ADVANCING MEASUREMENT OF PATIENT-CENTERED OUTCOMES AND QUALITY METRICS WITH ELECTRONIC HEALTH RECORDS

Tina Hernandez-Boussard, PhD, MPH, MS
Director, Surgical Health Services Research Unit
Assistant Professor Surgery & Medicine (BioMedical Informatics)
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Background

- National Initiatives to improve quality of healthcare delivered in the US - Affordable Care Act (ACA)
  - Value-based payment modifiers (Section 3007)
  - Patient-centered care initiatives (Section 10602)
  - Accountable Care Organizations (Section 3022)
    - Coordinated care; Information exchange
- Patient-Centered Outcomes Research Trust Fund
  - PCORI - $3.5B through 9/19

Accurate quality measurement is essential – and must include patient centered outcomes
Patient-Centered Outcomes (PCOs)

- POCs are outcomes from medical care that are important to patients which can not be measured by lab values or diagnostic tests
- Current government initiatives highlight the need to include PCOs in healthcare evaluations
- Prostate Cancer Outcomes
  - Prostate cancer treatments have different risks of patient-centered, such as urinary incontinence and erectile dysfunction
  - Current treatment guidelines regarding these outcomes have been inconclusive
    - Lack of clear evidence
Patient-Centered Outcome Evaluations Limited

- Relevant data are not captured in structured formats
- Existing methods to algorithmically annotate EHR free-text are limited
  - Interoperability is a problem
- Current assessments of patient-centered outcomes research rely on
  - Manual chart review
    - Labor intensive
    - Size limited
  - Administrative data
    - Lack clinical granularity
    - Lack patient centered outcomes
  - Patient Surveys
    - Select population
    - Not readily available
    - Size limiting
Electronic Health Records (EHRs)

- EHRs Offer New Opportunities for Quality Assessment
  - Improve quality, safety, efficiency, and reduce health disparities.
  - Engage patients and family
  - Improve care coordination and population and public health
- CMS has identified EHR Meaningful Use (MU)
  - Accessibility (MU-1)
    - National effort to increase EHR adoption
      - Opens new opportunities to facilitate comprehensive assessment of healthcare delivery
  - Granular Data (MU-2)
    - EHRs contain detailed information about care processes and outcomes
  - Improve healthcare delivery (MU-3)
    - *Future of EHRs*

*Just beginning to tap into the wealth of information contained in EHRs!*
Hurdles Using EHRs

- Comprehensive assessment of EHRs hindered due to methodological reasons
  - Data are not organized according to patient and treatment – EHRs are not intended for research
- ~80% of data are entered as free-text in clinicians’ notes
- Shared algorithms to use data with EHRs do not exist
  - Site or system-specific algorithms

While some studies have assessed 1-2 quality metrics, comprehensive quality assessment using EHRs is lacking
Research Question

- How can we use EHRs to improve measurement of quality indicators and patient-centered outcomes/metrics?
  - Efficiently and accurately measure patient-centered quality metrics using data stored in EHRs
  - Use case: Urinary incontinence in localized prostate cancer patients
Methods

- **Study Population**
  - Male patients seen at the Stanford Medical Center, 1995-2013

- **Inclusion criteria**
  - ICD-9 code for prostate cancer (185)
  - Prostatectomy procedure
    - ICD-9 and CPT codes
    - Open, laparoscopic, robotic

- **Exclusion criteria**
  - No clinical note in their EHR (narrative text)

2252 Prostate cancer patients with EHR note
Hurdle 1: EHR-Data Organization

- Develop EHR-Based Database
  - Identify cancer patients in EHRs using ICD-9 codes
    - Confirmed in state cancer registry
  - Map structured elements of EHR to relational database
    - Tables for patient, diagnoses, procedure, etc.
  - Each patient visit contains link to clinicians’ notes as free text

Integrates complex, longitudinal data from multiple electronic medical records and registries and provides a rich, validated resource for research on oncology care.
Hurdle #2: Assessing Free Text

- Processes free-text into matrices that indicate which medical terminologies were mentioned in each patient encounter
  - Ontology-based dictionaries
  - Natural language processing technologies
    - Negation, past medical history, family history, temporal sequencing
  - Standard measures to test accuracy

- Matrices have three dimensions
  - Rows are Patients
  - Columns are Medical Terms
  - “Sheets” are Time (different episodes of care)

- Matrices are used for further analyses

Hurdle #3: EHR Shared Algorithms

- Electronic Phenotypes
  - Electronic algorithms used to identify characteristics of patients within healthcare data
  - Team of clinical domain experts, bioinformaticians or NLP experts, and biostatisticians

- Electronic Quality Metric Phenotypes
  - Structured series of components that define an outcome or cohort of interest
  - Map quality metric terms to existing vocabularies and ontologies
  - Define temporal structure of elements
Quality Phenotype

- Pretreatment assessment of urinary incontinence

A.  
- time 
- Physician → Oncologist → Oncologist → Oncologist
- Prostate Cancer Diagnosis
- UI Assessment
- Treatment

B.  
- **Key Features**
  - Incontinent
  - Leaky bladder
  - Urinary incontinence
  - Nocturnal enuresis
  - Wears diaper

**Quality Phenotype: Pretreatment Assessment of UI**

- Diagnosis of Prostate Cancer
  - **NEXT**
  - *ICD-9 Code BEFORE Treatment*
  - 788.3 - Urinary Incontinence
  - **OR**
  - *Text Mention of Urinary Incontinence Before Treatment*
  - Urinary Incontinence (SNOMED: 165232002)
  - **NEXT**
  - Prostate Cancer Treatment

- Linked to Diagnosis codes
- Linked to Procedure codes
- And term mentions
Results

- 2252 Prostate cancer patients with EHR note
- Assessment of Urinary Incontinence
  - Pre-operatively
  - Recording of risks associated with treatment
  - Post-operatively

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<th>Open</th>
<th>Robotic</th>
<th>Other</th>
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<td>12.7%</td>
<td>29.5%</td>
<td>22.6%</td>
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</table>
Display of Urinary Incontinence in EHRs

Workflow performance outcome: precision: 98%; sensitivity: 97%; F1: 98%
Workflow performance discussion: precision: 82%; sensitivity: 93%; F1: 96%
Conclusions

- EHRs offer opportunities to enhance quality measurement
  - Add capability to include metrics on patient-centered outcomes
- We overcome many obstacles to use EHRs
  - Enhance accuracy of data through development of EHR-database linked to patient registries
  - Developed tools to annotate EHR free-text
  - Create electronic phenotype algorithms to standardize EHR-measurements
- EHRs are an untapped source of data
  - Patient-centered outcomes research
  - Quality assessment
  - Provider documentation and adherence to guidelines
Discussion

- Evidence of Research feasibility
  - Patient reported outcomes exist in EHRs
  - Accuracy of our workflow

- Potential Impact
  - Begin to reliably assess aspects of patient-centered care
  - Generate evidence for important comparative effectiveness research
    - Previous studies on PCOs have had limited generalizability
  - Identify value-based payments that are representative of patient values
Stanford Team Members

- Jim Brooks, Urology
- Doug Blayney, Cancer Center
- Nigam Shah, Biomedical Informatics
  - Shah Lab
    - Anna Bauer-Mehren
    - Suzanne Tamang
Thank you!

- Questions?
  - boussard@stanford.edu

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