IBM Patient Care and Insights:

Utilizing Analytics to Deliver Impactful Care Management
Healthcare Transformation: A Work in Progress

1st
US rank in Healthcare spending

37th
US rank in quality of care delivered

8.0
Hours each day an average family physician spends on direct patient care

21.7
Hours required to meet the patient care guidelines each day

$750B
(Billion) Wasted on missed opportunities along with unnecessary, error-prone and inefficiently delivered services

45%
US physicians still reliant on paper based medical records systems

An Ocean of Unused Data

90% of the world’s data was created in the last two years

80% of the world’s data is unstructured

What insights are trapped in your EMR and other systems?
20% of People Generate 80% of Costs

Disease and Cost of Care Progression

Health Status

Healthy Low Risk

At Risk

High Risk

Early Clinical Symptoms

Active Disease

Health Care Spending

Time

Early Intervention Opportunities Identification

Early Intervention Opportunities Identification

70% of US Deaths from Chronic Diseases
If we could only activate the relevant information to bring insights to the point of care when needed most ...

Time once spent manually interpreting data ... becomes time spent healing patients

- Aggregate, activate and enrich relevant patient information beyond what is known
- Surface new data driven insights that enable new intervention opportunities ... earlier
- Adapt to changes and proactively deliver individualized patient centered care
Seton Healthcare Family
Reducing CHF readmission to improve care

“IBM Content and Predictive Analytics for Healthcare uses the same type of natural language processing as IBM Watson, enabling us to leverage information in new ways not possible before. We can access an integrated view of relevant clinical and operational information to drive more informed decision making and optimize patient and operational outcomes.”

Charles J. Barnett, FACHE, President/Chief Executive Officer, Seton Healthcare Family

Business Challenge
Seton Healthcare strives to reduce the occurrence of high cost Congestive Heart Failure (CHF) readmissions by proactively identifying patients likely to be readmitted on an emergent basis.

What’s Smart?
IBM Content and Predictive Analytics for Healthcare solution will help to better target and understand high-risk CHF patients for care management programs by:

- Utilizing natural language processing to extract key elements from unstructured History and Physical, Discharge Summaries, Echocardiogram Reports, and Consult Notes
- Leveraging predictive models that have demonstrated high positive predictive value against extracted elements of structured and unstructured data
- Providing an interface through which providers can intuitively navigate, interpret and take action

Smarter Business Outcomes
- Seton will be able to proactively target care management and reduce re-admission of CHF patients.
- Teaming unstructured content with predictive analytics, Seton will be able to identify patients likely for re-admission and introduce early interventions to reduce cost, mortality rates, and improved patient quality of life.

IBM solution
- IBM Content and Predictive Analytics for Healthcare
- IBM Cognos Business Intelligence
- IBM BAO solution services

Featured on Forbes
What Really Causes Readmissions at Seton

Key Findings from Seton’s Data

The Data We Thought Would Be Useful … Wasn’t

- Structured data not available, not accurate enough, without the unstructured data - which was more trustworthy

What We Thought Was Causing 30 Day Readmissions … Wasn’t

- 113 possible candidate predictors expanded and changed after mining the data for hidden insights

New Hidden Indicators Emerged … Readmissions is a Highly Predictive Model

- 18 accurate indicators or predictors (see next slide)

<table>
<thead>
<tr>
<th>Predictor Analysis</th>
<th>% Encounters Structured Data</th>
<th>% Encounters Unstructured Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ejection Fraction (LVEF)</td>
<td>2%</td>
<td>74%</td>
</tr>
<tr>
<td>Smoking Indicator</td>
<td>35% (65% Accurate)</td>
<td>81% (95% Accurate)</td>
</tr>
<tr>
<td>Living Arrangements</td>
<td>&lt;1%</td>
<td>73% (100% Accurate)</td>
</tr>
<tr>
<td>Drug and Alcohol Abuse</td>
<td>16%</td>
<td>81%</td>
</tr>
<tr>
<td>Assisted Living</td>
<td>0%</td>
<td>13%</td>
</tr>
</tbody>
</table>

97% at 80th percentile
49% at 20th percentile
What Really Causes Readmissions at Seton

Top 18 Indicators

New Insights Uncovered by Combining Content and Predictive Analytics

- Top indicator JVDI not on the original list of 113 - as well as several others
- Assisted Living and Drug and Alcohol Abuse emerged as key predictors - only found in unstructured data
- LVEF and Smoking are significant indicators of CHF but not readmissions
- A combination of actionable and non-actionable factors cause readmissions

1. Jugular Venous Distention Indicator
2. Paid by Medicaid Indicator
3. Immunity Disorder Disease Indicator
4. Cardiac Rehab Admit Diagnosis with CHF Indicator
5. Lack of Emotion Support Indicator
6. Self COPD Moderate Limit Health History Indicator
7. With Genitourinary System and Endocrine Disorders
8. Heart Failure History
9. High BNP Indicator
10. Low Hemoglobin Indicator
11. Low Sodium Level Indicator
12. Assisted Living
13. High Cholesterol History
14. Presence of Blood Diseases in Diagnosis History
15. High Blood Pressure Health History
16. Self Alcohol / Drug Use Indicator
17. Heart Attack History
18. Heart Disease History
The Impact of Readmissions at Seton

CHF Patient X – What Happened?

Patient X was hospitalized 6 times over an 8 month period. The same basic information was available at each encounter and Patient X’s readmission prediction score never dropped below 95% (out of possible 100%)

Individual Patient Data at Each Encounter (Patient X @ Dec 20, 2009)

Description of Model Serial Number
10. Juxta-Venous Distention Indicator
17. Paid by Medicaid Indicator
16. Immunity Disorder Disease Indicator
15. Cardiac Rehab Admit Diagnosis with CHF Indicator
14. Lack of Emotion Support Indicator
13. Self COPD Moderate Limit Health History Indicator
12. With genitourinary system & Endocrine disorders
11. Heart Failure History
10. High BMP Indicator
9. Low Hemoglobin Indicator
8. Low Sodium Level Indicator
7. Assisted Living from ICA Extract
6. High Cholesterol History
5. Presence of diseases of the blood in diagnosis history
4. High Blood Pressure Health History
3. Self Alcohol/Drug Use Indicator (Canner + ICA)
2. Heart Attack History
1. Heart Disease History

Patient Population Monitoring
Clinical and Operational Data
What Have We Learned So Far?

Structured Data is Not Enough

- Unstructured data significantly increases the richness and accuracy of analysis and decision making ... including paper / faxes

Today’s Care Guidelines Only Get You So Far

- Not granular enough to deliver on the promise of personalized medicine with data driven insights \(^1, 2\)

Manual Processes and Traditional Workflow Approaches Don’t Work

- Process complexity increases with disease complexity ... changing conditions require process adaptability \(^3\)

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1. Dijun Luo, Fie Wang, Jimeng Sun, Marianthi Markatou, Jianying Hu, Shahram Ebadollahi, SOR: Scalable Orthogonal Regression for Low-Redundancy Feature Selection and its Healthcare Applications. SDM’12
IBM Strategy to Support Care Coordination:

A Smarter approach to delivering better outcomes

• Build longitudinal “data driven” evidence based population insights

• Uncover hidden intervention opportunities

• Proactively deliver accountable and personalized care in a patient centered model

• Collaborate across caregivers to focus on high cost, high need patients

• Prevent at-risk patients from progressing to high cost, high need
What IBM Announced

- An integrated and configurable **Patient Care and Insights** solution set of multiple solutions that can be sold separately or in conjunction with one another.

Announcement Overview

- IBM Content and Predictive Analytics (*new version*)
- IBM Similarity Analytics
- IBM Care Manager
- IBM Research Solution Services
- IBM Global Business Services Solution Assets
- Solution Value and Delivery Partners
Solution Strategy

**BUILD NEW EVIDENCE BASED INSIGHTS**
- Physicians, Clinicians, Care Coordinators, Case Managers, etc.

**UNCOVER HIDDEN INTERVENTION OPPORTUNITIES**
- Plan Administrators, Directors, Researchers, Analysts, Knowledge Workers, etc.

**DELIVER PERSONALIZED COORDINATED CARE**
- Patients, Family, Social Services, etc.

Solution Marketecture

**Dynamic User Experience**
- Search and Visually Explore (Mine)
- Monitor, Dashboard and Report
- Collaborate, Coordinate and Share

**Advanced Care Insights**
- Enterprise Content Analytics Platform
- NLP and LPR Solution Accelerator
- Predictive Analytics
- Similarity Analytics

**Care Management**
- Advanced Case Management Platform
- Integrated Outcome Management
- Active Care Management Accelerator
- Events Based Architecture

**Health Systems and Infrastructure**
- IBM Watson for Healthcare

**Health Integration Framework**
- Data Warehouse and Model
- Terminology and Ontology
- Rules / Clinical Guidelines
- Master Data / EMPI
- Social Services Data / Systems
- EMR / EHR / PACS / LPR
- Health Information Exchange
- Other Clinical / Op Systems
- Monitoring and Devices

**Raw Information**
- **Clinical or Operational**
  - Unstructured Data
    - (Nurses notes, claims, discharge summaries, lab results, loose papers, etc.)
  - Structured Data
    - (Billing data, EMR, supply chain, etc.)

**Health**
- Integration Framework
- Framework
- Framework
- Framework

**Data**
- Warehouse and Model
- Model
- Model

**Solution**
- Markecture
- Markecture
- Markecture
- Markecture

**Strategy**
- BUILD NEW EVIDENCE BASED INSIGHTS
- UNCOVER HIDDEN INTERVENTION OPPORTUNITIES
- DELIVER PERSONALIZED COORDINATED CARE
Improving How Clinical Decisions Are Made

• Doctors are oriented toward diagnosing and treating individual organ systems
• Clinical trials and health research typically focus on one disease
• Many patients do not fit these narrow profiles, and those are often the hardest to treat
  • **83%** of Medicaid patients have at least one chronic condition (almost **25%** have at least 5 co-morbidities) ¹
  • Medicare patients with 5 or more chronic conditions accounted for **76%** of all Medicare expenditures ²
• Treatment guidelines are applied to the “standard” patient and often fall short in complex treatment scenarios such as multiple disease states
• It is estimated that over 40% of the time, treatment is “ad-hoc” and the guidelines are not followed
• **Why not augment the guidelines with population specific patient based observational data (including unstructured data) to enhance decision making?**

². *The Rise in Spending Among Medicare Beneficiaries: The Role of Chronic Disease Prevalence and Changes in Treatment Intensity* from Health Affairs, August 2006
How Similarity Analytics Work, Part 1

- For this patient ...
- Analyze longitudinal data to develop profile across 30,000+ possible points of comparison
- Determine the individual risk factors for this patient based on the desired outcome
- Create an outcomes based personalized profile for this patient
• Based on this patient’s personalized profile ...

• Find the **most** similar patients (or dynamic cohort) from entire population

• Analyze what happened with the cohort and reasons why (30,000+ dimensions)

• Predict the probability of the desired outcome for this patient

• Create personalized care plan based on unique needs of this patient
Chronic Diseases with Comorbidities Are The Costliest

Heart Disease Organ Failure Scenario (Adapted 1)

45% of the population has a chronic medical condition (1/2 of these are polymorbid) ¹

83% of Medicaid patients have at least one chronic condition (almost 1/4 have at least 5 co-morbidities) ²

1. Heart Failure Scenario adapted from De La Sociedad Espanola De Cardiologia
Finding Hidden Interventions with *IBM Patient Care and Insights*

- **Patient Functional State**
  - Good
  - Poor

- **Early Onset of Disease**
  - Predict Onset 6-24 Months Before Diagnosis
  - Intervene with Wellness / Prevention Care Plan

- **Cost / Care Dynamic**
  - Lower Costs
  - Higher Costs

Time

- **IBM Patient Care and Insights**
Smith, Judy | MRN: 7300021

Age: 62 | Gender: female | DOB: 01/01/1960 | Last updated 02/18/2012

CHF onset

⚠ CHF onset risk score: 0.98

<table>
<thead>
<tr>
<th>Predictive Factor</th>
<th>Predictive Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankle Edema</td>
<td>85%</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>34%</td>
</tr>
<tr>
<td>Railes</td>
<td>4%</td>
</tr>
</tbody>
</table>

Risk Assessment

Changes were applied to the Kidney Disease Group
**Smith, Judy**  |  MRN: 7300021

Age: 52  |  Gender: female  |  DOB: 01/01/1960  |  Last updated 02/18/2012

**Hyperlipidemia**

**Hyperlipidemia Risk:** 0.72

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Outcome/LDL (mg/dl)</th>
<th>Cohort Description</th>
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<tbody>
<tr>
<td>LOVASTATIN</td>
<td><img src="image" alt="Histogram" /></td>
<td>Size: 192</td>
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<tr>
<td>ATORVASTATIN</td>
<td><img src="image" alt="Histogram" /></td>
<td>Size: 183</td>
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<tr>
<td>NIACIN</td>
<td><img src="image" alt="Histogram" /></td>
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Changes were applied to the Kidney Disease Group
Finding Hidden Interventions with IBM Patient Care and Insights

Time

Patient Functional State

Good

Early Onset of Disease

Poor

Physician Referral / Matching
Treatment Efficacy
Resource Utilization

Predict Better Outcomes and Understand Choices
Intervene Based on Changing Care Plan Conditions

Lower Costs

Higher Costs

Cost / Care Dynamic
### Patient Information

**Smith, Judy** | **MRN: 7300021**

- **Age:** 52  
- **Gender:** female  
- **DOB:** 01/01/1960  
- **Last updated:** 02/18/2012

### Physician Match

<table>
<thead>
<tr>
<th>Physician Name</th>
<th>Match Score</th>
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<tbody>
<tr>
<td><strong>Closest Nephrologist:</strong> Marcado, Venus</td>
<td>55</td>
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<tr>
<td>Troy, Helen</td>
<td>95</td>
</tr>
<tr>
<td>Hill, Lauren</td>
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<tr>
<td>Hernandez, Magee</td>
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<tr>
<td>Keller, Channing</td>
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<td>Duke, Emi</td>
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<td>Ochoa, Grady</td>
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<td>Miranda, Raphael</td>
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<td>Gibbs, Isadora</td>
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<tr>
<td>Todd, Tatyana</td>
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<td>Dotson, Jamilia</td>
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<td>Johns, Olivia</td>
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<tr>
<td>Kay, Malodie</td>
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</tr>
</tbody>
</table>
Smith, Judy  |  MRN: 7300021
Age: 62  |  Gender: female  |  DOB: 01/01/1960  |  Last updated 02/18/2012

Utilization

Overall Risk: 1.0

6 Month Utilization Profile

<table>
<thead>
<tr>
<th>Visit Type</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Emergency Room &amp; Urgent Care Visit</td>
<td>Actual: 3</td>
</tr>
<tr>
<td></td>
<td>Expected: 0.66</td>
</tr>
<tr>
<td>Independent Lab Visit</td>
<td>Actual: 7</td>
</tr>
<tr>
<td></td>
<td>Expected: 7.05</td>
</tr>
<tr>
<td>Inpatient Hospital Visit</td>
<td>Actual: 1</td>
</tr>
<tr>
<td></td>
<td>Expected: 1.05</td>
</tr>
<tr>
<td>Other (Specialist) Visit in Doctor’s Office</td>
<td>Actual: 0</td>
</tr>
<tr>
<td></td>
<td>Expected: 1.80</td>
</tr>
<tr>
<td>Other Visit</td>
<td>Actual: 0</td>
</tr>
<tr>
<td></td>
<td>Expected: 1.00</td>
</tr>
<tr>
<td>Outpatient Hospital Visit</td>
<td>Actual: 3</td>
</tr>
<tr>
<td></td>
<td>Expected: 3.27</td>
</tr>
<tr>
<td>PCP Visit in Doctor’s Office</td>
<td>Actual: 4</td>
</tr>
<tr>
<td></td>
<td>Expected: 4.28</td>
</tr>
<tr>
<td>Patient’s home</td>
<td>Actual: 5</td>
</tr>
<tr>
<td></td>
<td>Expected: 5.47</td>
</tr>
</tbody>
</table>

12 Month Utilization Profile

Overall Utilization Profile
Thank you

Paul Hake
phake@us.ibm.com