Pitfalls in medicine
How do internists reason and why does it matter?
Arnaud Perrier
Division of General Internal Medicine
Geneva University Hospitals and Faculty of Medicine

Winter School
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Saas-Fee
How do internists reason?
Diagnostic errors are frequent

Can electronic clinical documentation help prevent diagnostic errors?
Diagnostic errors are frequent

62% of claims come from these four high-risk areas.
percentage of all claims asserted 2005–2009, N=1,134 claims

- Diagnosis: 26%
- Surgery: 24%
- Obstetrics: 7%
- Medication: 5%

Top responsible services in diagnosis-related cases
percentage of all diagnosis-related claims asserted 2003–2007, N=314 claims

- Int Med: 32%
- Emergency: 10%
- Radiology: 10%
- Gastro: 5%
- Gen Surg: 4%
- Gynecology: 4%
- Neurology: 4%
Diagnostic errors are frequent

## Breakdowns in the Process of Care
percentage of all diagnosis-related claims asserted 2003–2007, N=314 claims

<table>
<thead>
<tr>
<th>Process of Care</th>
<th>% of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient notes problem and seeks care</td>
<td>6%</td>
</tr>
<tr>
<td>History &amp; physical, evaluation of symptoms</td>
<td>42%</td>
</tr>
<tr>
<td>Order of diagnostic labs/tests</td>
<td>60%</td>
</tr>
<tr>
<td>Test performance</td>
<td>7%</td>
</tr>
<tr>
<td>Test interpretation</td>
<td>35%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process of Care</th>
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<tbody>
<tr>
<td>Receipt/transmittal of test result</td>
<td>14%</td>
</tr>
<tr>
<td>Physician follow-up with patient</td>
<td>18%</td>
</tr>
<tr>
<td>Referral management</td>
<td>22%</td>
</tr>
<tr>
<td>Patient compliance</td>
<td>5%</td>
</tr>
</tbody>
</table>

* A case may have more than one breakdown in the process of care.
How frequent are diagnostic errors?

2201 adults in the US: experience of medical mistake in oneself, family or friends
How frequent are diagnostic errors?


• Less frequent in "visual disciplines" (radiology, pathology): around 5%
• In clinical disciplines, on average 15% of our diagnoses are wrong!
• Demonstrated in:
  – Autopsy studies
  – Emergency medicine
  – Family medicine (standardized patients)
A clinical case

• 85-year old male colleague

• Previous history:
  – Paroxysmal atrial fibrillation treated successively by amiodarone, beta-blockers and flecainide
  – Treated HTA
  – Heart murmur since teen-age (mitral prolapse)

• Present history:
  – **Worsening dyspnea** since 2 months

• Cardiological consult: (minus 2 months)
  – Unremarkable physical examination
  – Sinus rythm
85-year old male ex-physician

- Pulmonology consult: (minus 3 weeks)
  - Normal lung function tests
  - Reduced distance on 6-minute walking test, no drop in O2 sat.
  - Conclusion: physical deconditioning

- Returns to his cardiologist:
  - Echocardiogram: normal LV function, known mitral regurgitation

- Evolution:
  - grade II to gr. III-IV dyspnea, weight gain
  - Stopped his blood pressure medication (ACE) because of poor tolerance (malaise and hypotension)
  - BP remains well-controlled
  - No chest pain
85-year old male ex-physician

- **Physical examination:**
  - BP 140/80 mmHg. HR 76 per min. Afebrile. RR 20 per min.
  - Poor general condition
  - Elevated JVP. Peripheral edema +
  - High-pitched 2/6 holosystolic murmur with axillar irradiation.
  - No rales. Hypoventilation and dullness of the right lower lung field.
Working diagnosis

• Heart failure with normal ejection fraction decompensated due to high BP (stop medications)

• Treatment:
  – ACE inhibitor restarted
  – furosemide
85-year old male ex-physician

- Evolution under treatment:
  - Increasing weakness and dyspnea
  - No weight loss
  - Low blood pressure after iv diuretics

⇒ Where have we gone wrong???
Diagnostic mistakes and cognitive error
Cognitive errors
Arch Intern Med. 2005;165:1493-1499

- 100 autopsy-verified Dx errors
- 90 injuries, 33 deaths
- Analysis:
  - 93 cases with errors
  - Mean of 6.5 factors per case
  - Cognitive factors 74%
<table>
<thead>
<tr>
<th>Cognitive factor contributing to error</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty knowledge</td>
<td>11</td>
</tr>
<tr>
<td><strong>Faulty data-gathering</strong></td>
<td>45</td>
</tr>
<tr>
<td>- Failure to collect <em>appropriate information</em> from the initial interview and examination</td>
<td></td>
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<tr>
<td>- ...</td>
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<tr>
<td><strong>Faulty synthesis: faulty information processing</strong></td>
<td>159</td>
</tr>
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<td>- Overestimating or underestimating usefulness or salience of a finding</td>
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<td>- ...</td>
<td></td>
</tr>
<tr>
<td><strong>Faulty synthesis: premature closure</strong></td>
<td>106</td>
</tr>
<tr>
<td>- <em>Premature closure</em>: failure to consider other possibilities once an initial diagnosis has been reached</td>
<td></td>
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<tr>
<td>- Failure to periodically review the situation</td>
<td></td>
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<tr>
<td>- ...</td>
<td></td>
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</table>
Heuristics in medical reasoning

Klein JG. Five pitfalls in decisions about diagnosis and prescribing. BMJ 2005;330:781–4

Representativeness heuristic

• Categorical judgements made on the basis of how much an individual example resembles the stereotype of the category, largely ignoring the relative likelihood of falling into each category.

Availability heuristic

• Place particular weight on examples of things that come to mind easily because they are easily remembered or recently encountered

Overconfidence

• To use our knowledge effectively, we must be aware of its limitations
Dr Missouri

- Trained in the US in an area with a very high prevalence of histoplasmosis
- Moves to Saas-Fee, Switzerland (no histoplasmosis)
- Pulmonary infiltrate:
  - Continues to evoke histoplasmosis systematically despite very low prevalence

→ Representativeness bias
Dr Available

- Recently worked up a patient admitted for severe hypertension
- Diagnosis: Cushing’s disease!
- Thinks of Cushing’s disease in every hypertensive patient

→ Availability bias
Overconfidence as a Cause of Diagnostic Error in Medicine

Eta S. Berner, EdD, and Mark L. Graber, MD

*Department of Health Services Administration, School of Health Professions, University of Alabama at Birmingham, Birmingham, Alabama, USA; and *VA Medical Center, Northport, New York and Department of Medicine, State University of New York at Stony Brook, Stony Brook, New York, USA

ABSTRACT

The great majority of medical diagnoses are made using automatic, efficient cognitive processes, and these diagnoses are correct most of the time. This analytic review concerns the exceptions: the times when these cognitive processes fail and the final diagnosis is missed or wrong. We argue that physicians in general underestimate the likelihood that their diagnoses are wrong and that this tendency to overconfidence is related to both intrinsic and systemically reinforced factors. We present a comprehensive review of the available literature and current thinking related to these issues. The review covers the incidence and impact of diagnostic error, data on physician overconfidence as a contributing cause of errors, strategies to improve the accuracy of diagnostic decision making, and recommendations for future research. © 2008 Elsevier Inc. All rights reserved.

KEYWORDS: Cognition; Decision making; Diagnosis; Diagnosis, computer-assisted; Diagnostic errors; Feedback
Heuristics in medical reasoning

Klein JG. Five pitfalls in decisions about diagnosis and prescribing. BMJ 2005;330:781–4

Representativeness heuristic
- assumption that something that seems similar to other things in a certain category is itself a member of that category

Availability heuristic
- Place particular weight on examples of things that come to mind easily because they are easily remembered or recently encountered

Overconfidence
- To use our knowledge effectively, we must be aware of its limitations

Confirmatory bias
- Tendency to look for, notice, and remember information that fits with our preexisting expectations
Which diagnostic strategies?

Immediate recognition
Hypothetico-deductive process
e.g. dyspnea

Patient information

Hypothesis(es) generation

Data interpretation

Hypothesis(es) verification

Final hypothesis(es)

- It’s been hard to breathe for 3 weeks, particularly when I’m lying

- Heart failure? Lung problem?

- Orthopnea not discriminative

- Heart failure remains plausible, lung problem not excluded

- Heart failure
Clinical reasoning: a hybrid process


Approach is case-dependent

- Clinician is familiar with the case (« experts »)
  Immediate recognition

- Clinician is not familiar with the case (« learners »)
  Hypothetico-deductive process
CHEST PAIN

- Angina
- GERD
- Atherosclerosis
- Aortic dissection
- Pulmonary embolism
- Coronary embolism
- Foramen ovale
- Coronary vasculitis
- Pericarditis
- Thromboembolism
CHEST PAIN

Specific
- Angina
- Coronary vasculitis
- Coronary embolism
- Marfan

General
- Aortic dissection
- Pericarditis
- GERD
- Hiatus hernia
- Esoph. spasms
- Atherosclerosis
- Collagen diseases

Typical

Atypical

Prototypes: implications for teaching?

- Hoof sounds in Saas Fee...?

Horses not zebras!
• Back to the patient!
Hypothetico-deductive process
application to clinical case

Patient information

Hypothesis(es) generation

Data interpretation

Hypothesis(es) verification

Final hypothesis(es)

Worsening dyspnea, weight gain, orthopnea, normal echocardiogram

Heart failure, causes?

Normal echocardiogram not discriminative

Search for causes of heart failure

Heart failure due to...
Causes of heart failure syndrome

Left heart failure

- Arhythmia (tachy, brady)
- Ischemia
- High blood pressure
- Infection
- Pulmonary embolism +
- Valvular disease +++
- Constritive pericarditis +
- Tamponade +

Repeat echocardiogram!
85-year old patient: echocardiogram
Mitral regurgitation

- Left atrium
- Pulmonary vein
- Retrograde flow
Mitral valve prolapse and rupture of chordae tendinae
Gabbay & Yosefy, Int J Cardiol. 2010 Mar 6. [Epub ahead of print]
The underlying causes of chordae tendinae rupture: A systematic review.
Heuristics in medical reasoning
Klein JG. Five pitfalls in decisions about diagnosis and prescribing. BMJ 2005;330:781–4

✓ Representativeness heuristic
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✓ Overconfidence
  • To use our knowledge effectively, we must be aware of its limitations.

✓ Confirmatory bias
  • Tendency to look for, notice, and remember information that fits with our preexisting expectations.

Premature closure
Absence of verification
Frequent is frequent and rare is rare...

- A strange horse with stripes?

But rare happens!
What can we do to prevent it?

Medical students participating in bedside teaching during ward rounds under the guidance of Professor Richard Lovell, at left, 1957. Royal Melbourne Hospital.
Can clinical reasoning be taught?

Patient encounter conditions associated with diagnostic competency

- LeBlanc V Acad Med 2001;76:S18-20
How do experts do it?
Nendaz et al. Med Teach 2005;27:415-21

Differences

- Number of collected items (53-102)
- Goals of collected information
- Encounter progression strategies
- Number of diagnostic hypotheses generated (9-15)

Similarities

- Key questions asked early (within 1st 20 questions)
- Characterize and precise the complaint (30% of questions)
- Summarize information at hand (1.9 times)
- Use key hypotheses to frame clinical data collection
- Test final diagnosis early (10, 7-14)
Teaching students how to acquire relevant diagnostic information efficiently

Nendaz et al., AAMC meeting 2007

• Successive 3-month internal medicine elective rotations of students

• 30 students assigned to:
  – standard case-based reasoning seminars (control)
  – intervention seminars

• End of the elective, videotaped encounters of students with two standardized patients and summary chart

• Results:
  – No difference in accuracy of final diagnosis
  – Correct diagnosis more frequently listed in the differential
  – More relevant differential diagnosis
Establish a strategy of data collection for this chief complaint according to the initial spontaneous diagnostic hypotheses if any.

Before providing the requested information:
- What is the purpose of the information collected?
- Is chief complaint clarified enough?
- Summarize, rephrase, and reformulate the information at hand.
- What is/are the diagnostic hypothesis(es) tested?

Prioritize the hypotheses elaborated.
- Which data support the hypotheses?
- Which additional information is needed to confirm the hypothesis?

Final diagnosis and patient management.

Ask the preceptor for additional information.

Raise, compare, and contrast diagnostic hypotheses.

Presentation of the chief complaint and the demographics of the patient.

Clinical reasoning-learning seminars with enhancement of reflective practice on selected features related to diagnostic competence.

Teaching students how to acquire relevant diagnostic information efficiently

Nendaz et al., AAMC meeting 2007

Results:

• No difference in accuracy of final diagnosis
• Correct diagnosis more frequently listed in the differential
• More relevant differential diagnosis
Take-home messages

**Do’s**
- Collect information targeted to specific Dx hypotheses
- Elaborate hypotheses early
- Review the hypotheses according to new information
- Think of frequent conditions first
- Do not narrow down the differential too early
- Check backwards: does the diagnosis explain all the symptoms and findings

**Don’ts**
- Do not fire in all directions
- Do not ask questions without having any idea what Dx you are testing
- Do not be stubborn!
- Do not think of rare conditions first
- Do not forget completely about rare conditions
- Do not wear glasses with prisms
- Do not be overconfident!
Zebras do exist... and you might cross one sometime!
Conclusions

• Diagnosis is a key activity in internal medicine
• Diagnostic errors are frequent (15%) and potentially harmful
• Clinical reasoning is complex and involves a mix of immediate recognition and hypothetico-deductive reasoning
• Diagnostic errors are more often due to cognitive errors than insufficient knowledge
• There is preliminary evidence that appropriate teaching may reduce those errors
“He who knows best knows how little he knows.”

Thomas Jefferson
Establish a strategy of data collection for this chief complaint according to the initial spontaneous diagnostic hypotheses if any.

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• Prioritize the hypotheses elaborated
• Which data support the hypotheses?
• Which additional information is needed to confirm the hypothesis?

Final diagnosis and patient management

Ask the preceptor for additional information

Presentation of the chief complaint and the demographics of the patient

• Non-analytic diagnostic impression
• Directed and relevant data acquisition

• Characterization of chief complaint
• Problem representation
• Early elaboration of diagnostic hypotheses
• Early collection of key information

• Elaboration of relevant, prototypical diagnostic hypotheses to frame further data collection

Raise, compare, and contrast diagnostic hypotheses

© Mathieu Nendaz, University of Geneva, Switzerland, October, 2007
Teaching students how to acquire relevant diagnostic information efficiently

*Nendaz et al., submitted*

- **Intervention**: active and directed feedback during the case resolution to reinforce strategies used by experts
  
  a) setting up a plan for the collection of the information once the presenting complaint is exposed
  
  b) characterizing each complaint (*e.g.* duration, characteristics, etc.)
  
  c) regularly summarizing the information at hand
  
  d) generating early the diagnostic hypotheses to be evaluated by a directed enquiry and using these hypotheses to frame the collection of further information

- **Results:**
  
  - No difference in accuracy of final diagnosis
  
  - Correct diagnosis more frequently listed in the differential
  
  - More relevant differential diagnosis
### Faulty Synthesis: Faulty Information Processing (n = 159)

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>Example</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>Faulty context generation</td>
<td>Lack of awareness/consideration of aspects of patient’s situation that are relevant to diagnosis</td>
<td>Missed perforated ulcer in a patient presenting with chest pain and laboratory evidence of myocardial infarction</td>
</tr>
<tr>
<td>25</td>
<td>Overestimating or underestimating usefulness or salience of a finding</td>
<td>Clinician is aware of symptom but either focuses too closely on it to the exclusion of others or fails to appreciate its relevance</td>
<td>Wrong diagnosis of sepsis in a patient with stable leukocytosis in the setting of myelodysplastic syndrome</td>
</tr>
<tr>
<td>25</td>
<td>Faulty detection or perception</td>
<td>Symptom, sign, or finding should be noticeable, but clinician misses it</td>
<td>Missed pneumothorax on chest radiograph</td>
</tr>
<tr>
<td>23</td>
<td>Failed heuristics</td>
<td>Failure to apply appropriate rule of thumb, or overapplication of such a rule under inappropriate/ataypical circumstances</td>
<td>Wrong diagnosis of bronchitis in a patient later found to have pulmonary embolism</td>
</tr>
<tr>
<td>15</td>
<td>Failure to act sooner</td>
<td>Delay in appropriate data-analysis activity</td>
<td>Missed diagnosis of ischemic bowel in a patient with a 12-week history of bloody diarrhea</td>
</tr>
<tr>
<td>14</td>
<td>Faulty triggering</td>
<td>Clinician considers inappropriate conclusion based on current data or fails to consider conclusion reasonable from data</td>
<td>Wrong diagnosis of pneumonia in a patient with hemoptysis: never considered the eventual diagnosis of vasculitis</td>
</tr>
<tr>
<td>11</td>
<td>Misidentification of a symptom or sign</td>
<td>One symptom is mistaken for another</td>
<td>Missed cancer of the pancreas in a patient with pain radiating to the back, attributed to GERD</td>
</tr>
<tr>
<td>10</td>
<td>Distraction by other goals or issues</td>
<td>Other aspects of patient treatment (eg, dealing with an earlier condition) are allowed to obscure diagnostic process for current condition</td>
<td>Wrong diagnosis of panic disorder: patient with a history of schizophrenia presenting with abnormal mental status and found to have CNS metastases</td>
</tr>
<tr>
<td>10</td>
<td>Faulty interpretation of a test result</td>
<td>Test results are read correctly, but incorrect conclusions are drawn</td>
<td>Missed diagnosis of <em>Clostridium difficile</em> enteritis in a patient with a negative stool test result</td>
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</tbody>
</table>