A comprehensive understanding of the Dx error universe is neither possible nor necessary to solve important public health problems related to misdiagnosis.
SIDM Board Member (Unpaid)
Related Research/Grants
Non-financial COI (Career)
Diagnostic Errors: Prioritization

Key Points

1. The most potent diagnostic error solutions will likely be problem (or class-of-problem) specific, rather than cross-cutting
2. ‘Underdiagnosis’ and ‘overdiagnosis’ must be considered together to develop the most cost-effective solutions
3. We should prioritize problems in a public health framework that balances burden of patient harms and costs of remedy
4. We can leverage economic analysis to rank ‘top targets’ and to determine ‘worthiness’ of specific problems or solutions
5. We should start with a few ‘winners’ (symptom-disease pairs where we expect solutions will save lives AND reduce costs)
6. Barriers to diagnostic research should be eliminated (e.g., poor symptom coding & tracking and disease-based funding bias)
Prioritization for Diagnostic Error Problems & Solutions:

Definitions & Models
Diagnostic Error

...a diagnosis that is missed, wrong, or delayed, as detected by some subsequent definitive test or finding. (Graber, 2005)

Misdiagnosis-related Harm

...harm resulting from the delay or failure to treat a condition actually present (when the working diagnosis was wrong or unknown) or from treatment provided for a condition not actually present. (adapted from Newman-Toker, 2009)
Diagnostic Process Failure

Diagnosis Label Failure

“Near Miss” Process Failure
Preventable Diagnostic Error

“No Fault” Misdiagnosis

Opportunity for...
Quality Assurance: Safety
Suboptimal Diagnostic Process

Diagnostic Process Failure

Diagnosis Label Failure

Optimal Diagnostic Process

Standard yet Suboptimal Care

Preventable Diagnostic Error

“NEAR MISS” PROCESS FAILURE

UNAVOIDABLE

REDUCIBLE

UNDIAINED & UNDIAGNOSSABLE

Opportunity for...

Quality Improvement: Dissemination

Quality Assurance: Safety

New Science: Discovery
- Suboptimal Diagnostic Process
- Diagnostic Process Failure
- Diagnosis Label Failure
- Optimal Diagnostic Process

- Standard yet Suboptimal Care
- "NEAR MISS" PROCESS FAILURE
- Preventable Diagnostic Error
- HARM FROM OVERTesting & OVERDIAGNOSIS

- Opportunity for...
  - Quality Improvement: Dissemination
  - Quality Assurance: Safety
  - New Science: Discovery

- Undiagnosed & Undiagnosable
- Harm from Overtesting & Overdiagnosis
- Avoidable
- Reducible

- N O H A R M
  - B
Diagnostic Process Failure

Suboptimal Diagnostic Process

Diagnostic Process Failure

Diagnosis Label Failure

Standard yet Suboptimal Care

“NEAR MISS” PROCESS FAILURE

HARM FROM OVERTESTING & OVERDIAGNOSIS

Preventable Diagnostic Error

Preventable & Reducible Misdiagnosis-Related Harm

Preventable & Reducible
Suboptimal Diagnostic Process

Diagnostic Process Failure

Diagnosis Label Failure

“NEAR MISS” PROCESS FAILURE

HARM FROM OVERTESTING & OVERDIAGNOSIS

Preventable Diagnostic Error

Preventable & Reducible Misdiagnosis-Related Harm

Not Worth Fixing?
Prioritization for Diagnostic Error Problems & Solutions:

**Problem Specificity**
Diagnostic Errors: Prioritization

Problem Specificity of the Problem

We want GENERIC, cross-cutting solutions, but…

1. Most diagnostic errors happen at the bedside

2. Bedside diagnostic problems and solutions are typically domain-specific

3. Generic solutions are unlikely to solve some of the know major public health problems
## DIAGNOSTIC PROCESS FAILURES

![Image: Classification of diagnostic errors in 583 physician-reported cases using the Diagnostic Error Evaluation and Research project tool to localize where in the diagnostic process error occurred.](image)

**Schiff et al., 2009**

<table>
<thead>
<tr>
<th>Where in diagnostic process</th>
<th>What went wrong</th>
<th>No. of cases in each category (N=583)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Access/Presentation</strong></td>
<td>A. Failure/delay in presentation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>B. Failure/delay in presentation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>C. Failure in weighing</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>D. Failure/delay to follow-up</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td><strong>2. History</strong></td>
<td>A. Failure/delay in eliciting critical piece of history data</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>B. Inaccurate/missed diagnosis</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>C. Failure in weighing</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>D. Failure/delay to follow-up</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td><strong>3. Physical Exam</strong></td>
<td>A. Failure/delay in eliciting physical exam finding</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>B. Inaccurate/missed diagnosis</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>C. Failure in weighing</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>D. Failure/delay to follow-up</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td><strong>4. Tests (Lab/Radiology)</strong></td>
<td>A. Failure/delay in ordering test(s)</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>B. Failure/delay in performing test(s)</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>C. Error in test sequencing</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>D. Error in test interpretation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>E. Error in test interpretation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>F. Error in test interpretation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>G. Error in test interpretation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>H. Error in test interpretation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>I. Error in test interpretation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>J. Error in test interpretation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>K. Error in test interpretation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td><strong>5. Assessment</strong></td>
<td>A. Failure/delay in considering the diagnosis</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>B. Too little consideration given to the diagnosis</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>C. Too much weight given to the diagnosis</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>D. Recognizing symptoms/complications</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>E. Recognizing symptoms/complications</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>F. Recognizing symptoms/complications</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>G. Not recognizing symptoms/complications</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td><strong>6. Referral/Consultation</strong></td>
<td>A. Failure in ordering referral</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>B. Failure in scheduling/downloading referral</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>C. Error in diagnostic consultation performance</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>D. Failure/delay in communication/follow-up of consultation</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td><strong>7. Follow-up</strong></td>
<td>A. Failure to refer patient to a safe setting/monitoring</td>
<td>![Bar chart]</td>
</tr>
<tr>
<td></td>
<td>B. Failure/delay in timely follow-up/rechecking of patient</td>
<td>![Bar chart]</td>
</tr>
</tbody>
</table>

- Eliciting history
- Eliciting exam
- Ordering test
- Reading or interpreting test
- Considering or weighting diagnosis

Specimen handling; reporting; follow-up
FREQUENTLY MISSED DIAGNOSES

583 Physician-reported diagnostic errors (Schiff et al., 2009)

- 12% vascular
- 11% cancer
- 8% infection

Table 1. Most Frequently Missed Diagnoses Among 583 Physician-Reported Cases of Diagnostic Error

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary embolism</td>
<td>26 (4.5)</td>
</tr>
<tr>
<td>Drug reaction or overdose</td>
<td>26 (4.5)</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>23 (3.9)</td>
</tr>
<tr>
<td>Colorectal cancer</td>
<td>19 (3.3)</td>
</tr>
<tr>
<td>Acute coronary syndrome</td>
<td>18 (3.1)</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>18 (3.1)</td>
</tr>
<tr>
<td>Stroke, including hemorrhage</td>
<td>15 (2.6)</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>13 (2.2)</td>
</tr>
<tr>
<td>Fracture, various types</td>
<td>13 (2.2)</td>
</tr>
<tr>
<td>Abscess, various locations</td>
<td>11 (1.9)</td>
</tr>
<tr>
<td>Pneumonia, including type</td>
<td>10 (1.7)</td>
</tr>
<tr>
<td>Aortic aneurysm/dissection</td>
<td>9 (1.5 )</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>9 (1.5 )</td>
</tr>
<tr>
<td>Depression</td>
<td>9 (1.5 )</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>8 (1.4 )</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>8 (1.4 )</td>
</tr>
<tr>
<td>Anemia</td>
<td>6 (1.0 )</td>
</tr>
<tr>
<td>Bacteremia</td>
<td>6 (1.0 )</td>
</tr>
<tr>
<td>Metastatic cancer</td>
<td>6 (1.0 )</td>
</tr>
<tr>
<td>Spinal cord compression</td>
<td>6 (1.0 )</td>
</tr>
</tbody>
</table>
## Generalizable Problem-Specific Solutions

<table>
<thead>
<tr>
<th>Problem Class</th>
<th>Cognitive Defect</th>
<th>Insight?</th>
<th>‘System’ Solutions (M=Mandatory)</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Routine’ Screen/Monitor (Cancer, Diabetic, Pre-Natal, Post-Natal, Post-Op, Trauma surveys, Rx Complications…)</td>
<td>Forgot (to screen or follow up results)</td>
<td>Unaware</td>
<td>EHR-based reminders (M) ‘Closed loop’ lab results reporting (M) Multi-party results reporting (M)</td>
</tr>
<tr>
<td>Common Symptoms (Outpatient, ED, Inpatient)</td>
<td>Failed to consider (faulty hypothesis generation)</td>
<td>Unaware</td>
<td>Symptom-specific disease checklists (M) Diagnostic reminder system (M)</td>
</tr>
<tr>
<td></td>
<td>Misconception (faulty data gathering/interpretation)</td>
<td>Unaware</td>
<td>Problem-specific education (M) Automated data gathering or testing (M) Standardized care pathways (M)</td>
</tr>
<tr>
<td></td>
<td>Complacency (‘common things are common’)</td>
<td>Semi-aware</td>
<td>Problem-specific decision aids/support Symptom-specific feedback on accuracy</td>
</tr>
<tr>
<td>Visual Diagnosis (Radiology, Pathology, Dermatology, Ophthalmology)</td>
<td>Visual fatigue</td>
<td>Semi-aware</td>
<td>Shorter shifts (M) Independent second reads (M) Computer-assisted feature matching (M)</td>
</tr>
<tr>
<td>Critical Illness (EMS, ED, ICU, OR)</td>
<td>Information overload</td>
<td>Aware</td>
<td>Diagnostic Protocols Data visualization techniques</td>
</tr>
<tr>
<td>Rare Constellation (Outpatient, ED, Inpatient)</td>
<td>Knowledge deficit (no ‘symptom’ script)</td>
<td>Aware</td>
<td>‘Googling’ the diagnosis Rapid triage to subspecialist experts Multi-specialty case conference NIH Undiagnosed Diseases Program</td>
</tr>
</tbody>
</table>
Prioritization for Diagnostic Error Problems & Solutions:

DIAGNOSTIC VALUE
Low-Value Diagnosis

“Nervous Nellie”
• Emphasize safety
• Increase sensitivity
• Sacrifice specificity
• Increase costs

“Crazy Cowboy”
• Emphasize efficiency
• Increase specificity
• Sacrifice sensitivity
• Decrease safety
High-Value Diagnosis

“Deft Diagnostician”
• Better safety AND lower costs
• Increase sensitivity AND specificity
Prioritization for Diagnostic Error Problems & Solutions:

ECONOMIC ANALYSIS
Societal Value Perspective

Quadrant 1
Top Targets

Quadrant 2
Intermediate

Quadrant 3
Intermediate

Quadrant 4
Bottom Targets

Costs of Reducing Misdiagnosis

Burden of Harm from Misdiagnosis
If we consider ‘benign’ dizziness,
~$1 billion per year in savings
Prioritization for Diagnostic Error Problems & Solutions:

POSSIBLE ACTIONS
Diagnostic Errors: Prioritization

Suggested Action Plan

1. Focus on ‘top targets’ (low-value diagnosis where solutions are available or nearly so)

2. Convene experts & develop procedures for national prioritization (societal perspective)

3. Facilitate and finance a research infrastructure that supports diagnostic error research (symptom coding, eliminate disincentives to measure, funding changes)
SYMPTOM CODING TO TRACK MISDIAGNOSIS

Symptom-Specific Revisits as an EHR Trigger Tool for Misdiagnosis

- ‘Look-Back’ Approach
- ‘Look-Forward’ Approach

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**Complaint-Specific ED Treat-and-Release Visits Preceding an Inpatient Stroke Admission**

- dizziness and headache ED discharges
- control ED discharges (e.g., abdominal/back pain)

**Rate of return to Hospital with a Stroke or Heart Attack after being sent home from ED with “Benign Dizziness or Inner Ear Problems”**

--strokes (rate of readmission peaks early on)
- heart attacks (rate of return is a flat ‘base rate’)

Minor strokes initially misdiagnosed as ‘benign dizziness’ returning with major stroke (~26,000 per year in the US)

*Newman-Toker, et al., 2013, AHRQ, HCUP Data from 9 US States*

*Kim et al., 2010, California OSHPD database analysis*
Diagnostic Errors: Prioritization

Health System Disincentives to Measure

1. Not on the ‘publicly reported’ list → publicly-reported measures of ENGAGEMENT now while developing better measures (maybe even engage ‘raters’ – CR)

2. No financial incentives to measure or fix, but incentives for thoughtless ‘shotgun’ testing (DRG) → ‘S’RGs with accountability for accurate diagnosis (i.e., greater profits for high-value diagnosis)

3. Legal, cultural risks of disclosure → “indemnity through research” (RCT dx strategy); culture change
Diagnostic Errors: Prioritization

NIH – Disease-Based not Symptom-Based

1. Inadequate scientific review → create a standing CSR study section on Clinical Diagnosis

2. Lack of funding (40-fold less than smallpox, 4000-fold less than rare diseases) → Clinical Diagnosis Research Institute or earmarked funds at institutes (diagnosis is HALF of medicine)

3. Insufficient research capacity → Diagnostic Safety & Quality Centers of Excellence, training programs (T32, KL2, others)
Diagnostic Errors: Prioritization

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