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# What Were You Thinking? Cognitive Bias in Diagnosis

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# Overview

- Epidemiology of diagnostic error
- Cognitive biases
- Debiasing strategies
- Case studies
- Closing comments

# Diagnostic error

- Taxonomy of diagnostic error
  - Delayed diagnosis
  - Wrong diagnosis
  - Missed diagnosis
- Overall diagnostic error rate in hospital medical wards 10% to 15%
- 1 in every 100 errors will result in harm
  - Graber et al BMJ Qual Safe 2012
- Estimated 40,000 to 80,000 deaths annually in US
  - Newman-Toker, Pronovost JAMA 2009
- 17% of adverse events in hospitalised patients
  - Brennan et al N Engl J Med 1991
- Post-mortem studies: 5% to 20% disclose potentially treatable lethal diagnosis
  - Shojania et al Evid Rep Technol Assess 2002
- 10% of SAC 1 incidents and 20% of SAC 2 incidents related to diagnostic error
  - NSW Health Incident Information Management System (IIMS) 2014
- 13% of audited surgical mortality cases identify diagnostic error or delay
  - NSW Collaborating Hospitals' Audit of Surgical Mortality (CHASM) 2015

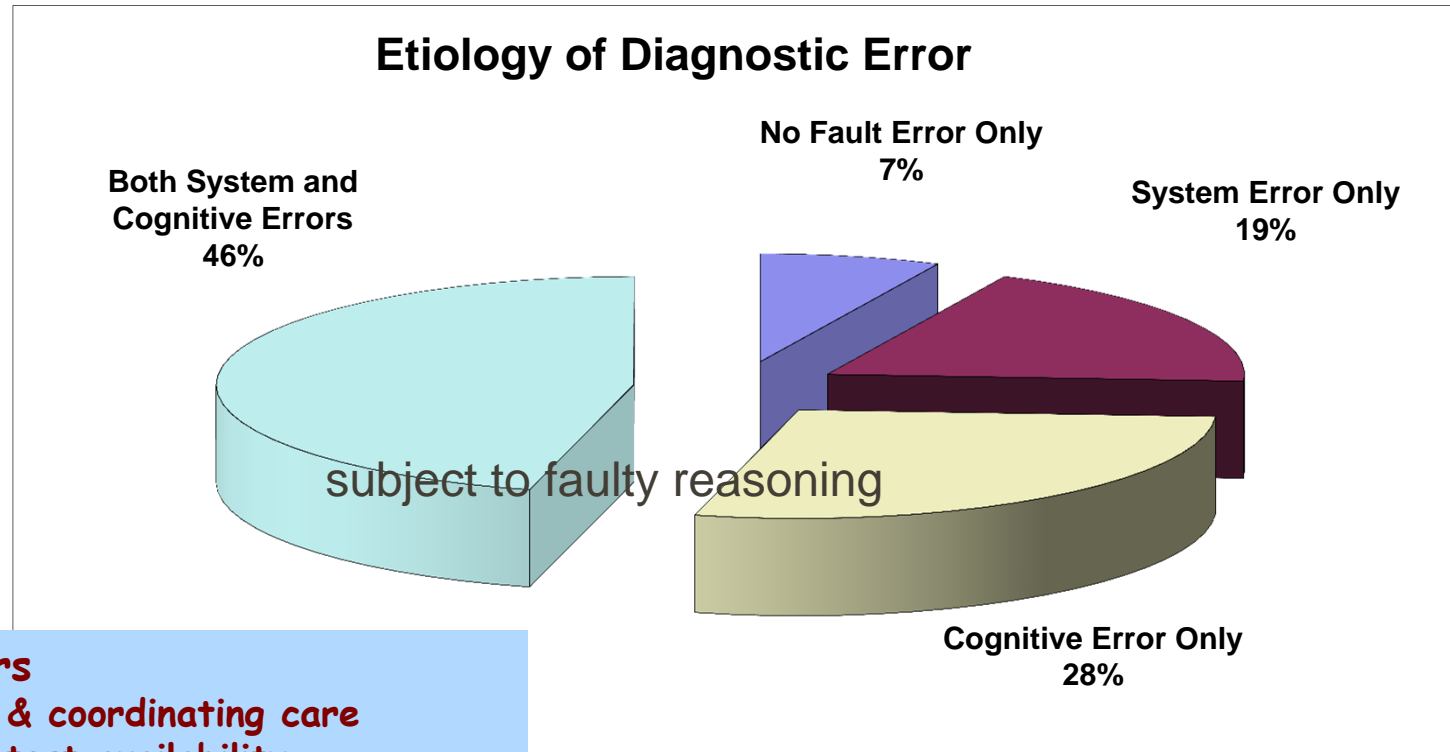
# Diagnostic error

## Other consequences

- Patient dissatisfaction and distrust
  - Malpractice claims
  - Increased health care costs
  - Psychological harm to professionals
- 
- All physicians subject to faulty reasoning despite talent, dedication and compassion

Graber et al Acad Med 2002

# Diagnostic error



## System errors

Communication & coordinating care  
Breakdowns in test availability,  
performance and alerting  
Records not available  
Inadequate supervision of trainees  
Expertise not available when needed  
after-hours

Graber et al Arch Intern Med 2005

# Cognitive biases

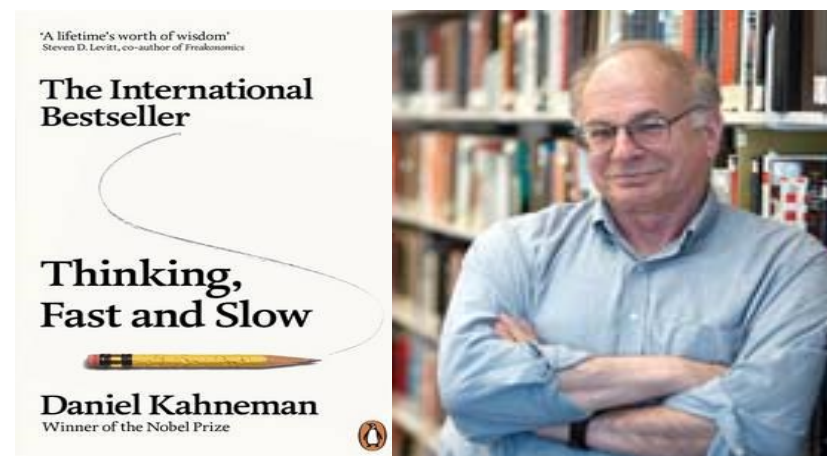
## 2 systems of thinking

### System 1: intuitive - fast, easy

- Based on personal 'mindlines', heuristics, beliefs, judgments, preferences
- Accurate for many decisions, but vulnerable to various cognitive biases (or systematic error driven by psychological factors)

### System 2: analytic - slow, takes effort

- Based on science, rational
- Data from a variety of environments demonstrates that human beings prefer to use System 1 thinking whenever possible
- Experienced physicians – 95% (Croskerry. Diagnosis 2014)



# Cognitive biases

Bias	Definition
Anchoring/ premature closure	Narrow focus on single feature in presentation to support a diagnostic hypothesis, despite other features refuting this hypothesis – accepting a diagnosis before it is fully verified
Availability bias	Tendency to think diagnoses that come immediately to mind are more likely or more common
Framing effects	Disproportionately influenced by how a problem is described, by whom, the setting, what has been previously accepted as a diagnosis (diagnostic momentum)
Base rate neglect/ Representativeness bias	Tendency to significantly overestimate likelihood of a diagnosis because the problem has some features representative of that diagnosis
Affective bias	Effects of emotional influences on thinking, including feelings towards their patients, both positive and negative
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Blind obedience	Inappropriate deference to recommendations of authority (superiors, 'experts') in absence of sound rationale



# Cognitive biases

## Situations where bias increases risk of error

- Handovers
- Time pressures
  - High patient volumes
  - Distractions/interruptions
- Individual physician factors
  - Fatigue/sleep deprivation
  - Personal stresses
  - Cognitively over-extended
  - Training and experience
- Patient factors
  - Unco-operative/difficult patient
  - Bad reputation
  - Complex illness ('heartsink' patient)
- Environmental factors
  - Lack of supervision
  - Lack of ancillary services (pathology, radiology)
  - Poor safety culture of organisation
  - Specialty service (as opposed to generalist)
  - Groupthink

# Cognitive debiasing

## Questions that should activate system 2 thinking

- What else could this be?
- Is there anything that does not fit?
- What can't I explain?
- Is this an atypical presentation?
- What should I be most worried about and why?
- How does this patient make me feel?
- Is it possible the patient has more than one problem?
- Is there any other reason I need to slow down?
- Do I need more expertise to assist me in making a diagnosis?

Trowbridge. Med Teacher 2008

# Cognitive debiasing

## Useful resources

### *Texts*

- Trowbridge et al. Teaching Clinical Reasoning. ACP. 2015
- Kassirer et al. Learning Clinical Reasoning. 2<sup>nd</sup> ed. Lippincott 2010
- Groopman J. How Doctors Think. Houghton Mifflin Company: New York. 2007

### *Articles*

- Scott. BMJ 2009; 339: 22-25.
- Scott et al. Med J Aust 2017 (in press)
- Croskerry. N Engl J Med 2013; 368: 2445-48.
- Croskerry et al. BMJ Qual Safe 2013; 22 Suppl 2: ii58-ii64; ii65-ii72
- Graber et al. BMJ Qual Safe 2012; 21: 535-537.
- Reilly et al. BMJ Qual Safe 2013; 22: 1044-50.
- Eva. Med Educ 2005; 39: 98-106.
- Eva et al. Med Educ 2007; 41: 1152-8.
- Bowen. N Engl J Med 2006; 355: 2217-25.
- Exercises in Clinical Reasoning – series in J Gen Intern Med

### *Websites*

- Society to Improve Diagnosis in Medicine: <https://improvediagnosis.org>
- Dx: Diagnostic Excellence: <http://www.med-u.org>
- RACP Diagnostic Error Q Stream: <https://www.racp.edu.au/fellows/supporting-physicians-professionalism-and-performance>

# RACP Congress App

App Store Search: RACP Congress

Log in with registration email

Password: 2017

# Test Question:

Are You....

- a) Male
- b) Female
- c) Prefer not to answer

# Case 1 - Overview

An 87 year old man is admitted with a diagnosis of acute coronary syndrome and is treated with anti-thrombotic treatment comprising clopidogrel, aspirin and warfarin. He has a history of COPD, chronic kidney disease, hypertension and atrial fibrillation (for which he was already warfarinised prior to admission). Just prior to presentation he developed a cough productive of brown phlegm and a mild fever. On day 2, his INR was found to be sub-therapeutic and enoxaparin was added until warfarin was therapeutic.

On day 4, he was found wandering the ward confused and disorientated. The JMO assessed him and found him to be clammy and diaphoretic but did not review the medical records as she was familiar with the patient. His vital signs showed he was hypotensive (BP 90/70) and mildly tachycardic (PR 110).

The JMO called the on-call medical registrar who was busy seeing patients in ED but had seen the patient earlier in the day. The medical registrar thought the patient was likely experiencing an acute delirium, secondary to sepsis from a lower respiratory tract infection (LRTI) in view of the productive cough. Sepsis management was initiated and the case was handed over to the night resident for follow-up.

During the night, the patient progressively deteriorated, becoming more hypotensive and tachycardic, and was found on CT imaging of the abdomen to have had a large retroperitoneal bleed. Emergency resuscitation with blood transfusion and cessation of anti-thrombotic treatment was initiated; however he subsequently died from multi-organ failure a few days later.

What are the factors relating to the diagnostic process involving this patient that led to the delayed recognition of a complication of anticoagulation?

# Case 1 - What are the factors relating to the diagnostic process involving this patient that led to the delayed recognition of a complication of anticoagulation?

- a) Poor communication between the JMO reviewing the patient and the medical registrar on call regarding the patient's current clinical symptoms
- b) The JMO failed to perform a thorough physical assessment of the patient
- c) The patient was difficult to assess because of his disorientation and confusion and was unable to provide a clear history
- d) Inadequate assessment and consideration of differential diagnoses by the medical registrar
- e) All of the above

# Case 1 - Answer

d) Inadequate assessment and consideration of differential diagnoses by the medical registrar



# What was the main cognitive bias?

	Bias	Definition
a)	Anchoring/ premature closure	Narrow focus on single feature in presentation to support a diagnostic hypothesis, despite other features refuting this hypothesis – accepting a diagnosis before it is fully verified
b)	Availability bias	Tendency to think diagnoses that come immediately to mind are more likely or more common
c)	Framing effects	Disproportionately influenced by how a problem is described, by whom, the setting, what has been previously accepted as a diagnosis (diagnostic momentum)
d)	Base rate neglect/ Representativeness bias	Tendency to significantly overestimate likelihood of a diagnosis because the problem has some features representative of that diagnosis
e)	Affective bias	Effects of emotional influences on thinking, including feelings towards their patients, both positive and negative
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g)	Blind obedience	Inappropriate deference to recommendations of authority (superiors, 'experts') in absence of sound rationale

# Discussion

**Q. What was the prime cognitive bias in this case:**

**A. Premature closure with overconfidence** – the provisional diagnosis of sepsis secondary to LRTI was accepted too readily, bringing the thought processes to a premature closure, before a list of alternative diagnoses could be considered that might also fit (or fit even better) with the clinical features of the case.

While sepsis need to be considered (fever, cough, past history COPD), the sudden onset of confusion and haemodynamic instability in an elderly patient receiving aggressive anti-thrombotic treatment should raise the possibility of haemorrhage into ‘silent’ areas such as the abdomen for which localising symptoms and signs may be absent.

***What predisposed the medical registrar to this bias:***

Time pressures and fatigue may have caused the medical registrar to rely too heavily on the information relayed by the JMO and her previous assessment of the patient’s condition.

# Case 2 - Overview

Flynn is a 17 month old boy with a 2 day history of malaise, loss of appetite and runny nose. After developing a temperature and sore throat, he was seen by the GP who diagnosed a viral illness with possible tonsillitis, but no signs of pus requiring antibiotics. Over the next 2 days, he developed vomiting and an erythematous rash spreading from his groin, under arms and behind his knees. At this point, he was taken back to the GP.

Flynn was seen by a different GP who fitted him into his busy clinic who noted worsening tonsillitis and commenced antibiotics. Later that evening, Flynn became irritable and more unwell. His rash had spread and he was taken to the local ED.

There had been several paediatric presentations with viral illness to the ED over the previous few days. The ED doctor reviewed Flynn and noted that his symptoms were very similar to those of a number of other patients on that shift. The doctor determined that the rash was either a viral exanthem or a reaction to the antibiotics.

Flynn was prescribed antihistamine and was sent home despite his parents' concerns regarding his condition. He remained unwell, lethargic and flat and was taken back to the GP the following day. He was seen again by the first GP who identified a significant deterioration and immediately sent Flynn to the tertiary referral paediatric facility.

Following admission, Flynn was diagnosed with streptococcal bacteraemia which was promptly treated and he recovered well with no long term sequelae.

Which of the following factors potentially contributed to the delay in Flynn's diagnosis?

## Case 2 - Which of the following factors potentially contributed to the delay in Flynn's diagnosis?

- a) The second GP missed the significance of new symptoms of vomiting and rash and did not take the opportunity to re-evaluate Flynn's medical problem
- b) The differential diagnosis of post viral rash or antibiotic reaction was based on the most prevalent conditions at the time and was insufficiently comprehensive
- c) The ED doctor interpreted Flynn's symptoms as being concordant with his impression of viral illness
- d) The seriousness of Flynn's condition during his 1<sup>st</sup> presentation to ED was not recognised which, if it had, would have justified monitoring his condition for a period of time
- e) All of the above
- f) None of the above - course of action was reasonable based on the difficulty, in many cases, in separating bacterial from viral illness in young children

# Case 2 – Answer

e) All of the above

# What was the main cognitive bias?

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F	Overconfidence	Tendency to think one knows more than one does, especially if placing faith in opinions without gathering necessary supporting evidence
G	Blind obedience	Inappropriate deference to recommendations of authority (superiors, 'experts') in absence of sound rationale

# Discussion

*Q. What was the prime cognitive bias in this case:*

**A. The availability heuristic**

The recent experience of the clinicians involved with multiple other cases of viral and gastrointestinal illness in young children caused them to over-estimate the likelihood of Flynn having the same problem

- Despite red flags: child's deterioration despite antibiotics, onset of a rash, and parental concern.

Novice practitioners more influenced by the availability heuristic than more experienced clinicians

- fewer 'illness scripts' which come readily to mind - limited to only the cases they have seen
- tend to be the more common (and usually more benign) cases

Availability heuristic may work in the opposite direction and result in error when a vivid case is rapidly recalled that was rare or involved a dramatic and unexpected outcome

- Example: A recent case is recalled of a missed diagnosis of pulmonary embolism in a healthy young woman who had vague chest discomfort but no other clinical findings or apparent risk factors.
- Clinicians seeing this case might then begin to overestimate the risk of pulmonary embolism in patients presenting with similar clinical features and request invasive investigations and potentially harmful anticoagulation despite the low probability of disease.

# Case 3 - Overview

Joan is a 74 year old lady with multiple co-morbidities, including a colostomy following resection of a rectal cancer, who is admitted for respite care and assessment for long term care placement. Two weeks into her stay, she developed epigastric pain in the late evening which Mylanta did not relieve.

The on-call doctor was contacted and a phone order for opioid analgesia was made (after which she was noted to be sleeping comfortably). The next morning, she developed a distended abdomen, felt nauseous and had no appetite. She then started vomiting black coloured liquid and the doctor was called to review her. Nurses reported concerns regarding her inactive colostomy and protruding stoma.

Joan was reviewed by the medical officer on call that afternoon who assessed her as having no abdominal tenderness on palpation, active bowel sounds, passed flatus and normal vital signs. She was diagnosed and treated for viral gastritis as her husband was also suffering symptoms of diarrhoea and vomiting. The black vomit was determined to be due to iron supplements.

Over the next 24 hours, Joan continued to vomit dark liquid intermittently. Her colostomy remained inactive and her vital signs became abnormal with BP lower than usual for her (but still within acceptable parameters) and moderate tachycardia with a PR 110 bpm. Viral gastritis complicated by upper GI mucosal bleeding was still thought to be most likely given the absence of abdominal pain and physical signs of peritonism, and the presence of bowel sounds. At mid-day the following day, she was found unresponsive and resuscitation attempts were unsuccessful. Post-mortem examination identified cause of death to be perforated bowel.

Which of the following decision making strategies may have assisted in avoiding diagnostic error at an earlier stage?



# Case 3 - Which of the following decision making strategies may have assisted in avoiding diagnostic error at an earlier stage?

- a) Considering and documenting the differential diagnoses
- b) Identifying and ruling out the worst case scenario
- c) Identifying signs that did not quite fit the working diagnosis
- d) Considering if any red flag features were present that might indicate a serious clinical problem
- e) All of the above
- f) None of the above

# Case 3 - Answer

e) All of the above

# What was the main cognitive bias?

# What was the main cognitive bias?

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# Discussion

**Q. What was the prime cognitive bias in this case:**

**A. Anchoring and confirmation bias**

Treating clinicians became 'anchored' to the diagnosis of gastritis based on initial impressions and the fact that her husband was also suffering symptoms suggesting viral gastroenteritis. This diagnosis was further reinforced by confirmation bias – seeking and interpreting clinical features and investigation results that appeared to confirm the working diagnosis of gastritis and ignoring clues that might disprove the favoured diagnosis.

These included:

- ongoing intermittent vomiting of dark fluid (as opposed to coffee-ground vomits more in keeping with gastritis)
- inactive colostomy and protruding stoma (suggesting bowel anergy which is rare in viral gastroenteritis)
- distended abdomen (suggesting a colonic problem rather than a gastric one)
- onset of tachycardia and low blood pressure (which was not present at the onset of her illness when you would expect them to be as a result of dehydration secondary to gastritis and poor oral intake).

Deliberately considering other possibilities, especially 'do not miss' diagnoses, guards against anchoring bias

But if applied indiscriminately, may also unintentionally create a tendency towards over-diagnosis and over-utilisation of resources in a futile chase after 'red herrings'

# Case 4 - Overview

A 65 year old male with past history of treated small bowel lymphoma presents with malaise, upper abdominal pain, deranged liver function tests (which had been normal one week previously) and thrombocytopenia. Physical examination reveals mild fever (T 38.5°C) and tenderness in the right upper quadrant. An abdominal ultrasound shows normal liver texture, no dilatation of the biliary ducts and normal gallbladder. A coagulation profile is not consistent with DIC. After the taking of blood cultures, the patient is commenced on broad spectrum antibiotics but his liver function tests continue to worsen.

A consult is sought from the GE unit and the GE registrar, after reviewing all results, postulates a broad differential diagnosis including:

- ?cholangitis
- ?acute viral hepatitis (Hep B, C, CMV, EBV)
- ?recurrent small bowel lymphoma
- ?drug reaction to concomitant PPI (although long-standing therapy)
- ?autoimmune hepatitis

She also requests – ‘just for completeness’ - iron studies, copper studies, and anti-trypsin 1 assay to rule out haemochromatosis, Wilson’s disease and anti-trypsin deficiency.

Which of the following statements describes the diagnostic error?

# Case 4 - Which of the following statements describes the diagnostic error?

- a) Most diagnostic errors are caused by failure to undertake the most appropriate investigations
- b) Diagnostic error often reflects lack of knowledge of atypical presentations of common clinical syndromes
- c) Ordering comprehensive test panels when considering a large list of differential diagnoses is likely to yield the correct diagnosis
- d) Diagnostic error can be reduced by selecting investigations based on a careful consideration of pre-test probability
- e) All of the above

# Case 4 - Answer

c) Ordering comprehensive test panels when considering a large list of differential diagnoses is likely to yield the correct diagnosis



# What was the main cognitive bias?

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# Discussion

*Q. What was the prime cognitive bias in this case:*

**A.** Base rate neglect where uncertainty about the cause of this patient's worsening liver function tests results in consideration and investigation of disorders which are very unlikely to be present in this patient.

The last three diseases mentioned are highly unlikely based on the patient's premorbid history with no suggestive clinical features, the prior presence of normal liver function tests, and the normal appearance of the liver on ultrasound.

Resorting to a blunderbuss approach and ordering tests 'just to be complete' without considering pre-test probability is a major cause of over-investigation which often leads to spurious false-positive results which leads to further unnecessary investigations and, in some cases, unjustified and potentially harmful treatments.

At the very least, over-investigation wastes precious resources, imposes discomfort on patients, and may lead to further delays in arriving at the correct diagnosis while waiting results of outstanding but clinically irrelevant tests

# Diagnostic Error – Systems vs Clinicians

- Policy and practical variability in practice
- Workers often develop and need to use work arounds to “get the job done”
- Work as done (reality, practical, worker) often does not equate with Work as intended (policy, direction, management)
- Clinicians often left carrying liability risks for both systems factors and clinician factors
- Reduction strategies most effective at what level:
  - Individuals?
  - Systems?
- High risk, low error organisations – characteristics

# Safety 1 and Safety 2

- Correctly differentiating Safety 1 and Safety 2 dimensions to this problem
- Identifying and incorporating systemic risks into workplace design and decision-making:
  - Functional Resonance Analysis Methodology (FRAM)
  - Resilience Engineering
- Can clinical systems be designed to naturally tolerate a degree of bias related events and avoid harms from them?
  - Variation in experience (e.g. novice to expert)
  - Variation in diagnostic approach and abilities
  - Harmless vs harmful cognitive bias
  - Avoidance of no-win situations, creation of always win when you lose systems
  - Embracing the reality of individuals and psychology (i.e. humanistic systems)
- Is productivity better in workplaces that incorporate **design factors to avoid bias related harms**, while retaining humanistic features? (high tolerance, high flexibility)
- Or are traditional **compliance and assurance** approaches more effective? (i.e. low tolerance, low flexibility)

# Closing Comments

- Thank you for participating

# References

## Case 1

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Singh, H. et al., Types and origins of diagnostic errors in primary care settings. JAMA Internal Med, 2013. 173 (6): p. 418-425

Giardina, T., et al., Root cause analysis reports help identify common factors in delayed diagnosis and treatment of outpatients. Health Affairs, 2013. 8: p.1368-1375

## Case 2

Croskerry, P. Achieving Quality in Clinical Decision Making: Cognitive Strategies and Detection of Bias. 2002, Acad Emerg Med. 9(11): p. 1184-1204

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