case exemplars should allow the Committee to identify specific diagnostic challenges, causal factors, and solutions to overcome information overload.

Examples of possible case exemplars:

- A burn victim who is intubated the ICU requires large-volume fluid repletion. Several days after admission, the blood pressure drops acutely and he has a low-grade fever, so the patient is pan-cultured and treated with broad-spectrum antibiotics for presumed sepsis pending culture results. Since sepsis was the presumed diagnosis, other causes of hypotension were not investigated. The patient dies of massive pulmonary embolism the next day.
- A patient with complex post-operative heart valve repair with a subtle increasing anion gap acidosis is missed. The trend reflects a lactic acidosis, indicating sepsis, and a delay in antibiotic administration results in a prolonged ICU stay for sepsis and bacteremia which infects the repaired valve, requiring additional surgery. Notably, the EHR has no trend analysis and there was no trigger to help identify this subtle trend.
- A complex outpatient with multiple co-morbidities and medications has been visiting multiple doctors and getting multiple tests. There is a large volume of test results that are poorly organized in the EHR, and a lack of cogent, narrative summaries. A positive Lyme serology is missed, and the patient goes on to suffer neurologic complications from delay in diagnosis and antibiotic treatment.

Question 2: Diagnostic Challenges and/or Causal Factors *(10 minutes)*

When reflecting on the case exemplars, consider: (1) How do the specific diagnostic challenges posed by these cases inform our understanding of common causes of information overload?, and (2) How do these different types or causes of information overload inform how we would develop countermeasures or solutions?

Examples of possible diagnostic challenges and/or causal factors:

- Clinical complexity (e.g., distracted by a bigger problem, busy chasing the usual suspects, findings are masked by the patient's clinical state)
- Information complexity
- EHRs designed without consideration of human factors
- Alarm fatigue
- Interruptions
- Process complexity (e.g., multiple steps to find the correct consultant or on-call provider)
- Physical fatigue (e.g., overnight shift, no sleep)
- Mental fatigue (e.g., alarm or alert fatigue, long shifts with highly repetitive diagnostic tasks in laboratory or radiology settings)

Question 3: Solutions *(20 minutes)*

When identifying promising solutions to prevent and overcome diagnostic errors due to information overload, consider: (1) What are the most promising global solutions that could help overcome this error?, (2) What are the most promising granular solutions within those strategies to help overcome this error?, (3) How can these solutions be operationalized across various settings and stakeholders?

When identifying solutions, ask yourself, "could this proposed solution measurably reduce misdiagnosis-related harms from information overload?" and "if scaled broadly, would it likely produce a public health benefit in terms of improved diagnostic outcomes (quality, safety, value)?

Examples of possible global and granular solutions:

- Protocolize known, high-stakes diagnostic pathways (e.g., hypotension in the ICU)
- Improve the usability of electronic health records through the use of trend and other visualization methods
- Reduce the number of notifications and increase clinical salience
- Use artificial intelligence (AI) to recognize data patterns to identify clinically relevant findings
- Reduce the number of extraneous tasks required by clinicians to find information, allowing clinicians to focus on clinical tasks (i.e., task offloading)
- Create a "single source of truth" that contains the clinician on-call list
- Simulation training of clinicians
- Teamwork to distribute cognitive load
- Decrease overall workload (e.g., limit the number of patients simultaneously cared for by a single clinician)
- Rotate or shift repetitive tasks at scheduled intervals

Question 4: Quality Measurement *(10 minutes)*

When identifying opportunities for quality measurement, consider:

1. What kind of diagnostic performance measures might be useful in assessing the incidence of process failures, diagnostic errors, and misdiagnosis-related harms for some of the specific clinical scenarios identified within this use case?
2. Are some measures more promising than others to be operationally feasible in current practice for purposes of ongoing monitoring or to determine the impact of interventions/solutions to help prevent harms from information overload from occurring?

Examples of possible measure concepts:

- Surveys by clinicians on EHR usability
- Rate of EHR data visualization methods meeting quality standards
- Clinical productivity of clinicians as a measure of cognitive load (e.g., patients seen per hour)
- Use of specific communications technology (e.g., texting)
- Time to detection of important clinical events (e.g., sepsis)
- Interoperability of health information technology through participation in a health information exchange

Use Case 4: Cognitive Error – Dismissed Patient

Prolonged diagnostic odyssey for chronic symptoms when the disease "signal" is almost nonexistent

Overview/Clinical Context

Patients with uncommon conditions, or unusual presentations of more common conditions, often experience long diagnostic delays in the assessment of chronic symptoms that are mild, non-specific, or evolving slowly. If an initial search identifies no "objective" abnormalities that correspond to the patient's symptoms, the patient may be labeled as having "medically unexplained symptoms" and the search may be terminated. If the patient, or clinician, insists on pursuing additional testing, the patient may begin a prolonged "diagnostic odyssey" in which the patient visits multiple specialist providers in search of a diagnosis. If no diagnosis is found despite substantial amounts of testing, the patient may be dismissed as having functional symptoms, somatization, or hypochondriasis; alternatively, the patient may be placed in a "wastebasket" diagnostic category without definitive diagnostic tests (e.g., chronic fatigue syndrome).

Some delays occur because a condition is rare and indolent, and therefore unknown or unfamiliar to the patient's provider. For example, hereditary angioedema (HAE) is a rare, genetic condition that involves periodic swelling of the face, airway, extremities, and abdomen and has a prevalence of 1 in 50,000. Diagnostic delays commonly occur in HAE patients, and the average time from first symptoms to diagnosis is greater than two years, with some delays in diagnosis taking up to 20 years. Similarly, non-classic manifestations of common diseases, such as migraine, may be known only in narrowly focused subspecialties (e.g., recurrent dizziness caused by vestibular migraine known to neuro-otologists).

Non-specific symptoms, such as fatigue or chronic low-grade abdominal pain, are especially prone to diagnostic odysseys because the symptoms cross many specialty lines and often multidisciplinary clinical communication is lacking. Diagnostic delays can lead to harm from failure to treat an underlying disorder or from the adverse effects of empiric symptomatic therapies. The odyssey itself can exact a major psychological and financial toll on the patient, family, and/or caregivers.

While most patients with symptoms deemed "medically unexplained" in the modern era do not develop an overt medical cause in follow-up, an estimated 1-5% do. Whether they turn out to be misdiagnosed or not, the psychological impact of this "non-diagnosis" diagnosis on patients can be substantial.[1] When patients do finally achieve a diagnosis, they often describe feeling dismissed or not listened to during their odyssey. In some cases, they key to the correct diagnosis was, in fact, something the patient tried to say but was not heard or appreciated by the clinician. In other cases, affective bias may have contributed. This may manifest as clinicians becoming angry or frustrated with the patient, failing to listen to or hear from the patient, and/or giving up on the patient.

Use case 4 will focus on the types of errors that originate in patients with chronic, unexplained symptoms. The use case will address specific causes for diagnostic odysseys that occur when patients are dismissed, and will consider global and granular solutions to prevent or mitigate these types of errors.

Question 1: Case Exemplars *(10 minutes)*

Identify a handful of specific clinical case exemplars that the Committee can use to "test run" ideas when working on the subsequent questions for use case 3. The clinical scenarios should demonstrate

the error in practice, and the scenarios should be different enough from one another with respect to settings and clinical context. The case exemplars should allow the Committee to identify specific diagnostic challenges, causal factors, and solutions to overcome errors due to dismissed patients.

Examples of possible case exemplars:

- A pediatric patient is having abdominal pain caused by gluten-intolerance in celiac disease. The pain is attributed to reflux, and gluten intolerance is not investigated by multiple family practice clinicians. Ultimately, the mother self-refers to a gastrointestinal specialist who makes the accurate diagnosis.
- A patient with multiple sclerosis is misdiagnosed as having fibromyalgia, which results in a direct dismissal of the patient. The multiple sclerosis is missed by many clinicians from various specialties who fail to consider alternative diagnoses once an early diagnosis of fibromyalgia is made. The patient is finally taken seriously when a clinician becomes concerned about the possibility of acute stroke symptoms. An MRI is performed, which reveals the correct diagnosis of multiple sclerosis.
- A patient with vestibular migraine (i.e., chronic, unrelenting dizziness triggered by head, eye, or world motion) presents with intermittent severe dizziness to many clinicians for multiple years. The patient has negative test results (e.g., brain imaging, tilt-table, and electrophysiologic testing), but the correct diagnosis is discovered by a neurologist who trials migraine medications.

Question 2: Diagnostic Challenges and/or Causal Factors *(10 minutes)*

When reflecting on the case exemplars, consider: (1) How do the specific diagnostic challenges posed by these cases inform our understanding of common causes of errors resulting from dismissed patients?, and (2) How do these different types or causes of these errors inform how we would develop countermeasures or solutions?

Examples of possible diagnostic challenges and/or causal factors:

- Relative rarity of the condition
- Non-specific nature of symptoms
- Involvement of multiple clinicians across settings
- Lack of primary care physician or clinician who synthesizes information from multiple sources

Question 3: Solutions *(20 minutes)*

When identifying promising solutions to prevent and overcome diagnostic errors due to dismissed patients, consider: (1) What are the most promising global solutions that could help overcome this error?, (2) What are the most promising granular solutions within those strategies to help overcome this error?, (3) How can these solutions be operationalized across various settings and stakeholders?

When identifying solutions, ask yourself, “could this proposed solution measurably reduce misdiagnosis-related harms from dismissing patients?” and “if scaled broadly, would it likely produce a public health benefit in terms of improved diagnostic outcomes (quality, safety, value)?

Examples of possible global and granular solutions:

- Use of AI/machine learning to detect patterns for diagnostic odyssey in EHR and/or claims data
- Early referral for genetic counseling
- Early referral for specialist care and detailed diagnostic testing
- Protocols for inducing consultations (e.g., three visits for the same symptom with no explanation)
- Clinician education on affective bias (e.g., performing a "gut check" for feelings of anger, frustration, hopelessness)
- Clinician education on patient-centered diagnostic decision-making
- Patient engagement in diagnosis

Question 4: Quality Measurement *(10 minutes)*

When identifying opportunities for quality measurement, consider:

1. What kind of diagnostic performance measures might be useful in assessing the incidence of process failures, diagnostic errors, and misdiagnosis-related harms for some of the specific clinical scenarios identified within this use case?
2. Are some measures more promising than others to be operationally feasible in current practice for purposes of ongoing monitoring or to determine the impact of interventions/solutions to help prevent harms from cognitive error- dismissed patient from occurring?

Examples of possible measure concepts:

- Time to diagnosis for rare conditions
- Patient surveys on their/ their children's diagnostic odyssey
- Total cost of the diagnostic odyssey

[1] Carr S. Unexplained Symptoms: When Diagnostic Uncertainty Becomes a Diagnosis. *Society to Improve Diagnosis in Medicine*. https://www.improvediagnosis.org/improvedx-july-2019/unexplained-symptoms-when-diagnostic-uncertainty-becomes-a-diagnosis/. Last accessed February 2020.