IBM Patient Care and Insights:

Utilizing Analytics to Deliver
Impactful Care Management

Healthcare Transformation: A Work in Progress

1st

US rank in Healthcare spending [1]

37th

US rank in quality of care delivered [2]

8.0

Hours each day an average family physician spends on direct patient care [3]

21.7

Hours required to meet the patient care guidelines each day [3]

$750B

(Billion) Wasted on missed opportunities along with unnecessary, error-prone and inefficiently delivered services [3]

45%

US physicians still reliant on paper based medical records systems [4]

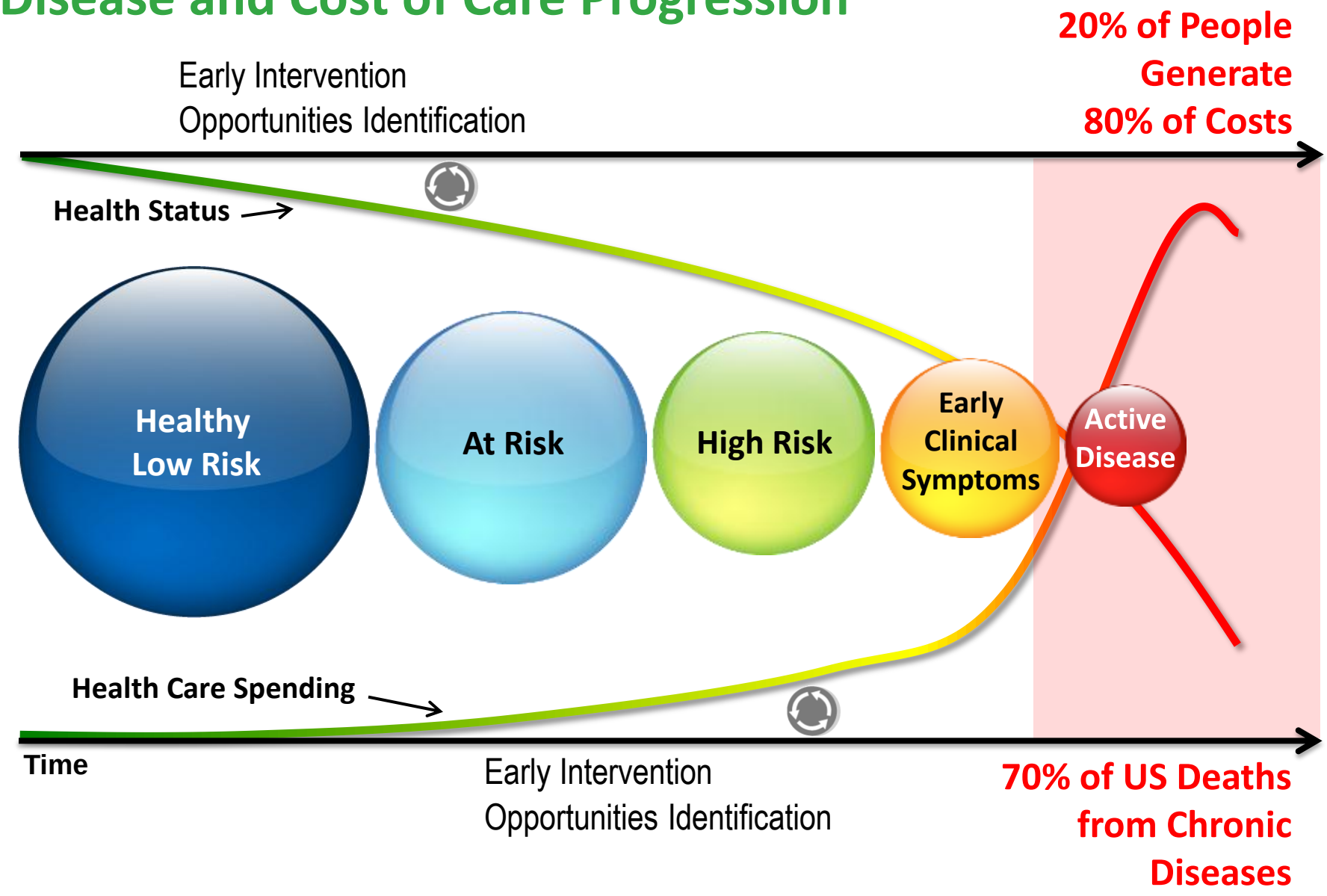
An Ocean of Unused Data

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

80% of the world's data is unstructured

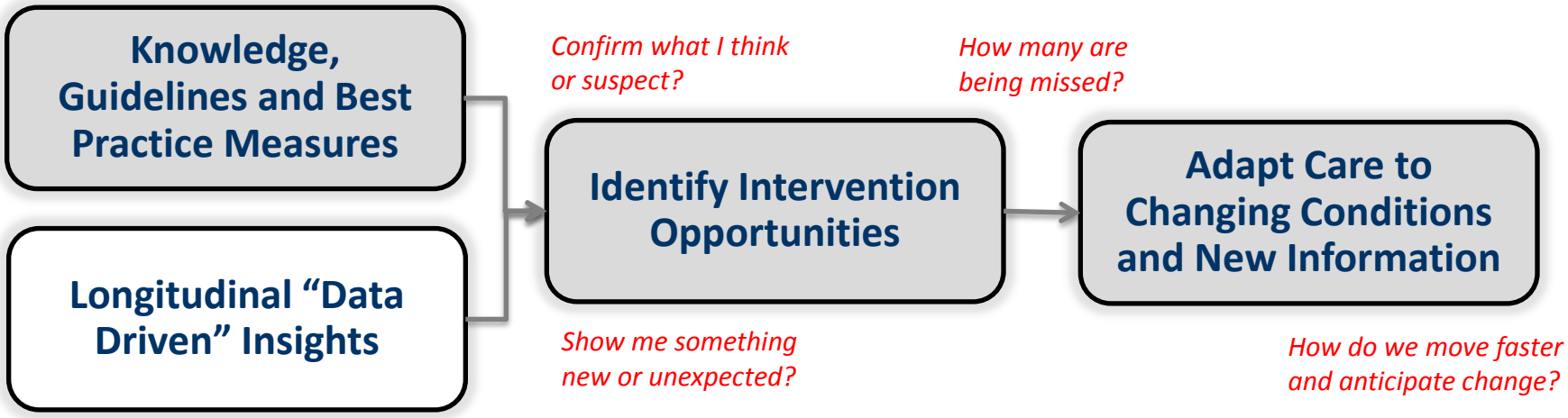
What insights are trapped in your EMR and other systems?

Disease and Cost of Care Progression



Information Should Aid Us, Not Lie Hidden and Dormant

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

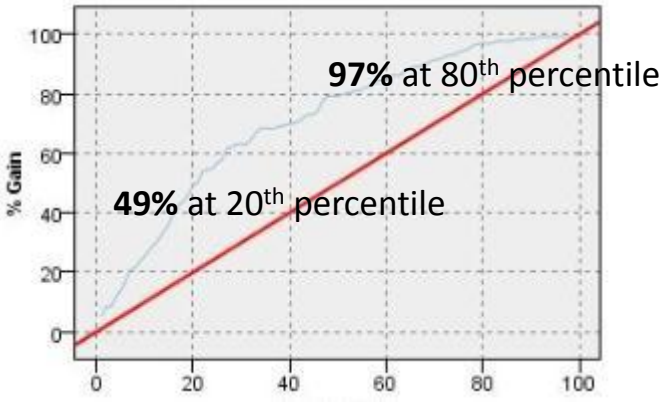
- Structured data not available, not accurate enough, without the unstructured data - which was more trustworthy

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)



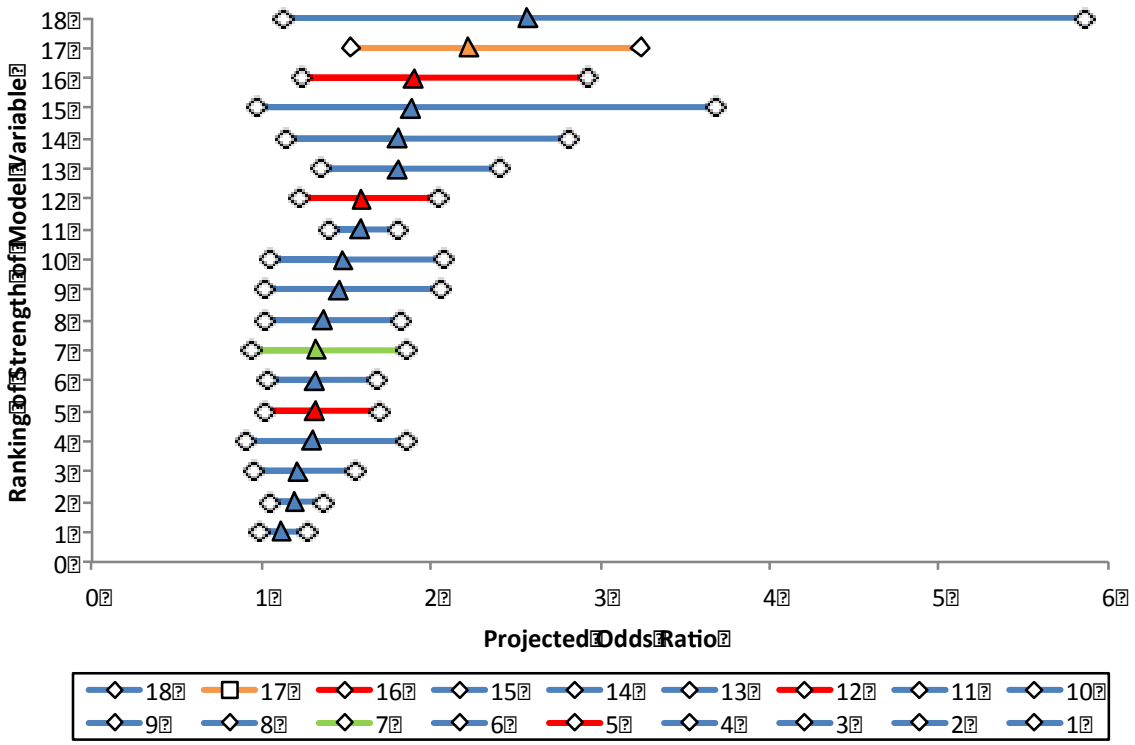
Predictor Analysis	% Encounters Structured Data	% Encounters Unstructured Data
Ejection Fraction (LVEF)	2%	74%
Smoking Indicator	35% (65% Accurate)	81% (95% Accurate)
Living Arrangements	<1%	73% (100% Accurate)
Drug and Alcohol Abuse	16%	81%
Assisted Living	0%	13%

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

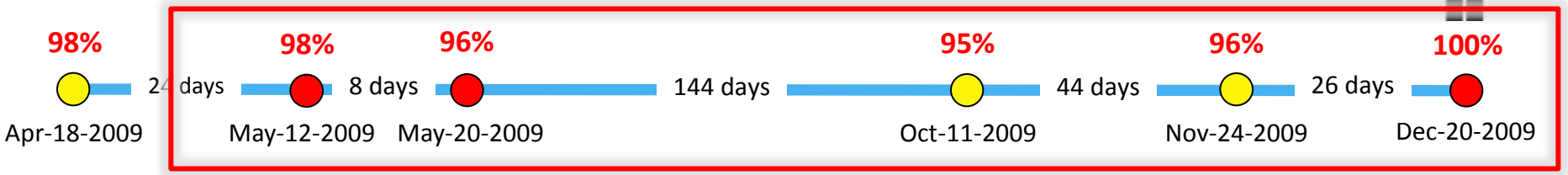
The Impact of Readmissions at Seton

CHF Patient X – What Happened?

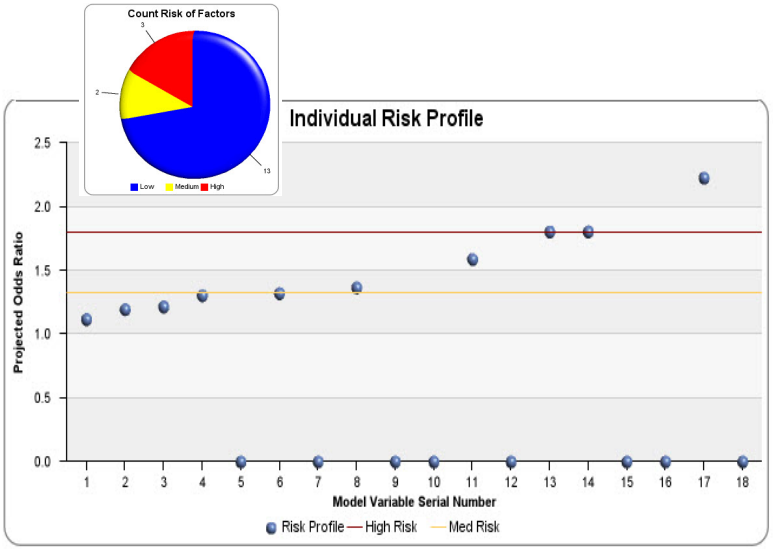
Admit / Readmission

30-Day Readmission

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

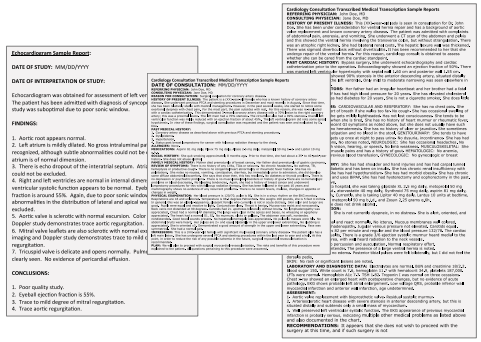
18. Jugular Venous Distention Indicator
17. Paid by Medicaid Indicator
16. Immunity Disorder Disease Indicator
15. Cardiac Rehab Admit Diagnosis with CHF Indicator
14. Lack of Emotion Support Indicator
13. Self COPD Moderate Limit Health History Indicator
12. With genitourinary system & Endocrine disorders
11. Heart Failure History
10. High BNP 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 (Cerner + ICA)
2. Heart Attack History
1. Heart Disease History

Patient Population Monitoring Clinical and Operational Data

What Have We Learned So Far?

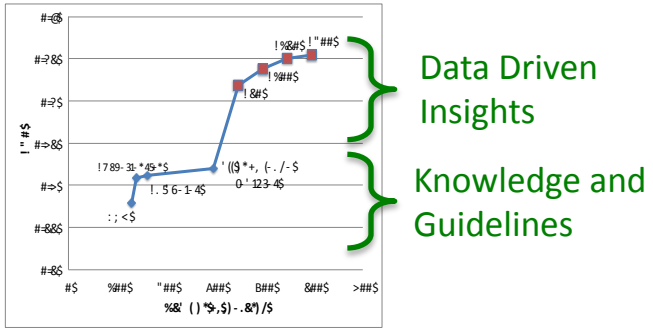
Structured Data is Not Enough

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



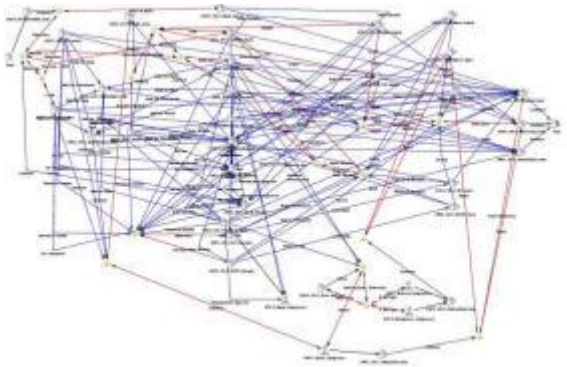
Today's Care Guidelines Only Get You So Far

- 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]



1. Dijun Luo, Fie Wang, Jimeng Sun, Marianthi Markatou, Jianying Hu,Shahram Ebadollahi, SOR: ScalableOrthogonal Regression for Low-Redundancy Feature Selection and its Healthcare Applications. SDM'12
2. Jimeng Sun, Jianying Hu, Dijun Luo, Marianthi Markatou, Fei Wang, Shahram Edabollahi, Steven E. Steinhubl, Zahra Daar, Walter F. Stewart. Combining Knowledge and Data Driven Insights for Identifying Risk Factors using Electronic Health Records. Under submission at AMIA'12
3. Blind Surgeon Metaphor Problem - W.M.P. van der Aalst, M. Weske, and D. Grünbauer. Case Handling: A New Paradigm for Business Process Support. Data and Knowledge Engineering, 53(2):129-162, 2005

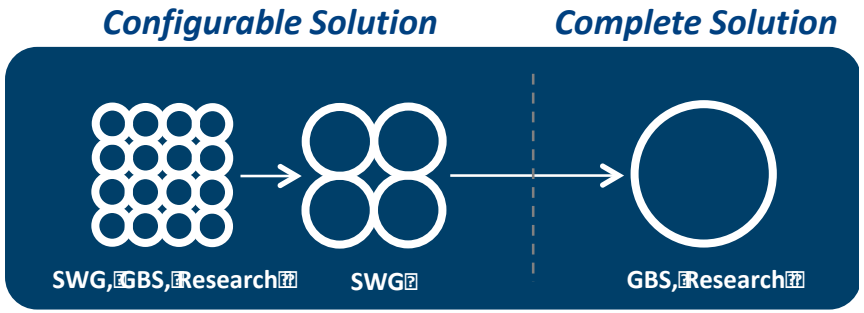
IBM Strategy to Support Care Coordination:

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

UNCOVER HIDDEN INTERVENTION OPPORTUNITIES

DELIVER PERSONAIZED COORDINATED CARE

Solution Marketecture

Physicians, Clinicians, Care Coordinators, Case Managers, etc.

Plan Administrators, Directors, Researchers, Analysts, Knowledge Workers, etc.

Patients, Family, Social Services, etc.

Dynamic User Experience

Search and Visually Explore (Mine)
Monitor, Dashboard and Report
Collaborate, Coordinate and Share

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.)

1010
0101
1010

- Speech Conversion
- Paper / Image Conversion

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

- Data Warehouse and Model
- Master Data / EMPI
- Health Information Exchange

IBM Watson for Healthcare

- Terminology and Ontology
- Social Services Data / Systems
- Other Clinical / Op Systems

Health Integration Framework

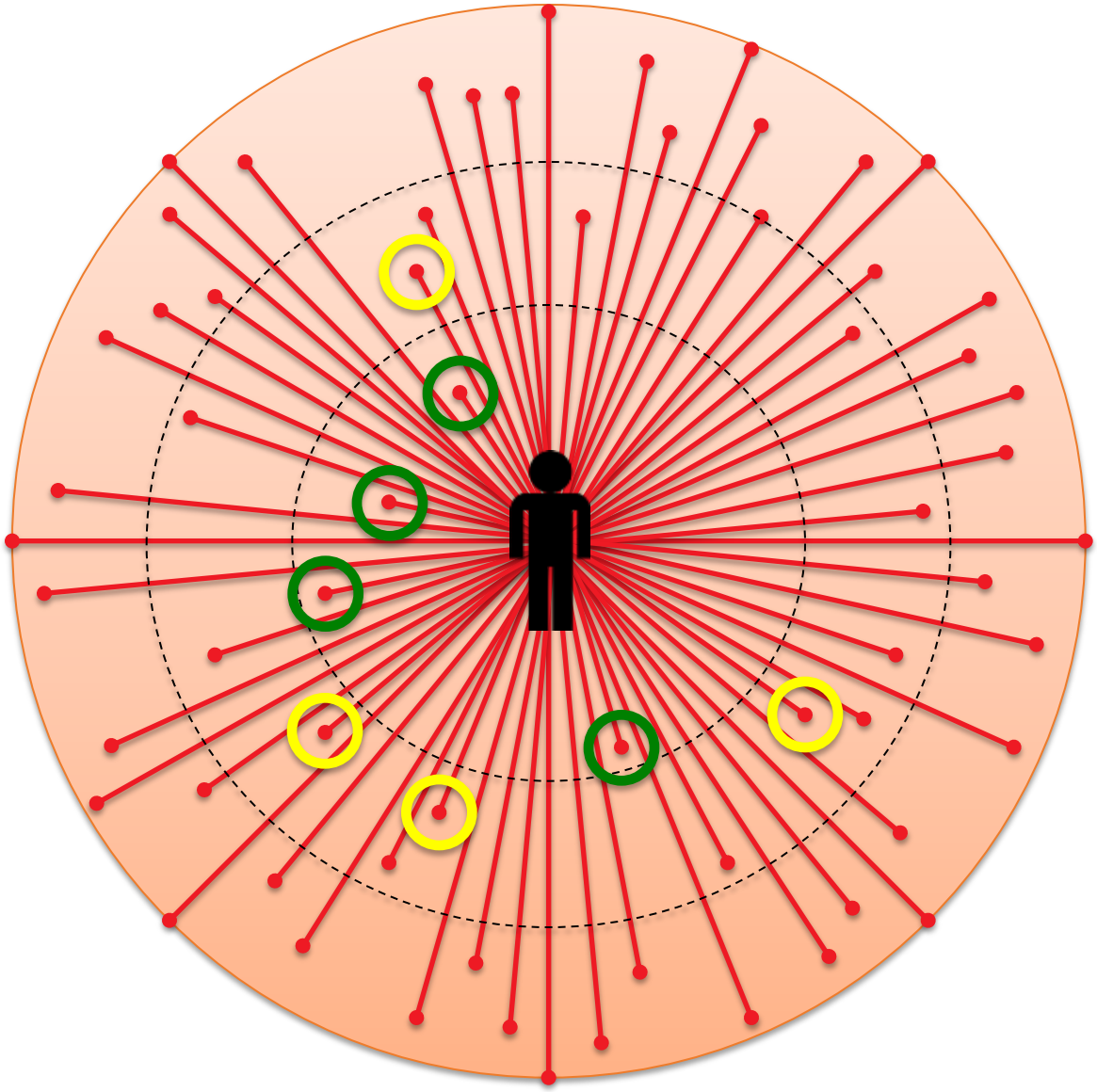
- Rules / Clinical Guidelines
- EMR / EHR / PACS / LPR
- Monitoring and Devices

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?**

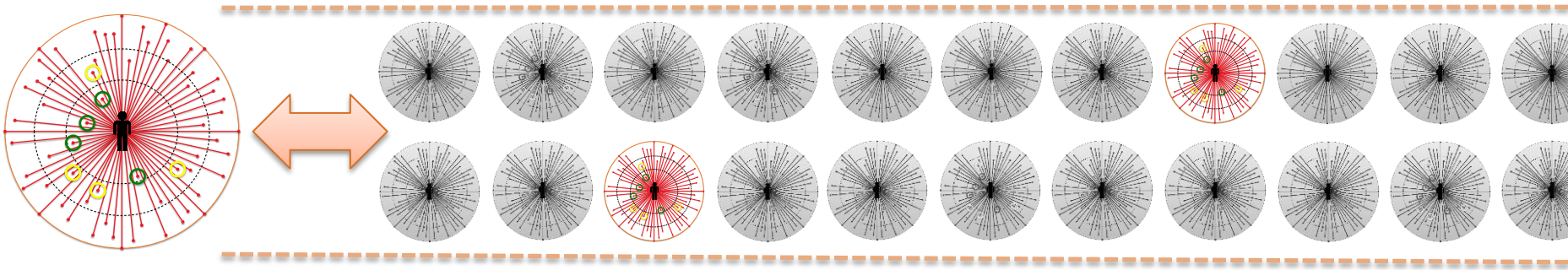
1. *Projection of Chronic Illness Prevalence and Cost Inflation* from RAND Health. October 2000
2. *The Rise in Spending Among Medicare Beneficiaries: The Role of Chronic Disease Prevalence and Changes in Treatment Intensity* from Health Affairs, August 2006

How Similarity Analytics Work, Part 1

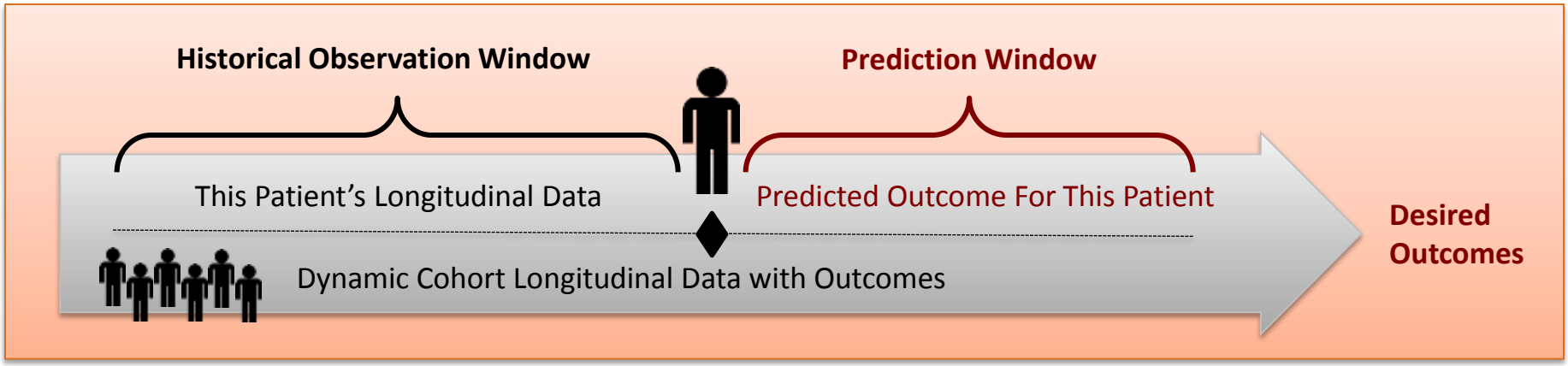


- For this patient …
- Analyze longitudinal data to develop profile across 30,000+ possible points of comparison
- Determine the individual risk factors for this patient based on the desired outcome
- Create an outcomes based personalized profile for this patient

How Similarity Analytics Work, Part 2

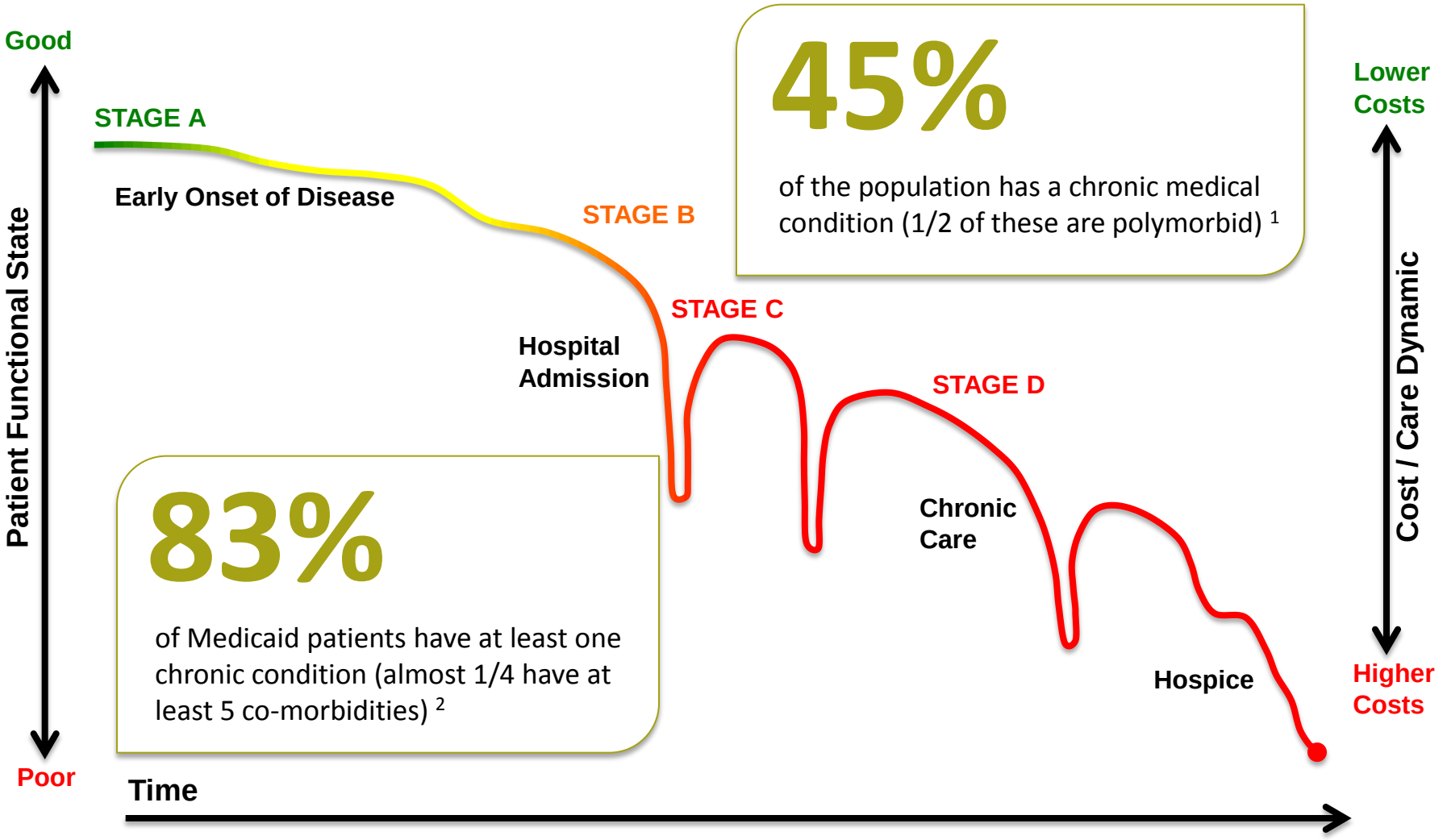


- Based on this patient's personalized profile …
- Find the **most** similar patients (or **dynamic cohort**) from entire population
- Analyze what happened with the cohort and reasons why (30,000+ dimensions)
- Predict the probability of the desired outcome for this patient
- Create personalized care plan based on unique needs of this patient



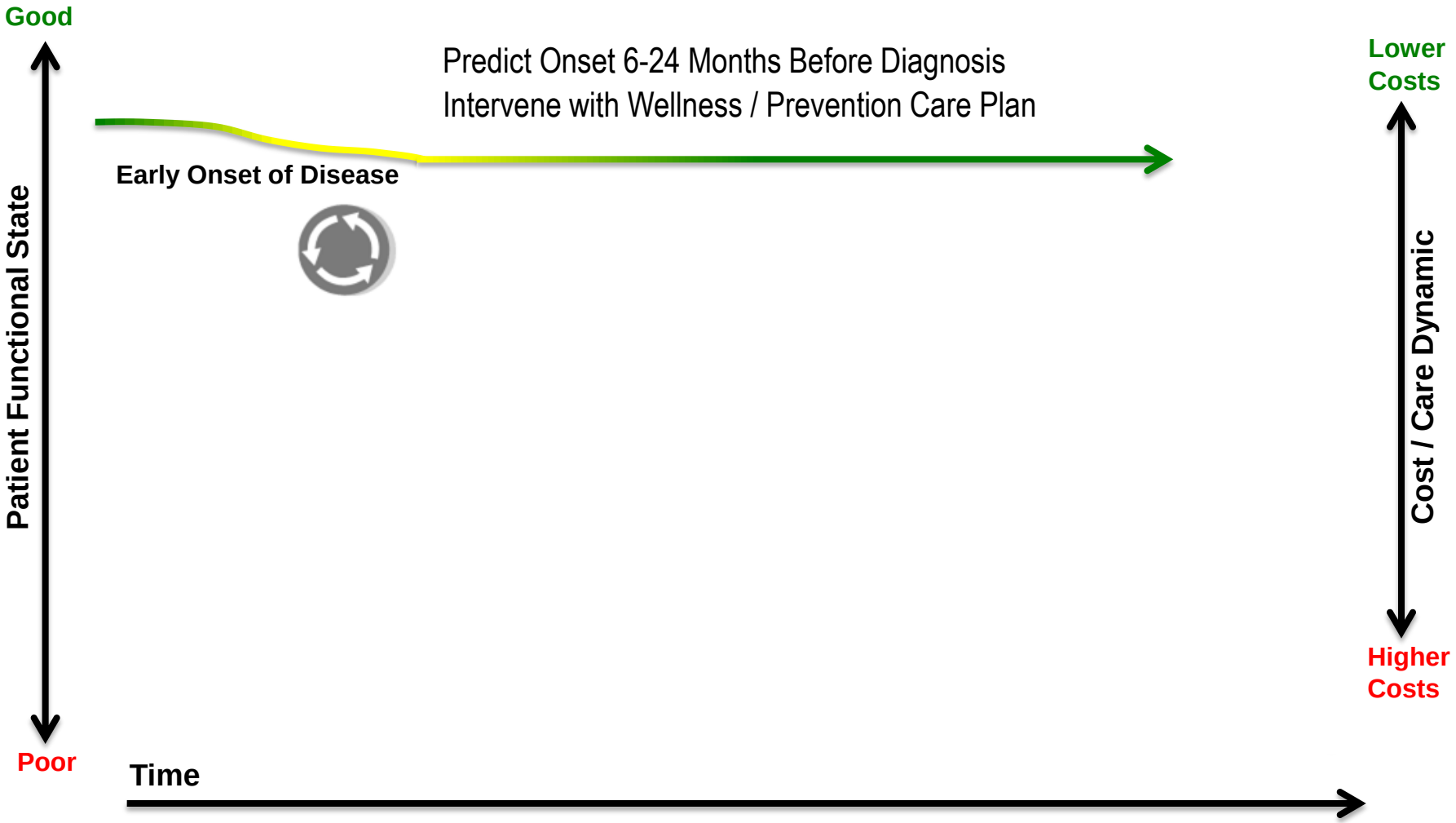
Chronic Diseases with Comorbidities Are The Costliest

Heart Disease Organ Failure Scenario (Adapted 1)



1. Heart Failure Scenario adapted from De La Sociedad Espanola De Cardiologia
2. *Projection of Chronic Illness Prevalence and Cost Inflation* from RAND Health. October 2000
3. *Medicare and Chronic Conditions Sounding Board* from New England Journal of Medicine 2005

Finding Hidden Interventions with *IBM Patient Care and Insights*



Overview | Patient List | Demographics

Groups

- Risk for Kidney Disease Onset (24)
  1 filter, modified 12:34 7/14/2012
- CHF Onset (345)
  1 filter, modified 12:34 6/30/2012
- CHF Readmission (127)
  1 filter, modified 12:34 6/30/2012
- Utilization (63)
  1 filter, modified 12:34 6/30/2012
- Hyperlipidemia (13)
  1 filter, modified 12:34 6/30/2012

Smith, Judy | MRN: 7300021

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

Show:

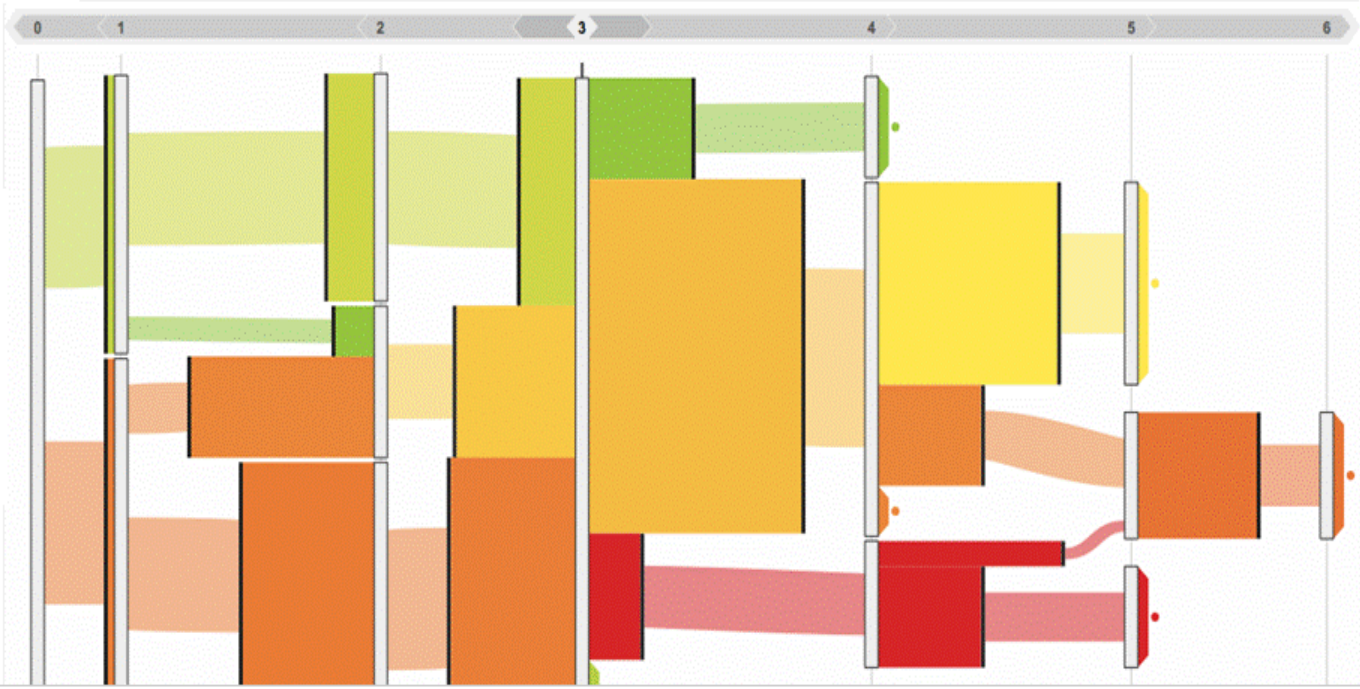
CHF onset

CHF onset risk score: 0.98

Predictive Factor	Predictive Weight
Ankle Edema	85%
Dispnea	34%
Rales	4%

Risk Assessment

0.0 1.0
Outcome



Changes were applied to the Kidney Disease Group

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Show:

Hyperlipidemia

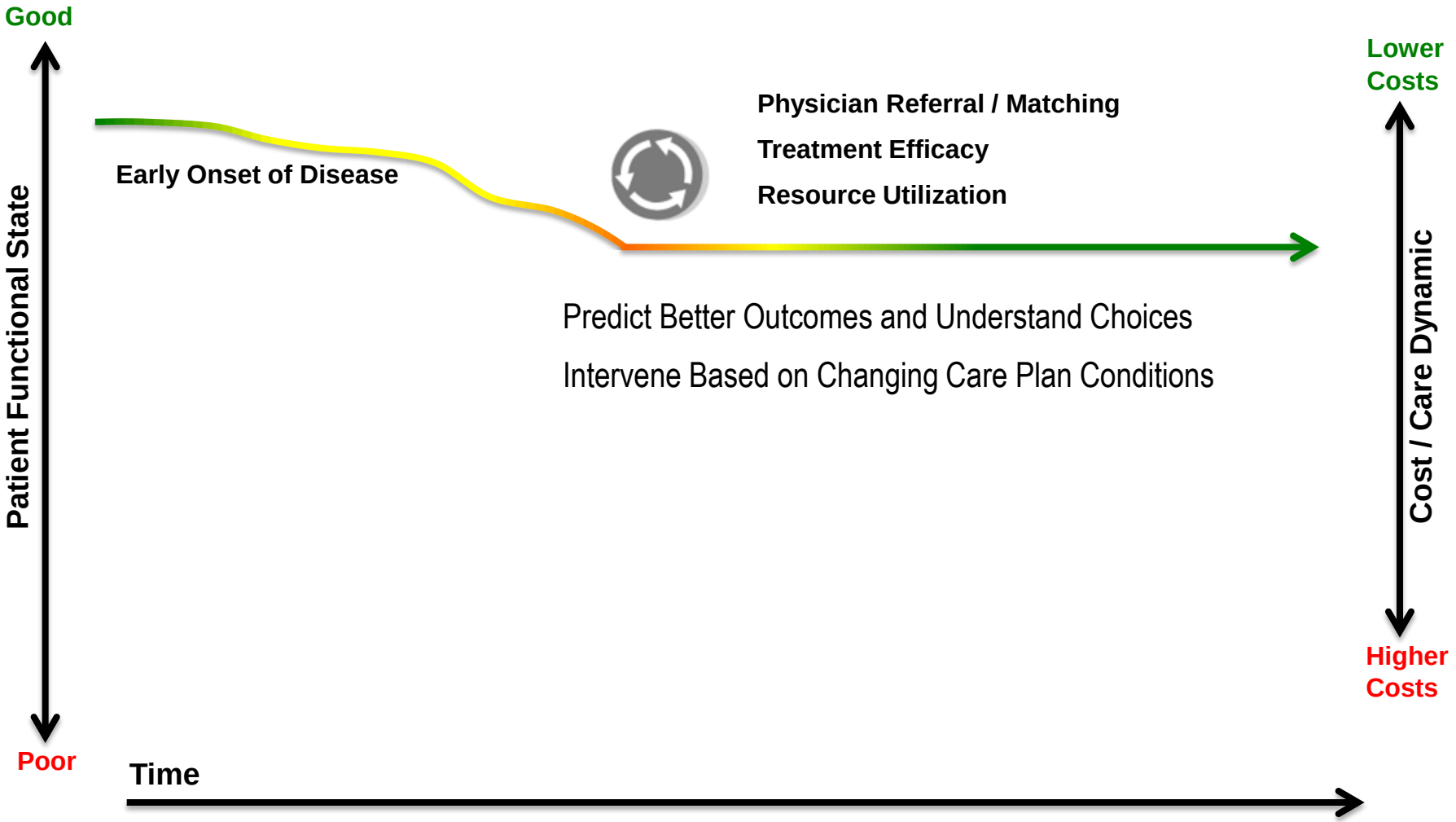
Hyperlipidemia Risk: 0.72

Charts per page:

Treatment	Outcome:LDL (mg/dl)	Cohort Description
LOVASTATIN	Current Patient: 168 (100, 130, 160, 200)	Size: 192
ATORVASTATIN	Current Patient: 168 (100, 130, 160, 200)	Size: 183
NIACIN	Current Patient: 168 (100, 130, 160, 200)	Size: 180
	Current Patient: 168	

Changes were applied to the Kidney Disease Group

Finding Hidden Interventions with *IBM Patient Care and Insights*



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Show:

Physician Match

Physician Name	Match Score
Closest Nephrologist: **Mercado, Venus**	55
Troy, Helen	95
Hilt, Lauren	95
Hernandez, Magee	94
Keller, Channing	92
Duke, Emi	90
Ochoa, Grady	88
Miranda, Raphael	88
Gibbs, Isadora	87
Todd, Tatyana	86
Dotson, Jamilia	85
Johns, Olivia	85
gay, Melodie	84

Changes were applied to the Kidney Disease Group

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Utilization

Overall Risk: 1.0

6 Month Utilization Profile

Visit Type	Frequency
Emergency Room & Urgent Care Visit	Actual: 3 Expected: 0.66
Independent Lab Visit	Actual: 7 Expected: 7.05
Inpatient Hospital Visit	Actual: 1 Expected: 1.05
Other (Specialist) Visit in Doctor's Office	Actual: 0 Expected: 1.80
Other Visit	Actual: 0 Expected: 1.00
Outpatient Hospital Visit	Actual: 3 Expected: 3.27
PCP Visit in Doctor's Office	Actual: 4 Expected: 4.28
Patient's home	Actual: 5 Expected: 5.47

12 Month Utilization Profile

Overall Utilization Profile

Changes were applied to the Kidney Disease Group

Thank you

Paul Hake
phake@us.ibm.com