NorthShore University HealthSystem
Center for Biomedical Research Informatics

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Informatics and Predictive Analytics has fundamentally changed our world!

- Credit card fraud detection
- Target can predict when you are pregnant
- Traffic monitoring and prediction
- SPAM filters
- Smart meters and utility grids
- Weather forecasting
- Netflix and Amazon predict your tastes
- Mobile phones become interactive assistants
- Science’s third pillar of data and computation!

- WHAT ABOUT MEDICINE?!
Patients with same diagnosis --> Non-toxic responders

Patients with same diagnosis --> Non-responders, toxic responders

Patients with same diagnosis --> Misdiagnosed
Provider, Patient & Payor Faced With Bewildering Choices: The Current Practice of “Qualitative” Medicine

From Patrick Soon-Shiong, MD
A “Fundamental Theorem” of Biomedical Informatics
Performance and Scale of EMR/Data at NorthShore University HealthSystem

- First Epic Inpatient Deployment (in 2003, enterprise)
- First in the U.S. awarded by HIMSS Analytics at the top level (Stage 7) of clinical system use (inpatient 2009, outpatient 2013) – deployed functionality
  - Many, many awards for IT, Admin, Informatics teams
- A single Epic system across 4 Hospitals, ~2000 Docs
- Over 4M Total healthcare visits / year
- Enterprise Data Warehouse (EDW) from many systems of approx. 2M patients in approximately 5TB of transactions/text (includes indexes)
- Only Round 1 Meaningful Use Both In/Out-Patient
CBRI Creates Opportunities to Scale (toward standardization/quality at lower cost)

- **Surveillance Algorithms**
  - System monitors and recommends specific intervention for patients who meet known criteria.

- **Predictive Algorithms**
  - System recommends specific intervention for patients by analyzing thousands of similar patients’ data.

- **Collection of Discrete Clinical Data**
  - System collects data in context-specific EHR workflows for research and quality improvement.

- **Integration of EMR/EDW & External Systems**
  - System exchanges data and extends workflow.
What’s Going Around
Syndromic Surveillance Across the NorthShore Population

Influenza | Strep Throat | Pertussis | Pediatric Asthma | Gastroenteritis

Influenza-Like Illness as of November 06, 2013
Three-Year Lookback Period

Colors represent the proportion of all patients seen in the Medical Group who had the syndrome of interest. Areas with insufficient data for accurate estimates are not colored.

How What’s Going Around Works.

‘What’s Going Around’ (WGA) demonstrates a new way in which an Electronic Medical Record system can benefit providers and patients. We believe WGA is the first platform in the world to translate EMR-based data into up-to-date local epidemiological information, and provide this information to clinicians at the point-of-care, in a patient-specific manner.

Click here for full description.
Eliminating Undiagnosed HTN 2010-2012
Eliminating Undiagnosed HTN 2010-2012

Patients Newly Diagnosed with Hypertension by Primary Care

- Research Pilot Study: 112 Physicians, 24 Practices
- MG Quality Program: 211 Physicians, 40 Practices

# of New Diagnosed Patients

# of New AOBP Readings

Jan Mar May Jul Sep Nov Jan Mar May Jul Sep Nov Jan Mar May Jul Sep Nov Jan Mar May Jul Sep Nov Jan Mar May Jul Sep Nov Jan
2008 2009 2010 2011 2012 2013

Mekhala Padwardan, Mike Rakotz, Chad Konchak, Ari Robicsek (and a cast of thousands)
Health Monitors for Chronic Disease by Gait Analysis with Mobile Phones

**Fig. 2.** Prediction accuracy of Global Initiative for Chronic Obstructive Lung Disease (GOLD) status for different walk periods. For the continuous model, the spatiotemporal gait parameters are calculated over discrete periods of time. Thirty seconds of walking is selected as the optimal walk period to balance prediction accuracy with practicality.
INFORMATION FLOW BETWEEN AN ELECTRONIC MEDICAL RECORD, PERSONAL HEALTH RECORD AND HEALTH HERITAGE

Medical, Surgical, Family History, Labs

EMR
EpicCare

PHR
MyChart

Health Heritage

Risk Results, Recommendations & Pedigree

Relevant personal health history data flows to HH; Tailored risk report and pedigree flows back to provider & patient

Leigh Baumgart, William Knaus, and many others
Genomic Health Initiative (efficient research)

- Enrollment/consenting at pre-existing medical contact points
  - Fully electronic through patient portal
  - At routine blood draws

- Multi-purpose consent
  - Bio-sample collection
  - Research
  - Options for return of clinical data, & patient re-contacting

- Biological specimens
  - Consenting patients are ‘flagged’ for bulk ordering
  - At next routine blood test, we collect the specimen

- Processing of blood specimens
  - Robotized methods
  - Transfer of DNA aliquot to genomics lab

- Integration with NS EHRs warehouse
  - Fully identified protected linkage inside the health system

- Genomics
  - Results not part of EPIC
  - Sharing of de-identified samples/data
  - Back to patient is defined in consent
  - Alignment with NS business plans
Clinical documentation is a rich source of information on interactions between the health system and individual patients. Question: How can we capture this information Consistently and Completely for analysis—especially the interesting parts of progress notes? Answer: Tools Balance Expressivity and Workflow.
Three Different Approaches

- Free Text
- Abstract Data
- Enter Data
  - Manual Chart Review
  - Web Form

Structured Tools

- Parse and Abstract Data
- Generate

Database

Natural Language Processing
<table>
<thead>
<tr>
<th>Toolkit</th>
<th>Live Date</th>
<th># Notes</th>
<th>Application Contexts</th>
<th>Approx # Custom Discrete Data Elements</th>
<th>Physician Lead</th>
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<tr>
<td>Parkinson’s Disease</td>
<td>Jul-2009</td>
<td>3,153</td>
<td>x</td>
<td>1,000</td>
<td>D. Maraganore</td>
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<td>Pancreatic Cancer Surgery</td>
<td>Sep-2011</td>
<td>3,373</td>
<td>x</td>
<td>300</td>
<td>M. Talamonti</td>
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<td>Migraine</td>
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<td>2,351</td>
<td>x</td>
<td>380</td>
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<td>780</td>
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<td>Urogynecology</td>
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<td>16,625</td>
<td>x</td>
<td>240</td>
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<td>Prostate Cancer</td>
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<td>3,483</td>
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<td>180</td>
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<td>7,020</td>
<td>x</td>
<td>1,510</td>
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<td>3,268</td>
<td>x</td>
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<td>Hysterectomy</td>
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<td>5,182</td>
<td>x</td>
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<td>Mild Traumatic Brain Injury</td>
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<td>390</td>
<td>x</td>
<td>340</td>
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<td>Thoracic Cancer</td>
<td>Mar-2013</td>
<td>5,052</td>
<td>x</td>
<td>40</td>
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<td>Colorectal Cancer</td>
<td>Jul-2013</td>
<td>98</td>
<td>x</td>
<td>200</td>
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<td>Epilepsy</td>
<td>Jan-2014</td>
<td>724</td>
<td>x</td>
<td>720</td>
<td>D. Maraganore</td>
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<td>Neonatal Infant Special Care Unit</td>
<td>Jan-2014</td>
<td>27,027</td>
<td>x</td>
<td>580</td>
<td>W. MacKendrick</td>
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<td>Inflammatory Bowel Disease</td>
<td>Mar-2014</td>
<td>999</td>
<td>x</td>
<td>270</td>
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<td>3,801</td>
<td>x</td>
<td>950</td>
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<td>805</td>
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<td>2,428</td>
<td>x</td>
<td>600</td>
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<td>Ophthalmology</td>
<td>Dec-2014</td>
<td>1,416</td>
<td>x</td>
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<td>924</td>
<td>x</td>
<td>250</td>
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<td>Vascular Surgery</td>
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<td>411</td>
<td>x</td>
<td>1,750</td>
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<td>Castration Resistant Prostate Cancer</td>
<td>Feb-2015</td>
<td>897</td>
<td>x</td>
<td>280</td>
<td>D. Shevrin</td>
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<td>Brain Health</td>
<td>Jun-2015</td>
<td>81</td>
<td>x</td>
<td>375</td>
<td>D. Maraganore</td>
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<td>Stroke</td>
<td>Jul-2015</td>
<td>234</td>
<td>x</td>
<td>700</td>
<td>D. Maraganore</td>
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<tr>
<td>Orthopaedics Total Joint Replacement</td>
<td>Dec-2015</td>
<td>197</td>
<td>x</td>
<td>550</td>
<td>R. Wixson</td>
</tr>
</tbody>
</table>

| Grand Total                          | 25        | 90,976  | 21                  | 10                  | 3                   | 12,095             |
Discretization

the translation of continuous information into discrete data

“Patient reports dyspnea”
“X complains of Shortness of breath”
“Pt denies SOB”

“Examination revealed rales”
“PE result: Crackles”
“negative for lung noises”

Analogies:
• analog signals vs. discrete waveforms
• film vs. JPG
SCDS Guiding Principles

1. It’s all research. It’s all clinical. It’s all best practice.
2. Document it all—let the IRB sort it out.
3. If it varies categorically*, it should be stored discretely.
4. One Source of Truth when possible.

* Corollary:
Almost everything can be represented categorically, as long as you include the category “other”.

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Quality improvement and practice-based research in neurology using the electronic medical record

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Roberta Frigerio, MD
Nazia Kazmi, MS
Steven L. Meyers, MD
Meredith Sefa, MS
Shaun A. Walters, MS
Jonathan C. Silverstein, MD, MS

Abstract
We describe quality improvement and practice-based research using the electronic medical record (EMR) in a community health system-based department of neurology. Our care transformation initiative targets 10 neurologic disorders (brain tumors, epilepsy, migraine, memory disorders, mild traumatic brain injury, multiple sclerosis, neuropathy, Parkinson disease, restless legs syndrome, and stroke) and brain health (risk assessments and interventions to prevent Alzheimer disease and related disorders in targeted populations). Our informatics methods include building and implementing structured clinical documentation support tools in the EMR; electronic data capture; enrollment, data quality, and descriptive reports; quality improvement projects; clinical decision support tools; subgroup-based adaptive assignments and pragmatic trials; and DNA biobanking. We are sharing EMR tools and deidentified data with other departments toward the creation of a Neurology Practice-Based Research Network. We discuss practical points to assist other clinical practices to make quality improvements and practice-based research in neurology using the EMR a reality. *Neurol Clin Pract* 2015;5:1-11
"We seek the development of a learning health system that is designed to generate and apply the best evidence for the collaborative healthcare choices of each patient and provider; to drive the process of discovery as a natural outgrowth of patient care; and to ensure innovation, quality, safety, and value in health care."
The mission of CAPriCORN is to provide a data and informatics infrastructure to support collaboration among Chicago area scientists in conducting patient-centered outcomes research.
...to provide software applications and appropriate governance to facilitate the sharing of EHR data among healthcare organizations for research purposes.
Collaborative data sets for specific studies

Specialty-focused data sets for ongoing research (e.g., consortium data sharing)

De-identified queries across entire community
96 Endorsements of the LHS Core Values*

(As of 3/21/2016)

*To be included on the www.LearningHealth.org website.