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AMIA 2014 Annual Symposium
November 14 - 19, 2014

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Friday, November 14, 2014
You have nothing scheduled for this day

Saturday, November 15, 2014

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<tr>
<th>Time</th>
<th>Session or Event Info</th>
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<tr>
<td>8:30 AM-4:30 PM</td>
<td>WG05: Data Mining for Medical Informatics (DMMI) – Electronic Phenotyping, Working Group Pre-symposium</td>
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<td>8:30 AM-4:30 PM (Conflict)</td>
<td>Data Mining for Medical Informatics (DMMI) – Electronic Phenotyping</td>
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<td>F. Wang; G. Stiglic; N. Peek; N. Shah</td>
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<tr>
<td>1:00 PM-4:30 PM</td>
<td>T04: Imaging Informatics: Foundations and Clinical Applications, Tutorial</td>
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<tr>
<td>1:00 PM-4:30 PM (Conflict)</td>
<td>Imaging Informatics: Foundations and Clinical Applications D. Rubin</td>
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Sunday, November 16, 2014
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Monday, November 17, 2014

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<tr>
<td>10:30 AM-12:00 PM</td>
<td>S23: Papers/Podium Presentations - Detecting Knowledge in Unstructured Data, Papers/Podium Presentations, Data Mining, NLP, Information Extraction Retrieval</td>
</tr>
<tr>
<td>10:30 AM-12:00 PM</td>
<td>Automated Identification of Unsuspected Lung Nodule Findings in Radiology Reports with Natural Language Processing and Text Classification R. Wise; J. Duckart; J. Yang</td>
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<tr>
<td>5:00 PM-6:30 PM</td>
<td>Poster Session 1, Poster</td>
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<tr>
<td>5:00 PM-6:30 PM</td>
<td>&quot;Doctors who ordered this also ordered…&quot; Automated physician order recommendations and outcome predictions by data-mining electronic medical records J.H. Chen; R.B. Altman</td>
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<tr>
<td>5:00 PM-6:30 PM</td>
<td>Computerized Clinical Decision-Support for The Evaluation of Suspected Pulmonary Embolism In The Emergency Department D.M. Mehta; R.P. Radecki; N.G. Okafor; S. Spence; H. Nguyen</td>
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### Tuesday, November 18, 2014

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<tr>
<td>5:00 PM-6:30 PM</td>
<td>Developing a Knowledge Base for Detecting Carotid Stenosis with pyConText D.L. Mowery; D. Franc; S. Ashfaq; E. Cheng; T. Zamora; W.W. Chapman; B.E. Chapman</td>
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### Wednesday, November 19, 2014

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<tr>
<td>5:30 PM-7:00 PM</td>
<td>Biomedical Imaging Informatics Working Group Meeting, Business Meeting</td>
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<td>10:30 AM-12:00 PM</td>
<td>S58: Papers - Personalized Medicine, Papers, Translational Bioinformatics and Biomedicine</td>
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<td>10:30 AM-12:00 PM</td>
<td>p-medicine: A Medical Informatics Platform for Integrated Large Scale Heterogeneous Patient Data J. Marés; L. Shamardin; G. Weiler; A. Anguita; S. Sfakianakis; E. Neri; S.J. Zasada; N. Graf; P.V. Coveney</td>
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<tr>
<td>10:30 AM-12:00 PM</td>
<td>Comparing the Value of Mammographic Features and Genetic Variants in Breast Cancer Risk Prediction Y. Wu; J. Liu; D. Page; P.L. Peissig; C. McCarty; A.A. Onitilo; E.S. Burnside</td>
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<tr>
<td>1:45 PM-3:15 PM</td>
<td>S66: Papers - Biomedical Insights through Data Mining, Papers, Data Mining, NLP, Information Extraction Retrieval</td>
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<tr>
<td>1:45 PM-3:15 PM</td>
<td>Automatic Detection of Dilated Cardiomyopathy in Cardiac Ultrasound Videos R. Mahmood; T. Syeda-Mahmood</td>
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<td>3:30 PM-5:00 PM</td>
<td>S79: Systems Demonstrations - Putting Health Data to Work, Systems Demonstrations, Simulation and Modeling</td>
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<td>3:30 PM-5:00 PM</td>
<td>Patient-Centered Case Management System (P-CMS) K.A. Butler; A. Berry; A. Walker; N. Pete; Y. Sung; C. Harrington; J. Haselkorn; W.P. Nichol; M. Oberle; M. Haselkorn; L. McCarthy</td>
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<tr>
<td>5:00 PM-6:30 PM</td>
<td>Poster Session 2, Poster Perceptions of Health Care Quality in an Emergency Department During a Planned Electronic Health Record Downtime N.G. Okafor; A.M. Mehta</td>
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### Time

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<tr>
<td>8:30 AM-10:00 AM</td>
<td>S83: Papers/Podium Presentations - Getting Data Right!, Papers/Podium Presentations, Clinical Informatics</td>
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| 8:30 AM-10:00 AM | **A Novel Method to Assess Incompleteness of Mammography Report**  
**Content** F. Gimenez; Y. Wu; E.S. Burnside; D. Rubin |
Data Mining for Medical Informatics (DMMI) – Electronic Phenotyping

F. Wang; 1; G. Stiglic; 3; N. Peek; 2; N. Shah; 4;
1. IBM T. J. Watson Research Center, Yorktown Heights, NY, United States.
2. Department of Medical Informatics, University of Amsterdam, Amsterdam, Netherlands.
3. Faculty of Health Sciences, University of Maribor, Maribor, Slovenia.
4. Center for Biomedical Informatics Research, Stanford University, Stanford, CA, United States.

Abstract: The life and biomedical sciences are massively contributing to the big data revolution, due to advances in genome sequencing technology and digital imaging, growth of clinical data warehouses, increased role of the patient in managing their own health information and rapid accumulation of biomedical knowledge. Under this context, data mining techniques, with the goal of knowledge discovery and deriving data driven insights from various data sources, has played a more and more important role in medical informatics. Effective data mining approaches have been applied in many medical problems including drug development, personalized medicine, disease modeling, cohort study, comparative effectiveness research, etc. The main theme of the workshop this year is electronic phenotyping, which aims to identifying the set of people for further study. This topic has received a lot of interests and debating recently. We would like to invite the researchers from both academia and industry who are interested in this topic to participate in this workshop, share their opinions and experience, as well as discuss future directions.
Imaging Informatics: Foundations and Clinical Applications

D. Rubin;¹

¹. Radiology and Medicine (Biomedical Informatics Research), Stanford University, Stanford, CA, United States.

Abstract: Medical imaging is a vital component of healthcare, providing information about disease phenotype. However, only a fraction of the rich biomedical content in images is utilized in research and clinical practice, since images are complex unstructured data, and informatics methods to extract and manage their semantic and quantitative content are only recently being developed. The proliferation of imaging provides enormous opportunities in the Big Data era, which will accelerate discovery and help to improve patient care. Specifically, researchers and clinicians are trying to relate phenotype information in images to molecular and clinical characterizations of disease on large scale in order to use non-invasive imaging for diagnosis and assessment of treatment response. The core imaging informatics topics of semantic annotation of images, integrating images with molecular and clinical data, image mining, content based image retrieval, and image-based decision support, are becoming crucial themes to advance medical practice and biomedical discovery; however, these topics are not commonly reviewed in tutorials. Reviewing and pointing out opportunities for using these imaging informatics methods and applications will ultimately improve our ability to diagnose disease, enable tailoring the optimum treatment to each patient, permit automated tracking disease response, and enable predicting clinical outcomes.

This tutorial will provide an overview of the foundational methods and emerging clinical applications in imaging informatics, including the key methodologies for acquiring and computationally analyzing images and informatics approaches for working with images as a unique type of biomedical data. We will stress the synergy of imaging informatics methods with those in biomedical informatics more broadly, and the implications for data integration, discovery, and clinical decision making in the Big Data era. At the conclusion of the tutorial, attendees will have a deeper understanding of the exciting developments driving the imaging informatics field, the use of informatics methods to access and work with image contents, new imaging algorithms/techniques, and the forthcoming image-related applications that will enable discovery in research and improvement in healthcare quality.
Automated Identification of Unsuspected Lung Nodule Findings in Radiology Reports with Natural Language Processing and Text Classification

J. Yang; 1; R. Wise; 1; J. Duckart; 1;
1. NWIC, Portland VA Medical Center, Portland, OR, United States.

Abstract: Detection of lung nodules on radiology images is the critical first step in timely follow-up and cancer diagnosis. Detection is hindered by the difficulty of identifying findings buried in radiology reports. An automated text classification algorithm is developed to detect these cases. The algorithm achieves a 94% recall in recognizing lung nodules. Future work is needed to integrate the algorithm into the workflow of the care coordinator for patient follow-up.
Automated physician order recommendations and outcome predictions by data-mining electronic medical records

J. H. Chen; 3, 4; R. B. Altman; 2, 1;
1. Bioengineering and Genetics, Stanford University, Stanford, CA, United States.
2. Medicine, Stanford University, Stanford, CA, United States.
3. Center for Innovation to Implementation (Ci2i), Veteran Affairs Palo Alto Health Care System, Palo Alto, CA, United States.
4. Center for Health Policy / Center for Primary Care and Outcomes Research (CHP/PCOR), Stanford University, Stanford, CA, United States.

Abstract:

Background

National healthcare reforms and incentive programs demand meaningful use of electronic medical records (EMR) to improve patient safety and cost efficiency. This will depend on EMRs integrating clinical decision support (CDS) to drive physician orders (labs, imaging, medications, etc.), the concrete manifestation of clinical decision making. Order sets, risk scores, and similar constructs already help consistency and best-practices, but they are limited by a top-down approach, requiring manual production and limited end-user awareness. A Big Data approach could instead crowd-source clinical expertise from the bottom-up, but it is unknown whether such a data-driven order recommendation system, analogous to Netflix or Amazon.com’s “Customer’s who bought A also bought B” system, can anticipate real physician orders and clinical outcomes.

Methods

EMR data was extracted from one year of inpatient hospitalizations at Stanford University Hospital (>5.4M structured data items from >18K patients, including physician orders, lab results, and diagnosis codes). Association statistics were counted for all pairs of the ~1,500 most common item types from a random training set of 16,408 patients to derive item-association conditional probability estimates, driving an order recommendation engine. For a separate random test set of 1,903 patients, data occurring within 4 hours of the hospital encounter was used to query for 10 recommended physician orders that were compared against the actual orders occurring within 24 hours. In addition to metrics of recall and precision, inverse frequency weighted variants are introduced to evaluate recommendations that are “specifically relevant” and not just common. The first 24 hours of data for each test patient was also used to query for the conditional probabilities of 30 day mortality and ICU admission within 1 week, which were compared against actual outcomes by ROC analysis.

Results

Compared to a reference benchmark of always recommending the most common items, the item-association order recommendation engine improves precision from 26% to 37% (p<10^-40). Integrating likelihood ratio estimates improves inverse frequency weighted recall from 3% to 17% (p<10^-120). The framework predicts 30 day mortality and 1 week ICU intervention with ROC AUC (c-statistic) of 0.88 and 0.78, respectively.

Discussion

This data-driven physician order recommendation engine improves upon a reference benchmark in anticipating real physician orders. Different evaluation metrics distinguish common orders from those more specifically relevant to a given clinical context. This same framework predicts clinical outcomes on par with state-of-the-art prognosis scores.
whose c-statistics range from 0.75-0.90 \(^2\) and 0.69-0.81 \(^3\) for predicting mortality and early ICU admission, respectively.<br/>
<br/>
The key concern with these results is whether their basis on common practice patterns represents ideal ones. Prospective trials will be necessary to answer this and many important clinical questions in the pursuit of evidence-based decision making. The inevitable reality of everyday clinical practice however is a perpetual gap of prospective data, resulting in routine dependence upon individual expert opinion and anecdotal experience. Tools as described in this work can still elevate clinical decision making to a data-driven process based on the experience of thousands of practitioners from real-world settings in the Big Data era of EMRs.<br/>
<br/>
References<br/>
Abstract: Introduction<br />
The American College of Emergency Physicians recommends the use of Wells' Score for Pulmonary Embolism (PE) and D-dimer as objective risk-stratification of patients with suspected PE prior to ordering computed tomography pulmonary angiogram (CTPA). Implementation of these recommendations by use of algorithmic clinical decision-support (CDS) incorporated into computerized provider order entry (CPOE) has been demonstrated with mixed results. Our objective was to evaluate the acceptability of such CDS at our institution, with the hypothesis this intervention would increase positive CTPA yield for PE.<br />

Methods<br />
This study was performed at a Level 1 academic emergency department with an enterprise-wide electronic health record. A CDS algorithm for guideline-compliant diagnosis of PE using Wells' Score and D-dimer was integrated into CPOE. A baseline CTPA positivity rate of 8.0% for acute PE was determined from the most recent 250 studies prior to the intervention going live. The evaluation period following CDS implementation was from March 1, 2014 until July 10, 2014. Upon placing a CTPA order, the CDS flow chart is reflected in Figure 1. Alert #1 prompted clinicians to complete a checklist for objective risk-stratification by Wells’ Score. Alert #2 prompted clinicians with recommendations to discontinue the CTPA order if the patient were low- or intermediate-risk, and the D-dimer result was <0.4 µg/mL. Data were collected retrospectively on all patients who had a CTPA ordered and charts were abstracted for the presence or absence of D-dimer results, Wells’ score documentation, and CTPA result.<br />

Results<br />
CTPA were ordered on 262 patients during the evaluation period. The flow of these patients through the CDS is summarized in Figure 1. 49 patients had an elevated D-dimer recorded and no prompts were displayed, 3 (6.1%) of whom were diagnosed with acute PE. Alert #1 was shown 213 instances, but acceptability was poor, with only 61 risk-stratification checklists completed. Overall, guideline-compliant care was performed in 69 patients, resulting in 7 (10.1%) positive CTPA. However, the overall positive CTPA yield of our institution’s entire CTPA cohort also increased to 13.8% during the observation period.<br />

Discussion<br />
The CDS tool had poor acceptance at our institution, as evidenced by the disproportionate number of CTPA completed without objective risk-stratification. Due to the limited sample of completed CDS checklists, no valid conclusions may be drawn regarding the effectiveness of the CDS. Causative factors for the increased yield of CTPA during the observation period are unclear. A Hawthorne effect associated with CDS implementation cannot be excluded.
Abstract: We present a pilot study to develop a semantic schema for extracting mentions of carotid stenosis and their modifiers from ultrasound reports to extend a natural language processing (NLP) algorithm, pyConText.
p-medicine: A Medical Informatics Platform for Integrated Large Scale Heterogeneous Patient Data

P. V. Coveney; 1; J. Marés; 1; L. Shamardin; 1; G. Weiler; 2; A. Anguita; 3; S. Sfakianakis; 4; E. Neri; 5; S. J. Zasada; 1; N. Graf; 6;

2. Fraunhofer Institute for Biomedical Engineering, St. Ingbert, Germany.
3. Universidad Politécnica de Madrid, Madrid, Spain.
4. ICS-FORTH, Heraklion, Greece.
6. University of Saarland, Saarland, Germany.

Abstract: Secure access to patient data is becoming of increasing importance, as medical informatics grows in significance, to both assist with population health studies, and patient specific medicine in support of treatment. However, assembling the many different types of data emanating from the clinic is in itself a difficulty, and doing so across national borders compounds the problem. In this paper we present our solution: an easy to use distributed informatics platform embedding a state of the art data warehouse incorporating a secure pseudonymisation system protecting access to personal healthcare data. Using this system, a whole range of patient derived data, from genomics to imaging to clinical records, can be assembled and linked, and then connected with analytics tools that help us to understand the data. Research performed in this environment will have immediate clinical impact for personalised patient healthcare.
Comparing the Value of Mammographic Features and Genetic Variants in Breast Cancer Risk Prediction

Y. Wu; 1 J. Liu; 1 D. Page; 1 P. L. Peissig; 2 C. McCarty; 3 A. A. Onitilo; 2, 4, 5 E. S. Burnside; 1
1. University of Wisconsin, Madison, Madison, WI, United States.
2. Marshfield Clinic Research Foundation, Marshfield, WI, United States.
3. Essentia Institute of Rural Health, Duluth, MN, United States.
4. Marshfield Clinic Weston Center, Weston, WI, United States.
5. University of Queensland, Brisbane, QLD, Australia.

Abstract: The goal of this study was to compare the value of mammographic features and genetic variants for breast cancer risk prediction with Bayesian reasoning and information theory. We conducted a retrospective case-control study, collecting mammographic findings and high-frequency/low-penetrance genetic variants from an existing personalized medicine data repository. We trained and tested Bayesian networks for mammographic findings and genetic variants respectively. We found that mammographic findings had a higher discriminative ability than genetic variants for improving breast cancer risk prediction in terms of the area under the ROC curve. We compared the value of each mammographic feature and genetic variant for breast risk prediction in terms of mutual information, with and without consideration of interactions of those risk factors. We also identified the interactions between mammographic features and genetic variants in an attempt to prioritize mammographic features and genetic variants to efficiently predict the risk of breast cancer.
Automatic Detection of Dilated Cardiomyopathy in Cardiac Ultrasound Videos

T. Syeda-Mahmood; R. Mahmood;
1. Medical Sieve Dept., IBM Almaden Research Center, San Jose, CA, United States.
2. Kennedy Middle School, Cupertino, CA, United States.

Abstract: In this paper we address the problem of automatic detection of dilated cardiomyopathy from cardiac ultrasound videos. Specifically, we present a new method of robustly locating the left ventricle by using the key idea that the region closest to the apex in a 4-chamber view is the left ventricular region. For this, we locate a region of interest containing the heart in an echocardiogram image using the bounding lines of the viewing sector to locate the apex of the heart. We then select low intensity regions as candidates, and find the low intensity region closest to the apex as the left ventricle. Finally, we refine the boundary by averaging the detection across the heart cycle using the successive frames of the echocardiographic video sequence. By extracting eigenvalues of the shape to represent the spread of the left ventricle in both length and width and augmenting it with pixel area, we form a small set of robust features to discriminate between normal and dilated left ventricles using a support vector machine classifier. Testing of the method of a collection of 654 patient cases from a dataset used to train echocardiographers has revealed the promise of this automated approach to detecting dilated cardiomyopathy in echocardiography video sequences.
Abstract: Seventy-five percent of U.S. health care dollars are spent on chronic illness and the cost is growing with population aging. MS is an example of chronic illness where case managers play an important role coordinating and monitoring complex treatment plans that unfold over months for outpatients. The number and duration of orders, combined with the complexity of conditions, require a wide variety of information to manage cases and coordinate care. Using information from a wide variety of resources can impose burdensome clerical tasks to access it, integrate it manually, then keep the ad-hoc collection current, on top of doing patient care. Without an information system that is well-designed specifically for case management these overhead tasks can be daunting, disrupt timely coordination, and risk needless errors. The specific purpose of P-CMS is to provide a single tool that integrates needed information in a highly usable, effective user interface to improve awareness of the progress of patients’ orders and conditions, while eliminating the wasted overhead of clerical information tasks.

P-CMS: Organizes needed information into layers based on an effective cognitive strategy of management by exception against time-based milestones for each type of order. The home page displays a list of all patients with color coding for quick visibility of any patient whose progress has fallen behind one or more milestones. Any patient’s order summary can be opened with one click, and any patient can be retrieved by name. Selectable column headers allow users to re-sort the list of patients with one click by:
- Any patients with new or changed orders, displayed by oldest to newest
- Any patients with order milestones that are late, displayed from most behind to least
- Patient’s next appointment date, displayed by nearest to furthest
- Patient’s last appointment date, displayed by most recent to oldest

All the page views provide color coding to identify patients with exceptions to expected progress.

STATUS: A functional prototype was implemented in HTML with anonymized patient data in a SQL database for usability testing and technical feasibility. Usability results with seven experienced nurses indicate it is highly learnable and easy to use for all use-cases. The Northwest VA regional data warehouse patient-level database was analyzed to successfully define links to the P-CMS database for daily surveillance of clinical orders, lab results, radiology results, consult and appointment tracking.

ACKNOWLEDGMENTS: This project was supported by grant number R01HS021233 from the Agency for Healthcare Research and Quality. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality. We gratefully acknowledge participation by the VHA MS COE, West, and VHA Office of Informatics and Analytics.
Perceptions of Health Care Quality in an Emergency Department During a Planned Electronic Health Record Downtime

A. M. Mehta, 1; N. G. Okafor; 1;
1. Department of Emergency Medicine, University of Texas - Health Science Center at Houston, Houston, TX, United States.

Abstract: Background
The adoption of electronic health records (EHR) has been touted as a necessary approach to improve patient safety and health care quality. Health care quality is defined by The Institute of Medicine using six aims: safe, effective, timely, efficient, patient centered and equitable. As more hospitals implement EHR systems, there is an increased need to understand how those six aims are affected when the EHR systems are unavailable, i.e. scheduled or unscheduled downtimes. It is imperative that hospitals develop solutions to minimize any associated negative impact on quality of care during EHR downtimes.

To date, there has been little to no research on the impact of an EHR system downtime on the aforementioned aims of health care quality in any clinical setting. The authors believe that this study is the first to evaluate the impact of an EHR system downtime on health care quality in an emergency department (ED). The authors suspect that safety, timeliness, effectiveness and efficiency of care are the most significant components of health care quality that would be impacted by an EHR system downtime. An examination of the clinician’s perception of the obstacles to optimal quality care during a downtime is a first necessary step in the analysis of EHR downtime procedures and their impact on health care quality.

Methods
The project was conducted in an academic emergency department with an annual census of 70,000 patient visits and a commercial enterprise-wide electronic health record system. The ED Quality Assurance and Informatics Divisions created an ED Downtime Throughput Summary questionnaire as part of a process improvement project aimed at understanding the clinician’s perception of the health care quality issues during the planned 12-hour EHR downtime. The standard EHR system downtime protocol included pre-made packets that included patient care forms and a dry-erase white board in each ED care area for tracking patients, diagnostic testing and clinician assignment status. For this project, in addition to the standard EHR downtime protocol, all ED technicians, nurses, midlevel providers, residents and faculty were instructed to document any perceived safety (harm to the patient), timeliness (delays in care), effectiveness (missed evidence-based interventions) or inefficient process issues attributable to the EHR downtime on the questionnaire form attached to every patient chart. Clinician observers were also present throughout the downtime to encourage the use of the questionnaire forms. The questionnaires were collected from each patient chart either at the patient departure or at the end the downtime.

Results
A total of 80 patients were evaluated in the ED during the EHR downtime, however, only 69 (86%) questionnaires were retrieved with any information. 52% of the patients evaluated were discharged, 4% were hospitalized, 39% were still in process, and the remaining 3% were transferred, eloped or left against medical advice. There were no reported health care quality issues related to patient safety. The only reported quality issue related to effectiveness was the lack of utilization of approved order sets. Quality issues related to timeliness centered on delays in provider notification of imaging and laboratory results often leading to multiple calls by ED providers to

...
The vast majority of quality issues were regarding inefficient processes. The reported inefficient processes included: difficulty locating newly roomed patients and their respective charts, need for additional paper forms, difficulty finding the appropriate forms to place orders or complete patient care dispositions, problems accessing to the radiology picture archiving and communication system (PACS) images or reports and inefficient patient, diagnostic testing and clinician assignment status tracking using the whiteboard. The whiteboards frequently contained incomplete information because they could not be updated in real-time and had a limited physical size. The clinical observers noted that whiteboards were not reviewed regularly because of their stationary location and limited information.

**Conclusion**

The most common health care quality issue was delays in care related to tracking patient status and diagnostic data, which is typically provided by the EHR track board. As a result, providers lacked situational awareness provided by the electronic EHR track board. Development of methods to remotely track these elements during a downtime is an important aspect of maintaining health care quality in an ED. Further studies could perform patient follow-ups to investigate any harm with EHR downtime.
A Novel Method to Assess Incompleteness of Mammography Report Content
F. Gimenez; Y. Wu; E. S. Burnside; D. Rubin;
1. Department of Radiology, University of Wisconsin, Madison, Madison, WI, United States.
2. Biomedical Informatics Training Program, Stanford University, Stanford, CA, United States.
3. Department of Radiology, Stanford University, Stanford, CA, United States.

Abstract: Mammography has been shown to improve outcomes of women with breast cancer, but the field is subject to inter-reader variability. One well-documented source of such variability is in the content of mammography reports. The mammography report is of crucial importance, since it documents the radiologist’s imaging observations, interpretation of those observations in terms of likelihood of malignancy, and suggested patient management. In the paper, we define a metric to measure how incomplete the information content is in the mammography report and provide an algorithm to calculate this metric. We then show that the incompleteness score can be used to identify errors in interpretation. This method has 82.6% accuracy at predicting errors in interpretation and can reduce total diagnostic errors by up to 21.7%. Such a method can easily be modified to suit other domains that depend on quality reporting.