Predictive Modeling Summit
September 15th, 2010

Analytics for Decision Support in Patient-Centered Medical Home Care Delivery

Speaker: Shahram Ebadollahi, PhD
Manager, Healthcare Informatics Research Group
Program Manager, Healthcare Transformation Big Bet
IBM T.J. Watson Research Center
Hawthorne, New York

E-mail: ebad@us.ibm.com
IBM Research Labs

- Eight Research Labs worldwide
- Over 3100 employees

Research
- Exploratory, Applied & Product Research
- Differentiation for next-generation products, services and solutions
Enabling Technologies for Healthcare Transformation
IBM Point of View

Thesis

The industry is moving towards an Evidence-centric healthcare ecosystem to drive healthcare transformation and yield lower costs and improved outcomes

Change Implications

Proper alignment of payment and incentives to evidence-centric healthcare delivery, along with large-scale comparative effectiveness evidence generation and delivery platforms is critical to drive this transformation

IBM Response

- Participate and lead transformation of Healthcare delivery models like Patient Centered Medical Home
- Deliver business analytics solutions that facilitate the implementation of evidence-centric models through service, software and cloud computing capabilities
IT reduces cost and data overload. It improves quality of care through systemic evidence generation and use, and allows new payment and delivery models.
There are four key IT components enabling healthcare transformation:

- **Evidence and outcome based payment models**
- **Optimization**
- **Tailoring payments to disease categories**
- **Workflow and Business process transformation**
- **Collaboration**
- **New delivery models**
- **Information in context**
- **Feedback loop**

- **Evidence-centric Point of Care**
  - Improve care delivery through consumable evidence at the point of care

- **Evidence Generation**
  - Enable transformation of Data to Evidence

- **Novel Incentives/Payment Models**
  - Provide incentives to enhance patient outcome and reduce cost

- **Service Quality**
  - Orchestrate an efficient workflow to increase safety and reduce errors

- **Practice-based Evidence / Comparative Effectiveness**
  - Cloud and Data Trusts at the infrastructure level
  - Analytics on federated data structures
  - Novel security paradigms

- **Evidence and outcome based payment models**
  - Optimization
  - Tailoring payments to disease categories

- **Evidence in the context of care delivery process**
- **Meaningful use**
- **Anticipate the need, tailor delivery**
The healthcare transformation at Geisinger is an example of how an evidence-centric ecosystem with novel incentives, comprehensive digitization of EHR, and analytics for identifying best practices can enable improved outcomes and operational efficiency.

**Geisinger ProvenCare (CABG)**

- **Implemented EHR in 1995, CDIS in 2009**
- **Developed best practice guidelines in 2008**
- **ProvenCare/Acute episodic care program provides warranty on outcomes**

**Benefits**

- **Readmission within 30 days** (6.9% → 3.8%); **average total Length of Stay (LOS)**: (6.2d → 5.7d)
- **Reduced hospital mortality** (1.5% → 0%); **number of Neurological complications** (1.5% → 0.6%);
Outcome based payment incentives lead to improved outcomes and demand for evidence at point of care. This requires large scale evidence generation and comparative effectiveness clouds.
Key Plays to Enable Evidence-Centric Healthcare Ecosystem

Evidence Generation
- SPSS
- COGNOS
- MDM / Initiate
- Smart Analytics System
- Patient Similarity
- Single View of Disease

Evidence Use
- Collaborative Care Solution
- Clinical Guidelines and Pathway Mining and Prediction
- Context-aware Information Selection & Visualization

Payment Policy and Simulation
- Accountable Care Solution
- Simulation As A Service
- Advanced Pay-for-Outcomes Enablement (e.g. ProvenCare)
- Simulation for Payment Policy
Collaborative Care Solution
IBM/AHM Collaborative Care SaaS/Cloud Solution

Health Analytics and Clinical Decision Support

- Clinical & Claims Data
- NCQA PCMH
- Accountable Care Enablement
- Fraud and Abuse Analytics
- PQRI quality measures
- Bio-Surveillance
- Care Engine
- Population Care and Patient Risk Stratification & Risk Management

HSP
(HIE Service Provider)

- Master Person & Provider Index
- Policy Repository
- Document Registry
- Secure Messaging
- Audit Log
- Consent Mgmt
- Data Repository
- Security
- NHIN connectivity CCHIT and EMR Adapters

Bi Directional Orders and Results

Reference Labs

Hospital Systems EMR

Shared Registration For EMR & Paper Based Practices

Results Delivery

Document and Image Sharing

Health Plan Claims Tx

Pharmacy Systems & PBM

© 2010 IBM Corporation
Overview of IBM Analytics in Solution

- Key industry drivers being addressed include:
  - Improving Quality of Healthcare
  - Reimbursement Incentives
  - Meeting NCQA Requirements
  - Demonstrating Meaningful Use
  - Cost Savings and foundation for ACO’s

- The Collaborative Care Analytics solution includes:
  - NCQA’s Physician Practice Connections–Patient-Centered Medical Home standards.
  - NCQA’s Disease Management programs certification in asthma, diabetes, chronic obstructive pulmonary disease (COPD), heart failure and ischemic vascular disease (IVD).
  - Financial analytics and predictive modeling (“what if”) capabilities to demonstrate real time performance against KPI’s & P4P/ Clinical Integration metrics (future)

- Current Release: provides initial foundation to analyze NQF performance measures required for NCQA and patient stratification by condition

- Future Releases: continue to extend the performance measures required to support the ARRA quality, safety, and efficiency health outcomes policy priorities

- IBM Research Project underway related to Predictive Cohort Analytics
Population Analytics for Collaborative Care Solution
Overview of Analytics

Patient Cohort Segmentation

Consider likely outcome, expected care load, and panel mix to optimize for care quality.

Assign patient to the specialist that is the best match.

Utilize records of similar patients to assist prognosis and treatment decision making.

PCP Panel Sizing

Identify appropriate panel sizing and mix to optimize for timely access, continuity of care, and improved clinical outcome.

Physician Outcome Model

Assess likely outcome based on patient characteristic, provider characteristics and care history.

Identify patient group and expected care intensity and frequency.

Care process Determination

PCP Assignment

Care Management

Specialist Referral

© 2010 IBM Corporation
Patient Similarity – A high-level view

Patient Data

EHR

Patient Similarity

Similarity assessment analytics

Patient characterization

Applications

Clinical Decision Support

CER & Outcomes Research

Resource Allocation
(Patient Referral Services)

Data Quality Services

Predictive Analytics
(Clinical Pathways)

Clinical Trial Services
(Patient Recruitment)

Patient social networks
Patient Similarity Assessment

- Objective: Given an index patient’s record, find clinically similar patients from database for decision support
Representing Patients using Information Obtained from Multiple Sources of Data

- IC9
- CCS hierarchy
- HCC hierarchy
- co-occurring HCC

- CPT
- CPT CCS hierarchy
- RVU as value

- NDC
- Ingredient
- Days of Supplies

- Lab results
- Break down by age and sex groups

- Age
- Gender

- Lab results
- Break down by age and sex groups

- Lab
Welcome to Analytics for Collaborative Care Solution.

Please select a patient:

10256  Submit
# IBM Analytics for Collaborative Care Solution

## Patient: 100256

### Diagnoses

<table>
<thead>
<tr>
<th>ICD9</th>
<th>Condition</th>
<th>Last Diagnosis</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td>71595</td>
<td>Osteoarthritis Nos-L, Leg</td>
<td>2009-09-23</td>
<td>April 08</td>
</tr>
<tr>
<td>V426</td>
<td>Joint Replaced Knee</td>
<td>2009-09-22</td>
<td></td>
</tr>
<tr>
<td>25000</td>
<td>Osteo Viscous Mt St Uncontr</td>
<td>2009-08-14</td>
<td></td>
</tr>
<tr>
<td>22800</td>
<td>Hemangioma Nos</td>
<td>2009-04-15</td>
<td></td>
</tr>
</tbody>
</table>

### Medications

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Dosage</th>
<th>Last Prescribed</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucocribe</td>
<td>5MG</td>
<td>2009-09-24</td>
<td>April 08</td>
</tr>
<tr>
<td>Niasin</td>
<td>1000MG</td>
<td>2009-05-22</td>
<td></td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>800MG</td>
<td>2009-09-21</td>
<td></td>
</tr>
<tr>
<td>Simvastatin</td>
<td>20MG</td>
<td>2009-09-21</td>
<td></td>
</tr>
</tbody>
</table>

### Procedures

<table>
<thead>
<tr>
<th>CPT / Description</th>
<th>Last Performed</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td>90213</td>
<td>2009-09-23</td>
<td>April 08</td>
</tr>
<tr>
<td>90212</td>
<td>2009-08-24</td>
<td></td>
</tr>
<tr>
<td>73560</td>
<td>2009-08-24</td>
<td></td>
</tr>
<tr>
<td>83036</td>
<td>2009-08-14</td>
<td></td>
</tr>
</tbody>
</table>

### Lab Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Last Result</th>
<th>Last Performed</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td>MALBRATI</td>
<td>5.0</td>
<td>2008-06-27</td>
<td>April 08</td>
</tr>
<tr>
<td>CHOL/HDL</td>
<td>6.3</td>
<td>2008-06-27</td>
<td></td>
</tr>
<tr>
<td>LDL</td>
<td>147.0 mg/dL</td>
<td>2009-08-14</td>
<td></td>
</tr>
<tr>
<td>HDL</td>
<td>33.0 mg/dL</td>
<td>2009-08-14</td>
<td></td>
</tr>
</tbody>
</table>
IBM Analytics for Collaborative Care Solution

Patient: 100256

Sex: Male
Age: 50
Location:

You are viewing the 99 most similar patients

© 2010 IBM Corporation
<table>
<thead>
<tr>
<th>Patient MRN</th>
<th>Overall Similarity</th>
<th>ICD9</th>
<th>Medications</th>
<th>Procedures</th>
<th>Labs</th>
<th>Age/Sex</th>
<th>Comorbid (HCC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100256</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>025942</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>094868</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>029019</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>039760</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>113951</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>012305</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>056378</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>114020</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>064736</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>105053</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Measure 1: MALBRATI

Measure 2: CHOLHDL

Insufficient info for this lab

Insufficient info for this lab

You are viewing 22 out of 99 similar patients.
Physician Outcome Model

Objective: predict the likely outcome of a (patient, physician) pair based on population medical records, to provide decision support for physician referral and organizing physicians into collaborative pods

Assess likely outcome based on patient characteristic, provider characteristics and care history

© 2010 IBM Corporation
Problem Formulation

- Data:
  - Diabetic patients and their Primary Care Physicians (PCP)
- Outcome
  - Lab test range change between first and last test

- Initial model focus:
  - Positive outcome: range change closer to normal
  - Negative outcome: range change further away from normal
Using dataset with minimum 10 patients per physician

Patients well managed by assigned physician

Patients suboptimally managed by assigned physician

Predicted probability of good outcome for each (patient, physician) pair
## Patient: 100256

### Required Specialty: PCP

<table>
<thead>
<tr>
<th>Rating</th>
<th>Physician</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16021</td>
</tr>
<tr>
<td></td>
<td>12488</td>
</tr>
<tr>
<td></td>
<td>13974</td>
</tr>
<tr>
<td></td>
<td>13158</td>
</tr>
<tr>
<td></td>
<td>17059</td>
</tr>
<tr>
<td></td>
<td>19931</td>
</tr>
<tr>
<td></td>
<td>12652</td>
</tr>
<tr>
<td></td>
<td>18060</td>
</tr>
<tr>
<td></td>
<td>20157</td>
</tr>
<tr>
<td></td>
<td>15424</td>
</tr>
<tr>
<td></td>
<td>19958</td>
</tr>
<tr>
<td></td>
<td>13253</td>
</tr>
<tr>
<td></td>
<td>18513</td>
</tr>
<tr>
<td></td>
<td>1994</td>
</tr>
<tr>
<td></td>
<td>18803</td>
</tr>
<tr>
<td></td>
<td>14216</td>
</tr>
<tr>
<td></td>
<td>13505</td>
</tr>
<tr>
<td></td>
<td>20578</td>
</tr>
<tr>
<td></td>
<td>18410</td>
</tr>
<tr>
<td></td>
<td>19925</td>
</tr>
</tbody>
</table>

### Office Location

**9/15/10**
This work focuses on designing the similarity measure that can leverage both patient characteristics and physician’s knowledge.
Near-term Prognostics using Similar Patient Cohort
Questions?