Cognitive Errors in Diagnosis

Tom Heaps
Consultant Acute Physician
University Hospitals Coventry & Warwickshire
Mortality Review

• Mr. OK, 52-year-old male with alcohol dependence
• 4th presentation to ED with chest pain, Monday afternoon
• Triaged in ED @13:10 as ‘chest pain r/o ACS’
• Seen by Cardiac Nurse Practitioner (CNP) @13:30
• ECG: T wave inversion in all leads (different to previous)
• CNP documented;
  – ‘possible history of melaena over weekend’
  – ‘?ACS, ?UGIB’
Mortality Review Cont.

- Seen by medical FY1 in ED at 15:00
- ‘central chest pain, loose black motions x6 yesterday, abnormal ECG, HR and BP normal, Rx as ACS’
- ‘Reviewed’ by Consultant at 17:00; ‘continue to treat as ACS’
- Moved to AMU, given aspirin, clopidogrel and clexane
- Collapsed at 22:20 with melaena, sBP 70mmHg
- Admission bloods showed Hb 7.1g/dl, INR 1.7, platelets 36
- resuscitated with fluids/blood products but arrested
- died at 23:00
What The F*@K Happened There?!

Diagnostic/decision-making error with few apparent systemic faults

a) The junior doctor was incompetent/reckless/lazy/stupid?

b) The junior doctor was tired/overworked/unwell?

c) It’s all the Consultant’s fault?

d) The doctor/s need a slap on the wrists?

e) The doctor/s need more specific training?

NOT A KNOWLEDGE DEFICIT – HOW ELSE CAN WE EXPLAIN THIS?
Diagnostic Errors

- 15% of CAEs (2\textsuperscript{nd} highest ranking behind medication errors)
- Acute Medicine, Emergency Medicine and General Practice
- 50-75\% of claims against EM doctors and 66\% of claims against family practitioners in US
- 85\% of diagnostic errors ‘preventable’ (50\% CAEs overall)
- Serious disability results in up to 50\% (1/3 CAEs overall)

**UP TO 15\% OF DIAGNOSES MADE BY DOCTORS ARE WRONG!**
Why Do Diagnostic Errors Occur?

1. No Fault Errors

2. Systemic Errors

3. Cognitive Errors and Biases

- for every diagnostic error there are on average 6 root causes
- cognitive errors and biases account for 2/3 of these
Why Do Cognitive Errors/Biases Occur?

**Dual Process Theory of cognition**

<table>
<thead>
<tr>
<th><strong>System 1</strong></th>
<th><strong>System 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intuitive</strong>, heuristic, hard-wired</td>
<td><strong>Analytical</strong>, systematic, rational</td>
</tr>
<tr>
<td>Automatic, subconscious, passive</td>
<td>Deliberate, conscious, active</td>
</tr>
<tr>
<td>Fast, effortless, high capacity</td>
<td>Slow, effortful, limited capacity</td>
</tr>
<tr>
<td>Low/variable reliability</td>
<td>High/consistent reliability</td>
</tr>
<tr>
<td>Highly affected by context</td>
<td>Less affected by context</td>
</tr>
<tr>
<td>Vulnerable to errors/biases</td>
<td>Less prone to errors/biases</td>
</tr>
<tr>
<td>Low scientific rigour</td>
<td>High scientific rigour</td>
</tr>
<tr>
<td>High emotional involvement</td>
<td>Low emotional attachment</td>
</tr>
<tr>
<td>Medial prefrontal cortex, nucleus accumbens, amygdala, lateral temporal cortex</td>
<td>Lateral prefrontal cortex, hippocampus, medial temporal lobe, posterior parietal cortex</td>
</tr>
</tbody>
</table>
Real World ‘Flesh & Blood’ Decision Making

• mainly use intuitive (system 1) reasoning (subconscious, hardwired)
  - use of heuristics or ‘rules of thumb’
  - pattern recognition
  - rule out worst-case scenario (ROWS)

• ‘fast and frugal’ with minimal cognitive effort required
• often effective in the face of uncertainty, time pressure and limited data
• usually allows good/accurate decisions to be made
• prone to cognitive biases; sometimes catastrophic errors occur
The Cognitive Iceberg

In medicine, most of our errors occur whilst in the intuitive (system 1) mode of thinking.....

and yet, this is where we seem to spend most of our time.....
Why Do Diagnostic Errors Occur?

**INTERNAL FACTORS**
- knowledge
- training
- beliefs/values
- emotions
- sleep/fatigue
- stress
- affective/physical illness
- overconfidence
- risk-taking behaviour

**COGNITIVE ERRORS/BIASES**
- use of intuitive (system 1) decision-making processes

**EXTERNAL FACTORS**
- distractions
- cognitive load
- decision density
- time pressures
- ambient conditions
- insufficient data
- team factors
- patient factors
- poor feedback

**DIAGNOSTIC FAILURE**
## Cognitive Errors and Biases

<table>
<thead>
<tr>
<th>Aggregate Bias</th>
<th>Gender Bias</th>
<th>Psych-Out Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchoring</td>
<td>Hindsight Bias</td>
<td>Representativeness</td>
</tr>
<tr>
<td>Ascertainment Bias</td>
<td>Multiple Alternatives</td>
<td>Search Satisficing</td>
</tr>
<tr>
<td>Attribution Error</td>
<td>Omission Bias</td>
<td>Sutton’s Slip</td>
</tr>
<tr>
<td>Availability</td>
<td>Order Effects</td>
<td>Triage-Cueing</td>
</tr>
<tr>
<td>Base Rate Neglect</td>
<td>Outcome Bias</td>
<td>Unpacking Principle</td>
</tr>
<tr>
<td>Commission Bias</td>
<td>Overconfidence</td>
<td>Vertical Line Failure</td>
</tr>
<tr>
<td>Confirmation Bias</td>
<td>Playing The Odds</td>
<td>Visceral Bias</td>
</tr>
<tr>
<td>Diagnostic Creep</td>
<td>Posterior Probability</td>
<td>Yin-Yang Out</td>
</tr>
<tr>
<td>Gambler’s Fallacy</td>
<td>Premature Closure</td>
<td>Zebra Retreat</td>
</tr>
</tbody>
</table>
1. Triage-Cueing: *geography is destiny*

- Common source of bias in ED; may propagate within ED
- Delayed/missed diagnosis or inappropriate over-utilization of resources
- *Patient presented with ‘chest pain’*
- *Triaged as ‘chest pain’ to Cardiac Nurse Practitioner*
- *Delay in initial assessment by a doctor*
- *Reinforced notion that chest pain was cardiac in origin*
- Patient with abdominal pain/vomiting triaged to surgeons (DKA)
- Patient with blurred vision triaged to eye casualty (methanol OD)
2. Diagnostic Creep/Momentum: *sticky labels*

- Tendency for particular diagnosis to become *de facto* without adequate supporting evidence

- ‘*like a boulder rolling down a mountain, the diagnosis gathers momentum, crushing all else in its path*’

- Usually involves several intermediaries including patient

- Often starts as an opinion (not necessary medical)

- Passed from one person to the next with increased certainty

- Diagnostic label becomes particularly ‘sticky’ once patient seen by Consultant/Specialist
3. Confirmation Bias: *following your hunches*

- Tendency to look for confirming evidence to support our initial hypothesis rather than looking for disconfirming evidence to refute it.

- Clinicians may even subconsciously *ignore* disconfirming/contradictory evidence that does not fit with their initial hypothesis.

- Disconfirming evidence undermines our initial decision and means that the thinking process must start again = more work.

- *ECG showed widespread T wave inversion ‘confirming’ diagnosis of ACS*.

- *History of melaena was selectively ignored*.

- *FY1 accepted diagnosis of ACS and moved on without repeating ECG, waiting for troponin or checking other bloods = premature closure*.
4. Visceral/Affective Bias: *countertransference*

- All clinical decisions should be made objectively and consistently from one patient to the next.

- Negative and positive feelings towards patients impact on quality of decision-making.

- Under- or over-investigation and/or treatment may result.

- Alcoholics, IVDUs, COPD patients who still smoke, morbidly obese, recurrent DSH, frequent flyers etc.

- **FY1 didn’t perform DRE because patient unkempt and didn’t really believe patient’s story of melaena (frequent attender, alcoholic)**

- **Moved on quickly to a ‘more deserving’ patient**
5. Availability Bias: *common things are common, recency effect, out of sight out of mind*

- Tendency for diagnoses to be made more frequently if they readily come to mind or are perceived as being common
- Conditions that are common or that a clinician has recently diagnosed/been taught about are more easily recalled
- May influence estimates of the base-rate of an illness
- *FY1 doctor had seen 2 patients with chest pain earlier that day*
- *Diagnosed both of them with ?ACS*
- *Looked up the management protocols for ACS*
6. Posterior Probability Bias: *history repeats itself*

- Estimate of likelihood of a diagnosis is based on a patient’s previous attendances and diagnoses made

- Risk that previous diagnoses were wrong and that alternative diagnostic possibilities may be ignored

- More likely if previous diagnoses were made by specialists or senior clinicians

- *Patient attended ED multiple times with chest pain*

- *TTOs all stated ‘chest pain ?ACS’ (troponins always –ve)*
# Cognitive Errors and Biases

<table>
<thead>
<tr>
<th>Aggregate Bias</th>
<th>Gender Bias</th>
<th>Psych-Out Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anchoring</strong></td>
<td>Hindsight Bias</td>
<td>Representativeness</td>
</tr>
<tr>
<td>Ascertainment Bias</td>
<td>Multiple Alternatives</td>
<td>Search Satisficing</td>
</tr>
<tr>
<td>Attribution Error</td>
<td>Omission Bias</td>
<td>Sutton’s Slip</td>
</tr>
<tr>
<td><strong>Availability Bias</strong></td>
<td>Order Effects</td>
<td><strong>Triage-Cueing</strong></td>
</tr>
<tr>
<td>Base Rate Neglect</td>
<td>Outcome Bias</td>
<td>Unpacking Principle</td>
</tr>
<tr>
<td>Commission Bias</td>
<td>Overconfidence</td>
<td>Vertical Line Failure</td>
</tr>
<tr>
<td><strong>Confirmation Bias</strong></td>
<td>Playing The Odds</td>
<td><strong>Visceral Bias</strong></td>
</tr>
<tr>
<td>Diagnostic Creep</td>
<td>Posterior Probability</td>
<td>Yin-Yang Out</td>
</tr>
<tr>
<td>Gambler’s Fallacy</td>
<td>Premature Closure</td>
<td>Zebra Retreat</td>
</tr>
</tbody>
</table>
Another example of a cognitive error/bias....

- 52♀ with history of IBS and migraines (none since childhood)
- Multiple ED attendances and admissions in last 2 months
- Also seen in neurology clinic; Δ chronic non-specific headache
- Numerous lx on results server (4x CT head, 2x LPs, 1x MRV)
- Re-presents to ED with headache and mild hypertension
- Discharged with diagnosis of ‘recurrent chronic headache’
- Found dead at home (aneurysmal SAH on coroner’s PM)
# Cognitive Errors and Biases

<table>
<thead>
<tr>
<th>Aggregate Bias</th>
<th>Gender Bias</th>
<th>Psych-Out Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchoring</td>
<td>Hindsight Bias</td>
<td>Representativeness</td>
</tr>
<tr>
<td>Ascertainment Bias</td>
<td>Multiple Alternatives</td>
<td>Search Satisficing</td>
</tr>
<tr>
<td>Attribution Error</td>
<td>Omission Bias</td>
<td>Sutton’s Slip</td>
</tr>
<tr>
<td>Availability</td>
<td>Order Effects</td>
<td>Triage-Cueing</td>
</tr>
<tr>
<td>Base Rate Neglect</td>
<td>Outcome Bias</td>
<td>Unpacking Principle</td>
</tr>
<tr>
<td>Commission Bias</td>
<td>Overconfidence</td>
<td>Vertical Line Failure</td>
</tr>
<tr>
<td>Confirmation Bias</td>
<td>Playing The Odds</td>
<td>Visceral Bias</td>
</tr>
<tr>
<td>Diagnostic Creep</td>
<td>Posterior Probability</td>
<td>Yin-Yang Out</td>
</tr>
<tr>
<td>Gambler’s Fallacy</td>
<td>Premature Closure</td>
<td>Zebra Retreat</td>
</tr>
</tbody>
</table>
# Cognitive Errors and Biases

<table>
<thead>
<tr>
<th>Aggregate Bias</th>
<th>Gender Bias</th>
<th>Psych-Out Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchoring</td>
<td>Hindsight Bias</td>
<td>Representativeness</td>
</tr>
<tr>
<td>Ascertainment Bias</td>
<td>Multiple Alternatives</td>
<td>Search Satisficing</td>
</tr>
<tr>
<td>Attribution Error</td>
<td>Omission Bias</td>
<td>Sutton’s Slip</td>
</tr>
<tr>
<td>Availability</td>
<td>Order Effects</td>
<td>Triage-Cueing</td>
</tr>
<tr>
<td>Base Rate Neglect</td>
<td>Outcome Bias</td>
<td>Unpacking Principle</td>
</tr>
<tr>
<td>Commission Bias</td>
<td>Overconfidence</td>
<td>Vertical Line Failure</td>
</tr>
<tr>
<td>Confirmation Bias</td>
<td>Playing The Odds</td>
<td>Visceral Bias</td>
</tr>
<tr>
<td>Diagnostic Creep</td>
<td><strong>Posterior Probability</strong></td>
<td>Yin-Yang Out</td>
</tr>
<tr>
<td>Gambler’s Fallacy</td>
<td>Premature Closure</td>
<td>Zebra Retreat</td>
</tr>
</tbody>
</table>
Yin-Yang-Out: serum rhubarb (UK), million dollar work-up (US), standing stool velocities (Canada)

- Patient has been investigated ‘up the yin-yang’ for a pre-existing condition or presentation
- Wrongly assumed that;
  - Everything that can be done, has been done
  - Further investigations will be unproductive/wasteful
- Some overlap with posterior probability bias
- Disease process may have evolved and become ‘diagnosable’
- Concurrent diagnoses may present in similar way to the first
One final example...

- 62 ♀ chronic schizophrenic
- recent change in antipsychotic Rx
- transferred from Ψ unit to ED for assessment
- abrupt change in personality, intermittently drowsy
- T° of 37.8°C on triage was not documented in clerking
- ‘neurological examination grossly normal’
- Δ ‘flair of schizophrenia’ or ‘side effects of antipsychotics’
- discharged back to Ψ unit
- readmitted in status epilepticus (final diagnosis HSVE)
# Cognitive Errors and Biases

<table>
<thead>
<tr>
<th>Cognitive Error</th>
<th>Bias Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Bias</td>
<td>Gender Bias</td>
<td>Psych-Out Errors</td>
</tr>
<tr>
<td>Anchoring</td>
<td>Hindsight Bias</td>
<td>Representativeness</td>
</tr>
<tr>
<td>Ascertainment Bias</td>
<td>Multiple Alternatives</td>
<td>Search Satisficing</td>
</tr>
<tr>
<td>Attribution Error</td>
<td>Omission Bias</td>
<td>Sutton’s Slip</td>
</tr>
<tr>
<td>Availability</td>
<td>Order Effects</td>
<td>Triage-Cueing</td>
</tr>
<tr>
<td>Base Rate Neglect</td>
<td>Outcome Bias</td>
<td>Unpacking Principle</td>
</tr>
<tr>
<td>Commission Bias</td>
<td>Overconfidence</td>
<td>Vertical Line Failure</td>
</tr>
<tr>
<td>Confirmation Bias</td>
<td>Playing The Odds</td>
<td>Visceral Bias</td>
</tr>
<tr>
<td>Diagnostic Creep</td>
<td>Posterior Probability</td>
<td>Yin-Yang Out</td>
</tr>
<tr>
<td>Gambler’s Fallacy</td>
<td>Premature Closure</td>
<td>Zebra Retreat</td>
</tr>
</tbody>
</table>
Cognitive Errors and Biases

<table>
<thead>
<tr>
<th>Aggregate Bias</th>
<th>Gender Bias</th>
<th>Psych-Out Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchoring</td>
<td>Hindsight Bias</td>
<td>Representativeness</td>
</tr>
<tr>
<td>Ascertainment Bias</td>
<td>Multiple Alternatives</td>
<td>Search Satisficing</td>
</tr>
<tr>
<td>Attribution Error</td>
<td>Omission Bias</td>
<td>Sutton’s Slip</td>
</tr>
<tr>
<td>Availability</td>
<td>Order Effects</td>
<td>Triage-Cueing</td>
</tr>
<tr>
<td>Base Rate Neglect</td>
<td>Outcome Bias</td>
<td>Unpacking Principle</td>
</tr>
<tr>
<td>Commission Bias</td>
<td>Overconfidence</td>
<td>Vertical Line Failure</td>
</tr>
<tr>
<td>Confirmation Bias</td>
<td>Playing The Odds</td>
<td>Visceral Bias</td>
</tr>
<tr>
<td>Diagnostic Creep</td>
<td>Posterior Probability</td>
<td>Yin-Yang Out</td>
</tr>
<tr>
<td>Gambler’s Fallacy</td>
<td>Premature Closure</td>
<td>Zebra Retreat</td>
</tr>
</tbody>
</table>
Psych-Out Errors:

- many cognitive errors/biases are pervasive in $\Psi$ patients

- *visceral bias, search satisficing, and posterior probability bias* are very common in $\Psi$ patients

- *comorbid medical conditions are common* in those with chronic psychiatric illness and often go undetected

- *medical illness often manifests as behavioural changes* in $\Psi$ patients
Can Cognitive Errors/Biases be Prevented?

• Recent efforts have focused on system approaches to patient safety
  – System improvements often degrade over time
  – System ‘fix’ may introduce new opportunities for error
  – Trade-offs are common e.g. EWTD
  – Most diagnostic errors due to cognitive biases NOT systemic failings

• Pessimism and inertia surrounding approaches to reduce cognitive error
  – Poor awareness of diagnostic error and cognitive biases
  – To err is human
  – Decision making naturally improves with experience and expertise
  – Limited research and evidence base for cognitive approaches
Cognitive Pills for Cognitive Ills!

- Education in cognitive error theory is key first step
- Encourage metacognition i.e. 'thinking about thinking'
- Improved feedback for trainees
- Use of problem-based learning or simulation to highlight cognitive errors
- Cognitive forcing strategies, generic or specific
- Cognitive 'autopsies' as part of M&M meetings
- Use of diagnostic timeouts

1. Are there any cognitive 'red flags' in this situation?
2. What is the evidence for and against my diagnosis?
3. What are the alternative explanations/diagnoses?
4. What is the one diagnosis I don't want to miss?
5. Do I need a senior review or a second opinion?

RED FLAG SITUATIONS FOR COGNITIVE ERRORS/BIASES

- Failure to respond to Rx or recurrent attendances for same problem
- Presenting symptoms e.g. headache, chest pain, back pain
- Patients with psychiatric disease, repeated self-harm, or somatization
- Other high risk groups e.g. alcoholics, IVDUs, morbidly obese, COPD
- Intrinsic factors e.g. stress, fatigue, sleep deprivation, physical illness
- Extrinsic factors e.g. excessive workload, multiple interruptions, high ambient temperature or noise levels
‘It sort of makes you stop and think, doesn’t it’
Recommended Reading

And/or any article written by Pat Croskerry on the subject of cognitive error or diagnostic reasoning...