Practical Use of Data Mining

July 27, 2016
CCI … a practical approach to data

- Committed to partnering with physicians, hospitals, and other healthcare providers understanding their challenges.
- Quality improvement focused on identifying low cost, highly scalable improvements
- Preparing clients for value-based reimbursement while they still live in a fee-for-service world {MACRA}
- Business Associate Agreements
- Support for Accountable Care Organizations
Value for Providers

• Quality reports that align with national standards
• Reports at the patient, provider, site and practice level
• Collection of data directly from EMR, billing and scheduling system
• Support for obtaining national recognitions
  • PCMH, meaningful use, and Million Hearts® Model
• Lean Six Sigma for health education, coaching, and certification
• Evidence-based protocols
• Opportunities for research, including funding to providers
• Opportunities for access to an evidence based prescription discount program
COVERAGE--CCI Network in South Carolina (ACTIVE)

Patients in all 46 counties

SC Population 4.8M
Value in combining diverse data

- Outpatient and Hospital
- Primary Care and Specialists
- Labs
- Medications
- Rural and Urban
- Diverse Populations
- Electronic Health Record, Scheduling, and Billing
- Social Determinants such as Census Track Data
- CPT and ICD Codes
- Longitudinal
CCI Labs: Accelerating the Revolution in Population Healthcare

Data (360° View & Learning)
- Clinical
- Patient-reported
- Socioeconomic, Geographic
- Cost

Step 1:
CCI captures clinical & population data

Step 2:
CCI obtains 360° view of data

Step 3:
CCI analyzes & models data

Analysis
- Prioritize common/diseases & clusters
- Identify key modifiable variables

Step 4:
CCI identifies areas to apply discoveries

Modeling & Risk Stratification
Apply key determinants of outcomes to:
- Clinical
- Patient
- Community

Implementation
- Implementation by clients
- Test Bed for early revolutions

Step 5:
CCI obtains 360° view of data

Step 6:
CCI analytics, research & services impact

Implementation Impact

Step 7:
CCI identifies areas to apply discoveries
CCI Labs: Accelerating the Revolution in Population Healthcare

**Step 1:** CCI captures clinical & population data
- Population (Community) Health & Policy Data
- Clinical Outcomes & Costs
- Healthcare Professional Performance & Satisfaction
- Patient Reported Outcomes & Engagement

**Data Fusion**
- Clinical process & outcome data
- Patient-reported outcomes
- Submitted & paid claims
- Cost of care
- National/Regional/State Data
- Crime, food, entertainment
- Job, absenteeism, productivity

**Step 2:** CCI obtains 360° view of data

**Analysis**
- Prioritize common/$$$ diseases & clusters and health promotion priorities
- Identify key modifiable variables/services to improve performance on priorities
- Define opportunities for system & staff optimization to deliver key services
- GIS mapping to refine clinic and community resource allocation

**Step 3:** CCI analyzes & models data

**Modeling & Risk Stratification**
- Apply key determinants of outcomes to:
  - QI/ROI/ROE opportunities
  - Guideline selection & refinement
  - Care Model Pathways, Best Practices
  - Practice Re-Design & Facilitation
  - Workforce needs, skills, training
  - Pt engagement, priorities & tools
  - Inform community health priorities

**Step 4:** CCI identifies areas to apply discoveries

**Step 5:** Implementation impact

**Step 6:** CCI analytics, *research & services impact

**Test Bed for early revolutions**
CCI Labs: Accelerating the Revolution in Population Healthcare

Healthcare Professional Performance & Satisfaction

Patient Reported Outcomes & Engagement

Clinical Outcomes & Costs

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Step 5: Implementation impact

Implementation
- Vetting process
- Governance process
- Implementation by clients
- Test Bed for early revolutions

Step 6: CCI analytics, *research & services impact
Why Data Mining in Healthcare?

• Significant opportunity to improve patient outcomes
• Opportunity to improve quality and reduce costs with greater patient satisfaction
• Healthcare has a myriad of unused data today
• Healthcare data is growing at astounding rates—IBM estimates by 2020 medical data will double every 73 days
Data Mining in Healthcare

• Data mining looks for hidden patterns in data
• Patterns can be used to predict future behaviors or results
• Several main types
  • Anomaly detection
  • Association learning
  • Classification
  • Regression
  • Cluster detection
Clustering

- Cluster analysis is the grouping of a set of objects in such a way that objects in the same group (cluster) are more similar to each other than those in other groups (clusters).
- Pattern recognition when there is no dependent variable.
Multiple Chronic Conditions

• Heart Failure Patients have an average of 10 Chronic Conditions

• How do you manage that?
The Process

Select Sample → Characterize → Association Measures → Clustering Algorithm → Groups
MULTIPLE CHRONIC CONDITIONS
27 Chronic Conditions

Congestive Heart Failure
Cardiac Arrhythmia
Valvular Disease
Pulmonary Circulation Disorders
Vascular Complications (PVD, CAD, MI, CVD)
Hypertension (with or without complications)
Diabetes (with or without complications)
Paralysis
Other Neurological Disorders
Chronic Pulmonary Disease (including asthma)
Hypothyroidism
Renal Failure
Liver Disease

Peptic Ulcer
AIDS/HIV
Cancer (Lymphoma, Metastatic, Solid Tumor)
Coagulopathy
Obesity
Weight Loss
Fluid & Electrolyte Disorders
Blood Loss Anemia
Deficiency Anemia
Mental Health (Depression, Psychoses, Drug or Alcohol Abuse)
Dementia
Lipid Metabolism Disorders
Osteoarthritis
Rheumatoid Arthritis/collagen vascular diseases
## Clustering Results

<table>
<thead>
<tr>
<th>Cluster</th>
<th>N</th>
<th>Predominant Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1170 (2.3%)</td>
<td>Hyperlipidemia</td>
</tr>
<tr>
<td>2</td>
<td>2706 (5.3%)</td>
<td>Hypertension</td>
</tr>
<tr>
<td>3</td>
<td>2007 (4.0%)</td>
<td>Osteoarthritis</td>
</tr>
<tr>
<td>4</td>
<td>4183 (8.3%)</td>
<td>Obesity</td>
</tr>
<tr>
<td>5</td>
<td>5383 (10.6%)</td>
<td>Cancer</td>
</tr>
<tr>
<td>6</td>
<td>6237 (12.3%)</td>
<td>Congestive Heart Failure</td>
</tr>
<tr>
<td>7</td>
<td>5226 (10.3%)</td>
<td>COPD / Asthma</td>
</tr>
<tr>
<td>8</td>
<td>6581 (13.0%)</td>
<td>Diabetes</td>
</tr>
<tr>
<td>9</td>
<td>3532 (7.0%)</td>
<td>Behavioral Health</td>
</tr>
<tr>
<td>10</td>
<td>4351 (8.6%)</td>
<td>Renal</td>
</tr>
<tr>
<td>11</td>
<td>5509 (10.9%)</td>
<td>Vascular</td>
</tr>
<tr>
<td>12</td>
<td>3742 (7.4%)</td>
<td>“Healthy”</td>
</tr>
</tbody>
</table>
### Why Initial Focus on CHF Cluster?
Mean 10 Chronic Conditions, ~12% of Pts over 65, ~38% of top 5% cost

<table>
<thead>
<tr>
<th>Chronic Condition</th>
<th>Number, %</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. CHF</td>
<td>5907, 100%</td>
<td>10. Valvular Heart Dz</td>
<td>2649, 45%</td>
</tr>
<tr>
<td>2. Hypertension</td>
<td>5561, 94%</td>
<td>11. Osteoarthritis</td>
<td>2607, 44%</td>
</tr>
<tr>
<td>3. Hyperlipidemia</td>
<td>4910, 83%</td>
<td>12. ESRD / CKD</td>
<td>2452, 42%</td>
</tr>
<tr>
<td>4. Vascular Disease</td>
<td>4495, 76%</td>
<td>13. Mental Health</td>
<td>2446, 41%</td>
</tr>
<tr>
<td>5. Arrhythmias</td>
<td>3761, 64%</td>
<td>15. Anemia</td>
<td>1837, 31%</td>
</tr>
<tr>
<td>6. Chronic lung dz</td>
<td>3330, 56%</td>
<td>15. Hypothyroid</td>
<td>1832, 31%</td>
</tr>
<tr>
<td>7. Fluid &amp; Electrolyte</td>
<td>2866, 48%</td>
<td>16. Pulmonary Circ</td>
<td>1518, 26%</td>
</tr>
<tr>
<td>8. Diabetes</td>
<td>2862, 48%</td>
<td>17. Other neuro</td>
<td>1167, 20%</td>
</tr>
<tr>
<td>9. Obesity</td>
<td>2662, 45%</td>
<td>18. Cancer</td>
<td>1151, 20%</td>
</tr>
</tbody>
</table>
More details on Clustering Chronic Diseases
Thursday at 9:45 AM
Brent Egan and Susan Sutherland
“Analyzing Clusters of Disease and Populations to Simplify and Improve Care Delivery”

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