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Abstracts*)

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Oral Plenary Abstracts Session

Sunday, October 8, 2017, 3:15-5PM

1) Use of Targeted Lab Monitoring to Reduce Undiagnosed Hyponatremia and Preventable Hospitalizations

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Statement of problem: Lab monitoring of outpatients on certain chronic medications allows potentially serious side effects to be promptly diagnosed before they cause harm. Thiazide diuretics and non-thiazide sulfonamides are commonly prescribed medications but can cause hyponatremia alone or in combination with ACE inhibitors or ARBs. Delayed hyponatremia diagnosis is harmful and may result in unnecessary hospitalization or emergency department (ED) visits.
Description of the intervention or program: Kaiser Permanente Southern California (KPSC) is an integrated delivery system serving >4 million members. KPSC routinely conducts audits of adverse drug-related events and identified undiagnosed hyponatremia as a cause of potentially preventable hospitalizations and ED visits. An outpatient safety program was implemented to monitor sodium levels at shorter intervals than what's measured for HEDIS guidelines. Electronic clinical surveillance algorithms scanned sodium lab results in the EHR data warehouse to triage patients into 3 risk-based follow-up groups, with repeat labs scheduled at closer intervals for lower sodium levels. Lab orders were created centrally and routed to the prescribing physician with information on patient's prior sodium value. When the sodium level was too low, an order for medication discontinuation was attached. The program goal was to facilitate prompt diagnosis of hyponatremia and medication discontinuation if needed.
Findings to date: To assess the impact of the outpatient safety program, we examined the combined all-cause hospitalization and ED rate among 504,673 patients on thiazide diuretics or non-thiazide sulfonamides from 2010-2015, divided into 3 phases: pre-implementation of the outpatient safety program (2010-2011), implementation (2012-2013), and post-implementation (2014-2015). The hospitalization/ED rate was 17.8, 17.3, and 16.7%, respectively (χ^2 p-value <.0001). Logistic regression was used to estimate the per-year hospitalization/ED rate and found a significant decline, OR = 0.980 (95% CI: 0.978-0.982). The per-phase decrease was OR = 0.961 (95% CI: 0.956-0.965). Nevertheless, in this observational study, it is possible that other factors explain these reduced hospitalizations. Because hyponatremia and adverse drug codes were under- and variably-utilized, associations could not be reliably estimated for hyponatremia-related outcomes alone. Future analyses will incorporate sodium values.
Lessons learned: KPSC leveraged knowledge from clinical audits and electronic health data to create a novel safety surveillance program to address under-diagnosis of a potentially serious condition. This program could likely be implemented in any system with electronic lab data. For maximum effectiveness, the health system should have the capability to centrally create follow-up lab orders and route them to the prescribing physician with the prior sodium result. This requires institutional leadership's interest and support.

2) The Diagnostic Error Index: A Tool for Measuring Diagnostic Errors

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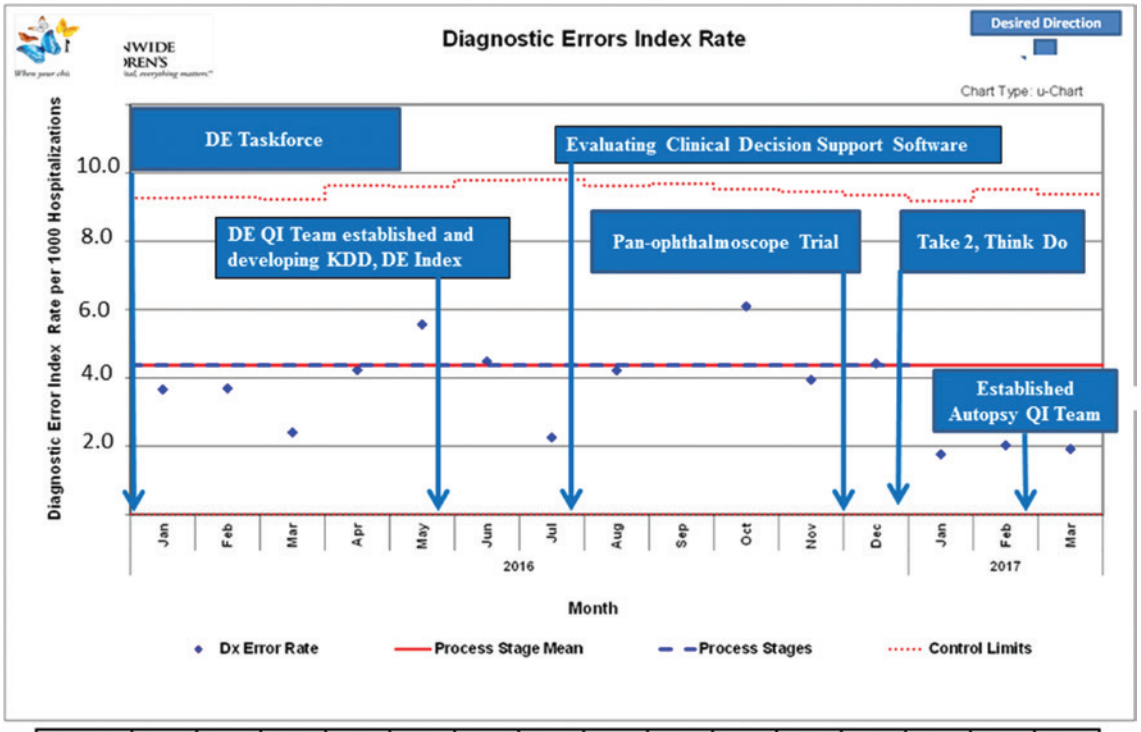
Statement of problem: Published literature suggests that diagnostic errors (DE) account for 6-17% of hospital adverse events. Major barriers to reducing DE are the difficulty in detecting these errors in clinical practice and the lack of effective measurement of DE. (NASEM, *Improving diagnosis in health care*, 2015.)
Description of the intervention or program: We developed a new tool to monitor DE, the DE Index. It is a proxy measure for major DE and a useful tool for evaluating the effectiveness of interventions to reduce DE. The DE Index is modeled after the preventable harm index (Brilli, McClead, Davis, et al., 2010). It consists of 5 elements: 1) non-forensic autopsy reports with class I findings, 2) root cause analyses (RCA) of adverse events with individual and system-related failures consistent with DE, 3) medical record triggers (e.g. missed appendicitis), 4) Morbidity and Mortality cases of DE, 5) other adverse event reports of DE. Potential errors are identified, and a multidisciplinary team meets monthly to adjudicate each case. The DEs are then totaled monthly.
Findings to date: The DE Index plotted on a C-chart from 1/2016-3/2017 revealed 5.8 major DE per month (UCL 11 DE/month). A G-chart showed 5.2 patient days between DE. A U-chart indicated a major DE rate of 4.37 per 1000 hospital admissions (figure). In 2016, there were

84 DE (13 class I autopsy findings; 8 RCAs; 25 adverse event reports; 14 M&M cases; and 24 DE triggers. Interventions evaluated to date include pan-ophthalmoscope for improved detection of retinal hemorrhages/child abuse; "Vitamin CDE" differential diagnosis mnemonic; clinical decision support software; and "Take 2, Think Do" (Walker & Clarke, 2015).

Lessons learned: The DE Index shows promise in capturing and categorizing DE. While it does not currently capture all DE, it identifies the most serious ones and provides a means for assessing the impact of interventions that might reduce DE. Quality improvement teams can use the DE Index to establish the incidence of DE and evaluate interventions designed to mitigate diagnostic errors using statistical process control charting. DE data is often 3 months delayed to permit completion of non-forensic autopsies and RCAs. Our institutional non-forensic autopsy rate is only 32%. Thus, we established a separate QI team to increase the autopsy rate. Discharged emergency patients with non-specific abdominal pain who return within 10 days has proven to be a reliable trigger for missed appendicitis.



Dx Errors	6	6	4	6	8	6	3	6	11	9	6	7	3	3	3
Admissions	1640	1625	1665	1419	1437	1339	1330	1423	1391	1477	1522	1583	1701	1480	1567

3) Indicate It - Feedback Loops to Improve Patients' Understanding of Their Medications

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Statement of problem: Since the NAM definition of error includes "explanation of the health problem to the patient," activities helping patients better understand their diagnosis and related treatments represent a key component of health problem diagnosis education/explanation and are important to advance. Accurate understanding of medication indications can both explain as well as aid patients' understanding of their diagnosis. This opportunity to take advantage of a key communication channel needs be leveraged to maximize safety and improve communication in the diagnostic process. This pilot project aims to explore patients' understanding of their diagnosis and treatment indications and to build evidence examining incorporation of indications into the prescribing process, targeting a vulnerable venue for drug use today—transitions home from hospital admission.

Description of the intervention or program: This is a study taking advantage of a natural experiment comparing 2 hospitals (Brigham and Women's Hospital/Partners HealthCare and Regions Hospital/Health Partners), one not placing vs. other placing indications on discharge medication prescriptions. The primary aim of this study is to evaluate patient's knowledge of their medications by comparing medications with and without indications on the discharge prescriptions.

Findings to date: We reviewed 20 eligible patients recently discharged who consented to be called at home (out of 21 patients approached). 20 phone interviews were completed querying patients on their medications (average 9.2/patient), half of which (4.5 meds/patient) were new or changed. Of the medications reviewed during the calls, 95% of the new or changed medication had indications on the prescription, and 58% of resumed medications had indications. Of the new and changed medications with indications (medications targeted for our study), patients knew on their own the reasons they were taking a medication for only 32.5% of these medications. However, patients were able to report the reason for taking their medication for an additional 65.3% of their medications by looking at the label or discharge medication sheet which displayed the indications, suggesting the value of adding indications to prescriptions.
Lessons learned: Treatment, indications, and communication of the health problem are all interwoven in the diagnostic process. Medication indications represents an opportunity to improve communication of diagnosis to patients. Adding indications to medication labels can help ensure patients understand their medications and their link to diagnoses. Indications are a powerful lever to improve patients' understanding of their medications, and thereby potentially improve their understanding of their health problem and overall outcomes in the diagnostic process.

4) Nursing Diagnosis: An Introduction to Its History and Current Status

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Background: According to *Improving diagnosis in health care* (NASEM, 2015), getting the right diagnosis is central to providing safe, high quality care. The definition of diagnosis is the identification of the nature of an illness or other problem by examination of the symptoms or the distinctive characterization in precise terms of a phenomenon. This process is not solely a medical act. Registered nurses, across all levels of education, engage in clinical reasoning and information gathering so as to systematically understand the needs of the patient, family, or community. The process and product of nursing diagnosis has been in place, beginning in 1953 and is sustained through the work of the North American Nursing Diagnosis Association (NANDA-I). Notably, the NASEM report is silent on this important work. To bridge this gap, this literature review highlights key achievements and challenges in the development of nursing diagnoses, and related nursing classification systems, and the status of nursing diagnosis in states' nurse practice acts.
Methods: CINAHL and MEDLINE were searched for historical articles using the terms nursing diagnosis, NANDA or nomenclature, English, and limited to U.S publications. Further, the UNH library catalogue was searched for the subject heading "nursing diagnosis."
Results: In 1953, Fry first proposed the idea of using the term diagnosis in nursing practice. In arguing that the act of diagnosing was required for individualized care, Fry noted that "it is estimated that one third to two thirds of all medical practice…consists of treating patients whose symptoms are, to a great extent, the results of emotional stress," and that the categorization and treatment of these symptoms is nursing practice. Chambers followed this up in 1962 with the first publication that answered, "What is a nursing diagnosis? How is it made and who makes it? What does it accomplish?" and clearly viewed nursing diagnosis as an independent nursing function. In 1973, the North American Nursing Diagnosis Association standardized language was introduced and focused on phenomenon that nurses independently diagnose and treat. Other nursing classification systems followed such as the Omaha System in 1981, Nursing Minimum Data Set in 1988, and the Nursing Outcomes Classification in 1996. This presentation will review the above history and report an updated review of state nurse practice acts' inclusion of diagnosis language.
Conclusion: Bridging the knowledge gap in the NASEM report regarding nursing diagnosis may help facilitate interprofessional collaboration on efforts to improved diagnosis in healthcare.

5) Missed Diagnosis of Cerebral Vein Thrombosis in the Emergency Department

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Background: Up to 165,000 cerebrovascular events are misdiagnosed annually in US emergency departments (ED). Cerebrovascular diseases that present with non-specific symptoms are particularly difficult to accurately diagnose in a timely fashion. Cerebral venous thrombosis (CVT), thrombosis of the dural sinus and/or cerebral veins, is an uncommon cerebrovascular condition that often affects young and middle aged patients resulting in substantial disability and death. Rates of CVT missed diagnosis in the ED have been understudied, though delayed diagnosis of CVT has been reported among patients who present with gradual onset headache or single seizure. Patient factors associated with CVT missed diagnosis are not known.
Methods: We performed a retrospective cohort study using administrative claims data provided to the Agency for Healthcare Research and Quality for its Healthcare Cost and Utilization Project (HCUP). We used data from all ED visits and nonfederal hospitalizations in New York from 2006-2013, California from 2005-2011, and Florida from 2005-2013. We identified a cohort of patients hospitalized for CVT using previously validated *International Classification of Diseases, Ninth Revision, Clinical Modification* codes. Missed diagnosis of CVT was defined as

having an ED discharged diagnosis of 'benign' headache or seizure in the 14 days prior to inpatient hospitalization for CVT. Multivariable logistic regression was used to evaluate for patient factors associated with CVT missed diagnosis and determine whether missed diagnosis was associated with adverse patient outcomes (intracerebral hemorrhage, discharge destination, and death). The threshold for statistical significance allowed for an alpha error of 0.05.
Results: We identified 5,966 patients with a hospital discharge diagnosis of CVT using administrative data. Mean patient age was 44 years old (SD 18) and 73% were female. A total of 216 patients (3.6%) had a missed diagnosis of CVT; most missed patients were hospitalized within 7 days of index ED visit (81.5%) and were initially diagnosed with 'benign' headache (97%). We did not identify any patient demographic or clinical factors that were associated with a significantly increased risk of CVT missed diagnosis. No pregnant CVT patients (n = 758) had a missed diagnosis. Missed diagnosis of CVT was not associated with an increased risk of any pre-defined adverse clinical outcomes.
Conclusion: In a large cohort of CVT patients, missed diagnosis of CVT occurred in nearly 1 out of 30 patients. Future research is needed to improve the accuracy of CVT diagnosis in the ED, particularly among non-pregnant patients.

6) In the Face of Uncertainty: Diagnostic Collaboration and Error Evaluation of Physicians in Internal Medicine Training Programs

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Background: In September 2015, the Institute of Medicine (IOM) released "Improving Diagnosis in Health Care," a landmark study on diagnostic error. The report described the epidemiology of, provided a formal definition for, and suggested improvement goals for diagnostic error. Based on the goals of the IOM report, we aimed to assess how Internal Medicine residents and faculty collaborate in the diagnostic process and approach diagnostic errors.
Methods: This is a multicenter, cross-sectional, mixed methods, survey study. Survey content was derived from the IOM's first and fourth goals for a total of 19 multiple choice questions. Some representative topics and respective answer choices include: frequency of collaboration (with radiologists, pathologists, interdisciplinary teams and patients) uncertainty, and occurrence of errors when making a diagnosis; factors that most negatively affect the diagnosis (time limitations, electronic health system, and patient factors); where diagnostic errors most frequently occur (access/presentation, history collection, physical exam, testing, assessment, referral, follow up). From June 2016 to March 2017, surveys were administered anonymously via e-mail or by paper during educational conferences. We targeted residents and faculty in Traditional Internal-Medicine, Primary Care Internal Medicine, and Internal Medicine-Pediatrics at nine community and University-based training programs in Connecticut. Comparison testing across institution, experience, and self-reported gender was performed using Pearson's chi-squared test on STATA© software.
Results: Of 484 physicians (87 attendings, 397 residents) targeted, 266 (70 attendings, 196 residents) responded. 158 (59.3%) surveys were in-person and 196 (73.7%) were from residents. Physicians reported collaborating at least weekly with radiologists (70.5% inpatient v. 13.2% outpatient) and pathologists (12.1% inpatient v. 2.6% outpatient) and at least daily in interdisciplinary teams (83.9% inpatient v. 50.4% outpatient). 45.4% of physicians reported explaining their diagnostic thinking and 14.2% of physicians reported using teach back with every patient. Physicians reported at least daily uncertainty of a diagnosis (49.0% inpatient, 40.6% outpatient). Time limitation was reported by 70.1% of physicians as most negatively impacting ability to make a diagnosis. Physicians reported at least weekly occurrence of a diagnostic error (46.0% inpatient, 40.2% outpatient). Physicians most often attributed diagnostic errors to history collection (38.3%).
Conclusion: In this multi-center survey study on diagnostic error, we found varying rates of collaboration with radiologists, pathologists, interdisciplinary teams, and patients, but usually less in the outpatient setting. Physicians regularly reported being uncertain of a diagnosis with time limitations playing a key role. When diagnostic errors did occur, history collection was the most likely etiology.

Oral Abstracts of Current Research and Educational Innovations

Tuesday, October 10, 2017 9:45AM-12:30PM

1) Diagnostic Discordance in Anxiety and Trauma-Related Psychiatric Disorders

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Background: Few studies have investigated diagnostic errors in psychiatric conditions, where accurate diagnostic labels greatly impact case identification and access to appropriate treatments. For instance, 480,663 Veterans enrolled in the Veterans' Healthcare Administration carry

a diagnosis of 'unspecified anxiety disorder' but this non-specific psychiatric diagnosis may be a barrier to receiving appropriate mental health services. Even though this is the most common anxiety diagnosis in primary care settings, it carries little clinical utility because treatment guidelines for unspecified anxiety disorder do not exist. In contrast to only 32% of Veterans with unspecified anxiety that receive mental health services in the year following diagnosis, 60-67% diagnosed with specific anxiety or trauma-related disorders (such as posttraumatic stress disorder, panic disorder, generalized anxiety disorder, and social anxiety disorder) do so. In order to lay groundwork for future interventions to improve the accuracy of anxiety and trauma-related diagnoses, we sought to examine the rate of diagnostic discordance among Veterans diagnosed with unspecified anxiety disorder.

Methods: A trained research assistant conducted a secondary review of medical records of 295 Veterans previously screened for inclusion in a trial of a skills-based intervention for late-life anxiety in primary care. Of these, 62 Veterans received an unspecified anxiety diagnosis in their electronic medical record (EMR) within the 2 years prior to intervention screening. To establish diagnostic discordance, we then compared the EMR-based unspecified anxiety diagnosis to diagnostic data from a 'gold standard' psychiatric diagnostic interview administered by trained study clinicians.

Results: Fewer than 2% of Veterans with an unspecified anxiety diagnosis in the EMR actually met the Diagnostic and Statistical Manual–5 diagnostic criteria for this disorder. Of the 62 Veterans who received an unspecified anxiety diagnosis in their medical record, 75% met diagnostic criteria for a specific anxiety or trauma-related disorder (generalized anxiety disorder 44%, posttraumatic stress disorder 37%, panic disorder 19%, social anxiety disorder 19%). The remainder did not meet diagnostic criteria for any anxiety and trauma-related diagnosis.

Conclusion: Discordances in diagnosis of unspecified anxiety disorder pose major barriers to receipt of appropriate evidence-based care for more specific psychiatric disorders that are amenable to evidence-based pharmacological and psychological treatment. The data from this study highlight the need to improve the diagnostic process for patients with anxiety and trauma-related disorders to ensure access to appropriate evidence-based treatments.

2) Detecting Patient Misidentification Errors in Diagnostic Radiology Exam Ordering

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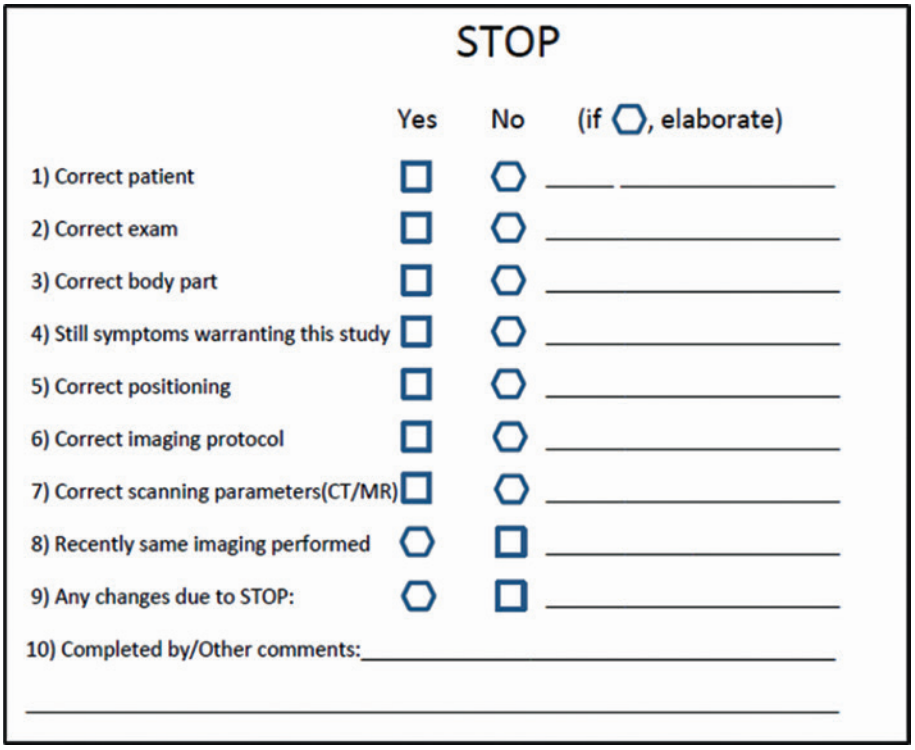
Background: While diagnostic radiology ordering errors pose significant risks to patients, comprehensive methodologies to detect them are underdeveloped. Approximately 30% of diagnostic imaging errors involve patient misidentification. Several cognitive, systems and process-related failures can contribute to patient misidentification in the radiology examination ordering process. Many of these failures go unrecognized and/or unresolved because the error is corrected prior to imaging (i.e. a "near-miss"). To better understand the scope and causes of misidentification errors, we developed a comprehensive surveillance program to detect near misses related to diagnostic imaging ordering.

Methods: We used two complementary methods to detect potential instances of patient misidentification among a cohort of all radiology exam orders placed during a 1-year period at a tertiary care Veterans Affairs facility. First, we implemented a pre-imaging checklist termed the "Safety-STOP", performed by radiology staff at multiple points during the imaging workflow, where a number of safety requirements would need to be satisfied before imaging (Figure). Any potential errors, including patient misidentification, would require direct provider communication for resolution prior to imaging, with details recorded in a departmental database. Second, we developed an automated error detection algorithm (i.e. a trigger) based on existing "Retract-and-Reorder" NQF endorsed methodology to detect misidentified orders which were cancelled, followed by provider exam reordering on the correct patient within a narrow time-frame. This trigger was applied to the corresponding ordering data of the study cohort within the electronic health record (EHR), and subsequently validated through retrospective EHR review.

Results: During the cohort year, 130 patient misidentification ordering errors were detected by either method among 76,468 total orders (error rate = 1.7/1,000 exams). The trigger tool identified 128 true positive instances of patient misidentification and 31 false positives (128/159; PPV = 81%). Of these 128, 125 (97.7%) erroneous orders were corrected by the provider prior to the patient imaging encounter. Only 5 uncorrected ordering misidentification errors were detected by radiology technologists at the imaging encounter via the Safety-STOP. Of these, 2 had not been detected by the trigger tool.

Conclusion: Although most imaging examination ordering misidentification errors are corrected outside of the radiology department, some errors must be addressed at the imaging encounter. These findings support the need for pre-imaging safety checklists and more real-time automated near-miss detection mechanisms for preventing and mitigating errors. These methods could guide additional investigation into the underlying causes of ordering misidentification error.



3) Video-Oculography-Guided Workups Vs. MRI-First for Stroke Diagnosis in Emergency Department Vertigo and Dizziness Presentations: A Model-Based Cost-Effectiveness Analysis

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Background: There are 4.4 million US Emergency Department (ED) visits annually for acute vertigo/dizziness at a cost of 10 billion USD. Many have benign inner ear disorders, but some have potentially life-threatening strokes. Hundreds of millions of dollars are spent on neuroimaging trying to detect the ~5% of patients with strokes—yet one-third of these strokes are still missed. Current care inappropriately relies largely on computerized tomography (CT) scans to differentiate between stroke and ear disorders, despite low sensitivity of CT for detecting acute ischemic strokes. Eye movement-based bedside diagnosis accurately differentiates strokes from ear disease, but requires clinical expertise not routinely available. Eye movement methods could be disseminated using portable video-oculography (VOG) technology paired to telemedicine or computer-based diagnostic decision support, but a simpler approach might be to obtain magnetic resonance imaging (MRI) in all vertigo/dizziness patients. It is unknown which approach would be more cost effective. This abstract compares the cost effectiveness of VOG-guided vs. MRI-first diagnostic methods relative to current diagnostic care for ED patients presenting acute vertigo/dizziness.
Methods: Decision tree cost-effectiveness analysis for the diagnostic evaluation of acute stroke among ED patients presenting vertigo/dizziness using a one-year time horizon. We restricted the model to consideration of neuro-vestibular causes for vertigo/dizziness (stroke, vestibular neuritis, benign paroxysmal positional vertigo, and vestibular migraine/Menière's disease). Model parameters (probabilities, utilities, and costs) were determined through literature review supplemented by expert opinion where literature-based estimates were incomplete. Model outcomes were measured in units of cost (USD, 2016) and effectiveness (health utility ranging from 0 to 1 in quality-adjusted life years [QALYs]). Incremental cost-effectiveness ratios (ICERs) were calculated.
Results: In comparison to current care ($4183, 0.69), the VOG-guided pathway incurred significantly lower cost and higher health utility ($3683, 0.73), while the MRI-first pathway resulted in higher costs for the same health utility ($4602, 0.69). VOG-guided care dominates both current care (ICER: -$12,497) and MRI-first (ICER: -$22,981) strategies. These results translate to 88,000 QALYs gained and >1 billion USD saved each year if VOG-guided care were routinely implemented in ED clinical practice nationwide.
Conclusion: Modeling suggests that VOG-guided diagnosis could save lives and reduce costs in the assessment of ED acute vertigo and dizziness suspected due to stroke or inner ear disease. A simpler, MRI-first strategy would increase costs without increasing quality. Future research should focus on prospective validation of VOG-guided diagnosis and barriers to dissemination of VOG-based diagnostic approaches.

4) Medical Diagnosis through Action: Evaluating a Point-of- Care Cognitive Aid for Junior Residents

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Background: The essential aspects of reflective practice in diagnosis have been described as: seeking Alternative explanations, exploring the Consequences of these alternative diagnoses, identifying evidence that may contradicT the provisional diagnosis, and lastly, being open to uncertainty. These necessary aspects were distilled into a 3-point checklist (abbreviated to ACT).
Methods: Eight written cases, ranging in difficulty, were selected from previous studies on diagnostic reasoning. Participants were instructed to read the cases, enter a provisional diagnosis for each case and follow the 3-point checklist, before deciding to retain or revise their provisional diagnosis. Seventeen first year medical residents from the University of Toronto participated, providing 105 sets of responses. Provisional and final diagnoses were scored as correct or incorrect. Items from the 3-step checklist were individually scored on a scale of 0 to 2. To determine if accuracy improved following use of the checklist, provisional and final diagnostic accuracy scores were submitted to a Chi-Square analysis. A secondary analysis looked at the relationship between residents' accuracy for completing the checklist and the decision to revise the provisional diagnosis.
Results: The 3-point ACT checklist was ineffective as an error reduction tool. Overall, 49 out of 105 (53%) provisional diagnoses were incorrect, with only 11 attempted corrections and no reduction of errors. Generally, scores for identifying alternatives(A) was lower than expected, indicating a limited ability to consider multiple unrelated diagnoses or consequences(C). Proportion correct for identifying consequences(C) for differential diagnoses was higher (87%) when provisional diagnoses were retained than when revised (67%, $(F(1,103) = 6.8, p < 0.05)$, indicating this evidence confirmed the provisional. Conversely, proportion correct, for detecting evidence contradictory(T) to the provisional diagnosis, was higher (57%) when provisional diagnoses were revised, than when retained (29%, $F(1,103) = 8.2, p < 0.01$).
Conclusion: The cognitive challenges that can result in diagnostic error can be compounded for the novice diagnostician transitioning into independent practice. It has been suggested that taking the time to self-assess one's knowledge and decisions can help reduce diagnostic error that results from cognitive decision failures. In the current study, there was some indication our participants were able to self-assess as attempts to revise incorrect diagnoses were related to more accurate detection of evidence that contradicted the provisional diagnosis. However, the decision to self-correct was not sufficient to reduce error overall. Effective error reduction strategies need to go beyond reliance on self-assessment.

5) Providers' Emotional Reactions to Patients in the Emergency Department: A Qualitative Investigation of Emotional Experiences, Effects on Diagnostic Reasoning, and Strategies to Reduce Error

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Background: Despite growing awareness among patient safety experts that providers' emotional experiences may compromise patient safety, little research has investigated these experiences and their possible contribution to diagnostic error. We sought to develop an understanding of emergency medicine (EM) providers' (a) emotional experiences when treating patients with and without mental health and/or substance-use conditions, (b) perceptions of how emotions may influence their assessment and treatment of these patients, and (c) strategies used to reduce any adverse effects of emotion on diagnostic reasoning.
Methods: Twenty-five EM providers (15 attending physicians, 10 registered nurses) recruited from a large academic medical center in the Northeastern US completed one-on-one semi-structured interviews. Using Grounded theory (an inductive, iterative, and rigorous approach to qualitative research) we identified emergent themes from the interviews and developed a theoretical understanding of the role that emotions are perceived to play in the practice of EM.
Results: Providers identified (a) patient factors (e.g., "difficult" patients), (b) system factors (including both local system factors [e.g., specific hospital policies] and larger system factors [e.g., lack of societal resources]), and (c) provider factors (e.g., biases, prejudices) that can adversely impact the diagnostic process. All providers associated these factors with emotional experiences, with the most frequently reported being frustration/anger, mentioned by over 95% of the sample. Indeed, this was also the most commonly reported emotion identified in response to patients with mental illness and/or substance use. Anxiety, especially about making errors, was also mentioned by numerous providers as a common emotional experience when diagnosing patients. All providers indicated an acute awareness that emotional reactions to patients can delay and interfere with diagnosis. Most providers further acknowledged that biases against patients with mental illness and/or substance use are prevalent, and all identified strategies they use to reduce the likelihood that their emotions will adversely influence the diagnostic process. Nonetheless, most acknowledged that despite their best efforts, emotional influences on diagnosis are likely to be common.
Conclusion: Some patient populations frequently elicit strong emotions in health care providers. Our findings suggest that EM providers are aware of these experiences, have some insight into the possibility that their emotions may influence the diagnostic process, and rely on strategies to decrease possible adverse effects. What remains unknown however, is whether these strategies are effective. Carefully controlled experimental research is needed to investigate this question.

6) Framing of Clinical Information Affects Physicians' Diagnostic Accuracy

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Background: How the diagnostician sees things may be strongly influenced by the way the problem is framed. Does framing bias result in clinically meaningful diagnostic error?
Methods: 69 clinicians answered three hypothetical clinical scenarios and provided their differential diagnosis and investigation list. Unbeknownst to them Scenarios 2 and 3 had two different versions, which were randomly assigned. One version was framed to suggest a particular diagnosis (Pulmonary Embolus and Interstitial Lung Disease respectively), while the other was framed neutrally. Both versions were however entirely identical in terms of the objective facts. Responses were compared. Scenario 1 was identical for all and served as a control for clinician baseline "aggressiveness".
Results: There was a significant difference in differential diagnosis and investigation (see Table 1). The "suggested" diagnosis was considered and investigated for the majority of the time in the "suggested" group, and the minority of the time in the "non-suggested" group, despite both groups receiving the same objective and factual information. This was most striking in scenario 2, where 100% versus 50% of clinicians considered PE in their diagnosis. This result remained robust when undertaking stratified analysis and logistic regression to account for differences in seniority and baseline aggressiveness- neither of the latter variables had any effect on the result.
Conclusion: This is the first study to demonstrate a clinically meaningful effect of framing bias on rates of diagnostic error. This framing bias exists in the way in which we present patients and conduct handovers on a day to day basis. Our study is strong in terms of its focus on a clinically meaningful outcome – investigations ordered. Our results are made more robust by the fact that they allowed for clinicians who ordered the 'right' test for the 'wrong' reason. This finding has implications for the way in which we conduct handovers and the way we teach juniors to communicate clinical information.

Table 1	Suggested group	Non suggested group	P value	RR
Scenario 2 PE in differential	39/39 **(100%)**	15/30 **(50%)**	<0.0001	2
Scenario 2 Ddimer/CTPA	37/39 **(95%)**	9/30 **(30%)**	<0.0001	3.2
Scenario 3 ILD in differential	25/31 **(81%)**	11/38 **(29%)**	<0.0001	2.8
Scenario 3 CT/Spirometry/Lung Function	23/31 **(74%)**	14/38 **(37%)**	0.002	2

Table 1 Legend:

Row 1: Randomised groups, p values and relative risk (RR)

Row 2: Proportion of clinicians listing pulmonary embolus in their differential for Scenario 2

Row 3: Proportion of clinicians requesting d-dimer or CT Pulmonary Angiography in Scenario 2

Row 4: Proportion of clinicians listing interstitial lung disease in their differential for Scenario 3

Row 5: Proportion of clinicians requesting CT chest or spirometry or other lung function tests in Scenario 3

Oral Abstracts of Practice Improvement Strategies

Tuesday, October 10, 2017 9:45AM-12:30PM

1) Opportunities to Improve Diagnosis in Acute Care – Findings from a Multi-Disciplinary Expert Panel

P. Mahajan[1], E. Alpern[2], K. Baird-Cox[3], R. Boothman[1], J. Chamberlain[4], K. Cosby[5], E. Duffy[6], H. Epstein[7], J. Gegenheimer-Holmes[1], M. Gerardi[8], T. Giardina[9], E. Mathias[10], C. Mollen[11], V. Patel[12], R. Radecki[13], R. Ruddy[14], J. Saleem[15], K. Shaw[16], D. F. Sittig[17], V. Vydiswaran[1] and H. Singh[18]
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[11]Children's Hospital of Philadelphia, Philadelphia, PA
[12]The New York Academy of Medicine, New York, NY
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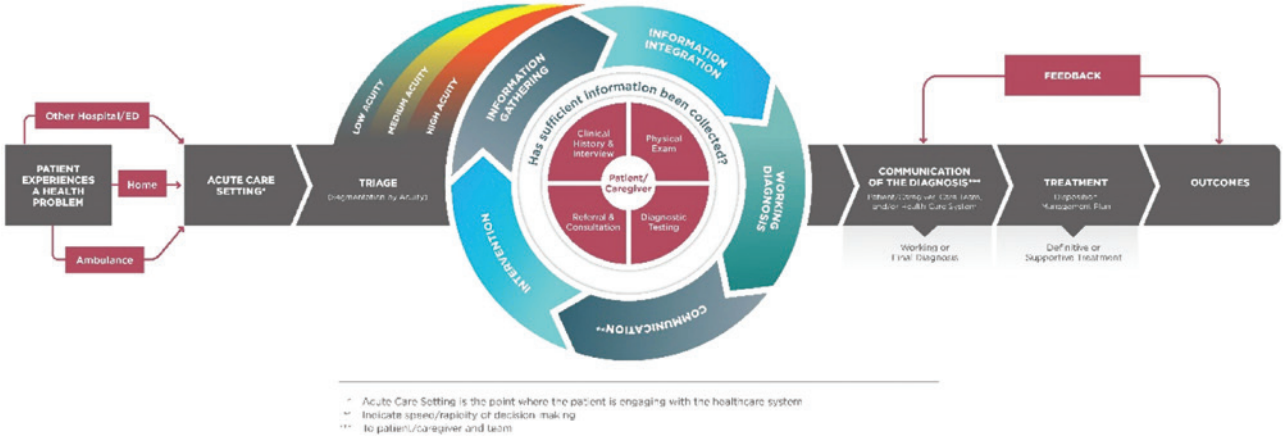
Statement of problem: Acute care settings, including emergency departments, are often chaotic and highly complex environments that pose unique challenges for diagnosis. To advance the science of defining and measuring diagnostic errors in these settings, we sought to build upon National Academies of Sciences Engineering and Medicine's (NASEM) definition and framework for approaching the diagnostic process.
Description of the intervention or program: We convened a 20-member multi-disciplinary panel with expertise in general and pediatric emergency medicine, nursing, patient safety, informatics, cognitive psychology, social sciences, human factors, and risk management, and a patient/caregiver advocate. We used modified nominal group technique to develop a shared understanding of how to operationally define diagnostic errors in acute care, and modify the NASEM conceptual framework to acute care.
Findings to date: In a 1.5-day in-person and web-based meeting, we relabeled diagnostic errors as "Opportunities to Improve Diagnosis in Acute Care" with the following working definition: *Divergence from normative diagnostic processes in the acute care setting that increases the risk of poor outcomes, despite the availability of sufficient information.* Diagnostic processes include tasks related to (a) acuity recognition, information gathering and synthesis, evaluation, coordination, and (b) communication with patients/caregivers and other diagnostic team members. Based on existing frameworks, we also developed a modified diagnostic process framework applicable for acute care (see Figure).
Lessons learned: Through qualitative methodologies, we developed an operational approach to define and measure acute care related diagnostic errors, which we now plan to validate through input from multiple stakeholders, including national associations that represent emergency providers (physicians, nurses and advanced practice professionals), regulatory organizations, and patient/caregiver representatives. This approach will be used in an AHRQ-funded project to measure diagnostic errors in real-world pediatric acute care settings.



2) Improving Diagnostic Skills with Real-Time Feedback through the Human Dx Technology System

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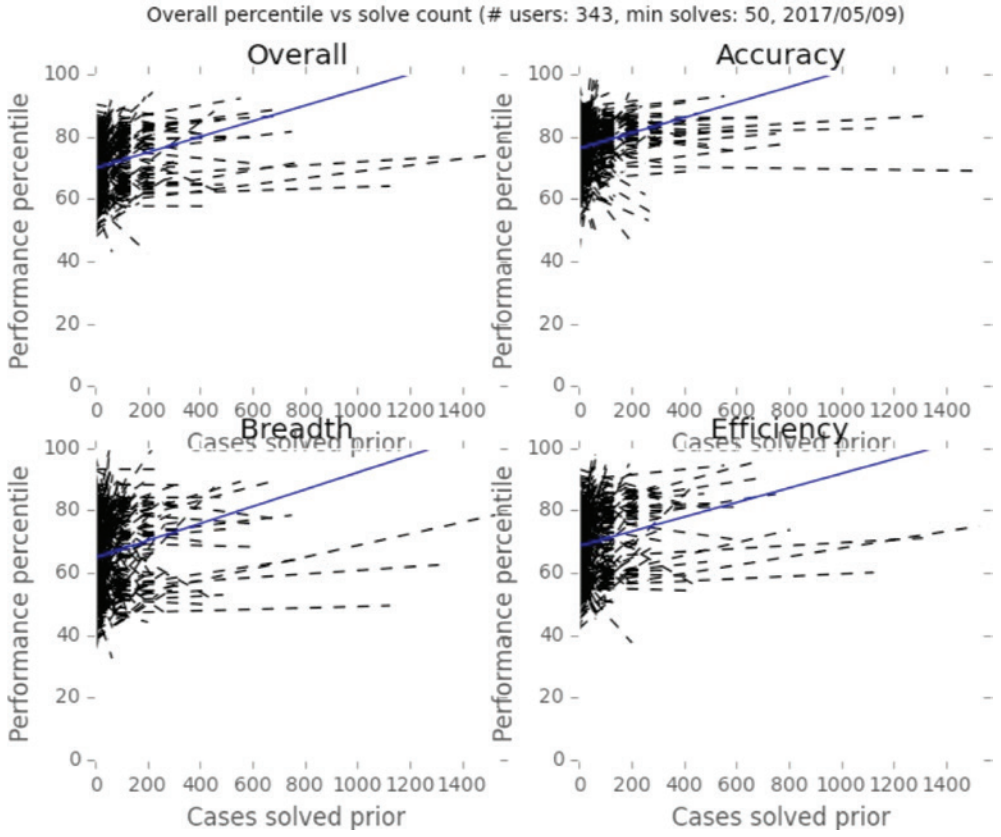
[2]NIH, Bethesda, DC
[3]The Human Diagnosis Project, Dunn Loring, VA
[4]University of Minnesota, Minneapolis, MN

Statement of problem: The development of diagnostic skills is one of the most important goals of medical education, yet there are actually few explicit, intentional approaches to longitudinal improvement. The 3 main components of an expert-performance approach include an (1) explicit goal for training, (2) feedback (immediate, accurate, and deliberate), and (3) opportunities for repetition and practice (Ericsson). Currently there are no consistent, objective, or longitudinal methods for trainees or practicing clinicians. One challenge to timely feedback is that a final diagnosis is often not available while a trainee or clinician is actively involved in the patient's care, and despite good intentions, following up on patients in modern fragmented healthcare is difficult. Another limitation with current diagnosis-related feedback is that it focuses on one component of the process (i.e., accuracy) and doesn't take into account other factors like efficiency.
Description of the intervention or program: The Human Diagnosis Project (Human Dx) is an open technology system that allows clinicians worldwide to upload and solve cases in a serial-cue based manner. After solving a case, the user receives a score (called "Clinical Quotient") based on accuracy and efficiency of differential diagnosis. Human Dx is a platform for clinicians to practice their diagnostic skills through iterative deliberate practice; the platform provides immediate feedback in the aforementioned domains after a case is solved.
Findings to date: We reviewed the diagnostic accuracy, efficiency, breadth, and overall performance of 343 Human Dx physicians and trainees who solved 50 or more cases on Human Dx since January 2011.Preliminary data shows that the user's average accuracy, efficiency and overall performance increase as they solve more cases in the platform, suggesting that iterative, deliberate practice improves diagnostic skills. This finding is preliminary and is subject of a number of confounders including technology learning curve, case selection bias, and user selection bias.
Lessons learned:

- Human Dx is an innovative and engaging platform for physicians and trainees to assess and improve their clinical reasoning ability through repeated cycles of performance and feedback.
- Early evidence suggests that the platform may improve clinical reasoning.



3) Improving Diagnostic Reliability By Obtaining Radiology Consultation Prior to Ordering a Diagnostic Exam

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[1]Southern California Permanente Medical Group, Woodland Hills, CA
[2]Southern California Permanente Medical Group, Pasadena, CA

Statement of problem: Diagnostic errors and delays in patient diagnosis may arise when physicians do not know the best imaging study or even if an imaging exam should be ordered for a given patient. Most institutions lack a convenient means of getting a consultation from a

radiologist prior to ordering an exam. The usual practice is that informal imaging consultations are done via phone calls without permanent documentation or review of the medical records by the radiologist.

Description of the intervention or program: In the first quarter of 2016 an Imaging MD Advice Program was launched at the Kaiser Permanente Woodland Hills Medical Center which is a 280-bed acute care hospital taking care of 252,000 members. The medical center is part of an integrated delivery system using a single EMR (EPIC). We utilized the Dr. Advice functionality to allow clinicians to request a consultation on specific patients when they were unsure of what radiology exam to order. Out of 18 radiologists in the department 2 of them participated in this pilot. When they received a consultation, they would review the request and the patient's medical record and then provide a written consultation back to the referring physician.

Findings to date: The average volume is 43 consultations per month. 79% of the staff requested from 1-5 consultations per week. 90% of them felt that they made more appropriate imaging orders. 59% cancelled or delayed orders. Consultations were categorized into the following categories: What to do 68% Is a biopsy indicated 15% Is an MR safe 11% Comparisons 6%. Overall user responses to this program were favorable. 44% expected a response in 24 hours, 40% in 48 hours, and 92% of physicians felt that the Radiologist consultants were willing to address follow up questions.

Lessons learned: Obtaining a formal radiology consultation prior to ordering an exam is operationally feasible and well received. Ordering physicians felt that this service improved their ability to know when to order studies and which studies. The use of the EMR facilitated convenience, documented the consultant recommendations, and provided clinically relevant educational material. Use of this program has the potential to decrease diagnostic errors or delays by insuring the most appropriate exam is performed and that there are not unnecessary delays from ordering examinations not indicated.

MD Request	MD Advice
Recent liver MRI follow up with 3 cm liver mass. GI advice suggests follow up with Radiology. Request: Suggest further imaging follow up for this indeterminate liver lesion? Or biopsy?	Review of MRI 12/28/2016 with eovist is consistent with FNH. No follow up is recommended as these are benign process.
Patient with personal history of colon cancer with right upper quadrant pain. Ultrasound reveals dilated renal cyst versus renal pelvis. Request: What should I do CTU or CT AP?	If further work up needed, I recommend CT urogram to better separate renal collecting system from peripelvic cysts.
Patient with 7 cm posterior neck mass rapid development. Probable lipoma but will need imaging. Request: Please advise modality MR versus CT. Patient problem vertebral artery stent is this patient MR compatible?	I would do CT neck without and with contrast.
Request: Can you please advise if gas pain and constipation can cause these problems on CT? Having trouble finding clinical correlation for symptoms.	I'm not impressed by the amount of stool or bowel gas present on the recent CT study. Mildly redundant sigmoid colon and less than distended distal / opacified small bowel loops were present. Subtle small bowel wall thickening in the ileum cannot be entirely excluded. But I do not think imaging evidence for constipation or significant bowel gas distension.
Incidental finding of 4 mm lung nodule. Patient was a 35 pack/year smoker who quit in 2000. Request: What should I do?	Consider getting baseline CT Chest for lung cancer screening without contrast, given 35 pack year smoker even though quit 15 years ago. Alternatively, you could wait and see how the neck node work up turns out and see if patient needs total CAP CT based on the lymph node workup. Your clinical evaluation drives which imaging pathway to choose.
Patient with history of ulcerative colitis and melanoma in situ. Repeated liver MRI shows bilateral growing renal cyst as well as spinal lesion. Request: Outside of spinal MRI, what you recommend for evaluation of renal cysts?	Low risk renal cyst already evaluated by contrast given for the liver exam. Bosniak 2 category renal cysts requires no additional imaging follow-up. Follow based on acute symptoms only.
57 year old female. 12/11/14: CT angio of chest revealed incidentally noted liver masses. 2/24/15: Follow up MRI noted a 2.3 x 1.3 cm lesion in the left lobe of the liver with Dx including fibronodular hyperplasia or adenoma. A 7-mm simple unilocular non-enhancing cyst at the pancreatic neck also noted She will soon schedule an MRI of pancreas without and with contrast for a 2 year follow up of on the liver MRI. Request: Does she need additional imaging of the liver lesion?	Pancreatic coverage on our routine protocol will not likely include the left hepatic lobe finding. Need to comment on pancreatic order to "please add some addition images through left lobe to evaluate known liver lesion."

4) Prioritizing Diagnostic Safety Efforts in the Physician Office Practice Setting

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[4]Center for Innovations in Quality, Effectiveness, and Safety, Michael E. DeBakey Veterans Affairs Medical Center and Baylor College of Medicine, Houston, TX

Statement of problem: Few systematic patient safety efforts or initiatives target physician office practices. These practices face increasing risk of adverse events and liability risks in midst of inconsistent processes and fragmented care. A large malpractice carrier (MCIC Vermont, LLC) convened a team to develop a program to understand and target high-priority safety risks in office practice.
Description of the intervention or program: To identify the current risks and opportunities and to define the program scope, the team first reviewed malpractice claims data and existing safety literature. Outpatient claims represent 30% of projected annual liability malpractice costs at MCIC with missed and delayed diagnosis accounting for approximately 50% of office-based practice liability risk. The team then conducted site visits to 8 clinics, all affiliated with five large academic medical centers in the northeast and interviewed both clinical and administrative leaders. Interview questions helped identify high-risk areas and how the clinic addressed them.
Findings to date: The team identified ten risk domains based on site visits and interviews. The risk domains were reviewed and prioritized using weighted criteria. Diagnostic test result practices consistently emerged as a common high-priority issue across all sites. A collaborative representing each site was formed for purposes of program development. The collaborative came to consensus to initially focus on improving diagnostic test results follow-up as a risk reduction effort. To further focus areas of improvement, we used a comprehensive literature review and the evidence-based framework of the ONC SAFER Guide on Test Results Reporting and Follow-up to develop nine "shared principles" for communicating diagnostic test results. These principles (Table) will guide each site on institution-specific pilot projects and guidelines for diagnostic test results follow-up processes.
Lessons learned: While office practices face several safety challenges, we worked with leadership from 8 clinics to develop a collaborative approach to address their highest priority topic - diagnostic test result follow-up. In the next year, the sites will focus on implementation of intervention projects and integration of the "shared principles" within their institutional policies, procedures and care processes. This approach could serve as a model to identify and share lessons learned and develop and disseminate standardized test results follow-up best practices.

5) The LOOP Study: A Multi-Center, Interdisciplinary Initiative to Improve Diagnostic Reasoning and Patient Safety through Consistent, Rapid Feedback

J. N. Lessing[1], E. M. Caruso[2], J. Clemons[3], C. J. DeMott[4], K. P. Lane[5], B. K. Mathews[6], J. K. Schaefer[5], G. A. Turner[2], B. Wheeler[7] and A. P. J. Olson[5]
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[2]Thomas Jefferson University Hospital, Philadelphia, PA
[3]University of Colorado, Aurora, CO
[4]Virginia Tech Carilion School of Medicine, Roanoke, VA
[5]University of Minnesota, Minneapolis, MN
[6]HealthPartners and University of Minnesota Medical School, St. Paul, MN
[7]University of Colorado, Colorado Children's Hospital, Aurora, CO

Statement of problem: Development of expertise in diagnostic reasoning is one of the most important goals of medical education, and feedback is fundamental for improving performance. There are many barriers to effective feedback for trainees about clinical decisions, including multiple transitions of care and fragmented health care systems. Trainees frequently lack the opportunity to consistently determine what happens to patients that they admit to hospital, nor do they have opportunity to follow a patient throughout an entire hospital course. We must create intentional mechanisms to standardize feedback about clinical decisions across transitions of care for medical trainees. The LOOP Study is a national expansion of the previously described pilot project to standardize feedback about clinical decisions across transitions of care for residents and promote a culture of continuous improvement in diagnostic reasoning.
Description of the intervention or program: After successful pilot at the University of Minnesota, the study was expanded to include 9 institutions. IRB approval was obtained at all sites, and participation by residents was encouraged but voluntary. Pre- and post-surveys were administered to determine trainees' self-efficacy in diagnostic reasoning and giving and receiving feedback, as well as satisfaction with current level of feedback. Teams who assumed care of patients after night admissions were encouraged daily to send feedback forms to the admitting teams, comparing initial and subsequent diagnostic impressions. The feedback forms were gathered, coded, and categorized for content to capture changes in diagnosis over the initial days of care for hospitalized patients.
Findings to date: Preliminary data from the pre-survey reveals that many (43%) of residents are less than somewhat confident in their ability to identify diagnostic errors or near misses in their own practice. There is substantial room for improvement in physicians' discussion of diagnostic reasoning, and a majority of residents stated that they do not get the same amount of feedback about patients they admit at

night compared to those during the day. Nearly all residents agree (89%) that they like receiving feedback, but only 47% like giving it. Data collection and analysis with respect to post-surveys and the feedback forms are presently underway, and will be presented at the conference.
Lessons learned: Trainees desire feedback about diagnostic reasoning and are more comfortable receiving feedback than giving it. Night admissions are often a lost opportunity for residents to receive feedback about reasoning. Workflow-congruent methods to encourage feedback completion are important for success and sustainability.

6) Ambulatory Safety Nets for Lung and Colon Cancer to Prevent Missed and Delayed Diagnosis

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[2]Partners HealthCare, Boston, MA

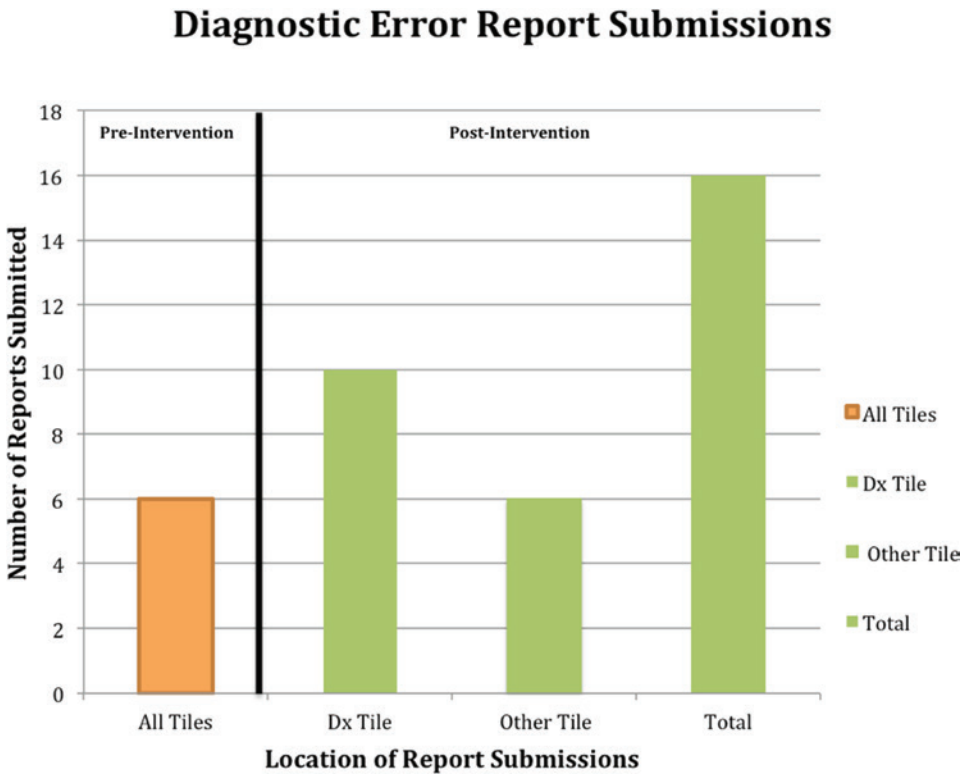
Statement of problem: Diagnostic error in the ambulatory setting is often related to challenges in abnormal test result follow-up, leading to missed and delayed diagnoses of cancer. Our project strives to create patient safety nets for lung and colon cancer from the point of abnormal test resulting, to ensuring the patient comes back within the correct time period for appropriate follow-up testing.
Description of the intervention or program: The scope of our program is patients at Brigham and Women's (BWH) with either incidental lung nodules identified by various radiology imaging modalities or colonoscopies with abnormal pathology performed or patients with rectal bleeding and/or iron deficiency anemia. Our patient safety nets include four key components: electronic registries, modified workflows, patient outreach, and tracking follow-up.
Findings to date: Our safety nets have been informed through multi-disclipinary working groups with primary care, population health management, relevant specialists and the patient safety team. Redesign of primary care and specialty workflows to support safety net work has been undertaken. Two out of three electronic registries have been built through leveraging electronic medical record data with functionality to support direct patient outreach, clinician communication, and patient tracking. One registry will serve as a GI Recall Registry for patients with abnormal pathology following colonoscopy who are due for follow-up testing and the second registry will identify patients at-risk for colon cancer based on the presence of rectal bleeding and/or iron deficiency anemia. The third registry for lung nodules is planned for development in 2018 based on Radiologist identifying and coding incidental lung nodules at that time of reading the imaging study. In the interim, we have utilized natural language processing (NLP) to identify a retrospective list of patients seen during 2016 with lung nodules, without lung cancer, with a BWH primary care physician, and without any documentation follow-up imaging in the recommended timeframe. We will be launching an extension of our existing alert notification system for critical test results (ANCR) in July 2017 which will notify ordering clinicians of incidental radiology findings, allow them to agree or disagree with recommended follow-up imaging and then send to central radiology scheduling to help with ensuring follow-up imaging.
Lessons learned: The development of robust ambulatory patient safety nets require multiple parallel efforts integrating EMR functionality with modified clinician and administrative workflows led by a central patient safety team for patient tracking and outreach.

7) Capturing Diagnostic Errors in Incident Reporting Systems

K. T. Gleason[1], S. Peterson[1], E. Kasda[1] and D. Newman-Toker[2]
[1]Johns Hopkins University, Baltimore, MD
[2]Johns Hopkins University School of Medicine, Baltimore, MD

Statement of problem: Diagnostic errors remain largely unmeasured by health care organizations and are vastly underreported by health professionals. Most incident reporting systems that health professionals use to report errors and potential errors are not designed to specifically identify diagnostic concerns. The lack of a designated place to report diagnostic concerns creates significant additional work to identify these reports and patterns, and impedes the identification of systems based problems that are specific to diagnosis.
Description of the intervention or program: This project at Johns Hopkins Medicine focused on the development of a pathway in the Hopkins online event reporting (HERO) system that specifically identifies and elaborates on diagnostic concerns. The location was a specific "tile" within the reporting system with queries specific to diagnostic improvement that included: specifying whether the event was a wrong or delayed diagnosis, contributing factors, presenting signs and symptoms, correct diagnosis, diagnosis rendered, and whether there was an opportunity to diagnose earlier or more accurately that might have altered the outcome positively. Education was delivered across the healthcare system regarding diagnostic errors and the new method available for reporting diagnostic concerns when the intervention was implemented. We compared reporting rates of diagnostic concerns pre- and post- development of this tile. A patient safety expert reviewed event reports and labeled relevant reports as a diagnostic event for pre- and post- implementation rates.
Findings to date: The diagnosis-specific category has been in use since March 2017, and submissions related to diagnostic error have increased since its creation. In the two months pre-intervention, there were six diagnostic specific reports submitted. In the two months post-intervention, there were ten reports submitted to the new diagnosis specific category, and six reports submitted to other categories that described diagnostic error (Figure 1).

Lessons learned: Inclusion of a diagnosis-specific category in the incident reporting system increased reports of diagnostic errors and facilitated collection of data related to diagnostic events. While the development of this tile appears to have facilitated identification of diagnostic specific concerns, it should be noted that diagnostic concerns were being previously reported, and still are reported, to other locations (where they are more labor intensive to identify). This intervention can ease the burden on identifying relevant reports and further development could allow for a system that provides directed feedback for diagnostic improvement purposes.



8) Initial Results from the Kaiser Permanente Gross Hematuria Surenet Screening Program

P. Elliott[1], R. Loo[2], C. Ng[3], R. Timmins[4], M. H. Kanter[5] and E. Rhee[6]
[1]Kaiser Permanente, Los Angeles, CA
[2]Kaiser Permanente, Oakland, CA
[3]Kaiser Permanente, Panorama City, CA
[4]Kaiser Permanente, Pasadena, CA
[5]Southern California Permanente Medical Group, Pasadena, CA
[6]Kaiser Permanente, San Diego, CA

Statement of problem: Gross hematuria, even when transient, can be an ominous symptom, with an estimated 12% of patients ultimately being diagnosed with a urologic malignancy. Oftentimes, however, hematuria is identified but no workup is initiated, resulting in potentially avoidable delays in diagnosing urologic cancer.
Description of the intervention or program: Kaiser Permanente is a fully integrated healthcare system serving over 4.8 million members in Southern California. Between the dates of January 1st 2016 and April 1st 2017, we identified over 1200 patients with gross hematuria using ICD-9 code 599.71 or ICD-10 code R31.0, and who had no urologic encounters subsequent to the date the symptom was recorded. These patients were compiled into the Gross Hematuria SureNet, a regional safety net program. SureNet programs have been previously described to identify patients that need follow up but who have not received it. A workflow algorithm was implemented to further evaluate the gross hematuria: an urologist reviewed the patient's chart to determine if follow up was needed. Patients with scheduled urologic follow up or an identified benign cause (urinary tract infection with >100,000 cfu at the time of diagnosis, renal calculus >5mm on imaging, or traumatic catheter insertion) were removed from the SureNet. Next, the patient was contacted by a urologist or trained LVN first by telephone, then by email to arrange follow up or identify why there was no follow up. Next, the patient was scheduled for appropriate imaging and cystoscopy at their local Kaiser facility.

Findings to date: 466 patients were screened with the intention of identifying patients who still needed evaluation. 194 (42%) required no further evaluation due to an identified benign cause, or because a hematuria workup was completed within the last 18 months. 272 patients (58%) required follow up. Of these patients, 171 (63%) were never referred to urology, and 101 (37%) were referred but either refused follow up, missed their appointment, or were never scheduled. To date, 84 patients have undergone cystoscopy based on the SureNet program, with 9 bladder cancers identified (11%).
Lessons learned: We have created a systematic, efficient, and reproducible approach to identify and evaluate patients with gross hematuria who otherwise may have been lost to follow up resulting in delayed diagnosis of urinary tract malignancy. Our workflows and process have been well accepted and implemented at multiple medical centers across Kaiser Permanente Southern California.

Oral Presentation of Clinical Vignette

Sunday, October 8, 2017 1:30-2:30PM

Decision-Making Shortcuts Leading to a Missed Diagnosis of Near-Fatal Chronic Acetaminophen-Induced Fulminant Liver Failure

M. L. Baker[1] and F. Al-Ali[2]
[1]Wayne State University, Detroit, MI
[2]Beaumont Hospital, Dearborn, MI

Learning objectives: - Heuristic pitfalls in decision-making lead to declines in patient care. - Consideration of cognitive biases and alternative hypotheses positively impacts morbidity and mortality.
Case information: An 18-year-old female 27 weeks pregnant presented with a week of congestion, nausea, and fever. She was diagnosed with a viral URI, given IV fluids and Tylenol, and advised to continue Tylenol PO for fever. Thirty hours later, the patient returned with continued symptoms and abdominal cramps. She was diagnosed with gastroenteritis and discharged with Zofran and Pepto-Bismol. Two days later, she presented with SOB and abdominal pain. Examination revealed lethargy, tachycardia, tachypnea, and generalized abdominal tenderness. Influenza B PCR was positive and Oseltamivir was started. Labs revealed leukocytosis, transaminitis in the thousands, and lactic acidosis. She was given broad spectrum antibiotics and a diagnosis of "Influenza/possible sepsis". Further questioning revealed the patient had taken 1 g tylenol q4 hours. However, despite evidence of acute fulminant hepatitis due to chronic acetaminophen over-ingestion, the antidote was held for 10 hours because acetaminophen levels were <10.
Discussion: Acetaminophen is the most widely-used analgesic antipyretic in the US. While considered safe at usual therapeutic doses of up to 4 g per 24 hours, it is also one of the most common cause of drug-induced liver injury and most common cause of acute liver failure. In this case, the diagnosing physician did consider an acetaminophen overdose, but missed the early diagnosis because he anchored the main diagnosis on the prior ED visit diagnosis of a URI, used mental shortcuts to analyze the transaminitis as representing sepsis or viral hepatitis, and used the negative acetaminophen level as a safety net. This case demonstrates the importance of considering biases in patient care, and maintaining a high index of suspicion for acetaminophen toxicity in cases of compatible patient histories.

Poster Presentations-Clinical Vignettes, Scientific Abstracts and Applied Innovations

Sunday, October 8, 2017 5PM-7PM

Monday, October 9, 2017 7AM-8:45AM

1) Crystals in Time May Come: Misunderstanding Gout Lab Limitations

J. N. Lessing[1], T. N. Garland[2], M. N. Morcos[3], G. S. Baird[3] and J. B. Lynch[3]
[1]University of Colorado, Denver, CO
[2]Denver Health, Denver, CO
[3]University of Washington, Seattle, WA

Learning objectives: 1) Recognize phenomenon of latent crystal formation in gout/pseudogout. 2) Recognize all tests, even the gold standard, are imperfect.
Case information: A 51yo man was admitted after acute onset of swollen and painful right elbow. Pain started suddenly without incitation. Fevers/constitutional symptoms were absent. He denied drug use, recent travel or sex. The patient appeared uncomfortable, resisting all movement of his right elbow. The joint was swollen/erythematous/warm. Remainder of exam, including other joints, was normal.

WBC was normal. Synovial fluid was straw-colored with 9,696 nucleated cells (91% neutrophils), glucose 133 (147 serum). Ordinary and polarized light microscopy was negative for crystal formation. Gram stain/bacterial culture were negative. Patient was discharged on antibiotics for suspected culture-negative septic arthritis in absence of more likely diagnoses. At clinic follow-up for unchanged pain, provider noticed synovial fluid results indicating monosodium urate crystals, confirming gout.

Discussion: Latent crystal formation in gout and pseudogout is a phenomenon not recognized by most clinicians. In this case, diagnosis and treatment of gout was delayed due to failure to recognize this phenomenon. Little is written on this subject, but a study from University of Washington suggests latent crystal formation is common: 7 of 107 (6.5%) samples of synovial fluid analyzed in consecutive patients suspected of gout were initially crystal-negative but became crystal-positive after 24-hour latency period. Of total number of crystal-positive cases, 24% were detected only upon repeat examination. Given heavy crystal burden, authors of that study favor latent crystal formation as the more plausible explanation. Awareness of latent crystal formation is crucial to optimal care of patients suspected of having crystal arthropathy. An alert system, similar to blood cultures, should directly notify provider and confirm notice was received. Yuan S et al. Repeat examination of synovial fluid for crystals: is it useful? Clin Chem. 2003 Sep;49(9):1562-3.

2) A New Super-Villain Strikes Under the Cover of DKA

C. Schifeling
University of Colorado School of Medicine, Aurora, CO

Learning objectives: Highlight (and thereby add to differential diagnoses) an emerging, highly virulent *Klebsiella* infection associated with diabetes that demands a high index of suspicion since prompt diagnosis is paramount for management.

Case information: A Hispanic man in his 50s with no past medical history was admitted to the ICU for new onset diabetes with DKA. His presentation was notable for abdominal pain, altered mental status, leukocytosis of 28 and chest X-ray with bilateral hazy nodular opacities suggestive of edema or infection. One day after this presentation, CT scan showed a liver abscess found to be due to *Klebsiella pneumoniae* with septic emboli to lungs, brain, prostate, retina and kidneys. He was successfully treated with an extended (>2 month) course of ceftriaxone and metronidazole.

Discussion: A new strain of hypervirulent, community-acquired *Klebsiella pneumoniae* is an emerging infection which causes liver abscesses that shower septic emboli, frequently leading to pneumonia, meningitis, endophthalmitis and necrotizing fasciitis[1,2]. This infection originated in Asia but is growing in prevalence globally, particularly in people with poorly controlled diabetes or with Asian or Hispanic ethnicity[2]. It often infects younger and healthier people but has significant morbidity (loss of vision and limbs, and neurologic sequelae) and mortality (up to 42%) due to tendency for metastatic spread[1]. Despite the importance of rapid recognition for successful treatment, only one third of cases are diagnosed on admission[2]. As such, increased awareness is imperative for the diagnosis and management of this new superbug[1,2].

MOST WANTED!	
Alias	*Klebsiella pneumoniae* serotypes K1 and K2
Appearance	Fever (70-95% of patients), leukocytosis (70-82% of patients) and elevated alkaline phosphatase (2-3 times the upper limit of normal)[3]
Modus operandi	Liver abscess with septic emboli often causing pneumonia, meningitis, endopthalmitis and necrotizing fasciitis[1,2]
Under the hood	Isolated colonies are hypermucoviscous with positive "string test" wherein colonies when touched by loop and lifted will form an unbroken line between the loop and the plate[1]
Last seen	Globally[1,2]
Reward	Prompt treatment of patients at risk for significant morbidity and mortality[2]

References:
1. Shon AS, Bajwa RP, Russo TA. Hypervirulent (hypermucoviscous) Klebsiella pneumoniae: a new and dangerous breed. *Virulence*. 2013 Feb;4(2):107-18.

2. Siu LK, Yeh KM, Lin JC, Fung CP, Chang FY. Klebsiella pneumoniae liver abscess: a new invasive syndrome. *Lancet Infect Dis*. 2012 Nov;12(11):881-7.

3. Lederman ER, Crum NF. Pyogenic liver abscess with a focus on Klebsiella pneumoniae as a primary pathogen: an emerging disease with unique clinical characteristics. Am J Gastroenterol. 2005 Feb;100(2): 322–31

3) A Mimic of Acute Coronary Syndrome

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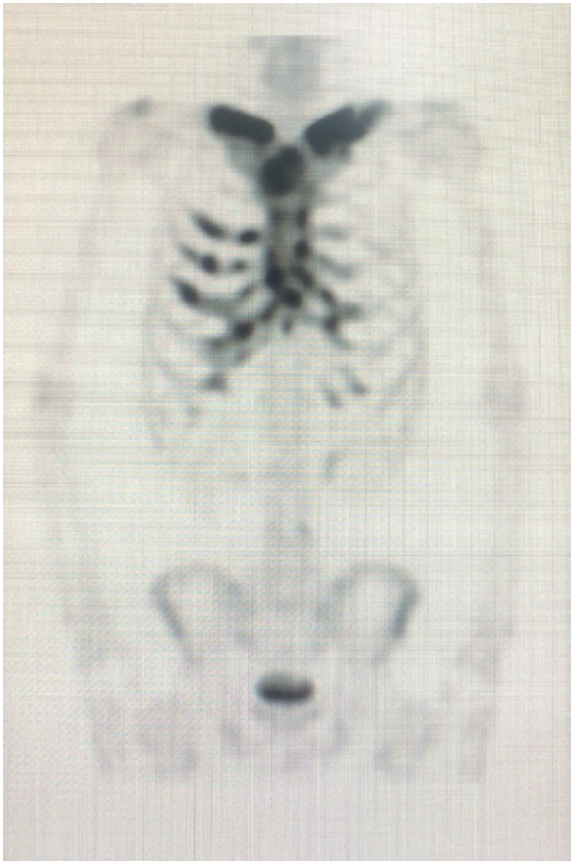
Learning objectives: SAPHO (synovitis, acne, pustulosis, hyperostosis, and osteitis) syndrome with pericardial adhesion due to advanced sternal osteitis, is rare, but one of the mimics of acute coronary syndrome (ACS).
Case information: A 60 year-old man with ischemic heart disease presented with worsening chest pain for several years. The pain was dull, continuous, exacerbated by exertion, located in the center of his chest, accompanied with tenderness. 2 years before admission, acne-like rash developed and remitted spontaneously. On examination, his vital signs were stable. His sterno-costoclavicular joint was remarkably swollen. There was psoriatic rash in his bilateral elbows. Laboratory revealed elevated serum troponin-I, but normal CK-MB. Electrocardiogram was normal. Trans-thoracic echocardiogram showed mild hypokinesis and high-echoic pericardium in mid wall of the left ventricle which was consistent with pericardial adhesion. He was diagnosed with ACS and had coronary arteriogram revealing no significant coronary stenosis. However, his chest pain persisted. Bone scintigraphy showed remarkable radionuclide accumulation in sterno-costoclavicular joint (Figure), which was consistent with SAPHO syndrome. He was started on immunotherapy.
Discussion: SAPHO syndrome is rare, but can be one of the mimics of acute coronary syndrome. Acnes is a key diagnostic clue for SAPHO syndrome, but is not essential for the diagnosis. Approximately 20% of patients with SAPHO syndrome do not develop skin lesions. Pericarditis is one of the complications of SAPHO syndrome. In this case, the inflammation of sternal osteitis due to the aggressive type of SAPHO syndrome presumably extended to his pericardium and partial myocardium, thereby causing chronic pericarditis and elevated Troponin-I. In patients with chest pain symptom and elevated cardiac enzyme, physicians can be anchored to the possibility of ACS. This case underscores the difficulty in differentiating SAPHO syndrome from ACS.



4) Congestive Hepatopathy - a Mimicker of Alcoholic Hepatitis

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Learning objectives: 1. Recognize and avoid premature closure when seeing patients with a history of substance abuse 2. Recognize congestive hepatopathy as a mimicker of other common causes of liver injury

Case information: A 35 year-old woman with a history of polysubstance abuse presented to the emergency room with abdominal pain. Her lactate was 7.6. Liver function tests revealed: AST 48, ALT 56, TBili 2.7, and INR 2.0. Chest x-ray revealed multifocal infiltrates and a right-sided pleural effusion. CT of the abdomen revealed hepatic steatosis and small volume ascites. She denied drinking more alcohol than 2 drinks monthly on admission but alcohol abuse was noted in prior documentation. She was diagnosed with alcoholic hepatitis and received IV steroids with a discriminant function of 52. However, over the next 24 hours her lactic acidosis failed to clear with fluid administration. Subsequent echocardiogram revealed severe biventricular dysfunction and ventricular trabeculation concerning for noncompaction syndrome, and her liver injury was subsequently attributed to congestive hepatopathy. The patient was managed with inotropic support and afterload reduction.
Discussion: While noncompaction syndrome is a very rare diagnosis, heart failure is an entity encountered regularly by internal medicine residents. However, the diagnosis of congestive hepatopathy can be difficult to identify as a cause of hyperbilirubinemia and coagulopathy. In this individual with a charted history of polysubstance abuse, her liver dysfunction was more readily related to substance abuse due to premature closure. Congestive hepatopathy can mimic alcoholic hepatitis and other hepatic disorders, and can present with 3 or more-fold elevations in transaminases, hyperbilirubinemia to 15-20 mg/DL, and elevation of the INR.[1] Providers must avoid premature closure when seeing those with substance abuse and maintain a broad differential for presenting complaints. References: 1. Fouad YM and Yehia R. Hepatocardiac disorders. World J Hepatol. 2014; 6:41-54.

5) Back to Basics: Using the Physical Exam to Diagnose the Patient

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Learning objectives: To understand the importance of conducting a complete history and physical exam in making an accurate diagnosis
Case information: 62 year old with a history of endometrial cancer, lupus and sarcoidosis who presented to the emergency department with 2 days of diaphoresis, headache, photophobia and blurry vision after visiting her daughter in college. In the emergency department, the patient's vital signs were: T 103.1, HR 106, RR 18, BP 134/76, 95% on RA. Her lumbar puncture showed no evidence of meningitis. Chest X-ray showed plate-like atelectasis in the left lower lobe but no other pathology. Head CT and urinalysis were unremarkable. She had mild leukocytosis but no other lab abnormalities. She was subsequently admitted for further evaluation. The following day, the patient's symptoms resolved but she continued to experience persistent fevers to 103. Surveillance blood cultures remained negative. She complained of mild cough and sinus tenderness but no other symptoms. On hospital day #3, Infectious disease was consulted. They recommended several studies including anaplasma, lyme, RPR, HIV and a chest CT. Chest CT showed left lower lobe consolidation. After receiving the CT findings, the team went back to talk to and re-examine the patient. She endorsed having a cough productive of scant green sputum. On physical exam, she was found to have dullness to percussion, marked egophony and increased tactile fremitus in the left lower lobe. The patient was ultimately diagnosed with community acquired pneumonia and discharged in stable condition on levofloxacin.
Discussion: This case illustrates the importance of history and physical exam in making a diagnosis. Given the patient's atypical presentation, pneumonia was excluded early on in the decision making process. However, once diagnoses such as meningitis and bacteremia were ruled out, the primary and consulting teams failed to re-examine the patient in depth. This led to unnecessary testing and delayed diagnosis.

6) Delayed Diagnosis: Malignant Spinal Cord Compression Presenting with Chest Pain

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Learning objectives: Consider cancer recurrence and metastatic disease as etiology of symptoms in cancer patients with chest pain
Case information: A 62-year-old female with a history of lung adenocarcinoma in remission and cocaine use presented to the ED with right-sided chest pain for one week. Pain was dull and associated with numbness and tingling of her right arm and fingertips, not improved with APAP-codeine. VS: Afebrile, BP: 170/100 HR: 128, RR: 18. PE: Normal rhythm/rate, lungs CTA. Chest X-ray, EKG and troponin were all normal. CT Chest was negative for pulmonary embolism but showed tumor recurrence and mediastinal lymphadenopathy. While hospitalized, she complained of persistent right shoulder, scapular, and neck pain. CT of the cervical spine revealed vertebral metastasis at C6 and C7 with spinal cord compression. Neurosurgery and radiation/oncology were immediately consulted, and patient underwent emergent radiation therapy x 2 with improvement in symptoms. She was discharged with follow up for further radiation therapy.
Discussion: Malignant spinal cord compression is a medical emergency. Delay in diagnosis and treatment can lead to permanent neurological deficits. Pain is the most common symptom of malignant cord compression, followed by paresthesia and weakness. This patient presented with all three of these symptoms. However, given her age and risk factors, acute coronary syndrome and pulmonary embolism were of greatest concern at presentation. When initial cardiopulmonary evaluation yielded normal results, providers should have considered the patient's

tumor recurrence and worsening metastatic disease as a possible etiology of her symptoms. Additional and more detailed history of her symptoms along with a thorough initial neurologic exam could have identified the patient's sensory deficits and dermatomal distribution of pain, thereby raising earlier concern for cervical myelopathy and the need for advanced imaging of the spine.

7) The Dangers of Anchoring in the ED: A Case of Mistaken Labial Abscess

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Children's Hospital of Michigan, Detroit, MI

Learning objectives: Define anchoring bias and discuss the implications in terms of diagnostic error. Recognize and identify the clinical symptoms of new onset diabetes and commonly associated conditions.
Case information: A 10 year old female with history of labial abscess requiring I&D in 2014 presented with labial pain and dysuria. ED physician reported to floor team that patient had labial abscess which would require inpatient treatment. Pelvic US, bmp, cbc, ESR, and UA were ordered and ED physician signed patient out to oncoming physician. Prior to obtaining results, patient was admitted to floor. Pelvic US negative for abscess, urinalysis showed SpG 1.043 with 3+ glucose and 3+ ketones. Patient arrived to floor on dextrose fluids started by ED. Accucheck obtained immediately and found to be 287. CBG notable for HCO3 19, base deficit 4.5, lactate 1.6. BMP showed glucose 274, HCO3 21, anion gap 16. Serum osmolality and beta-hydroxybutyrate were 307 and 28, respectively. HgbA1c 14. Patient noted to have significant vulvovaginal candidiasis with no evidence of abscess on exam.
Discussion: The combination of anchoring bias and a desire to make a diagnosis prior to signing the patient out resulted in an incorrect diagnosis and medical error of placing a new onset diabetic on dextrose containing fluids which could have caused DKA in this patient. Following admission, normal saline bolus was given and patient's fluids were change to 0.9NaCl. Patient was started on insulin for new onset diabetes. With further history, patient had 5 month history of polyuria with new onset urinary incontinence with 6 kg weight loss over the past 5 months.

8) The Best Place to Hide a Leaf Is in a Forest.

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[2]Okinawa Muribushi Project for Teaching Hospitals, Urasoe, Okinawa, Japan
[3]Hyogo Prefectural Amagasaki General Medical Center, Hyogo, Japan

Learning objectives: In patients with chest abnormal shadow in endemic areas of tuberculosis, acid-fast bacillus should be looked for on sputum smear before immunosuppressive therapy is started for vasculitis.
Case information: A 66-year-old Japanese man with asthma presented with a 2-month history of fatigue followed by abdominal pain over the last 1 month. He received bronchodilator and steroid therapy 4 months previously for possible asthmatic attack at another hospital. On physical examination, he appeared chronically ill with wheezing. Blood tests showed eosinophilia (leukocytes: 20,400/mm3; eosinophils: 43%) and chest radiography showed consolidation. On day 3 of admission, he developed acute onset of severe weakness for which polyneuropathy was considered. He received 1,000 mg of methylprednisolone for 3 consecutive days under a probable diagnosis of eosinophilic granulomatosis with polyangiitis (EGPA). On day 17, his ileum was perforated and emergency surgery was performed. Follow-up computed tomography of the chest revealed new consolidations in the lungs. Sputum acid-fast bacilli staining was positive for Gaffky 2, and Mycobacterium tuberculosis DNA was detected by polymerase chain reaction. Culture and polymerase chain reaction testing of the resected intestinal tissue yielded negative results for tuberculosis, but histological examination of the intestine showed necrotizing vasculitis affecting small- to medium-sized vessels. Histopathological examination in conjunction with clinical findings of polyneuropathy, asthma, and eosinophilia, confirmed a definitive diagnosis of EGPA.
Discussion: In the country where the patient lived, tuberculosis is endemic and pulmonary tuberculosis should always suspected in patients with abnormal chest radiograph. However, it may be difficult to make two distinct diagnoses in patients with both tuberculosis and vasculitis, since these are systemic inflammatory diseases and clinically mimic each other. Under conditions complicated by two diseases –infection and vasculitis– the treatment only for vasculitis may worsen the infection.

9) Where There's Smoke There May be Eosinophilic Pneumonia

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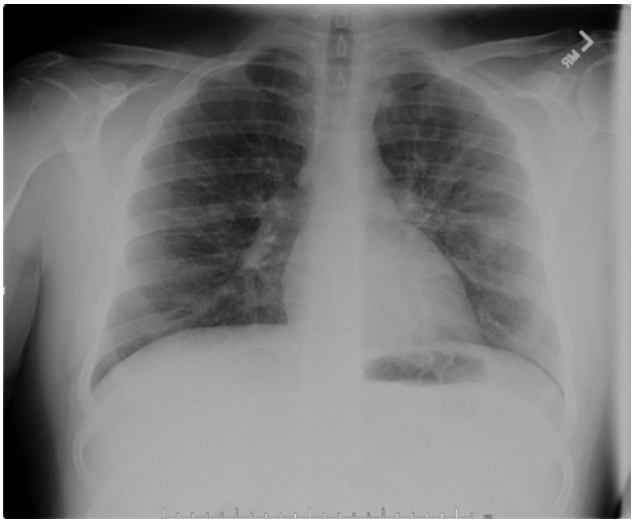
Learning objectives: Identify diagnostic features of eosinophilic pneumonia Recognize triggers to increase suspicion for rare conditions

Case information: A 21 year-old man with fever, dyspnea, and hypoxemia was admitted for asthma exacerbation due to pneumonia. He had diffuse expiratory wheezing and diminished vesicular breath sounds. WBC was 25 (38% eosinophils), respiratory PCR panel was negative, and CXR revealed subtle airspace opacity. History revealed recently treated sinopulmonary infection and asthma exacerbations. Four months prior, he took amoxicillin for cough and sinus congestion, with no improvement. He then received albuterol, corticosteroids and azithromycin with 35% eosinophils on CBC. His symptoms and eosinophilia improved transiently; however recurrence prompted a third visit and additional oral and inhaled corticosteroids. He again improved but relapsed after stopping inhaled steroids 1.5 weeks prior to admission. He reported ongoing inhaled marijuana and tobacco use. CT scan revealed diffuse patchy ground glass opacities. BAL had 50% eosinophils. He was diagnosed with eosinophilic pneumonia and treated with prednisone. He quit inhaled marijuana and tobacco, with sustained improvement in symptoms and resolution of CXR findings.
Discussion: Acute eosinophilic pneumonia is a rare condition characterized by acute onset febrile illness, hypoxemia, diffuse bilateral infiltrates on imaging, pulmonary eosinophilia with more than 25% eosinophils in BAL or lung biopsy, often with peripheral eosinophilia, and no other known cause of eosinophilic lung disease. Treatment is corticosteroids and avoidance of triggers, usually responding rapidly with no long term sequelae or relapse. Often no cause is identified, though it is associated with smoking exposure especially in younger individuals. Non-specific findings of wheezing, cough, and hypoxemia can make it difficult to differentiate from ARDS, asthma, or pneumonia. Outpatient diagnostic errors are difficult to detect. Unplanned hospitalizations and multiple outpatient evaluations should raise index of suspicion. In this case, earlier recognition may have been attained by flagging his recurrent visits and laboratory findings.



10) Diagnostic Error in Globalization Era: Bias and Its Solution

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[2]Dokkyo Medical Hospital, Tochigi, Japan

Learning objectives: De-biasing strategies should be applied to support in improving diagnosis even in the circumstance of the language barrier and the low endemic areas.
Case information: A 30-year-old Gabonese man presented with fever. He visited Japan eleven days prior, and three days after, he developed fever, chill, and back pain. He visited a primary care physician one day prior. A rapid antigen testing for influenza was negative, and was diagnosed with common cold, sent home with antipyretics. His fever persisted, however, and he visited another physician and was eventually referred to our hospital for further investigation. On examination, he looked exhausted but was alert and oriented. He had fever of 39.6 Celsius degree. Detailed history including travel history raised concern on malarial infection. He was tested with a rapid diagnostic test for *Plasmodium falciparum*, which turned out to be positive. Peripheral blood smear showed *Plasmodium falciparum* (ring form) within erythrocyte. Polymerase chain reaction of blood for *Plasmodium falciparum* was positive. He was diagnosed with Malaria infection and successfully treated with mefloquin.
Discussion: This case illustrated two potential biases. First, availability bias: Due to scarcity of experience in diagnosis of Malaria infection in Japan, it is potentially missed by physicians in making differential diagnosis of high fever. Instead, "common cold" as an available, incorrect diagnosis kicks in. Second, communication problems: There lied a challenge in gathering pivotal clinical information for the diagnosis because of language barrier, while the patient's travel history and past history were essential in making the correct diagnosis. The patient could speak only Gabonese and English, and the first two physicians did not speak both of them well. To avoid those biases, thorough

thinking process based on system 2 thinking and/or other de-biasing strategies should be applied to support in improving diagnosis even in the circumstance of the language barrier.

11) A Case of Confirmation Bias Involved with a Syndrome Described in Uppercase As Combination of Symptoms and Signs.

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[3]Okinawa Muribushi Project for Teaching Hospitals, Urasoe, Okinawa, Japan

Learning objectives: Proper observation for all available clinical information suggestive of another important syndrome may help avoid a diagnostic error.
Case information: A 66-year-old woman with a history of hypertension presented with recurrent fevers of unknown etiology for 20 years. The febrile episodes had occurred several times a year and these resolved spontaneously in a couple of days. At the current episode she developed sore throats along with fever and visited an otolaryngologist. She was diagnosed with acute pharyngitis and admitted to our hospital. The patient received antibiotics and systemic glucocorticoid and the symptoms improved temporarily. But after the treatment she developed left ankle joint tenderness with swelling. The synovial fluid of the joint did not contain any crystals and was sterile. A consultation to general medicine was made. On exam, She had bilateral tonsillar swelling and sporadic aphthous stomatitis but no cervical lymphadenopathy. In laboratory tests, abnormal results included leukocytosis and high erythrocyte sedimentation rate. A tentative diagnosis of PFAPA syndrome (Periodic Fever; Aphthous stomatitis; Pharyngitis; and Adenitis) was made, and she was started with cimetidine and discharged. However, soon after the discharge, multiple pustules developed on the palms. Chest CT showed osteosclerosis and osteohypertrophy of the left clavicle next to the sternoclavicular joint. Thus she was diagnosed with SAPHO syndrome (Synovitis; Acne; Pustulosis; Hyperostosis; and Osteomyelitis).
Discussion: Making diagnosis of a syndrome with combination of symptoms and signs may have a risk of confirmation bias, which is a cognitive tendency to collect clues likely to confirm an initial hypothesis but not to pay proper attention to clues not compatible with it. For avoiding the confirmation bias and subsequent misdiagnosis, physicians need to consider all available set of symptoms and signs. High index of suspicion for alternative important diagnosis may be a key to avoid cognitive bias and make a correct diagnosis.

12) How We Almost Missed Six Gastric Ulcers

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[2]Wayne State University, School of Medicine; Detroit Medical Center, Detroit, MI

Learning objectives: Understand how biases arise and their effect on managing patients known for falsifying symptoms.
Case information: A 28-year-old woman with ESRD was admitted for intolerable headaches and non-specific body aches. Per medical records, she is known to "exaggerate and falsify symptoms." Over the past year, she had 21 hospital admissions for various incongruous, often dubious, complaints. Her headaches and body aches improved with an NSAID-based regimen, but after being informed she was to be discharged, she started complaining of severe epigastric pain, with guarding on exam. Abdominal x-ray was unremarkable. EGD obtained several months earlier for similar complaints was normal. Despite the patient's apparent discomfort, her new symptoms were disregarded as being factitious. As she was preparing to leave the hospital, she passed a large, bloody bowel movement. EGD was done and showed six ulcers in the pre-pyloric antrum.
Discussion: Given her prior extensive, often benign workup for multiple complaints and what we perceived to be a factitious symptom, we overlooked her epigastric pain and planned to discharge her on NSAIDs, which could have had potentially fatal consequences. Patients presenting with apparent somatic or factitious symptoms pose numerous challenges for physicians. Such patients can engender negative countertransference, making providers susceptible to cognitive diagnostic errors and missed diagnoses. As physicians, it is easy to attach labels to patients, which can introduce biases, impairing our ability to truly assess patients objectively. It is therefore imperative that physicians remain cognizant of the potential for biases and how they can impact our clinical judgment, and to focus on guiding our decisions with objective findings and evidence-based medicine.

13) A Series of Unfortunate and Shocking Events

P. C. Roldan
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Learning objectives: 1. Describe the clinical findings of amlodipine toxicity 2. Understand the pharmokinetics/dynamics of amlodipine 3. Identify the treatment options for amlodipine toxicity

Case information: 68-year-old male presented with hypotension, dyspnea and oliguria and was admitted for undifferentiated shock and acute renal failure. His past medical history included chronic kidney disease stage III, type II diabetes mellitus, heart failure with preserved ejection fraction and paroxysmal atrial fibrillation on chronic anticoagulation. For a week prior to admission, despite feeling ill, he continued taking his medications, including warfarin, amlodipine, gabapentin and insulin.
Discussion: Patient was initially treated as septic shock with intravenous fluids, broad-spectrum antibiotics and norepinephrine with minimal improvement and a negative infectious work-up. An abdominal ultrasound revealed newly diagnosed cirrhosis which explained his supratherapeutic INR of 7.5. A transthoracic echocardiogram (TTE) showed an acute large pericardial effusion with right ventricular diastolic collapse and ventricular interdependence suggestive of cardiac tamponade. A pericardiocentesis removed 700cc of hemorrhagic fluid. However, the patient remained hypotensive, severely hyperglycemic, lactic-acidotic and oliguric. With pulmonary artery catheterization data was mixed, it was most suggestive of cardiogenic shock; thus, dobutamine was started but ineffective. A repeat TTE showed preserved left ventricular function and no recurrent pericardial effusion. He was started on hemodialysis for volume overload, metabolic acidosis and hyperkalemia and mechanical ventilation for his respiratory failure. After discussing the case with the Rocky Mountain Poison and Drug Center, he was placed on NE, an insulin drip, and was given IV calcium and IV glucagon boluses for calcium channel blocker toxicity. The patient's hemodynamics slowly improved and he was slowly weaned off hemodialysis, the ventilator and infusions. Given the transient obstructive and mixed cardiogenic and distributive shock, severe acidosis, and hyperglycemia, we strongly suspect the patient's hemodynamic collapse was due to amlodipine toxicity in the setting of cirrhosis, acute renal failure and gabapentin concomitant use.

14) Vitamin Is What You Need

K. Kano, K. Nakano and K. Akazawa
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Learning objectives:
Malabsorption can be a common complication in people who underwent total gastrectomy for gastric cancer. We experienced a case of a severe Kwasiorkor malnutrition presenting dementia and ataxia induced by gastrectomy syndrome. We reviewed etiology and management of postoperative malnutrition with dementia.
Case information:
The patient is an 80 years old male, who underwent Roux-en-Y total gastrectomy for gastric cancer 5 years ago. 2-3 months prior to admission, he started showing ataxia, nervosa, and incontinence. He came to our hospital because of loss of appetite and ataxia. His blood test showed low levels of hemoglobin, vitamin B12, total protein, albumin, and copper. But more significantly, his tryptophan level was very low. We diagnosed him as Pellagra and gave amino acid infusion which improved his symptoms
Discussion:
Although malabsorption and malnutrition are common in patients after a gastrectomy and several studies showing some complications, cases developing into Pellagra is rare. Therefore for more accurate nutritional assessment such as protein fraction should be considered rather than measuring common biochemical parameters.

15) If You Can Dream It, You Can Do It.

S. Tobe, K. Nakano and K. Akazawa
Shonan Fujisawa Tokushukai Hospital, Fujisawa, Japan

Learning objectives:
Pulmonary embolism (PE) displays various symptoms. Though there are several common symptoms, it can range from no symptoms to sudden death. Even if they are symptomatic, symptoms are not always related to respiratory symptoms. If PE can become a differential diagnosis from the story, you should look closely for clues of PE and perform enhanced CT if you find any.
Case information:
4 days before admission, a 62 years old woman was traveling and sat for over 8 hours. She came to our emergency department with nausea that started 2 days ago. Her ECG showed negative T-wave at leads III and aVf. But from her symptoms, we diagnosed her as gastro-esophageal reflex disease (GERD). The following day she came back with same symptoms and was discharged same diagnosis. The next day, she came back again with same symptom and tachycardia. We took an enchanced CT scan of her chest and found emboli at her pulmonary artery.
Discussion:
Nausea is not a common symptom of PE. Because of that, the patient was not assessed as PE. Because PE is very difficult to diagnose, there are many scoring system to rule out PE. But the very important thing is to suspect PE. The patient had a history of 8 hours of immobilization which is a good risk for DVT. With that history, you should consider PE as one of the diagnosis and check for symptoms and signs of PE. Rare signs

are arrhythmia, syncope, fever, jugular venous distention, etc. Negative T-wave on leads III and V1 of the ECG has sensitivity and specificity of 88% and 99%. With this patient's history and the ECG change, PE must be considered. Though diagnosing PE is difficult, history is essential to suspect PE which means that your history taking can change the patient's life.

16) Cognitive Bias: A Blindfold

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Learning objectives: Apply communication tools to reduce Cognitive Bias
Case information: A 20-year-old female is referred to family practice for anxiety and depression, not unusual. With a 10-minute visit, this is an easy one. A quick assessment just to verify: social withdrawal, sadness, pessimism, sense of failure, fear/discomfort in new environs, especially at night. Write a prescription, schedule a follow-up; on to the next patient. No curiosity, no questioning as to why the patient was anxious. But this one was different. The patient suffered unknowingly from deteriorating vision caused by Retinitis Pigmentosa. This negatively affected her ability to function in society resulting in significant, but episodic, anxiety and disorientation. Ironically, two years prior, a Retinal Specialist had rendered this very diagnosis but did not communicate to understanding. Patient was, literally, in the dark.
Discussion: Cognitive bias, the Curse of Knowledge, and Diagnostic Momentum. They're real and they affect People! What if either provider had looked at the patient with new eyes? Perhaps the family practitioner had stayed curious and asked why, rather than assume it was just another anxious, depressed teenage girl. Investigative assessment might have led to the underlying cause instead of merely medicating the symptoms. What can be behind presenting symptoms? Asked if she understood her degenerative condition? How often are providers too busy to employ emotional intellegence, listen, utilize teach-back, and empathize? How often are they giving information without verifying the patient understands the message-sent? The tools of communication are cheap and easy to use, if we take the time to use them. In this climate of do more with less, improving communication hits the bullseye of the Triple Aim. It's about communication. Even if for a moment, willingness to join the patient's journey will reap huge rewards towards diagnostic accuracy.

17) Deep Vein Thrombosis, Is Not Always Simple, a Rare Presentation of a Common Disease.

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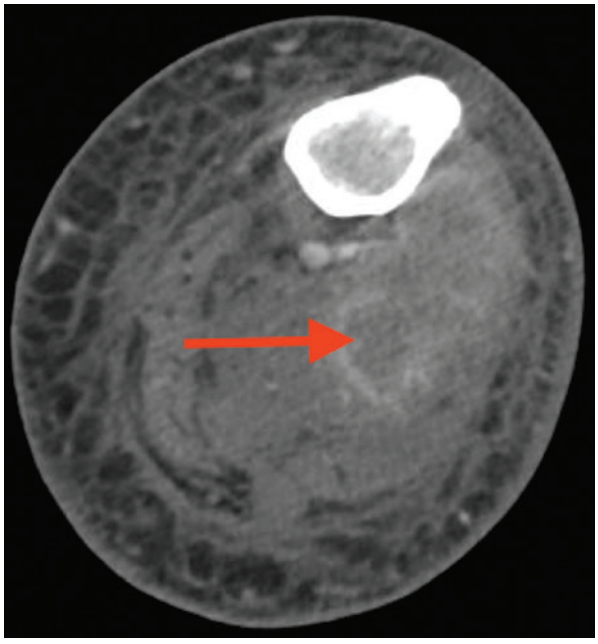
[2]Detroit medical center/Wayne state university, detroit, MI

Learning objectives:
Deep vein thrombosis in cancer is usually secondary to hypercoagulability, however other causes such as obstructive masses from metastasis should be considered.
Anchoring is a common cognitive bias that results in diagnostic errors.
Development of insight and awareness of the known cognitive biases amongst healthcare providers may reduce the incidence of diagnostic errors and prevent morbidity.
Case information:
A 51-year-old smoker lady, with a Past medical history of remote localized laryngeal cancer treated with radiation therapy and chronic lymphocytic leukemia in remission. Presented with a 3-day history of Left Lower extremity pain and swelling. The clinical exam was positive for a grossly tender swollen LLE, with no erythema, or hotness. Muscle power Pulses and sensation were intact bilaterally.
The patient was diagnosed with Malignancy-associated DVT based on Doppler US and anticoagulation with heparin was initiated. Her pain continued to increase with a remarkable escalation in pain medication requirement over five days. The performed CT angiography revealed contrast-enhancing mass replacing the fibular head, compressing the adjacent vasculature. Further work revealed metastatic adenocarcinoma of the lung, the patient responded to radiation therapy and anticoagulation.
Discussion: This case demonstrates an example of a cognitive error that resulted in a diagnostic error. The patient presented with acute severe unilateral extremity pain and was initially diagnosed with DVT by means of a lower extremity duplex US. Despite being on the correct treatment for the initial diagnosis of acute DVT, her pain steadily progressed with pain medication requirement drastically increasing to a level where Intravenous patient controlled analgesia was administered with no or minimal pain relief. Despite repeated encounters with health care providers from various clinical disciplines and an atypical progression of the initial diagnosis of deep vein thrombosis, the differential diagnosis was only revisited on day 5 of admission where repeat imaging was done revealing the correct diagnosis.



18) The Crisis Under the Pacific

M. Zhou and J. Rencic
Tufts Medical Center, Boston, MA

Learning objectives: 1.Recognize phlegmasia as a sign of progression of deep venous thrombosis (DVT), and reinforce DVT as a differential for cellulitis. 2.Discuss the importance of query for diagnostic adequacy and its difficulties in a system with frequent hand-offs.
Case information: A 70 year-old man with alcohol abuse and recurrent lower extremity cellulitis presented with leg pain and erythema. He was admitted by the long-call resident who handed off the case to the night float, then the day team. He had been admitted twice prior with similar presentations, and recurrence was attributed to non-compliance with his discharge antibiotic regimens. History obtained from the patient was limited due to alcohol intoxication. Past medical history included remote stage IIB prostate cancer treated with prostatectomy. Exam showed normal vital signs, erythema and tenderness of both shins with mild surrounding edema, left more prominent. He received vancomycin. The next day, erythema decreased, and both legs were cool to palpation. In the evening, he was found to be non-responsive in pulseless electrical activity, and died despite cardiopulmonary resuscitation. Jugular veins were noted to be distended. Post-hoc analysis revealed evidence of prostate cancer relapse, and preceding pulseless extremities with mottled skin. A unifying diagnosis was speculated: possible underlying Trousseau's syndrome with DVT progression to pulmonary embolism, preceded by phlegmasia alba, though D-dimer was 320 pg/mL. Autopsy was declined.
Discussion: The presumed misdiagnosis was contributed by several factors. First, the history of cancer relapse was missed in the setting of limited history and frequent hand-offs. Second, phlegmasia alba might have been misinterpreted as improvement of cellulitis. Third, initial diagnosis was not examined for its adequacy despite atypical presentations. Diagnostic momentum and anchoring bias also likely played a role. To avoid such error, systemic change to minimize hand-offs, knowledge enhancement for imperative diagnoses, and alertness for adequacy of diagnosis and biases are required.

19) Malignancy: A Phantom Menace

T. Shizuku, K. Nakano and K. Akazawa
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Learning objectives:
Past medical history is always important. Especially, the history related to malignant disease. If the patient who lived healthy until yesterday presents lactic acidosis, elevated CRP, elevated WBC and DIC, many people will first come up with sepsis. Multiple organ failure of unknown

reason tends to be misdiagnosed as sepsis. However, when your patient has had the history of malignancy even once, you always need to think about the recurrence of the disease.

Case information:

The patient is a 77-year-old male who had colon carcinoma in adenoma treated with EMR 5 years ago. On the day of admission he was lying on the roadside and was brought to our ER. He had no fever, no hypo or hyper pressure but needed 5L/min of oxygen to keep him oxygenated. Blood test showed lactic acidosis, elevation of liver and biliary enzyme, and acute kidney injury. Leukocytosis, thrombocytopenia was noted and procalcitonin was 1.670. Sepsis was suspected and broad-spectrum antibiotic began. Bone marrow biopsy and bronchoscopy biopsy showed adenocarcinoma. Then, acute lung injury occurred and the CT scan of the chest showed diffuse GGO. The patient was diagnosed with pulmonary tumor thrombotic microangiopathy (PTTM). We started chemotherapy right away but the same day, he passed away.

Discussion:

PTTM is a cancer-related pulmonary complication that progress rapidly sometimes causing sudden death. The patient usually presents dyspnea that progress to ALI / ARDS within days. PTTM is caused by metastatic carcinomas emboli, fibrocellular intimal proliferation, and thrombus formation in small pulmonary arteries. It is very hard to diagnose and is usually diagnosed after mortem. The only treatment is chemotherapy so making the diagnosis is essential. When patients with history of malignancy presents dyspnea, PTTM should always be considered and tests should be performed to make the diagnosis.

20) Lessons Learnt from a Case of "Hypertensive Emergency"

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Learning objectives: 1. Distinguish hypertensive urgency from hypertensive emergency. 2. Recognize blood pressure reduction goal for hypertensive urgency.

Case information: A 72 year-old male with history of hypertension and benign prostate hypertrophy presented to emergency room with blood pressure of 210/110 on both arms. His home medications included Metoprolol Succinate and Tamsulosin. He just returned from a two-week trip to Southeast Asia. Prior to travel his blood pressure was usually around 120/70. He was asymptomatic. Physical examinations were largely unremarkable including a normal fundoscopic exam. EKG showed left ventricular hypertrophy. Laboratory investigations were notable for an elevated creatinine of 1.45 mg/dl (baseline creatinine 0.9 mg/dl). CBC, electrolytes, troponin and urinalysis were within normal limits. The patient was admitted for presumed hypertension emergency, given acute kidney injury. On hospital day 1, he received two doses of 10mg IV Labetalol which led to a transient drop of systolic blood pressure to 140. On hospital day 2, renal consult was called when creatinine rose up to 1.82 mg/dl. A renal ultrasound showed moderate bilateral hydronephrosis, enlarged prostate and 850cc of post void residual urine volume. A Foley catheter was placed. His blood pressure and kidney function quickly improved following resolution of urinary obstruction.

Discussion: Hypertensive emergency is defined as severe hypertension with evidence of acute end-organ damage. In our case, urinary obstruction was proved to be the cause of both acute kidney injury and hypertension. Retrospectively, we could conclude this patient did not have hypertensive emergency since kidney injury was not due to hypertension. The worsening of kidney function after IV Labetalol could be explained by hypoperfusion from rapid lowering of blood pressure. While the goal is to reduce blood pressure by 10-20% within hours for patients with hypertensive emergency, lowering of blood pressure may occur over days in patients with hypertensive urgency.

21) Fever in an Infant

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Learning objectives: Recognize the clinical presentation of Kawasaki Disease in an infant

Case information: TJ is a 5 month old, ex-full-term, previously healthy, fully immunized female who presented for three days of fever, rhinorrhea, diarrhea, emesis and one day of difficulty breathing while febrile. The fever was nearly constant with a Tmax of 40 C, and did not respond to appropriate dose of acetaminophen. The child initially was admitted to the observation unit and treated for community acquired pneumonia where she remained febrile and tachycardic despite multiple boluses. Swelling of the hands and feet was documented and attributed to IV fluid administration. Urinalysis was initially positive for pyuria and the subsequent urine culture resulted as 10-100,000 CFU GBS. The child was admitted to nephrology service for febrile UTI. Despite antibiotics the child remained febrile, tachypnic and tachycardic for two days and developed diffuse anasarca and a diffuse papular rash. On day three of hospitalization the laboratory informed Nephrology that the positive culture was a result of laboratory error. Infectious Disease was consulted and the diagnosis of Kawasaki Disease was made. The patient did not respond to the first dose of IVIG and high dose aspirin and progressed to cardiorespiratory

collapse requiring mechanical ventilation and pressors. Echocardiography demonstrated right proximal coronary aneurysm and dilation of all coronaries. She responded to Infliximab, high-dose steroids and additional IVIG and follow-up outpatient echocardiograms have demonstrated normal anatomy.
Discussion: The incidence of Kawasaki Disease is lower in infants, which is typically thought of as a disease that affects children between 1-5 years of age. However, it is important to consider KD in the differential of an infant with prolonged fever because the clinical manifestations in this population tend to be more severe and cardiac involvement is more common. This case demonstrated multiple errors including anchoring bias, laboratory error, bandwagon effect and confirmation bias.

22) Hoofbeats of a Striped Horse: Gastric Ulceration Caused By Colchicine Toxicity in a Medically Complex Patient

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Learning objectives:
- Drug toxicity is a common cause of morbidity but may be overlooked in the search for more unusual pathology.
- Careful consideration of drug toxicity and discontinuation of unnecessary medications may reduce diagnostic testing.

Case information: A 44-year-old woman with multiple autoimmune conditions including systemic lupus erythematosus presented with one year of daily emesis and loose stools, generalized abdominal pain, and a 90-pound weight loss. She had presented to multiple physicians in the clinic and Emergency Department over the preceding year for numerous complaints, including chest pain. Her chest pain was attributed to pericarditis and treated with NSAIDs and colchicine, which were continued for several months due to recurrent symptoms. On physical examination, she was ill-appearing and cachectic with dry mucus membranes and a diffusely tender abdomen. A broad diagnostic work-up was initiated, including multiple imaging and laboratory tests. Esophagogastroduodenoscopy (EGD) showed a large gastric ulcer. Pathology of the ulcer revealed colchicine toxicity. Colchicine was discontinued. The patient's gastrointestinal symptoms resolved, and she gained fifteen pounds. Follow-up EGD showed resolution of the ulcer.
Discussion: We present a patient who developed unusually severe colchicine toxicity due to delay in diagnosis. The attribution of her symptoms to colchicine toxicity likely eluded clinicians for months due to several factors, including the patient's multiple comorbidities, many symptoms, and fragmented care. Her medical record became cumbersome to navigate, and clinicians siloed in their own departments and institutions had difficulty communicating with each other. Clinicians may use a variety of cognitive short-cuts in clinical reasoning, especially when pressed for time, and such shortcuts likely contributed to a delay in diagnosis in this case. For instance, perceptual blindness may have resulted in neglecting the patient's gastrointestinal symptoms while focusing on her chest pain, while anchoring bias led to repeated diagnosis of pericarditis and continuation of colchicine.

23) Diagnostic Error Caused By Copy and Paste of Templates on Electronic Health Records

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Learning objectives: To recognize the use of "copy-and-paste" function of the Electronic Health Records (EHR) as a source of diagnostic error
Case information: A 65-year-old man was presented to the emergency room (ER) because he was generally sick. The resident physicians assessed his condition and observed the following issues: microcytic anemia, back pain, high brain natriuretic peptide level, and immobility. He was immediately admitted to the ward. The next day, echocardiography revealed impaired atrial and mitral valves with vegetation and severe regurgitation. Heart murmur grade was 5/6 (Levine scale) and assumed to have been consistently overlooked since admission, resulting to a delayed diagnosis of endocarditis. Consequently, emergency operation was performed. The hospital adopted the EHR with unlimited copy-and-paste function. Physicians can freely construct templates in their system and paste and modify them on the progress notes. All three doctors who examined the patient upon admission used the hand-made templates filled with negative physical findings and copied and pasted them to his chart. Busy physicians used the EHR to bypass physical examination.
Discussion: The use of EHR is broadly adopted in developed countries and is expected to reduce the diagnostic error by detecting errors, improving access to information, and reducing the burden of retyping through its copy-and-paste function. The safety of EHR has not yet been well established despite its widespread use. Singh et al. reported that copy-and-paste errors from the previous notes contribute to diagnostic error in primary care settings. In this case, copy and paste from hand-made templates deteriorated diagnostic capacity of physicians and induced delay of the diagnosis. This type of error has not been previously reported. Therefore, the risk and ethical and safety design of EHR should be considered in using its copy-and-paste function.

24) An Unusual Cause of Septic Emboli – the Dangers of Anchoring on the Heart

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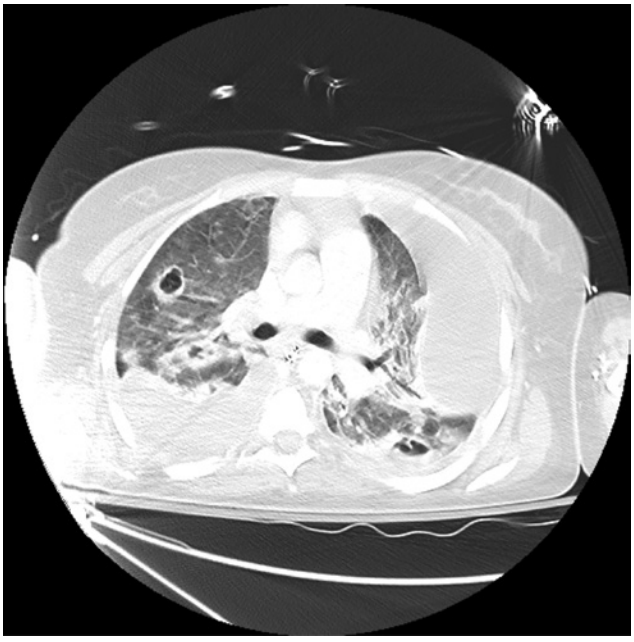
Learning objectives: 1. Understand the role that anchoring bias and the Semmelweis effect can have in diagnostic error 2. Recognize that Lemierre's disease is a diagnostic possibility in a young patient presenting with refractory sepsis and septic emboli
Case information: A 25 year-old woman presented with septic shock. One week prior, the patient had developed pharyngitis followed by cough and confusion. On presentation, she was tachycardic, hypotensive, and hypoxic. She was in distress with the presence of diffuse rhonchi. Cardiac exam did not reveal murmurs, and she demonstrated no stigmata of endocarditis. She was intubated, resuscitated, and given broad spectrum antibiotics. CT scan demonstrated findings consistent with septic emboli. Transthoracic and transesophageal echocardiography did not reveal valvular vegetations, however, a presumptive diagnosis of infective endocarditis was made. Blood cultures subsequently revealed bacteremia with Streptococcus angiosus. An ultrasound conducted to evaluate incidental inflammatory changes noted on her initial CT revealed thrombophlebitis, leading to a diagnosis of Lemierre's Syndrome.
Discussion: Jugular vein suppurative thrombophlebitis, called Lemierre's Syndrome, has a classic presentation of pharyngitis leading to thrombophlebitis, systemic infection, and septic emboli. Diagnosis requires careful history-taking and a high index of suspicion, leading to confirmation by imaging. This vignette provides an example of two key biases: Anchoring bias, and the Semmelweis effect. Anchoring bias, or relying too heavily on information gained early in the diagnostic process, played a role in that the presence of septic emboli in the lungs led to a presumed diagnosis of endocarditis. The Semmelweis effect, or the tendency to reject information that contradicts the favored diagnosis, also played a role as that the diagnosis of infective endocarditis persisted despite inconsistent clinical and historical features. Awareness of the presence and interplay between these two cognitive biases may provide insight into the impact this can have on the diagnostic process in future cases.



25) Hypovolemic Shock Masked By Sympathomimetic Medication

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Learning objectives: If there are unnatural points in the clinical course of shock patients, reconsider the diagnosis and investigate possible causes.
Case information: A-58-year-old Japanese man was presented the emergency department (ED) with vertigo lasting 2 hours. He had been receiving hemodialysis for 4 years. He had experienced similar symptom two years ago and diagnosed Meniere's disease. After admission, he had lost his consciousness when he was treated for vertigo, and his systolic blood pressure decreased to 70mmHg. Fluid resuscitation was started and additional quick history taking revealed the history of latex allergy. Adrenaline 0.3mg was administered and he recovered from

shock. Then he was hospitalized for diagnosis of anaphylaxis. However when the inpatient team took history again after hospitalization, a new fact emerged. Actually, 2 hours prior to admission he took droxidopa, which had been prescribed for intradialytic hypotension, because he had frequently diarrhea and his home systolic blood pressure had decreased to 80mmHg. Reviewed the records of emergency service, the patient's blood pressure was fluctuated dramatically in the course of transit. We changed the diagnosis from anaphylaxy shock to hypovolemic shock masked by droxidopa.
Discussion: Because shock is an emergency condition and the physicians are required to resuscitate the patient while thinking about differential diagnosis, they are easy to be misled by uncertain information. In this case, the patient had no rash or dyspnea, which are typical findings for anaphylaxis, and the gloves used at the ED didn't contain latex. Droxidopa is often prescribed for orthostatic hypotension and intradialytic hypotension in Japan. But sometimes it is difficult to take medical history of Droxidopa at ED, because it is a medication to be taken as needed. Initially we had misled by jumping at the uncertain information, but finally we could correct the diagnosis by taking detailed history and reviewing emergency service's record.

26) Of Black Swans

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Learning objectives: Karl Popper's scientific paradigm is that hypotheses should be tested by falsification, actively reviewing evidence that does not support our initial judgments, rather than seeking out only evidence that confirms them. If we suppose all swans are white, you will not find any swans other than white swans
Case information: An 86-year-old woman presented to the emergency department (ED) with a diagnosis of intracerebral aneurysm. The patient developed a diffuse headache two weeks ago. She presented to an outside hospital about a week ago, and had a negative CT of her head and was discharged home with symptomatic therapy. She continued to have headache so 5 days ago presented to the same hospital where a CTA of her head and neck was obtained which showed a 9.5 mm cerebral artery aneurysm at the M2 bifurcation. She was treated with Tylenol.with follow-up scheduled with neurosurgery in 2 weeks. She was unable to wait due to the persistent headache, and presented to the ED for a neurosurgical consultation. The treating physician felt that the aneurysm was a red herring. A better history elicited that around the same time (~1.5-2 weeks ago), she developed new left-sided jaw pain while chewing. A few days ago, she also noted left thigh weakness and pain. On examination, there was no temporal artery tenderness. The sedimentation rate sent came back at 79 mm/hr. The patient was started on steroids and temporal artery biopsy confirmed giant cell arteritis..
Discussion: The diagnostic process is one of the most important and complex aspects in medicine The process is not just about just history and physical examination but also requires exceptional observational skills and deductive reasoning. Karl Popper's methodology should be a paramount guide in the medical diagnostic process. In fact, we should search for black swans as we go through the diagnostic process.

27) Elevated Alkaline Phosphatase: Bone, Liver or Both?

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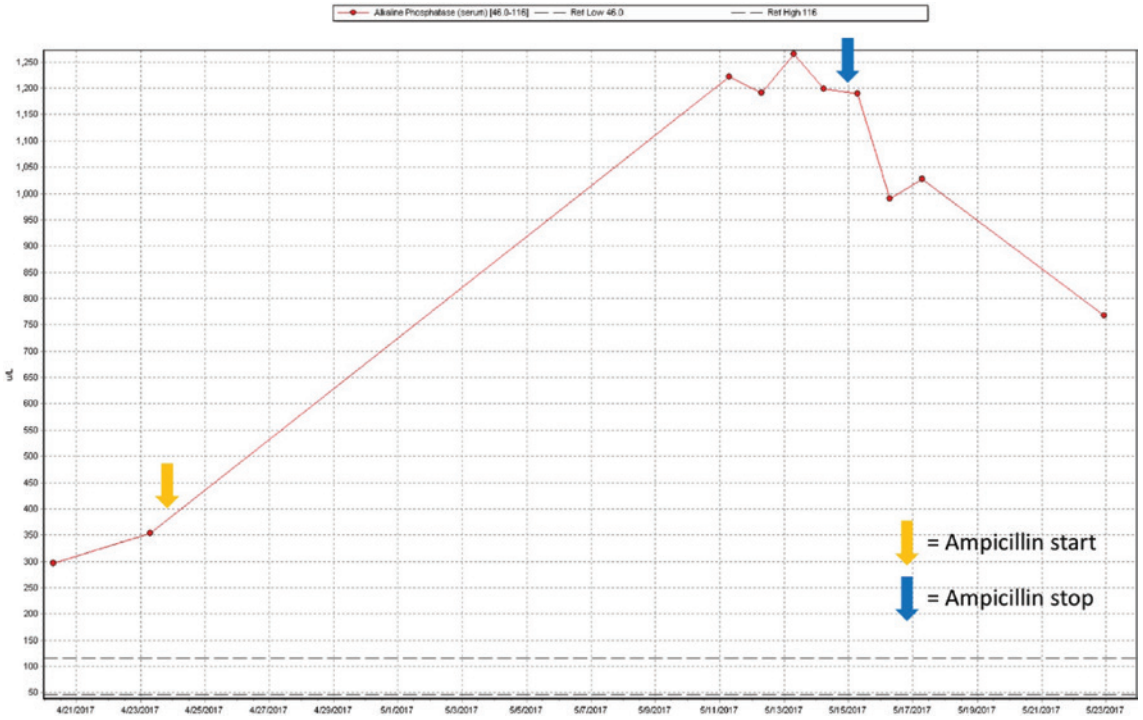
Learning objectives: Premature closure errors and failure to consider alternative differential diagnoses can lead to delay in diagnosis and prolonged exposure to harmful agents.
Case information: A 74-year-old African American man was admitted to the hospital with high alkaline phosphatase (ALP) of 1260 IU/L and normal serum aminotransferases and bilirubin levels. He had no abdominal pain or other gastrointestinal symptoms. He recently underwent an amputation of his right 5th toe and was started on 6 weeks of IV ampicillin for osteomyelitis. An ALP fractionation test showed a thermostable ALP fraction of 16%, suggesting that the ALP elevation is likely due to bone disease. The patient remained under observation, on IV ampicillin. It wasn't until four days later that a Gamma-glutamyltransferase (GGT) was obtained and found to be 764 U/L. After Ampicllin was switched to Linezolid, both ALP and GGT levels started decreasing.
Discussion: The initial ALP elevation was detected on a routine comprehensive metabolic panel done at the skilled nursing facility where the patient was receiving his IV ampicillin. This panel doesn't include a GGT. The elevation of ALP was attributed to his active osteomyelitis and amputation. This was confirmed by a thermostable ALP fraction of 16%. When a GGT was obtained, intrahepatic cholestasis secondary to Ampicillin became evident. Although it might have been clinically correct in this setting to attribute a high ALP to a bone etiology, the degree of elevation should have triggered a suspicion of an additional etiology. GGT level remains a fast, simple and informative laboratory test to perform when ALP is elevated. GGT level in this case was obtained right when a different medical team assumed care of the patient. The reason why it wasn't ordered initially might be the result of an anchoring error with a premature closing.



28) Delayed Diagnosis of Arterial Dissection and Stroke: A Learning Opportunity

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Learning objectives: Discuss a challenging diagnosis of vertebral arterial dissection and list types of learning opportunities uncovered on case analysis
Case information: A 44-year-old female with 2.5 years of vague neurologic symptoms, including intermittent sensory changes, was being evaluated for multiple sclerosis (MS). However, she failed to attend scheduled visits for definitive testing. In 2016, she presented to the emergency department and her primary care office three times over 1 week for worsening headache, dizziness, and visual disturbances. Her symptoms resolved spontaneously within 10 minutes or post-meclizine. There was no report of trauma, fever, or speech changes. On her third consecutive visit, she underwent a brain MRI which revealed a small lesion with restricted diffusion but normal vasculature, which neurology felt related to MS. Two days later, she was seen by her primary neurologist at a different facility who, after reviewing the MRI, felt her symptoms were unrelated to previous complaints and suspected ischemia secondary to vertebral artery dissection. She underwent a head and neck CTA which confirmed left vertebral artery dissection and posterior circulation ischemic infarction.
Discussion: Arterial dissections, which account for 10-25% of strokes in those less than 50, should be considered in the differential for young patients with stroke-like symptoms. While often associated with trauma or predisposing conditions, such as fibromuscular dysplasia and Marfan syndrome, arterial dissections can also occur spontaneously. Despite multiple visits over a short period, we found numerous opportunities that were missed, which could be useful for learning. Contributing factors to diagnostic delay included failure to follow-up, delayed ordering of appropriate imaging, incomplete workup in the ED, erroneous interpretation of imaging, and anchoring bias. Opportunities for improvement include imaging the neck during one of the ED visits, deliberate consideration of a broader differential, and verbal face-to-face communication with the radiologist to clarify uncertain MRI findings.

29) A Diagnostic Dilemma with Conflicting Treatments

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Learning objectives: Recognize the risks of search satisficing and premature closure even when a diagnosis appears obvious. Rule out histoplasmosis with multi-faceted approach prior to starting treatment for sarcoidosis.

Case information: A 41-year old man with no medical history presents with two weeks of fever and worsening dyspnea. He lived in rural Pennsylvania and had already failed two prior antibiotic courses. On exam, he was diaphoretic but lungs were clear to auscultation. CT chest showed pulmonary nodules and lung biopsy demonstrated non-necrotizing granulomas consistent with sarcoidosis. All cultures remained negative during hospitalization therefore treatment with steroids was initiated and symptoms improved. Two weeks later, he returned with recurrent fevers and dyspnea. In the interim, a fungus culture had turned positive that was not acted upon by the receiving physician or identified by the re-admitting team. He now had new pancytopenia and bilateral inspiratory rales. Symptoms did not improve with broad-spectrum antibiotics or increased steroids. Bone marrow biopsy identified *Histoplasma capsulatum*. Histoplasmosis was also identified on re-examination of prior lung biopsy. Patient was promptly treated with amphotericin-B and symptoms improved.
Discussion: This case demonstrates the search satisficing heuristic. Once sarcoidosis was noted on the biopsy, further evaluation was not rigorously pursued. It is essential to rule out histoplasmosis before initiating treatment, especially when patients reside in endemic areas. Additionally, no diagnostic modality is 100% sensitive for histoplasmosis and a multi-faceted approach is recommended. This includes culture/cytology, antigen testing and serologies. The appropriate tests were completed in this situation, but the results were not followed up after discharge. Physicians often rotate off service and it can be unclear who will follow up on pending results or who they should be reported too. This case is a dramatic example of a missed post-discharge result drastically altering management and institutions should develop mechanisms to avoid this scenario.

30) The Dangers of Anchoring Bias: A Case of Obstructive AKI Admitted As Heart Failure Exacerbation from Cardiology Clinic

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Learning objectives: To recognize the dangers of anchoring bias and how the framing effect can contribute to its development.
Case information: A 64-year-old man with recent diagnosis of heart failure (HF) presented from cardiology clinic with weight gain and orthopnea. The admitting team was instructed to "treat for a HF exacerbation". On exam, the patient had peripheral edema and clear lungs. Labs revealed a mildly elevated BNP and an acute kidney injury. A chest radiograph was normal. For the first 24 hours, he received furosemide resulting in further creatinine rise. The next day other etiologies for hypervolemia were considered. Work-up revealed a post-void residual of >700 mL and the patient was diagnosed with urinary obstruction secondary to benign prostatic hyperplasia. A urinary catheter was placed leading to improvement of peripheral edema and renal function.
Discussion: This case demonstrates how the framing effect of a patient referred by a cardiologist led to anchoring on the diagnosis of HF exacerbation despite conflicting evidence. While the absence of pulmonary edema on chest radiograph does not rule out decompensated HF[1], it prompted the admitting team to reconsider their interpretation of the data. Ultimately, the patient was found to have an obstructive uropathy which has been associated with volume expansion[2,3]. Cognitive biases are frequently faced in medicine and anchoring bias was identified as one of the most common by 88% of residents participating in a study at the University of Pennsylvania[4]. They reported influence from contextual factors such as subspecialty service and time pressure. A systematic review of cognitive biases found that physicians that expressed biases such as anchoring were more likely to make diagnostic errors than those who did not[5]. By increasing awareness on the prevalence and dangers of cognitive biases, we may be able to keep an open mind and avoid diagnostic error.

31) Multidisciplinary Teamwork and the Pathology Diagnosis: Improving Internal Quality Assurance?

B. Kane
Sweden

Statement of problem: aaaaaa Description of the intervention or program: aaaaaa Findings to date: aaaaaa Lessons learned: aaaaaaa Recent controversies concerning cancer misdiagnosis have prompted recommendations that cancer patients are managed by a multidisciplinary team (MDT). The MDT is most often recommended for its value in triple assessment in diagnosis, its decisions by consensus, and for the key role MDTs play in the choice of treatment option and patient management. The traditional role of the pathologist as providing the Gold Standard in diagnosis is no longer so clear. For the pathologist, being a key member of the MDT brings benefits and challenges, and not only at MDT meetings. This poster focuses on workflow in the pathology department, and describes the consequences that have resulted for the department, and routine work practices, from active participation by pathologists in MDTs. The benefits and challenges for pathology in participating in multidisciplinary team meetings are highlighted. Methods: Long-term ethnographic study of the MDTs at a large teaching hospital, that includes interviews with participants, provides most of the data, and the context, for this study. The ethnographic observations are supplemented with targeted data gathering exercises from time to time, to check observations and investigate specific questions in more detail. The data for this poster includes an analysis of workflow in the pathology department, and the specific role of the pathologist during Gynaecological MDT meetings. Results: Preparation for MDT meetings and attendance consume considerable

resources for the pathology department. When cases are listed for discussion, the pathology samples on those patients are reviewed. There can be discrepancies (mostly minor) between the initial report, and the review prior to the MDT meeting. The patient diagnosis agreed by the MDT can differ from the pathology report. Policies and procedures are in place that gives greatest importance to the MDT diagnosis. The impact on internal workflow in the pathology department is significant. Two staff rosters are now in place. One roster for routine reporting of pathology specimens, and a second roster to review cases for MDT meeting discussion. Having two pathologists involved in reviewing pathology cases, has enhanced the quality of reporting in the department, and also plays an important role in in-service training and staff development. Conclusion: The involvement of pathologists in MDT meeting consumes significant resources for the department. But pathology participation in the MDT, and the preparation prior to meetings, in particular, has improved the quality assurance process in pathology.

32) A Pregnant Patient with Leg Pain

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Learning objectives: 1. Recognizing handoffs as a cause of medical errors. 2. Describe the presentation of arterial occlusions and ramifications of delayed diagnosis. 3. Discuss diagnosis momentum as a cause of medical errors.
Case information: A 39 year old female presented to a community emergency department with atraumatic extremity pain. Her exam showed reduced pulses and swelling of the left lower extremity. The patient underwent a negative evaluation for deep venous thrombosis. Routine labs showed a hemoglobin of 6.3 g/dl, a positive pregnancy test, and an ultrasound with no visualized intrauterine pregnancy. The patient was transferred to a tertiary care center for management of a possible ectopic. The patient was then admitted for anemia and a pregnancy of unknown location. Upon assessment by the admitting hospitalist, pallor and absent dorsalis pedis and posterior tibial pulses were noted to the affected extremity. The patient underwent CT-Angiogram showing a thrombus with occlusion of the left femoral and popliteal arteries. The patient eventually required amputation.
Discussion: The patient was a 39 yo female who presented with atraumatic leg pain. She was noted by the original care provider to have decreased pulses in the affected extremity, but it is not known if this was relayed to the accepting physician. Transferring the patient required multiple handoffs, which are a major cause of medical errors. Diagnostic errors included failure to pursue arterial imaging. Diagnosis momentum also played a role. For example, the accepting emergency department received "an anemic patient with possible ectopic." The leg pain was neglible as the prior hospital had found no emergent process. All of these factors led to a delay in diagnosis resulting in tissue ischemia and loss of limb.

33) Diagnostic Momentum Resulting in Delayed Diagnosis of Pulmonary Embolism

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Learning objectives: •Recognize how diagnostic momentum can interfere with making the correct diagnosis. Repeating and obtaining the history directly from the patient, rather than accepting a previous story, can improve diagnostic accuracy. •Identify PE as a possible diagnosis when hypoxia worsens despite treatment of other potential causes of hypoxia.
Case information: A 78-yo female long-time smoker was evaluated at various clinics and hospitals for progressively worsening hypoxia. Her reported initial presentation was back/shoulder pain after heavy lifting, plus dyspnea/productive cough; initial diagnosis was muscle strain. Symptoms failed to improve, and chest film was read as pneumonia. Despite antibiotics, oxygen requirements increased. She also began to notice weight gain/lower extremity swelling. Repeat imaging revealed pulmonary edema, echocardiography indicated severe pulmonary hypertension. Despite diuretics, oxygen requirements continued to escalate. Eventually, she was transferred to a tertiary hospital for management of pulmonary hypertension. When evaluated, she expressed frustration at having to retell her story. However, insistence that she tell her story from the beginning revealed different information: shoulder pain actually started as acute pleuritic pain and dyspnea. Concerned about missed thromboembolism, CTPE revealed diagnosis of pulmonary embolism (PE).
Discussion: Diagnostic momentum (Bandwagon effect) is going along with a previously stated diagnosis while failing to adequately investigate or consider other possibilities. In the setting of previously stated diagnoses (muscle strain, pneumonia), PE was not considered. In this case, the patient received care from multiple providers and was resistant to retelling her story. Failure to repeat and thus obtain accurate history, compounded by the patient's frustration, led to history distorted by indirect communication that obscured clues pointing to the correct diagnosis. This, in conjunction with diagnostic momentum, contributed to delayed diagnosis. Repeating history directly from the patient, considering diagnoses not considered by previous providers, and revisiting the diagnosis when not responding to treatment as expected can help avoid cognitive error.

34) Don't Fix Hickham's Dictum

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Learning objectives:
Tuberculosis should be considered in patients with multiple nodules of the lungs until proven otherwise in countries with high prevalence. Hickham's dictum may be correct rather than Occam's razor for explaining multiple organ diseases in elderly patients.
Case information:
A 71-year-old woman presented with intermittent severe epigastralgia. She denied cough or sputum. On examination, she appeared ill. Her blood pressure was 152/89 mmHg, but the rest of vital signs were normal. There was no jaundice. Abdominal examination revealed epigastric tenderness. In laboratory test, hepatobillary enzymes were normal.
An abdominal CT was performed revealing mass in the pancreatic body and multiple nodules in the liver and para-aortic lymphadenopathy. This CT scan included the image of the lower portion of the lungs, showing multiple nodules bilaterally. Then the chest CT was obtained, showing diffuse polygonal structure and pleural effusion. Contrast-enhanced abdominal CT showed there were hypovascular mass lesions in the pancreatic body. We first considered she had probably pancreatic cancer with multiple metastasis. However, after six hours, another hypothesis of miliary tuberculosis was suspected, we then ordered acid-fast staining of the sputum, showing positive. The patient was transferred to another hospital for tuberculosis management, where PCR test for tuberculosis was positive.
Discussion: In our case, we developed a wrong diagnostic hypothesis as lymphangitis carcinomatosa. The initial cognitive error was probably related to anchoring bias and intuitively based on the rule of Occam's razor. This rule dictates entities should not be multiplied unnecessarily and is usually employed in clinical reasoning for diagnosis of multiple organ diseases in relatively young patients. However, in patients of relatively old age, application of Hickham's dictum, simultaneous occurrence of multiple common conditions, can be used. Since our patient was old, Hickham's dictum should have been considered and the patient might have received earlier diagnosis of tuberculosis.

35) Scleroderma Overlooked By Multiple Specialists Despite of Typical Presentation

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Learning objectives: Physicians tend to be biased by preconceived notions when there exist explainable alternative diagnoses.
Case information: 50-year-old previously healthy male presented with generalized weakness. He had noticed color changes of skin pallor on his fingers after cold exposure, generalized weakness, heartburn, and gangrene of bilateral 3rd and 4thtoes, since 15, 3, 2 and 1 years prior to admission, respectively. His generalized weakness followed by gait disturbance worsened since 4 months prior to admission. He had never sought medical care until he became bedridden, when he was transferred to our hospital 12 days prior to admission. Complete atrioventricular block was noticed at the emergency department and he was transferred to the other hospital for pacemaker implantation by Cardiologist. In the hospital, Plastic surgeon and Brain surgeon were referred for gangrene and generalized weakness, and implied the possibilities of peripheral vascular disease and cervical spondylosis. His generalized weakness and gait disturbance sustained, and he was transferred back to our hospital for rehabilitation purpose. Physical examination revealed rigidities in fingers, neck, elbows and knees with sclerotic and thickened skin, which were initially considered to be due to disuse. Laboratory results revealed mildly elevated anti-nuclear antibody, otherwise normal. After his history and physical examination had been carefully reviewed, the clinical presentation was found to be consistent with scleroderma, therefore skin biopsy was performed which confirmed the diagnosis.
Discussion: Scleroderma is characterized by progressive fibrosis of skin and internal organs, and is diagnosed primarily upon presence of characteristic clinical findings. There were clues that suggested scleroderma, including longstanding Raynaud phenomenon, gastroesophageal reflux, cardiac conduction disturbance and sclerotic skin. However, they had been explained by alternative diagnoses including, vascular or orthopedic disorders, or disuse, most likely due to faulty information processing (Graber, 2005).

36) Troponinemia: Red Flag or Red Herring

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Learning objectives:
Cardiac troponins are highly sensitive and specific biomarkers of myocardial ischemia and are extensively used in for the diagnosis of acute myocardial infarction (AMI) and other acute coronary syndromes (ACS). Occasionally, abnormal levels of troponin are found in patients who are not suffering from an ACS.

Case information:
A 63 years old man with history of coronary artery disease s/p inferior MI (2011) s/p PCI (to RCA) presented to his cardiologist as a follow from his recent admission three days ago in a local hospital. He was admitted with a one-week history of shortness of breath and chest pain. He was found to have a troponin of 0.09 ng/ml (<0.01 ng/ml), and EKG with NSR and RBBB (known prior). The troponin leak led to a Regadenoson SPECT showing ischemia of inferior wall (known) but no new areas of ischemia. Pt was discharged with a plan to follow up with cardiologist. His cardiologist did a bedside ultrasound showing RV dilation concerning for right heart strain and an elevated D-dimer to 7.89 µg/mL. He was discovered to have multiple extensive bilateral subsegmental PE on CTA and underwent catheter-directed lysis and was discharged home on apixaban.
Discussion:
Falsely elevated levels of troponin have been seen in certain common conditions such as atrial fibrillation, congestive heart failure, pulmonary embolism, myocarditis, sepsis and chronic renal insufficiency. This is contrary to what is generally thought about troponin being myocardial specific or specific for acute coronary syndrome(ACS). The elevated troponin can be a red herring in making an incorrect diagnosis of ACS. Alternatively, it can be viewed as a red flag to help diagnose other conditions.

37) This Time Around: Repeated Lymph Node Biopsy Revealed Malignant Lymphoma

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Learning objectives: If malignant lymphoma is suspected, lymph node biopsy should be repeated if the first biopsy results are negative.
Case information: A 73-year-old man with no background disease was referred to our hospital due to unintentional weight loss and bilateral inguinal lymphadenopathy. We suspected malignant lymphoma from the clinical course, and first performed a biopsy of the right inguinal lymph node. However, the pathological finding showed follicular hyperplasia. Since the clinical course and physical findings did not match the pathological findings, and the lymph nodes continued to enlarge during the follow-up observation period, we performed a biopsy from the left inguinal lymph node after three months. Based on the detection of Reed-Sternberg (HRS) cells in the biopsy specimen and the positive immunological staining, we made the final diagnosis of classical Hodgkin's lymphoma.
Discussion: · When lymphadenopathy occurs, it should be borne in mind that the small, superficial lymph nodes around the enlarged lymphoma might be swollen in reaction to antigen presentation or inflammation. · A biopsy of a lymph node that is swollen in reaction to antigen presentation or inflammation may not initially indicate a malignancy. If a discrepancy between the clinical course and pathological findings occurs, we recommended repeating the lymph node biopsy if a malignant lymphoma is suspected.

38) Two Cases of Polymyalgia Rheumatica Nearly Underwent Unnecessary Surgeries

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Learning objectives: Obvious focal findings may conceal overall picture.
Case information: Case 1: 70-year-old male with history of bilateral knees osteoarthritis presented with 1 day of fever. He had bilateral lower extremities pain, back pain and right shoulder pain since 2 months prior to admission, without improvement regardless of multiple intraarticular injections and analgesics, given by an orthopedic physician. He was diagnosed as right rotator cuff tear and the repair surgery was scheduled. However, he had 38.1 degrees Celsius on the day of the surgery, and he was transferred to our hospital. He had no focal signs of infection, nor abnormal laboratory data except for elevated ESR/CRP. Prednisone was initiated for possible Polymyalgia rheumatic (PMR), which rapidly resolved the pain and fever. Case 2: 55-year-old female with history of cervical herniated disc was referred from an orthopedic hospital for evaluation of unexplainable elevated ESR/CRP on the day of the planned neck surgery. She initially complained pain in neck, bilateral hips, thighs, arms and shoulders, with morning stiffness. Thereafter, she was diagnosed as exacerbated cervical herniated disc by MRI in the orthopedic hospital, and the surgery was scheduled. After the referral to our hospital, Prednisone was initiated for possible PMR, which rapidly relieved her pain.
Discussion: PMR is relatively common, however its diagnostic criteria have been controversy, which make it difficult to be differentiated from other orthopedic diseases that may be surgically indicated. The surgical indications need to be determined based on clinical symptoms, extent of impairment of daily activity, and responsiveness to conservative treatment. (Dunn WR 2005, Ellenberg MR 1994) Nevertheless, in these cases, surgical indications were determined by apparent focal abnormal findings in the images, and these patients nearly underwent unnecessary surgeries, potentially due to lack of comprehensive and integrated perspectives, and premature closure.

39) A Diagnostic Cue.

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Learning objectives: It is a common belief that memory retrieval is a simple process. Information is stored in working memory, transferred to long-term memory, and can then be retrieved as needed. However, the reality of memory retrieval is more complex than this simple, certain path. Cues can help in this process.
Case information: A 53 years old woman with history of multiple sclerosis, spinal stenosis, alcohol and IV drug use presented to an outside hospital for witnessed tonic-clonic seizures. On arrival there, pt was afebrile with BP 204/119, P 149, RR 38, O2 100% on 6L NC. Pt was subsequently intubated in the ED. Utox with methamphetamines, benzos, opiates. Troponin 1.62. PT 14.5, INR 1.1, PTT 48. CBC with WBC 24.5, Hgb 11.7, PLT 31. Cr 2.58 and glucose 372. AG was 19. LFTs with Tbili 1.7 and ALP 130. Ammonia 57. Lactate 1.9. CT of the head without contrast showed areas of decreased attenuation in both thalamic nuclei probably representing subacute ischemic infarcts. The patient was treated with Keppra and transferred to a tertiary care center with a diagnosis of seizures versus stroke. At the receiving hospital, MRI brain findings were suggestive of PRES. She was empirically treat with antibiotics for meningitis and admitted. The physician was informed by the nurse of a critical platelet value of 17. This triggered an automatic response in the physician to question the diagnosis of TTP. The patient was started empirically on plasmapheresis after blood smear showed schistocytes. ADAMT13 activity subsequently came back low. Husband confirmed that the patient sometimes injected crushed oral opiates, a known cause of TTP.
Discussion: A retrieval cue is a prompt that helps us remember. When we make a new memory, we include certain information about the situation that acts as triggers to access the memory.

40) Temporary and Asymptomatic Cause of Hypophosphatemia

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Learning objectives:
Acute respiratory alkalosis should be ruled out first in patients with hypophosphatemia so that unnecessary supplementation of phosphates could be avoided.
Physicians with confirmation bias might not pay proper attention to information which is not compatible with initial hypothesis.
Case information:
A 37-year-old woman with no significant past medical history presented with a 1-day history of vomiting. She denied headache, chest or abdominal pain, or dizziness. On examination, she had tachycardia and tachypnea. Both Chvostek's and Trousseau signs were positive. The remainder of physical exam was normal.
Venous blood gas analysis revealed pH of 7.60, PvCO2 of 21 mmHg and bicarbonate of 21 mEq/L. Serum phosphate level was 1.0 mg/dL. Electrocardiogram was normal. Phosphate deficiency was suspected and the order of intravenous phosphate supplementation was placed, although she did not have symptoms of hypophosphatemia.
However, before the infusion, repeated blood test revealed phosphate of 3.4 mg/dL. The patient was diagnosed with hypophosphatemia temporarily caused by acute respiratory alkalosis. Psychological interview was conducted, noting panic disorder.
Discussion:
Hypophosphatemia is defined as a serum phosphate concentration below 2.5 mg/dL. The manifestations of severe hypophosphatemia below 1.0 mg/dL include weakness, arrhythmia, CNS symptoms or hemolysis.
In our case the cause of hypophosphatemia was ultimately attributed to transcellular redistribution by acute respiratory alkalosis, which was involved with hyperventilation state. Hypophosphatemia by acute respiratory alkalosis can improve as resolution of alkalosis and the recognition of this mechanism is important so that unnecessary supplementation could be avoided. Respiratory alkalosis should be ruled out first when seeing patients with hypophosphatemia. Initial cognitive error in this case was probably related to confirmation bias. This bias might have led us not to pay proper attention to information (no symptoms of hypophosphatemia) not compatible with our initial hypothesis.

41) Fooled By the Frequent Usage Alert

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Learning objectives: Frequent users of the Emergency Department (ED), a heterogenous group of patients who overuse ED resources, have become increasingly common in the United States . With ED use always on the rise and waiting room times ever increasing, management of ED frequent users is becoming a very important issue. Frequent usage alert is one way to identify such patients to cut down on the cost. The alert is based on a high number of emergency department visits, opioid prescriptions, and different opioid prescribers.
Case information: A 34-year-old male with a history of prior distant left nephrectomy for a gunshot wound, alcohol abuse, chronic abdominal pain and multiple hospital visits for right flank pain presented with right flank and abdominal pain for two days. The treating physical was alerted by the electronic health record of frequent usage of the emergency room by the patient. The physician primed by the alert did a brief examination and discharged the patient much the chagrin of the patient. The patient insisted as he was discharged that his pain was

different. The patient represented the next day with ongoing pain, and work up revealed pneumoperitoneum, and exploratory laparotomy showed a perforated pre-pyloric ulcer.
Discussion: The problem of holding preconceived notions is that they can lead us to have negative beliefs about others and can affect our behavior. Frequent usage alert can create feelings about the patient which can be lead to a completely different outcome. The thinking gets shaped by the expectation.

42) A Guillain-Barre Syndrome Mimicry, Myasthenia Gravis

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Learning objectives:
① Correct diagnosis can be sidetracked by biases in atypical presentations of uncommon disease.
② Experts' opinions are helpful but contain some biases.
③ Clinician should analyze atypical features to eliminate the biases.
Case information: A 33-year old woman was admitted to our hospital because of progressive, symmetric muscle weakness of both extremities of 12 days duration. Paresthesia in hands and legs accompanied the weakness. Ocular, facial and bulbar weakness were not observed. No preceding infection was noted. On examination, depressed deep tendon reflex on left limb was detected by neurologist. CT of the chest revealed no thymic tumor. Acetylcholine receptor antibody was ordered. The differential diagnosis included Guillain-Barre syndrome(GBS) and Myasthenia gravis(MG). In this case, the patient showed progressive muscle weakness, paresthesia, and depressed deep tendon reflex. Neurologist suggested these findings favored the diagnosis of GBS. However, the patient showed fluctuating muscle weakness after admission. Nerve conduction study demonstrated no abnormalities. Edrophonium test revealed positive response. The patient was diagnosed with MG and was transferred to a higher order medical institution for further evaluation and treatment.
Discussion: Although it is rare, there has been reported case of MG with sensory symptoms. It is difficult to make the correct diagnosis in atypical presentations of uncommon diseases, because the doctor has often never seen the disease before. Many bias lead misdiagnosis in this case. A lack of ocular symptoms and the presence of numbness made it difficult to reach the correct diagnosis of MG. The expert's opinion that favored GBS raised an overconfidence bias. The physical findings, the tentative diagnosis on admission of GBS, and the expert's opinion lead anchoring bias. Recognizing that bias affects our judgment is important, and in this case, analyzing atypical features helped to overcome these biases.

43) Recurrence of Amoebic Colitis 1 Year after Previous Diagnosis of Non-Specific Colitis

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Learning objectives: Identify patients with amoebic colitis that mimics ulcerative colitis or other types of colitis.
Case information: A 50-year-old man presented with diarrhea that had persisted for over 1 month. Colonoscopy revealed pan-colitis with skipped erosions. Colon biopsies were obtained, with a suggested diagnosis of ulcerative colitis. The histopathological findings revealed non-specific colitis, so we kept him under observation only, as 5-ASA drug therapy had relieved his symptoms. One year later, he presented with severe diarrhea and general fatigue with jaundice. Laboratory findings revealed that he was positive for HBs antigen and HBc antibody, with markedly elevated liver enzyme levels, which indicated acute hepatitis B virus infection. Screening for sexually transmitted diseases revealed human immunodeficiency virus infection. We therefore considered amoebic colitis. Colonoscopy revealed multiple erosions with exudate throughout the colon that was worse than that in the previous year. The findings of *Entamoeba histolytica* cyst in colon tissues confirmed the diagnosis of amoebic colitis. He was successfully treated with metronidazole. Later, he was found to be homosexual. A review of the biopsy specimens taken at the time of the first colonoscopy revealed that he already had amoebic cysts 1 year earlier.
Discussion: Clinical symptoms of amoebic colitis are varied. Amoebic colitis sometimes does not exhibit remarkable endoscopic features. Cases of missed or delayed diagnosis of amoebic colitis have been reported to lead to severe outcomes such as fulminant colitis or perforation. This case highlights the importance of reviewing findings as follows: 1) recalling the diagnosis properly during endoscopy and providing the pathologist enough information; 2) reexamining the pathological findings when the result does not consist of clinical manifestations; and 3) rethinking the true diagnosis even when the treatment seems to improve symptoms.

44) Overlooking the Aberrant Lab: A Case of Hypercoagulability and Confirmation Bias

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Learning objectives: Better identify confirmation bias in clinical thinking and how it can cause error. Learn to be more mindful of departures from our illness scripts.

Case information: A 40-year old man without significant PMH presented with three weeks of new, worsening headaches associated with nausea and photophobia. Physical exam was normal except for sinus tachycardia. Admission laboratory evaluation showed leukocytosis and hypoalbuminemia. A CT head was obtained and showed bilateral transverse sinus thrombosis. He was admitted to the neurology service and started on anti-coagulation. Hypercoaguable workup was negative. On the day of discharge (hospital day #4), the rheumatology service was consulted for "autoimmune etiology of venous thrombosis." After sending urine studies to evaluate his hypoalbuminemia, he was discharged. Studies showed that the urine protein loss estimate was 6 grams/day. Patient was re-admitted and renal biopsy demonstrated membranous nephropathy. Further evaluation for an underlying cause identified positive ANA, SSA, and anti-dsDNA consistent with systemic lupus erythematosus. ACE-inhibitor was initiated and patient will follow-up with Rheumatology and Nephrology.
Discussion: This case highlights confirmation bias and how it can lead to diagnostic error. Hypoalbuminemia is not commonly associated with transverse sinus thrombus, and therefore was initially ignored. Representative restraint, or identifying only typical presentations of disease also played a role. Without evidence of volume overload or renal dysfunction, his presentation does not fit with an illness script for nephrotic syndrome. Despite normal kidney function, the presence of this degree of proteinuria is an indication for renal biopsy. Biopsy diagnosis of membranous nephropathy here allowed for identification of underlying cause. Causes of membranous nephropathy include autoimmune disease, infection, malignancy, and certain medications, though most commonly it is idiopathic. Treatment included management of underlying cause and initiation of an ACE-inhibitor or ARB.

45) Interstitial Pneumonia Induced By "Japanese Kampo Medicine" and an Accidental Challenge Test"

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Learning objectives: "Japanese kampo medicine", which is one of the alternative medicine in Japan, sometimes induces severe adverse events.
Case information: A 77-year-old woman presented to our hospital with a 4-hour history of dyspnea. She had been hospitalized until three days before arrival because of an undiagnosed interstitial pneumonia. On physical examination at arrival, SpO2 was 78%, ambient air, fine crepitation was heard at her chest. Chest X-ray revealed diffuse reticulo-nodular shadow in both lung fields as well as the last emergency visits. We suspected summer-type hypersensitivity pneumonitis or drug induced pneumonitis as her diagnosis since she had recurrence immediately from her discharge. The Japanese kampo medicine "saiko-keishi-kankyoto" had been suspected a cause of pneumonitis at her discharge. It was accidentally mis-provided her again at her discharge because a primary resident was different when she admitted form when she discharged. Her symptoms were rapidly improved after admission by discontinuing the suspected medication.
Discussion: "Japanese kampo medicine" is well known a comfort drug in Japan and it used for various symptoms. "Saiko-keishi-kankyoto" usually was prescribed for neurosis, insomnia, menopause, and so on. However, one of famous severe side effects for it is interstitial pneumonia. It is typically diagnosed by clinical courses. We accidentally carried out a drug challenge test. Although Japanese kampo medicine was often used unidentified complaints, it is not sufficiently aware of side effects. It is preposterous that a comfort drug causes a severe event. Drug information of commonly-used drug should be well known. It is a misunderstanding that common drug should be safe.

46) Military Medical Evaluation Board Role in Labeling of Misdiagnosed Case of Crohn's Disease

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Learning objectives:
1. Highlight the impact of premature closure, diagnostic inertia and inappropriate labeling on treatment exposure and outcome.
2. Discuss the usefulness of Military Medical Evaluation Boards to manage diagnostic inertia and inappropriate labeling of patients in future medical field interactions.

Case information: A 35-year-old male military veteran with history of Crohn's disease presents to the emergency room with abdominal pain and is admitted under presumed diagnosis of acute flare of his Crohn's disease. Patient states he was diagnosed with Crohn's during deployment in Iraq in 2008. He was initiated on mesalamine, prednisone, and infliximab. Discharged from military because of this diagnosis. 2009-present: Based on patient's reports, he was treated with prednisone, mesalamine, infliximab, and azathioprine by local gastroenterologist. However, he had continued abdominal symptoms consisting of cramping abdominal pain and alternating diarrhea and constipation most days of the year. Due to his continued pain, his primary care physician prescribed tramadol and oxycodone. He subsequently had multiple ED visits and hospitalizations for abdominal pain. Multiple CT scans and endoscopic procedures revealed no evidence of Crohn's disease. 2017: Hospitalized. Due to past negative work-ups, copies of patient's military medical records and records from initial gastroenterologist were obtained. After detailed review, original colonoscopy and biopsy results were not consistent with Crohn's disease, but infectious colitis. Patient diagnosed with mixed-irritable bowel syndrome complicated by opioid-associated constipation vs narcotic bowel syndrome.
Discussion: Despite the patient's recurrent symptoms, multiple failed treatment modalities and lack of objective evidence of active Crohn's disease, multiple care teams continued to attribute his abdominal symptoms to a prior diagnosis of Crohn's that was based on a premature closure over a decade prior. This highlights the willingness of medical providers to accept previous diagnoses without appropriate confirmation. Labeling of this patient led to not only inappropriate treatment but failed to address the underlying cause of his symptoms.

47) Canagliflozin: Masking Hyperglycemia in DKA

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Learning objectives: Diabetic ketoacidosis (DKA) can present with euglycemia in patients using the Sodium-Glucose Cotransporter 2 (SGLT-2) inhibitor, Canagliflozin.
Case information: A 32-year-old man presented with nausea and vomiting for four days. He also noticed that he started getting short of breath when climbing the stairs for the last two days and has had sneezing and runny nose for the past week. His medical history includes type II diabetes mellitus for which he takes Canagliflozin and Glipizide. He didn't experience abdominal pain or blurry vision. He was afebrile with a blood pressure of 126/74 mmHg, heart rate of 118 bpm, respiratory rate of 16 breaths/minute and oxygen saturation of 98%. Lungs were clear to auscultation, abdomen was non-tender but he had dry mucus membranes. His blood work revealed potassium of 5.1, bicarbonate of 19, blood sugar 181 and an anion gap of 18. Beta-hydroxy-butyrate was 73.1 and urinalysis had 2+ ketones. He was admitted to the step down unit for management of diabetic ketoacidosis and was started on insulin and 10% dextrose in water drips. After 24 hours, the anion gap was 12 and his bicarbonate corrected to 24. He was discharged home in an improved condition and was instructed not to restart Canagloflozin.
Discussion: DKA in patients with type 2 diabetes account for one third of all DKA cases, with a rate of 0.5 per 1000 patient-years. SGLT2 inhibitor–associated DKA may present with normal or mildly increased blood glucose levels (<250 mg/dl), which can lead to delays in recognition or diagnosis. The estimated incidence rates of this complication are 0.5, 0.8, and 0.2 per 1,000 patient-years with canagliflozin 100 mg, canagliflozin 300 mg, and comparator, respectively. SGLT-2 inhibitors must be witheld during any situation that might precipitate DKA (eg, acute illness, surgery, dehydration, excessive alcohol intake)

48) An Understanding of Appropriate Workup and Latency of Symptom Onset May Assist in Diagnosing Atypical Presentations of Malaria.

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Learning objectives: 1. Understand that onset of malaria symptoms may be delayed up to an entire year following return to the U.S. Geographic areas of travel and return dates should be obtained and documented. 2. Recognize other lab abnormalities associated with malaria and incorporate them into the workup for returning febrile travelers, especially for non-specific presentations.
Case information: A 76 year old female with history of breast cancer and mastectomy presented to the ED with fatigue, low-grade fever, abdominal discomfort, and diarrhea for two days. Patient travels frequently between the United States and India, last returning to the US 6 weeks prior. Tmax = 100.4; HR = 122; repeat HR = 90. Physical exam shows mild diffuse abdominal tenderness. Platelets = 96, AST = 93, ALT = 75. Urinalysis, CXR, and CT abdomen/pelvis were negative. Patient's symptoms resolved during ED stay and she was discharged. The following day, patient returned short of breath and was found to have a pulmonary embolism. While hospitalized, she developed altered mental status (AMS) and fever. Blood smears were consistent with malaria (P. Vivax).
Discussion: Identifying geographic areas and timeframe of travel is key to evaluating the febrile patient for possibility of malaria. P. Ovale, the most common form of malaria, will develop symptoms within 1 month 95% of the time. However, up to 50% of those infected with P. Vivax undergo a latent period of up to 1 year. Not all malaria patients present with cyclical fevers. Additional findings may include anemia, thrombocytopenia, hypoglycemia, AMS, liver abnormalities, and DIC. Our patient presented with low grade fever, thrombocytopenia, transaminitis, and ultimately AMS. Malaria was not pursued due to timeframe and lack of cyclical fevers. As malaria cannot be entirely excluded based on timeframe alone, it should be considered in any patient with suggestive labs returning from an endemic area, even if the trip was months ago.

Poster presentations—Applied Innovations

49) "Medical Malpractice Insights - Learning from Lawsuits," an Educational Newsletter for Healthcare Providers

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Statement of problem: Healthcare providers are learning almost nothing from the mistakes of our colleagues. When an error is made, especially a diagnostic error, the most egregious of these become lawsuits. And the most egregious lawsuits are settled before trial, almost always with a non-disclosure or canfidentiality clause. While trial verdicts become public records, pre-trial settlements generally do not, because all parties have a vested interest in keeping the results quiet. The defense wants to protect the reputations of its client and is often willing to pay

more for that privilege. The plaintiff hopes to obtain the largest settlement possible and will agree to confidentiality if it achieves that. And the insurer wants to limit information provided to future plaintiffs that might lead to more lawsuits and help plaintiff attorneys successfully litigate those cases. None of these interests coincide with a goal of most plaintiffs: To prevent the same mistake from happening to someone else. Non-disclosure clauses impede learning. Transparency that shares the teaching points of verdicts and settlements is the lowest-hanging fruit in the patient safety movement.

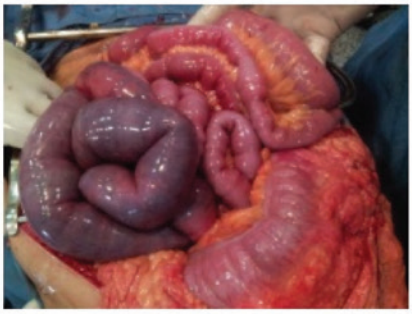
Description of the intervention or program: Information about medical malpractice verdicts and settlements is collected using a variety of sources. Each case is then anonymized and summarized in an easily readable "story" format including the "Facts" of the case, the "Plaintiff's" position, the "Defense" position, the "Result" and the "Takeaways" or learnings. The "stories" are then compiled into a monthly newsletter and distributed through various channels to the target audience.

Findings to date:

- The project is now 2 1/2 years old with over 1400 newsletter readers currently and another 1000 on emDocs.
- 96.7% agree that the stories help them practice more safely (63.3% find it "highly effective.")
- 90.3% of readers read each issue in its entirety
- The "story" format is given 3.7 stars on a 4 star scale.
- The "relevance" of the material is rated 3.8 out of 4 stars.
- 75% of readers have shared the newsletter with colleagues
- Positive comments have been received from over 100 readers
- Only 1 reader has "unsubscribed

Lessons learned: A newsletter using a "story" format to emphasize teaching points from medical malpractice lawsuits is effective at helping healthcare professionals practice more safely. Burying the mistakes of our colleagues behind confidentiality clauses assures that they will be repeated. Such transparency can improve patient safety, honor injured patients and reduce the cost and stress of medical malpractice lawsuits.

Mesenteric ischemia: An often overlooked cause of abdominal pain



6 months of abdominal pain and weight loss

Jane Doe v. Forbes Hospital et al. (Allegheny County, Pennsylvania)

Facts: A 49 yo married mother of 2 sees her PCP for recurrent bouts of post-prandial abdominal pain, occasional vomiting and diarrhea. She is referred to a gastroenterologist who orders an upper GI series and does both a UGI endoscopy and a colonoscopy. According to the medical records, these studies are all mis-interpreted. The patient's pain continues, sometimes leaving her writhing on the floor, and is unrelieved by opioids. Her weight drops 35% to 65 pounds. She is seen in the ED 3 times over a 6 month period for abdominal pain and weight loss. A gastroenterologist covering for her primary GI doc suggests the correct diagnosis of bowel ischemia 3 times but the primary gastroenterologist, PCP and an endocrinologist appear to disregard the opinion. On the final admission, the covering gastroenterologist, with the help of a surgeon, prevail. A mesenteric angiogram is ordered and the diagnosis made, but by now the entire bowel is dead. After several surgeries, the patient expires 3 months later.

Plaintiff: My PCP, gastroenterologist and endocrinologist all ignored my symptoms and didn't listen to the one GI doc who knew what was going on. If you had paid attention, listened to my complaints - the pain, the post-prandial vomiting and diarrhea, the weight loss, and thought of the possibility of mesenteric ischemia, then done the right test earlier, I would be alive today. You were so sure of yourselves that you didn't listen.

Defense: We considered mesenteric ischemia but didn't think the likelihood was high enough to get the angiogram earlier. You had other issues going on.

Result: The covering gastroenterologist was dismissed from the suit and a "substantial" pre-trial settlement was reached with the other defendants.

Takeaway: A mesenteric infarct is most often an acute presentation, but like heart disease it can present with "angina" as well as an acute MI. Sudden onset abdominal pain in anyone over 50 should suggest mesenteric infarct, among other diagnoses. If confirmed, stenting or bypass can be performed. More on chronic mesenteric ischemia here. More on acute mesenteric ischemia here.

50) Teaching Second Year Medical Students to Prevent Diagnostic Errors via DX: Diagnostic Excellence Online Virtual Patient Modules

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Statement of problem: In the U.S. about 5% of outpatient and 15% of inpatient diagnoses are in error, resulting in 40,000 - 80,000 deaths per year. The causes of these errors include system and cognitive factors. Despite its gravity and frequency, diagnostic error is not explicitly addressed in most medical school curricula during the pre-clinical years, revealing a substantial educational gap.
Description of the intervention or program: The DX: Diagnostic Excellence modules are 6 online, interactive, virtual patient modules that aim to improve student knowledge and attitudes about diagnostic error and patient safety. Currently they are being piloted at 6 medical schools during their longitudinal integrated clerkships and at the Chicago Medical School (CMS) in the MS2 Patient Safety course. This presentation will describe the CMS students' perceptions of diagnostic error education and resultant changes in their knowledge and attitudes based on these modules. A series of 6 modules was developed based on consensus learning objectives. A total of 188 MS2s completed these modules with accompanying multi-disciplinary assessment cases. Each student wrote a reflection about those modules. The reflection content had no impact on the course grade.
Findings to date: Of 188 MS2s, 183 (97%) found the DX modules worthwhile. Students thought that the modules helped them recognize pre-existing unintentional biases that led to diagnostic errors, develop specific strategies to avoid diagnostic errors, and realize the importance of patient safety investigations and disclosure. After completing these modules, students felt more confident about voicing concerns to peers and superiors. They understood the importance of identifying mistakes and using them as learning opportunities.
Lessons learned: Some students commented that portions of the modules were beyond the scope of their knowledge. In the future, we plan on providing the students with information on applicable abbreviations, definitions, diagnostic tests and procedures and offering an optional small group session in conjunction with the modules.

51) Generalist Physicians and Clinical Uncertainty: Time for Reflection

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Statement of problem: Primary care physicians (PCPs) and hospitalists, as generalists, reside at the threshold of caregiving that can progress flawlessly with the best possible outcomes or come apart unexpectedly with diagnostic error, iatrogenesis and high cost. They often work in diagnostic silos which can increase risk of diagnostic error. Meta-cognition and reflective reasoning may help decrease error but structured forums for collegial engagement rarely occur in clinical practice.
Description of the intervention or program:
To address clinicians' needs for real-time discussion of challenging cases, Practice Inquiry (PI) was started in 2002 at three outpatient clinics in the San Francisco Bay Area. In PI, primary care clinicians meet regularly to tackle diagnostic, therapeutic, prognostic, and/or ethical dilemmas. Currently PI occurs in 16 primary care settings, engaging over 125 clinicians annually. This model was adapted by the UCSF Division of Hospital Medicine with the development of Cases and Conundrums (C&C) in 2011. Hospitalists engage in twice monthly, one-hour meetings to discuss challenging cases. In both groups, facilitators ask colleagues to share cases for which they desire guidance, peer mentorship or feedback. They lead discussions structured to uncover blind spots, search for "evidence", recognize error, and reconstruct decision options, all while maintaining a safe and collegial environment. Patient logs are maintained and reviewed to follow-up patient outcomes. Educational credits and lunch are provided
Findings to date: Twenty-eight PI groups comprised of 5 to 12 PCPs have met regularly (e.g., monthly) for at least one year. Sixteen groups still meet in 2017: three with a 12-year longevity, three with 6 years. 137 of 457 cases (30%) presented between 2002- 2015 in 16 groups represent diagnostic uncertainty, focusing on etiology, evaluation, and diagnostic/management mixes. Biweekly C&C meetings are comprised of 8-12 hospitalists and the majority of the 70 UCSF hospitalists have attended C&C. Cases that hospitalists propose for discussion generally fall into 3 categories; diagnostic dilemmas, management dilemmas or clinical pearls (lessons learned from cases), with approximately a third being diagnostic dilemmas. (See Table for cases.)

Lessons learned:
The positive reception for C&C and PI reflects clinicians' desire for dedicated time to allow for peer mentorship and reflection when approaching challenging cases. Participants aim to minimize diagnostic errors and share lessons learned among colleagues. Case follow-up continues to be a challenge and requires additional resources and support for both groups. Aspirational goals include facilitator training expertise, enhanced methods for real-time case discussion, and research to demonstrate the impact of PI and C & C on clinical decision-making.

Uncertainty Cases Presented at Cases & Conundrums (C & C) and Practice Inquiry (PI)

Program	Uncertainty	Patient, Clinician, Relationship Data	Group Discussion Points	Follow – Up (Subsequent mtgs)
C&C	What is the cause of hepatitis and other lab abnormalities?	47 yo h/o mastectomy, recently treated with ciprofloxacin and then septra/doxcycline for total of 4 weeks for breast cellulitis. Presented with dark urine, nausea, low grade fevers. Recently traveled to Mexico for 1 week. No unusual exposures, no diarrhea, no sick contacts, safe water, no new sexual partners. Labs with AST 1000, ALT 600, T bili 2.0, AP nl. Cr 1.3, WBC 2.0 (ANC 880), Hgb 8, plts nl, LDH > 2000, coags nl. Tylenol negative, Hep A/B negative	• Current thought process: DRESS/DIHS, reaction to breast implant, HLH, Echinococcus • What do do next: HSV, parvovirus testing, G6pD, repeat UA, ferritin, review smear, consider heme or ID consults	• Probably with sulfa toxicity causing hepatitis and bone marrow suppression • Viral work-up negative
PI	When do we stop working up this patient's symptoms? Is there an underlying psychosocial issue I am missing?	15yo F, with multiple joint pains, migrating, presenting every few months for c/o pain and excuse for school; pain not improved with meds, worsens with PT; only no moving helps; no objective findings on exam; parents want dx; PMH: urgent visits for chronic abd pain – dx intussusception, alopecia; provider: frustrated, limited time, no continuity	• Diagnosis or not, pt not having fun • Shift focus to strengths, function , gymphobia – give excuse from gym (??) • Consider: elimination diet, acupuncture, symptom diary • Can continuity be re-established? (prior PCP returning) • How to diagnose school avoidance/secondary gain? • Is it fibromyalgia? – how to manage in teenager? • Danger of labeling with disease; focus on coping skills	• Pt now established here with different PCP • Pt now reporting panic attacks @ school, school issues • We all have MUS cases suspicious for underlying depression/anxiety • Strategies: has there been a good day? What does good day look like? When last time well? Point out normals/more wellness than illness

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52) Does Improving Diagnostic Efficiency Have Financial Impact on Hospitals? a Cost Effective Analysis of Clinical Decision Support Implementation.

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Statement of problem: Accurate and timely detection of C Difficile patients is an important goal and ongoing goal. However, overly sensitive diagnostic criteria may prompt the unnecessary use of antibiotics and contact isolation, thereby contributing to antibiotic resistance and increasing physician workload. We therefore seek to determine the hospital financial consequences of increasing the specificity of a diagnostic algorithm for patients in which C Difficile is suspected.
Description of the intervention or program: A markov model simulated analysis was performed to understand the clinical and hospital financial outcomes associated with implementing Clinical Decision Support (CDS) in an academic medical center. Specificity of diagnostic tests were stratified by the decision to implement CDS. Simulations were performed with 9,999 replicates in each arm. One way sensitivity analysis was performed for all transition probabilities and outcome measures.

Findings to date: The average for annual hospital costs were $3,941 for no CDS implementation (range: $2,401 - $5,746) among patients suspected of C Difficile. After CDS implementation, hospital costs were only slightly higher at $3,958 (range: $2,471 - $5,724).
Lessons learned: The patient safety consequences of CDS implementation is an important issue. CDS is shown to be a cost-effective way to improve diagnostic algorithms. Future studies should focus on the systematically analyzing the costs associated with different diagnostic methodologies.

53) Empowering Residents to Embrace and Communicate about Uncertainty in the Diagnostic Process

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Statement of problem: Ambiguity is ubiquitous in medicine, and intolerance and suppression of ambiguity are likely common cognitive contributors to diagnostic error. Ambiguity and uncertainty may be encountered in many ways during clinical encounters by both providers and patients. As we move to a model of shared diagnostic reasoning between the health care team and patients, we must develop methods to acknowledge and embrace ambiguity and uncertainty in order to avoid diagnostic errors. However, relatively few specific, robust, implementable educational strategies to improve trainees' ability to acknowledge and explain ambiguity to patients and families have been described. Here we describe a novel educational intervention to improve resident physicians' observed ability to discuss diagnostic ambiguity with patients and families.
Description of the intervention or program: We implemented a longitudinal series of 2 workshops focused on improving pediatric residents' ability to discuss diagnostically ambiguous situations with patients and families as well as their ability to develop shared diagnostic reasoning. This is an extension of our long-standing curriculum about diagnostic safety in the Pediatric Residency Program at the University of Minnesota. We adapted and validated a communications rating tool to assess learners' abilities to convey accurate diagnostic information, discuss ambiguity, engage patients and families in the diagnostic process, and use empathy. This tool was then used to assess learners and provide immediate formative feedback based on direct observation of simulated patient encounters. The encounters were specifically designed to be diagnostically ambiguous, and learners were tasked with helping the patients and families understand the diagnostic process. Each trainee performed 2 encounters twice in 6 months, receiving immediate feedback after each encounter and participating in group debriefing exercises.
Findings to date: While final data are still being analyzed, preliminary data show that residents have varying skills in communicating about the diagnostic process in ambiguous situations. Further, residents also have varying skill in developing rapport and shared decision-making with patients and families in these situations. Excitingly, residents were grateful for this experience and rated it as valuable; many of them stated during debriefing sessions and/or demonstrated during simulated encounters that they had applied the feedback received during previous simulated patient encounters in this intervention.
Lessons learned: It is important to empower physicians, especially trainees, to acknowledge and communicate about diagnostic ambiguity with colleagues, patients, and families in order to improve diagnostic safety. Focused educational interventions that allow for deliberate practice in communicating ambiguity should be implemented.

54) Atrius Health Safety Nets: Prostate Cancer

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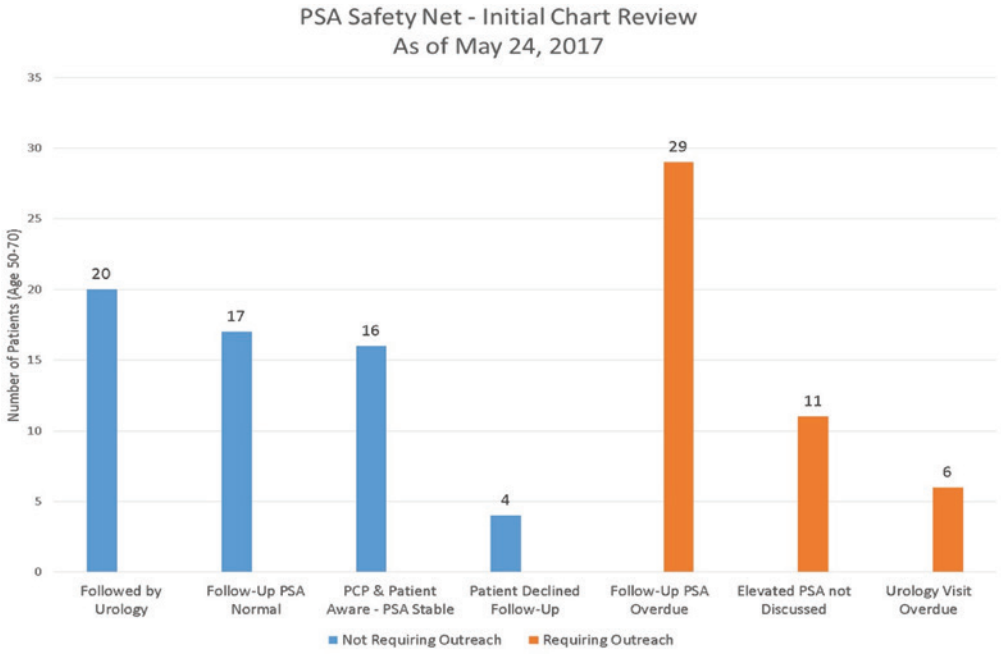
Statement of problem: Diagnostic delay and diagnostic failure are a leading source of malpractice claims at Atrius Health. Missed and delayed diagnoses of cancer are the most frequent and highest cost cases. A systematic review of these claims has shown opportunities for improvement at many junctures in the diagnostic process; patient assessment, ordering of diagnostic labs/tests and physician follow-up with patients. Safety nets are designed to identify and close gaps in these areas.
Description of the intervention or program: The automated surveillance system will scan our entire population of patients for specific high risk clinical scenarios related to failures in the diagnostic process. This system will leverage both electronic health record and payer claims data to provide monthly surveillance of the population. The team-based workflow will involve a centralized project manager responsible for monthly oversight and primary initial review of the surveillance system output, supported by both a primary care medical director and specialty physician support. The central team will send an internal EPIC staff message to the patient's PCP to notify the PCP of the findings and the plan for outreach and follow-up. Standing orders related to the safety nets will be developed to ease the administrative burden on the PCP; generation of the tracked referral will have the added benefit of bringing the patient back into our standard referral work flow. The referral tracking workflow will provide a second layer of protection under our existing "close the loop" referral program.
Findings to date: Work developing safety nets for diagnostic failure of prostate, lung and colorectal cancers is ongoing. As safety nets are being implemented for pilot, preliminary operational data is available and continues to be accrued for patients with elevated PSA testing without appropriate follow-up. (Please see attached image)

Lessons learned: Centralized oversight of high risk clinical scenarios has resulted in the following lessons:
- Confirmation that there are a significant gaps in tracking high risk clinical scenarios within Atrius Health that warrant attention and resources
- Centralized ownership of information management has increased the joy of medicine for primary care providers by helping manage the complex flow of clinical data.
- Acting on retrospective data requires disclosure of errors to patients. There is an opportunity to support providers in those conversations.
- Prostate cancer screening remains a controversial area with conflicting guidelines, our work focuses on ensuring appropriate follow-up once the decision to test has been made



55) Technology That Actually Brings Us Back to the Bedside – a Study of Point of Care Ultrasound to Improve Patient's Understanding of Diagnostic Process

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Statement of problem: Experience over the last 25 years has shown that point of care ultrasound (POCUS) has become an extension of the clinical examination and a valuable diagnostic tool when used by non-radiologists. Technological advances in medicine, such as POCUS, may be a powerful vehicle for communication to improve patients' understanding of the diagnostic process and their health problems.
Description of the intervention or program: This is a prospective, controlled trial involving a sample of adult hospitalized patients that are either holdovers or new admissions. There are 2 arms with a control group (standard care) with providers delivering usual care without POCUS and an intervention group with providers adding POCUS to standard care. We here report the preliminary results. The aims of the study are: 1. To determine if the use of POCUS impacts hospitalized patients' and physician's agreement on key factors in the diagnostic process as measured by level of agreement between patients' & providers' reason for their admission in the hospital, explanation of the health problem(s) and what information is used to get to their diagnosis. 2. To determine if the use of POCUS improves hospitalized patients' accuracy in identifying their main health problem leading to hospitalization as compared to the physician's identification. 3. To determine the relative frequency and importance of POCUS in the care hospitalized patients
Findings to date: To date, 10 patients have been enrolled in the study with 1:1 control:intervention allocation. Providers opted to use POCUS in 80% of POCUS eligible patients, and these patients rated POCUS as important to their care. Patients in the POCUS arm appear better able to determine their primary health problem and have a better understanding of their providers' explanation. These data are actively being collected and will be updated prior to the presentation.
Lessons learned: The preliminary findings suggest value in adding POCUS to aid in communication with patients. There are strong data from previous studies suggesting that POCUS also improves diagnostic accuracy and efficiency. Combined with previous data, these preliminary findings suggest that POCUS may be a tool uniquely poised to improve not only the outcomes of the diagnostic process but also enhance patients' understanding of and engagement in that process.

56) Diagnostic Errors: Impact of an Educational Intervention on Pediatric Primary Care

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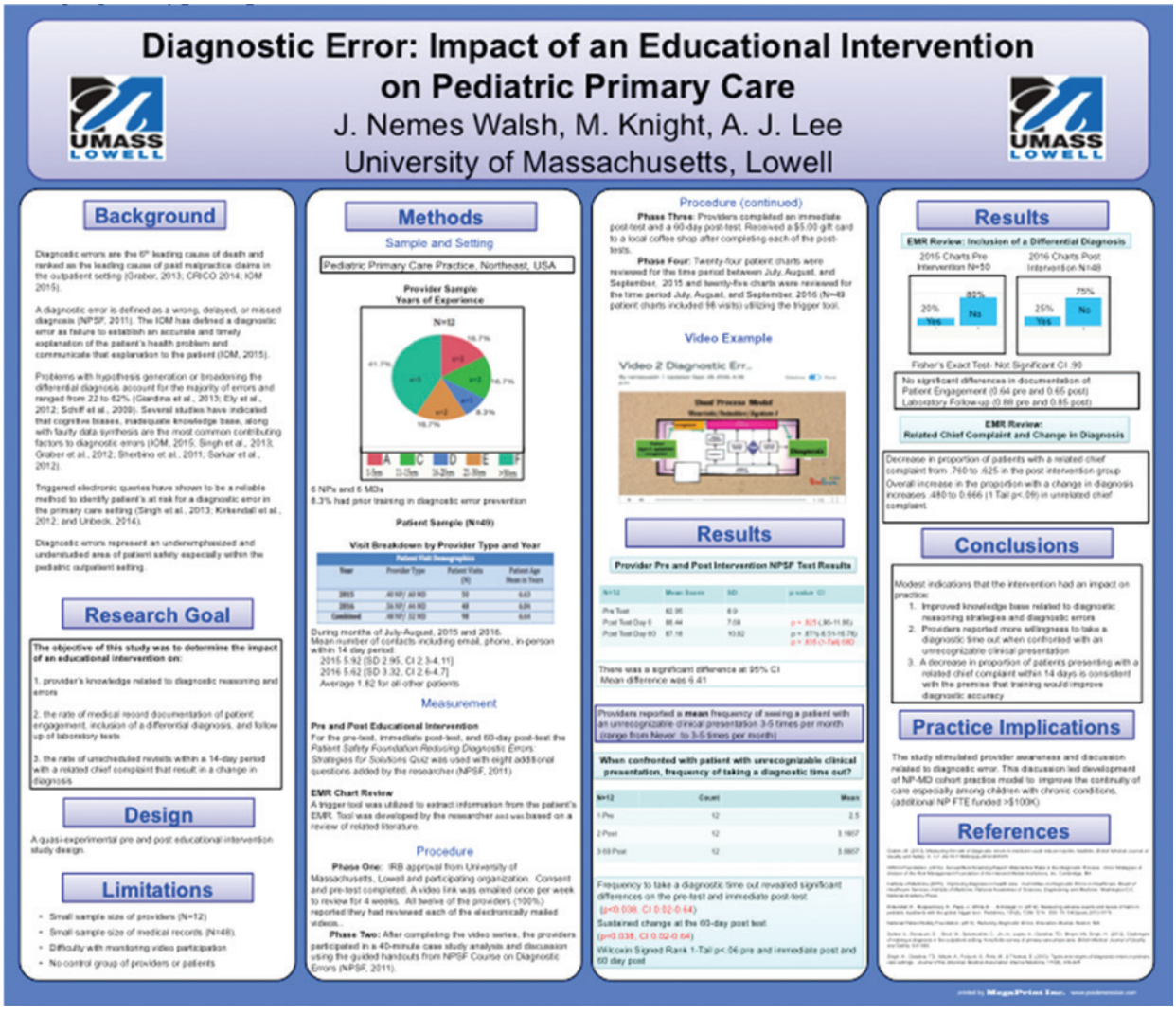
Statement of problem: Diagnostic decision-making skills are the most important cognitive skills a nurse practitioner or physician can develop and refine. The majority of diagnostic errors occur in the primary care settings and diagnostic errors are twice as likely to cause a patient's death more than any other type of medical error. The purpose of this study was to determine the impact of a content specific educational intervention on a provider's knowledge related to diagnostic errors and diagnostic reasoning strategies.
Description of the intervention or program: A quasi-experimental pre and post educational intervention study was undertaken utilizing a multi-media approach and case study discussion with six nurse practitioners and six pediatricians practicing in a pediatric primary care setting. The educational intervention took place during the month of June, 2016. A pre and post-test developed by the National Patient Safety Foundation and several additional questions developed by the researcher examined the effectiveness of the educational intervention on the provider's knowledge base and reported changes in self reflective behaviors. The study also included a review of electronic medical records of patients assessed by the 12 participants at two points in time, pre-intervention (July-September, 2015) and post-intervention (July-September, 2016). The researcher used a trigger-generated process to identify medical records of patients who had a revisit within 14 days and were cared for by the study participants.
Findings to date: One hundred percent of the participants completed all aspects of the pilot study. Knowledge related to diagnostic errors improved from the pre to the post-test scores with sustained 60-day differences ($p < .025$). Although there was a decline in the proportion of patients returning with the same chief complaint within a 14 days period, it was not significant. When providers were confronted with an unrecognizable clinical presentation they reported an increased use of a "diagnostic time out" ($p < 0.038$).
Lessons learned: Providers developed an increased awareness of the presence of diagnostic errors in the primary care setting, the contributing patient risk factors for a diagnostic error, and possible strategies to reduce diagnostic errors. These factors had an unexpected impact on changing the type of practice model utilized by the pediatric primary care practice.



57) The Right Reasons: A Faculty Development Workshop for Teaching Clinical Reasoning

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Statement of problem: Clinical reasoning- the application of knowledge and experience towards problem solving- is a core tenet of medical education. Teaching clinical reasoning can be difficult, however, due to inconsistent curricular time and lack of standardization. This pilot study of an innovation in medical education hopes to advance past workshops with two paired sessions that build on concepts and promote retention of information.
Description of the intervention or program: Participants were faculty members from three Internal Medicine residency programs across Connecticut. Four groups of 24 total faculty members participated in the pilot curriculum from January 2017 to April 2017. Faculty development workshops included two, one-hour sessions administered roughly four to eight weeks apart. The first session ("Diagnose the Learner") was designed to teach faculty members how to identify clinical reasoning deficits in learners. The first part of the session included a 20-minute didactic on dual process theory and an explanation of the different steps in the clinical reasoning process (data collection, problem representation, hypothesis generation, illness script selection, and management), which were derived from an extensive literature review. The second part of the session included a 30-minute activity where small groups practice paper case scenarios of learner limitations and discuss answers with the larger group. The second session ("Treat the Learner") occurred four to eight weeks after the initial session and was designed to teach faculty how to remediate deficits in learner clinical reasoning. The first part of the session included a 20-minute didactic describing methods to promote increased learner experience and knowledge organization with topics including, but not limited to, cognitive dispositions to respond (CDR) and Bayesian analysis. The second part of the session included a 30-minute activity where small groups rotated in workstations on precepting strategies ("One Minute Preceptor"), identification of CDR, and practice using electronic clinical reasoning apps. Each participant was provided a laminated 3" x 6" tip sheet summarizing teaching points for each session for self-directed learning.
Findings to date: The workshop was universally well-received with faculty appreciating the relevance to their educational practice. Participants were particularly unfamiliar with the dual process theory, CDR, and Bayesian analysis. Each session's activities were consistently the favorite aspect for participants.
Lessons learned: There continues to be a large demand from educators for faculty development on clinical reasoning, particularly with opportunities for supervised practice. In the future, we hope to use simulation centers to test the effectiveness of this well-received curriculum.

58) Cogpod: Patient Safety Enhancement and Cognitive Labor

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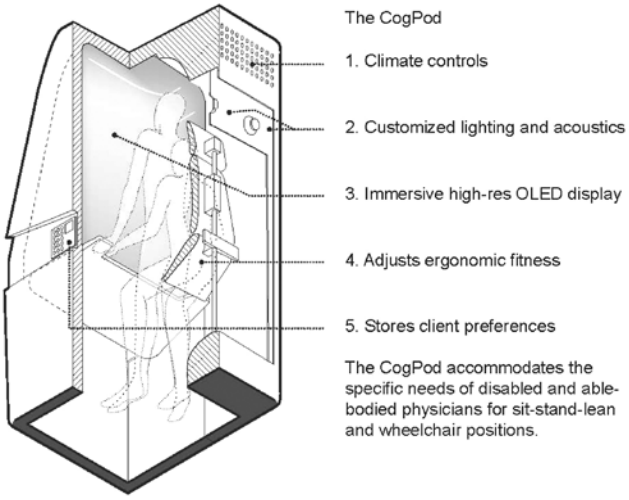
Statement of problem: Diagnostic errors lead to patient harm. Research suggests that such errors have origins in both system and human domains. For example, systems issues such as electronic medical records and data flow are known factors in diagnostic errors. Similarly, cognitive biases and knowledge gaps are recognized human problems that contribute to error. Kahnemann proposed two modes of decision-making: System 1 and 2. System 1 thinking is instinctive, quick, and effortless, but prone to error; conversely, System 2 thinking is deliberate, but also more time consuming. As System 2 thinking is relevant to preventing diagnostic error, we designed micro-architecture to foster reflective thinking.
Description of the intervention or program: We designed a "cognitive pod," a phone-booth like enclosure or capsule that a physician may enter to critically evaluate diagnosis, diagnostic reasoning and differentials. The CogPod motivates System 2 thinking by providing a distraction-free space that cultivates intent, informational awareness and creative capacity. The CogPod will provide access to key resources – such as electronic medical records for information processing or websites such as UpToDate -- and individual preference-setting profiles for ergonomic fitness, light, temperature, and sound dampening.
Findings to date: Initial research-identified products, such as educational pods and airport nap pods, and break-out spaces in the tech industry, which emphasize concepts germane to the CogPod. However, the CogPod differs as it does not focus on relaxation, but also on enhancing cognitive acuity by neutralizing environmental stress and audio-visual distractions inherent to the hospital. A full-scale prototype was developed to organize key systems and reviewed with clinicians. Based on critical feedback, the design is being refined to accommodate a range of environmental and ergonomic settings. As a physician enters the CogPod, lighting, sound, and temperature are synchronized to appropriate seating and work heights relative to an immersive high-resolution, 180° wallpaper display. The CogPod will be situated within the healthcare setting.
Lessons learned: The CogPod provides a reflective space for purposeful thinking within stressful environments. Given the demand placed on clinicians, the ability to de-stress and refocus cognitive load is a distinct advantage. Studies to test the CogPod with medical providers in the workplace are planned.



59) Taking Two Steps Back: An Innovative Online Curriculum in Clinical Reasoning

S. Tilstra, D. DiNardo, G. Tabas, T. Bui, T. Painter and W. Follansbee
University of Pittsburgh School of Medicine, Pittsburgh, PA

Statement of problem: There are few resources with which to teach clinical reasoning efficiently and effectively to a large group of trainees. We aimed to develop an interactive online curriculum for internal medicine residents that teaches the language, theory, principles, and process of medical decision making.
Description of the intervention or program: Six clinician educators at the University of Pittsburgh were tasked with developing an online module series to teach the principles of clinic reasoning. After extensive review of the literature and expert consultation, eleven modules were created using the online platform DecisionSim.™ Modules are multimedia with video-discussant, interactive patient videos, text, multiple choice and short-answer questions, and accommodate branching logic. Topics covered include: diagnostic error; intuitive and analytical reasoning; definition and development of key clinical findings, problem representation, illness scripts, summary statements; heuristics; and cognitive biases. The last 5 modules are dedicated to a “diagnostic checklist,” which teaches a systematic process to think through medical decision making in the clinical setting. All internal medicine residents at the University of Pittsburgh were granted access to modules 1-6 in October 2016 and were given instructions for completion within 2 months as part of a program expectation. Modules 7-11 were distributed in May 2017, again with the expectation of completion within 2 months.
Findings to date: As of March 2017,199/199 (100%) residents had completed module 1 and 154/199 (77%) residents had completed module 6. Average completion time for modules 1-6 was 2 hours. Written feedback was received from approximately 80% of learners, the substantial majority of which were very positive: “Modules were well organized,” “Great intermixing of video, questions, and didactic throughout,” “Helped me to better understand the biases,” and, “Thank you for emphasizing the importance of thinking about our thinking.” Ways to improve the modules included increasing the number of clinical cases, adding summary documents that could be accessed in paper format, and adding a progress bar. Some found the content regarding the language and psychology of clinical reasoning to be too basic. Within the next 6 months we will analyze the questions that are embedded within the modules to assess for completeness and accuracy of answers.
Lessons learned: Implementation a of a clinical reasoning curriculum has been successfully received in our internal medicine residency program. Investigation of module questions are needed to evaluate the effectiveness of the curriculum.

60) Medical Communication Deficiencies Solved with Pathologytracker

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Statement of problem: Deficiencies exist with the current Electronic Medical Record (EMR) software utilizing Health Language 7 (HL7) and Smart on FHIR software. These ubiquitous EMR software platforms (1) create an environment where "Real-Time" communication is inefficient between providers and patients, (2) do not support quality metrics to assess completeness, and (3) do not interconnect specific patient events. Because communication is the most important event that occurs between physicians, patients, and others; resolving these deficiencies is critical to patient care. Pathologytracker provides the answer.

Description of the intervention or program: Realizing the deficiencies with the current EMR systems, a consortium of pathologists and dermatologists was held to create a new communication system based on "tracking numbers" created uniquely for each pathology specimen acquired in the exam room. The tracking number is linked to the RFID (radio frequency identification) specimen labels enabling physical location tracking that is linked to the pathologist's report, and linked to all patient communication, scheduling, and documentation of closed treatment loops. Additionally, unique "Recommendation Codes" were defined to codify the pathologist's recommendations referenced in the pathology reports and linked to the tracking number. In Real-time, all data are shared on a Web-based paltform with built-in time metrics for every step of the process. The entire care team including the patient, physician, pathologist, Medicare, medical malpractice carrier, and national registries can access the data.
Findings to date: Pathologytracker software was studied from 2/1/2016 to 1/31/2017 at the Georgia Skin and Cancer Clinic. There were 24,279 patients yielding a total of 50,467 biopsies (average of 2 biopsies per order). Malignacies were identified with 6,813 patients and 6,702 patients were treatment in our clinic (98.4%). Of the remaining, 111 (1.6%) cases were not treated in our clinic, 44 were treated at an outside clinic with no documentation, 34 have upcoming appointments, 3 elected to deferred treatment, and 30 patients could not be contacted and were sent certified letters. No cases were left "Open"
Lessons learned: Pathologytracker software helps eliminate and resolves "Communication Deficiencies" through utilization of "tracking numbers" which facilitates communication among providers, patients, and others involved with the patient's health care. Also, Pathologytracker enables quality performance metrics measures that can be shared across the entire health care continuum. The latter leads to improving electonic documentation of medical outcomes and closed-loop documentation. With the demonstrated safety of the Pathologytracker software several medical malpractice companies are offering malpractice premium discounts to physician users.

61) Application of Fault Tree Analysis for Insights into Diagnostic Error

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Statement of problem: Diagnostic errors affect about 5% of US adult outpatients yearly, but formal analytic techniques are infrequently used to understand them. Analysis and modeling of diagnostic errors is particularly challenging due to the elusiveness of diagnostic reasoning, and multiple system and cognitive contributing factors that interact in complex pathways. *Fault Tree Analysis (FTA)* is a form of Root Cause Analysis that has been used successfully in other high-complexity, high-risk contexts. Our aim is to demonstrate that factors contributing to diagnostic errors can be systematically modeled by FTA to inform error understanding and error prevention.
Description of the intervention or program: A team of three experts reviewed ten published cases of diagnostic error and constructed fault trees (FT). FT were modeled to show relationships between causes and undesirable events according to currently available conceptual frameworks characterizing diagnostic error. The ten trees were then synthesized into a single Fault Tree to identify common contributing factors and pathways leading to diagnostic error.
Findings to date: First, FTA is a visual, structured, deductive approach that depicts the temporal sequence of events, and their interactions, in a formal logical hierarchy. This enables easier understanding of causative processes and rapid identification of common pathways and interactions. Second, it allows modeling cognitive and system factors together in one visual. This addresses an important methodological limitation of current methods that evaluate these separately. Third, FTs are mathematically equivalent to a series of Boolean equations. Solving these equations can result in deeper insights into errors including common contributing factors, rare causes, shortest paths to errors, and probability assessments. Fourth, a symbolic representation of FTs facilitates computational analysis, which can be programmed with additional work into EHRs to support safer diagnosis, e.g., warning of potential errors or high-risk situations. Finally, FTA provides a framework for calculation of experimental estimates for causative pathways. Each of the basic and intermediate events can be associated with estimates based on historical data or simulations. Thus, fault trees might provide a useful framework for both quantitative and qualitative analysis of diagnostic errors.
Lessons learned: In real-world implementation of fault trees, the team must be multidisciplinary and include patient safety experts, and clinicians, and other disciplines useful for rigorous development and/or application, such as cognitive scientists, human factors, informatics, and systems engineering. Development and validation of Fault Trees on larger subset of error cases to provide deeper insights into sources and prevention of diagnostic error.

62) The Clinical Reasoning Case Conference: Use of Principles from "Example Based Learning" in a Conference Format

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Statement of problem: While components of clinical reasoning are infused into standard residency education, explicit instruction regarding these principles is often lacking. Trainees may be expected to intuit the reasoning processes used by their clinical teachers when approaching

a patient. The quality of this learning experience can be highly variable when a common language for discussion of clinical reasoning principles does not exist, and when clinical teachers lack the skills to make their reasoning processes explicit. In order to address this educational challenge, we developed an interactive case-based conference with a focus on discussion of clinical reasoning principles, including cognitive bias.

Description of the intervention or program: Our monthly "Clinical Reasoning Case Conference" includes sequential delivery of clinical information from a real patient case to an expert discussant, who in turn describes their approach to the unknown case in a "think-out-loud" format. The conference is facilitated by a "clinical reasoning expert" faculty member, who, in keeping with principles from example based learning, provides explicit commentary regarding the clinical reasoning processes being used.

Findings to date: Our conference series has become a favorite of faculty and trainees alike. In a convenience sample of 31 attendees in March 2017, 100% of Faculty, 85% of residents, and 80% of medical students rated the conference as "more valuable" than other programmatic educational experiences. Three themes emerged in review of narrative feedback from attendees, including appreciation of: 1. the conference focus on the diagnostic process rather than the final diagnosis, 2. the opportunity to compare one's own reasoning with that of an expert, and 3. the venue for open discussion of topics such as diagnostic uncertainty and cognitive bias. In addition, we have observed increased levels of familiarity with core clinical reasoning concepts and vocabulary by both faculty and residents.

Lessons learned: Traditional "unknown case conferences" tend to focus on the ability of an expert discussant to reach a difficult or unusual diagnosis, often without an explicit focus on clinical reasoning principles that can be applied more broadly by learners. In our case-based interactive conference series, a focus on the clinical reasoning process and on potential for cognitive bias has contributed to the development of a shared clinical reasoning vocabulary within our program and to the dissemination of clinical reasoning skills for application in the clinical setting for patient care and teaching.

63) The CYCLE of Epidemiologic and Diagnostic Error in Medicine

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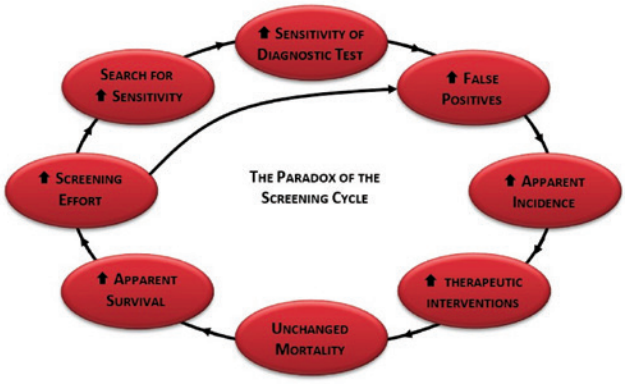
Statement of problem: The power of a diagnostic test is dependent on many factors including, but not limited to: the methodology used, technical application, commercialization, clinical implementation, personnel training, and instrument maintenance. These factors influence the sensitivity and specificity that can be achieved at the point of clinical diagnosis. However, it is the prevalence of a disease that determines the Positive Predictive and Negative Predictive Values of a test and so the total number of false positive and false negative diagnoses. Unfortunately, epidemiologic data used to estimate prevalence is often based on the results of the diagnostic test itself, and this could lead to a paradox where the test influences its own perceived reliability.

Description of the intervention or program: A literature search was carried out to identify diseases where prevalence has risen while the death rate has stayed the same or dropped. These were studied to determine how test characteristics might have influenced disease prevalence. A computer program was written to model impact prevalence can have on the number of false positive and false negative diagnoses and whether a test might influence its own perceived diagnostic power.

Findings to date: There has been a significant rise in the diagnosis of thyroid, breast, and prostate cancer without a rise in mortality. Many causes can be identified including but not limited to technical, financial, and social factors leading to and influencing screening programs. Part of the rise may be due to rising median population age while decreasing mortality may be due to new therapies that affect advanced stage disease. However, the model shows test characteristics and use may influence disease prevalence and, so, perceived diagnostic power.

Lessons learned:

- The complex interaction of various factors greatly influences the rate of diagnostic error and so, epidemiologic error.
- As the test utilization rises the number of false positives rises leading to a rise in apparent prevalence.
- This rise in prevalence increases apparent positive predictive value of the test and may overstate diagnostic power.



64) Discussing Diagnostic Error: Knowledge and Perceptions of a Pediatric Hospital Medical Staff

J. A. Grubenhoff[1,2], S. I. Ziniel[1,2] and D. Hyman[1,2]
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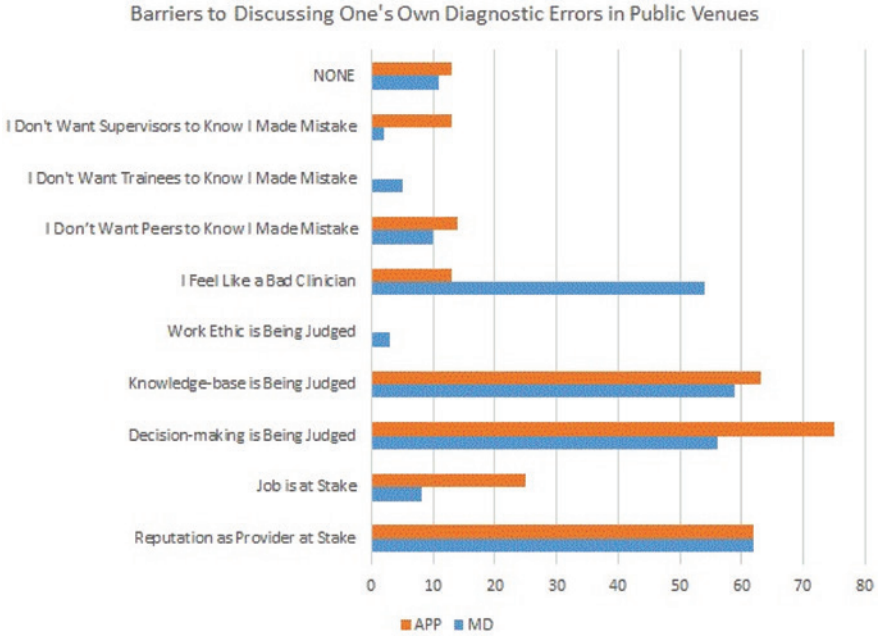
Statement of problem: The recognition, reporting and discussion of diagnostic errors (DxEs) are critical components to improving patient safety. It is unclear whether diagnosticians possess the vocabulary to facilitate discussion or recognize heuristics operating in clinical reasoning. Further, we know little about diagnosticians' comfort discussing their own DxEs in Morbidity and Mortality Conferences or Root Cause Analyses. For case review forums to produce actionable organizational learning at our institution, we required an understanding of diagnosticians' current knowledge base surrounding heuristics and perceived barriers that hamper discussion of DxEs in established case review forums.
Description of the intervention or program: We surveyed critical care, emergency medicine and hospitalist providers at our tertiary care pediatric hospital. The survey sought to establish a baseline awareness of common heuristic definitions and diagnosticians' facility with identifying heuristics operating in clinical vignettes of diagnostic reasoning. The survey also explored diagnosticians' comfort discussing DxEs in case reviews and perceived barriers to those discussions.
Findings to date: Eighty-eight (17 advanced practice providers [APPs] and 71 physicians) of 229 eligible providers participated (38% overall response rate). Only 16% reported any formal training in diagnostic reasoning beyond professional school and 74% reported personally committing a DxE during their career. Only 11% of respondents chose the correct definition for ≥4 of 5 heuristics while 73% chose the correct definition for ≤2 definitions. Similarly, only 10% of respondents correctly identified heuristics in 3-4 of 4 vignettes. Physicians were significantly more likely than APPs to be "pretty or very comfortable" discussing their own DxEs in case reviews (30% vs 0%). However, physicians (83%) and APPs (87%) both felt discussing DxEs in case review was "pretty or very important" for patient safety. The most frequently encountered barriers are shown in the attached table.
Lessons learned: At our institution, pediatric medical staff have little formal training in diagnostic reasoning and this is reflected by a limited knowledge of or ability to identify common heuristics employed in common clinical scenarios. While the majority of medical staff surveyed feel that discussing DxE is an important part of patient safety efforts, our data suggest they are not comfortable discussing their own errors. Institutional efforts to reduce patient harm from DxEs must address both the knowledge gaps and cultural barriers that exist surrounding diagnostic reasoning.



65) An Innovative Step-Wise Clinical Reasoning Conference for Pre-Clinical Medical Students

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Statement of problem: In a recent report, the National Academy of Medicine identified diagnostic error as a key contributor to adverse patient outcomes and called for better training in decision-making across all medical fields. The AAMC has echoed this by designating key clinical reasoning skills as core competencies for undergraduate medical education. Traditionally, clinical reasoning education tends to occur

in the latter half of medical school as students progress to clinical rotations, while such curricula are not commonly implemented during the pre-clinical years. This innovation describes a curricular intervention designed to introduce clinical reasoning concepts to pre-clinical students and to provide opportunity for skills practice.

Description of the intervention or program: This intervention was designed as a case-based conference that is tailored to the current topic of study in an organ-system based curriculum. The aim of this curriculum is to introduce clinical reasoning concepts to pre-clinical medical students, and to introduce the process of diagnostic reasoning utilizing the principle of example-based learning. Each case conference occurs in two parts: (1) An introduction to one clinical reasoning concept, with illustrative examples, and (2) An opportunity for immediate practice in the context of a case. During the case presentation portion, a clinical case is presented in a stepwise fashion to an experienced clinician, who in turn describes their approach to the case. Importantly, a moderator provides explicit commentary regarding the reasoning processes being used, and probes the students to compare the approach of the expert to their own. Each session ends with a review of the clinical reasoning concepts used, as well as learning points underscoring the clinical condition described.

Findings to date: The implementation of this curriculum began in January 2017, with cases presented in the Immunology, Microbiology, and Neurology courses. Clinical reasoning concepts introduced include that of key clinical findings, semantic qualifiers, and problem representation/summary statements. Attendance at each session have been comparable to attendance at other in-person class sessions, with an overall subjective approval from the students.

Lessons learned: With the implementation of this curriculum, several major themes have emerged. The first is that contrary to prior practice, a clinical reasoning curricula that uses the principles of example based learning can be seamlessly incorporated into pre-clinical undergraduate medical education. Secondly, a tailored case-conference can both provide reinforcement for medical knowledge but also an opportunity to practice clinical reasoning skills even in early learners.

66) The Present State of Clinical Terminology and Diagnostic Nosology Hinders the Reduction of Diagnostic Error in Medicine

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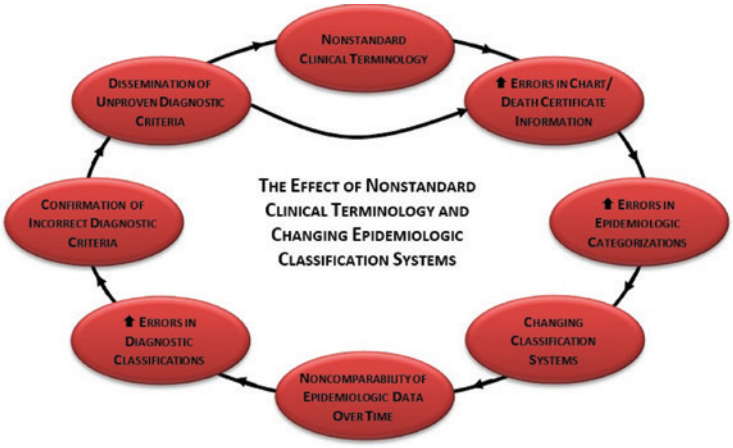
Statement of problem: Much of the statistical data regarding Diagnostic Error in Medicine is reliant on epidemiological data gathered through sources that include but are not limited to death certificates, tumor registries, state health agency reports, and hospital based chart reviews. The heterogeneity of the reporting terminology used by clinicians and classification systems used by collecting agencies has prevented the establishment of a standardized diagnostic nosology. This has led to inaccurate documentation of causes of morbidity and mortality making it difficult to validate the power of diagnostic tests as well as clinical criteria causing Diagnostic Error in Medicine.

Description of the intervention or program: A literature search was carried out regarding issues related to the collection, classification, and reporting of epidemiologic data. A schematic model was developed to illustrate the impact this can have on Diagnostic Error in Medicine. A solution is proposed to achieve a more reliable degree of standardization in clinical terminology, diagnostic criteria, and organization of clinical data used to report to registries and governmental agencies.

Findings to date: The result of the study reveals that, in the past, changes in incidence, prevalence, and mortality rates have been influenced by clinical terminology used by physicians, classification systems used by state and national repositories, as well as changes in diagnostic nosology. This is, in part, due to advances in scientific knowledge leading to new diagnoses. The most recent problem we face is the move from ICD9 to ICD10 where significant differences and gaps between the two classification systems will influence future trends in the epidemiologic basis for diagnostic medicine.

Lessons learned:

- The complexity of clinical terminology and diagnostic nosology reduces the accuracy of epidemiologic data.
- Inaccurate epidemiologic data has led to systematic Diagnostic Error in Medicine.
- Until this confusion is resolved, systematic Reduction of Diagnostic Error in Medicine will be difficult to achieve.



67) Listening to Reason: Strategies for Instilling a Culture of Clinical Reasoning in Medical Education

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Statement of problem: The IOM has recently identified diagnostic error as an important contributor to adverse patient outcomes and highlighted the urgent need for better training in decision making. The ACGME and AAMC have identified the development of clinical reasoning skills as a priority for medical education. Despite this wide recognition, there are varying degrees of instruction regarding clinical reasoning principles in graduate and undergraduate medical education. Further, there is equipoise about how to best design this curriculum. Our goal was to institute a multilevel program-wide culture change in our Division of Internal Medicine that emphasizes explicit clinical reasoning, identification of bias, and an open discussion of error.
Description of the intervention or program: We have developed a multipronged approach for the creation of a culture of clinical reasoning with the intention to (1) disseminate the common language that governs clinical reasoning, (2) role-model a systematic approach to case solving, and (3) create an environment where uncertainty, bias, and errors can be freely discussed. To fulfill these goals, a series of diverse multilevel interventions were implemented. The changes started with faculty development sessions that detailed the principles of cognitive psychology of decision making. Internal Medicine residents were similarly taught these concepts through the use of interactive online modules, an introductory workshop during intern orientation, and education on remediation of clinical reasoning during our rising resident retreat. Interventions were also tailored for multiple levels of undergraduate medical education. Additionally, division-wide interventions included a case conference with the aim to make the reasoning process explicit through the use of a concomitant discussant and clinical reasoning moderator.
Findings to date: There are myriad ways that the effects of these efforts are seen. Changes that have been observed include increased utilization of vocabulary by faculty and by housestaff, attendance at clinical reasoning case conference, participation rates in online modules, spontaneous discussion of biases and clinical reasoning at resident report, submissions of clinical reasoning vignettes to national meetings, and requests to disseminate the curriculum to other departments.
Lessons learned: Through the introduction of this multilevel multi-modal intervention to change the culture of clinical reasoning at our institution, there have been several principles that have emerged as essential. The first principle is that change at our institution occurred best through changes enacted from a centralized and bidirectional top-down and bottom-up approach. Secondly, the dissemination of a common language facilitates communication and discussion about clinical reasoning. Lastly, the introduction of a cognitive scaffolding for decision-making allows for skill-specific education and remediation.

68) A Tale of Two Programs. Reducing Diagnostic Error: The Johns Hopkins and Medstar Experience.

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Statement of problem: Diagnostic errors in medicine stem from system factors, cognitive factors and their interactions. Up to 74% of diagnosis-related harms could be traced to flaw in cognitive process. Solutions for the system-based problems are relatively easy to envision, but few interventions to reduce cognitive errors and improve clinical reasoning have been implemented or even proposed. The lack of formal curricula in graduate medical education could be explained by overall limited education and appreciation of cognitive psychology, nomenclature of diagnostic errors, sparse data on what to teach and how to teach. In addition, there are no validated assessment tools. In the narrative review by Schmidt and Mamede it was highlighted that research is lacking and that there is a real need for studies that may help us progress in the domain of clinical reasoning. It goes on to say that medical educators need to do more and in a systematic fashion. A dedicated curriculum in diagnostic reasoning would potentially optimize providers' approaches to diagnostic process, decrease chances of making diagnostic error, and make a meaningful difference in the lives of patients.
Description of the intervention or program: The curriculum that aimed to train internal medicine residents in both residency programs to use optimal approaches to diagnostic process and to establish and communicate accurate explanations for patients' healthcare problems had been developed. Kern's curriculum development model was implemented. Interns were exposed to three one-hour sessions on introduction to a framework for diagnostic reasoning, taxonomy of cognitive errors/heuristics with application in clinical vignettes, and application of Bayesian reasoning. Application of these concepts was reinforced throughout the year during planned monthly educational conferences using the diagnostic process guide to work on real-life cases.
Findings to date: The feedback from residents after didactic and practical sessions was collected regularly. We also interviewed the residents and key faculty members. Data saturation was reached. Learners reported change in knowledge and attitude.
Lessons learned:

1. Making a diagnosis is a team sport. We have been continiously expanding our team with enthusiastic faculty members and residents.
2. This curriculum teaches the learner factors that influence diagnostic decision making and that are vulnerable to diagnostic errors. However, will the change in knowledge and attitude last?
3. We are yet to identify ways to evaluate effectiveness of this intervention on skills and patient outcomes.

69) A Proposed MODEL for Presenting Laboratory Test Results to Reduce Diagnostic Error in Medicine

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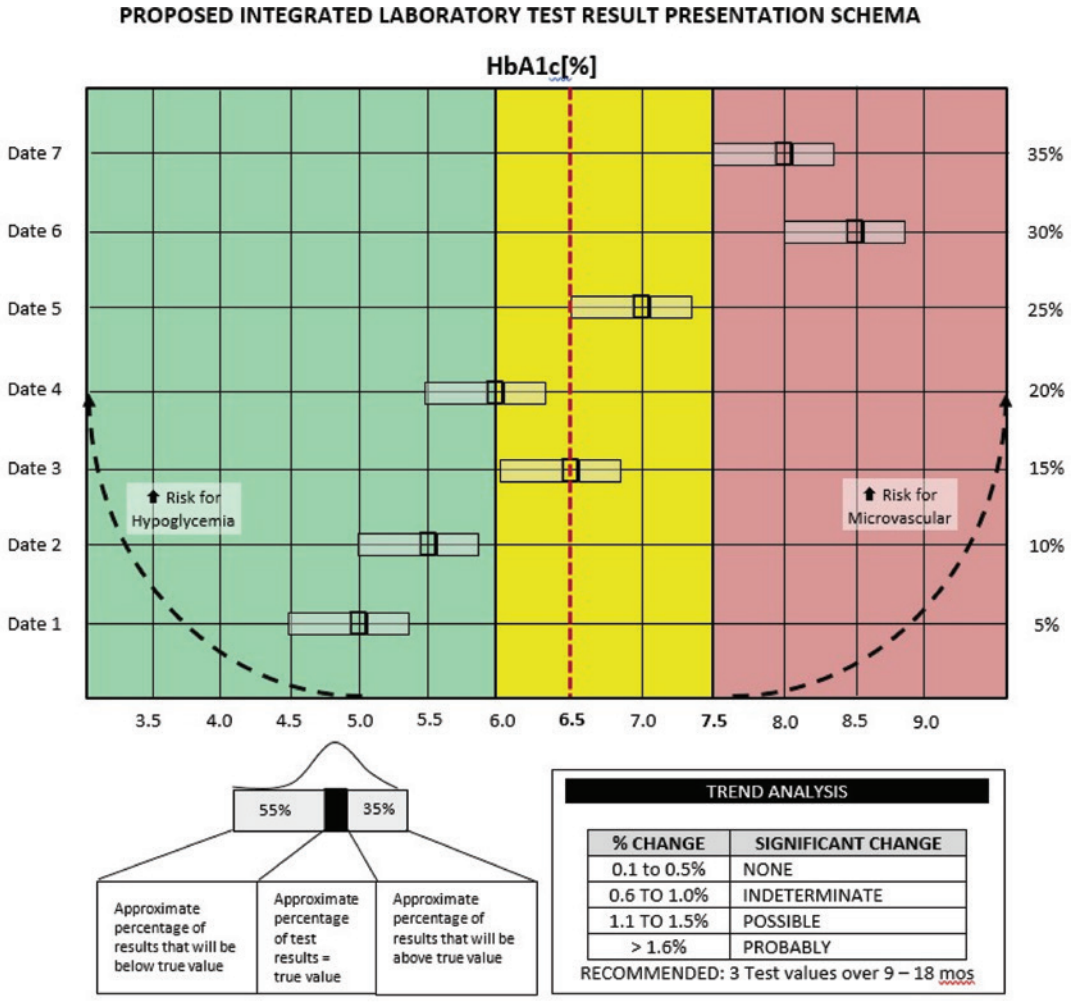
Statement of problem: The number of different laboratory tests available for and the number of test results generated by the diagnostic process have risen dramatically over the past half-century. This has led to a significant increase in the volume and complexity of laboratory data presented to the clinician. Despite the remarkable capacity of computers to collate and format information, today's eHR's add little to the presentation of test results beyond a simple chronologic listing and graphic plot. Furthermore, available quality control data that could provide valuable information as to the technical limitations of each test are hidden as are the quirks of individual patient biologic variation. The result; important information needed to safely interpret laboratory tests is not easily accessed by the clinician and so excluded from informing clinical judgment.

Description of the intervention or program: A proposed set of characteristics to aid the safe interpretation of laboratory test results are presented based on a literature search. These characteristics are incorporated into a two-dimensional graphic schema designed to convey the most information about a test result with the least confusion including critical risk issues needed to protect the patient from an erroneous or delayed diagnosis.

Findings to date: The model shows that, to a certain degree, a multidimensional set of laboratory test characteristics can be displayed in a two-dimensional format to provide information about technical limitations and biologic variation thereby better assuring patient safety. However, additional textual explanations may be necessary to describe what the clinician is seeing and additional specimen analysis carried out to establish each individual patient biologic set-point.

Lessons learned:

- Individual laboratory test results are often misleading while chronologic reports are limited in their usefulness.
- Multiple characteristics, both technical and biologic need to be included to assure appropriate interpretation.
- A two-dimensional grid with integrated technical information appears to fulfill most but not all this need.



70) A Self-Directed Virtual Simulation Tool for Working up Patients While Learning Diagnostic Reasoning

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[6]vCases, Milan, MI

Statement of problem: The high rate of diagnostic error today is unacceptable. Strengthening skills in diagnostic reasoning is a recognized goal in medical education. How can medical education be improved to combat this problem?
Description of the intervention or program: We developed an online, virtual simulation of open-ended, self-directed case workups deigned to teach diagnostic principles. The approach includes opportunities for students to make all decisions based on:
- Risk factors
- History question selection
- Patient response interpretation
- Physical exam choice
- Sign interpretation
- Test choice (including cost considerations), and
- Test interpretation.

Unknown information on relevant diseases, symptoms, signs, exams, and tests can be accessed immediately in an integrated library. Selection and narrowing of differential diagnoses are requested 4 times/case. Each disease description begins with "Key Diagnostic Elements", a list of 3-5 key diagnostic items followed by a short paragraph sub-titled "Making the Diagnosis." A section on disease pathophysiology follows annotated lists of risks, symptoms, signs, and tests relevant to the disease. The case ends with an epilogue comparing choices made by the student vs. the case author.
Findings to date:
Like real patient workups, simulated workups offer experience-based learning. But they have the added educational value of providing feedback for:
- patient profile analysis
- history-taking
- physical examination
- test-ordering, and
- differential narrowing.

We expected that this simulation approach would be best suited for medical students in their third and fourth years. However, initial feedback from nearly 300 first year and 300 second year students showed a remarkable appreciation, understanding, and outright "love" for the approach, many describing the above features.
Lessons learned: Self-directed engagement in decision-making is a hallmark of excellence in medical education. We have learned that virtually simulated, self-directed, open-ended case workup experiences aimed at improving diagnostic skills can be understood, enjoyed, appreciated, and valued as early as the first year of medical school. This project was supported in part by Award Number R43RR026159 from the National Center For Research Resources of the NIH.

Poster presentations—Research/Scientific Abstracts

71) Understanding the System Factors Influencing Patient Risk: Does Overcrowding and the Presence of a Handoff Increase the Likelihood of Return within 72 Hours?

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Background: Emergency department (ED) crowding is a regularly occurring issue faced in large academic hospitals and has been shown to negatively impact patients. Many hospitals now utilize the National Emergency Department Overcrowding (NEDOC) score to effectively estimate and manage the degree of ED overcrowding. Handoffs have long been recognized as a high-risk moment in a patients' care experience, as communication failures can result in inappropriate or delayed treatment resulting in suboptimal care. A handoff occurring when

NEDOC is high may result in a higher patient risk. One potential method for measuring patient risk is returns to the emergency department within 72 hours, a previously established quality of care indicator. We sought to determine effects of NEDOC score and handoffs on patient outcomes. We hypothesized that 1) the occurrence of a handoff and 2) higher average NEDOC scores would increase likelihood of returning within 72 hours and returning within 72 hours with admission.
Methods: A retrospective cohort sample was used to evaluate the impact of NEDOC score and handoffs on adult patients admitted to the emergency department at a large volume tertiary care hospital in southwest Virginia from 2010-2016. Outcomes were compared between patients who experienced one and zero ED physician to physician transfers of care at shift change. The relationship between overcrowding and average patient NEDOC score was also evaluated. The NEDOC score was calculated hourly from patient arrival to discharge. This was averaged to create a patient specific score. Primary outcomes included return within 72 hours with and without subsequent admission.
Results: Between 2010 and 2016 there were 18,333 returns within 72 hours and 3,375 returns with admission for rates of 5% and 1% respectively. There was no statistically significant effect of handoffs on either returns or returns with subsequent admission when including ED length of stay in the model. There was a negative relationship between the average NEDOC score and returns ($\beta = -0.18$, $p < 0.001$) as well as returns with admission ($\beta = -0.22$, $p < 0.001$).
Conclusions: Experiencing a lower NEDOC score was found to be a statistically significant predictor of returns within 72 hours with and without admission. Handoffs were not a statistically significant predictor of returns. These results are counterintuitive. The increased diagnostic accuracy experienced during these periods demonstrated by the lack of returns may result from increased clinician attention due to non-standard workflow. Future investigation is required to further explore this unexpected result.

72) Stroke Risk after Outpatient Diagnosis of Benign Vertigo Varies across Specialties

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Background: Though vertigo can be the primary or even exclusive symptom of cerebrovascular disease, stroke presenting with vertigo is often misdiagnosed as benign inner ear disease. Patients discharged with "benign vertigo" are known to have a higher risk of stroke than the general population, but this risk has never been compared across medical specialties.
Methods: Patients diagnosed with first incident vertigo (ICD-9-CM 386.x, 780.4) in outpatient departments were identified from the National Health Insurance Research Database of Taiwan (2002-2009). In defining "benign vertigo", we excluded patients (i) who were referred to emergency department or admitted as inpatients on the same day of index OPD visit; (ii) who had stroke-related diagnosis (ICD-9-CM 430-438) at the index OPD visit; (iii) who were diagnosed with "vertigo of central origin" (ICD-9-CM 386.2) at the index visit. All included patients were classified based on the specialty of the physician providing diagnosis as follows: (1) neurology; (2) ENT, (3) internal medicine, (4) general medicine, and (5) other specialties. All patients were followed until stroke, death, withdrawal from database, or current end of database (December 30, 2012) for a minimum follow-up period of 3 years. 180-day and 3-year stroke incidence was analyzed. Risks of stroke were compared between neurology and other specialties using a Cox proportional hazards model.
Results: We studied 178,981 patients (neurology: 7,140; ENT: 20,098; internal medicine: 36,279; general medicine: 80,838; other specialties: 34,626). Short-term (180-day) stroke incidences were 0.48% in neurology, 0.24% in ENT, 0.58% in internal medicine, 0.44% in general medicine and 0.20% in other specialties. Long-term (3-year) stroke incidences were 1.29% in neurology, 0.86% in ENT, 1.81% in internal medicine, 1.61% in general medicine, and 0.73% in other specialties. The unadjusted hazard ratio of stroke in neurology was higher than ENT (HR = 1.47, 95% CI = 1.25-1.72), other specialties (HR = 1.71, 95% CI = 1.48-2.00), and lower than internal medicine (HR = 0.76, 95% CI = 0.66-0.87) and general medicine (HR = 0.83, 95% CI = 0.73-0.95). After adjusting for age, gender, urban status, geographic area, and cardiovascular risks, adjusted stroke hazard in neurology was comparable with ENT (aHR = 1.10, 95% CI = 0.93-1.25) and other specialties (aHR = 0.97, 95% CI = 0.83-1.13), but was still lower than internal medicine (aHR = 0.80, 95% CI = 0.69-0.92) and general medicine (aHR = 0.86, 95% CI = 0.75-0.98).
Conclusion: When adjusted for demographic factors and overall cardiovascular risk, the risk of stroke following a diagnosis of dizziness differs depending on the specialty of the physician providing diagnosis. This may reflect underlying differences in the rate of misdiagnosis of benign vertigo among medical specialties.

73) Informing Action through Evidence: Examining Patient Perspective, Interpretation, and Use of Test Results from Patient Portals

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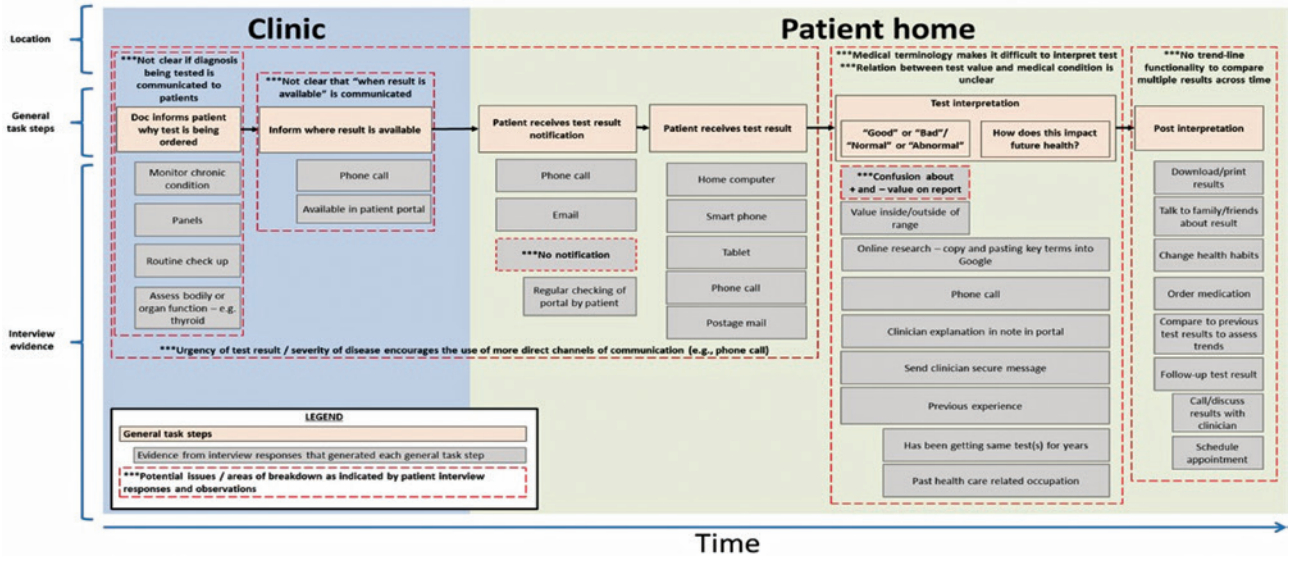
Background: The use of "patient portals" provides an avenue for patients to access health information including test results, but it is unclear how patients retrieve and use test results information. The current study examines processes related to patients' use of online portals to access, interpret, and use test result information and identifies limitations of current patient portal designs that constrain patients' ability to access and comprehend their test results.
Methods: Ten semi-structured interviews and three observations were conducted with current patient portal users who access laboratory test results. Data from interviews and observations were transcribed and used to construct a test result process map from the perspective of patient portal users. After creating the patient-based test result process map, interviews and observations were reanalyzed to determine shortcomings that limited patients' ability to access or understand their test results. They were incorporated into the test result process map to identify at which step each shortcoming occurred.
Results: The resulting process map portrays: where each task step in the process takes place; the necessary task steps that need to be fulfilled for patients' to access and interpret their test results; and at which task steps shortcomings of the patient portal limited patients' ability to access or interpret their test result. In total, six task steps were created and seven limitations were identified from thirty-nine interview comments and observed behaviors. Some particularly interesting shortcomings of patient portals included: 1) the lack of a notification being sent to the patient that informs them a test result is complete; 2) difficulty in determining the relationship between the value reported on the test result and their medical condition; and 3) the lack of ability to trend results across time.
Conclusion: Studying the patients' perspective to create a depiction of the test result process provides a unique look at the way patients use patient portals to access, interpret, and inform action based on test results. Future work will use this diagram to identify design features to enhance patients' ability to access, comprehend, and follow-up on test results obtained from patient portals.



74) When What You Say Is Not What They Hear: Critical Patient Information Agreement after Communication Model Instruction

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Background: Handover, a form of transfer of accountability, has been identified as one of the weakest link in patient safety. Concerns regarding handover are exacerbated when training systems change, including restriction of duty hours and the implementation of "night float residents". Existing handover literature focuses primarily on human factors approaches including what, rather than how, information is conveyed; such as SBAR (Situation, Background, Assessment, Recommendation) communication models. There is no evidence of increased agreement between the presenter and receiver of handover on critical patient information.
Methods: This observational study was the first in a planned series to develop an increased understanding of the cognitive processes involved in handover. Morning handovers from 18 medical staff, residents, and clinical clerks in Internal Medicine—who have been on call for the Emergency Room during the observation period—were witnessed and recorded. All participants involved had received training on the SBAR system.

Following the handover of each patient, both the presenter and the receiver of handover independently completed a short survey. The survey used both open ended questions and ratings on a 5-point Likert scale to examined their perceptions of success during handover.
Results: Across 18 individuals, 21 unique patient handovers were observed - consisting of 17 novel 'presenter- 'receiver' handover pairings. Upon completion of handovers, majority of individuals agreed that all necessary information was conveyed (x = 4.1 and 4.4 for the presenter and receiver of handover) and understood (x = 4.2 and 4.5 for the presenter and receiver). However, only 34% of the time the presenter and receiver agreed on what the two most critical pieces of patient information were.
Conclusion: Despite training on the SBAR communication model and perceptions by both the presenter and the receiver that the transfer of accountability was completed well, there continues to remain a discordance in their interpretation of critical information. The patient information that the presenter considered most critical was most often not interpreted the same by the receiver. This disagreement may have important influences on future behaviours and outcomes. To date, the focus on human factors has been necessary yet insufficient to solve the problems identified over the course of handover. In future, other literatures, including cognitive psychology, may provide insights into how to reconceptualize our thinking of the issues in handover.

75) Burden of Missed Diagnostic Opportunities in General Practice in the United Kingdom

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Background: Data on incidence, types and contributory factors for diagnostic errors in primary care are only now emerging. To date there are no large-scale epidemiological studies in the United Kingdom (UK) to reliably quantify diagnostic error and associated harm in primary care. Diagnostic error rates vary according to how 'error' is defined but one suggested hallmark is clear evidence of a missed opportunity to make a correct or timely diagnosis. This study aimed to (1) determine the incidence of 'missed diagnostic opportunities' (MDOs) in English general practice, (2) identify the confounding and contributing factors that lead to MDOs and (3) determine the (potential) impact of the detected MDOs on patients in terms of harm.
Methods: We conducted retrospective medical record reviews of electronic health records (EHRs) in the Greater Manchester (GM) area in UK. We recruited 21 practices which were sampled and stratified according to their size and socio-economic deprivation. Four trained physicians conducted reviews using a pre-tested data collection instrument. Pairs of physicians independently reviewed the same 100 randomly selected patient consultations for every practice, reviewing a 12 month period for consultations with new diagnostic activity. They then jointly reviewed records where either one or both had identified an MDO to gain consensus. All patients were ≥18 years and attended a face-to-face index consultation with either a General Practitioner (GP) or nurse Practitioner (NP).
Results: We reviewed 2070 EHRs; and of these 1530 contained some new diagnostic activity. Patients included had a mean age of 49.5 years (SD 18.3; range 18-94). After joint review, at least one clinician thought an MDO was likely or certain in 4.6% (95% CI: 3.4 to 6.1) of consultations, and both concurred that an MDO was likely/certain in 2.8% (95% CI: 1.9 to 4.2). In final consensus, reviewers agreed that an MDO had occurred for 61.4% of the consultations where at least one reviewer identified an MDO. The overall kappa statistic was 0.69. 53% of the mutually agreed MDOs (n = 43) were rated as likely to cause moderate or severe harm.
Conclusion: In this first and large epidemiological assessment of diagnostic errors in UK primary care, we found their frequency comparable to that in US outpatient care more than half of which were likely to cause moderate or severe harm. Agreement was higher than most prior similar studies. Further work will include exploring possible contributory factors to the occurrence of MDOs.

76) US Federal Research Funding on Diagnostic Error Substantially Lags Its Public Health Burden

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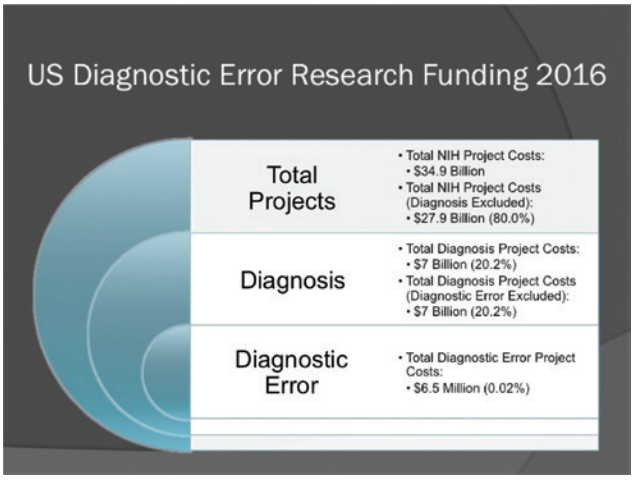
Background: Diagnostic errors affect 12 million Americans annually. Some estimates suggest that harms from misdiagnosis, costs of inappropriate diagnostic test and treatment use, and malpractice claims, in aggregate, may exceed $100 billion per year in the US. Federal funding for diagnostic error research has historically been limited, but has not yet been quantified.
Methods: Cross-sectional analysis of public-use National Institutes of Health (NIH) databases to identify federally-funded research projects. We queried the NIH ExPORTER and RePORTER databases for projects related to diagnosis and diagnostic error, identifying both the number and total spending in US dollars for the fiscal year 2016. We determined total federal projects and spending from the ExPORTER database.

We estimated diagnosis-related and diagnostic error-related projects and spending from the RePORTER database. We used structured queries of research project abstracts followed by human abstract review to verify query strategies. The query for diagnosis-related abstracts used wildcard characters to capture any word with the letters “diagnos” at the beginning, middle, or end of a word. The query for diagnostic error-related abstracts included multiple keyword phrases combining terms missed, wrong, or delayed with diagnosis. We summarize total projects and dollars with descriptive statistics.

Results: US federal healthcare agencies (predominantly NIH) spent a total of $34.9 billion on 71,827 research projects (ongoing and newly funded) in 2016 (Figure). Agencies allocated $7.1 billion (20.2% of total funding) to 14,148 (19.7%) research projects mentioning any diagnosis-related word in the research abstract. We identified 52 abstracts for funded projects using the diagnostic error query, 27 (52%) of which were confirmed to be diagnostic error related projects by human review. Agencies (predominantly NIH and AHRQ) allocated $6.5 million (0.02% of total funding) to these 27 research projects (13 setting-specific; 10 disease-specific; 3 symptom-specific, and 1 for the Diagnostic Error in Medicine conference). Human audit of the first 100 abstracts retrieved by the diagnosis query (but not captured by the diagnostic error query) found 1/100 (1.0%) were diagnostic error-related. We therefore estimate that approximately $6.5 to 71 million (0.02-0.2% of total federal healthcare research spending) is focused on missed, wrong, or delayed diagnosis.

Conclusion: US federal research funding for diagnostic error appears to be very limited and not adequate to the magnitude of its public health burden. Policy makers and funding agencies should strongly consider allocating resources to address what the National Academy of Sciences, Engineering, and Medicine called a "moral, professional, and public health imperative."



77) Diagnostic Error in Stroke Mimics with Discordant Admission and Discharge Diagnoses

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Background: The accurate diagnosis of acute stroke is often difficult due to the variety of neurological conditions that may present with similar symptoms. Approximately 1 in 4 stroke cases admitted for hospitalization are discharged as a stroke mimic. Misdiagnosis is detrimental to patients outcomes as discordance between admitting and discharge diagnoses is associated with increased morbidity, mortality and duration of hospital stay. Diagnostic error’s contribution to stroke mimic misdiagnosis is currently not described in the literature. The objective of this study was twofold. First, we aim to characterize diagnostic error in cases with an admitting diagnosis of stroke and discharge diagnosis of a stroke mimic. We also examined the time of symptom onset, presence of altered mental status, and prior stroke history with the intention of uncovering underlying factors contributing to diagnostic error in stroke mimics.

Methods: This study was a retrospective chart review conducted at a medium sized rural hospital from the May - August 2016. We used our system’s electronic medical records to examine all cases admitted as stroke in the aforementioned period. Cases with a diagnosis of a stroke mimic at discharge were further examined. Of these cases, those with diagnostic error were include study included in this study. The underlying diagnostic error was characteristic as system based, cognitive, or knowledge gap.

Results: We examined 121 cases admitted as a stroke during the study period. A total of 31 cases were determined to have a stroke mimic discharge diagnosis and 30 of such cases were found to have underlying diagnostic error. Cognitive, system based, and knowledge gaps were found in 81.8%, 37.5% and 16.7% of cases respectively. Altered mental status was present in 26.7% of cases; however, the diagnosis changed to a stroke mimic prior to altered mental status resolution in 75% of such cases. Of cases with clear documentation of last known well, 50% met the tpa inclusion criteria. The patient had a prior history of the discharge diagnosis in 46.7% of cases with diagnostic error while 43.3% of such cases had a prior history of stroke.

Conclusion: Diagnostic error is common in stroke mimics case with disagreement between admission and discharge diagnoses. Cognitive, system based and knowledge gap errors each contributed to discordant diagnoses. While altered mental status may limit examination of neurological symptoms, the results suggest that the presence of altered mentation does not explain stroke mimic misdiagnosis when altered cognition is present.

78) Dissecting Choosing Wisely Recommendations for More Prudent Diagnostic Decisions

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Background: With clinical and political pressure to reduce healthcare costs, many groups have published strategies to address wasteful testing and treatment, including the American Board of Internal Medicine (ABIM)'s Choosing Wisely campaign. ABIM asked specialty societies to create lists of "Things Providers and Patients Should Question" of tests and treatments that may be unnecessary, cause harm, or are not supported by evidence. We aimed to classify the types of recommendations made in the Choosing Wisely Guidelines, focusing on those related to diagnostic tests. For this study, we created a conceptual classification of these diagnosis related recommendations to complement our ongoing work (funded by the Moore Foundation) to develop broad, overarching diagnosis principles for making prudent diagnostic decisions.
Methods: We reviewed all published Choosing Wisely lists, creating a database of 439 individual recommendations from 71 different specialty organizations. We then developed and iteratively refined a coding system, assigning both primary categories and, when relevant, secondary categories. Recommendations fell into the following broad categories: diagnosis, treatment, monitoring, pre-operative testing, prevention, and patient-centered care. Within the category of diagnosis, recommendations were categorized as general, screening, monitoring, staging, or methodology.
Results: Slightly more than half (53%) of all Choosing Wisely recommendations were related to diagnosis, whereas 47% were related to treatment. Within those recommendation related primarily to diagnosis, 64% were related to specific diagnostic tests, and 24% were related to screening of healthy patients. The other 13% of diagnosis recommendations were related to monitoring conditions, determining the stage of an illness, and the best methodology for specific diagnostic tests. Some societies' recommendations were more concerned with reducing costly testing while others focused on reducing testing that commonly produces false positives and excess anxiety for patients. While the largest category of diagnosis recommendations included recommendations about specific tests, reducing regular screening of healthy patients was the second largest category.
Conclusion: Diagnosis was the leading type of recommendation in Choosing Wisely guidelines. All diagnosis recommendations were actionable items, with concrete suggestions of specific tests to avoid or reconsider ordering. However, different specialty societies took somewhat different approaches in compiling their lists. Virtually all recommendations center around reducing cost and waste from unnecessary diagnostic testing, which we believe needs to be re-conceptualized more broadly to both enhance patient buy-in as well as convey general principles for wiser choices.

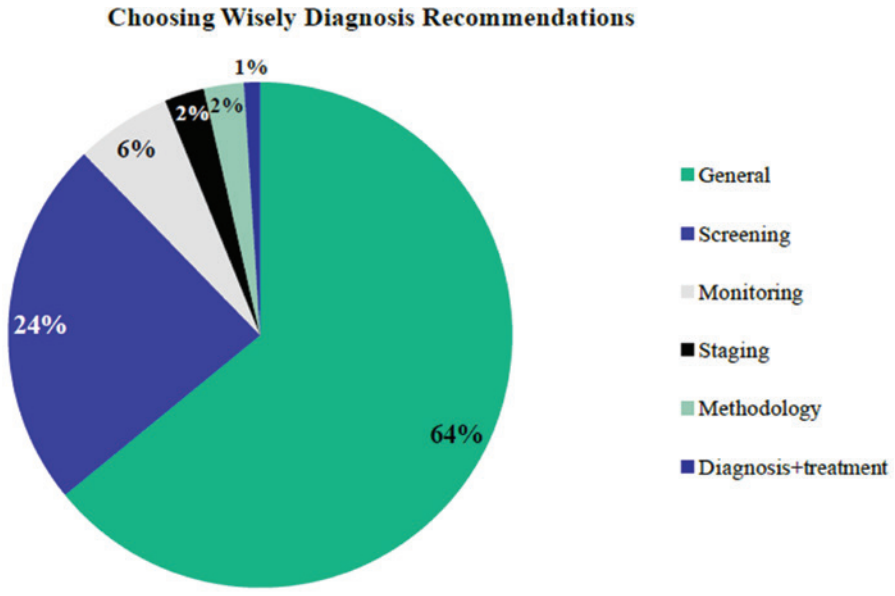

Figure 1. Diagnosis- related Choosing Wisely recommendations classified into diagnosis sub-groups.

79) Beyond Dr. Google: The Evidence about Consumer-Facing, Digital Tools for Diagnosis

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Background: Consumer-facing, interactive digital tools using algorithms, telehealth and crowdsourcing go well beyond "Dr. Google"-type searches. These direct-to-consumer (DTC) diagnostic tools offer the potential for faster, more convenient and more personalized information to promote patient autonomy while reducing unneeded visits and tests. Systematically engaging patients in use of reliable web sources may also help improve outcomes. However, use of DTC diagnostic tools could also lead to diagnostic error and either delay treatment or lead to overtreatment. Our objectives were to determine the current state of evidence about these tools and what methods are being used to evaluate whether they provide useful diagnostic advice.
Methods: Using structured terms, free text, and keywords we searched PubMed, Google Scholar, PSNet and clinicaltrials.gov for the period from Jan. 1, 2014 through Jan. 31, 2017. We also manually reviewed article bibliographies. Our gray literature search included trade and general-interest publications and non-traditional sources such as venture capital firm reports and interviews. Our search criteria included articles on English-language, interactive, DTC health platforms that suggest an initial clinical diagnosis. We included interactive symptom checkers, crowdsourcing platforms, and downloadable apps, whether accessible on a desktop, laptop or mobile device. We excluded static search engines, online encyclopedias or physical tests, as well as tools primarily facilitating a clinician conversation. We analyzed findings qualitatively using the SPIDER framework (Sample; Phenomena of Interest; Design; Evaluation; Research type).
Results: We identified 25 peer-reviewed evaluations that in whole or part examined DTC diagnostics related to a specific clinical area and found two evaluations outside the literature. Fifteen of the 25 articles focused on diagnostic accuracy, and five of those also evaluated usability. Evaluative methodologies for evaluation were highly variable, and a lone article on inter-rater reliability of evaluation found poor agreement. Diagnostic accuracy of these tools was generally lower when compared to physicians, although some appeared useful for appropriate self-triage for general medical conditions. Nine studies focused on identifying or characterizing tools in a specific clinical area (e.g., examining the number of depression apps available to the public). Four peer-reviewed technology evaluations suggested smartphone sensor accuracy will increase significantly, but also cast doubt on the accuracy of some algorithms.
Conclusion: The evidence for DTC diagnostic tool effectiveness is limited and often preliminary, although study methodologies are highly variable. These findings highlight the current lack of reliable evidence to inform decisions by clinicians, patients, policymakers or other stakeholders.

80) Experienced Nurse Know so Many Patients, so Many PRN Orders.

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Background: From the viewpoint of patient safety, doctor-nurse communication is important to prevent system errors during hospitalization. Due to shortage of physicians, especially during midnights, weekends, and national holidays, the PRN orders "pro re nata" has been widely throughout Japan. These are ordered by attending physicians in advance and let nurses to administer medications to the patients as needed. However, there have been few reports regarding the actual consultations by nurses to physicians when nurses have concerns about patients' conditions when following the PRN orders.
Methods: To investigate the current status of PRN orders and calling doctors during the night shift in Japan, we conducted a cross sectional survey with a questionnaire based on the website of a commercial journal for nurses, NURSE SENKA. To understand the relationship between clinical experience and difference in the implementation of PRN orders, we divided three groups of nurses with post graduate year 1-3 (Junior), 4-8 (Middle), and 9 or more (Experienced). We performed Pearson's chi square tests for the three groups, and Chi square test for comparison between two groups using Bonferroni correction.
Results: We obtained 286 responses in our two-week survey (May 1-14, 2016). Approximately two-thirds of the nurses reported that the PRN orders were unsuitable for some patients' conditions (190/285, 66.7%). The most common PRN orders were oral medications, followed by blood sugar management, and management of fever. Further, 74.4% nurses had concerns about whether the PRN orders should be conducted or not, and 82.1% nurses tried to discuss these with their attending physicians, while 17.9% did not. Further, compared with the Junior group, the middle and experienced groups tended to have concerns about the PRN orders significantly more (49.5% vs 70.6%, P-value <0.01). The frequency of consultations of nurses to attending physicians about confirming PRN orders were significantly low in the Junior group in comparison to the Middle or Experienced group (61.1% vs 85.3%, P-value <0.01). However, there were no significant differences in the doctors' responses by the three groups (P-value 0.60).

Conclusion: Less experienced Japanese nurses have lower likelihood to identify concerns about PRN orders and to consult them to attending physicians. This issue might lead to greater risk for diagnostic error in Japan.

81) Diagnostic Errors: The Complex Relationship between Cognitive and System-Related Factors

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Background: Diagnostic errors are known to stem from cognitive or system-related factors. Cognitive factors generally result from clinician biases (e.g., knowledge gaps) whereas system-related factors are attributed to organizational process failures (e.g., distractions). Although these classifications have helped to identify causes of diagnostic error, examining how factors are interrelated and influence one another is less known. Therefore, we sought to develop a better understanding of how medicine teams approach the diagnostic process and where they felt most vulnerable in relation to cognitive and system-related factors.
Methods: Using qualitative methods, data were collected through observations, focus groups, and interviews with 8 inpatient internal medicine teams from two academic hospitals. Participants included medicine attendings, residents, interns, and medical students. Teams were observed on both call and post-call days during morning rounds and post-round work. Observations were documented using open field notes and focused on capturing discussions surrounding the diagnostic process. Focus groups with team members and interviews with attendings were then conducted to gather their experiences with diagnostic errors and contributing factors. Focus groups and interviews were recorded and transcribed. Data were aggregated and analyzed using content analysis.
Results: Participants identified many factors that span cognitive and system issues that could contribute to diagnostic error. The electronic medical record (EMR) was mentioned as a source that disperses -- rather than integrates -- information. For example, clinicians have to sift through various screens to find exam, lab, and imaging results but, given the fragmentation, are not necessarily making essential diagnostic connections between these data. In addition, the forced nature of a preliminary diagnosis for admission and billing purposes (system factor) was cited as a source of error because the tendency is to assume all evidence had been collected and confirmed (cognitive factor). As a result, "anchoring" (the tendency for clinicians to stick with their initial impression) to an initial but preliminary diagnosis often resulted in a failure to reason through various diagnostic considerations at the outset. Some participants also recognized their role in the anchoring process. For example, consults, which require a possible diagnosis, were felt to make specialists susceptible to anchoring.
Conclusion: In order to reduce diagnostic error, interventions that acknowledge and simultaneously address both cognitive and system-related factors appear necessary. For example, reexamination of EMRs role in the diagnostic process may pinpoint particular areas where errors are most likely to occur leading to a possible redesign that addresses both cognitive and system-related factors.

82) Perceptions and Experiences of Clinicians and Radiologists in Discussing Diagnosis

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Background: Safe, efficient, and high-value diagnostic decision-making requires collaborative communication between all members of the diagnostic team, especially between clinicians and radiologists. However, there are significant barriers to this communication occurring, including lack of co-location, busy clinical environments, and lack of personal relationships. Further, both clinicians and radiologists are in unique positions to identify diagnostic errors made during the course of a patient's diagnostic evaluation and thus provide important feedback and potentially decrease error. We present a survey of clinicians and radiologists examining their experiences and perceptions regarding communication and collaboration about diagnostic decision-making and diagnostic error.
Methods: After an IRB exemption was obtained, a survey was sent to members of listserves from the Society to Improve Diagnosis in Medicine, the Association of University Radiologists, the Society of Hospital Medicine, and the Society of General Internal Medicine as well as faculty and trainees at the investigators' institutions. Data were analyzed using descriptive statistics, and Chi-square tests were used for comparison of dichotomous variables.
Results: Overall, 240 unique individuals (100 radiologists and 140 clinicians) responded to the survey. 61% of radiologists indicated that they discover a diagnostic error a few times per month or more while interpreting imaging tests, while only 16% of clinicians identified a diagnostic error a few times per month or more when reviewing results of imaging tests. However, almost all respondents stated that they discover a diagnostic while interpreting or reviewing interpretations of imaging testing at least a few times per year. Despite this, both radiologists (68%) and clinicians (58%) feel somewhat or very inhibited in disclosing diagnostic errors. More radiologists than clinicians (61% vs 25%, $p < 0.001$) have seen ineffective feedback regarding diagnostic errors discovered by radiologists, while both groups identify educational, collegial and specific as important characteristics of effective feedback about diagnostic error. 52% of radiologists report discussing cases in person with referring providers at least weekly, while only 16% of clinicians report participating in these in-person conversations at least weekly.
Conclusions: Clinicians and radiologists have the opportunity to identify errors in the diagnostic process, yet many feel inhibited in discussing these errors. This may be due in part to the ineffective feedback experienced when errors are discussed. Systems should consider means

to increase interaction and relationship building between referring clinicians and radiologists and provide specific training and frameworks to allow clinicians and radiologists to provide each other with high quality, effective feedback.

83) Diagnostic Paths to Pediatric Hypertension

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Background: A diagnostic path is the series of diagnostic steps (i.e. clinical encounters, tests, referrals, procedures, etc.) from first presentation of a symptom or sign to establishment of a diagnosis. Guidelines for the diagnosis and management of pediatric hypertension have been available for forty years. Unfortunately, for a variety of reasons, including the complexity of diagnostic standards, errors in blood pressure measurement technique, and unfamiliarity among clinicians with current guidelines, the diagnosis is missed in the majority of cases. Our aim was primarily to study children who have been diagnosed with hypertension and to investigate patient characteristics associated with diagnosis as well as to identify and visualize the diagnostic paths of a small number of children to gain insight into how a diagnosis is made.
Methods: We obtained electronic health records (EHR) data from six large community-based practices which are part of a larger clinical data research network. Using a computable phenotype based on the measurement of three blood pressure readings ≥ 95th percentile within 12 months, we identified children ages ≥ 3 and ≤18 who met National Institutes of Health standards for hypertension. We calculated diagnostic rates based on recording of a diagnosis of hypertension as an encounter or problem-list diagnosis n the EHR. Univariate and multivariate logistic regression was used to identify characteristics associated with diagnosis. We completed detailed manual chart reviews of diagnosed children to extract diagnostic paths. Visual representations of diagnostic paths were created using specialized software.
Results: We identified a total of 1478 children with hypertension, only 85 (6.1%) of whom received a correct diagnosis. Univariate logistic regression revealed that three characteristics - age ≥ 12, obesity, and a past diagnosis of chronic renal disease were associated with a higher likelihood of correct diagnosis. In the multivariate analysis, age ≥ 12 compared with a reference age category of ≤6, was associated with a higher likelihood of correct diagnosis with an odds ratio (OR) of 1.96, 95% CI(1.16, 3.32). Diagnostic paths varied greatly with diagnosis made in some cases through careful measurement of blood pressure over time, in others based on specialist referral, and in others, incorrectly (over-diagnosis).
Conclusion: Hypertension is missed in the vast majority of children regardless of demographic and other characteristics. Diagnostic paths vary greatly. More systematic approaches to diagnosis are badly needed.

84) Electronic Trigger-Based Measurement of Delays in Diagnostic Evaluation of Cancer: Time to Think Implementation

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Background: Failure to follow-up on abnormal test results can lead to harmful delays in cancer diagnosis. We created and validated electronic "trigger" algorithms that analyzed electronic health record (EHR) data from a large Veterans Affairs (VA) network to identify patients with potential delays in diagnostic evaluation for multiple cancers.
Methods: Using input from clinical experts, our multidisciplinary team created five trigger algorithms to detect delays in diagnostic evaluation of possible bladder, breast, colorectal, hepatocellular, and lung cancer. Each used structured clinical data to identify patient records with "red-flag", abnormal test results that warrant further diagnostic evaluation, including high-grade hematuria (>50 red blood cells/high powered field; bladder cancer trigger), abnormal mammograms (breast cancer trigger), iron deficiency anemia or positive fecal immunochemical tests (colorectal cancer trigger), elevated alpha-fetoprotein (hepatocellular trigger), or chest imaging flagged as "suspicious for malignancy" (lung cancer trigger). The trigger excluded patient records where follow-up would be unnecessary (e.g., those in hospice) and records where follow-up was documented within 30 (lung cancer trigger) or 60 days (all other triggers). We validated triggers by applying them retrospectively to EHR data for all patients seen (see table for timeframes and sample sizes). For each trigger, we reviewed a random selection of 100 trigger negative and 400 trigger positive records (or all if <400 trigger positives were found) to verify delays in diagnostic evaluation and determine each trigger's positive predictive value (PPV), negative predictive value (NPV), extrapolated sensitivity, and extrapolated specificity.
Results: The five triggers yielded PPVs ranging from 56.0-82.3%, NPVs ranging from 88.0-98.0%, sensitivity from 64.1-91.7%, and specificity from 81.1-96.5% (see table). Further, we estimate that these triggers have the potential to identify 1,192 diagnostic errors in the VA network studied per year.
Conclusion: Our triggers have potential to identify large numbers of patients experiencing delays in diagnostic evaluation. Implementing prospective electronic trigger-based measurement systems using these algorithms could support health systems in reducing delays in

follow-up of abnormal test results related to cancer. Our work lays the foundation for other health systems to adapt, evaluate and implement these triggers to reduce delays in cancer diagnosis.

Cancer Trigger	Unique Patients with Trigger Positives	Unique Patients Seen	Timeframe	PPV % (95% CI)	NPV % (95% CI)	Extrapolated Sensitivity % (95% CI)	Extrapolated Specificity % (95% CI)	Estimated Number of Diagnostic Delays Found per Year
Bladder	495	310,331	Jan 2012-Dec 2014	58.0 (53.0-62.9)	97.0 (90.8-99.2)	64.1 (59.4-68.5)	96.2 (95.6-96.6)	95.7
Breast	552	365,686	Jan 2010-May 2015	70.8 (66.0-75.1)	93.0 (85.6-96.9)	76.8 (72.7-80.4)	90.8 (89.2-92.1)	72.2
Colorectal	1,073	245,158	Jan 2013-Dec 2013	56.0 (51.0-61.0)	88.0 (79.6-93.4)	68.6 (65.4-71.6)	81.1 (79.5-82.6)	600.9
Hepatocellular	130	333,828	Jan 2011-Dec 2014	82.3 (74.4-88.2)	98.0 (92.3-99.7)	89.1 (81.8-93.8)	96.5 (94.8-97.7)	26.7
Lung	655	208,633	Jan 2012-Dec 2012	60.5 (55.5-65.3)	97.0 (90.8-99.2)	91.7 (88.6-94.1)	81.7 (79.6-83.7)	396.3
								1191.8

*CI=Confidence Interval

85) Patient Perceived Breakdowns in Diagnosis and Treatment in Urgent Care

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Background: Understanding breakdowns in care that lead to errors in diagnosis requires input from all healthcare stakeholders, including patients and families. Only then can we truly define the scope of the problem. The present study aims to examine patient perceived breakdowns in care, including perceived errors in diagnosis and treatment, in patients using urgent care facilities within a large health system in the mid-Atlantic region of the U.S.
Methods: A sentiment analysis was conducted of the open comments of completed CAHPS (Consumer Assessment of Healthcare Providers and Systems) surveys for patients seen at the health system's urgent care facilities (n = 16) between February and April, 2017 (3-months). We systematically reviewed the negative, neutral, and comments coded as both positive and negative. From these comments, patient perceived breakdowns were identified and classified as quality, safety, and/or experience issues and sub-categorized based on the perceived breakdown. Content codes were developed using standard methods for grounded theory; these will be used for a examining a longer period of CAHPS data capture.
Results: There were 758 reported comments during the study period. The respondents were 74.1% female with a mean age of 54 (SD 16) years (range 18-97 years). A total of 409 comments indicated less than positive perceived quality, safety, and/or experience, including 21 service alerts requiring follow-up. (A "Service Alert" indicates the need for direct follow-up with the patient for service recovery.) Most of the CAHPS responses were related to experience, however 21% (n = 86) related to breakdowns in care quality and 16.6% (n = 68) were breakdowns in safety. Patient perceived safety concerns included concerns around medications (over prescribing, under prescribing, incorrect medication), diagnosis (delayed diagnosis, incorrect diagnosis), testing (over testing, under testing, testing related harm, re-do testing), equipment (broken, unavailable), treatment (incorrect treatment, treatment delay, under treatment) as well as concerns around hand washing or cleanliness of the clinician, just culture, and process (i.e., leaving a patient alone in a treatment room for more than one hour).
Conclusion: Routinely collected CAHPS surveys provide a useful source of patient perceived care breakdowns and opportunities to identify diagnostic challenges in acute and ambulatory care in need of remediation.

86) Pulling Back the Curtain: Education and Reporting on Diagnostic Errors of Physicians in Internal Medicine Training Programs

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Background: In September 2015, the Institute of Medicine (IOM) released "Improving Diagnosis in Health Care," a landmark study on diagnostic error. The report described the epidemiology of, provided a formal definition for, and suggested improvement goals for diagnostic error. Based on the goals of the IOM report, we aimed to assess Internal Medicine residents' and faculty's education and training in the diagnostic process, work system and culture around the diagnostic process and the reporting environment for diagnostic error.
Methods: This is a multicenter, cross-sectional, mixed methods, survey study. Survey content was derived from the IOM's second, fifth, and sixth goals for a total of eight multiple choice questions. Some representative topics and their respective answer choices included: whether training program teaches communication about diagnostic error (single answer- Yes, No, Unsure); how trainees are encouraged to report

diagnostic error (all that apply- not encouraged, senior resident, chief resident, attending, program director, electronic reporting program); comfort reporting diagnostic errors (single answer- very uncomfortable to very comfortable). From June 2016 to March 2017, surveys were administered anonymously via e-mail or by paper during in-person educational conferences. We targeted residents and faculty in Traditional Internal-Medicine, Primary Care Internal Medicine, and Internal Medicine-Pediatrics at nine community and University-based training programs in Connecticut. Comparison testing across institution, experience, and self-reported gender was performed using Pearson's chi-squared test on STATA© software.

Results: Of 484 physicians (87 attendings, 397 residents) targeted, 266 (70 attendings, 196 residents) responded. 158 (59.3%) surveys were in-person and 196 (73.7%) were from residents. Less trainees than attendings reported that their training program taught residents how to communicate about diagnostic errors (43.5% Yes v. 64.7% Yes, $p < 0.01$). Less trainees felt comfortable reporting diagnostic errors when they occur (55.4% comfortable v. 69.1% comfortable, $p = 0.05$). Trainees also differed from attendings in whether they felt residents were encouraged to report errors to senior residents (59.4% v. 44.8%; $p = 0.04$), chief residents (20.9% v. 32.9%; $p = 0.05$), attendings (56.1% v. 79.1%; $p < 0.01$), and program directors (9.6% v. 19.4%; $p = 0.04$).

Conclusion: In this multi-center survey study on diagnostic error, we found that residents are not always taught how to report diagnostic errors. When they do report diagnostic errors, they are less likely to feel comfortable and report them to senior supervision (chief residents, attendings, and program directors).

87) Trends in Incidence and Liability Costs from Diagnostic Error in Inpatient Settings: Insights from the National Practitioner Data Bank

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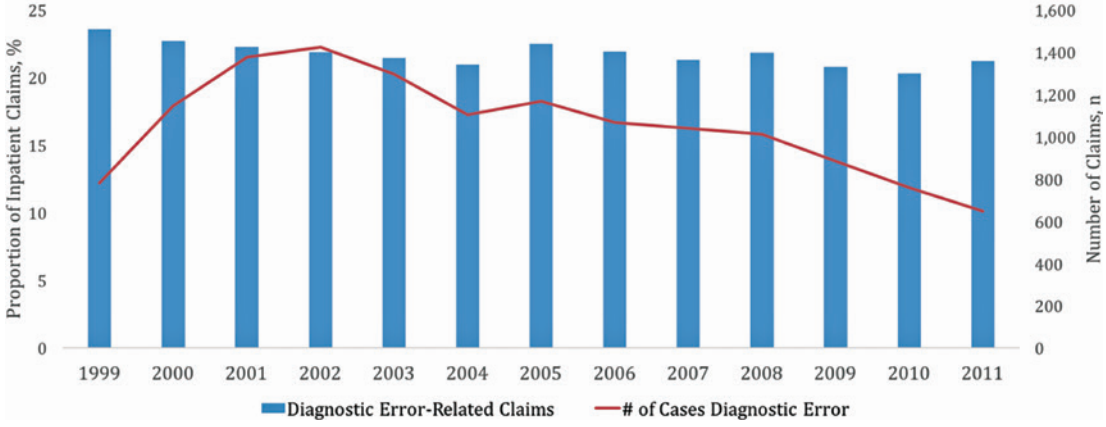
Background: Little is known about the prevalence and consequences of diagnostic error in the inpatient setting. We used a publically available national malpractice claims database to examine incidence, clinical and economic consequences of diagnostic errors in hospitalized patients.

Methods: The National Practitioner Database was used to identify liability payments for allegations of diagnostic error occurring between 1 January 1999 and 31 December 2011. Patient- and provider-level characteristics associated with claims were tabulated using descriptive statistics. Differences between claims alleging diagnostic error vs. other categories (e.g., surgical, anesthesia, medication) were assessed using Wilcoxon rank-sum and chi-square tests. Multivariable logistic regression was performed to identify patient- and provider-factors associated with paid claims alleging diagnostic error. Trends for incidence of diagnostic error-related paid malpractice claims and median annual payment were assessed using the Cochran-Armitage and nonparametric trend test.

Results: A total of 13,682 (21.7%) of the 62,966 paid claims related to inpatient malpractice were attributed to diagnostic error. Over the study period, the proportion of payments attributable to diagnostic error decreased from 23.5% (n = 779) in 1999 to 21.2% (n = 645) in 2011 (p = 0.001). Compared to non-diagnostic error claims, characteristics significantly associated with claims paid for diagnostic error were: male patients, patient age >50 years, provider age <50 years, and providers in the northeast region. The most common categories of diagnostic error resulting in paid malpractice claims were: failure to diagnose (50%, n = 6,883), delay in diagnosis (27%, n = 3,750), and wrong diagnosis (5%, n = 721). Following adjustment for patient and provider characteristics, paid claims for inpatient diagnostic errors were associated with an approximately two-fold risk of disability and death compared to other claim types. Inpatient diagnostic error accounted for $5.7 billion in payments over the study period, and median payments for diagnosis-related claims increased at a rate disproportionate to other claim types.

Conclusion: Physician malpractice payments related to diagnostic error in the hospital are prevalent and more often associated with disability and death than other claim types. Research focused on understanding and mitigating diagnostic errors in hospital settings is necessary.

Figure. Proportion and Number of Diagnostic Error-Related Claims (by year of filing) in Hospital Settings



88) Measuring the Effect of Point-of-Care Ultrasound on Diagnostic Confidence in the Emergency Department: A Prospective Study

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Background: Point-of-care ultrasound (POCUS) is increasingly used in the emergency department (ED) and has been shown to reduce time to diagnosis and improve clinical outcomes. 94.8% of adverse events are attributable to negligence, mostly due to diagnostic error1. Although there is extensive research on the effectiveness and efficiency of POCUS as a diagnostic tool in the ED, there is little research on how this influences the clinical reasoning process. This study measured the influence of POCUS on clinical suspicion (CS) - a physician's degree of confidence in a given diagnosis.
Methods: Data were prospectively collected at an academic Level I Trauma Center ED between January and June 2017. This was a convenience sample of planned POCUS encounters on adult patients by emergency physicians, both residents and attendings. Research assistants surveyed subjects before and after completing POCUS. Subjects reported diagnosis-specific clinical suspicion for up to 3 leading diagnoses as a whole integer between 0 (no suspicion) and 10 (high suspicion). The primary outcome variable was the absolute change between the pre- and post-POCUS clinical suspicion. For some analyses, initial CS was divided into three groups: low (0-3), moderate (4-7) and high (8-10). Non-parametric analytic tests were used for all analyses.
Results: 125 encounters by 46 providers were recorded with a total of 146 leading diagnoses. Clinical suspicion scores changed significantly following POCUS (Wilcoxon sign-rank test, $p < 0.0001$). The median change in CS score was 1 (IQR = 0,3). Residents and attending physicians did not differ in initial CS score ($p < 0.17$) or in absolute change in CS ($p < 0.14$). Initial CS level was associated with the pre- and post-ultrasound change in CS score (Kruskal-Wallis, $p < 0.0001$). Moderate initial CS scores changed slightly more (median 3; IQR 1,4) than low (median 2; IQR 1,2) and considerably more than high (median 0; IQR 0,1) initial CS scores.
Conclusion: POCUS significantly changes physicians' clinical suspicion of leading diagnoses, irrespective of their medical training level. In particular, we noted a larger effect on low or moderate initial CS demonstrating that POCUS played a greater role in the clinical reasoning process for providers with lower initial certainty in their leading diagnoses. If clinical suspicion is related to diagnostic error, and our results show that POCUS has a significant effect on CS, then POCUS also likely has an effect on diagnostic error. This relationship warrants further study.

89) Relationship between Diagnostic Interval and Pancreatic Ductal Adenocarcinoma (PDAC) Resectability: A Single-Center Retrospective Analysis.

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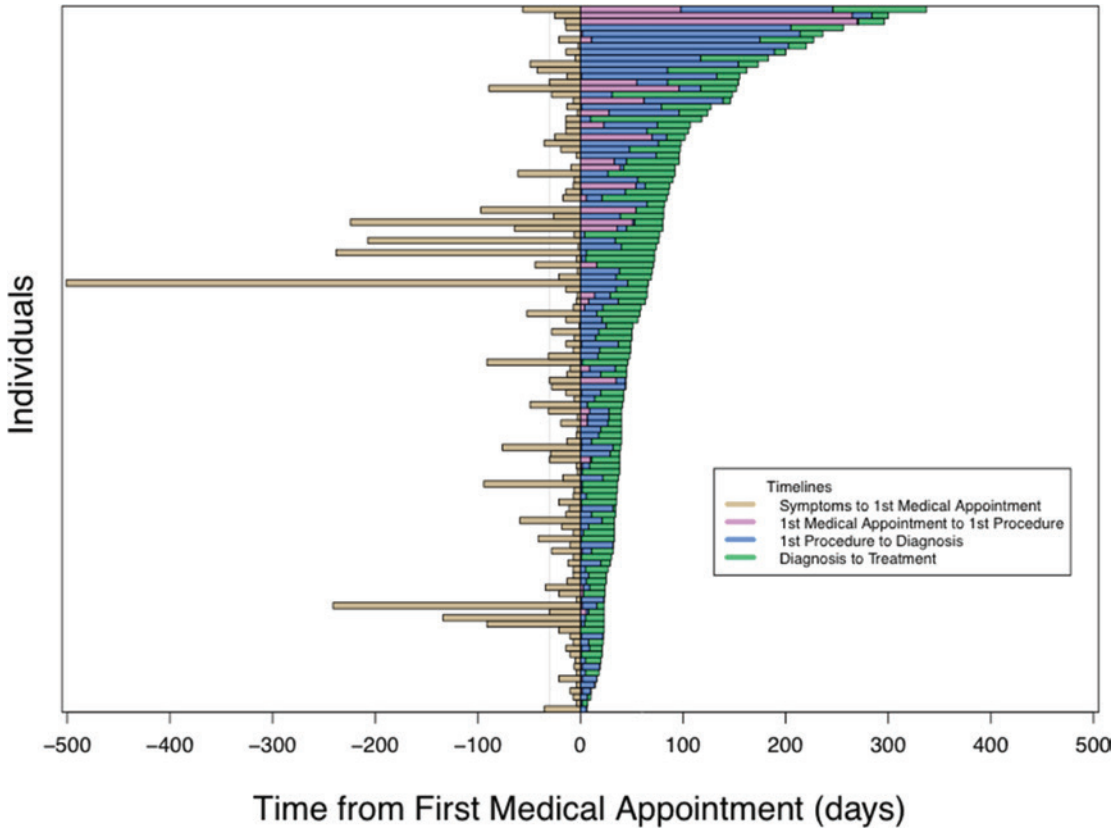
Background: PDAC often presents with nonspecific symptoms and the workup for suspected PDAC is not standardized. While surgery remains the only curative therapy, only 20% of PDAC is resectable due to local extension or metastasis. We examined the relationship between diagnostic interval of PDAC and surgical resectability.
Methods: We performed a retrospective chart review of patients evaluated for PDAC at the Center for Pancreas Cancer at Johns Hopkins in 2014. Data were collected on the patient, diagnostic, and treatment time intervals (defined as days between first symptoms to medical presentation, presentation to diagnosis, and diagnosis to treatment), diagnostic tests performed, and the type of initial treatment. Asymptomatic patients diagnosed incidentally, or those for whom initial medical presentation was unclear, were excluded from our analysis.
Results: Of 453 charts reviewed, 116 patients met our inclusion criteria. The median patient interval was 14 days (IQR 6-30), the median diagnostic interval was 22 days (IQR 8-46), and the median treatment interval was 26 days (IQR 15-35). The median number of diagnostic tests performed was 8 (IQR 6-11). At the time of diagnosis, 7 patients (6%) had stage 1, 53 (46%) had stage 2, 24 (21%) had stage 3, and 32 (28%) had stage 4 disease. A total of 38 patients (33%) received upfront surgery for treatment of PDAC and 78 (67%) received nonsurgical treatment. Non-white individuals had lower odds of receiving surgery (Adjusted Odds Ratio [aOR]: 0.09, 95% Confidence Interval [CI]: 0.01, 0.74, $p = 0.024$). After adjusting for age, sex, race and diagnostic clinic, the odds of receiving surgery significantly increased for individuals with a patient interval of 1 month or less (aOR: 3.47, 95% CI: 1.003, 12.0, $p = 0.010$) and with a diagnostic interval of 2 months or less (aOR: 15.3, 95% CI: 1.90, 122, $p = 0.019$).
Conclusion: A patient interval of less than 1 month and a diagnostic interval less than 2 months for symptomatic PDAC were associated with an increased probability of upfront surgical treatment. These data indicate that extended intervals prior to PDAC diagnosis may reduce the odds of obtaining a potentially curative treatment.



90) Diagnosis in the Hospital: The Intern's Environment

J. Forman[1], R. Sankaran[2], M. Quinn[2], M. Harrod[1], S. Winter[2], K. Fowler[1], S. Saint[1,2] and V. Chopra[1,2]
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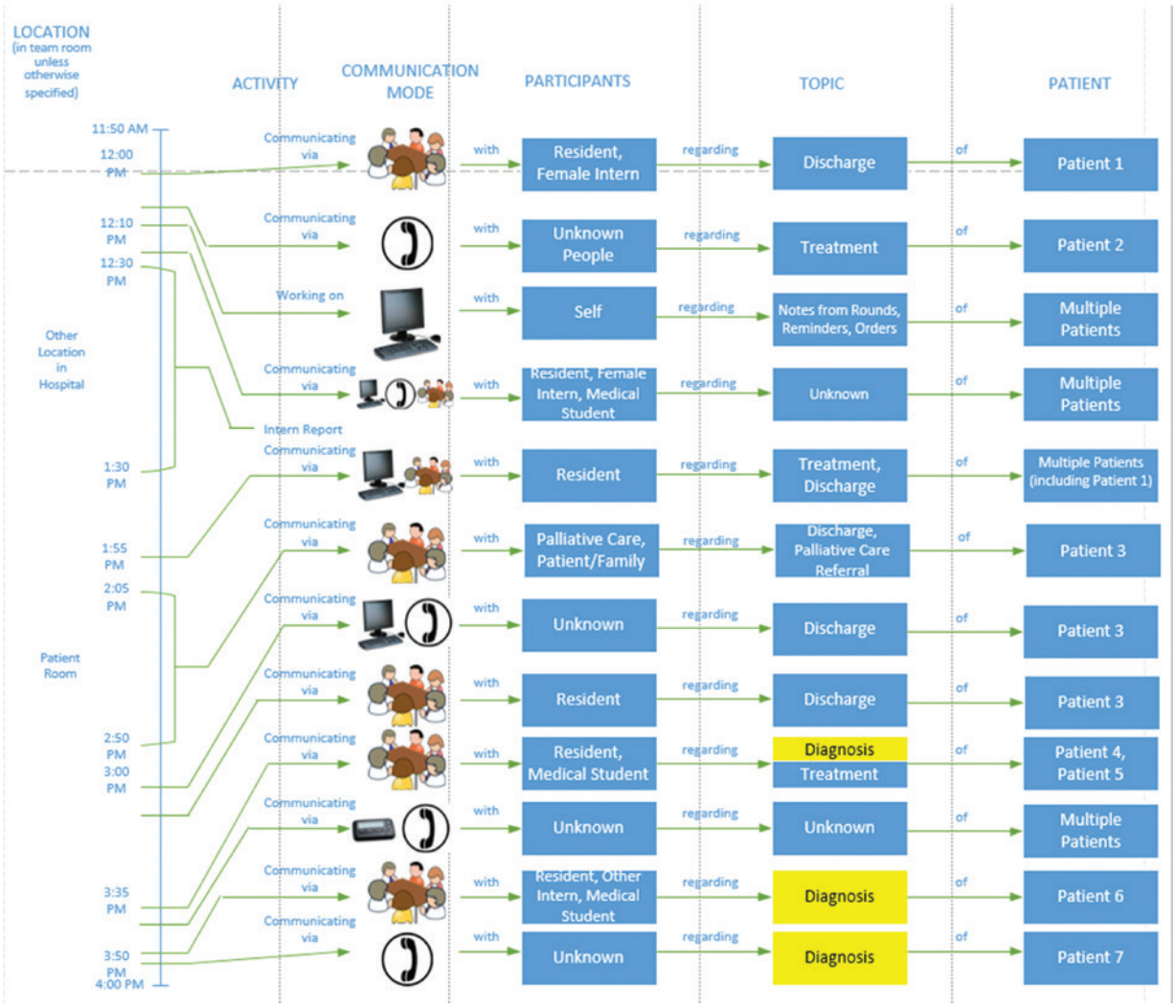
Background: Teaching hospitals are complex environments where novice physicians must gather, make sense of, and share with team members data vital for accurate patient diagnosis and management. We sought to describe the information and communication environment in which interns -- recently graduated medical students who are now novice physicians -- perform these tasks.
Methods: As part of a multi-method, focused ethnographic study, we conducted field observations of internal medicine teaching teams before and during morning rounds, and in the afternoon following rounds to examine the diagnosis process. Teams consisted of a medical attending, a senior resident, 2 interns, and 2-4 medical students. Observations included the team at large as well as individual team members. Observers sensitized to the National Academy of Science model for diagnosis took unstructured field notes, which included time stamps for discrete activities in order to understand workflow. Using these notes, diagrams of an observed intern's activities were created, highlighting activity, communication mode, participants, topic (including diagnostic decision-making), and patient.
Results: Interns juggled an influx of data on 3-10 existing and new patients from multiple sources at various times during the day (Figure 1). Importantly, they completed myriad tasks (e.g., writing progress notes; entering orders; requesting consults; making and receiving phone calls and pages to gather data, oversee treatment and patient discharge; visiting patients) under time constraints, making focusing on each patient for a substantial duration difficult. Frequent short, impromptu conversations with team members to seek advice related to diagnosis or management were the norm. Despite the fragmented nature of data, no defined time period for diagnosis outside of morning rounds existed.
Conclusion: Internal medicine interns worked in an environment in which data required to make diagnoses was fragmented across time and space. Focusing on individual patients for an extended duration was challenging. Although some time to discuss diagnosis did exist, these moments occurred in a complex, chaotic context, and there was little chance to do so formally outside of morning rounds. Improving the process of diagnosis -- particularly creating time and space to discuss diagnosis -- appears necessary, especially in the afternoon when test results and consultation recommendations are known.

Figure. Intern communication



91) Accuracy of a Machine Learning Based Ddx Generator

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Background: Isabel is a well-known DDx Generator used by over 170 institutions around the world. It is built using machine learning as opposed to traditional pre-defined rules based methods.
Methods: 563 cases of diagnostic error were collected over a period of 2 years from case reports, journals and detailed press articles. The cases covered 300 diagnoses and 27 specialties and, on average, contained 6 clinical features each. The free text case presentations were entered into Isabel DDx Generator and the position of the known final diagnosis within the tool's list of ranked possible diagnoses recorded.
Results: In 74% of the cases the final diagnosis was in the top 3 suggestions. In 87% of cases the final diagnosis was in the top 5 suggestions and in 98% of cases the final diagnosis was in the top 10 suggestions.
Conclusion: The level of accuracy shown with a wide range of cases entered in free text demonstrates the potential value and utility of machine learning based DDx Generators in daily practice.

92) Computer-Based Differential Diagnosis Support Tool Improves Patient Satisfaction and the Diagnostic Accuracy of Skin Conditions

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Background: Several studies have shown that clinical decision support systems (CDSS) may improve diagnostic accuracy of skin conditions. In addition patient satisfaction is an important indicator of health care quality, however, no data has to date showed if CDSS affects patient satisfaction. Therefore, the objectives of our study were to assess (i) patient satisfaction, (ii) diagnostic accuracy of skin diseases, and (iii) the consultation lengths by comparing CDSS consultations with standard consultations (SDR).
Methods: General practitioners (GPs) were randomized to conduct either SDR (n = 21) or CDSS (VisualDx, NY, USA) consultations (n = 16), the latter familiarized themselves in a training webinar two weeks prior to the study. Patients (n = 31) with a dermatologist-confirmed skin diagnosis were first examined by GPs in the SDR arm. The following week the same cohort of patients was examined by GPs using the CDSS. All patients were examined by 3-8 GPs in both arms. Patient satisfaction was assessed after each examination with a validated patient questionnaire. For each patient GPs documented the diagnosis and the consultation length using electronic case report forms. The diagnostic accuracy was determined by comparing the diagnoses stated by the GPs with the dermatologist-confirmed skin diagnoses. Statistical analysis was performed with Wilcoxon signed-rank test, Mann Whitney U test and χ^2.
Results: A total of n = 334 consultations were carried out (SDR: n = 175, CDSS: n = 159). Using the CDSS, more patients felt involved in the decision making (P = 0.05), and more were exposed to images during the consultations (P = 6.8e-27). Overall, 83% of the patients that were shown images felt better supported by this. The patient cohort represented 21 different skin diseases consisting of common (e.g. eczema) and uncommon (e.g. morphea) skin conditions. Importantly, the use of CDSS significantly improved the diagnostic accuracy by 34% (P = 0.007), while the mean consultation length was slightly longer in the CDSS arm compared with the SDR arm (11.1 ± 3.6min vs 10.3 ± 4.3min; P = 0.01). Diagnostic accuracy was not affected by the GPs' age, years of practice, level of practice with CDSS or the length of consultation.
Conclusion: This study shows for the first time that the use of CDSS by GPs during consultations improves patient satisfaction, and it confirms previous studies that CDSS increases the diagnostic accuracy of skin diseases. If CDSS is implemented in the clinical routine of a GP's office, it has the potential to increase the overall quality of consultations at the point-of care.

93) Laboratory Medicine Interdisciplinary Team Actions to Avert Diagnostic Adverse Events with Interpretative Risk Stratification of Significantly Abnormal Patterns of High Risk Blood Test Results

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Background: Clinical physicians are faced with a great number of uninterpreted test results which unless classified into manageable groups, can delay and complicate diagnostic decisions, ending in adverse events. Non-interpreted abnormal biomarkers in the health care site's EMR are the "weakest link in the chain." The increasing volume of electronically available patient information creates significant challenges, impeding efficient review of high risk patient information The evidence base for use of Laboratory Medicine pathophysiologic data in risk adjustment is overwhelming. It can be used either for Patient Safety Indicators (PSI) or for global risk adjustment. Significantly abnormal pathophysiologic data is the first available, fastest risk assessment data for clinical decision - making. It is rapidly available, particularly in hospital chains, much less expensive than manual chart abstraction, has tremendous face validity with clinicians and is customizable in site - specific patterns designed by clinical and laboratory team's experts using middleware applications that avoid data extraction from the site's enterprise EMR.
Methods: Systematic literature review and metaanalysis of peer-reviewed journal articles, that evaluated any intervention to decrease diagnostic errors in any clinical setting and with any study design, provided that they addressed a patient-related outcome.
Results: Laboratory-directed quantitative and visual interventions to optimize the reporting of significant patterns of abnormal biomarkers using diagnostic interpretation are available and have proven effectiveness in reducing diagnostic errors and misdiagnoses. One logical direction to pursue is the graphical representation of numerical data. Graphical laboratory value displays reduce review times and are more effective for answering different clinical questions. Different clinical settings may benefit from differing data summary formats.
Conclusion: Early detection and aversion of adverse diagnostic events requires disruptive innovation of a local health care site's conventional blood test reporting practices to improve clinical physician's awareness of a high-risk patient's critical organ dysfunctional severity. Laboratory Medicine team - directed actions using interpretative quantitation and risk stratification of significantly abnormal patterns of high risk blood test results is needed to accelerate the transmission of "trigger signal" risk data to clinical physicians in time to avert diagnostic adverse events. The capacity of a physician to correlate patterns of significantly abnormal test results with patient's clinical problems rises in direct proportion to the degree of deviation of patterns of abnormal biomarker results in one or more critical organs and systems. Great deviations are explainable. Minor deviations are frequently without explanation.

94) Physician Perspectives on System-Level Changes to Improve the Process of Diagnosis

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Background: Physicians working in complex and chaotic hospital environments experience frequent interruptions and distractions. While evidence suggests that environment, time constraints imposed by heavy caseloads and the need to formulate diagnosis as quickly as possible can impair diagnosis, strategies to overcome these challenges are not well defined. Therefore, through interviews of clinicians at various stages of training, we asked physicians to identify specific system-level changes that may improve diagnosis or reduce potential for errors.
Methods: Between January and May 2016, we conducted semi-structured, in-person interviews and focus groups with internal medicine physicians at two separate, but affiliated, teaching hospitals. We purposefully selected attendings (senior-level physicians), senior residents (second or third-year postgraduate trainees) and interns (first-year postgraduates) and invited them to participate. Interviews and focus groups were recorded and transcribed. Content analysis was conducted and common themes were identified. Data was aggregated from all respondents and reviewed for suggestions for improvement to the diagnostic process.
Results: A total of 31 physicians, including 8 attendings, 8 senior residents, and 15 interns participated. Suggestions revolved around three domains: the physical environment, the information/data environment, and the communications environment. Ideas pertaining to the physical environment included redesigning 'team rooms' to reduce clutter, noise and use by outside clinicians. In addition, restructuring workspaces to include larger and multiple computer screens was suggested to allow physicians to multi-task and better view imaging tests. Themes related to the information environment included better integrating what was perceived as fragmented patient data within the electronic health record. Strategies related to reducing information overload and presenting data in more clinically-relevant ways were also suggested. Finally, in the communication environment, suggestions included improving hospital communication systems, primarily pagers, to reduce the number of interruptions and increase efficiency. Carving out a set time every day to huddle with their team and discuss challenging diagnostic cases was also suggested as a valuable initiative to improve diagnosis.
Conclusion: The physical environment, information and data sources, and the current communications environment were identified by physicians as suggested areas of improvement for the diagnostic process. These domains may serve as actionable targets for interventions aimed at improving diagnosis, efficiency and workflow.

95) A Typology of Experienced Physician Descriptions of Diagnostic Intuition in Generalist Practice

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McMaster University, Hamilton, ON, Canada
A Typology of Experienced Physician Descriptions of Diagnostic Intuition in Generalist Practice

Background: Almost all physicians say they have experienced clinical intuition, or non-analytic, rapid, System 1 reasoning. Despite the ubiquity of these "gut feelings", the literature on clinical reasoning is dominated by the examination of slow, analytic, System 2 thinking. We employed qualitative methods to answer the question: "How do expert physicians describe clinical intuition and the contexts in which it is used?"
Methods: Using Qualitative Description, we interviewed 27 generalist physicians (Family, Emergency, Internal medicine) with 5-36 years of experience. We elicited their stories of specific instances in which they used clinical intuition and probed contextual and patient factors to get a better understanding of how they understand this mode of reasoning.
Results: Experienced physicians provide various descriptions of what diagnostic intuition is, when it occurs, and what type of activity it prompts. From these descriptions we created a typology of different types of intuition, including: Sick/Not Sick, Something Not Right, Abduction, Frame-Shifting, and Magic. Most physician accounts of diagnostic intuition linked this phenomenon closely to analytic reasoning, and emphasized the importance of experience in developing a trustworthy sense of intuition that can be used to effectively engage analytic reasoning.
Conclusion: Our findings are congruent with cognitive theories that conceptualize intuitive and analytic reasoning as a set of parallel processes that work together, rather than binary processes in competition. They also suggest that experience is essential to the development of reasoning. The role and value of experience is worth considering as medical education shifts increasingly towards formats which subjugate experience to performance.

96) A Correlation between Disease Prevalence and Treatment Threshold Probability May Render the "Base Rate Neglect" Cognitive Bias Unimportant

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Background: Psychologists have pointed to potential diagnostic inaccuracy due to base rate neglect when physicians diagnose heeding the similarity of the patient to a disease's prototype. Most physicians, however, figured that "when you hear hoofbeats don't think of zebras" is

sufficient reminder about disease prevalence. Analysis of the typical diagnostic situation may support their limited concern. Physicians' differential diagnosis lists include the likely causes (high probability diseases, usually with little harm if missed) as well as the dangerous possibilities (low probability diseases, usually with high harm if missed). With the positive correlation between disease prevalences and treatment probability thresholds among the considered diseases, the diseases may start out with probabilities near their respective treatment thresholds. In such a disease ecology, disease prevalence may appear to get little attention in physicians' diagnostic reasoning. As daily diagnosis is grounded in physicians' subjective judgments, we assessed whether the hypothesized positive correlation between disease prevalence and treatment threshold could be found in their reported judgments.

Methods: Physicians' judgments regarding 9 diseases that can cause acute chest pain were investigated. A patient with chest pain was described, and physicians stated their probability the patient has each disease. Additionally, they were asked to judge the utility of appropriately treating and of not treating each disease, and of mistakenly applying treatment for one diagnosis to a different diagnosis, e.g., "treating myocardial infarction as if it were a pulmonary embolism." The 100 situations were divided into 12 subsets to make the response task manageable, combining all judgments into one matrix for the total analysis. In addition, one attending judged the utility of every combination of true disease and treatment. The formula for treatment threshold probability is in the Figure.

Results: In pilot study, twelve 2nd or 3rd year family medicine residents and one faculty member provided judgments. Correlation between residents' average disease probabilities and the treatment thresholds calculated from their utility judgments was 0.48. For the faculty member, it was 0.65.

Conclusion: Preliminary results support the hypothesized positive correlation between disease prevalence and treatment threshold probability in the differential diagnosis list for one patient complaint. Some illogical utility judgments were observed, and procedures are being improved. Further work will study a larger number of respondents, with procedures assuring higher quality judgments; basing probabilities and utilities on available literature; replication with other complaints. Further, the equations provide a basis for dynamic reassessment of treatment thresholds as information is acquired.

Threshold probability (Pr_{th}) for treating Disease A =

$$\Pr_{th}(Dis_A) = \frac{1}{\frac{util(TruePositive) - util(FalseNegative)}{util(TrueNegative) - util(FalsePositive)} + 1}$$

where utility impact of missing Disease A = util(TP) - util(FN) =

$$u(Treat_A \mid Dis_A) - \frac{\sum_{B \neq A} \Pr(Dis_B) * util(Treat_B \mid Dis_A)}{\sum_{B \neq A} \Pr(Dis_B)}$$

and utility impact of false alarm of Disease A = util(TN) - util(FP) =

$$\frac{\sum_{B \neq A} \Pr(Dis_B) * [util(Treat_B \mid Dis_B) - util(Treat_A \mid Dis_B)]}{\sum_{B \neq A} \Pr(Dis_B)}$$

and $\sum_{B \neq A}$ means the sum for all B's that are different from A.

97) An Evaluation of the P.T.T. Advisor Mobile Application for Improving Clinical Laboratory Test Ordering and Diagnosis

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[2]Centers for Disease Control and Prevention, Mount Juliet, TN
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[7]Center for Innovations in Quality, Effectiveness, and Safety, Michael E. DeBakey Veterans Affairs Medical Center and Baylor College of Medicine, Houston, TX

Background: Appropriately selecting and ordering laboratory tests is essential to accurate diagnosis. However, primary care physicians are uncertain about what tests to order in nearly 1 in 7 patients (Hickner et al., 2014). Health IT has the potential to reduce diagnostic errors by facilitating timely and easy access to information (El-Kareh et al., 2013). As such, the CDC's Clinical Laboratory Integration into Healthcare Collaborative (CLIHC) developed *PTT Advisor*, a mobile application (app) that assists physicians with follow-up test ordering and diagnosis related to certain types of coagulation and bleeding disorders (when patients have normal prothrombin and abnormal partial thromboplastin times). We evaluated whether the app would be perceived as useful for learning and would improve clinical decision making related to test ordering and diagnosis.
Methods: Between September 2016 and April 2017, we recruited internal medicine physicians/hospitalists to diagnose eight paper-based patient vignettes and answer a questionnaire. Vignettes consisted of challenging clinical scenarios prompting physicians to make laboratory test ordering and diagnosis decisions while seeking help from one of two resource conditions: the *PTT Advisor* app or their usual clinical decision support. Each physician solved four vignettes in each condition in a counterbalanced fashion (the order of the conditions and the vignettes in each condition varied between physicians). We assessed impact on clinical decision making by collecting percent of test ordering and diagnostic decisions made correctly, reported confidence, and time taken to assess the vignettes. The questionnaire assessed physicians' perceptions about the app's usefulness for clinical decision making and learning using a modified Kirkpatrick Training Evaluation Framework.
Results: We recruited 47 physicians and found significant advantages for using *PTT Advisor* over usual clinical decision support for the following outcome variables: mean accuracy (83.3% vs 70.3% correct; $p < .001$); mean confidence in decision (7.9 vs 6.6 out of 10; $p < .001$), and mean vignette completion time (3:09 min. vs 3:49 min.; $p = .02$). Additionally, physicians reported positive perceptions of the app's potential for improved clinical decision making and learning. However, a desire was noted for the app to address broader diagnostic challenges.
Conclusion: Our results indicate that *PTT Advisor* may contribute to better diagnostic decision making related to test ordering and serve as a learning tool for the diagnostic evaluation of certain coagulation and bleeding disorders. This work serves as a model for thorough evaluation of other patient care apps. Future efforts should consider how to integrate rigorously tested decision-support tools into physicians' clinical workflow.

98) Focused Ethnography to Improve Diagnosis in Teaching Hospitals: Introducing the Michigan Model of Diagnosis

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[1]University of Michigan, Ann Arbor, MI
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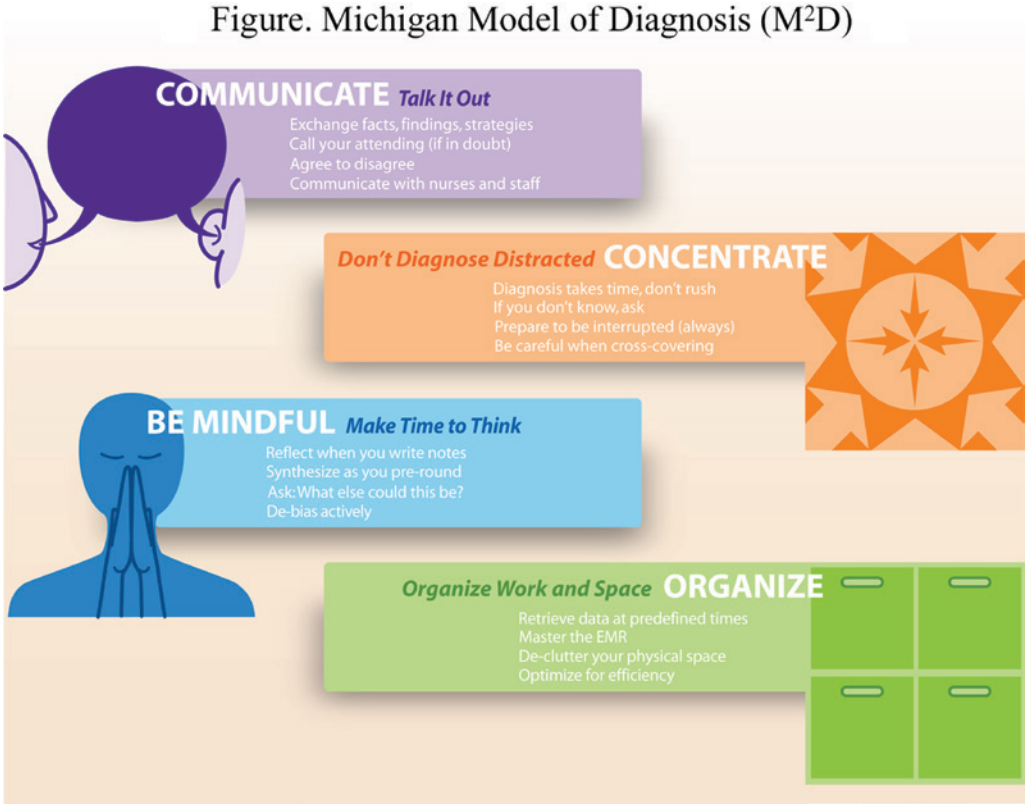
Background: Although diagnostic errors in teaching hospitals are common, views and approaches of internal medicine attending physicians, residents and medical students regarding diagnosis have not been previously reported. Our goal was to first observe and understand diagnostic decision-making in teaching hospitals, and then develop a conceptual model to improve this process.
Methods: This is a focused ethnography of inpatient medicine teaching teams consisting of: attending physicians, residents, interns and medical students. Two affiliated academic medical centers in the United States were observed. Inpatient medicine teaching teams were observed for one-week intervals during and after rounds that included on-call and no call days. Field notes regarding the diagnostic process (e.g., information gathering, integration and interpretation, working diagnosis) and the work system (e.g., team members, organization, technology and tools, physical environment, tasks) were recorded. Following observations, recorded focus groups and interviews were conducted to understand viewpoints on the diagnostic process and identify problems and solutions to improve diagnosis. Inductive analysis was conducted on field notes and interview transcripts to identify key themes. These themes were used to develop an improved approach to diagnosis.
Results: Between January 2016 and May 2016, four teaching teams (4 attendings, 4 senior residents, 9 interns and 12 medical students) were observed for a combined total of 168 hours. Observations of medical decision-making led to the identification of four key themes: (a) diagnosis is a social phenomenon; (b) data necessary to make diagnoses are fragmented; (c) distractions undermine the diagnostic process; and (d) time pressures interfere with diagnostic decision-making. These themes were used to create the Michigan Model of Diagnosis (M2D) with the following recommendations: 1. Talk it out; 2. Organize work and space; 3. Make time to think; 4. Don't diagnose distracted.
Conclusion: The M2D Model – produced through a focused ethnography of learners while making medical diagnoses -- is an innovation that may help prevent diagnostic error in teaching hospitals.

Figure. Michigan Model of Diagnosis (M^2D)



99) Relationship between Student Self-Assessment of Diagnostic Confidence Versus Diagnostic Performance Against a Panel of Case Vignettes

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Background: Medical educators have long stated that a physician's ability to accurately self-assess knowledge and skills is essential to maintaining and improving clinical competencies, while those who cannot, are likely to provide sub-optimal patient care. In 2008, Berner and Graber suggested that overconfidence was a significant cause of diagnostic error. In 2015, the Health and Medicine Division of the National Academies of Sciences, Engineering and Medicine stated that diagnostic error was among the leading concerns of the patient safety community, while other authors suggested that diagnostic error may be the third leading cause of death in America. Relatively little is known about how well medical students are able to accurately self-assess their knowledge and skills. The purpose of this investigation is to determine the degree to which year-two medical students' self-assessments of diagnostic confidence are correlated with objective evidence of their diagnostic performance.
Methods: Our year two curriculum revolves around instructional modules designed to develop presentation-specific (e.g., Acute Chest Pain, Dyspnea, Cephalgia, etc), and task-specific (diagnose, treat, manage, explain) competencies. The curriculum also employs a course evaluation process designed to elicit student generated estimates of their confidence in performing each task addressed in each module. We set out to determine the correlation between the students' 'diagnostic' confidence estimates against eight specific, respiratory system related patient presentations (Acute Dyspnea, Chronic Dyspnea, Cough, Diffuse Pulmonary Infiltrates, Hemoptysis, Pleural Abnormalities, ENT complaints and Pediatric Cough/Dyspnea) versus their objective diagnostic performance against a panel of from 5 - 20 case vignettes for each of these same eight patient presentations.
Results: The resulting correlations were positive in seven of the eight presentations, and statistically significant in five of the eight presentations (Chronic Dyspnea,* Diffuse Pulmonary Infiltrates,* Hemoptysis,* Pleural Abnormalities* and ENT presentations**; * < 0.01, **2 < 0.05). The level of correlation attained for these five presentations was modest and averaged 0.22.
Conclusion: In five of eight patient presentations investigated, the results indicated that year-two medical students self-estimates of diagnostic confidence does significantly correlate, albeit at a modest level, with their diagnostic performance. The ability to accurately self-assess capabilities and competencies is thought to involve the developmental progression of metacognitive skills. We plan to conduct further analysis of this data to determine the percentage of students who are poorly calibrated (express high confidence in the presence of low performance) as the basis for explorations into the role of metacognitive skills in diagnostic performance.

100) When Patient Challenges to Diagnosis Are Desirable

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Background: Rare diseases pose a unique set of challenges for providers and patients. Symptoms of rare diseases often mimic more common conditions that must be ruled out before rare disease is suspected. When a diagnosis and treatment protocols do not fully address patients' symptoms, patients may be forced to take a more active role in the diagnostic process, however, little is known about how patients navigate this process. This project uses Cushing's syndrome (CS) as a case study of the role of patient engagement in the diagnostic process to understand how such engagement might aid in diagnosis.
Methods: This study draws upon a series of 60 interviews from the *Cushing's Help* podcast series which documents the experiences of women with diagnosed or suspected CS. Interviews were conducted from 2008 through 2016 by MaryO, an activist and former CS patient, to detail patient experiences with symptoms, diagnosis, treatments, and outcomes. Qualitative content analysis was used to elicit themes from the interviews.
Results: Most patients ultimately diagnosed with CS experienced physical symptoms typical of CS prior to diagnosis, including extreme rapid weight gain, facial hair growth, and depressed mood. Nevertheless, patients and providers often misattributed these symptoms to other medical conditions such as depression, polycystic ovarian syndrome, or fibromyalgia, or to non-medical causes such as age, stress, assumed poor diet and exercise, or stereotypes about ethnicity or gender. These attributions often delayed further investigation and, ultimately, accurate diagnosis and treatment. Patients and providers were, generally, unlikely to question their misdiagnoses unless symptoms persisted or became severe. Factors that *prevented* recognition of a misdiagnosis were trust in accuracy of providers and medical tests, aversion to identifying as a sick person, psychiatric attributions, and fragmented care. *Recognizing* a misdiagnosis involved sustained self-advocacy in seeking explanation for symptoms (e.g., seeking new providers and additional medical testing), provider-driven investigation of unusual symptoms, encouragement from friends or family to question providers, and prior experience with CS by providers or significant others.
Conclusion: Patients experiencing a misdiagnosis of a rare disease face multiple social and clinical forces that prevent suspicion of an alternate explanation. Symptoms of rare diseases may be misattributed to more common conditions or to normal phenotypical variation in healthy persons, making it challenging for patients and providers to recognize diagnostic errors. Patients who take a persistent and empowered role can help recognize diagnostic error when providers are willing to consider diagnostic error a possibility.

101) Medical Student Concerns about Diagnostic Error

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Background: Medical error can be catastrophic, not only for the patient but for doctors themselves. Little attention, however, has focused on how medical training can prepare doctors for the inevitability of error. In designing such interventions, it is helpful to understand how medical students think about and anticipate medical error. In this paper, we examine student concerns about diagnostic error, as well as other types of medical error.
Methods: We conducted 23 in-depth qualitative interviews with students in Australia just prior to graduation from medical school and commencement of internship. Participants were asked to discuss anticipated career challenges and thoughts about medical error. Transcriptions were submitted to descriptive coding and a thematic analysis.
Results: All participants raised concern about making a medical error that harms the patient, and some were very worried about error. Medication errors and making mistakes during procedures appeared to be at the forefront of participants' minds, though diagnostic errors were also discussed. Participants varied in how they viewed the frequency and severity of diagnostic error. Some saw diagnostic error as common and potentially benign, with one participant stating, "Generally, nothing bad happens to the patient because of it." Other participants expressed concern that they might miss a key symptom, resulting in a potentially dangerous misdiagnosis, or that they could contribute to a diagnostic error by failing to communicate relevant information. Most planned to try to reduce medical error in their upcoming internships by asking more experienced others for help, but they anticipated difficulty in striking a balance between being overly dependent on others versus being overconfident and potentially putting their patients at risk.
Conclusion: Medical students are concerned about medical error and anticipated personal consequences such as a loss of confidence and professional identity after an error. While research tells us that diagnostic error is prevalent and causes a great deal of patient harm, students were generally less concerned about diagnostic error than medication or procedure error. They did worry about missing key symptoms and failing to communicate pertinent patient information. Our results suggest that as students embark upon their careers, some have an underappreciation of the importance of diagnostic error. We conclude that educational interventions aimed at increasing knowledge of diagnostic error and approaches to reducing these errors, as well as training on how to cope with the aftermath of diagnostic error, will likely be of benefit to students.

102) Using Ethnography to Understand the Diagnostic Process in a Pediatric Intensive Care Unit

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Background: The Pediatric Intensive Care Unit (PICU) is a complex environment where a multidisciplinary team cares for critically ill children under stressful conditions. Autopsies and chart reviews show that diagnostic errors (DEs) are common and harmful in this setting. In its conceptual model of the diagnostic process, the National Academy of Medicine (NAM) highlighted that the diagnostic process occurs within a larger work system. Thus, to prevent DEs in the PICU, we must develop a deeper understanding of the diagnostic process and how DEs occur within this work system. Our objective is to pilot test an ethnographic method using direct observation and semi-structured interviews to determine: 1) the feasibility of the approach, and 2) usefulness of qualitative data for examining the diagnostic process during patient admissions to the PICU.
Methods: We conducted a pilot ethnographic study in an academic tertiary referral PICU and used the NAM model to develop observation and interview guides. Two anthropologists observed diagnosis-related activities for a newly-admitted patient including: 1) PICU arrival; 2) initial patient-PICU team bedside encounter; 3) PICU team discussions regarding diagnosis and management; and 4) bedside procedures. They interviewed 6 PICU staff members caring for the patient (attending physician, fellow, resident, bedside nurse, charge nurse, respiratory therapist) regarding their perceptions of the diagnostic process, especially the role of teamwork. We reviewed field notes and audio recordings, identifying key concepts relating to the feasibility of the approach and usefulness of the data.
Results: During the 8-hour pilot, we found that PICU patients and staff were willing to participate and research activities did not disrupt patient care. Trained data collectors could conduct ethnographic methods in real time. However, we found that data collection will be facilitated if data collectors first are immersed in the unit, becoming familiar with workflow/staffing and allowing staff to become accustomed to their presence. Moreover, at least 3 data collectors are required per patient admission to capture major events of interest. Furthermore, we identified potential themes that we could map onto the NAM model (**Figure 1**).
Conclusion: Ethnography using direct observation and semi-structured interviews appears to be a feasible approach to understanding the evolving diagnostic process in real time within the complex PICU work system. We likely can use ethnographic data to adapt or extend the NAM model to both create a PICU-specific conceptual model of the diagnostic process and support efforts to understand and improve diagnostic safety in intensive care.

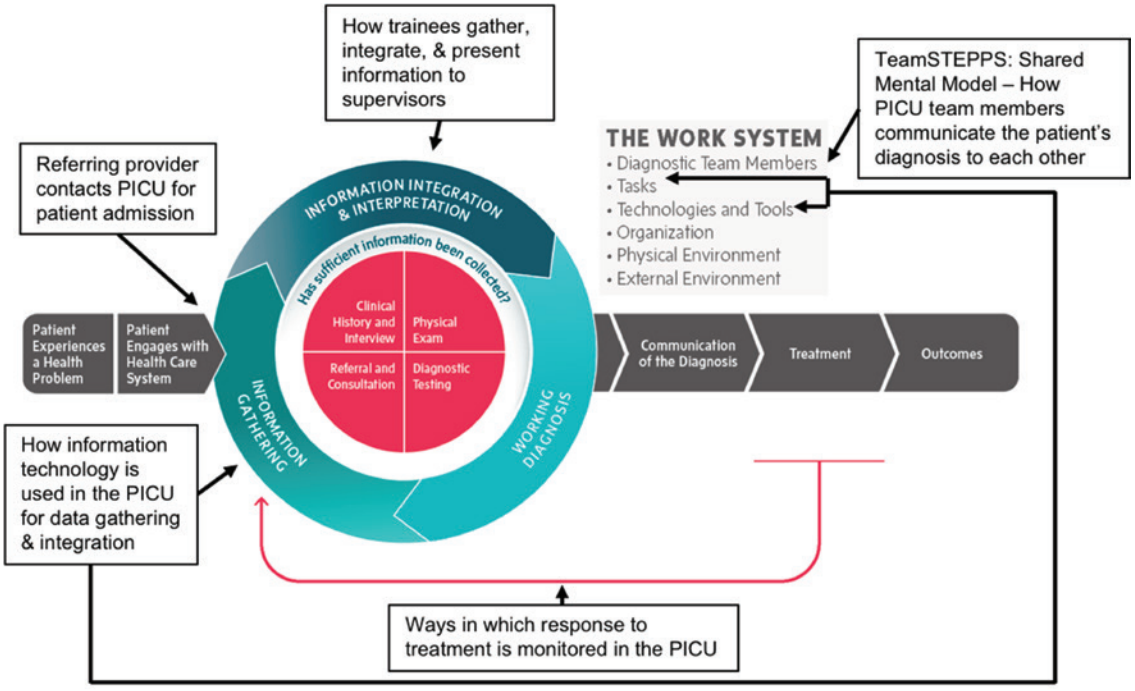

Figure 1. Themes from Ethnographic Pilot Study Mapped to the National Academy of Medicine Conceptual Model of the Diagnostic Process

Figure adapted from: National Academies of Science, Engineering, and Medicine. 2015. Improving diagnosis in health care. Washington, DC: The National Academies Press. *Reproduced with permission.*

103) Test Result Notification Via the Patient Portal: An Exploration Patients' Experiences

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Background: Online portals are being increasingly implemented to engage patients in their care. While patient portals are now being implemented to provide patients access to their health information, little is known about how patients use these new electronic tools and what strategies maximize patient engagement. Test results review is an area of high interest to patients and provides an opportunity to foster their involvement in preventing abnormal test results from being overlooked, a common patient safety concern. We conducted a mixed-methods study to explore patients' experiences and preferences when accessing their test results via patient portals.
Methods: We conducted semi-structured and structured interviews with eligible participants (adults who viewed a test result in their portal) at four large outpatient clinics settings. We used an exploratory mixed-method design to explore the patient experience of receiving test results through the portal. Semi-structured interviews were coded using content analysis and transformed into quantitative data and integrated with the structured interview data. Descriptive statistics were used to summarize the structured data.
Results: We conducted 95 interviews (13 semi-structured and 82 structured) with eligible participants between April 2015 and September 2016.Participants were 56% male, 65% white with average age 54.6 years; 62% had one or more chronic condition(s). Nearly two-third (63.2%) did not receive any explanatory information or test result interpretation at the time they received the result in the portal and 46% conducted online searches for further information about their result. Patients who received an abnormal result were more likely to experience negative emotions than those who received a normal result (56% and 21%, $P = 0.003$). Finally, patients who received abnormal results were more likely to call their physician compared with those who received normal results (44% and15%, $p = 0.002$).
Conclusion: Our study provides one of the first mixed-method studies examining a new area of research, patients' experiences of receiving test results through the patient portal. Providing patients access to their test results via portals should be accompanied by strategies to help patients interpret and manage results received. Additional work must devise strategies to leverage this technology to improve patient engagement.

104) Continued Research on Factors of Unexpected Readmissions within 7 Days after PRIOR Discharge from a Japanese ACUTE Hospital

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Background: Data of unexpected readmissions to hospital within six weeks after prior discharge is available in Japan. However, data regarding unplanned readmissions with a 7 day window period is very rare, and no reports analyzing factors associated with those readmissions are available in Japan.
Methods: This is a retrospective cohort study in a Japanese acute hospital with over 600 beds. All admitted patients from 1st January 2014 to 31st December 2014 were included. For departments with higher re-admission rates (3.0% and more) with sufficient populations, gastroenterological medicine department and general internal medicine department, extended research was conducted by dividing them into three groups according to their reasons for readmission: A (terminally ill), B (readmitted with diagnosis different from current illness), and C (insufficient treatment and/or complication from treatment).
In addition, among patients readmitted to general internal medicine department, following parameters are analyzed, number of medication prescribed, annual admission frequency, CRP, body temperature, Cr, eGFR, Hct, and ALB at discharge.
Results: 20,127 patients were admitted to the hospital during the research period. 372 patients had unexpected readmissions within 7 days following their prior discharge, and after review by clinical departments, 369 (1.83%) were confirmed as unplanned. The average age of the cohort was 68.2 years old. In gastroenterological medicine department, 41% of unexpected readmission with a 7 day window period was due to terminal condition (mainly cancer), and 23% was related with insufficient treatment and/or complication from treatment.
In general internal medicine, 48% of readmissions was terminal condition, and 46% of patients readmitted with diagnosis different from current illness. Also, readmissions due to insufficient treatment and/or complication from treatment account for 6%. Main causes were miss prescription, insufficient prescription, and medication related dysfunctions. Among patients with unplanned readmissions with a 7 day after prior admissions, 74% of them were female, 65% of them had dementia, and 70 % of them were bedridden in general internal medicine.
Conclusions: This retrospective study has suggested that cognitive and ADL decline associate with unexpected readmissions within 7 days after prior discharge from a Japanese acute hospital in an aging society.

105) Factors Associated with Delayed Follow-up of Abnormal Labs: A Qualitative Exploration of Primary Care Physicians' Perspectives

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Background: Delayed or missed follow-up of abnormal lab results is a common and intractable patient safety issue. As part of a mixed-methods study evaluating the incidence and risk factors for outpatient medical errors, we explored factors related to delayed follow-up of elevated creatinine lab values for patients at risk of chronic kidney disease (CKD) in a large, integrated healthcare system.
Methods: We conducted semi-structured qualitative interviews with primary care physicians (PCPs) and used maximal variation sampling to identify clinicians with high versus low rates of delayed lab follow-up (high: PCPs with ≥60% of patients meeting predefined delay criteria; low: <40%). Interviews were recorded, transcribed, coded, and analyzed. We used a deductive-inductive team coding approach. Deductive thematic categories were derived *a priori*; thematic sub-categories were developed inductively.
Results: We conducted 15 PCP interviews; 75% had high rates of delayed follow-up. We identified several robust themes. **1) System-level factors**: PCPs perceived inefficiencies in the electronic health record (EHR) system ("in-basket") used to manage labs. Volume of data was the primary concern ("*You have to put in extra time…keeping up with the in-basket is very difficult*."). Labs ordered as part of a panel and resulted back to the provider in batches was perceived as contributing to missed follow-up *("…if we got each lab result individually, then I know the ones I've clicked are done and not be worried that [another will] come later into my in-basket.")*. Borderline glomerular filtration rates (GFR) are often not flagged as abnormal *("…somebody [with] a GFR less than 60 [with] CKD 3, though they're creatinine is in the normal range, maybe that shouldn't show up as a normal lab.")*. Additionally, while most would welcome sharing responsibility for triaging and managing labs results (e.g., from nurses, mid-level providers), PCPs reported sole responsibility for managing labs. **2) Provider-level factors**: PCPs perceived role ambiguity regarding follow-up of labs ordered by specialists contributing to delayed follow-up. PCPs also reported variable strategies for in-box management, with some lacking proficiency in EHR tools. **3) Perceived patient-level factors**: PCPs perceived patient access to lab facilities, lab overload *("Some [patients] express lab fatigue…all the different lab [orders]…coming from different places*."), and confusion about the need for labs as patient-level contributors.
Conclusion: Multiple types of factors were perceived to be related to delayed follow-up of abnormal labs. Developing multi-level strategies to address the themes we identified is critical to improving test results follow-up and related patient outcomes.

106) Bibliometric Study of Diagnostic Delay in Year 2016: Are We Making Progress?

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Background: Quantitative estimates of diagnostic delay could serve as benchmarks for improving diagnostic accuracy, either for individual clinicians or for health care systems. However, the availability and accuracy of estimates of diagnostic delay for specific conditions are not well established
Methods: Using the MEDLINE database, we repeated our 2013 bibliometric search for citations using the MESH term "diagnostic delay" and restricting our search to publications in year 2016. We categorized citations by disease and disease category, sought quantitative delay estimates, and compared findings with those from 2013 citations. For three commonly reported diseases with diagnostic delay, we explored the reporting and expression of quantitative estimate of delay.
Results: A total of 190 citations were identified by the MESH term "diagnostic delay". The distribution of disease categories was similar for 2016 citations compared with 2013 (n = 135); infection (33/190, 17%), cancer (30) and neurologic disease (28) were again the most commonly reported. For 2016, the more common specific diagnoses of tuberculosis (16/190, 8%), ALS (15), endometriosis (4) were reported in the 2013 citations. Newcomers since 2013 were citations for inflammatory bowel disease (8), celiac disease (8), and melanoma (4). For the 7 studies of ALS reported in 2016 (3167 patients from 5 countries), estimates of diagnostic delay ranged from medians/means of 9.0 to 13.6 months. For the 5 studies of inflammatory bowel disease reported in 2016 (2184 patients from 5 countries), reports of diagnostic delay ranged from medians/means of 3 to 12 months. Of the 4 citations related to diagnostic delay in endometriosis, only 2 of the 4 studies offered quantitative estimates of delay (65.7 and 89 months, respectively), albeit with different methodologies. Even for these three specific diseases, there was significant variation among studies in how diagnostic delay was expressed.
Conclusion: Based on the increased number of citations, interest in researching diagnostic delay is growing. A comparison of citations from 2013 to 2016 show a persistent focus on ALS and TB and new interest in other diseases. Even for specific diseases associated with diagnostic delay, reports of diagnostic delay are few in number, use variable methodologies, and inconsistently express quantitative delay estimates. Although a useful theoretical concept with an active medical literature, quantitative estimates of diagnostic delay are still not mature enough to be useful in quality improvement activities for individual clinicians or health care systems.

107) Erreur De Diagnostic: Comparing Malpractice Claims in France and the U.S.

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Background: ProAssurance and the Societe Hospitaliere D'assurances Mutuelles (SHAM) collaborated to study American and French malpractice claims with an allegation of diagnostic error. This study and the reported results are for educational purposes only, do not represent the views of ProAssurance and are not intended for any other purpose.
Methods: 150 medical malpractice claims were reviewed. All analyzed claims occurred in the hospital setting, with allegation of diagnostic error, and closed in 2014 with an indemnity payments. Study factors included incident date, location of injury, medical specialty, patient demographics, patient medical condition, care provided, and patient outcome. The Companies analyzed medical records, expert witness testimony, and records of trial and other legal proceedings. Investigators then identified common contributing factors.
Results: SHAM's study revealed significant patient health or medical histories were present in 20% of claims, but not considered by the treating physicians in 10% of claims. The ProAssurance study of the claims showed the patients' medical histories were clinically pertinent in 23.8% of claims, but not always considered in the diagnostic process. Most diagnostic errors SHAM observed related to Traumatology specialty (46.7% of cases). In those cases, SHAM identified the most frequently missed diagnoses as either fracture or dislocation (43% of cases). ProAssurance observed the specialty most frequently associated with diagnostic errors is emergency medicine (37.21%) where most patients presented with abdominal or gastrointestinal pain (19.1%). The main causes SHAM found contributing to diagnostic error allegations included: failure to order additional tests or exams (57.6%), poor clinical examination, medical background not reviewed, (42.4%), misinterpretation of X-rays exams, blood tests or EKGs (32,3%), and no requirement of specialist (15.1%). ProAssurance identified main causes contributing to diagnostic error included failure to order additional testing (21.74%), improper interpretation of a study (20.29%), inadequate physical exam (13.04%), and failure to seek consultation of a specialist (13.04%). Other contributing issues outlined by investigators included outdated protocols, understaffing, non-availability of physician, delays in writing medical reports, and access to patient record, test, or lab results. Additionally, investigators observed opportunities for improvement in communication between providers and nursing staff, documentation (including EHRs), and tracking and follow-up processes for test results.
Conclusion: By studying these claims the Companies identified distinct situational differences but overall similar results. Comparison of the claims experience from different legal environments provided insights not available in other claim reviews. aThe study also identified a learning need for future physician and hospital staff education.

108) Risk Factors for Care-Gaps in Abnormal Lab Results Follow-up within a Large Integrated Health System

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Background: Lack of timely follow-up of abnormal lab tests can result in delayed or missed diagnoses. To identify risk factors for care-gaps in the follow-up of abnormal creatinine labs, we examined patient-, physician-, and system-level factors in a large, integrated delivery system.
Methods: We included Kaiser Permanente Southern California (KPSC) members age >= 21 years with a creatinine lab result indicating an abnormal estimated glomerular filtration rate (eGFR) during 2010-2015. Patients were excluded if they had a history of chronic kidney disease or kidney cancer, or an abnormal eGFR within the prior 2 years. Expected care (i.e., no care-gap) was defined as a repeat creatinine test 60-150 days after the incident abnormal lab result, or an earlier repeat lab with a normal result. Multivariable logistic regression with physician as a random effect was used to identify factors associated with care-gaps in lab follow-up.
Results: Among 246,518 patients, 60% had a care-gap in lab follow-up. Patients with higher (better) eGFR values were more likely to have a care-gap. Patients with a larger percent change since their last eGFR result were less likely to have a care-gap. An abnormal creatinine flag was significantly protective against care-gaps in lab follow-up (OR = 0.47, 95% CI: 0.46-0.49). Registration on a patient portal was unassociated with lab follow-up (OR = 0.99, 95% CI: 0.97-1.01), as was physician panel size (OR = 1.05, 95% CI: 0.94-1.16 for >2700 vs. <1800 patients). Care-gaps were significantly lower when the incident lab was ordered by someone other than the patient's assigned PCP (Other PCP, OR = 0.76, 95% CI: 0.74-0.79; Other MD, OR = 0.72, 95% CI: 0.68-0.77). A quality improvement program contacting physicians who fell behind on their In-Basket was not associated with lab follow-up. Additional factors associated with an increased risk of a care-gap were: younger patients, female patients, Non-Hispanic whites compared with other race/ethnic groups, longer membership length, and longer physician employment within KPSC. Factors associated with a decreased risk of a care-gap were: higher Charlson comorbidity score, diabetes, hypertension, obesity >= 35kg/m^2 vs. normal/underweight, physician specialty other than family medicine, and being seen by a board-certified physician.
Conclusion: On quantitative analysis, we identified several patient-, physician-, and system-level factors contributing to delays in follow-up of abnormal eGFR results. Certain factors, such as adding an abnormal eGFR lab flag, could potentially be addressed now, but most predictors

require further exploration with qualitative methods. This work underscores the need for mixed methods research to understand and reduce diagnostic delays.

109) Are Emergency Department to Emergency Department Transfers at Risk for Diagnostic Errors? a Needs Assessment for a Resident Curriculum.

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Background: ED transfers are common at academic medical centers. Many EM residencies are based at a tertiary care hospital that acts as the hub for a regional referral network. Little is known about the rate of diagnostic errors within this transfer population. Our goal is to determine the rate of diagnostic errors made in the receiving hospital in the transfer population at our institution. In order to help inform and develop a resident curriculum around ED transfers.
Methods: This is a retrospective chart review with a primary outcome measure of diagnostic error in the ED transfer population. Diagnostic error was defined as a discrepancy between the diagnosis made by the EM attending notes and the final diagnosis made by the admission team on discharge. The study was performed at an urban, academic tertiary care referral center with an affiliated 3 year EM residency. All patients transferred to the ED between 07/2016 and 09/2016 were eligible. There were 1785 ED transfer patients during this time period. We did a power calculation using an error rate of 0.13% (from previous published data from our institution for all-comers) with an expected error rate of 2% in the ED transfer population requiring at least 102 cases for an alpha of 0.05% and power of 80%. Individual records of 143 randomly selected patients were reviewed. Diagnostic discrepancies between these items were reviewed by two blinded attending physicians and adjudicated as errors if the diagnosis occurred within the first 24 hours of the hospitalization, was not documented for in the ED note and if the two reviewers agreed it was a missed ED diagnosis.
Results: The average age was 60 for the population studied and 51% were male. Four errors were found among the 143 patients for an error rate of 2.8% (CI 0.1-5.5). Diagnostic errors from all-comer ED population to the ED transfer population were compared ($p = 0.002$).
Conclusion: In this single tertiary center study, the diagnostic error rate was found to be 21 times higher in the ED transfer population than all comers to the ED.This could be due to multiple issues, including the fact that many patients are transferred to a tertiary care facility because they are medically complex or hemodynamically unstable. In this unique population an educational curriculum centered around the transfer population, anchoring bias, and cognitive debiasing strategies may improve care.

110) The Association between Patient Safety Culture and Medical Office Problems That Could Lead to Diagnostic Error

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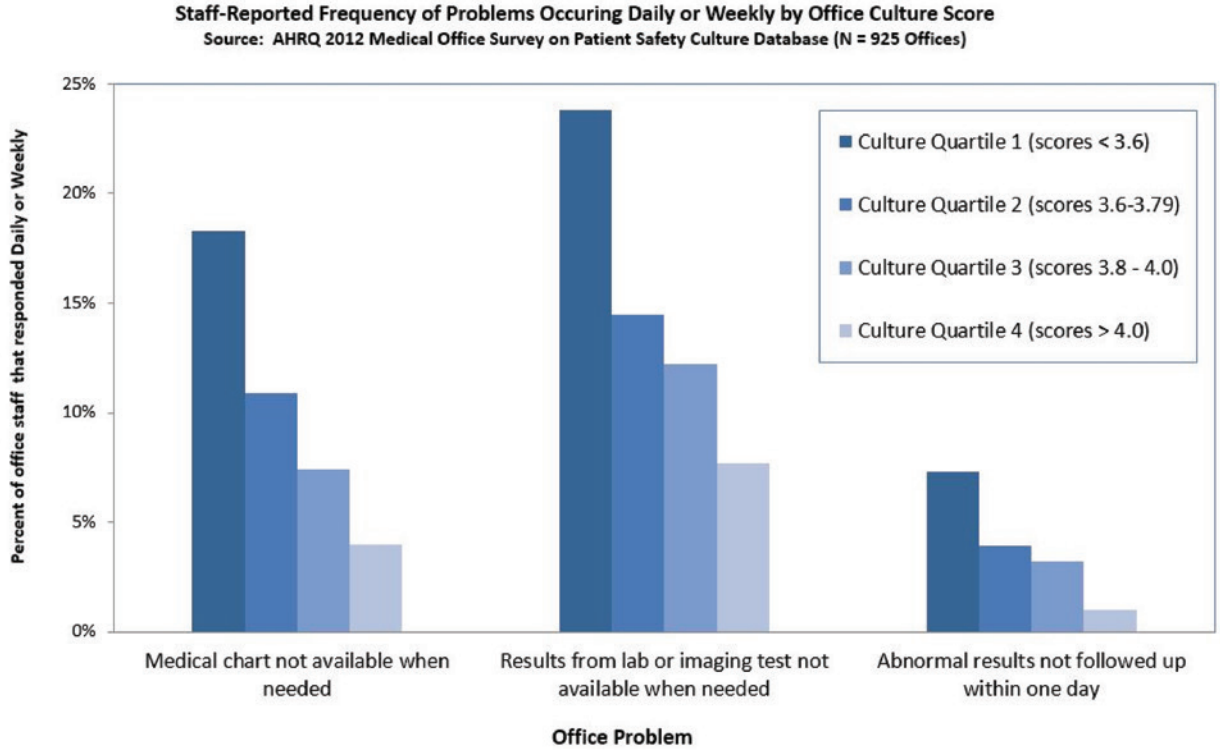
Background: Patient safety culture is often viewed as a contextual factor that shapes staff behaviors and influences the process of care and intervention effectiveness. Diagnostic errors may cause harm to patients by preventing or delaying appropriate treatment or by providing unnecessary or harmful treatment. We aimed to estimate the relationship between staff perceptions of patient safety culture and the frequency of select office problems that could lead to diagnostic error.
Methods: We used survey data from 925 medical offices nationwide that voluntarily submitted results to the 2012 Agency for Healthcare Research and Quality Medical Office Survey on Patient Safety Culture database. We calculated an overall culture score as the average of the survey's ten dimension scores ranging from 1 to 5, with 5 as the most favorable. The following three problems were analyzed: 1) patient medical chart not available when needed; 2) testing results not available when needed; and 3) abnormal results not followed up within one day. For each problem, frequency was defined as the percent of survey takers that responded that the problem happened daily or weekly over the past twelve months. At the office level, we ran a multivariate regression model to estimate the effect of culture on problem frequency while controlling for office-reported implementation levels of electronic health records and electronic access to patients' laboratory and imaging results (health IT); office characteristics; and survey characteristics such as response rate and the percent of respondents that were physicians.
Results: The most frequent problem was "results from a lab or imaging test were not available when needed" with a mean of 15% of office staff responding that it happened daily or weekly. The mean overall culture score was 3.8 with a minimum of 2.6 and a maximum of 4.7. In all models, the overall culture score had a negative, significant relationship with problem frequency. Compared to offices with completed health IT implementation, offices in the process of health IT implementation had higher frequency of problems. Larger offices (10 or more doctors) had higher frequency of problems than offices with less than four doctors

Conclusion: Diagnostic-related office problems happened more frequently in offices with lower scores of patient safety culture. Medical offices should measure patient safety culture; those with lower culture scores may be more vulnerable to office process problems that could lead to diagnostic error, especially during the implementation of new health IT.



111) Inter-Rater Agreement for the Diagnosis of Stroke Versus Stroke Mimic after Thrombolysis

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Title: Inter-rater agreement for the diagnosis of stroke versus stroke mimic after thrombolysis

Background: After intravenous thrombolysis for acute stroke, a substantial portion of patients lack evidence of acute infarction on brain imaging making the final diagnosis of ischemic stroke uncertain. We sought to characterize the reliability of physician diagnosis in differentiating aborted or imaging-negative acute ischemic stroke from stroke mimic (SM) among patients treated with thrombolysis. We defined SM as an episode of neurological dysfunction not caused by focal brain ischemia.
Methods: We constructed 10 case-vignettes of patients treated acutely with thrombolysis who had subsequent improvement in symptoms and without radiographic evidence of cerebral infarction on magnetic resonance imaging. Using an online survey, we asked physicians to select a diagnosis of aborted or imaging-negative acute ischemic stroke versus SM and rate their diagnostic confidence on a scale of 0-100. Inter-rater agreement was evaluated using percent agreement and kappa statistic (κ) with 95% confidence intervals (CI) reported.
Results: Sixty-five physicians participated in the survey. Most participants were in practice for ≥5 years (n = 46) and more than half were vascular neurologists (n = 35). Physicians agreed on the most likely final diagnosis 71.4% of the time, κ of 0.21 (95% CI, 0.06-0.54). Four of the 10 case-vignettes had >80% agreement. Percent agreement was similar across participant practice locations, years of experience, subspecialty training, and personal experience with thrombolysis. Overall average rater confidence for the diagnosis selected was 68%.
Conclusions: We found modest agreement among physicians in distinguishing ischemic stroke syndromes from SM in patients without radiographic evidence of infarction and clinical improvement after thrombolysis. Validated diagnostic criteria are needed to improve stroke classification for imaging-negative patients treated with thrombolysis across studies and practices.

112) Incidence of Diagnostic Error Among Patients Hospitalized for CVT at a Single Urban Center

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Background: Cerebral vein thrombosis (CVT) is a rare cerebrovascular disease caused by a thrombus formed in the cerebral sinuses or veins. Symptoms associated with CVT are commonly non-specific with isolated headache and seizure among the most common presenting features. Making a timely diagnosis of CVT can be challenging but may improve clinical outcomes allowing clinicians to treatment sooner. More then 150,000 cerebrovascular cases are misdiagnosed in US emergency departments each year. Delay in the diagnosis of CVT has received limited attention. Particularly, misdiagnosis of CVT among patients who first present to an outpatient practice has not been previously described.
Methods: We performed a retrospective chart review at Montefiore Medical Center using electronic medical records. We identified all CVT patients hospitalized between 9/1/2005 to 9/1/2015 using *International Classification of Diseases, Ninth Revision, Clinical Modification* codes and detailed chart review. Misdiagnosis of CVT was defined as an instance when a patient sought medical attention for headache or seizure and then found to have a CVT within 30 days of initial presentation. We tested whether demographic, clinical, and radiographic features were associated with CVT misdiagnosis and whether misdiagnosis was associated with adverse outcomes including admission to intensive care unit (ICU), intracerebral hemorrhage, discharge disposition or death. Categorical variables were compared using chi-squared and continuous variables using student t-test. P-value of <0.05 was used to determine statistical significance.
Results: We identified a total of 74 CVT patients. Mean age was 46 years old (SD: 18) and 44 were female (67%). A total of 21% ($n=15$) had a CVT misdiagnosis. Among the misdiagnosed patients, 12 (80%) had initially presented to the ED as opposed to 3 (20%) who initially presented to outpatient clinics. We found no differences in the clinical characteristics, radiographic features, or outcomes of misdiagnosed CVT patients compared to those not misdiagnosed. Patients with misdiagnosed CVT were younger (35yr vs. 48yr, $P=0.017$), and were more often Spanish speaking ($n=3$ vs. $n=0$, $P=0.02$). There were no racial differences between the two groups. Four pregnant people were found to have a CVT, only one pregnant patient with molar pregnancy had a misdiagnosis.
Conclusion: We found substantial evidence of CVT misdiagnosis in a single center retrospective cohort of CVT patients, particularly among young non-English speaking patients. Interventions to improve diagnostic accuracy among patients with CVT should be explored, particularly among high-risk patient subgroups.

113) Trends in Diagnosis-Related Paid Medical Malpractice Claims Using Data from the National Practitioner Data Bank

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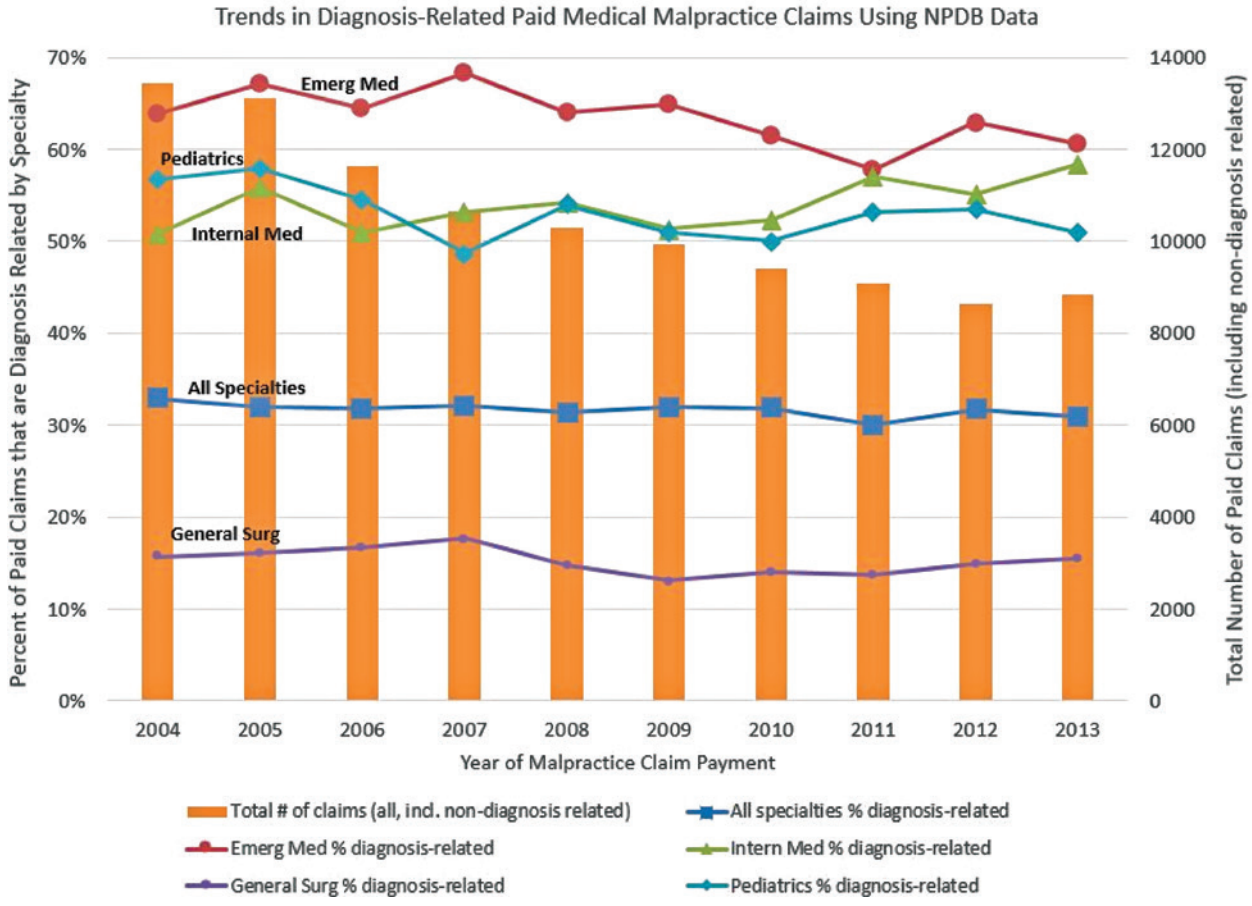
Background: The National Practitioner Data Bank (NPDB) is a government-run database to which all medical malpractice payments made on behalf of individual physicians must be reported. Among the fields collected by the NPDB is malpractice allegation group; diagnosis-related is an option for this field. We undertook an analysis of diagnosis-related claims using NPDB data covering the period 2004-2013. This time period was chosen due to the existence of NPDB data linked to physician specialty for this period.
Methods: The NPDB Public Use Data File was linked to physician specialty by the NPDB using National Provider Identifier (NPI). An anonymized version of the dataset, without NPI, was made available for analysis. Allopathic attending and resident physicians on whose behalf a malpractice payment was made from 2004 to 2013 were included. Paid malpractice claims were analyzed by whether they were diagnosis-related and by physician specialty. The physician specialties included were emergency medicine, general surgery, internal medicine, and pediatrics.
Results: During the study period (2004-2013), the total annual number of paid medical malpractice claims steadily decreased, from 13,441 in 2004, to 8,845 in 2013. Despite this decrease in the total number of paid medical malpractice claims, the percentage of paid claims that were diagnosis-related remained essentially constant, ranging from 30.0-32.8%. Similarly, the specialties examined had roughly constant percentages of all paid claims that were diagnosis-related over the study period. Unsurprisingly, the percentage of paid claims that were diagnosis-related varied by specialty, ranging from 15.3% in general surgery to 63.7% for emergency medicine. Among all specialties, the mean payment amount for diagnosis-related claims was $348,225, which was significantly larger than the mean payment of $306,375 for paid claims that were not diagnosis-related ($P<0.0001$, using Wilcoxon rank-sum test, performed in JMP).
Conclusion: Despite a decrease in the total number of paid medical malpractice claims over the study period, the percent of paid claims that were diagnosis-related remained roughly constant. Moreover, the mean amount paid on diagnosis-related claims was significantly greater than on paid claims that were not diagnosis related. These findings highlight the ongoing need to work to decrease diagnosis-related adverse events. A related analysis was published as: Schaffer AC, Jena AB, Seabury SA, Singh H, Chalasani V, Kachalia A. Rates and Characteristics

of Paid Malpractice Claims Among US Physicians by Specialty, 1992-2014. *JAMA Intern Med*. Published online March 27, 2017. doi:10.1001/jamainternmed.2017.0311



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