Scientific Abstracts

Using Mobile Technology (and Big Data) to Understand Medical Errors

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Background: Academic radiology and cognitive psychology research have helped reveal the underlying causes of certain types of medical image search errors; however, several sources of these errors have remained elusive. In the current presentation, we will discuss how data collected from millions of searchers across billions of trials can inform specific medical image search problems that have been especially hard to address in laboratory or clinical settings. Specifically, we will present data that informs search errors related to *satisfaction of search*—an increased risk of missing a target (e.g., an abnormality in an X-ray) after having already found another target.

Methods: We have partnered with Kedlin Co., the makers of a smartphone app called *Airport Scanner*, to obtain "big data." *Airport Scanner* is a game where the player serves as an airport security officer and searches for contraband in simulated carry-on bags. The game contains numerous elements that are ideal for research endeavors—a variable number of targets per bag, a variable number of distractors per bag, multiple levels with varying difficulty, hundreds of different target types and distractor types, a secondary distraction task, etc. We have access to over 2 billion trials from over 7 million devices, and we have used this unique dataset to address questions that have been previously intractable.

Results: Multiple-target visual search errors contribute to diagnostic errors related to X-ray image reading, cytology, pathology, etc., and it is critical to understand the core causes of the problem to improve medical image searches and diagnostic performance. We will present a number of findings, include data that suggest that *satisfaction of search* is partially caused via a 'perceptual set' mechanism—after finding a target, you are more likely to find other targets that are perceptually and conceptually similar. Likewise, we will show how target frequency (how often a *specific* target appears across all searches) can greatly affect diagnostic performance.

Conclusions: It is vital to minimize medical image search errors, but this can only be done by understanding the causes of each error type. We will present a novel technique for investigating the general search behaviors that can underlie search errors. This approach complements and expands current research endeavors, and most importantly, can address previously intractable problems.

Pediatric Primary Care Practitioners' Interest in Diagnostic Error Reduction

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Background: Despite their potential burden, diagnostic errors in children have not been well studied. For example, in one survey, 54% of pediatricians reported making diagnostic errors at least monthly and 45% reported making harmful diagnostic errors at least annually. In order to reduce these harmful diagnostic errors, we must first assess primary care pediatricians' (PCPs) interest in and experience with diagnostic errors. As preliminary work for developing an intervention-based research project, we investigated PCPs interest in diagnostic error reduction initiatives.

Methods: We conducted an electronic survey of the American Academy of Pediatrics' Quality Improvement Innovations Network (QuIIN), a national group of pediatricians interested in improving the quality of care for children, regarding their interest in diagnostic error reduction topics. The survey asked PCPs about their general interest in our proposed future project to reduce diagnostic errors, their interest in projects trying to improve specific types of diagnostic errors, which diagnostic errors, if any, they were working on improving, and which diagnostic errors their electronic medical record (EMR) could help reduce.

Results: Of the 300 PCPs on the QuIIN listserve, 77(26%) responded. Of these, 48 saw ambulatory patients and were included in the study. Twenty-seven (53%) reported they would be very interested and 18 (35%) somewhat interested in participating in a project to reduce diagnostic errors. As illustrated in Figure 1, when asked to choose from 15 acute and sub-acute diagnostic errors, PCPs were "most" interested in working to reduce diagnostic errors related to missed diagnosis of hypertension (17%), delayed diagnosis because of missed subspecialty referral (15%), and delayed diagnosis of abnormal laboratory values. Sixteen practices (33%) reported they were "trying to improve" delayed diagnosis of abnormal laboratory values. Practices also reported "trying to improve" additional diagnostic errors: missed diagnosis of asthma (n=15), missed diagnosis of post-partum depression (n=15), or missed diagnosis of obesity (n=15). Finally, practices reported their EMR helps reduce delayed diagnosis of abnormal laboratory values (n=15; 31%) and missed diagnosis of obesity (n=15; 31%), whereas 16 (33%) reported their EMR did not help reduce any diagnostic errors.

Conclusion: Pediatric primary care providers expressed a high interest in reducing certain types of diagnostic errors, including missed diagnosis of hypertension, and delayed diagnosis due to referrals and laboratory values. However, few practices are currently working on initiatives to reduce diagnostic errors and leveraging their EMRs to support these efforts.

Reporting Wisely - Trigger Signals" for Early Detection of High Risk Patients to Avert Diagnostic Adverse Events

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Background: Most diagnosis-related errors occur in the testing phase in complex care patients with multiple organ dysfunction seen in general medicine, emergency medicine and ambulatory care settings Early identification of vulnerable patients likely to experience medical diagnostic errors is difficult in both outpatient and acute care venues, because biomarker test reports are raw, uninterpreted, machine-generated data and their delivery efficacy is disorganized. Most missed diagnoses are common conditions in primary care, and test results for biomarkers in blood, body fluids and cells are critical tools for physician decision-making. Failure to promptly establish a differential diagnosis and its influence on test ordering has the most impact on diagnostic failure.

Methods: Systematic literature review and metaanalysis of peer-reviewed journal articles, and with any study design, that evaluated the effectiveness of improved biomarker results reporting formats linked with defined positive and negative outcomes for complex care patients with common diseases/conditions, most frequently associated with diagnostic and other adverse medical events.

Results: Metaanalysis of peer-reviewed literature showed statistically-significant associations between quantitated, abnormal biomarker values from multiple organs, arranged in "patterns of abnormals," and outcomes for complex care patients most vulnerable to diagnostic and other adverse events. Evidence-based studies reported that graphical laboratory value displays led to reduced review times and that graphical and tabular representations were more effective for answering different clinical questions.

Conclusion: Improved test reports to physicians early in the decision-making phase is critical for physicians to identify vulnerable high risk patients. Early recognition of patient risk requires a paradigm shift in the reporting of abnormal biomarkers from single to multiple, simultaneously interpreted, quantified patterns rather than isolated single values. This presentation introduces a simplified, visual biomarker reporting process, personalized patterns of "Trigger Tool" diagnostics, to assist physicians at the time of medical decision making how to recognize patterns of abnormality that signal a patient's high risk level for one or more adverse events. The process involves the health care venue's most common high risk diseases/conditions associated with diagnostic errors that can be easily implemented in local venues, founded on local best practice patterns and expert physician oversight.

Can We Improve Diagnosis in Medicine with Better Assessments? an Integrative Review.

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Background: The literature concerned with medical errors suggests that diagnostic reasoning errors are particularly harmful to the society [1–4]. Family Medicine (FM) practitioners require strong clinical reasoning skills to care for the fullest spectrum of patients and diseases. Previous work has identified significant variations in diagnostic reasoning in FM practice [5]. To guide future physicians' training, a better assessment of diagnostic reasoning skills during the residency program is necessary, and valid instruments are required. The purpose of this work was to answer two questions: 1) What methods are described in the literature to assess diagnostic reasoning? 2) What validity arguments are presented for these methods?

Methods: An integrative literature review was conducted based on a PubMed search for citations referencing "clinical reasoning" or functionally equivalent concepts in the context of undergraduate and graduate medical education. An initial review of articles' titles and abstracts was conducted by two reviewers to select potentially relevant articles. These articles were then read (full text) by a single reviewer to select relevant articles based on inclusion and exclusion criteria. Inclusion criteria specified: English or French citations with abstracts, reports on individualized learning or validity arguments for methods or instruments. Exclusion criteria specified non-research publications, subjective measures or knowledge-only assessments. Applied analytical frameworks included Downing and Yudkowsky's [6] diagnostic reasoning assessment methodology, and construct validity frameworks described by Messick [7]; and AERA, APA and NCME[8].

Results: 3,501 citations were identified in the search. Across the 146 articles finally selected, diagnostic reasoning was predominantly assessed through diagnostic accuracy (90%), based on clinical vignettes (68%) and utilized written tests (82%: constructed-response formats 39%, and selected-response formats 43%). Methodology used to assess diagnostic reasoning was absent or significantly incomplete in 18% of the articles. Only three percent of the articles explored at least four sources of validity. Arguments of validity were missing in 30% of the articles and were implied but not explored for at least one source of validity in 46% of the articles. A majority of arguments were related to internal validity of measures (57% of the articles).

Conclusion: No single method emerges in concert with well-developed validity criteria to assess clinical reasoning. Greater validity arguments are needed to ensure the quality of diagnostic reasoning skills' assessments. These improvements would support a better certification of residents' diagnostic reasoning skills and, associated with a remediation process when needed, enhance diagnosis in Medicine as well as patient safety.

Graded Sentinel Indicators of Risk for Complex Care Patients Most Vulnerable to Adverse Diagnostic Events

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Background: Physicians at all levels of care encounter multiple abnormal biomarkers test results in patients with multiple chronic conditions, and must analyze, integrate, correlate and grade the raw values into severity levels at the time the report is received to understand the degree of dysfunction of a patient's organs/systems. There is a relationship between multimorbidity and quality of care, and comorbid conditions interact with one another to increase clinical complexity (comorbidity interrelatedness) because of direct and indirect interactive pathophysiologic effects. Patients with higher comorbidity index scores have greater risk of diagnostic adverse events as well as more early and late readmissions. This presentation describes a simplified, on-site risk grading method for rapid assessment of patient's vulnerability, adaptable for local use in outpatient or higher level sites of care, with data derived from subjective clinical and scientific analytic sources.

Methods: Systematic literature review and metaanalysis of peer-reviewed journal articles, and with any study design, based on evidence-based, statistically-significant grading and risk stratification relationships between established diagnoses and patterns of severity-graded patient cofactors and significantly abnormal biomarkers.

Results: The evidence base reviewed that studied the use of physiologic data for patient risk adjustment is overwhelming. Four basic patient cofactors are needed by physicians to establish a baseline level of patient risk for adverse events. These include the number of patient comorbidities, medications, biometric data and metrics from clinical and biometric tests on blood, body fluids, cells and tissues. Each one of these key risk cofactors is composed of patterns that are unique for each patient. Combining the four sets of patterns and grading the abnormal factors and values provides physicians with a baseline and ongoing risk status for adverse events based on comorbidity as treatment progresses.

Conclusion: Patient risk level measurement capability is currently absent in most EHR and mobile medical decision support applications, leaving physicians to estimate risk severity level at the time they receive abnormal blood test results using their subjective, heuristic skills rather than quantitatively defined risk levels. To avert diagnostic and other adverse medical events caused by organ/system pathophysiology and comorbid effects in complex care patients, simplified, patient-specific graded sentinel risk indicators need to be tailored to clusters of multiple chronic organ dysfunction (MCOD).

Identifying Error Types in Radiological Image Interpretation of Learners

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Background: Errors occur in different phases of the image interpretation process of learners. Insight in the error types made by learners is crucial for giving effective feedback. Using a step-by-step-questions assessment procedure to identify error types in image interpretation and reveal partial knowledge of or latent errors in the interpretation process, we investigated which error types can be identified in the image interpretation process of radiology clerks and the reliability of this procedure in terms of inter-rater agreement.

Methods: Hundred-nine radiology clerks took a radiology image interpretation test consisting of ten CT image cases and one to three X-ray cases. The image interpretation questions concerned step-by-step questions: labelling an abnormality (perception), describing the abnormality (analysis) and giving a diagnosis and/or advice (synthesis). Errors were coded as perception, analysis, synthesis or undefined errors by two independent observers. A latent error was identified if a correct diagnosis was given, based on an incorrect perception or analysis. Partial knowledge was identified if an incorrect diagnosis was given based on a correct perception and/or analysis. Consensus was reached after discussion, in case of discrepancies. Prevalence of error types and inter-rater reliability of the procedure were calculated.

Results: With our step-by-step questions procedure applied to 1351 cases, 828 errors were identified. 650 errors were found in the process of image interpretation (79%), of which 39% were perception errors, 20% analysis errors and 41% synthesis errors. The step-by-step questions revealed latent errors in 125 cases (9%) and partial knowledge in 243 cases (18%). We found a mean inter-rater reliability of Cohen's $\kappa = 0.8$.

Conclusion: A step-by-step question approach can reliably distinguish perception, analysis and synthesis errors. Besides, the approach reveals latent errors and partial knowledge of students.

Cognitive Bias and Diagnostic Error: Is Bias in the Eye of the Beholder?

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Background: It is widely accepted that cognitive biases contribute to diagnostic errors. While experimental studies suggest that cognitive biases exist, there is little prospective evidence of these biases in clinical practice. Analyses of causes of diagnostic errors are usually based on retrospective reviews (e.g. of patient records, or incident reports) where the reasoning processes of practitioners are inaccessible and the reviewer is aware of the case outcome. If identifying biases can minimize diagnostic error, then prospective identification of these biases should be independent of outcomes that are unknowable at the time. The aim of this study was to determine whether experts in clinical reasoning could reliably identify and agree upon the presence of cognitive biases independent of case outcomes.

Methods: Thirty-nine clinician members of the SIDM listserve volunteered to participate in the study. The participants were asked to read 8 clinical vignettes online, then 1) indicate whether a diagnostic error had occurred and 2) identify cognitive biases present in the case description. Cases contained history and exam findings suggesting two approximately equiprobable diagnoses, and described the ”clinician” ordering a definitive test for one of the two diagnoses. The experimental manipulation was that the test result came back either positive (confirming the diagnosis) or negative (disconfirming the clinician's diagnosis and suggesting the alternative). Each participant encountered 4 cases with a confirming test and four with a disconfirming test, all counterbalanced. There was no attempt to include or exclude specific biases, as this would presume the conclusion. The primary measure was the number of biases identified under the two conditions.

Results: When the test confirmed the diagnosis under consideration, participants indicated a diagnostic error in 8% of cases; when it disconfirmed the diagnosis, they indicated an error in 62% of cases. When the test confirmed the diagnosis, participants identified 1.7 biases per case; when the test disconfirmed the diagnosis they identified 3.4 biases ($F = 71$, $p<.0001$). Agreement among participants about presence of specific biases, using a generalized kappa coefficient, ranged from 0.0 to 0.04.

Conclusion: Clinicians versed in recognizing cognitive biases did not agree on the presence or absence of specific biases. Twice as many biases were identified when test results disconfirmed a diagnosis. Since the case descriptions were identical other than the outcome, these judgments appear vulnerable to hindsight bias. These findings suggest that reliable prospective identification of bias as a means to reduce diagnostic error is difficult.

Diagnostic Error in Idiopathic Intracranial Hypertension (IIH)

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Background: Primary benign headaches are common, occurring in up to 24% of young women. This, combined with the increasing prevalence of obesity and awareness of IIH, has led to an increase in costly and invasive evaluations for headache, often in the absence of documented papilledema. Our objective was to delineate the factors contributing to diagnostic error in the evaluation of IIH among patients seen on our Neuro-Ophthalmology service.

Methods: We performed a retrospective review of all new patients seen between November 1, 2013 and June 26, 2014. Patients referred for a working diagnosis of IIH or suspicion of IIH because of abnormal optic nerve appearance or headaches were included. For each patient, we reviewed the demographic and clinical characteristics as well as the utilization of healthcare resources. For cases referred with a working diagnosis of IIH and a discrepant final diagnosis, we applied the Diagnosis Error Evaluation and Research (DEER) taxonomy tool to classify them according to the location and type of error in the diagnostic process.

Results: 1249 new patients were seen in the neuro-ophthalmology clinic between November 1, 2013 and June 26, 2014. Of these, 165 (13.2%) had been referred either with a pre-existing diagnosis of IIH (n=86; 52.1%) or to rule out IIH (n=79; 47.9%). Of the 86 patients referred with a pre-existing diagnosis of IIH, 35 (40.7%) did not have IIH. Final diagnoses were pseudopapilledema (40%), primary headache disorder (25.7%), optic disc drusen (5.7%), optic atrophy (5.7%), and one each (2.9%) of optic neuritis, dry eyes, sequential nonarteritic anterior ischemic optic neuropathy (NAION), dominant optic atrophy, acute zonal occult outer retinopathy (AZOOR) and physiologic blind spot. 28 (32.6%) had a lumbar puncture, 10 (11.6%) had >1 lumbar puncture, 30 (35%) had a brain MRI, 9 (10.5%) had an MR-venogram/CT-venogram, 1 (1.2%) had a lumbar drain, 4 (4.7%) were referred for surgery. Of 35 patients misdiagnosed with IIH, we ascribed the error primarily to an ophthalmologist in 12 (34.2%), a neurologist in 10 (28.6%), a neuro-ophthalmologist in 10 (28.6%), an optometrist in 2 (5.7%) and unassigned in 1 (2.9%).

Conclusion: Diagnostic errors resulted in the incorrect diagnosis of IIH in 40.7% of patients and prompted unnecessary tests in 34.9%, invasive procedures in 32.6% and missed diagnoses in 5.8%. The most common error was inaccurate ophthalmoscopic examination in headache patients, reinforcing the need for rapid and easy access to specialists with experience in diagnosing optic nerve disorders.

Use of a Modified Fishbone Diagram to Analyze Diagnostic Errors in Emergency Medicine

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Background: Reilly et al described a structured approach to the analysis of diagnostic errors by using a novel, modified fishbone diagram. However, the application of this tool in emergency medicine had not been reported. The aim of this study was to identify complex diagnostic errors in the emergency department (ED) of a community hospital by adapting the modified fishbone diagram.

Methods: Sixty one cases of diagnostic errors involving ten board-certified emergency physicians (EPs) were identified through peer review process. Using a qualitative study approach, we conducted in-depth, semi-structured interviews with EPs. All interview audiotapes were transcribed verbatim. We performed content analysis on all textual data to identify the factors underlying errors using modified fishbone diagram.

Results: In 61 cases, we identified 165 diagnostic errors (2.7 per case). The underlying contributions to errors fell into 7 categories: cognitive error(54/61,88%),knowledge gap(32/61,52%),clinical data gathering(22/61,36%),organization issues(12/61,20%),affective related(9/61,15%),context of care(9/61,15%),communication(5/61,8%).The most common cognitive factors included anchoring bias, blink obedience, and premature . One of the most prominent problems, associated knowledge gap, occurred primarily due to insensitivities of EPs to recognize various presentation of a specific disease in different stages. Failure to perform focused physical examination was the most frequent problem in the category of clinical data gathering. In the category of organizational issues, failure to provide appropriate follow up mechanism contributed most to the cause of diagnostic errors. In the category of affective factors, negative moods most likely arose from long work hours in the ED. In the context of care, delay in consultation was the major problem. Finally, in the category of communication, poor quality of communication occurred primarily during patient handoff or consultation.

Conclusion: The modified fishbone diagram is a useful tool to perform root cause analysis on diagnostic errors in ED. These findings provide a basis on which to build a framework for teaching EPs how to avoid misdiagnosing in the ED setting. Additionally, the results point out important organizational problems that require improvement.

Utilizing Physician and Patient Complaints As a Quality Assurance Marker in Emergency Medicine

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Background: The value of systematic evaluation of both patient and physician complaints in emergency medicine remains poorly characterized as a marker for ED quality assurance.

Methods: We prospectively collected data for consecutive patients presenting to an urban, tertiary care academic medical center Emergency Department with an annual volume of 57,000 patients between January 2008 and December 2014. Patient complaints were initially prescreened by an experienced evaluator and those not pertaining to possible physician error were removed. We randomly assigned both patient and physician complaints to be reviewed by physician evaluators not involved with the patients' care. Reviewers used an 8-point Likert scale to determine the presence of error and adverse events. If a reviewer felt that the case had a possible error that resulted in the need for intervention, additional treatment, or caused patient harm, it was referred to a 20-member trained quality assurance (QA) committee who made a final determination as to whether or not an error and/or adverse event occurred.

Results: We identified 570 complaints within a data-base of 383,419 total cases of which 33 were patient-generated and 537 were physician-generated. In the subset of cases where there was a complaint by either patient or physician, physician errors that led to a preventable adverse event were detected in 2.9% (95%CI 1.38 range 1.52% to 4.28%). Further analysis revealed 9.1% of patient complaints correlated to preventable errors leading to an adverse event (95%CI 9.81 range -0.71% to 18.91%). 2.6% of complaints made by a physician alone were found to be preventable physician errors leading to an adverse event (95%CI 1.35 range 1.25% to 3.95%). Near miss events (errors without adverse outcome) were more accurately reported by physicians, with physician error found in 12.1% of reported cases (95%CI 2.76 range 9.34% to 14.86%) and in 9.1% of those reported by patients (95%CI 9.81 range -0.71% to 18.91%). Adverse events in general that were not deemed to be due to preventable physician error were found in 12.1% of patient complaints (95%CI 11.13 range 0.97% to 23.23%) and in 5.8% of physician complaints (95%CI 1.98 range 3.82% to 7.78%).

Conclusion: Screening and systemized evaluation of emergency department patient and physician complaints may be an underutilized and efficient quality assurance tool. Patient complaints may more accurately identify physician errors that result in preventable adverse events, while physician complaints may be more likely to uncover a near miss that did not lead to an adverse event.

Diagnostic Vulnerabilities and Patient Safety in the Ambulatory Setting

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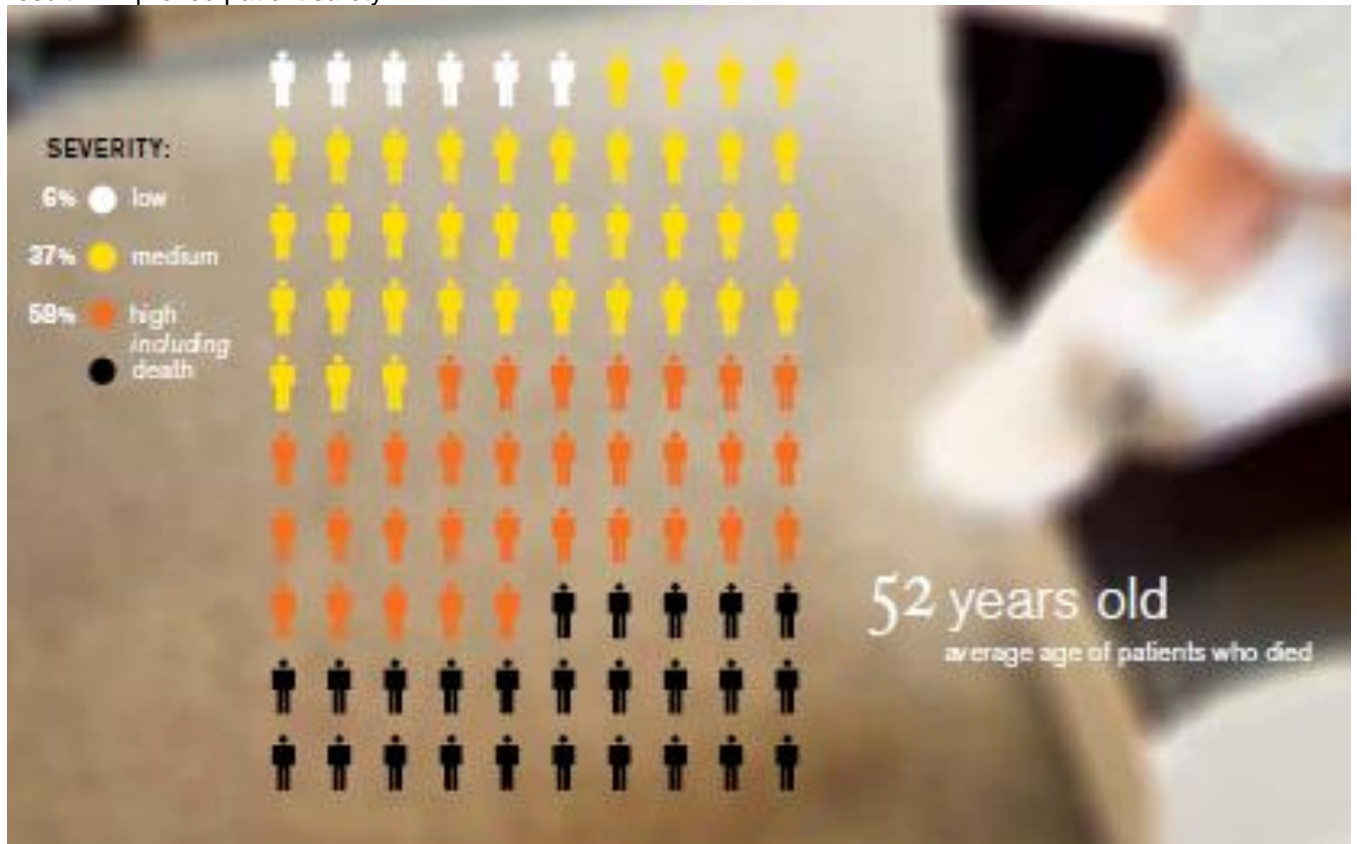[2]CRICO Strategies, Cambridge, MA

Background: To understand common vulnerabilities that lead to the claim of ambulatory diagnostic error, we reviewed 2,685 ambulatory medical open and closed malpractice cases with the allegation of missed or delayed diagnosis that led to patient harm.

Methods: The nature of diagnostic errors remains a challenge and particularly in ambulatory care. Review of 23,527 medical malpractice cases filed from 2008-2012 noted that 20% of those cases were linked to diagnostic error, (28% were surgical treatment, 23% were medical treatment, 7% obstetrics and 22% other). A drill into the 4,703 diagnosis related cases found that most diagnostic error, 2,685 cases occurred in ambulatory care. Ambulatory care excludes emergency medicine cases. Based on the identification of a greater percentage of ambulatory diagnostic malpractice cases, a focused analysis was conducted. Recognizing the growing focus of diagnostic failure, the detailed review of these cases help to shine a brighter light on diagnostic vulnerabilities and potential opportunities to improve diagnostic patient safety in ambulatory care.

Results: The most frequently named responsible service was medicine with 49% followed by surgery with 17%, radiology with 15% and pathology/other with 19% of the cases. The top three diagnostic failures were of cancer 45%, followed by heart disease and orthopedic injuries each occurring in 6% of the diagnostic failure cases. Case review resulted in 82% of the identified contributing factors were able to be mapped to the 12 step diagnostic process of care. The 12 steps diagnostic process of care factors were then refined to three broad phases; Initial diagnostic assessment failures 58%, Testing and results processing 29%, and Follow up/ Coordination 46%.

Conclusion: There are expansion of diagnostic capabilities that include the use of cancer screening guidelines such as breast care and colorectal, electronic support to assist in closing the loop of communication of diagnostic imaging and referral management systems that can track the referral process through from time of referral made through to patient made aware of results and plan. The use of the whole team in assessing potential practice vulnerabilities or in conducting a diagnostic "time out" can

result in improved patient safety.

SEVERITY:

6% low
37% medium
59% high including death

52 years old
average age of patients who died

Evaluation of a Diagnostic Checklist for Use in Internal Medicine Resident Education

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Background: Flawed clinical reasoning and cognitive bias contribute to diagnostic errors. We developed a "diagnostic checklist" to promote cognitive de-biasing in internal medicine resident education using principles of reflective reasoning. The purpose of this study was to test the effect of this checklist on diagnostic accuracy and to obtain feedback from users.

Methods: We performed a within-subjects controlled experimental evaluation of the checklist on written cases, followed by focus group interview. We invited all post-graduate 3 (PGY-3) residents at the University of Pittsburgh Medical Center (UPMC) to complete 10 clinical cases in a proctored setting. First, we instructed residents to record the first diagnosis that came to mind after reading the case. Second, we asked them to evaluate 5 of the initial 10 cases again, using prompts from the diagnostic checklist prior to making a final diagnosis. We counterbalanced control (non-checklist) and intervention (checklist) cases using a block design. Two independent investigators scored diagnostic accuracy. We used repeated measures regression to assess the effect of checklist use on diagnostic accuracy, controlling for case complexity. Two investigators reviewed audiotapes of the structured debriefing focus groups and identified key themes related to usability and acceptability of the checklist for clinical teaching and decision making.

Results: A total of 34 of 51 eligible PGY-3 residents (67%) participated. Inter-rater reliability of scoring suggested near-perfect agreement (k=0.93). Average diagnostic accuracy increased from 72% to 86% with the checklist for simple cases and from 34% to 37% for complex cases. In a random effects regression, checklist use was statistically significantly associated with improved diagnostic accuracy overall (p=0.05). This effect did not vary within strata of case complexity (simple vs. complex; p=0.29 for interaction). The dominant themes from the focus group interviews included: 1. The checklist was acceptable and understandable for use in evaluating clinical cases, 2. The tool would be most useful in real clinical settings when evaluating complicated cases, when teaching early learners, or when evaluating patients who have been handed off from other providers, and 3. Specific questions on the checklist were deemed to be particularly useful.

Conclusions: In this single-center study of PGY-3 internal medicine residents in the US, the use of a diagnostic checklist led to a statistically significant improvement in diagnostic accuracy on written clinical cases. Residents found the checklist to be acceptable for use, and offered valuable insights into the potential applications of the checklist in real clinical scenarios.

Diagnostic Evaluation of Patients Presenting with Hematuria: An Electronic Health Record-Based Study

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Background: Hematuria is a potential symptom (gross) or sign (microscopic) of a urologic malignancy and should prompt urologic evaluation in the absence of an obvious benign cause. However, prior literature has revealed a lack of timely evaluation and a prolonged time to diagnosis in a sizable proportion of patients with hematuria. The objective of our study was to evaluate the diagnostic evaluation of patients that present with hematuria.

Methods: We performed a retrospective review of electronic health records (EHR) of 100 consecutive patients who presented with new onset hematuria to a Veterans Affairs (VA) facility between 10/1/2011 and 12/31/2012. The VA's EHR offers a comprehensive longitudinal picture of the patient's diagnostic journey. We excluded patients who sought diagnostic care outside the institution (n=8), patients with cystoscopy within 3 years prior (n=4), patients with hematuria in the setting of active urinary tract infection (n=2), and patients with terminal illness (n=1). We collected detailed patient demographic data, medical/psychiatric history, and times to diagnostic evaluation (abdominal imaging, urologic referral, and cystoscopy). We defined delay as time to diagnostic evaluation of >60 days from the time the patient presented with hematuria. Univariable logistic regression was performed to identify predictors of delay in diagnostic evaluation.

Results: Of the 85 patients remaining after exclusions, 26 (30.6%) presented with microscopic hematuria and 59 (69.4%) presented with gross hematuria. There was an increased rate of urology referral in patients with gross hematuria (88.1%) vs. microscopic hematuria (69.2%, p=0.06). Patients with gross hematuria were more likely to undergo cystoscopy (81.4%) vs. those with microscopic hematuria (57.7%, p=0.02). In 80.8% of patients with microscopic hematuria and 62.7% of those with gross hematuria, cystoscopy, urology referral, and/or abdominal imaging were not performed within 60 days of hematuria presentation. There was no difference in median days to abdominal imaging completion (29.5 vs. 25, p=0.29), urology referral completion (29 vs. 23.5, p=0.41), or time to cystoscopy completion (70 vs. 69, p=0.71) between those presenting with microscopic vs. gross hematuria. On univariable logistic regression, there were no variables that predicted lack of action within 60 days. Within one year-post presentation, 12 (20.3%) patients with gross hematuria were found to have bladder neoplasms.

Conclusion: In patients presenting with hematuria, diagnostic evaluation is prolonged >60 days in a substantial proportion of patients. Identifying strategies to decrease this gap may help improve the quality

of diagnosis for these patients.

Table: Univariable logistic regression for predictors of no action taken within 60 days

	Odds Ratio	95% CI	P-value
Hematuria			
Microscopic	Ref.	Ref.	
Gross	0.40	0.13-1.21	0.11
Urinalysis			
Negative for blood	Ref.	Ref.	
Positive for blood	0.62	0.21-1.80	0.38
Charlson comorbidity index			
CCI 0-2	Ref.	Ref.	
CCI 3-4	0.34	0.10-1.13	0.08
CCI >4	0.59	0.16-2.14	0.43
Age (continuous)	0.99	0.95-1.03	0.67
Aspirin, clopidogrel, warfarin (no, ref.)	1.31	0.51-3.34	0.58
Psychiatric history (no, ref.)	1.41	0.54-3.67	0.48

Quantitative Investigation about Correlation Between Success of Medical Interview and Adequacy of Question/Answer By Doctor/Patient through Discrete-Stochastic-Process Simulative Experiment

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Background: Generally in practice, medical interview has important role on identifying what to do next. In principle, interview consists of doctor's question and patient's answer. This answer-to-question sequence repeats until some decision is established. Good question/answer clarifies patient's health problem. Not good question/answer masks problem and may cause diagnostic errors. Adequacy of question/answer has considerable influence on success of interview. However, the influence is not quantitatively well investigated.

Methods: : In this research, influence of adequacy of question/answer on success of medical interview is quantitatively investigated by a discrete-time stochastic process simulation. For the sake of clarity, purpose and process of interview are abstracted and simplified. The purpose is to obtain sufficient number of good answer to figure out what to do next, and process is regarded as discrete-time stochastic process. Once "next thing to do" is figured, the process ends. As long as the number of good answer is insufficient, process continues. In this discrete-time stochastic process simulation, some conditional probabilities are used. Those are, $Pr(GA/GQ)$: a probability that patient gives good answer to doctor's good question, $Pr(GQ/GA)$: a probability that doctor gives good question after patient gave good answer to previous question, $Pr(GA/NQ)$ and $Pr(GQ/NA)$ are defined in the same fashion. By substituting any reasonable number (0 to 1) for these conditional probabilities with Monte-Carlo method and multiple-regression analysis, correlation between those conditional probabilities and success of interview is investigated and ranked.

Results: After over 10000-time simulation, results are obtained as following. With simple diseases that require relatively small number of good answer to figure out what to do next, ranking of correlation to success of interview is that $Pr(GA/NQ)$, $Pr(GA/GQ)$, $Pr(GQ/NA)$, $Pr(GQ/GA)$. With complicated diseases that require relatively large number of good answer, ranking of correlation is $Pr(GA/GQ)$, $Pr(GQ/GA)$, $Pr(GA/NQ)$, $Pr(GQ/NA)$

Conclusion: For any disease, adequacy of patient's answer always has more influence on success of interview than adequacy of doctor's question. For simple diseases, $Pr(GQ/NA)$ has more correlation to success of interview than $Pr(GQ/GA)$. This suggests that it is important for physician to conjecture the patient's real intention. For complicated disease, $Pr(GA/GQ)$ and $Pr(GQ/GA)$ have high correlation to success of interviews. This suggests "good answer to good question" sequence is quite important to diagnosis for complicated diseases.

Recording Diagnostic Uncertainty in Outpatient Settings

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Background: Errors of diagnosis affect about 1 in 20 US adults annually in outpatient settings. Because providers often make decisions in the midst of uncertainty, appropriate management and documentation of diagnostic uncertainty could potentially avert harm from an error. We conducted a secondary analysis of the nationally representative and publically available National Ambulatory Medical Care Survey (NAMCS) dataset to examine how physicians recorded diagnostic uncertainty in the medical record.

Methods: We pooled NAMCS datasets from years 2006-2010 and identified two visit-based cohorts of patients whose primary diagnoses were likely uncertain. Cohort 1 consisted of visits with primary diagnoses coded using ICD-9-CM codes 780-799 (signs, symptoms, and ill-defined conditions; SSIDs). The rationale for considering these diagnoses "uncertain" was that ICD-9-CM coding guidelines recommend reporting "clinical condition(s) to the highest degree of certainty for that encounter/visit." Thus, we considered the diagnosis uncertain when the primary ICD-9-CM code reflected absence of a relevant definitive diagnosis. Cohort 2 consisted of visits for which the physician, office staff, or NAMCS staff reported the diagnosis as a "probable, questionable, or rule-out diagnosis" on the NAMCS survey instrument (NAMCS-defined uncertainty). Patient visits without primary diagnoses (0.65%) were excluded. We compared the weight-adjusted percentages of visits with diagnostic uncertainty and their overlap in the cohorts using STATA 12.1 (Stata Corp).

Results: Over the 5-year period, 153,133 un-weighted physician office visits with a primary diagnosis were recorded in NAMCS, representing 4.86 billion outpatient visits. Of these, 12,578 met definitions for diagnostic uncertainty (Cohort 1 or 2). Extrapolating to the NAMCS sampling frame, we estimated that Cohort 1 criteria applied to 325.3 million visits (6.7%), whereas Cohort 2 represented 47.3 million visits (0.97%). In total, we extrapolated both definitions of diagnostic uncertainty to 370.2 million visits (7.62%; 95% CI 7.33-7.92%). Physicians coded an estimated 44.95 million visits (0.92%) using a specific diagnosis code (instead of SSIDs) despite being defined as uncertain in NAMCS.

Conclusion: We found evidence of diagnostic uncertainty in approximately 8% of outpatient visits. In nearly 1% of visits (approximately 9 million visits/year), definitive diagnoses were coded despite the presence of diagnostic uncertainty. Diagnostic uncertainty, while common, is inadequately addressed by the current coding and billing structure (ICD-9 CM and ICD-10). A code for uncertain diagnosis could be one way to ensure that patients are not labelled incorrectly with diagnoses they don't have. Our findings call for new strategies to ensure accurate recording of diagnostic uncertainty in outpatient

settings.

Table 1: Uncertainty in primary diagnosis as defined using ICD-9-CM SSID codes and the NAMCS survey instrument				
		Uncertainty defined by the use of SSIDs % (95% CI)		
		Uncertain	Certain	Total
NAMCS Defined Uncertainty % (95% CI)	Uncertain	0.049% (0.037-0.066%)	0.925% (0.84-1.02%)	0.974%
	Certain	6.647% (6.36-6.95%)	92.379% (92.08-92.67%)	99.026%
	Total	6.696%	93.304%	100%
Note: Percentages indicate nationally representative weight-adjusted estimates.				

A Naturalistic Evaluation of a Diagnostic Support System for Family Physicians

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Background: We designed a diagnostic support system (DSS) prototype based on the principle of "early support" (Kostopoulou et al. 2015a; 2015b) and integrated it with an electronic health record (EHR) system, using the EHR's application interface. The DSS currently supports three clinical problems: abdominal pain, chest pain, and dyspnea. It is triggered when the physician enters the main patient problem, and immediately displays a list of suggested diagnoses for the specific patient. It enables physicians to code easily presence and absence of symptoms and signs, while the list of suggested diagnoses is updated accordingly. At the end of the consultation, all the information that the physician has recorded is automatically transferred into the patient's EHR.

Methods: 34 UK family physicians diagnosed 12 standardized patients (actors) in simulated clinics, in 10-minute appointments. Each physician consulted with 6 patients using their usual EHR, and on a second occasion, with 6 different but matched for difficulty patients, using their EHR with the integrated DSS. Physicians completed a usability questionnaire at the end. Actors completed a patient satisfaction questionnaire after each patient-physician encounter. Data were analyzed using logistic or linear regressions with random intercept to account for data clustering, and patient sequence as a repeated measure.

Results: Mean diagnostic accuracy was higher with the DSS than without: means 0.58 [0.52-0.65] vs. 0.50 [95% CI 0.42-0.57], odds ratio 1.41, 95% CI [1.13-1.77] ($P<0.01$). Physicians felt more certain about their diagnosis when using the DSS (B=0.39 [0.12-0.67], $P<0.05$), and coded significantly more information with the DSS than without (means 12.35 vs. 1.64 data items). There was no significant difference in consultation length: means 14.42 minutes with the DSS vs. 13.73 without. Physicians were generally satisfied with the usability of the DSS (mean 3.40, SD 1.12; answers provided on 7-point scale, with lower numbers indicating better usability). Satisfaction with usability decreased with increasing years in practice (B=-0.03, [-0.05 to -0.003], $P<0.05$). Patient satisfaction with the consultation did not differ between conditions (means 3.31 without vs. 3.29 with the DSS; answers provided on 5-point scale).

Conclusion: We showed a clinically significant improvement in diagnostic accuracy, in a high fidelity simulation. Perceived usability and patient satisfaction are encouraging. This was the first time that the physicians were using the DSS prototype, following a 30-minute training session. We are currently analyzing how the DSS influenced performance in more detail, and planning to extend the scope of the clinical problems supported.

Team Analysis of Clinical Thinking (TACT) for Better Outcomes through Better Diagnosis.

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Background: Team analysis of clinical thinking (TACT) is a tool designed in an effort to circumvent diagnostic errors or improve error detection using a team-based approach. It works by streamlining the thought process and simplifying the complexities underlying the pathobiology of disease presentation.

Methods: The process involves assigning specific roles to at least 5 team members who address pathophysiology, worst-case scenario and the biggest questions concerning patient management. The team members include a moderator who assigns the roles and keeps the flow moving, a case presenter, a " Big Question" member who asks relevant questions that can potentially affect patient safety, a "worst-case scenario" member and a team member dedicated to the pathophysiology of diseases. The TACT process was applied to all new patients admitted to the resident service over 8 weeks. A structured group protocol similar to De Bono's colored hats was applied to efficiently process each case. Subsequently, a survey was distributed to involved residents.

Results: We found that among the responders who had used the TACT sheets for one week or more, 66% thought that this process had a positive impact on patient care. The survey also included questions regarding the length of stay, excessive testing and the duration of rounds.

Conclusion: Based on the survey and informal impressions, our experience suggests that TACT is a valuable educational exercise, and may have a significant impact on diagnostic error. We plan a pilot study that rigorously assesses diagnostic accuracy, patient safety, and potential costs of the approach.

'Big Data' Insights into Missed Diagnostic Opportunities for Cancer: Evidence from 0.67 Million Patients with 35 Cancers

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Background: It would be ideal if family doctors were able to suspect a malignancy when patients subsequently diagnosed with cancer first present to them with symptoms. However, current limitations in diagnostic technology and medical knowledge prevent us from achieving this ideal. For example, in countries such as England and Denmark, only a minority of all cancer patients is diagnosed through the 'suspected cancer' referral pathways that shorten diagnostic intervals to rapid specialist assessment. Studying variation in 'suspected cancer' referrals between patients with different cancers and characteristics can elucidate factors contributing to delayed diagnosis, and inform targeted diagnostic quality initiatives and research.
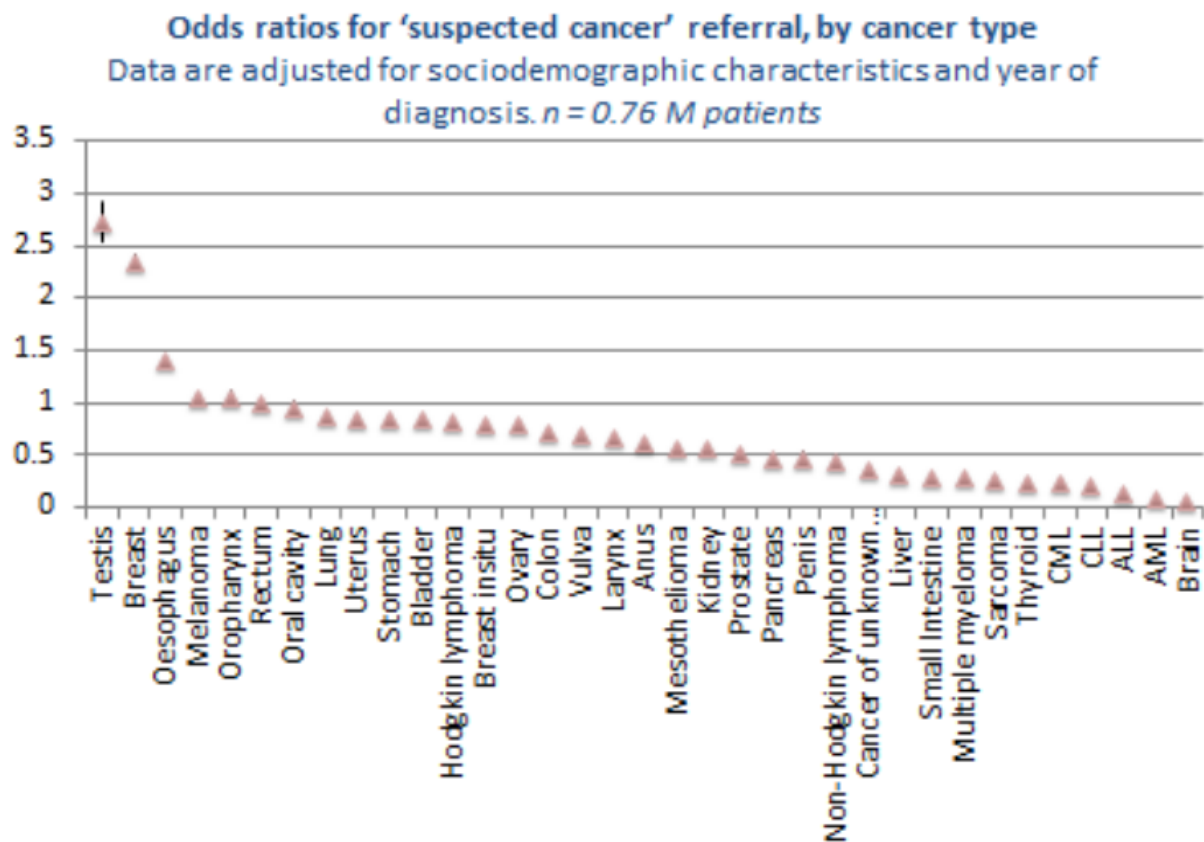
Methods: We examined anonymous data from about 0.76 million cancer patients diagnosed 2006-2010 following either a 'suspected cancer' or 'routine' family doctor referral to hospital specialists. We used data from the English population-based 'Routes to Diagnosis' project – a linked healthcare data resource. We used logistic regression to examine variation (by cancer type, age, sex, socioeconomic group and year of diagnosis) in the odds of 'suspected cancer' (as opposed to 'routine') referral.

Results: Patients with cancers with a symptom signature characterized by the presence of 'alarm' (or 'red flag') presenting symptoms in most patients (such as testicular, breast, esophageal, and melanoma cancers) were more likely to be referred through the 'suspected cancer' pathways (and consequently be subject to minimal delay). In contrast, patients with cancers where most patients present with non-specific symptoms at presentation were least likely to be referred through a 'suspected cancer' pathway – these included patients with brain cancer, multiple myeloma and Cancer of Unknown Primary. Younger patients were less likely to be referred via the 'suspected cancer' pathway, without notable variation by sex or socioeconomic status.

Conclusion: Patients with cancers with clear symptom signatures are much more likely than average to benefit from faster referral. As clinical guidelines, by their nature, focus on 'alarm' symptoms, their effectiveness in accelerating diagnosis is concentrated on few symptomatic presentations and, as our data suggest, on some cancers only. Therefore other interventions, beyond simple implementation of 'red flag' focused clinical guidelines, are needed to improve diagnostic timeliness and safety in primary care. These may include the development of new diagnostic (ideally point-of-care) tests, electronic health record embedded interventions (such as 'triggers') to support decision-making both during and after the

clinical encounter, greater use of 'active monitoring' approaches and patient empowerment interventions.

Odds ratios for 'suspected cancer' referral, by cancer type
Data are adjusted for sociodemographic characteristics and year of diagnosis. $n = 0.76$ M patients

A Stratified Framework for Diagnostic Quality and Safety Resarch: How the Risk of Cancer Diagnosis Varies for 2000 Different Cancer Type-Age-Sex-Socioecnomic Group Strata.

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Background: The diagnosis of cancer as a medical emergency is associated with poorer outcomes. Avoidable delays before emergency presentation may be implicated in some cases. Sociodemographic and cancer site variation in cancer diagnosis as an emergency has been previously described, but relatively little is known about how this risk may vary differentially by sex, age and deprivation group between patients with a given cancer.

Methods: Data from the Routes to Diagnosis project on 749,645 patients (2006-2010) with any of 27 cancers that can occur in either sex were analysed. Crude proportions and crude and adjusted odds ratios were calculated for emergency diagnosis, and interactions between sex, age and deprivation with cancer were examined.

Results: The overall proportion of patients diagnosed as emergencies varied greatly by cancer. Compared with men, women were at greater risk for emergency diagnosis for bladder, brain, rectal, liver, stomach, colon and lung cancer (e.g., bladder cancer-specific odds ratio for women vs men, 1.50; 95% CI 1.39-1.60), whereas the opposite was true for oral/oropharyngeal cancer, lymphomas and melanoma (e.g., oropharyngeal cancer-specific odds ratio for women vs men, 0.49; 95% CI 0.32-0.73). Similarly, younger patients were at higher risk for emergency diagnosis for acute leukaemia, colon, stomach and oesophageal cancer (e.g., colon cancer-specific odds ratio in 35-44- vs 65-74-year-olds, 2.01; 95% CI 1.76-2.30) and older patients for laryngeal, melanoma, thyroid, oral and Hodgkin's lymphoma (e.g., melanoma specific odds ratio in 35-44- vs 65-74-year-olds, 0.20; 95% CI 0.12-0.33). Inequalities in the risk of emergency diagnosis by deprivation group were greatest for oral/oropharyngeal, anal, laryngeal and small intestine cancers. The included figure has the following legend, and is ncluded as a demonstration of the size of between-strata variation. **Cancer-specific odds ratios and 95% confidence intervals for emergency presentation by age group compared with 65–74 years (reference).**Note that where cancer-specific age groups contained no cases or all cases were either emergency or non-emergency presentations, odds ratios cannot be estimated and are not shown. This relates to the two younger age groups (25–34 or 35–44), for a total of 30 individual tumours across nine cancers

Conclusion: Among patients with the same cancer, the risk for emergency diagnosis varies notably by sex, age and deprivation group. The findings suggest that, beyond tumour biology, diagnosis through an emergency route may be associated both with psychosocial processes, which can delay seeking of medical help, and with healthcare factors impeding timely diagnostic suspision of cancer after

presentation to primary care.
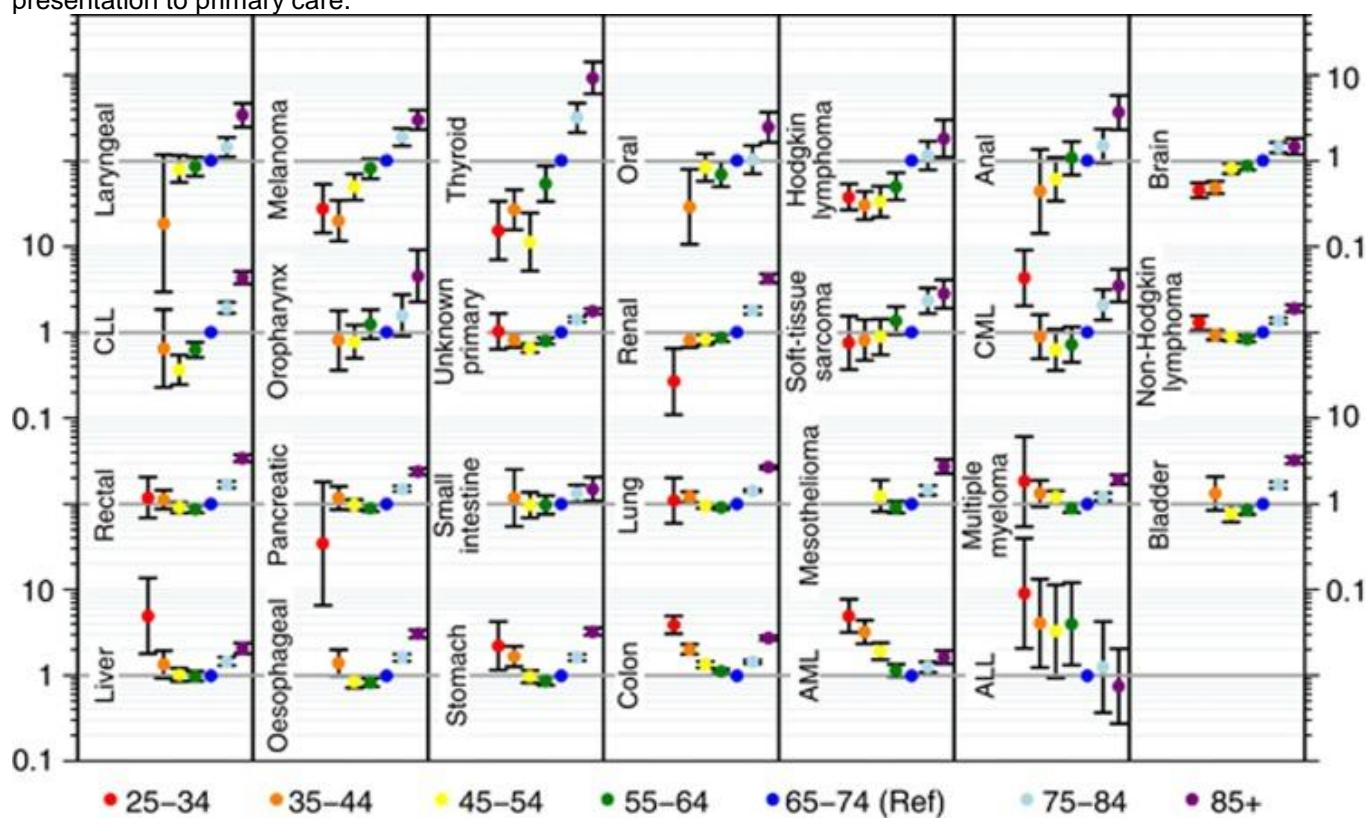
Identifying the Issues: A State-Wide Evaluation of Reported Delayed and Missed Diagnoses

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Background: There is an increasing awareness of errors relating to diagnostic processes across the New South Wales (NSW) Health System. The challenges in measuring errors in diagnosis are well documented in the literature and are multifactorial. Despite this, the NSW state-wide incident information management system demonstrates a significant number of delayed and missed diagnoses enabling a detailed analysis to be undertaken.

Methods: All incidents reported within the delayed and missed diagnosis subcategory over 2 years across all NSW health facilities were extracted and reviewed. Information extracted includes; incident location, clinical specialty, incident description, incident investigation, incident date and time, severity assessment code (SAC) and notifier designation. From this information a final diagnosis and the types of error were determined. Incidents with a SAC rating of 1 were further analysed to include identification of system, patient and cognitive factors that may have impacted the decision making process. Reported incidents that did not clearly demonstrate an error in diagnosis, incidents where the diagnosis was known, but there was a delay or problem in treatment decisions and incidents where there was insufficient information were excluded.

Results: A total of 5028 reported incidents over 2 years were reviewed. 1040 (573 delayed and 467 missed) incidents provided sufficient incident detail and evidence that a diagnostic error had occurred. Table 1 identifies incidents by severity rating with 1 the most severe and 4 having little or no impact on patient outcome.

	2012				2013			
	1	2	3	4	1	2	3	4
Delayed	27	48	156	69	22	51	137	54
Missed	29	52	109	43	24	49	114	41

The most frequently reported errors are clinically grouped as; Fractures (15.4%), Cardiac (12.9%), Peri-natal conditions (11.4%) and Abdominal / GI (8.4%). 429 (41.2%) of incidents were reported to have occurred during the hours of 5pm and 8am. A total of 772 contributing factors across the 1040 reported incidents were identified including errors in; assessment, history and interpretation, performing or reporting investigations, identifying significance or urgency and missed escalation or referral where appropriate. Most frequently these are reported by nursing (46.5%) and medical staff (35.8%).

Conclusion: Reporting and evaluating clinical incidents relating to diagnostic error can provide a rich source of information to which strategies for improvement can be targeted. It is important, however to recognise the information provided depends on incidents being recognised and a local culture of reporting and therefore remains merely the tip of the iceberg.

Do Delays in Diagnosis Influence the Patient Experience of Subsequent Care? Evidence from 73,000 Respondents to the English Cancer Patient Experience Survey

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Background: It is often thought that delays in diagnosis and missed diagnostic opportunities may negatively affect patient experience, but evidence about this assertion is sparse. We conducted a study to explore this question empirically using patient-reported data.

Methods: We analysed data from 73,462 respondents to two English Cancer Patient Experience Surveys to examine whether patients with three or more (3+) pre-diagnostic (pre-referral) consultations with a family doctor were more likely to report negative experiences of subsequent care compared with patients with 1 or 2 consultations in respect of 12 *a priori* selected survey questions. For each of 12 experience items, logistic regression models were used, adjusting for prior consultation category, cancer site, socio-demographic case-mix and response tendency.

Results: There was strong evidence (p<0.01 for all) that patients with 3+ pre-diagnostic consultations reported worse care experience for 10/12 questions, with adjusted odds ratios compared with patients with 1-2 consultations ranging from 1.13 (95% confidence intervals 1.08-1.19) to 1.68 (1.60-1.77), or between +1.5% and +10.6% greater percentage reporting a negative experience. Associations were stronger for processes involving primary as opposed to hospital care; and for evaluation than report items. Considering 1, 2, 3-4 and '5+' pre-diagnostic consultations separately a 'dose-response' relationship was apparent.

Figure: Odds ratios (and 95% CIs) for negative experience for patients with 'three or more' pre-diagnostic consultations with a general practitioner, compared with patients with 1-2 consultations (reference). Questions ordered by effect size with evaluative questions on the left and report questions on the right.

Conclusion: We provide large scale evidence documenting the presence and size of negative associations between multiple pre-diagnostic consultations with a family doctor and the experience of

subsequent care.
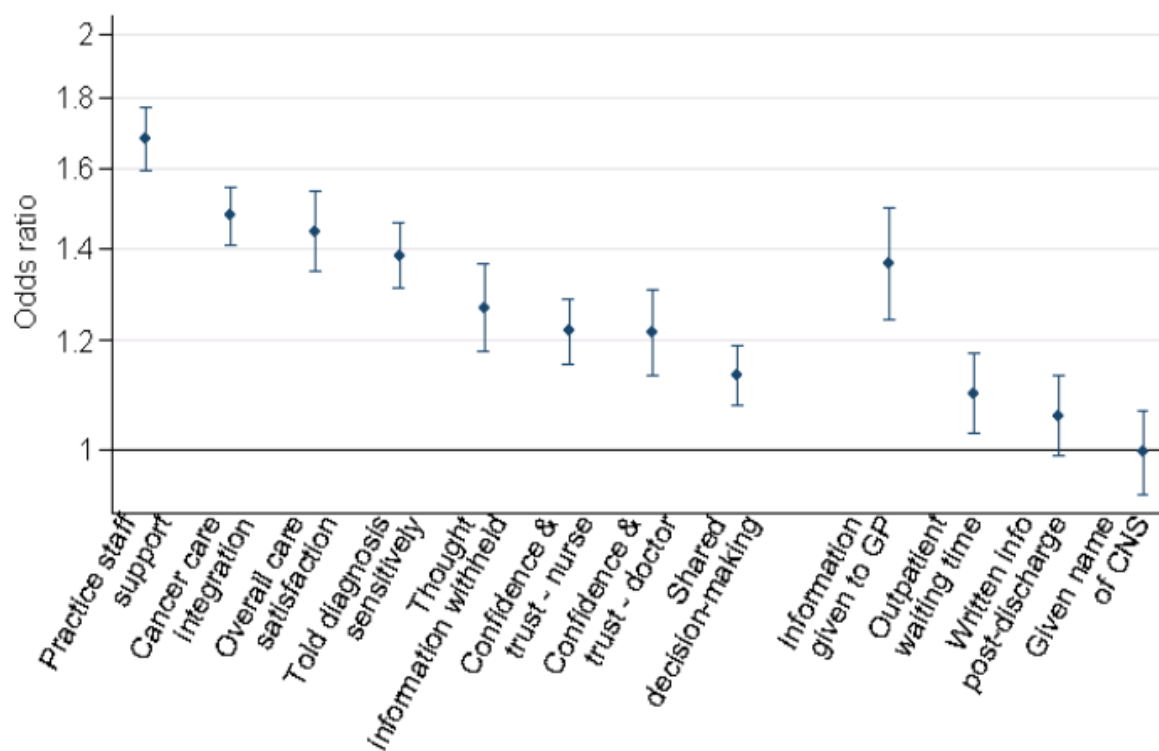
Performance, Uptake and Evolution of Multiplex PCR Testing for Acute Diarrhea

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Background:

Infectious diarrhea is usually self-limited, and determining the pathogen has traditionally been difficult and of limited clinical utility. The automated polymerase chain reaction panel (GIPCR) allows safer specimen handling, quicker results than stool culture, simultaneous testing for multiple organisms with a single stool sample, and more accurate pathogen identification. However, the impact of GIPCR on diagnostic/treatment strategies is not known. We examined the performance, uptake, and evolution of GIPCR testing at one academic health care system after replacement of more traditional stool culture techniques.

Methods:

Diagnostic test - Multiplex PCR panel for 13 different organisms (virus, bacteria, parasitic) (GIPCR). Testing for *C. difficile* was not included on the GIPCR panel.

Study design - We examined all GIPCR panels ordered at a single academic health care system during the 6 month period (1/10- 6/17/2015) after the GIPCR replaced stool cultures and parasite testing. We performed chart review on adult patients for the first and sixth months to determine patient characteristics (age, immunocompromise, clinical setting), intermediate diagnostic tests (concomitant stool testing, stool for WBCs), and pathogen identification.

Results:

Of 1136 GIPCR panels ordered during the 6 month period, 30.0% (340/1136) were positive for a pathogenic organism. Overall, viruses were most common (19.0%, 216 /1136), followed by bacteria (9.5%) and protozoa (1.0%). Comparing adult patients seen in the 1st or 6th month of implementation, there was no significant difference in the number of GIPCR tests ordered, (101 vs 104), no difference in source clinical settings (hospital 55.5%, ambulatory 27.2%, ED, 12.0%), nor in the prevalence of positive GIPCR tests. Ambulatory adults in primary care (n=61) were more likely to have a positive GIPCR than hospitalized patients (n=91) (24.5% vs 19.7%) and were more likely to have a bacterial organism (13.1% vs 7.7%). Immunocompromised (n=62) were more likely to have a positive GIPCR than nonimmunocompromised patients (n=91) (24.2% vs 18.3%), but more likely to have a viral rather than a bacterial cause (4.8% vs 10.8%). Among adult primary care patients, chart review showed no obvious change in diarrhea duration, use of intermediate diagnostic tests, or antibiotic use.

Conclusion: In this setting, GIPCR has rapidly replaced the standard clinical evaluation of acute diarrhea. There was no evidence of excessive ordering or diagnosis creep of the GIPCR; clinician guidance on testing indications does not seem necessary. The GIPCR will dramatically influence future diagnostic and treatment algorithms for acute diarrhea.

Missing the Diagnosis of Early Cancers in Primary Care: The Role of First Diagnostic Impressions

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Background: Delays in cancer diagnosis are a common problem in primary care both in the USA and Europe. Physicians' cognitive processes are thought partly responsible. Psychology research and physicians' own accounts suggest that initial diagnostic impressions are paramount for the outcome of the diagnostic process. We aimed to demonstrate and measure the association between physicians' initial diagnostic impressions and subsequent diagnosis and management of potential cancers.

Methods: Ninety UK family physicians diagnosed and managed six detailed patient scenarios online, while on the phone with a researcher. Three of the scenarios depicted possible cancers (colorectal, lung, myeloma), while the other three could not be cancers. The latter three scenarios were employed to get participants used to the study methodology, and as decoys, to avoid giving the impression that the study was about cancer. The cancer scenarios contained no alarm symptoms for cancer (e.g. hemoptysis, rectal bleeding). All scenario patients presented twice, the second time with no improvement of their main symptom and some new symptoms. After reading the introductory patient description and presenting problem, physicians could ask for more information, which was displayed online by the researcher. In two scenarios, participants thought aloud. Two independent raters coded the physicians' first impressions, i.e. their verbalizations immediately after they read the introductory information and before asking further questions, as either acknowledging the possibility of cancer or not. We measured the associations of first impressions with information search, diagnosis, and referral.

Results: First impressions were strongly associated with both diagnosis and referral decisions: when cancer was not acknowledged initially as a possibility, the odds of subsequently giving it either as the working diagnosis or in the differential were reduced on average by 74% (odds ratio 0.26 [95% CI 0.16 to 0.45]); the odds of urgent referral (within two weeks) were reduced by 57% (OR 0.43 [0.23 to 0.80]); and of any referral by 44% (OR 0.56 [0.32 to 0.99]). The number of cancer-related questions that participants asked mediated the relationship between first impressions and diagnosis, explaining 28% of the total effect.

Conclusion: The study established the strong association between family physicians' first diagnostic impressions and their subsequent diagnosis and referral of possible cancers, as a potentially important reason for delay in cancer diagnosis. Interventions to reduce missed cancers in primary care, such as decision support or educational strategies, should target the early, hypothesis generation stage of the diagnostic process.

Developing a Criterion to Explore Treatment As a Deductive Process during Diagnosis in Primary Care

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Background: Analysis of providers' cognitive work suggests diagnostic testing is not the only way to generate new evidence. The administration of treatment and observation of response may be used to generate clinical information. Thus, response to treatment may help physicians deduce their diagnostic hypothesis. We aimed to develop criteria for operationally defining a "deduction-by-treatment" (DbT) strategy for chart reviews, to study the occurrence and impact of the DbT phenomenon by primary care providers (PCP).

Methods: To establish criteria for identifying the DbT strategy, an iterative process was used to define and apply the criteria to an expanding set of cases. Three diagnosis researchers, including 1 primary care physician and 2 human factors professionals, reviewed and discussed cases to identify patterns that define the DbT strategy. Discussions involved the identification of features in PCP notes for each case that either confirmed the use or non-use of a DbT strategy. Each criterion was discussed until a consensus was reached to establish the DbT criteria. In total we reviewed 17 cases randomly selected from a previous study on diagnostic quality (in which 12 preceded unplanned admissions, and 5 did not).

Results: Discussions of features that identify the DbT strategy resulted in the criterion found in Table 1.

Table 1 Criterion to identify the deduction-by-treatment strategy in patient charts	
1.	There is a diagnosis recorded in the chart within the index visit being analyzed
2.	There is some expression of uncertainty associated with the recorded diagnosis
3.	There is **no** record of diagnostic tests or consults being performed to test the recorded diagnosis
4.	There is a treatment plan recorded in the chart that is appropriate for the recorded diagnosis and would affect the recorded diagnosis in a way that is observable in an appropriate time frame

In applying the criteria to the 12 cases related to unplanned admissions, 7 (53%) showed some use of the DbT strategy.

Conclusion: Our preliminary analysis of primary care visit charts support the construct of a 'deduction-by-treatment' strategy. Applying the criteria to diagnostic error cases suggest our newly developed criteria is effective at identifying situations of DbT in the primary care setting. The criteria resulting from the current study can inform future chart review studies and provide more information on the occurrence, frequency, and context of use of the DbT technique by primary care clinicians.

Absent Confidence Intervals and Persistent Use of Relative Risk: Lessons from the Nurse Practitioner Clinical Literature

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Background: As the nurse practitioner profession is maturing, so is its literature. NPs now consult journals written by and for nurse practitioners. Two journals, *Journal of the American Association of Nurse Practitioners* and *The Journal for Nurse Practitioners*, predominate this market. These journals publish original research as well as clinical review articles. This published work should help NPs understand the state of the science about a particular clinical issue and clearly communicate uncertainty and risk so that the reader can make informed decisions. This is essential to providing high quality, evidence-based practice. Therefore, the question is whether these two journals publish manuscripts that meet the standard for communicating uncertainty and risk?

Methods: To answer this question, three years of each journal (2011-2013) were evaluated for whether one of more of the authors had the DNP and/ or PhD degree, the presence of confidence intervals when reporting a p-value and for explicitly stating relative or absolute risk when reporting risk and/ or risk reduction.

Results: JAANP & JNP articles explicitly reported p-values in 75 out of 174 articles that could have reported confidence intervals. For those reporting p-values, only 35 articles explicitly provided confidence intervals, primarily in research reports using logistic and other regression analyses. Overall, confidence intervals were mostly missing in action. Similarly, for the reporting of risk, most authors did not specify absolute or relative risk reduction when reporting risk. However, on close reading, most authors were reporting relative risk reduction in their literature reviews.

Conclusion: The NP journals must follow long-standing, international guidelines for reporting original research and clinical reviews. This requires the inclusion of confidence intervals and the reporting of absolute risks and benefits for informed, shared decision-making. Reviewers and authors may be unfamiliar with these issues so editors and educators must take the lead. Undergraduate nursing students may be best served by learning Bayesian thinking before null hypothesis statistical testing.

Using Public Deliberation to Define Patient Roles As Partners in the Diagnostic Process

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Background: The health field lacks patient-focused strategies to improve diagnostic quality. Most initiatives focus on physicians and healthcare systems; few engage the healthcare consumers in preventing, identifying, and reporting diagnostic error.

Methods: We are conducting a 2-year NIH-funded research project where healthcare consumers engage in deliberation to develop informed and practical patient-focused strategies for reducing diagnostic error. We are using a randomized and controlled experimental research design that involves healthcare consumers. Participants are being randomly assigned into two matched-pair panels as well as a third unmatched panel of healthcare consumers, and a control group of healthcare consumers. Participants in the two matched-pair panels are randomly assigned for exposure to one of two protocols: (1) education about diagnostic error, or (2) education and deliberation about diagnostic error. The deliberative panels are exploring the role(s) patients are willing and able to play in preventing, identifying, and reporting diagnostic error, as well as strategies to enable patients to assume those roles. The recommendations created by these deliberative panels will be tested with the third (unmatched) deliberative consumer panel, which will also rank and prioritize the recommendations. SIDM will use the recommendations to develop strategic plans, policy statements, and research agendas about patient engagement in reducing diagnostic error, as well as to create a patient engagement "toolkit" for healthcare systems, providers, and consumers.

Results: This research is currently in progress. To evaluate the project, we are using pre- and post-test surveys administered to all panels and the control group, along with interviews of SIDM personnel. During the presentation, we will explain the innovative research design, present the preliminary results from the surveys of the first deliberative panel with consumers, and reveal the initial recommendations from the first healthcare consumer panel. We will also invite conference attendees to *participate in our research*by offering feedback at our poster display. We will give this feedback to the second consumer panel as they finalize their recommendations.

Conclusion: In addition to informing the work of SIDM, the project will inform the Agency for Healthcare Research & Quality about the impact of consumer deliberation on improving quality of healthcare. The deliberative panels will explore the role(s) patients are willing and able to play in preventing, identifying, and reporting diagnostic error; the strategies that should be used to enable patients to play those roles; and the systems and structures needed for patients to assume those roles.

Evidence of the Predominant Use of Disease Prototypes over Individual Case Exemplars Prior to and Following Diagnostic Training Among Early Year One Medical Students

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Background: One of the primary impediments to diagnostic accuracy is that most diseases are ill-defined (i.e., lack a criteria meeting set of signs and symptoms which are either necessary and/or sufficient for confidently conferring a diagnosis at the bedside). Dual Processing Theory's (DPT) System I constructs (Exemplars and Prototypes) provide educators and researchers a framework with which to both design training approaches, and explore the cognitive factors, likely to improve diagnostic performance against ill-defined diseases. This investigation utilized these two System I constructs to: 1) create an instructional activity intended to improve diagnostic capabilities, and 2) determine whether any observed diagnostic performance improvements were primarily driven by Exemplars or Prototypes.

Methods: Following IRB approval, 117 third month, year one medical students volunteered to participate in a two hour instructional activity involving nine common and important ill-defined disease differentials for the problem of Acute Chest Pain. Evidence of diagnostic improvements were based upon a pre and post training assessment instrument containing the same 27 test case vignettes with each of the nine diseases represented in turn by three vignettes (one most typical, one mid-typical and one least typical portrayal). Stratification of these 27 cases into three sets of vignettes representing the nine most typical, mid typical, and least typical portrayals, enabled determination of the correlation between performance and the typicality of these three sets of vignettes. As typicality was defined in this investigation, a positive correlation between performance and typicality would suggest the students' predominant use of System I Prototypes while no correlation between performance and typicality would suggest predominant use of System I Exemplars.

Results: A pre vs post training performance comparison revealed a highly significant improvement in diagnostic capabilities; $t=14.04$, $p<0.001$, Cohen's $d=1.32$. Following assignment of all 117 subjects into three performance groups (low, middle and high; $N = 39$ subjects per group), the post-training correlation between performance and the typicality of the test cases was positive for each group (low, 0.29; middle = 0.34; high = 0.33). Evidence of a positive correlation across all three performance groups suggests that disease prototypes more likely served as the primary driver of the observed performance improvements than disease exemplars.

Conclusion: DPT is a useful framework for both designing improved approaches to diagnostic training and a means of investigating the cognitive factors driving improvements in the diagnostic capabilities of early medical students in dealing with ill-defined diseases.

Public Reactions to Diagnostic Error Burden in US Outpatient Care

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Background: Diagnostic errors pose a significant threat to patient safety; however, little is known about public perceptions of diagnostic errors. A recent study estimated that diagnostic errors affect at least 5% of US adults per year (or 12 million) in the outpatient setting about half of which could be harmful. We sought to explore online public reactions to media reports on the frequency of diagnostic errors in the US adult population.

Methods: We conducted a qualitative content analysis of comments made in response to the online news reports on the study as proxy for public reaction to the newly reported diagnostic error burden. Within 2 weeks of release, we identified 25 online news articles reporting on the error frequency. Thirteen of these websites had public comments available and were included. There were a total of 289 anonymous comments, ranging from 1 to 79 per website. Fifty-three comments (18.3%) were excluded due to lack of relevance to the research objective, and the remaining 235 comments were analyzed in depth.

Results: Overall, there was very little commentary on the frequency or burden of diagnostic errors. Commenters instead focused on US health care policy as it relates to diagnostic quality of care. Two major categories emerged: 1) perceptions of US health care providers (n=79; 73 commenters) and 2) the role of current US health care reform-related policies, most commonly focused on the Affordable Care Act (ACA) and insurance/reimbursement issues (n=62; 47 commenters). Commenters expressed strong feelings, both positive and negative, about the quality of care in the US and appeared to have mixed perceptions of physicians' role. Policy concerns included care degradation and increased costs related to the ACA and insurance companies. Additionally, in response to the media coverage, 44 commenters shared 54 personal experiences of diagnostic errors. This included both patients who shared their own or their relatives' experiences and health care providers, who shared either personal or colleagues' experiences.

Conclusion: The public appears to have substantive concerns about the impact of the ACA and other reform initiatives on the diagnostic quality of care. Unfortunately, policy issues around diagnostic errors and improving diagnosis are understudied and underdeveloped and are largely absent from the current national conversation on improving quality and safety. In order to address this public concern, researchers and policymakers should investigate the effects of changes in policy on diagnostic accuracy. Measurement of health care reform's impact on quality and safety should include an assessment of its impact on diagnosis.

Utilizing Electronic Health Record Data to Model Diagnostic Error

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Background: Diagnostic error in medicine is relatively common, and is associated with poor outcomes, complications, and mortality. As medicine has become increasingly complex, more opportunities for human error have emerged. Achieving diagnostic proficiency is essential to avoiding diagnostic errors; however, maintaining proficiency is equally important for reducing complications rates and improving outcomes. AHRQ has recommended that clinicians need regular feedback on their diagnostic performance as they are frequently unaware of diagnostic errors committed. A promising source of data to quantify diagnostic error is the electronic health record (EHR). An analytical tool is needed that can not only identify diagnostic error but also predict probable skill degradation and specify appropriate retraining regimens to avoid diagnostic error.

Methods: A hybrid cognitive model of physician skill decay was developed using a dataset of 1.1M individual patients to identify occurrence of clinical skill degradation within the outpatient domain and predict when specific diagnostic skills will be likely to degrade. A derivative of the power law was developed to temporally model estimated predictions of decay while a rule based pattern recognition component captures the deviation between the nationally recognized standards of care and the quality of care the physician has provided. Bayesian inference provides a confidence estimate that the captured deviation is in fact associated with diagnostic error. Diagnostic errors were then correlated with outpatient adverse events to determine if implementation of the hybrid cognitive model could in fact identify and prevent adverse outcomes.

Results: Initial results suggest that physician skill decay estimated from the EHR correlates with adverse events across diseases including diabetes mellitus, asthma, cardiovascular disease, rheumatoid arthritis and dementia. Continuing work consists of investigating the predictive power of the hybrid model and validating the model in a hospital setting.

Conclusion: EHR data may utilized as a source for the modeling and prevention of diagnostic errors. Complementing with objective measures of cognitive skill decay that interactively assess the particular skills and knowledge areas that have degraded for a physician is expected to improve model accuracy.

Applied Innovations

Use and Perception of a Computerized Diagnostic Decision Support Tool in the Inpatient Setting

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Maine Medical Center, Tufts University School of Medicine, Portland, ME

Statement of problem: A major contributor to many diagnostic errors is the failure to generate an appropriate differential diagnosis. Although clinical decision support in the form of differential diagnosis generators is one potential solution, data is lacking regarding the utility and acceptability of these programs.

Description of the intervention or program: Isabel is a computerized diagnostic decision support (CDDS) program that provides a non-rank ordered differential diagnosis for a specific combination of clinical signs and symptoms as entered by the user. Isabel was implemented at a 637-bed community-based tertiary care academic medical center. Coincident with the implementation, an extensive educational campaign regarding the potential utility of the program was directed towards the Adult Medicine service line, inclusive of the Emergency Department and adult inpatient medical services. Prior to implementation, members of the service line were surveyed regarding impressions of CDDS and its potential to decrease diagnostic error. The survey was repeated six months after implementation. Detailed usage data was also recorded.

Findings to date: The pre-implementation survey response rate was 52% (n=106). 77% believed CDDS could decrease their rate of diagnostic error while 32% felt the time needed to use CDDS would outweigh the benefits of doing so. Post-implementation response rate was 47% (n=95). Among all respondents, 60% felt Isabel could decrease the rate of diagnostic error in medicine, 24% felt its use decreased their personal rate of diagnostic error and 28% felt the benefit of using Isabel was outweighed by the time incurred in utilizing it. Among self-defined regular users (n=18), 94% believed Isabel could decrease diagnostic error and 78% felt use decreased their personal rate of error, but 67% felt the benefit of using Isabel was outweighed by the time incurred in utilizing it. Usage data revealed consistent use of Isabel with an average of component use rate of 623 per month. Peaks in use correlated with educational campaigns introducing Isabel.

Lessons learned: We found that most clinicians believe that CDDS can decrease the rate of diagnostic error in medicine and that Isabel has this potential. Regular users of Isabel noted a decrease in their rate of diagnostic error but were also dissuaded from use by the time necessary to employ the tool. We also found that the implementation of such tools needs to be accompanied by intensive educational campaigns. More streamlined integration into the clinical workflow will likely be necessary before such tools are widely accepted and utilized.

Reflections on a Longitudinal Curriculum on Diagnostic Error at Two Years

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Statement of problem: Most quality improvement and patient safety educational programs devote little attention to diagnostic error, leaving a gap in trainee education.

Description of the intervention or program: We implemented a longitudinal resident curriculum with these objectives:

1. Learners will begin to understand how they make diagnostic decisions.
2. Learners will reflect on their own, their mentors', and their colleagues' experiences when error occurred, and identify strategies to reduce these errors.
3. Learners will develop the skills to for constructive, non-judgmental feedback when diagnostic error occurs.
4. Learners will practice engaging patients and families as key members of the decision-making team, will identify patient empowerment as an important error-prevention tool, and will build expertise in discussing ambiguity and diagnostic error with patients and families.
5. Learners will demonstrate use of these knowledge and skills in real-life settings.

Findings to date: Residents reported that the curriculum has been understandable, useful, and has impacted they way they approach patient care. On a scale of 1 (strongly disagree) to 5 (strongly agree), residents rated sessions at an average of 4.2 in response to: "I feel that this block education session will improve my future practice in pediatrics." Among residents who completed an abbreviated version of the curriculum, pre and post-test data revealed significant improvements in ability to define various cognitive errors. In response to: "I am aware of strategies I can use to reduce the impact of cognitive errors in my patient care," 45% of residents responded "agree" on the pre-test vs 94% on the post test ($p < 0.0001$).

Lessons learned: Based on our experiences piloting this curriculum, we have adapted it for use elsewhere using five guiding principles:

1. *No content expert needed*: this topic is amenable to shared learning—having faculty learn alongside residents reinforced that these topics are relevant across the continuum of learning.
2. *Locally relevant*: content can be easily adapted to reflect institution-specific situations that are more personally relevant.
3. *Adaptable to time constraints:* given the varied nature of education in residency, the curriculum can be delivered in in multiple time formats.
4. *Integrated into workflow*: Putting theory into action real-time is key to reducing diagnostic errors.
5. *Values and respects vulnerability of the physician and the patient*: Recognizing the emotional distress that providers and patients feel following an error, and creating a supportive environment, is paramount.

Improving Diagnostic Reasoning through Structured Peer Feedback

K. Lane and **A. Olson**

University of Minnesota, Minneapolis, MN

Statement of problem: Residents on nightfloat rotations perform a significant number of admissions that are then cared for by daytime ward teams. However, they typically receive little formal feedback regarding their diagnostic reasoning. It is up to the nightfloat individual's prerogative to sift through the day team's notes and labs to determine how and why the diagnoses change in order to improve future clinical decisions. Further, according to the ACGME survey, only 50% of our Internal Medicine residents are satisfied with the overall feedback they receive. Our training program lacks regular, standardized, formal feedback regarding clinical reasoning.

Description of the intervention or program: In order address this lack of formal clinical reasoning feedback for Internal Medicine residents on nightfloat rotations, we created and will pilot a "Diagnostic Reasoning Feedback" form utilizing the secure messaging function of our electronic medical record. The pilot will consist of Internal Medicine residents on ward day and nightfloat teams. When a patient is admitted by a nightfloat resident, the day team accepting that patient will be asked to discuss the case and fill out the feedback form, briefly explaining how and why the differential diagnoses changed over the first day of admission and providing any relevant clinical pearls. The completed form will then be sent securely to that nightfloat resident and available for review within 24 hours of admission. This form was designed to be brief and easily incorporated into the teams' preexisting workflow. This form allows for formative feedback over the course of that resident's nightfloat rotation directly from his or her colleagues. Surveys will be distributed to residents before and after the pilot to determine satisfaction with the quality and type of feedback received, to evaluate changes in team discussions of clinical reasoning and diagnostic error, and to assess if this type of feedback changes current and future clinical practice.

Findings to date: This project will be piloted during August and September 2015 and preliminary data will be presented at the meeting. We have received an IRB exemption and pledges of support from our program director, administration, and chief residents.

Lessons learned: This project will be piloted during August and September 2015. We have no formal lessons to report as of yet but will have nearly two months of the project to report on at the meeting.

Check: A Mobile App for Better, Safer Diagnosis from the Human Diagnosis Project

S. Nundy

The Human Diagnosis Project, Dunn Loring, VA

Statement of problem:

Clinicians often experience uncertainty when evaluating new patient problems. Unlike in teaching hospitals in which patients are routinely presented and discussed on rounds, in routine clinical practice the vast majority of clinicians have little to no means to get input from peers on clinical decisions. The problem is two-fold: first, currently available tools such as curbside consults, referrals, practice guidelines, and online content repositories have major limitations, particularly in diagnosis; and second, clinicians self-select which patient problems to get input on and may not know what they do not know.

Description of the intervention or program:

Check is a mobile app for informal, peer consults created by the Human Diagnosis Project, or Human Dx. Human Dx is a global, open medical project to map any health problem to its possible diagnoses. The Project intends to empower anyone, anywhere, with the world's collective medical insight by enabling the first open diagnostic system. Using Check, clinicians have a simple and fast way to get input from colleagues and the global medical community on clinical cases. Using the Human Dx app, clinicians create an anonymized clinical case by entering the key findings and the current differential diagnosis. Clinicians from around the world then give input on the differential diagnosis and next steps in diagnosis. All of the interactions are encoded in structured data so that the system can synthesize the collective insight of the Project community.

Findings to date:

Since January 2015, Check has been pilot-tested by physicians and trainees at some of the top academic medical institutions. The majority of use has been by primary care physicians and generalists. Cases range from diagnostic dilemmas where the diagnosis is unknown to cases in which the diagnosis has been confirmed but in which a clinician wants input on alternative approaches to the case.

Lessons learned:

Lessons learned include:

- Check is an helpful and engaging way to get input on clinical cases. Despite lack of workflow integration or incentives, clinicians are routinely voluntarily checking cases.
- Check is currently well-suited for ambulatory care in which fewer healthcare resources are available and clinicians often practice independently rather than in multispecialty teams.
- There are significant barriers to integrating Check into routine clinical workflow including EHR interoperability and competing demands on time. The business case for reducing missed or delayed diagnoses remains limited.

Using Mobile Applications to Support the Management of Patients with Coagulation Disorders

K. Wilson

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Statement of problem: Partial Thromboplastin Time (PTT) testing is used for managing bleeding and clotting problems requiring quick follow-up action in emergent situations. Consultative services are not readily available to physicians in the field, therefore mobile applications may provide real time clinical information.

Description of the intervention or program: In 2012, the Centers for Disease Control and Prevention's Clinical Laboratory Integration into Healthcare Collaborative (CLIHC™) program developed a mobile application, the PTT Advisor, to provide clinical decision support with respect to the laboratory evaluation of patients with coagulation disorders. The PTT Advisor offers guidance on selecting the appropriate coagulation test which may be useful for assuring the correct test is selected and results are applied in a timely manner. This clinical decision support intervention integrates diagnostic algorithms created and reviewed by coagulation subject matter experts. The mobile technology is based on the iOS platform and is available at no charge on the iTunes store. The process for developing the algorithms and mobile app could be a model for others to use.

Findings to date: The PTT Advisor has resulted in over 1,300 downloads to date since becoming available approximately three years ago. During the beta test, family physicians who participated in a small-scale usability survey were asked "how satisfied are you with the information gained from the application?" Six of the nine (67%) respondents reported that they were "very satisfied" with the information gained from the application.

Lessons learned: The presenter will discuss the novel process of developing the mobile applications and lessons learned.   Developing a mobile application focused on providing decision support to physicians requires 1) having a plan that describes how the scientific content will be developed and revised as new information becomes available; 2) researching internal and external scientific, and legal requirements; 3) knowing the most appropriate funding mechanisms to support project costs; 4) evaluating the mobile application for user satisfaction and impact on clinical practice; and 5) designing an outreach campaign to distribute the tool to the audience of interest. The easily accessible and freely downloadable PTT Advisor could provide a useful example for developing mobile applications to help healthcare professionals in multiple settings.

The Identification and Follow-up of Clinically Relevant Radiologic Findings at One Institution

A. P. Gupta[1], **C. Wilkes**[1] and **D. Liebovitz**[2]

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[2]Northwestern University, Chicago, IL

Statement of problem: Advancing technology has increased the burden of incidental radiologic findings. Provision of patient care is fragmented due to multiple access points such as the outpatient clinic, Emergency Department (ED) and inpatient hospitalization. This study examines the utility of targeted text queries to identify radiology reports with the potential need for clinical follow-up.

Description of the intervention or program: A query of radiology reports using selected inclusion and exclusion criteria was performed on the Northwestern Medical Enterprise Data Warehouse as part of a quality improvement initiative. Inclusion criteria consisted of all CT, X-ray, MRI, and ultrasound radiology orders from 2010 and 2011. More than 28,000 radiology reports were searched for key phrases based on modified tools of Natural Language Processing to uncover incidental radiologic findings of potential clinical significance. Four clinicians independently audited the charts of the 797 identified reports to determine if clinically relevant radiologic findings were disclosed, documented and followed up. Clinician auditors contacted the ordering provider or primary care provider to determine if adequate clinical follow-up was completed if it was not evident upon chart review. Patients who did not have adequate documentation or appropriate follow-up will be contacted via letter or phone call. The results of this study may lead to a future pilot study to investigate the role of built-in safeguards to electronically filter clinically relevant radiologic incidental findings.

Findings to date: 797 reports were selected for review. 631 have been completed. Fifteen charts have been identified to have potentially significant clinical findings which did not have adequate clinical documentation or follow up. Reasons for this include the lack of documentation or disclosure in the progress notes or discharge summary, lack of follow-up within the health system due to an outside Primary Care Provider, or other comorbidities which may overshadow the relevance of these findings.

Lessons learned: 1. Natural Language Processing may be a useful tool to electronically filter clinically relevant radiologic incidental findings and monitor follow-up. 2. Reducing ambiguity in the wording of radiology reports and a standardized reporting of results such as BI-RADS (Breast Imaging Reporting and Data System) may ensure better follow-up of clinically relevant findings. 3. Due to fragmented care, a system-based notification for both patients and physicians may encourage better follow-up of clinically relevant findings for patients. 4. Improving documentation with clear instructions for follow up may enhance patient follow-up of clinically relevant findings

Improving Diagnostic Accuracy through Mandatory Chart Reviews

D. Meyer and **R. Trowbridge**

Maine Medical Center, Tufts University School of Medicine, Portland, ME

Statement of problem: Although providers generally want feedback on diagnostic performance, most do not receive sufficient feedback because of barriers related to hand-offs and systems of care.[i]

Description of the intervention or program: Hospitalist providers at a tertiary care academic medical center were asked to perform chart reviews and reflect upon at least ten admissions per month. A review tool was created within the electronic medical record that allowed providers to simultaneously view their initial history and physical and the final discharge summary. Providers were asked to track their findings and reflections in a separate worksheet that was audited for compliance. Participation in chart reviews, but not use of the review tool, was required of hospitalists as part of their annual quality-based compensation. Hospitalists were surveyed prior to the start of the project and at six-months.

Findings to date: Eighteen hospitalists participated in the trial. At baseline, 11/18 (61%) of the providers reported they did not receive sufficient feedback on diagnostic performance. Only 44% of providers reported conducting regular chart reviews on at least ten charts per month, with 33% conducting no regular reviews of charts. All providers (100%) participated in the required reviews and overall monthly participation averaged 92.7% over the six-month period. On average, hospitalists reviewed 9.5 charts per month. Survey response rate was 83%. Approximately half (53%) of hospitalists reported regularly using the review tool. Of those that didn't, the primary reason was they forgot (5/7 respondents) or they did not find it useful (2/7 respondents). There was no significant change in providers' satisfaction with the amount of feedback they received or in perceived rates of diagnostic error. The majority (57%) felt mandatory reviews should continue with 14% stating the reviews should not be required.

Lessons learned: This project demonstrates the feasibility of implementing mandatory diagnostic reviews as part of hospital based quality improvement initiative. Overall acceptance was high with a monthly participation of nearly 93%. Development of a tool within the EMR to support conducting these reviews was likely helpful for the portion of providers who were not already conducting these reviews. Although the majority felt mandatory reviews should continue, there was not a significant change in providers' self-reported rates of diagnostic error or satisfaction with the amount of feedback received. Further research is needed to determine how to best deliver feedback to improve diagnostic performance. [i] Gallagher TH, Prouty CD, Brock DM, Liao JM, Weissman A, Holmboe ES. Internists' attitudes about assessing and maintaining clinical competence. *J Gen Intern Med* 2014;29(4):608-14.

Real Time Liability "SNAP SHOT" Assessment Model for Malpractice Underwriting and Competitive Market Differentiation

S. Smith

CEO and Founder Complete.MD, Savannah, GA

Statement of problem: The Public needs to have an objective, insightful, and meaningful tool to evaluate Health Systems and Physician practices.   A public website that documents in "Real Time" a health system and physician's practice quality metrics is essential to assess patient communication, patient scheduling, closed treatment loops, and outcomes. The reported performance measures aid patients in differentiating care and selecting physicians. The data can also aid Malpractice carriers in rewarding Health Systems and Physician practices that provide quality services.

Description of the intervention or program: A public and Malpractice Carrier facing web site was created to report daily outcomes of a Pathology Closed loop reporting system using Pathologytracker.com. Practice norms were established by tracking 20,651 specimens and determining average times for report posting, communicating with patients, scheduling intervals and times to close treatment loops. Through these simple parameters, an assessment of practice quality assurance systems were established for the entire organizational process including specimen tracking, patient and system communication, mobile patient engagement systems, and documentation of "Pathology Closed Loops."Utilizing a "Real Time" assessment software tracking daily performance with PathologyTracker.com and a daily public WEB reporting system empowered all vested parties to participate on the same platfrom and as a result improved outcomes.

Findings to date: Since, January 1, 2015, 6,490 patients with 20,651 specimens have been treated with defined parameters of 16 days between biopsy and patient notification, and 40 days for "Closed Loops" of treatment. Two thousand five hundred eighty (2580) patients required additional procedures and each patient was notified within 16 days and received treatment within 40 days. All patients were treated within the defined parameters. The Web Site displays the practice compliance and is available for the public and the malpractice carrier to access.

Lessons learned: Physician practices reporting their Pathology Quality Assurance systems fosters system quality achievements. Patients appreciate access to objective performance reporting. Malpractice Carriers can use this reporting system to obtain a "Snap Shot" of ongoing Health System and Physician quality controls processes.

Intraoperative Protocol for Microscopic Examination of Small Biopsies to Reduce Diagnostic Error

M. Gusack

Veterans Affairs Medical Center of Huntington WV, Huntington, WV

Statement of problem: Rapid advancements in diagnostic screening methods combined with more effective therapeutic modalities have placed increasing pressure on clinicians to diagnose significant disease as early as possible. This has led to the growing use of interventional procedures that minimize morbidity resulting in ever increasing numbers of smaller specimens that harbor borderline lesions. Intraoperative microscopic review of smears and touch preps provides a means of reducing sampling error while increasing yield to fully characterize lesions with only one procedure.

Description of the intervention or program: Over the past six years I have developed a protocol that guides rapid intraoperative microscopic review and categorizes each specimen directing both the interventionist and the pathologist. The purpose was to minimize risk for morbidity and mortality from both the procedure and the diagnostic effort while maximizing the yield in specimen volume, quality, and diagnostic usefulness.

Findings to date: Application of the protocol has resulted in:

- Reducing second procedures.
- Reducing number of aspirations/biopsies per procedure.
- Increasing quantity and quality of specimen produced.
- Increasing quality of smears and touch preps for follow on examination.
- Facilitating tumor characterization and staging to direct appropriate therapeutic management.

Lessons learned: The presence of an experienced pathologist during interventional procedures utilizing a decision matrix provides significant advantages. These include but are not limited to relieving the interventionist from having to do two separate tasks; real time guidance for adjustment of the biopsy or aspiration needle position; intraoperative identification of tumors allowing early termination of the procedure, and indicating when additional specimen is need as well as which preservative to utilize. This increases the number of definitive diagnoses, subclassifications, and stagings in a timely manner while reducing adverse outcomes secondary to the procedure itself.

A Modelelectronic Compendium of Clinical Laboratory Tests to Reduce Diagnostic Error

M. Gusack

Veterans Affairs Medical Center of Huntington WV, Huntington, WV

Statement of problem: The number and value of today's clinical laboratory tests place a very powerful diagnostic tool in the clinician's hands. However, paradoxically, this power has led to the discovery of numerous previously unrecognized diagnoses that can now be effectively treated by new therapeutic modalities. This confluence of trends has greatly amplified the risk for significant diagnostic errors. The development and implementation of an online searchable compendium of laboratory tests based on advanced relational database capabilities provides a powerful means of reducing diagnostic error.

Description of the intervention or program: Over the past three years I have developed a highly configurable user friendly electronic compendium [eCMP] that provides information regarding proper selection, acquisition, preservation, submission, and interpretation of laboratory tests. Furthermore, the eCMP provides the means of configuring multiple optional diagnostic protocols linked to and based on criteria established in medical literature that can be stored locally, or accessed via the internet.

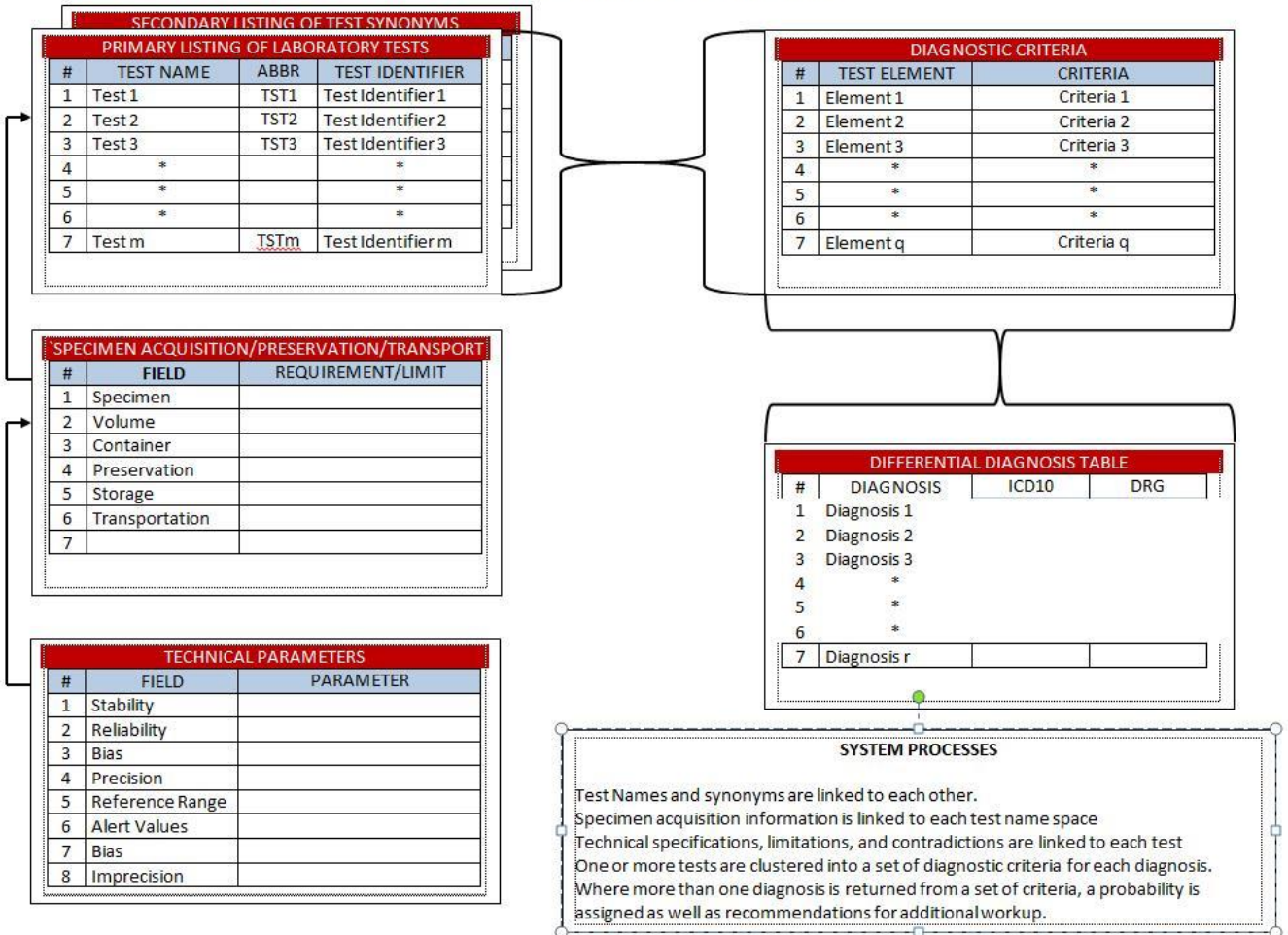**Findings to date:** The present model compendium:

- Allows searchable synonyms for test names to avoid duplicate or wrong test ordering.
- Communicates specimen acquisition, preservation, and submission instructions for optimal test reliability.
- Provides theoretical utility of one or more tests in the diagnostic workup of specified clinical states.
- Delineates technical issues complicating or invalidating test results.
- Provides capacity to establish diagnostic protocols utilizing test data.
- Provides capacity to establish information regarding use of confirmatory tests.

Lessons learned: The availability of an easy to use compendium of clinical laboratory tests provides a prospective means of assuring that correct test(s) are ordered reducing both diagnostic error and delay. Conversely, this same tool allows for establishing a means of reducing unnecessary test ordering that can potentially lead to a spurious diagnosis and inappropriate treatment. The combination can

simultaneously reduce both diagnostic error and costs while improving the overall quality of care.

ELECTRONIC LABORATORY TEST COMPENDIUM

SECONDARY LISTING OF TEST SYNONYMS

PRIMARY LISTING OF LABORATORY TESTS

#	TEST NAME	ABBR	TEST IDENTIFIER
1	Test 1	TST1	Test Identifier 1
2	Test 2	TST2	Test Identifier 2
3	Test 3	TST3	Test Identifier 3
4	*		*
5	*		*
6	*		*
7	Test m	TSTm	Test Identifier m

DIAGNOSTIC CRITERIA

#	TEST ELEMENT	CRITERIA
1	Element 1	Criteria 1
2	Element 2	Criteria 2
3	Element 3	Criteria 3
4	*	*
5	*	*
6	*	*
7	Element q	Criteria q

SPECIMEN ACQUISITION/PRESERVATION/TRANSPORT

#	FIELD	REQUIREMENT/LIMIT
1	Specimen	
2	Volume	
3	Container	
4	Preservation	
5	Storage	
6	Transportation	
7		

DIFFERENTIAL DIAGNOSIS TABLE

#	DIAGNOSIS	ICD10	DRG
1	Diagnosis 1		
2	Diagnosis 2		
3	Diagnosis 3		
4	*		
5	*		
6	*		
7	Diagnosis r		

TECHNICAL PARAMETERS

#	FIELD	PARAMETER
1	Stability	
2	Reliability	
3	Bias	
4	Precision	
5	Reference Range	
6	Alert Values	
7	Bias	
8	Imprecision	

SYSTEM PROCESSES

Test Names and synonyms are linked to each other.
Specimen acquisition information is linked to each test name space
Technical specifications, limitations, and contradictions are linked to each test
One or more tests are clustered into a set of diagnostic criteria for each diagnosis.
Where more than one diagnosis is returned from a set of criteria, a probability is assigned as well as recommendations for additional workup.

A State-Wide Approach to Minimising Diagnostic Error – "Take 2- Think, Do"

A. Walker and **T. Clarke**

Clinical Excellence Commission, Haymarket, Australia

Statement of problem: There is an increasing awareness of errors relating to diagnostic processes across the New South Wales (NSW) Health System. This is supported by analysis of our state-wide incident information system and reportable mortality database. Strategies that encourage clinicians to switch from a rapid diagnostic decision to a more detailed review when necessary are required to improve diagnostic processes.

Description of the intervention or program:

"Take 2 – Think, Do" is a framework to support accurate diagnostic decision-making in complex clinical environments. It is designed to improve awareness and recognition of the potential for errors across a broad clinical arena, and reduce the morbidity and mortality associated with wrong, missed or delayed diagnosis in the NSW Healthcare system. The program consists of three components:

- **Take 2 minutes to deliberate the diagnosis**– promotes a quick reflection for each clinical presentation. While deliberating the diagnosis;
    - **Document** the differential diagnoses
    - **Detect** any deviations
    - **Debate** the diagnosis at handover
    - **Decide** on the final diagnosis
- **Take a closer look when …**provides clinicians with insight into clinical situations in which it may be appropriate to think twice and take a closer look
    - There are patient, system and cognitive factors present that may impact diagnostic decision making;
    - Double check at specific patient journey checkpoints (e.g. Rapid Response Calls)
    - Take 2 for you (locally specific high risk presentations)
- **Take a closer look using…**strategies that enable clinicians to take action:
    - Diagnostic Time-out
    - Red Team / Blue Team Challenge promoting dialogue around diagnostic clinical decision making
    - Seek a second opinion, refer or escalate

Findings to date: The Framework is currently undergoing clinician testing. This is highlighting the need for further development of supportive resources for successful implementation across diverse clinical environments (e.g. in smaller, rural facilities as opposed to larger, tertiary referral centres). State-wide implementation will require significant culture change, and supporting Junior Medical Officers to challenge the authority gradient is a key to success.

Lessons learned: Framing the problem in a positive manner is less confrontational and enhances clinician engagement. Having a catchphrase that can be adopted in clinical practice is useful to encourage uptake (e.g. – Wait, we need to Take 2 on this one…). Measuring diagnostic processes and diagnostic error remains difficult, however reviewing documentation of differential diagnoses is facilitated in the electronic medical record setting and allows recognition of delays and changes to provisional diagnoses.

Integrated Synoptic Based Diagnostic Criteria to Reduce Surgical Pathology Diagnostic Error

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Statement of problem: Safe health care requires accurate and timely diagnoses. Rapid advancements in diagnostic screening tests have led to earlier and earlier intervention to achieve ever more timely diagnoses. This trend has yielded a growing number of specimens harboring earlier lesions that are diagnostically indeterminate. The outcome has been increasing over and under diagnosis and, therefore, inappropriate management.

Description of the intervention or program: A working application implementing a Synoptic Anatomic Pathology Reporting System has been developed and presented previously. The present version implements a synoptic approach to configuring up-to-date diagnostic, grading, and classification criteria into the application that can be referenced and applied to the diagnostic process either manually or through a differential diagnosis engine. Each criterion can be linked directly to the supporting medical literature as well as images for use in teaching and training to attain greater diagnostic accuracy. This approach also provides a means to automate ongoing validation of criteria through standardization of terminology within a highly structured and searchable synoptic data structure.

Findings to date: A suite of supplementary capabilities has been added to the application to implement the integrated model for linking in and applying diagnostic, classification, and grading criteria. At this point I have successfully implemented:

- A configurable set of diagnostic criteria for any gross or histologic diagnosis.
- A configurable set of linked medical literature from which the criteria can be reviewed at their source.
- A configurable set of linked gross and microscopic images for use as a teaching, validation, and calibration.
- A configurable set of predefined standardized values or states that can be linked in a context sensitive manner to each individual Synoptic Pathology Element [SPE] providing an extremely efficient and open ended means of applying diagnostic, classification, and grading criteria using standardized terminology for use in follow on analytical tasks.

Lessons learned:

- First, the inclusion of applicable and useful criteria based on standardized terminology is critical in preventing diagnostic error.
- Second, use of standardized configurable synoptically based criteria facilitates and assures their uniform application to all cases.
- Third, the capacity to link in supporting medical literature and images assures proper application through real time prospective teaching, validation, and calibration.

Minimising Diagnostic Error – the Red Team / Blue Team Challenge

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Statement of problem: There is an increasing awareness of errors relating to diagnostic processes across the New South Wales (NSW) Health System. A deficit in questioning diagnoses and challenging decision-making has been identified. Supporting Junior Medical Officers to challenge the authority gradient is recognised as a key component of robust team-based diagnostic deliberations.

Description of the intervention or program: The "Red Team / Blue Team" strategy was developed by the military as a method of testing force readiness and is now entering the corporate world as gaming theory to test strategy and security systems. In gaming theory, the blue team develop a security system, while the red team strive to find weaknesses in the system that have been over looked by designers. In health, traditional hierarchical structures inhibit challenge within teams, and thus weaknesses in a diagnostic process largely go undetected. This program aims to test the hierarchical model and provide the training and tools for team members to safely challenge the decision making process. It designates clinicians to approach diagnostic decision-making from a "Devil's Advocate" position, allowing juniors to develop skills in assertiveness, whilst protecting them from the potential negative consequences of questioning more senior clinicians. Juniors are rewarded for developing alternative possible diagnoses, questioning the relevance of investigations, and ruling out the worst case scenario. It encourages teams to develop a dynamic that enables red team challenge across hierarchies to generate discussion and critical thinking in relation to diagnostic decision making.

Findings to date: The program is currently in clinician testing phase, with strongly positive feedback from piloting clinicians. State-wide implementation will require significant culture change, and supporting Junior Medical Officers to challenge the authority gradient is a key to success. Ensuring end of term appraisals reflect an adjusted role, and that JMOs will be assessed on how well they challenge, develop alternate diagnoses, rule out worst case scenarios and ask appropriate questions is a crucial element.

Lessons learned: Teams need to define where the challenge takes place (e.g. in corridor or meeting room as opposed to the bedside) in order to ensure no loss of patient / carer confidence in the health care team. Senior clinicians may need to plan for ward rounds that take slightly longer due to enhanced discussion and explanation of clinical reasoning, but teaching is significantly enhanced. Outcomes are difficult to assess, but state-wide incident monitoring processes support analysis of diagnostic error.

Reducing Diagnostic Errors in a Diabetic Retinopathy Screening Program: Implementation of a Centralized Reading Center

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Statement of problem: Screening for diabetic retinopathy (DR) is standard of care for diabetic patients, but visual diagnostic errors in reading these images are common. For over a decade, the literature has identified diagnostic error as a quality problem in DR screening and called for systematic improvements. However, few systematic approaches to identify these errors in a large population have been reported; even fewer studies delineate methodologies to reduce them. With over 29 million diabetics in the United States, the number of people impacted by errors in diagnosing DR is huge. We identified potential diagnostic errors in our screening when comparisons to published data revealed our DR prevalence was substantially lower, and when we identified substantial variation in DR prevalence between medical centers.

Description of the intervention or program: The program was implemented across all 13 medical centers in the Southern California region of Kaiser Permanente, an integrated delivery system managing 4 million members. Until 2010, DR screening was performed with retinal photos graded by medical center-based ophthalmologists and optometrists, using standardized definitions that combined "minimal" and "moderate" retinopathy in a single category. To reduce diagnostic error, ophthalmologists agreed upon grading criteria that included distinct categories for minimal, moderate, and severe retinopathy. We then instituted a centralized reading center staffed by dedicated Certified Ophthalmic Assistants (COAs) and Technicians (COTs). The reading center required rigorous, standardized training for COAs/COTs, who worked under the supervision of retinal specialists and within strict quality control guidelines. All sites received feedback on ungradeable photos and instructions on how to reduce this.

Findings to date: DR prevalence increased from 10.1% prior to implementation to 22.1%, a level consistent with national averages. The variation between medical centers measured using the coefficient of variation (standard deviation divided by mean) decreased for all groups: 0.08 to 0.04 for "no retinopathy" (p=.02), 0.43 to 0.14 for "minimal/moderate" (NS), 0.53 to 0.32 for "severe" (p<.01), and 0.76 to 0.27 for "ungradeable" (p<.01). The rate of ungradeable photos decreased from 7.5% to 4.0%. Revising the grading scheme allowed for more accurate, specific diagnosis and treatment. Patients with any retinopathy are counseled about diabetes control.

Lessons learned: Errors in DR diagnosis can be identified in a large population and reduced. Key elements include creating standard criteria for interpretation, and using a centralized reading center with dedicated and properly trained COAs/COTs. This model may be generalizable to other areas where visual diagnostic errors occur.

Journal of General Internal Medicine's Exercises in Clinical Reasoning: From Print to Rounds

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Statement of problem: Cognitive mistakes by physicians lead to 30% of diagnostic errors. Currently, few curricula exist to teach diagnostic reasoning skills and metacognition to students and residents. There are few on-line resources available for motivated faculty to teach clinical reasoning (CR) concepts *with cases*. This creates a barrier for attendings interested in teaching CR concepts to their students and residents.

Description of the intervention or program: In 2010 the *Journal of General Internal Medicine* (JGIM) created the Exercises in Clinical Reasoning (ECR) series. This series presents complex cases in a sequential fashion to expert clinicians who share their thinking in a typical clinical problem solving format. The innovation in the ECR series is the inclusion of a running commentary that deciphers the clinical reasoning process of the discussant. This parallel process allows the reader to understand the framework used to solve the case, and lays the groundwork for a didactic model that can be used as a teaching guide for clinical faculty. We are creating a website which will make it easy for faculty to quickly grasp key CR concepts and to then utilize *JGIM's* cases in teaching conferences. Each CR concept will have its own webpage that includes downloadable teaching points, a case-based teaching guide, and teaching slides. The website will also feature a link to the Society to Improve Diagnosis in Medicine's Clinical Reasoning Toolkit for course participants interested in reviewing more in depth material.

Findings to date: This educational innovation is a work-in-progress. We are prioritizing four CR concepts: dual process theory, illness scripts, problem representation, and heuristics. One or two published cases from the *JGIM* ECR series has been selected to illustrate each concept. Teaching guides (text and slides) for each CR concept are being developed. Figure 1 illustrates the webpage for problem representation.

Lessons learned: We chose to target clinical faculty because we believe they can effectively introduce clinical reasoning concepts to their leaners, utilizing a 'train the trainers' approach to widely disseminate a CR framework. We decided to emphasize key reasoning vocabulary such as "problem representation," "illness scripts," and "anchoring bias" to familiarize learners with these terms. Future work involves launching the website, surveying users, expanding the number of CR concepts based on material published in the ECR series, and creating an interactive interface in which faculty utilizing the site can

share their experiences and offer teaching tips.

The Cognitive Boot Camp for Accelerated Learning and Formation of a Repertoire of Illness Scripts

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Statement of problem: Expert diagnosticians possess extensive organized knowledge built through years of purposeful, continuous engagement in clinical practices. Given restricted clinical exposure in current medical education, novel approaches to teaching are needed to promote expedient development of diagnostic expertise.

Description of the intervention or program: An illness script is an efficient cognitive structure which organizes the salient features for a given disease. This form of organized knowledge defines diagnostic superiority among expert diagnosticians. Illness scripts cannot be "transmitted mind to mind" via traditional educational methods (i.e. memorizing the scripts). Trainees must engage in deliberate practice (DP), an effortful, repetitive training of knowledge and skills with immediate and corrective feedback, to successfully learn and organize the knowledge. We aimed to develop a module prototype for accelerated learning of diagnostic expertise. The module integrates DP principles for optimal learning, illness scripts for making the diagnosis, and learning curves for immediate feedback. We created a computer-assisted DP module based on pediatric diseases resulting in respiratory distress. For each case, the learner selects a diagnosis, receives structured feedback on the correct diagnosis, and then creates an illness script with a subsequent expert script for comparison. The module provides a real time learning curve, a graphical relationship between the learner's effort and learning achievement, to promote self-directed learning.

Findings to date: We designed and developed a Web-based module for learning illness scripts. A panel of content experts developed 50 clinical scenarios of pediatric respiratory distress for repetitive learning of 35 illness scripts. We piloted the module with 15 learners at a variety of levels of expertise and found our module successfully generated learning curves as an indicator of deliberate practice and accelerated learning. Information gleaned from the pilot was used to refine the module.

Lessons learned: Conceptual frameworks grounded in educational theories and evidence-based best practices can guide development and evaluation processes of an educational innovation.The analyses of group and individual learning curves (effort, rate, direction and maximal potential of learning) can be beneficial to education management by instructors. Further work will evaluate if our module enhances a learner's skill at formulating illness scripts and acquisition of content.

What Are We Talking about? Discussion of Error in Medicine Morbidity and Mortality Conference

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Statement of problem: The Morbidity and Mortality (M&M) Conference is a longstanding tradition in many academic departments but cases presented and topics addressed at M&M Conferences have not been well described in the literature. Historically, M&M conferences have focused on procedural error but with the increasing visibility of the Patient Safety and Quality Improvement movement in academic medicine, more M&M Conferences have started to focus on the discussion of other errors and opportunity for improvements in quality and patient safety.

Description of the intervention or program: This study classifies and describes a multi-year experience with Medicine M&M Conferences and seeks to identify the characteristics of the cases presented and discussions held in the conference.   One hundred twenty-two of an approximate total of 246 (49.5%) conferences were reviewed, including conferences over a six year period from a single institution's Department of Medicine.   Cases are generally selected by Chief Medical Residents from cases discussed at other conferences or on rounds; sometimes, cases are suggested by residents or faculty members.

Findings to date: Of the conferences reviewed, 49.2 percent of cases discussed cognitive error, 13.9 percent discussed system error and 52.5 percent of cases involved an interesting or rare disease process. The subspecialty areas of critical care, infectious disease, hematology/oncology, gastroenterology, surgery, cardiology, and nephrology were represented heavily, while cases from other subspecialties were rarely discussed and most cases (71.3%) involved care that involved another institution. More than half (52.5%) percent of cases involved care known to have been provided by other institutions. Finally, the mortality rate of patients presented during the conferences (41.8%) was approximately ten times the mortality rate of the hospital affiliated with the Department of Medicine (4.0%).

Lessons learned: In conclusion, cases discussed at Medicine M&M tend to discuss cognitive error and rare diagnoses and comprise cases from a few specialty areas of medicine. Further, cases that involve care occurring at other medical institutions are commonly presented and might represent a bias in case presentation and an opportunity for improvement.   Analysis of these conferences is not only instructive to a wider audience but also demonstrates the necessity at creating an index of M&M cases to avoid over-

representation of specialties, patients, or disorders.

Figure 1 - Type of conference presented.
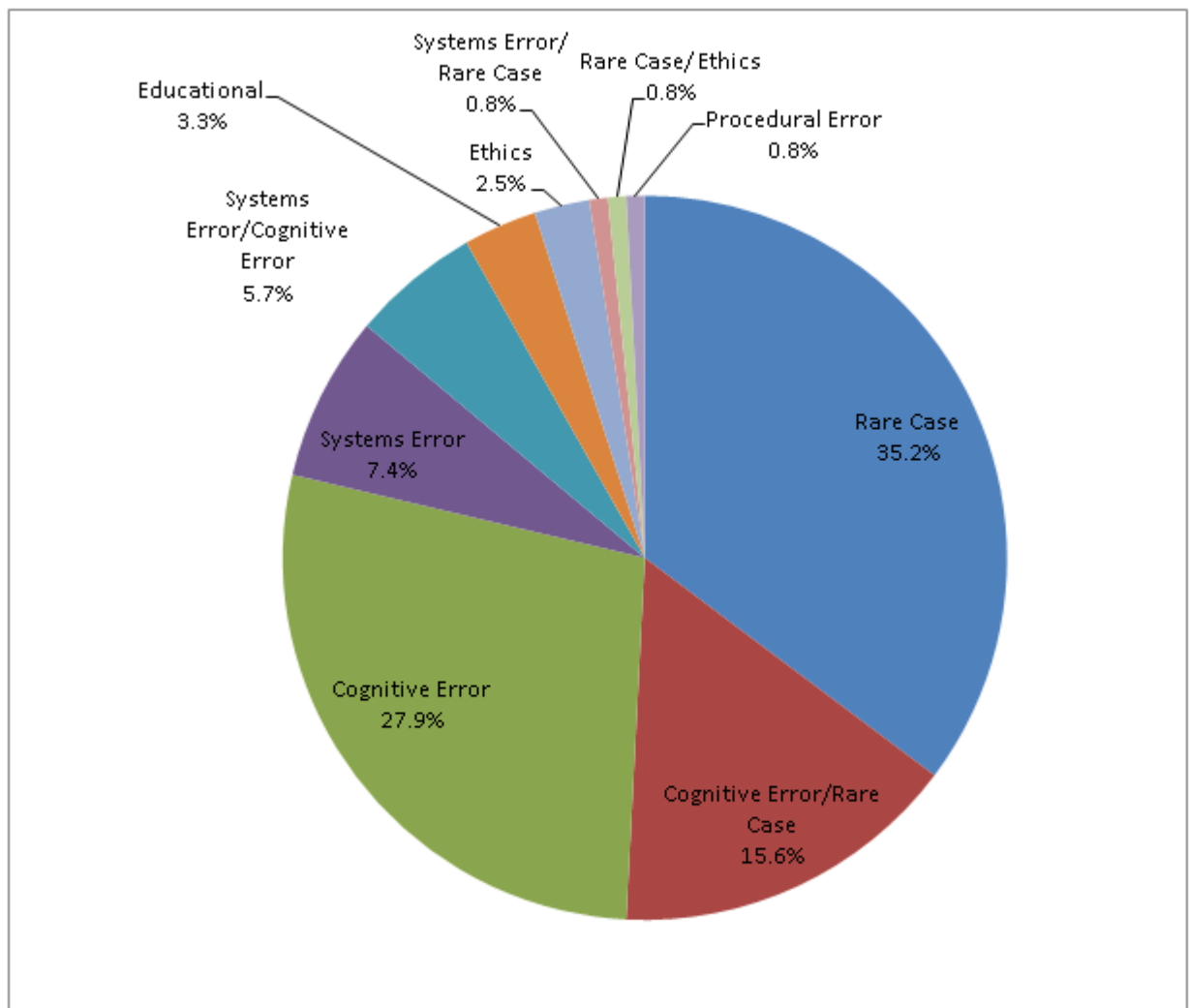
A large majority (78.7%) of cases presented in Morbidity and Mortality Conferences dealt with cognitive error, rare cases, or a combination of both.

Return on Investment for Quality Initiatives to Improved Cancer Diagnosis

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Statement of problem: Sixty million surgical biopsies are performed each year for the identification and diagnosis of cancer. Of these biopsies, 1.6 million are diagnosed as cancer. On inter-institution review, 18-25% of cases have diagnostic discrepancies and over 6% of cases have major diagnostic error that results in a change in diagnosis and therapy. Literature has identified the economic cost to healthcare for each major diagnostic error at $21-$70,000 pending the type of cancer studied. Patient, family, and final outcome costs need to be considered also but are not included in this review. With 100,000 patients annually experiencing a misdiagnosis for cancer, and the healthcare industry moving to value based payment, this medical specialty need of additional quality initiatives is proposed. However, quality investments in healthcare are budgeted and each medical segment must compete for valuable and limited quality investment dollars. On literature search, no return on investment models were identified that could help institutions justify additional investments in quality.

Description of the intervention or program: A Return on Investment (ROI) financial model based on third party published studies related to and including the direct cost of misdiagnosis for caner was developed. Selection of metrics for the inclusion in the model was based on published data availability and included; Pathology Practice attributes, CMS incremental reimbursement for quality applications, potential rebates from risk insurers, misdiagnosis costs, re-admission costs, and cost avoidance in claims litigation. The model is balanced against incremental spending in desired quality initiatives. The model was generated to demonstrate the value of participation in an external, sub-specialist quality assurance program to identify areas of improvement that if addressed may increase the accuracy of cancer diagnosis and reduce the cost of misdiagnosis.

Findings to date: The model was vetted in six institutions and adopted for budget request submissions. The model can be easily changed or customized for other applications.

Lessons learned: Supporting studies do not use standardized formulas for determining cost of misdiagnosis. This results in a large swing in estimated misdiagnosis cost. To be conservative, the model uses the lower estimates of cost studies. It is difficult to estimate the soft cost to families and long term outcome. The model does not make an attempt to do so but those participating in the quality investment decisions, need to include this in their process. Length of stay is a desired metric to include in the model but no published data could be found that describes the incremental length of stay based on cancer misdiagnosis.

Patient Centric Quality Assurance Tracking System for Pathology

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Statement of problem: Tracking specimen locations, patient communication, pathology recommendations, and documenting complete treatment of patients are challenging tasks that have yet to be solved. Pathology specimens can be mislabeled, misplaced or lost in transit. Pathologists' recommendations (recorded in comment sections of reports that are not codified), can be missed by practitioners and lead to delays in treatments. Documenting patient communication and treatment outcomes can be challenging for physicians, pathologists, and patients who are not using the same platform. To address these challenges, and improve the communication means, PathologyTracker.com was developed.

Description of the intervention or program: PathologyTracker.com is a new, efficient and cost effected patient-centered quality assurance process that objectively tracks and documents the entire life cycle of the pathology specimen via closed treatment loops. Using Microsoft Surface Touch Screens, specimens are labeled with radio frequency identification labels (RFID) which are then tracked (like FedEx shipments) through the health system and by patients using a Complete.MD Mobile App. The RIFD labeled specimen and patient data is sent to the pathology lab for pre-assessing, pathology examination, and obtaining pathologist codified recommendations (Patent Pending). The pathology reports (jpeg files), ICD 9/10 codes, and the Pathologists' recommendations (codified) are then sent to a quality assurance software interface. Physicians evaluate the recommendations with the patient and together they develop a treatment plan. The QA software system tracks the pathology ICD 9/10 codes, pathology recommendation codes, and physician treatment codes, and the patient's complete treatment. Also, the quality assurance software system integrates the communication, retains scheduling, and documents outcomes of treatment. Via Complete.MD Mobile Apps, patients are updated in "Real Time" regarding specimen locations, specimen processing, specimen results, and means of communication. Patients additionally have a HIPAA secured encrypted communication platform to contact the entire care team.

Findings to date: Since January 1, 2015, 6,490 patients and 20,651 specimens have been tracked by using PathologyTracker.com. Specimen locations were fully documented and communicated with patients. Documentation and follow up of Pathologist recommendations and ICD9/10 diagnosis requiring treatment were "Closed" successfully in all patients. Also, the Patient Mobile Quality Assurance system promoted patient engagement.

Lessons learned: Pathology.Tracker.com is an efficient Quality Assurance means that enables reliable tracking of pathology specimens documenting completed treatment loops. It also empowers patients to be the center of a communication platform.

Dynamic Checklists for Diagnosis That Learns from Collective Wisdom

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Statement of problem:

Human cognitive biases play a significant role in missed, delayed, and incorrect diagnoses. In well-defined clinical scenarios, guidelines can be useful in deciding certain diagnostic tests or treatments. However, guidelines are less helpful in complex cases with multiple symptoms, numerous signs, and one or more lab abnormalities. We would like to propose a method to create dynamic checklists for diagnosis.

Description of the intervention or program: The clinical decision support system (CDSS) is based on pattern recognition and Bayesian statistics. It uses an innovative method that links relational and non-relational data structures to interact very effectively to ensure optimized clinical decisions while maintaining scalability. This allows clinicians to add or fix existing checklists based on clinical results in real time or based on up-to-date literature. It is also designed to capture (a) clinician's' opinions as expressed in feedback or (b) analytics from a large database and incorporate those opinions, visible to other clinicians, into the decision tree.

Findings to date: In a study using published clinical cases, 45% of practicing clinicians, when were provided with one or two initial presenting symptoms, failed to ask for a finding that will would eventually have been helpful in making the diagnosis when they are provided with one or two initial presenting symptom/s. (Example, looking for organomegaly in a patient with progressive lower extremity weakness or extreme leukocytosis in a case of unexplained hyperkalemia). However, with the assistance of CDSS, 85% of the clinicians were able to get to the right diagnosis.

Lessons learned: Ensuring high quality and uniformity in diagnosis is a significant challenge. Identifying key decision points from case reports and feeding updated information into the algorithm was found to be effective in preventing similar errors in future cases. It can be a certain pattern, contexts, performance characteristics of an investigation etc . CDSS was found to be effective in assisting clinicians to look for findings from symptom or laboratory data that turn out to be very useful in building a differential diagnosis. The quality of results from a decision support system depends on the entries by the clinician. Checklists at each step will ensure that all relevant questions are asked at every step. However, how well such a CDSS can be incorporated into the current work flow is unknown. More studies are required in this field.

Using Cloud-Based Simulated Patients to Teach a Problem Based, Systematic Approach to Diagnostic Reasoning

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Statement of problem: Diagnosis is a key competency, and yet errors in diagnostic reasoning are common and costly. Misdiagnosis is responsible for 40,000 to 80,000 deaths in the U.S. annually and contributes to the estimated $700 billion in unnecessary healthcare costs. Autopsy studies show that 5% of patients die with a potentially treatable diagnosiss. Cognitive factors contribute to error in 74% of cases, including faulty synthesis, premature closure, & misjudging the salience of findings. The reasons for these errors are complex but partly reflect shortcomings in the current education and evaluation of diagnostic reasoning.

Description of the intervention or program:

- University of Chicago faculty have reviewed the medical literature on common complaints & 300 common diseases that cause them to obtain the sensitivity and specificity of their signs, symptoms and lab values. This facilitates the creation of a rational, organized, systematic and articulated approach to the evaluation of these symptoms published in *Symptom to Diagnosis: An Evidence Based Guide* (McGraw Hill 2005, 2010, 2015)

- This *Symptom to Diagnosis approach* has been explicitly articulated to help clinicians efficiently approach patients, and includes (1) the explicit evaluation of pivotal concepts that limit a broad differential diagnosis into a limited subgroup utilizing elements of the history and physical exam, (2) exploration of the remaining subgroup by searching for risk factors, associated symptoms and signs, and finally, (3) utilizing this information to rank the remaining hypotheses.

The project

- 150 computer-based simulated cases focusing on 15 common internal medicine symptoms. This project is fundamentally different from prior computer-based simulation programs in several ways:

- A systematic approach has been developed for each symptom which is consistently emphasized in each case.
- The history and physical exam must be *actively* obtained. This ensures that clinicians learn to *obtain* the critical information; it is not given automatically.
- The system *automates* feedback including the clinicians use of the history and physical exam in the following domains
  - Proper symptom characterization
  - Appropriate use of pivotal questions
  - Appropriate use of explore questions
  - Appropriate differential diagnosis
  - Appropriate testing

In addition to the cases, 30 hours of video recorded lectures have been produced for these most common symptoms/problems.

Findings to date: A comprehensive patient encounter can be simulated which incorporates a systematic diagnostic approach and evaluates the proper use of the history, physical exam and lab testing.

Lessons learned: This allows the teaching **and systematic evaluation** of clinical reasoning at a scale

that is impossible with other venues (e.g. standardized patients or high fidelity patients)

Clinical Vignette

Hypopituitarism in an Intellectually Disabled Man with "Psychotic Features"

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Learning objectives: 1) Treat ACTH deficiency first in hypopituitarism, as unopposed thyroxin therapy worsens features of cortisol deficiency. 2) Adult subjects with childhood-onset growth hormone deficiency (GHD) warrant evaluation of the hypothalamic-pituitary-adrenal (HPA) axis.

Case information: A 45-year-old Japanese man treated as schizophrenia was referred for evaluation of few days fever, hypotension, and bradycardia. Thyroxine was initiated three days ago, while several antipsychotics were used for sedation. He was a pale looking man with short stature, previously treated for childhood-onset GHD. Antibiotics were initiated for pneumonia. Despite successful treatment, hypotension and bradycardia persisted. Psychiatric evaluation revealed mild intellectual disability with psychotic reactions; antipsychotics were withdrawn in denial of schizophrenia. Anorexia and nausea developed, with episodes of hypoglycemia and hyponatremia. A second random cortisol since the normal results on admission, revealed low ACTH reserve. Further evaluation of other anterior pituitary hormones showed under secretion, with a brain MRI showing an empty sella. The patient was subsequently treated with ACTH supplementation for the diagnosis of hypopituitarism.

Discussion: Two diagnostic errors existed: 1) Adrenal insufficiency was precluded upon a single random cortisol with normal result during an acute stress phase, and 2) anchoring bias of the diagnosis of schizophrenia lead to overlook the key history of GHD and disregard non-specific symptoms. The clinical presentation of hypopituitarism varies, depending upon the time course and severity of hormonal deficiencies. Adult subjects with childhood-onset GHD are at high risk of developing adrenal insufficiency, while its clinical spectrum ranges from developing adrenal crisis to subtle dysfunction in asymptomatic patients. However, clinically asymptomatic patients may have lower secretory cortisol capacity than healthy subjects, failing to react to stressful stimuli. In this case, pneumonia with thyroxine

preceding glucocorticoid replacement is thought to be the trigger of causing overt adrenal insufficiency.
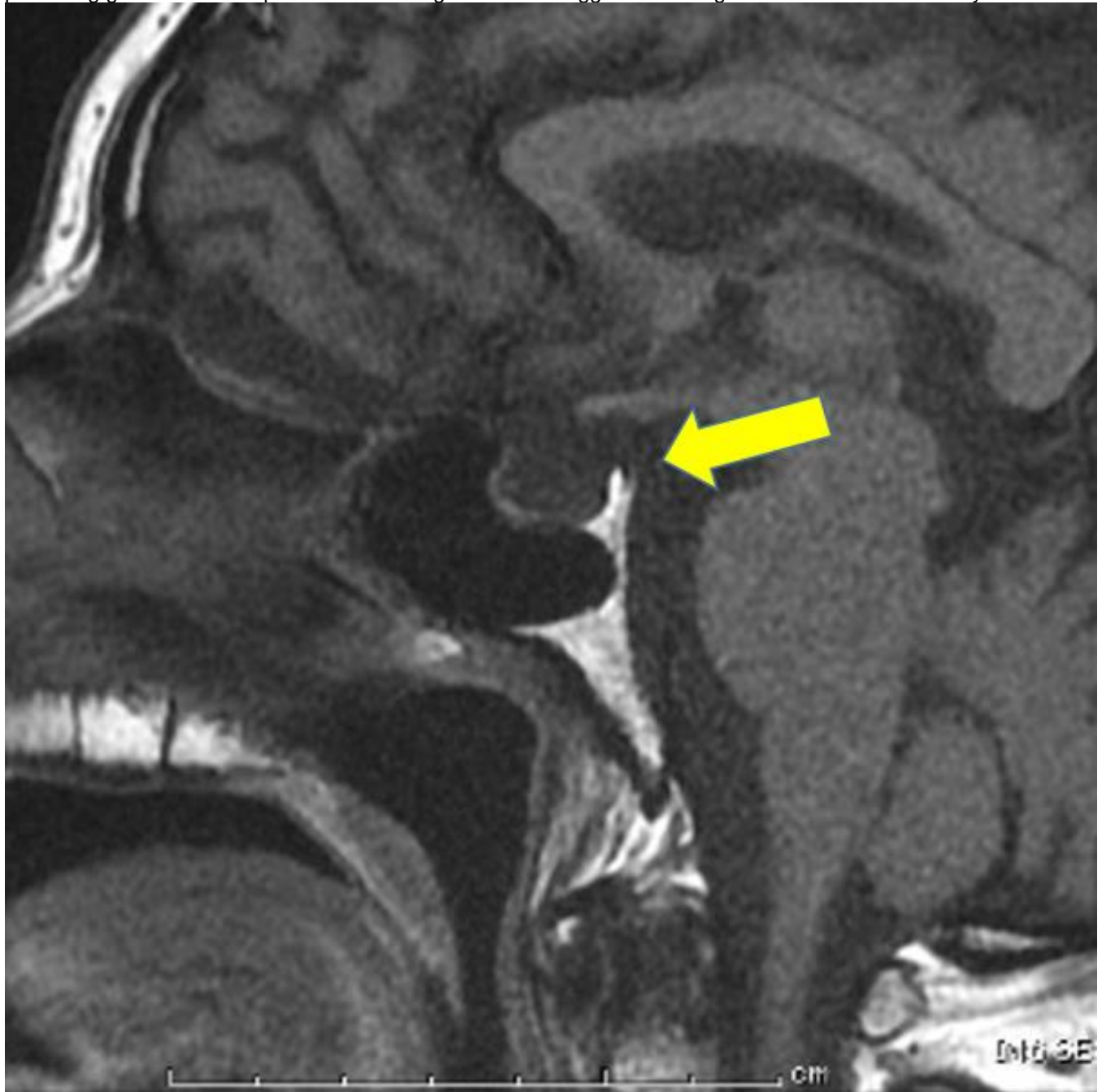
An Insidious Presentation of Apap Poisoning

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Learning objectives: Identify acetaminophen poisoning in the quiescent phase.

Case information: Acetaminophen (APAP) poisoning may be missed during the quiescent stage if there is no reported overdose, the patient is minimally symptomatic, and the physician suspicion is low. Case details: A 63 y/o woman presented to the ED complaining of depression, abdominal pain, and requesting a zolpidem refill. She denied any suicidal ingestions or plan. She suffered intermittent epigastric pain since running out of her pantoprazole one year prior. The patient reported taking Excedrin for chronic pain, but denied exceeding recommended doses and had no fever, vomiting, or diarrhea. Presentation vitals: T 98.0, P 72, RR 18, 100% on RA, BP 168/106. PE: Comfortable-appearing, alert and oriented x 3, anicteric, soft and non-tender abdominal exam. Psychiatry labs were ordered as per protocol (APAP level included). Liver function tests (LFTs) were ordered solely due to the chronic abdominal pain and patient age. Labs: See Table 1. Due to concern that this could potentially be APAP poisoning, N-acetylcysteine treatment was empirically started while LFTs and APAP level were trended. AST/ALT reached a high of 11,400 and 2,929 respectively approximately 10.5 hours later. The patient was transferred to a liver transplant center in stable condition for further management and transplant, if indicated.

Discussion: Due to the acuity of the rise in LFTs, there was suspicion that an overdose had been taken prior to her presentation. The diagnostic challenge was that the patient presented during the quiescent stage of APAP poisoning. With no history of overdose and a normal exam, physician suspicion was low. Fortunately liver tests were drawn and our routine ED psychiatry labs included APAP. Conclusion: APAP poisoning may present insidiously. Patients complaining of depression and who have access to acetaminophen products should be evaluated more carefully despite lack of symptoms.

Table 1.

Time	APAP level	AST	ALT	INR	Total Bili
21:52	33 mcg/ml (10-30)				
22:59	38	1,833	545	1.82@01:39	1.6
09:29	15	11,400	2,929	2.30	1.5
16:59		5,626	2,990	2.96	1.8

Fever of Unknown Origin but Unknown to Whom?

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Learning objectives: Fever of unknown origin (FUO) remain one of the most difficult diagnostic challenges in medicine. Diagnosing FUO is tricky. The best tools are history, history, careful chart review, history, physical exam, and history.

Case information: A 41-year-old male presented to the emergency room in with intermittent near daily fever with temperature around for102°F for at least 7weeks. He had been evaluated by an infectious disease doctor and workup included an extensive array of blood tests and a CT of the chest abdomen and pelvis. The only remarkable result was an ESR and CRP. His LFTs were slightly abnormal with an AST of 147 and ALT of 282 and a positive p-ANCA. He completed a two-week empiric trial of doxycycline 4 days ago. His temperature was better controlled with maxes of 99°F while on the doxycycline. The patient workup in the emergency room was unremarkable and he was restarted back on his doxycycline from which there was an apparent response. He was to follow up back with his doctor. However, he returned the next day because of return of fever as well as headache. A diligent review of his past history revealed that for the past 3 years the patient was on minocycline for folliculitis on his face and neck. During the time he was on doxycycline, he stopped his minocycline. The patient was admitted to the hospital. The minocycline was stopped. His fever improved and a comprehensive work remained negative. A final diagnosis of minocycline induced drug fever was made. The patient remains fever free.

Discussion: FUO is an important problem in clinical practice and a challenging problem worldwide. Most patients with FUO are not suffering from unusual diseases; instead they exhibit atypical manifestations of common illnesses. Many patients are placed in the FUO category because the physicians overlook, disregard or reject an obvious clue.

Utility of Lactic Acid As a Marker for Mesenteric Ischemia

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Learning objectives: Lactic acid should not be used as initial screening test for diagnosis of mesenteric ischemia

Case information: 58 year old man presented to an outside ED with abdominal pain and blood in the stool. He had a normal lactate and unremarkable non contrast abdominal CT. He was discharged home with diagnosis of constipation. Patient came back with same symptoms and decreased urine output 2 days later and was found to have mesenteric ischemia with bilateral ischemic renal infract. Refer attached image

Discussion: In high risk patients, abdominal pain with or without blood in stool requires more history and diagnostic work up to evaluate for mesenteric ischemia. Lactate level should not be used to rule out

mesenteric ischemia. Lactate level could be normal until late in the course.

Key Facts Are Not Key Facts.

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Learning objectives: The process of formulating a diagnosis is called clinical decision making. The clinician uses 'key facts' gathered from the medical history and physical examinations to generate a diagnosis. However, key facts are ultimately subjective and in reality no fact can truly be considered 'key'.

Case information: A 30 year-old man was seen in the emergency room after a witnessed first-time generalized tonic clonic seizure. He had left temporal headache for the last 3 weeks. His past medical history was significant for an abdominal dysplastic nevus removal in the last 3 years. This was reported as benign. The neurologic examination shows him to have mild post-ictal confusion. The motor as well as the sensory examination was normal.The skin examination showed him to have no local recurrence of the nevus. A CT scan of the head without contrast showed a 2.6 cm hemorrhagic left anterior temporal lobe mass with surrounding edema and some mass effect. This was thought to be a metastatic melanoma. The overall impression on MRI of the brain was of a hemorrhagic neoplasm such as a melanoma metastases. The clinical diagnosis based on the 'key facts' was of a seizure secondary to metastatic melanoma. Patient underwent left temporal craniotomy for excision of the left anterior temporal lobe hemorrhagic mass. The surgical pathology findings were characteristic of a cavernous malformation. The final diagnosis was a cavernous hemangioma which bled.

Discussion: Facts lack intrinsic keyness. There is subjectivity in facts as there is in keyness. The diagnostic process has to continually adapt and adjust and recognize that what are key facts may not be facts at all.

The Strength of the Clinical Thinking

D. Mineva

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Learning objectives:

1. Analysis of atypical pain in acute myocardial infarction
2. Recognizing symptoms modified in elderly
3. Creating a paradigm of the clinical thinking

Case information: Patient 78 years old, man, examined at home by emergency physicians for the first time at night. Medical history: sudden occurrence of pain in the left elbow joint, a permanent nature, with a duration of 3hours without changing the nature of load and weather factors, without irradiation, and no influence of Aspirin. In the past - rheumatism. Objective status: elevated arterial pressure 160/100 mmHg, tachycardia 100 / min. and expressed anxiety.

Discussion: The key point of clinical thought was "joint pain" on the background of rheumatic history of life. The sudden onset, unaffected by aspirin, which is a drug of first order for rheumatoid arthritis, lack of temperature and joint changes such as erythema, swelling and heat, rejected the hypothesis of rheumatic ethiology. Anxiety prompted a life-threatening condition. Assume was an acute myocardial infarction with atypical localization of thoracic pain and taken hospitalization. Electrocardiographic evidence of left bundle branch block and ST elevation in precordial area. The autopsy: acute stage of an extensive front myocardial infarction. The case describes a modified symptom in the elderly, namely: thoracic pain, overlapped by joint pain and anxiety. Importance for the diagnosis had anxiety and tachycardia Modified symptoms are felt otherwise differently, which is due to reduced cerebral irrigation. "î think about them. By creating its own paradigm of clinical thinking is avoided diagnostic error - elements and own experience:

- Descriptions of specificities of each symptom
- Two aspects of diagnosis: what is there and what is no
- Symptoms form a whole (diagnosis) with a logical connection and consistency
- Analysis of small deviation and shades – way to accurate diagnosis.

Catching the Culprit Flagrante Delicto By Gram Stain Exam

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Learning objectives:

To understand the importance of Gram staining exam for identifying culprit pathogen of bacterial infections

Case information:

An 88-year-old man presented to another hospital with a one-day history of fever. A diagnosis of empyema was suspected based on turbid, neutrophilic and acidic pleural effusion and the patient received piperacillin/tazobactam for only 8 days along with chest tube drainage. However, the culture of pleural effusion was negative, his condition improved only minimally and he was referred to our hospital one month later.

On exam, the patient appeared ill but the vital signs were normal. The body mass index was 12. He had multiple teeth decay with periodontal diseases. Examination of the lungs showed slight dullness in the left lower field. Laboratory tests showed white blood cell count of 12200/mcl. The follow-up chest image showed increased left pleural effusion with pleural thickness and mass like lesion in left upper lung field. Thoracentesis was performed, revealing purulent fluid with abundant neutrophils and filament-like Gram-positive rods compatible with *actinomyces israelii* (Figure 1). The patient was started with ampicillin/sulbactam but he died from respiratory failure on day 17.

Discussion:

To diagnose and treat infectious diseases, it is important to principles, including identifying an infective organ and a pathogen and appropriate antimicrobial treatment and appropriate follow-up. For identifying pathogen, Gram stain exam is quick, inexpensive and can sometimes capture atypical pathogens, which could not be grown in conventional cultures. Physicians throughout Japan now conduct this test in caring for patients with suspected bacterial infections.

Accurate diagnosis of actinomycosis is difficult because of difficulty in culturing this organism but is important since actinomycosis is potentially curable by appropriate management. Gram stain test is useful

for identifying this pathogen, similarly by catching the culprit flagrante delicto.
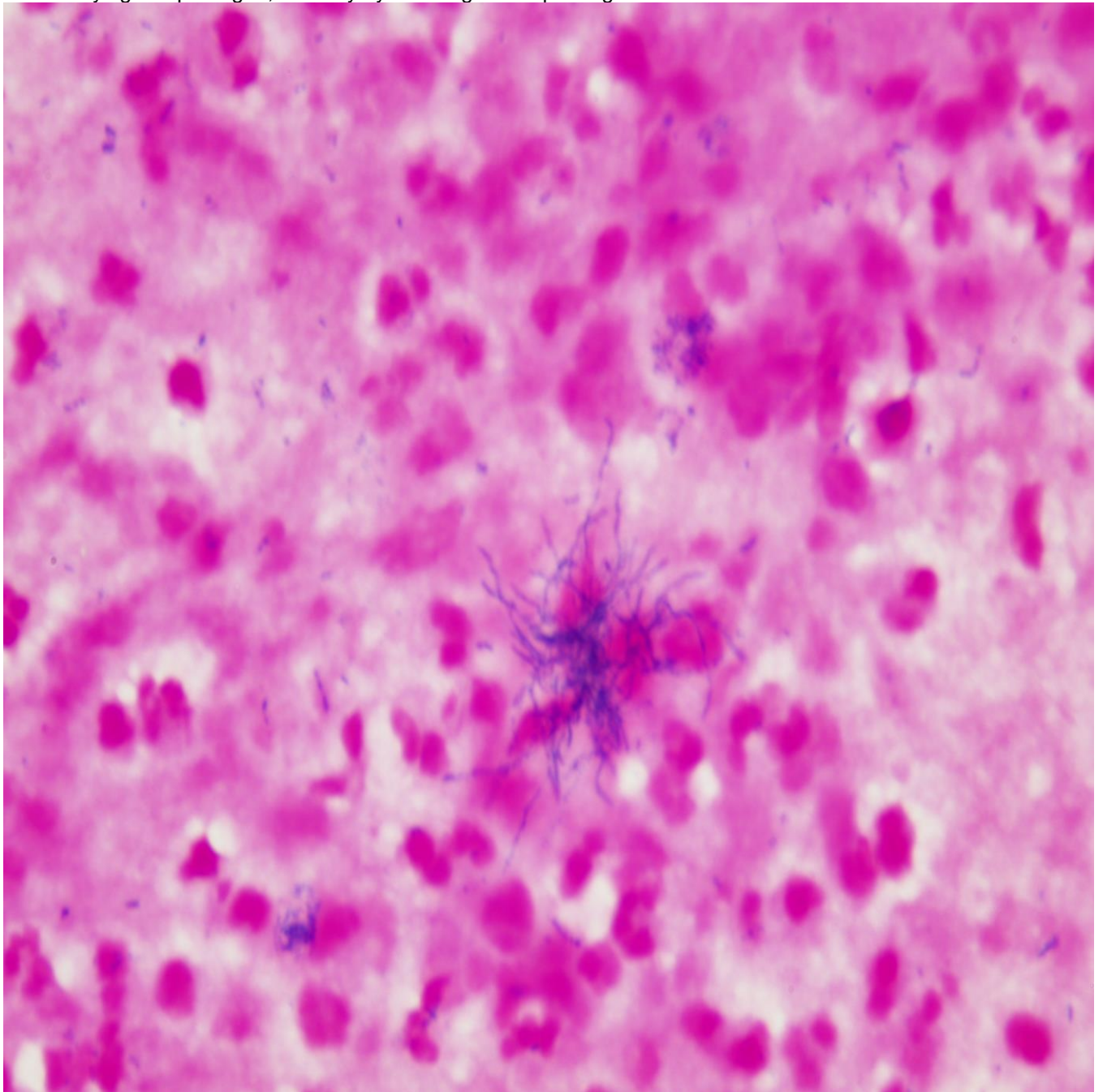
Negative Sign for Peritonitis Does Not Rule out Fulminant Colonic Ischemia.

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Learning objectives: Physical signs of peritoneal inflammation may not be present at the early phase of acute mesenteric ischemia.

Case information: A 77-year-old Japanese man with hypertension, diabetes mellitus and chronic kidney disease presented with a 2-day history of acute onset severe abdominal pain and hematochezia, followed by weakness and dyspnea on the day of hospital arrival by ambulance. On exam the patient appeared severely ill and pale and he had tachycardia and tachypnea. There was moderate tenderness over the entire abdomen without guarding or rebound tenderness. Laboratory data revealed metabolic acidosis, elevated levels of blood urea nitrogen and creatinine but normal leukocyte count. Non-contrast CT scan showed massive ascites and pan-colonic dilation and wall-thickening. Since peritoneal signs were not present, diagnosis of acute enterocolitis was made at the emergency department and conservative management was initiated. However, five hours later his mental status became obtunded and he developed hypotension. Gastroenterology consultation was obtained and abdominal paracentesis was performed, revealing stool colored ascites and he underwent urgent operation, revealing pan-colonic necrosis without mesenteric arterial occlusions. Total colectomy was performed, showing gangrenous colonic ischemia in the pathology exam. The patient died on day 35 from multiple organ failure.

Discussion: Timely urgent surgical intervention is mandatory for fulminant intestinal ischemia. In its early stage, the abdominal examination may show only subtle abnormality without peritoneal signs despite severe pains. If acute onset severe abdominal pain is developed in patients with vascular risk factors such as diabetes and hypertension, a diagnosis of intestinal ischemia should be pursued in a timely manner.

Hidden Cause of Severe Recurrent Rhabdomyolysis

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Learning objectives: Rhabdomyolysis by cytomegalovirus (CMV) infection can cause respiratory arrest through severe respiratory muscle weakness. The high index suspicion for CMV infection is important in immunocompromised patients with rhabdomyolysis because of its potential treatability.

Case information: A 69-year-old Japanese woman presented with a 2-day history of severe weakness and generalized myalgia. She had had rheumatoid arthritis and dyslipidemia her medications included golimumab, methotrexate, tacrolimus and pitavastatin. On exam, she was afebrile but appeared ill. There was severe muscle tenderness over the upper and lower extremities. Laboratory test showed thrombocytopenia, hemolytic anemia and marked elevation of creatine phosphokinase. Statin-induced rhabdomyolysis was suspected and the drugs were discontinued. However, the symptoms became progressive with development of CO_2 narcosis by respiratory muscle weakness and she required mechanical ventilation. MRI scan showed abnormal signal intensity on multiple muscles of the lower extremities. After she developed third recurrent episodes of rhabdomyolysis, positive test of CMV viremia was received and muscle biopsy was conducted, showing positive CMV immunostaining in cellular nucleus. A diagnosis of CMV infection with rhabdomyolysis was considered. After she was started with intravenous ganciclovir, steroids and immunoglobulins, her condition was gradually improved and she left hospital by walking with cane after the rehabilitation.

Discussion: Rhabdomyolysis can be caused by infections, drugs, toxins, heat illness or autoimmune diseases. Although patients on statins are at risk for drug-induced rhabdomyolysis, this diagnosis requires careful exclusion of other important causes. CMV infection should be considered as a potentially curable cause of rhabdomyolysis in immunocompromised hosts. The early stage of our case might have involved with confirmation bias, since thrombocytopenia and hemolysis were not typical features of statin-induced rhabdomyolysis.

All That Glitter Is Not Gold

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Learning objectives: It is important to carefully evaluate every possible differential diagnosis to avoid premature closure.

Case information: 75-years-old Japanese female with history of ovarian tumor status post ovariectomy was brought to the emergency department (ED) with altered mental status on the day of admission after 1 month of anorexia and 2 weeks of vomiting, when she was diagnosed as constipation by the near-by clinic. On arrival, her vital signs were within normal limit except for Glasgow Coma Scale (GCS) of 14 (E4V4M6) and blood pressure of 164/98mmHg, heart rate of 58 bpm. The laboratory date showed leukocytosis, elevated CRP, and elevated BUN (62.1mg/dL) and Creatinine (2.5mg/dL). Urinalysis showed pyruia with bacteriuria. Brain MRI revealed multiple small acute infarction. She was admitted for acute pyelonephritis complicated by dehydration, pre-renal failure and acute ischemic stroke. Although her mental status was improved to be clear after 2-days of intravenous (IV) antibiotics and IV fluid, her renal dysfunction persisted. (BUN=60.5mg/dL, Creatinine=2.7mg/dL) When investigating the cause of the persisted renal dysfunction, serum calcium level was found to be 16.9mg/dL which was not covered by the routine laboratory test on admission, followed by elevated intact parathyroid hormone. Parathyroid adenoma was found and resected, and serum calcium level and renal function returned to the normal level afterward.

Discussion: Hypercalcemia is a common cause of altered metal status with renal dysfunction. In patients presenting with these complaints, calcium needed to be checked on admission. In this case, presence of 2 reasonable diagnoses for them, dehydration and infection, obscured the other possible differential diagnosis such as hypercalcemia.

A Japanese Young Male Patient with Fever and Neutropenia in October 2014.

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Learning objectives: Fever and neutropenia with measles-like rash is the key to the diagnosis of dengue fever.

Case information: The end of October 2014, healthy 34-year-old male went to the clinic with fever five days. Blood test showed white blood cell count was 900/µl with 38% neutrophil and platelet was 70,000/µl and he was referred to hematology department of our hospital. At the time of admission, he was afebrile, but developed rashes throughout the body, and had laboratory abnormalities of liver function test. According to this physical examination, we could suspected measles or rubella as an acute febrile disease. Bone marrow aspiration was done due to a severe bicytopenia(white blood cell count of 1,000/µl, platelet count of 16,000/µl**)**. However, as a result, there was no findings to suggest hematological malignancy and hemophagocytic syndrome. A few days after admission, his rash had disappeared and any other laboratory abnormalities were resolved spontaneously. On additional history taking for infectious route, it was found that he had been bitten many times by mosquitoes while working in the forest around the workplace three weeks prior to admission. It was a place of 1km from Yoyogi Park where a lot of autochthonous patients of dengue fever reported in Japan in the summer 2014. Later, immunoglobulin M antibody for dengue virus was positive.

Discussion: Fever and neutropenia has potential risk of anchoring bias in misdiagnosis of a hematological disease. Moreover, it is difficult to diagnose of dengue fever in patient with a lack of recent overseas travel history. Thus, physicians need to remember that a leukopenia with the maculopapular rash which arises 3-5 days after fever onset becomes the key to the diagnosis of dengue fever.

EBV-Positive Diffuse Large B Cell Lymphoma in a Young Patient Can be a Clue to Diagnosis of HIV Infection.

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Learning objectives: To obtain HIV testing when a diffuse large B cell lymphoma is diagnosed in a young patient.

Case information: Thirty five-year old Japanese man without significant health problems presented with throat pain. He was seen by his Ear-nose-throat doctor and found to have a pharyngeal mass, which was biopsied. The pathological examination revealed EB virus positive diffuse large B cell lymphoma (DLBCL) with CD20 expression. He underwent a standard chemotherapy (R-CHOP) and went into a remission. He saw his ophthalmologist because he became aware of visual blurring and scotomata. The ophthalmologist diagnosed CMV retinitis and found him to be seropositive for HIV. He was referred to the division of infectious disease. Valganciclovir hydrochloride therapy and an antiretroviral therapy (tenofovir, emtricitabine, and dolutegravir) were started. Seven days after the referral, he presented with fever, black nodular lesions and multiple lymphadenopathies. One of the nodular lesions was biopsied and *Mycobacterium Kansasii*was isolated. Treatment consisting of isoniazid, rifampicin and ethambutol was started. The patient's fever, nodules, and lymphadenopathy improved on the treatments for HIV, and *Mycobacterium Kansasii.* These opportunistic infections might bave been prevented if HIV infection had been diagnosed before the chemotherapy was initiated.

Discussion: Although Primary effusional lymphoma and plasmablastic lymphoma occur predominantly in immunocompromised patients, particularly those infected with HIV, DLBCL is seen in immunocompetent patients as well. In Japan, HIV antibody testing is not recommended for all the patients that visit hospitals because of a low prevalence of HIV infection. In addition, DLBCL are thought to be a common type of lymphoma in Japan. Therefore generally speaking, when hematologists see patients diagnosed with DLBCL do not always order HIV testing. However, DLBCL typically occurs in elderly patients, physicians should consider to order HIV testing, when DLBCL occur in young patients.

Pseudo Acute Kidney Injury in a Patient with Past History of Pelvic Radiotherapy, Sudden Onset Abdominal Pain and Ascites: Consider Bladder Rupture!

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Learning objectives: Bladder rupture may cause pseudo acute kidney injury (AKI) via urine reabsorption through peritoneum back into systemic circulation.

Case information: A 67-year-old Japanese woman presented to another hospital with a 1-week history of sudden-onset severe lower abdominal pain immediately after she stood up from a chair. Sixteen years previously, the patient had received radical hysterectomy and pelvic radiotherapy for her cervical carcinoma. Serum creatinine concentration (Scr) obtained was 1.5 mg/dL and non-contrast CT scan reportedly showed normal study and she was sent home. However, the abdominal pain persisted and she also developed abdominal distention and she arrived at our hospital. The vital signs and jugular venous pressure were normal and abdominal examination showed abdominal distension. The Scr level was elevated and CT scan showed massive ascites. Upon a diagnosis of AKI with unknown etiology, she was admitted to nephrology service. Abdominal paracentesis was performed and ascites: serum creatinine ratio was 3.6, suggesting a urinary leak into peritoneum. She underwent urgent cystoscopy, revealing bladder rupture and it was surgically repaired successfully.

Discussion:

Bladder rupture can be life-threatening, but prompt diagnosis is difficult because of its various presentations. It may lead to markedly elevated Scr and blood urea nitrogen via reabsorption of these molecules through peritoneal membrane back into systemic circulation, mimicking laboratory pattern of AKI.

This case might be involved with confirmation bias, leading to the false diagnosis of AKI by sole interpretation about the elevated Scr and ignorance of the important history of this patient. It is important to comprehensively evaluate all available clinical information especially by history taking for accurate diagnosis.

The Imperfect Observer

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Learning objectives:

Errors in diagnostic radiology comprise perceptual errors, which are failure of detection, and interpretation errors which are errors of diagnosis. Perceptual error occurs at the detection phase of image reading, and is almost without exception, failure of abnormality detection.

Case information: A 23-year-old female presented to a trauma center after a motor vehicle accident. She was noted to have altered mental status at the scene and drug paraphernalia were found in the car. Her past medical history was significant for intravenous drug use. Her current medications were reported to be gabapentin and topiramate. Her physical examination in the trauma bay was unremarkable except for bilateral knee abrasions. Her urine drug screen was positive for opiates even though this was not a part of her prescribed medications. A trauma panel scan was negative for any injury. The CT scan of the abdomen and pelvis was read as negative. The uterus, adnexa, urinary bladder and colon were unremarkable with no traumatic injury. However a casual review of the CT scan by the emergency room physician showed an abnormal object in the patient's vagina. It looked like a pill bottle. Radiology was requested to reinterpret the scan. They read the images to show a large cylindrical foreign body in the vagina most likely a pill bottle. A pelvic examination later on showed no foreign body and was removed surreptitiously by the patient. The patient quietly eloped from the hospital the next day.

Discussion:

Diagnostic errors are not uncommon and are most frequently perceptual in nature.The most perplexing aspects of perceptual error is that abnormalities are usually very obvious once pointed out. It is vital to understand that a radiologist's read is an 'opinion' and there is room for error. He remains at best an imperfect observer.

Unusual Clinical Course of Pyelonephritis: Think Renal Abscess!

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Learning objectives:

Renal abscess should be considered in a case of unusual clinical course of suspected pyelonephritis

Case information: A 25-year-old Japanese woman with 10 or more times recurrent history of cystitis presented to her primary care physician with a 2-day history of fever. Acute pyelonephritis was suspected and she was started with oral levofloxacin. On next day, since she had persistent fever and developed left back pain, she visited another hospital, where abdominal CT without contrast was performed, showing inflammatory findings of adipose tissue around left kidney. Under the same diagnosis she was sent home. However, a few hours later she developed nausea, vomiting and headache, and she visited our hospital.On exam, she appeared ill with hypotension, tachycardia, high fever, and tenderness on left costovertebral angle. Again diagnosis of acute left pyelonephritis was given and she was started with cefotiam intravenously. On day 2 of admission, her fever had persisted and she developed left lower abdominal pain with rebound tenderness. Contrast-enhanced CT scan revealed left renal abscess. After the antibiotic was switched to meropenem, her condition was recovered without drainage.

Discussion: Renal abscess could be a potentially life-threatening disease if its diagnosis is delayed. Renal abscess should be considered in patients with suspected pyelonephritis who did not respond to conventional antibiotics. Its diagnosis usually requires contrast enhancement CT or MRI scans and thus high index of suspicion is mandatory. Availability bias of physicians might have been involved in diagnostic error of this case, since the patient had multiple episodes of recurrent urinary tract infections with responses to conventional antibiotics.

A Case of Systemic Lupus Erythematosus with Negative Antinuclear Antibody Titer Test

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Learning objectives:

Systemic Lupus Erythematosus (SLE) is an autoimmune disease with several diagnostic criterias. One of the criteria is a positive antinuclear antibody (ANA). Measuring ANA titer is a golden standard when detecting ANA. We present a case of normal ANA titer SLE, of which ANA was detected through another method, teaching us that we must consider alternative methods to reach a diagnosis.

Case information: A 76 years old female came to our ER with left abdominal pain. Her skin showed jaundice and abdominal CT scan showed splenomegaly. Further investigation found photosensitivity, nonerosive arthritis, hemolytic anemia, which are the criterions of SLE. Indirect immunofluorescence (IFA) was performed to measure ANA titer but the result came negative. However, suspecting SLE, we performed enzyme-linked immunosorbent assay (ELISA) and her ANA ratio showed 1.35, a positive ANA. She was diagnosed with SLE and given corticosteroid as a treatment, and her symptoms improved.

Discussion:

Positive ANA is a very strong criterion of SLE diagnosis and IFA and ELISA are two common ways to detect ANA. In a recent study, the sensitivity and specificity of ELISA compared to IFA was 93% and 54% consecutively. In the study, it is stated that IFA should be performed for confirmation of ANA. The present case had symptoms very similar to SLE, but her IFA was negative and ELISA was positive. Had we performed ELISA first, we could have made the diagnosis earlier, leading to treatment at an earlier stage. When a case presents several criterions without a positive ANA, he/she may be treated as ANA negative SLE. But the present case shows that not only IFA, but ELISA should also be considered on detecting ANA. In Japan, IFA is more common, but ELISA may serve better as a screening process for ANA, and further investigation should be performed.

Hide and Seek:Abruptly Spreading Silent Killer Under the Skin.

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Learning objectives: Necrotizing fasciitis without typical skin findings caused premature closure and late diagnosis.

Case information: 85-year-old female with history of lumbar compression fracture and femoral fracture was brought to the Emergency department (ED) for back pain and delusion after being diagnosed as some viral infection by her primary care physician (PCP). On arrival, she was disoriented and delusional, her vital signs showed body temperature of 37.4 Degrees Celsius, Blood pressure of 102/37mmHg, heart rate of 103 bpm, respiratory rate of 30/minute, SpO2 90% (room air). Because of her altered mental status, we only could identify the pain located at diffuse area of her back without skin findings. Whole-body plain CT only showed possibly new 1st lumber spinal compression fracture, which could explain the back pain and altered mental status. 8 hours after arrival, her mental status deteriorated and her blood pressure declined. 9 hours after arrival, cardiac arrest occurred and the patient deceased despite full resuscitation. Autopsy showed necrotizing fascia under purpura with bulla on the back, which was consistent with necrotizing fasciitis by Streptococcus equisimilis found in blood cultures later.

Discussion: Necrotizing fasciitis can cause rapid exaggeration without typical skin findings initially, and needs prompt diagnosis and treatment. Frequent back examinations may have helped us find back skin findings, which may have lead earlier diagnosis. To avoid this type of premature closure and late diagnosis, it is important to consider the possibility of necrotizing fasciitis even without typical skin findings for acutely deteriorating patients.

Anchored to an Uncomfortable Diagnosis

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Learning objectives: When a patient's attitude and behavior are suggestive of a psychiatric disorder, to a make a diagnosis of a common disease without first undertaking a detailed examination and tests must be avoided.

Case information: A 55-year-old woman with borderline personality disorder and abdominal aortic stenting, presented to the outpatient clinic two months before admission with severe dyspnea. The physician suspected emphysema, and corticosteroid inhalation therapy was commenced, but her symptoms did not improve. From one month before admission she sought medical advice on several occasions. She was eventually hospitalized due to hypoxia and continuous chest discomfort. Chest computed tomography (CT) and pelvic magnetic resonance imaging were performed after hospitalization. The physician identified ovarian cancer and pulmonary tumor thrombotic microangiopathy from the imaging findings. However, the patient deteriorated suddenly and died in hospital the next day.

Discussion: Cognitive bias should be avoided in every diagnostic case. Especially in diagnostically challenging cases, cognitive bias is one of the key factors of diagnostic errors. This case exhibits an example of misdiagnosis with an irreversible disease, and also showing typical cognitive error-anchoring. The physician in this case was anchored to an intuitive diagnosis of emphysema. However, the true diagnosis was markedly different. The reason for this pitfall bias was that the patient had a psychiatric disorder and she presented to the hospital several times, which was considered to be psychosomatic overlay. In addition, there was a failure to check the previous CT ordered by the Emergency Room which could have led to an alternative diagnosis sooner. Here I propose a method to try and avoid the pitfalls of diagnostic error.

Diagnostic Delay of Graves' Disease Due to Faulty Data Gathering

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Learning objectives: Despite a typical presentation of a disease, we tend to overlook clues of the diagnosis especially in an emergent situation due to faulty data gathering.

Case information: The patient is a 45 year-old female with history of asthma and smoking habit, who presented with dyspnea. She had not seen her primary care physician for 3 months and stopped using steroid inhalant, and increased frequency of smoking lately. She developed dyspnea 2 hours prior to call an ambulance. When she arrived at the Emergency department, body temperature 36.3℃, blood pressure of 131/88mmHg, heart rate 142bpm, respiratory rate 36/min, saturation 99% (on 5L O2 mask). She was lethargic, and wheezing and stridor were significant. The arterial blood gas analysis showed pH 7.235, PCO2 52.2mmHg, HCO3 23mmol/L. She was intubated immediately and methylprednisolone 40mg every 8 hours and ceftriaxone 1g daily were initiated for severe asthma exacerbation. Her respiratory status was improved and she was extubated successfully on Day 3. After the extubation, she was found to have sustained tachycardia, weight loss and exophthalmos by careful physical examination which implies Graves' disease, whose diagnose was confirmed by lab test. Methimazole was started followed by normalization of heart rate and thyroid function.

Discussion: Exophthalmos, weight loss and tachycardia are classical findings of Graves' disease, which were failed to collect from the initial interview by incomplete history and physical examination. Tachycardia was noted on arrival but was explained by alternative possibilities, which were dyspnea and beta stimulant. This type of cognitive contributions to diagnostic error is not rare especially in emergent situation, so thorough and complete initial history and physical examination are crucial not to miss the overall picture.

The Curious Case of a Missing Left Shoe.

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Learning objectives:

It is widely taught that diagnosis is revealed in the patient's history. 'Listen to your patient they are telling you the diagnosis' is a much quoted aphorism. Often the history alone reveals a diagnosis. Sometimes it is all that is required to make the diagnosis.

Case information:

A 61-year-old man with a history of a aortic dissection, status post repair and mechanical valve on warfarin presented to the emergency room at the advice of his cardiologist. He was had a minor motor vehicle accident three days ago. At that time evaluation at an outside facility with a CT scan of the head was negative, and he was discharged home. His INR was subtherapeutic. He returned to the same emergency room the next day because of persistent headache and was discharged home with advice to speak to his cardiologist regarding his subtherapeutic INR. The patient on evaluation today had a mild headache and no new symptoms. Detailed neurologic examination was unremarkable. The patient was admitted to medicine for resumption of anticoagulation therapy. A chance comment by the wife chastising the patient for losing his left shoe caught the attention of the physician. He has been intermittently losing his left shoe since the accident and presented without his left shoe. A repeat careful sensory examination showed him to have normal sensory examination. However he had left-sided extinction on double simultaneous stimulation. A CT scan of the head showed hypodensity in the posterior right MCA territory compatible with acute infarction.

Discussion:

This aphorism still holds as true, if not truer, despite the then unimaginable advances in medicine over the next 100 or so years. Attempting to make a diagnosis based on an incomplete history leads to a less focused approach to the problem, more laboratory and imaging tests, and sometimes, a delay in diagnosis and treatment.

Everything That Wheezes Is Not Asthma : A Case of Early Closure.

G. Singh

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Learning objectives: Differential diagnosis of wheezing.

Case information: 78 year old female with PMH of Hypertension, Diabetes Type 2 and Carcinoma in situ of b/l vocal cords presents to the ED with shortness of breath and labored breathing. Her vitals were normal and on physical exam b/l bronchospasm was appreciated and the patient was diagnosed with a new onset asthma. This patient was admitted to the residency service and was re-evaluated by the residency team. On Physical Examination it was found that the patient had b/l wheezes which were better heard in the upper airways as compared to the lower ones. This and the fact that she had a history of carcinoma in situ of her vocal cords, made the team get a ENT consultation to rule out an upper airway obstruction. Bedside flexible laryngoscopy was done, which showed a mass along with u/l paralysis of one of the vocal cords. Patient was upgraded to the SICU and was intubated for airway protection.

Discussion: This is a good learning case which underlines the fact that vocal cord paralysis can present like asthma leading to diagnostic errors and patient harm. It is very important to have a broad differential in mind especially in cases of new onset asthma and in patient's who have risk factors for upper airway obstruction.

Faulty Information Synthesis, Distracted By Co-Existing Adnexal Incidentaloma

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Learning objectives: Ovarian torsion is one of the important differential diagnosis of Women's lower abdominal pain. However it is difficult to diagnose, and several other differential diagnosis are mimicking, and we need to carefully rule out other possibilities.

Case information: We experienced 16 cases of suspected ovarian torsion from January 2013 to December 2014. Four of them had other diagnosis despite co-existing adnexal masses. We introduce these cases including appendicitis, ovarian abscess, pelvic infectious disease, and ruptured of ovarian tumor. 50 year-old female history of IUD (Intrauterine device) insertion with adnexal mass had left lower abdominal pain found to have adnexal abscess. 23 year-old previously healthy female with left ovarian mass had left lower abdominal pain found to have PID (Pelvic Inflammatory Disease). 30 year-old previously healthy female with right ovarian tumor had right lower abdominal pain found to have appendicitis. 36 year-old previously healthy female with left ovarian tumor had left lower abdominal pain found to have ruptured ovarian tumor.

Discussion: A definitive diagnosis of ovarian torsion is made by direct visualization of a rotated ovary at the time of surgical evaluation. Yasui (2013) reported the rate of correct diagnosis of ovarian torsion preoperatively is 37~50%. Our 4 cases were misdiagnosed initially because of faulty synthesis, "Distraction by other issues", which are eye-catching co-existing adnexal incidentalomas. For accurate diagnosis, carefully taking history and physical examination to rule out other possibilities are helpful and may avoid unnecessary surgery.

Anchoring Bias during Season of Influenza Outbreak

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Learning objectives: Delayed diagnosis and treatment caused by anchoring in a patient with fever and myalgia in influenza season.

Case information: 74-year-old male with past history of hypertension and gastric cancer, status post gastrectomy, was brought to the emergency department (ED) for 2-days of anorexia and fatigue and 1-day of myalgia and fever with shaking chills in January. He was alert and oriented. His vital signs showed body temperature of 38.2 degrees Celsius and heart rate of 141 beats per minute, blood pressure of 80/57mmHg. His physical examination was insignificant except for diffuse muscles tenderness. The laboratory date showed WBC 11,200/mm^3 and CRP 19.84mg/dl. Urinalysis, chest x-ray, head and body CT didn't reveal the source of fever. His hypotension rapidly responded to intravenous (IV) fluid, and the symptoms were relieved by acetaminophen. Although rapid influenza antigen test was negative, influenza was suspected based on symptoms and influenza outbreak. He was admitted to the hospital for susceptibility to bacterial infection due to unrecognized splenectomy, found by abdominal CT. 12 hours later, 2 sets of blood cultures showed positive chained gram-positive cocci (GPC). Vancomycin and Ceftriaxone were initiated for suspected pneumococcal bacteremia. On the next day, he was found to have altered mental status with nuchal rigidity. Cerebrospinal fluid (CSF) was consistent with bacterial meningitis, followed by positive Streptococcus pneumonia in CSF and blood cultures, eventually complicated with brain abscess and mild cognitive impairment.

Discussion: This case represents delayed diagnosis and treatment of invasive pneumococcal disease. Typical flu-like symptoms in the influenza-outbreak season caused anchoring bias and lead us to underestimate crucial history of splenectomy. It is essential to consider wide varieties of differential diagnosis of fever and myalgia with thorough history taking.

Diagnostic Pitfall Evaluating Leg Ulcers in Patients with Multiple Atherosclerotic Risk Factors

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Learning objectives:

Leg ulcers warrant systemic evaluation including vascular assessment and detailed history in revealing its etiology.

Case information: A 63-year-old man was admitted for 2 months history of painful leg ulcer with pedal edema, absent pedal pulse, and low ankle brachial index. Referral to a vascular surgeon was considered in suspect of arterial insufficiency, with his active smoking history despite cerebral infarction due to atrial fibrillation. However, further questioning revealed fever and weight loss together with chronic polyarthritis. With a positive rheumatoid factor and anti-CCP antibody, the patient fulfilled diagnosis of rheumatoid arthritis. Furthermore, interstitial pneumonitis was identified on background of high disease activity suggested by inflammatory markers. Despite a negative skin biopsy, the patient was treated in suspicion of rheumatoid vasculitis with high-dose steroids and azathioprine; complete ulcer healing was seen after 4 months.

Discussion: Leg ulcers disclose multifactorial etiologies such as venous, arteriosclerotic, diabetic, and vasculitic disease. In care of this patient with high risk of cardiovascular disease, findings suggestive of arterial insufficiency mimicked an atherosclerotic ulcer. However, a full clinical assessment was effective in pointing out the correct diagnosis of vasculitis. There lies clinical significance in the interrelation of pathophysiology in vasculitis and atherosclerosis. While systemic inflammation is the cardinal feature of vasculitis, localized inflammation of the endothelium is also described which may possibly carry out risks of atherosclerosis. Moreover, treatments for vasculitis with corticosteroids favor progression of atherosclerosis by impairing glucose tolerance and inducing hypertension. Prevention as well as early detection and treatment of premature atherosclerosis should be viewed as one of the primary objectives

in the long term management of vasculitis.

Legionella Pneumonia Mimicking Acute Gastroenteritis

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Learning objectives: Gastrointestinal symptoms may be initial presentation of Legionella pneumonia, which is mimicking acute gastroenteritis.

Case information: The patient is 70 year-old previously healthy male presented to the emergency department (ED) with worsening fatigue, dyspnea, and loss of appetite. He initially had diarrhea, fever and mild cough 5 days prior to arrival when he was diagnosed as acute gastroenteritis and treated with oral third generation cephalosporin. On arrival, his vital signs showed body temperature of 40.3℃, blood pressure of 140/70mmHg, heart rate of 102bpm, respiratory rate of 24/min and saturation of 95%(on 6L/min of O2 mask).   Chest auscultation showed significant course crackles bilaterally.   Laboratory test showed white blood cell count of 8300/μl, BUN of 14.9mg/dl, and sodium of 125mEq/l. Chest CT revealed bilateral infiltrates, and urine Legionella antigen test was positive.   Legionella pneumonia was diagnosed and Quinolone was given which made him better.

Discussion: Legionella pneumonia mimics gastroenteritis when its symptoms begin with gastrointestinal symptoms. Initially this patient had mild cough which was not recognized as an important symptom due to faulty detection or perception. But it needs to be considered as one of differential diagnosis when you encounter combination of upper respiratory and gastrointestinal symptoms.

A Surprising Cause of Right Upper Quadrant Pain.

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Learning objectives: Sir Zachary Cope advised in rhyme: Distension, rigidity,vomiting,pain. Are actors abdominal which often deign. To act on behalf of the chest or brain…. Clinicians should not forget that what happens in the chest can present in the abdomen.

Case information: A 77 year-old woman developed right lateral chest/upper abdomen pain radiating to the back about a year ago. This was thought to be neuropathic versus zoster without rash and was treated with gabapentin and nortriptyline twice. Her symptoms persisted and six months later a right quadrant ultrasound showed small gallstones resulting in a a laparoscopic cholecystectomy. She subsequently developed increasing pain and a CT abdomen and pelvis showed no acute abnormalities. A spinal x-ray was read normal. A chest x-ray showed atelectasis. She was treated with a lidocaine and fentanyl patch. She continued to have pain and a gastroenterologist at a University hospital though the pain was musculoskeletal. In the past few days she had increasing shortness of breath, not able to lay flat, and developed leg swelling. She was sent to the emergency department by her pain physician. A CT of the chest revealed a mediastinal mass extending into the right/left atria with obstruction of the right inferior pulmonary vein causing right lower lobe venous infarct. The mass also obstructed the IVC, and T7/8 lesions were seen with small to moderate pericardial effusions. A needle core biopsy of the thoracic vertebral body was consistent with very non-squamous cell lung cancer as a possible primary site.

Discussion: The experience of this patient is a potent reminder that the chest needs careful attention and examination in any patient with abdominal pain. Abdominal pain often have causes for their pain located outside of the abdominal cavity. The differential diagnoses should be broadened and referred pain considered after several negative tests for an abdominal cause.

Fatal Nonchalance

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Learning objectives:

1. Discuss the appropriate work-up of a breast mass.
2. Discuss how the age of the patient affects the work-up.
3. Discuss methods of differentiating scar tissue from other lesions in the breast.

Case information: J.T. had a breast reduction in 2001 at the age of 22. One year later she felt a lump in the upper right breast. An ultrasound was done and was read as normal. She was told that the mass was due to scarring. She bore a child in 2004 and another in 2011. She had bariatric surgery in 2012. J.T. reported that the mass in the right breast had gotten larger after the birth of her second child and felt even larger after her bariatric surgery. Again she was told that it was probably scar tissue. She had her first mammogram in April, 2013, and a breast ultrasound. An apparent malignancy was visualized on mammogram and ultrasound. Biopsy revealed poorly differentiated invasive ductal carcinoma with perineural invasion, ER+, PR+, HER2neu negative. The tumor measured 7 cm and two lymph nodes contained tumor: Stage IIIA. The patient was found to have a BRCA2 mutation. Initial metastatic work-up was negative. She completed a full course of chemotherapy and radiation therapy and was started on Tamoxifen. J.T. presented with back and hip pain in January, 2015. Metastatic work-up revealed metastatic disease in the lymph nodes in the neck, mediastinum, hilum and retroperitoneum, and in the right lung, liver, spine, including a pathologic fracture of C7, and in the left hip.

Discussion: Although breast cancer is rare in women in their twenties, every breast abnormality warrants a thorough work-up and should be re-evaluated if a concern persists. A delay in diagnosis of up to eleven years adversely affected this woman's disease-free and likely her overall survival.

"There Is Nothing More Deceptive Than an Obvious Fact."

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Learning objectives: When evaluating a patient, a physician must consider common diagnoses before rare ones because clinicians are taught that common things are common. However, sometimes, the obvious diagnosis is not the right one.

Case information: A 25-year-old female who was seen in the emergency room with a 5 week history of bifrontal headache and visual blurred vision. Patient was evaluated for the this a few weeks ago, and had an MRI of the brain read as unremarkable. On physical examination she was obese and funduscopic examination showed her to have disc edema. A clinical diagnosis of idiopathic intracranial hypertension was made based on her age/sex/weight and symptoms of headache and visual symptoms. A CT venogram done was negative for dural venous sinus thrombosis. A bedside lumbar puncture was unsuccessfully attempted. Plan was for patient to be discharged home on acetazolamide with an early neurology outpatient follow and a repeat lumbar puncture. However, the patient had an anxiety attack got admitted. The lumbar puncture performed by IR showed opening pressure of only 12 cm of water with CSF white blood count of 455/cc mm and RBC 250/cc mm. MRI of the orbit showed abnormal enhancement along the optic nerves bilaterally. A CT scan of the chest showed right paratracheal and hilar lymphadenopathy consistent with a stage II sarcoidosis with both mediastinal and lung involvement. Surgical pathology of transbronchial biopsy showed non- necrotizing granuloma and giant cells. Patient was diagnosed with neurosarcoidosis.

Discussion: Clinicians tend to be highly confident in a diagnosis when the patient and their symptoms are highly representative of the typical presentation. ''If it looks like a duck, walks like a duck, quacks like a duck, then it is a duck.'' Yet restricting decision-making along these pattern-recognition lines leads to diagnosis being missed.