RESEARCH ON MISSED OPPORTUNITIES IN CANCER DIAGNOSIS IN THE US:
DEFINING, MEASURING AND REDUCING

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Using health information technology and sociotechnical approaches to understand and reduce diagnostic errors

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Objectives

- Lessons from early research on missed opportunities in cancer diagnosis
- Building a robust conceptual foundation for defining, measuring and reducing missed opportunities
- Ongoing work on intervening to reduce missed opportunities in cancer diagnosis
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Over a Decade Ago...

- ‘Diagnostic error’ literature emerged mostly from US malpractice claims
- Delayed cancer diagnosis topped the list
- Key Questions:
  - Was the diagnosis missed by someone?
  - Was the delay preventable?
  - Could we have diagnosed the cancer earlier?
Clinical encounter and patient follow-up are likely the most harmful and expensive types of diagnostic errors. We aimed to understand the prevalence, origins, and prevention of errors in cancer diagnosis. Common cancers for which early diagnosis offers clear benefit (melanoma and lung, prostate, colon, and lung).

Methods
We searched Ovid Medline and PubMed from 1966 until April 2007 for publications that met our review criteria. We manually searched references of key publications. Our search yielded 110 studies, of which five were prospective studies and the remaining were retrospective studies.

Results
Errors in cancer diagnosis were not uncommon in autopsy studies and were associated with significant harm, such as loss of life, in malpractice claims. Literature on prevalence was scant. For each type of cancer, we identified preventable errors according to their origins in patient-physician interaction, diagnostic test or procedure performance, pathologic confirmation of diagnosis, follow-up of the patient or test result, or patient-related delays.

Conclusion
The literature reflects advanced knowledge of contributory factors and prevention for diagnostic errors related to the performance of procedures and imaging tests and emerging understanding of pathology errors. However, prospective studies are few, as are studies of diagnostic errors arising from the clinical encounter and patient follow-up. Future research should examine further the system and cognitive problems that lead to the many contributory factors we identified, and thereby recommend specific and generalizable solutions.
Early Work

- Evaluated evidence of ‘errors’ in consecutive tumor registry cases in an integrated system

- Detailed review of comprehensive EHR to evaluate diagnostic process in the patient’s journey across the continuum of care
  
  - Data available from primary care, specialty (secondary) care, ER, hospital, diagnostics (lab/imaging/pathology), procedures
Colorectal cancer

- Endoscopic evaluation not initiated despite presence of one or more clues that warranted a diagnostic workup (provider related)

- Two reviewers agreed on presence of at least one missed opportunity in 161/513 (31%) patients ($\kappa = 0.75$)

- Missed anemia striking
Lung Cancer

- 2 reviewers independently agreed on at least 1 missed opportunity in 222 (37.8%) of 587 patients ($\kappa = 0.69$)

- Failure to act on abnormal imaging common

- Median time to diagnosis 132 days (vs. 19 days)
Test Results Follow-up in EHRs

- Evaluation of 1,163 outpatient abnormal lab & 1,196 abnormal imaging test result alerts
  - 7% abnormal labs lacked timely follow-up at 30 days
  - 8% abnormal imaging lacked timely follow-up

- Abnormal results lost to follow-up despite being read

Teamwork & Responsibility!

Timely Follow-up of Abnormal Diagnostic Imaging Test Results in an Outpatient Setting

Are Electronic Medical Records Achieving Their Potential?

Hardeep Singh, MD, MPH; Eric J. Thomas, MD, MPH; Shrimathi Mani, BA; Dean Sittig, PhD; Harinder Arora, MD, MPH; Donna Espadas, BS; Myrna M. Khan, PhD, MBA; Laura A. Petersen, MD, MPH

Background: Given the fragmentation of outpatient care, timely follow-up of abnormal diagnostic imaging results remains a challenge. We hypothesized that an electronic medical record (EMR) that facilitates the transmission and availability of critical imaging results through either automated notification (alerting) or direct access to the primary report would eliminate this problem.

Methods: We studied critical imaging alert notifications in the outpatient setting of a tertiary care Department of Veterans Affairs facility from November 2007 to June 2008. Tracking software determined whether the alert was acknowledged (ie, health care practitioner/provider [HCP] opened the message for viewing) within 2 weeks of transmission; acknowledged alerts were considered read. We reviewed medical records and contacted HCPs to determine timely follow-up actions (eg, ordering a follow-up test or consultation) within 4 weeks of transmission. Multivariable logistic regression models accounting for clustering effect by HCPs, analyzed predictors for 2 outcomes: lack of acknowledgment and lack of timely follow-up.

Results: Of 123,638 studies (including radiographs, computed tomographic scans, ultrasonograms, magnetic resonance images, and mammograms), 1,106 images (0.97%) generated alerts; 117 (18.1%) of these were unacknowledged. Alerts had a higher risk of being unacknowledged when the ordering HCPs were trainees (odds ratio [OR], 5.98; 95% confidence interval [CI], 2.86–10.89) and when dual-alert (>1 HCP alerted) as opposed to single-alert communication was used (OR, 2.02; 95% CI, 1.23–3.36). Timely follow-up was lacking in 91 (7.7%) of all alerts and was similar for acknowledged and unacknowledged alerts (7.3% vs 9.7%; P=.22). Risk for lack of timely follow-up was higher with dual-alert communication (OR, 1.99; 95% CI, 1.06–3.48) but lower when additional verbal communication was used by the radiologist (OR, 0.12; 95% CI, 0.04–0.38). Nearly all abnormal results lacking timely follow-up at 4 weeks were eventually found to have measurable clinical impact in terms of further diagnostic testing or treatment.

Conclusions: Critical imaging results may not receive timely follow-up actions even when HCPs receive and read results in an advanced, integrated electronic medical record system. A multidisciplinary approach is needed to improve patient safety in this area.

Arch Intern Med. 2008;168(17):1578-1586

Communication breakdown is consistently identified as a preventable factor in studies of adverse events and a significant contributor to patient diagnostic errors from a lack of follow-up of abnormal test results. The volume of outpatient care and nature of high-risk transitions between health care practitioners/providers (HCPs), settings, and systems of care makes timely communication particularly challenging. For example, a patient referred for diagnostic workup for respiratory symptoms by a primary care physician needs to be communicated rapidly and effectively to the treating HCPs to ensure adequate follow-up.

Electronic communication using alerts (computerized notifications of critical information such as abnormal diagnostic test results) can facilitate transmission and potentially a response and follow-up action by the ordering HCP—an advantage over paper-based reporting. For instance, the electronic medical record (EMR) used by the Department of Veterans Affairs (VA) mostly relies on a notification system (the “View Alert” window) to alert clinicians about critical test results, whereas only in
Too many electronic health record alerts may be leading doctors to skip them

Your doctor may be more likely to ignore your test results if they come electronically.

A new study published in the JAMA Internal Medicine on Mar. 4 revealed that doctors receive about 63 electronic health record (EHR)-based alerts each day, which are supposed to let them know about abnormal patient results. And, almost one-third of the doctors surveyed — about 30 percent — admitted that they had missed some results because of too many alerts.

"If you're getting 100 emails a day, you are bound to miss a few. I study this area and I still sometimes miss emails. We have good intentions, but sometimes getting too many can be a problem," Dr. Hardeep Singh, chief of health policy, quality, and informatics at the Michael E. DeBakey Veterans Affairs Medical Center, in Houston, told TIME.
Other Factors Contributing to Missed Opportunities

- Overconfidence
- Faulty data gathering
- Faulty synthesis
- Process failure
- Sample mix-up
- Failure to detect physical finding
- Perception error
- Wrong estimate of pretest probability
- Failure to follow-up abnormal test
- Communication failure
- Language barrier
- Uninformed patient
- Faulty triggering
- Misinterpretation of test
- Inadequate follow-up
- Failed heuristic
- Knowledge deficit
- Unintended consequence of policy
Physicians' Diagnostic Accuracy, Confidence, and Resource Requests: A Vignette Study

Ashley N. D. Meyer, PhD; Velma L. Payne, PhD, MBA; Derek W. Meeks, MD; Radha Rao, MD; Hardeep Singh, MD, MPH

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IMPORTANCE Little is known about the relationship between physicians' diagnostic accuracy and their confidence in that accuracy.

OBJECTIVE To evaluate how physicians' diagnostic calibration, defined as the relationship between diagnostic accuracy and confidence in that accuracy, changes with evolution of the diagnostic process and with increasing diagnostic difficulty of clinical case vignettes.

DESIGN, SETTING, AND PARTICIPANTS We recruited general internists from an online physician community and asked them to diagnose 4 previously validated case vignettes of variable difficulty (2 easier; 2 more difficult). Cases were presented in a web-based format and divided into 4 sequential phases simulating diagnosis evolution: history, physical examination, test results, and final diagnosis. Participants were surveyed on their diagnostic confidence and then asked to estimate their diagnostic accuracy. Participants were asked to rate their diagnostic confidence and ability to make a final diagnosis on a 100-point scale at each step and were asked to estimate their diagnostic accuracy on a 100-point scale at the end of each phase.
Research Reveals Lots to Fix!

- Failure to elicit key history or exam finding
- Overlooking critical information/cognitive issues
- Inadequate information systems
- Chaotic clinical settings with interruptions, inadequate time, workload and administrative burden
- Lack of measurement and feedback systems for improvement

Schiff et al Arch IM 2009; Singh et al JAMA IM 2013; Sarkar et al BMJQS 2012
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Key to Reducing Missed Opportunities

You cannot improve what you cannot measure!

You cannot measure what you cannot define!
Understanding Diagnostic Process

The diagnostic process involves more than what’s in the doctors head

Five “process” dimensions of diagnosis
Patient-Provider Encounter

- Problems with history, physical exam or ordering diagnostic tests for further work-up
Problems with ordered tests either not performed or performed/interpreted incorrectly
Follow-up and Tracking

- Problems with follow-up of abnormal diagnostic test results or scheduling of follow-up visits
Referrals/Specialty Consultations

- Lack of appropriate actions on requested consultation or
- Communication breakdown from consultant to referring provider

Gandhi et al JGIM 2000
Patient Behaviors/Adherence
Understanding missed opportunities for more timely diagnosis of cancer in symptomatic patients

G Lyratezopoulos

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Abstract: The diagnosis of cancer is a complex, multi-step process. In this paper, we highlight factors involved in missed opportunities to diagnose cancer more promptly in symptomatic patients and discuss responsible mechanisms and potential strategies to shorten intervals from presentation to diagnosis. Missed opportunities are instances in which post-hoc judgement indicates that alternative decisions or actions could have led to more timely diagnosis. They can occur in any of the three phases of the diagnostic process (initial diagnostic assessment; diagnostic test performance and interpretation; and diagnostic follow-up and coordination). Involving patients, relatives and healthcare providers in decision-making is a key theme in this presentation.
Few valid and reliable data sources

Missed opportunity measurement must reflect real-world practice

- more than just what’s in “the doctors head”
- Sociotechnical health care system, team members, and patients, all inevitably influence clinicians’ thought processes

Singh BMJQS 2013; Sarkar et al BMJQS 2012
Safer Dx Framework for Measurement & Reduction

Sociotechnical Work System*

Diagnostic Process Dimensions
- Patient-provider encounter & initial diagnostic assessment
- Follow-up and tracking of diagnostic information
- Subspecialty consultation/referral issues
- Diagnostic test performance & interpretation

Measurement of diagnostic errors
- Reliable
- Valid
- Retrospective
- Prospective

Changes in policy and practice to reduce preventable harm from missed, delayed, wrong or over diagnosis
- Collective mindfulness
- Organizational learning
- Improved calibration
- Better measurement tools and definitions

Feedback for improvement

Improved value of health care
Improved Patient Outcomes

* Includes 8 technological and non-technological dimensions

Singh & Sittig BMJQS 2015
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‘Trigger’-based Measurements

- Diagnostic Tests
- More Patient-Provider Encounters
- Consultations to Sub-specialists
- Correct Diagnosis

- Certain Diagnosis
- Uncertain Diagnosis
Why Triggers Are a First Step?

- Algorithms to select high-risk patient records for further reviews to look for missed opportunities
  - Picking up ‘needles in a haystack’ by making the haystack smaller

- Not risk assessment/decision support tools during consultation but ‘back-up’ support system after the patient-doctor encounter
  - Application retrospective or prospective surveillance

Murphy et al BMJQS 2013
Singh & Thomas AHRQ Special Report 2009
Retrospective Return-Visit Triggers

- Triggers based on patterns of patients’ unexpected return visits after initial GP visit
- Queries applied in EHR repository to identify high-risk visits among 212,165 total visits
- 1957 chart reviews confirmed 190 diagnostic errors, including cancer
- Possible retrospective triggers in UK setting: multiple consultations, significant event audits post ED presentation

Singh et al BMJQS 2011; Singh et al. JAMA IM 2013
Preliminary results of a feasibility study of the use of information technology for identification of suspected colorectal cancer in primary care: the CREDIBLE study

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Creating a Trigger-Based ‘Safety Net’

- Triggers look for follow-up actions on clues (or red flags) to detect delays prospectively
  - Basic version: + hemoccult or microcytic anemia with no subsequent colonoscopy in 60 days OR suspicious chest-X ray with no follow-up CT scan in 30 days

- Searched large EHR repositories at 2 sites for patients with delays in diagnostic evaluation for colorectal and prostate cancer (n=300,000 patients over a year)
  - 1564 trigger positive: Positive Predictive Value = 58%-70%
  - Estimated 1048 instances of delayed or missed follow-up of abnormal findings and 47 high-grade cancers found

Murphy et al BMJQS 2013
Electronic health record-based triggers to detect potential delays in cancer diagnosis

Daniel R Murphy,1,2 Archana Laxmisan,1,2 Brian A Reis,1,2 Eric J Thomas,3 Adol Esquivel,4 Samuel N Forjuoh,5 Rohan Parikh,6 Myrna M Khan,1,2 Hardeep Singh1,2

ABSTRACT

Background Delayed diagnosis of cancer can lead to patient harm, and strategies are needed to proactively and efficiently detect such delays in care. We aimed to develop and evaluate ‘trigger’ algorithms to electronically flag medical records of patients with potential delays in prostate and colorectal cancer (CRC) diagnosis.

Methods We mined retrospective data from two large integrated health systems with comprehensive electronic health records (EHR) to iteratively develop triggers. Data mining algorithms identified all patient records with specific demographics and a lack of appropriate and timely follow-up appointments for diagnostic follow-up of abnormal clinical findings suspicious for cancer.

BACKGROUND

Identifying and preventing delays in cancer diagnosis have proved elusive and challenging to overcome.1 2 For certain cancers, delays are common and lead to poor outcomes and increased malpractice litigation.3–8 While root causes of such delays are multifactorial,2 9–11 many delays arise when abnormal cancer screening results or other ‘red flags’ are missed by providers.3 5 12–21 These missed opportunities are delayed diagnosis...
Evaluating An Intervention

- Prospective trigger application + confirmatory manual review of triggered records + communication of this information to GPs
- Cluster RCT of 72 GPs from 2 sites
- 3 types of triggers (colorectal, prostate, lung) applied to total 118,400 patients
- Of 10,673 with abnormal finding, trigger flagged 1256 (11.8%) as high-risk
RCT Results

- Reduced delays in diagnostic evaluation of colorectal and prostate cancer
  - Lower times to diagnostic evaluation for CRC (median 104 vs. 200 days; n=557; \( p<0.001 \)) and prostate (40% received evaluation at 144 vs. 192 days; n=157; \( p<0.001 \))
  - No effect for the lung trigger (median 65 vs. 93 days; n=19; \( p=0.59 \))
  - More diagnostic evaluation by final review (73.4% vs. 52.2%; RR 1.41; 95% CI, 1.25-1.58)
Time for Surveillance & Safety Net?

- Creating ‘intelligence’ related to diagnostic safety needs resource and time investment
  - Institutions/practices have too many competing priorities
  - Will it give bang for the buck outside of research?
  - Contacting GPs
- Unintended consequences need to be monitored
  - More (or unnecessary) testing/treatment could occur
Creating system-wide approaches for measurement and reduction in a large VA network of 7 hospitals

How do we integrate “near real-time” surveillance information and feedback about missed opportunities into PCP practices?

Revised national VA policy to standardize and improve test results follow-up

http://www.hsrd.research.va.gov/research/abstracts.cfm?Project_ID=2141701900
The patient is in: patient involvement strategies for diagnostic error mitigation

Kathryn M McDonald, Cindy L Bryce, Mark L Graber

ABSTRACT
Although healthcare quality and patient safety have longstanding international attention, the target of reducing diagnostic errors has only recently gained prominence, even though numerous patients, families and professional caregivers have suffered from diagnostic mishaps for a long time. Similarly, patients have always been involved in their own care to some extent, but only recently have patients sought more opportunities for engagement and participation in healthcare improvements. This paper brings these two promising trends together, analysing strategies for patient involvement in reducing diagnostic errors in an individual’s own care, in
Potentially Useful Next Steps for UK, Others

- Use robust systems-based conceptual models to define/measure/reduce missed opportunities
- Use ‘deep dive’ methodologies to create better understanding of process breakdowns in ‘real-world’ practice
- Leverage health IT to create and evaluate a trigger-based safety-net system
- Engage patients as active partners in diagnosis
Thank you…

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- National Institute of Health
- Office of National Coordinator (SAFER Guides)
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