

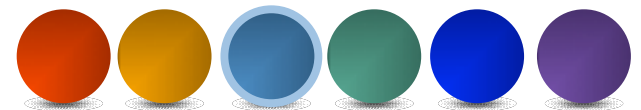
**Predictive Modeling Summit
September 15th, 2010**



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



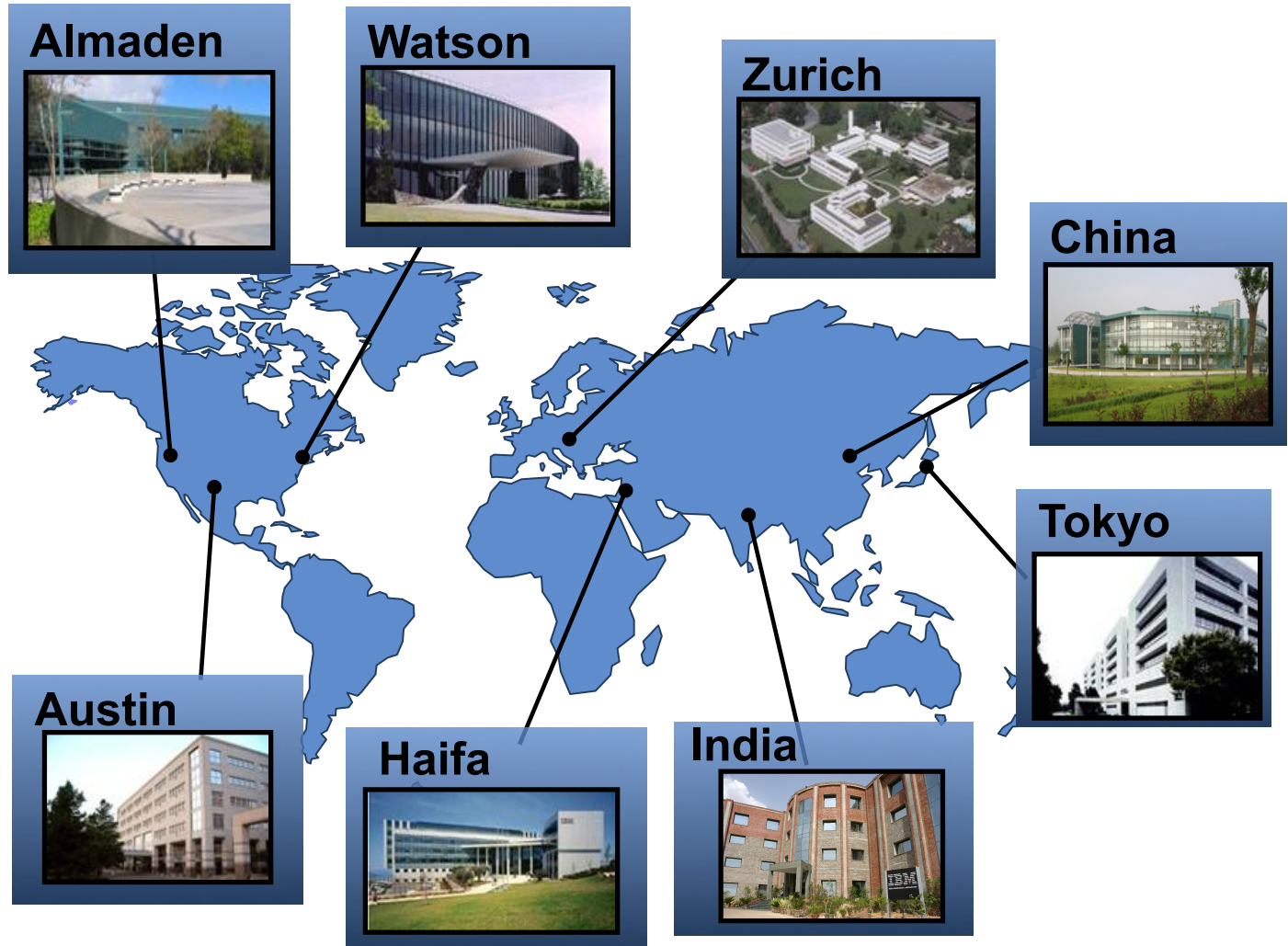
IBM Research Labs

- Eight Research Labs worldwide

- Over 3100 employees

- Research

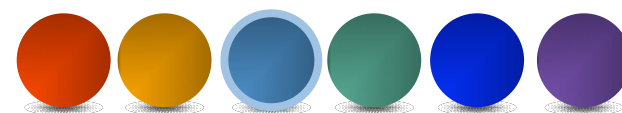
- Exploratory, Applied & Product Research
- Differentiation for next-generation products, services and solutions





GTO 2010

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

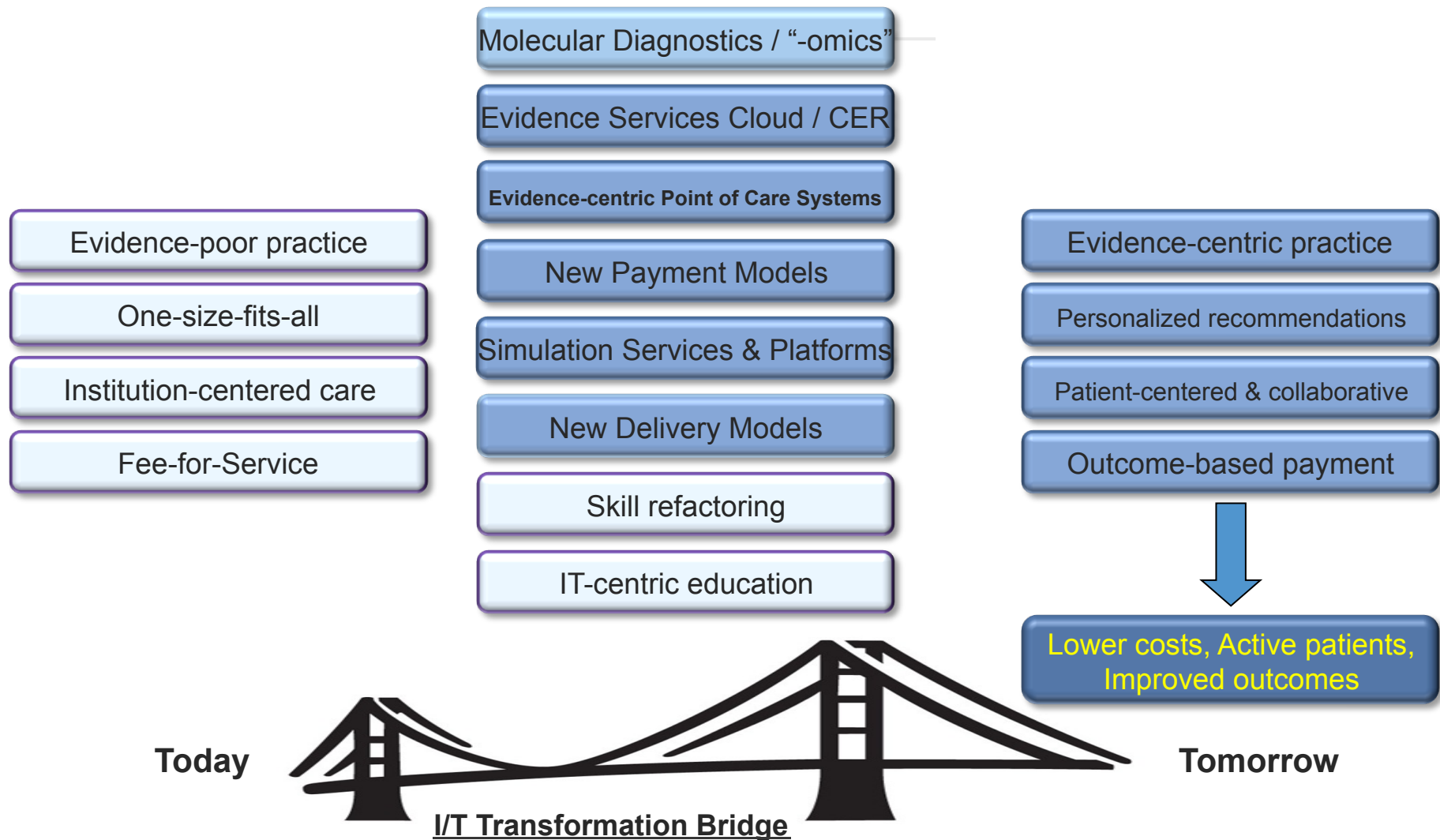
Change Implications

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

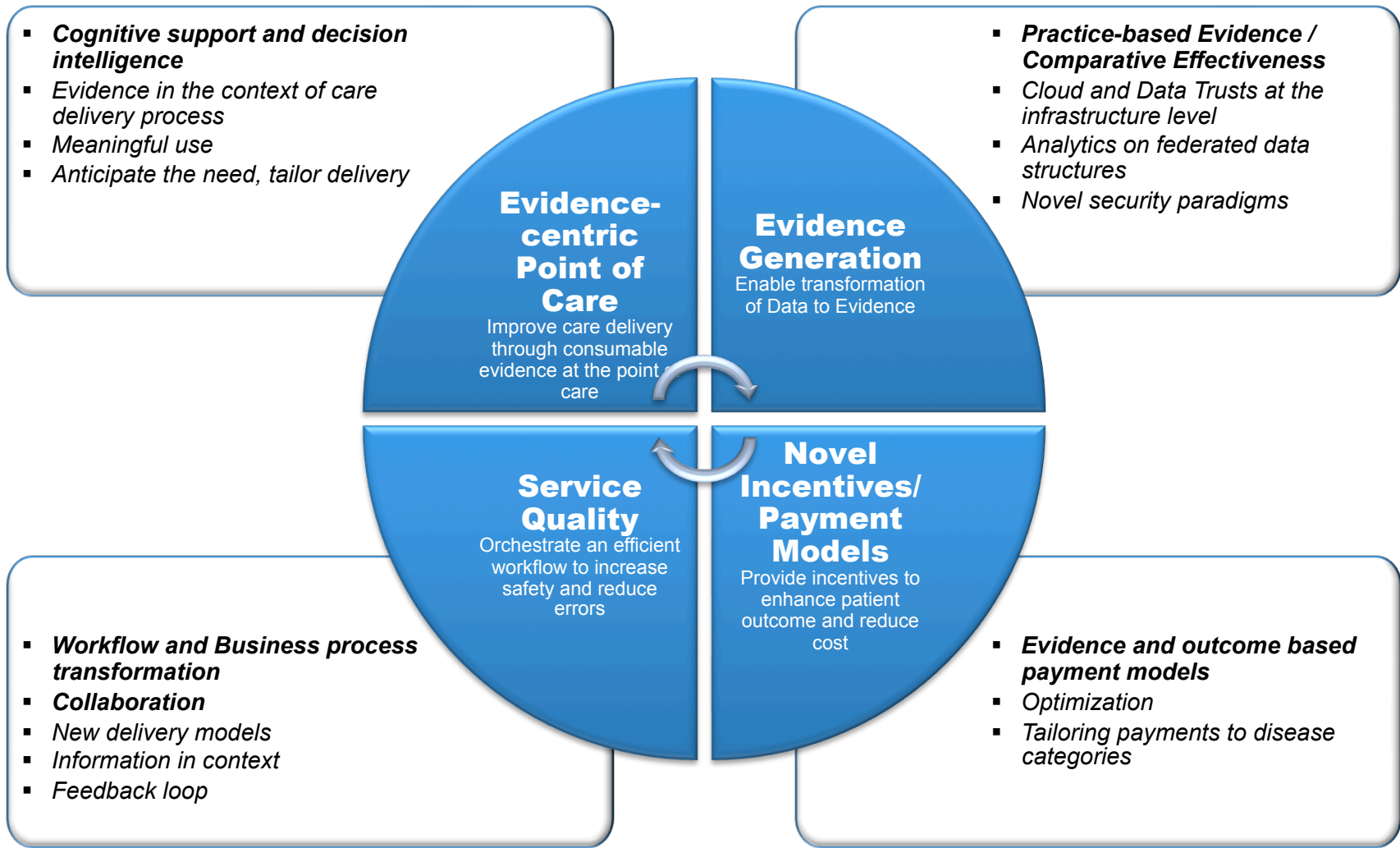
IBM Response

- ◆ **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



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)

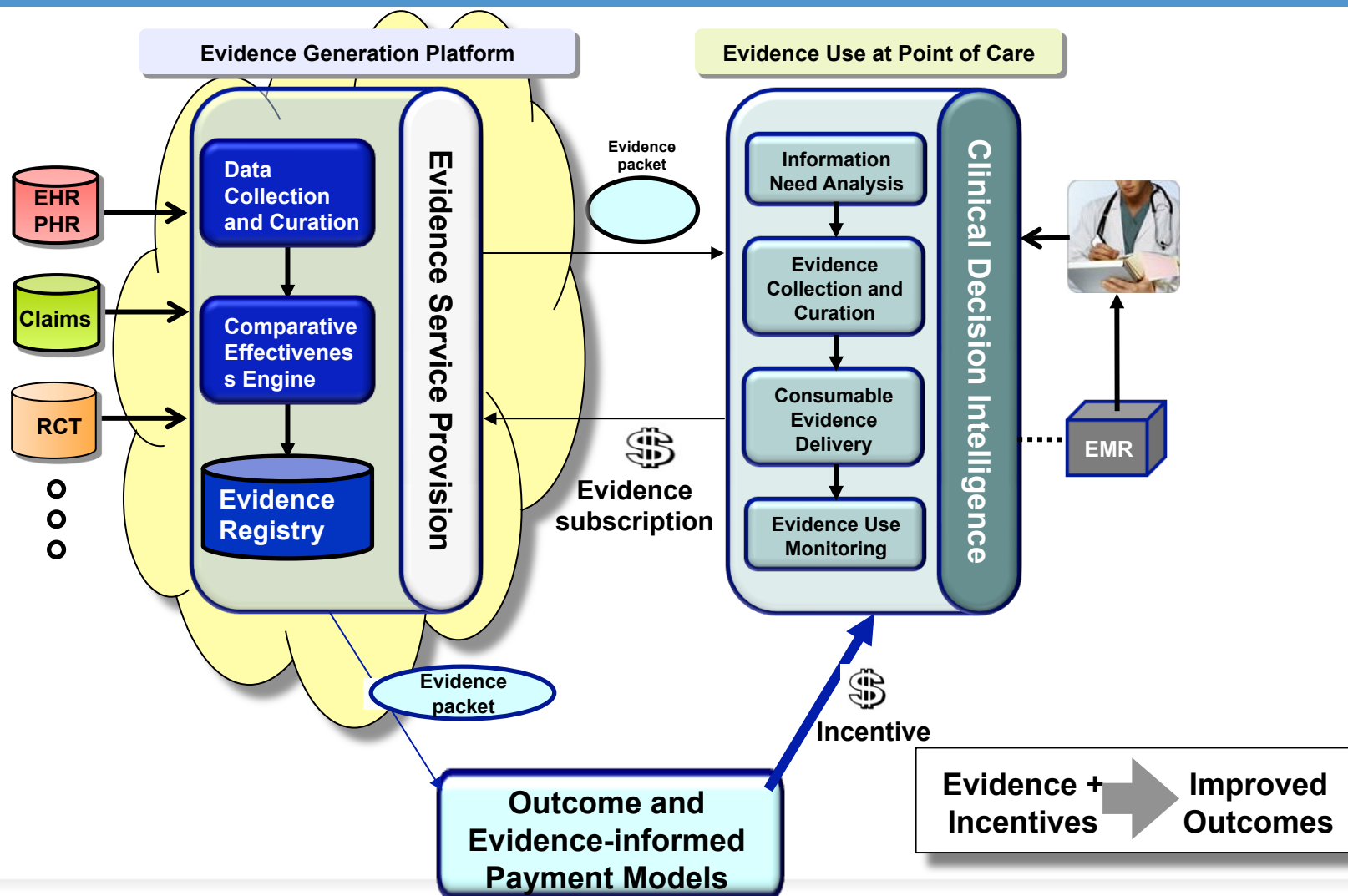
- *Implemented EHR in 1995, CDIS in 2009*
- *Developed best practice guidelines in 2008*
- *ProvenCare/Acute episodic care program provides warranty on outcomes*

Benefits

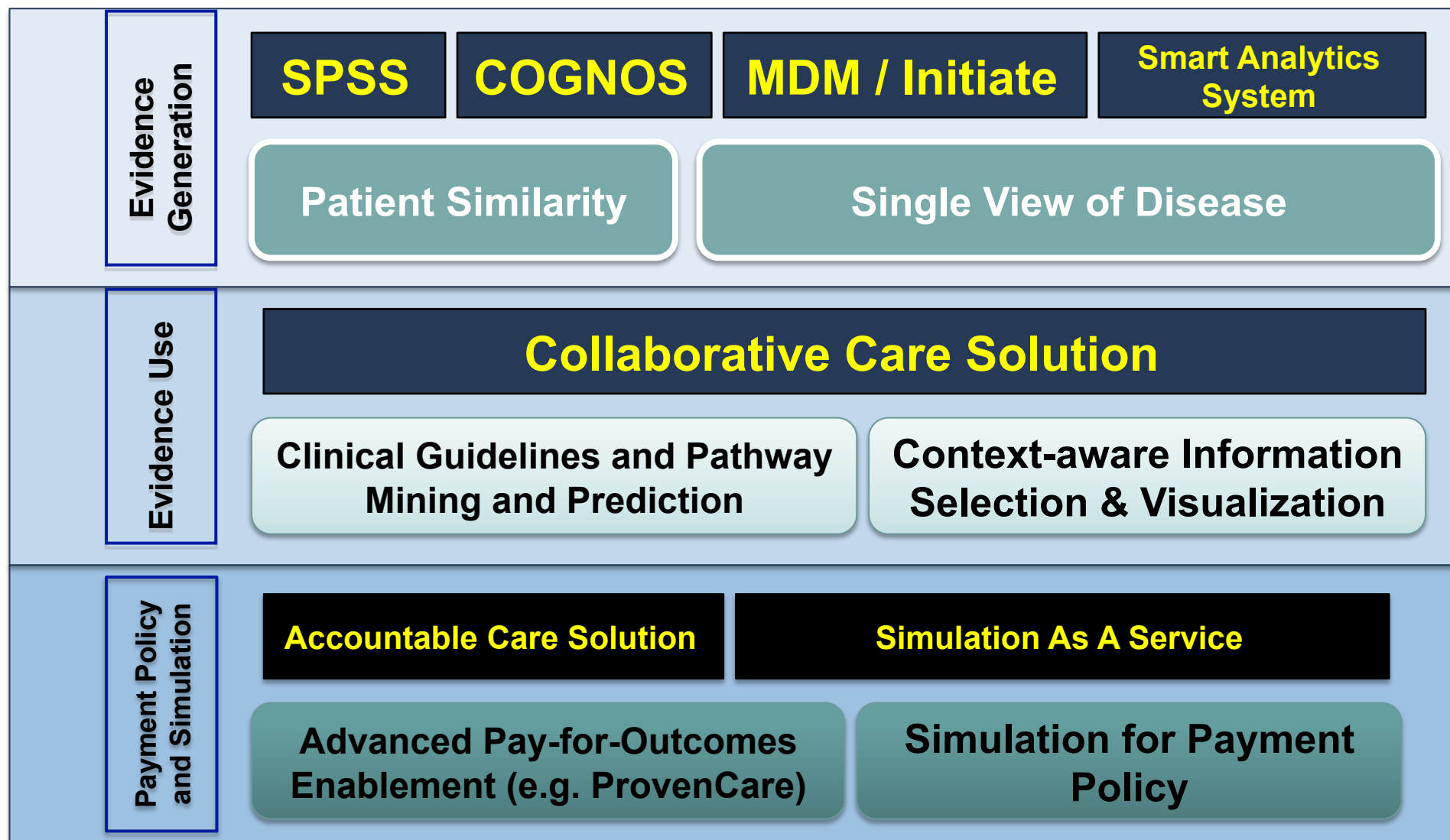
- *Readmission within 30 days (6.9% → 3.8%) ; average total Length of Stay (LOS): (6.2d → 5.7d)*
- *Reduced hospital mortality (1.5% → 0%); number of Neurological complications (1.5% → 0.6%) ;*

Healthcare Transformation

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.

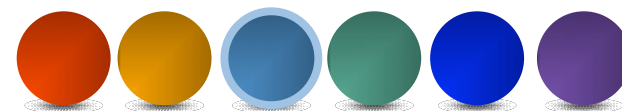


Key Plays to Enable Evidence-Centric Healthcare Ecosystem

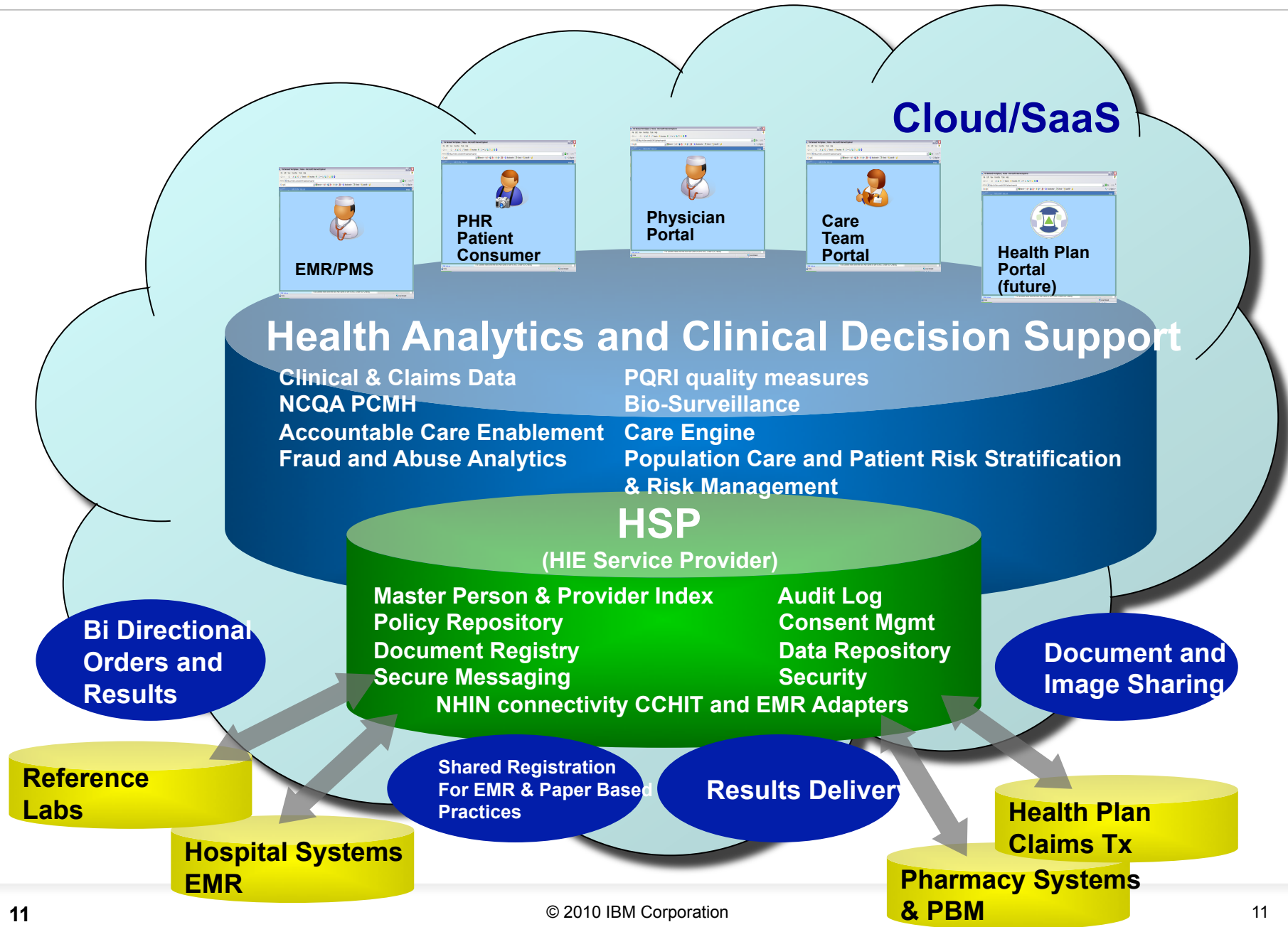




Collaborative Care Solution



IBM/AHM Collaborative Care SaaS/Cloud Solution

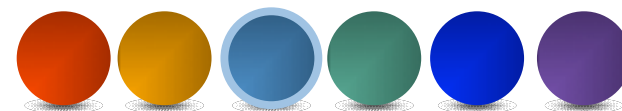


Overview of IBM Analytics in Solution

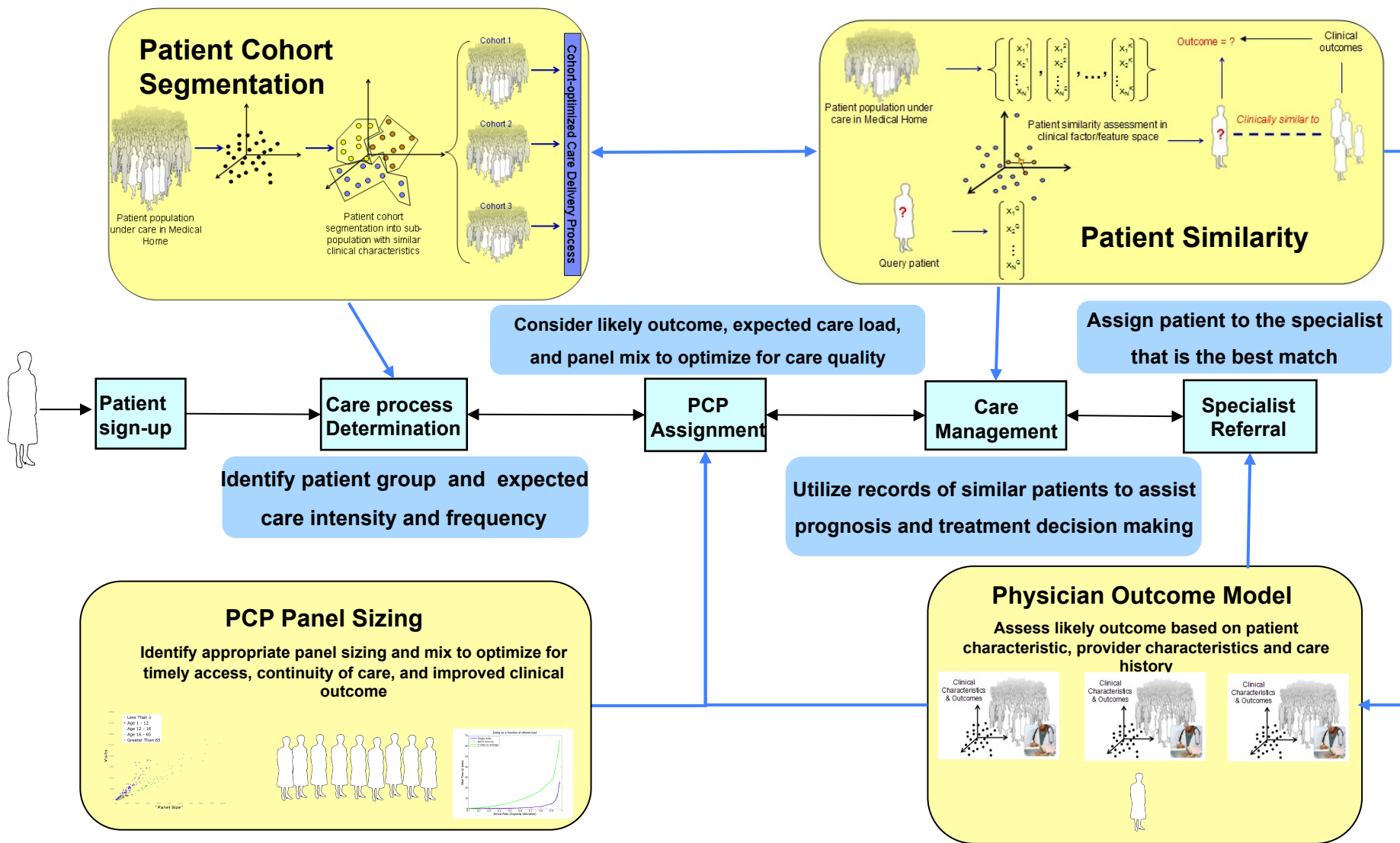
- **Key industry drivers being addressed include:**
 - Improving Quality of Healthcare
 - Reimbursement Incentives
 - Meeting NCQA Requirements
 - Demonstrating Meaningful Use
 - Cost Savings and foundation for ACO's
- **The Collaborative Care Analytics solution includes:**
 - NCQA's Physician Practice 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 Similarity – A high-level view

Patient Data

EHR

Transcription of histology report (2010-01-01 10:00)

HEALTHY PERIPHERAL:
T-10. Medial head of the coracoid, Diaphragm, color flow mapping, and pleural and costophrenic vein. Diaphragm intact.

ADRENAL GLANDS:
None seen.

ADREN:
None appear to be enlarged. The proximal aorta (head) is 2.2 cm (tail) is 4.0 cm.

NEURAL TISSUE:
None. No vertebral or paravertebral lesions are present by color flow mapping.

HEALTHY SPINE:
None. No vertebral or paravertebral lesions are present by color flow mapping.

HEALTHY SPINE:
None. No vertebral or paravertebral lesions are present by color flow mapping.

HEALTHY SPINE:
None. No vertebral or paravertebral lesions are present by color flow mapping.

Patient Similarity

Similarity assessment analytics

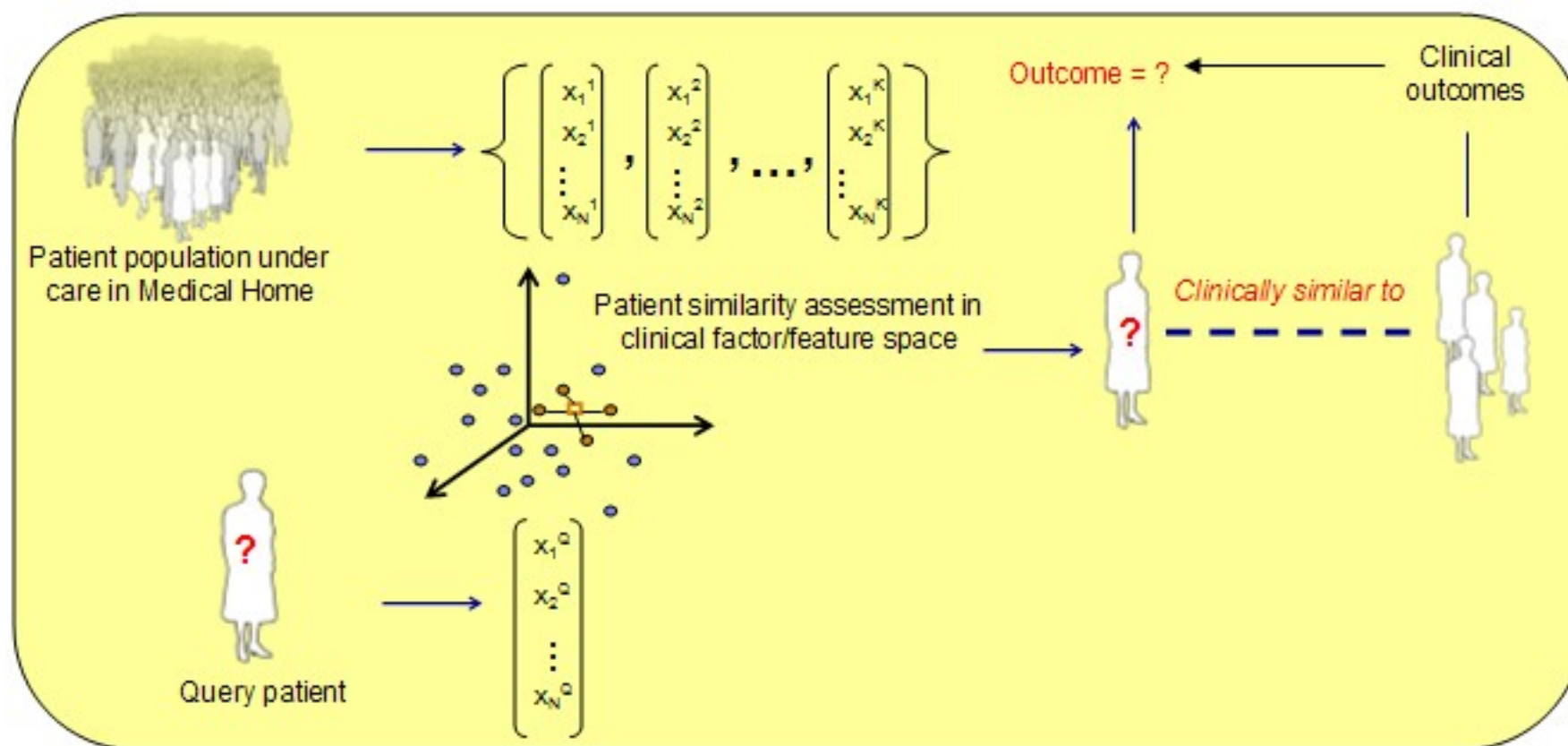
Patient characterization

Applications

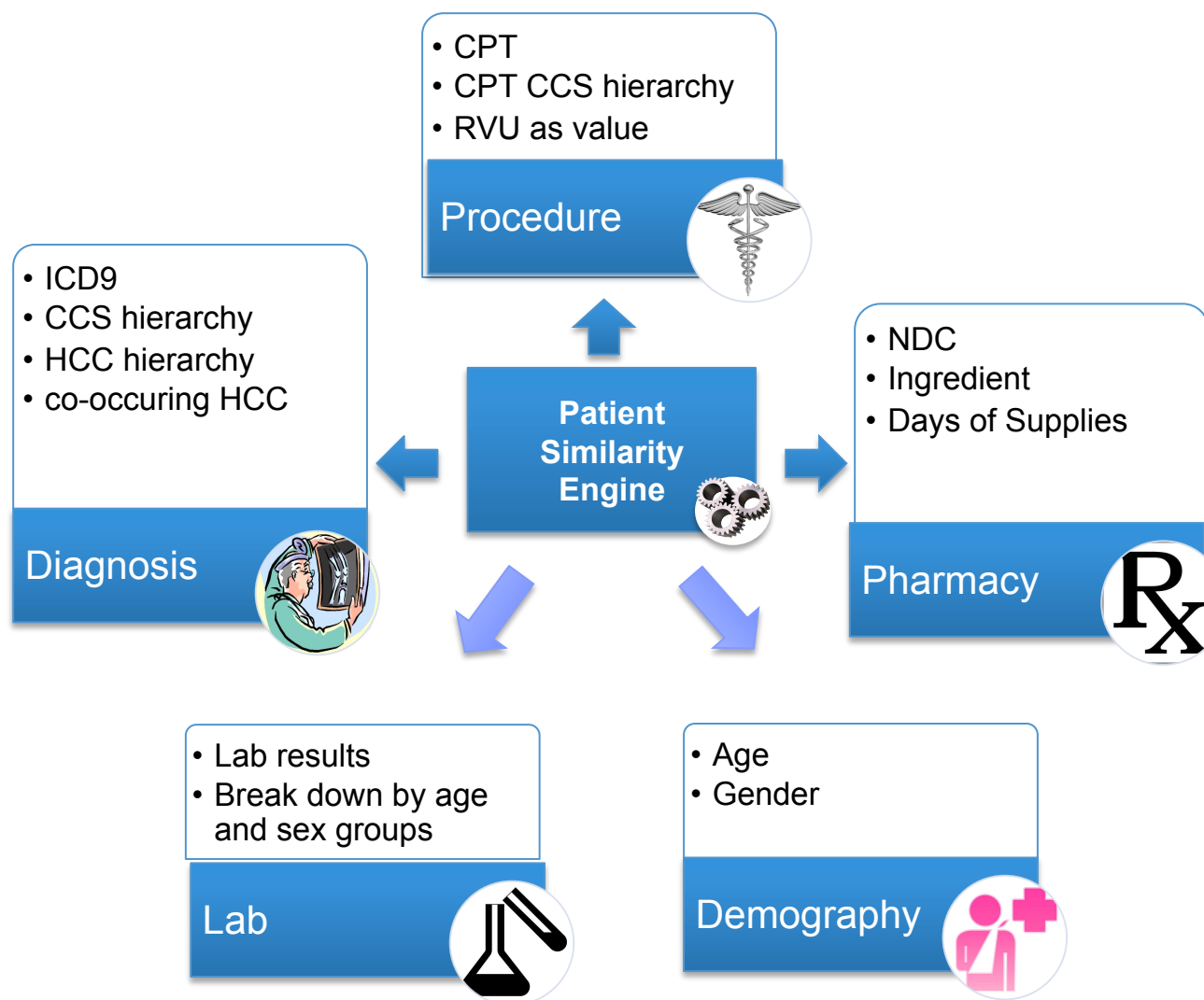
- Clinical Decision Support
- CER & Outcomes Research
- Resource Allocation (Patient Referral Services)
- Data Quality Services
- Predictive Analytics (Clinical Pathways)
- Clinical Trial Services (Patient Recruitment)
- Patient social networks

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



Analytics for Collaborative Care Solution | Welcome - Mozilla Firefox: IBM Edition

File Edit View History Bookmarks Tools Help

http://localhost:8080/Sharp Demo/

Most Visited IBM Lenovo ThinkPad W50... IBM

IBM Analytics for Collaborative Care Solution

Welcome to Analytics for Collaborative Care Solution.

Please select a patient:

100256 Submit

Done

9/15/10

Patient Summary for 100256 - Mozilla Firefox: IBM Edition
 http://localhost:8080/Sharp Demo/summary.jsp?patient=100256

IBM Analytics for Collaborative Care Solution

Patient Summary | Patient: 100256 | Sex: Male | Age: 50 | Location: [REDACTED]

[Similar Patients](#) | [Physician Referral](#)

Diagnoses

| ICD9 | Condition | Last Diagnosis | History |
|-------|--------------------------|----------------|--|
| 71596 | Osteoarthros Nos-L/Leg | 2009-09-23 | April 08, July 08, October 08, January 09, April 09, July 09 |
| V4365 | Joint Replaced Knee | 2009-09-23 | April 08, July 08, October 08, January 09, April 09, July 09 |
| 25000 | Dmii Wo Cmp Nt St Uncntr | 2009-08-14 | April 08, July 08, October 08, January 09, April 09, July 09 |
| 22800 | Hemangioma NOS | 2009-04-15 | April 08, July 08, October 08, January 09, April 09, July 09 |

Medications

| Ingredients | Dosage | Last Prescribed | History |
|-------------|--------|-----------------|--|
| Glyburide | 5MG | 2009-09-24 | April 08, July 08, October 08, January 09, April 09, July 09 |
| Niacin | 1000MG | 2009-09-22 | April 08, July 08, October 08, January 09, April 09, July 09 |
| Ibuprofen | 800MG | 2009-09-21 | April 08, July 08, October 08, January 09, April 09, July 09 |
| Simvastatin | 20MG | 2009-09-21 | April 08, July 08, October 08, January 09, April 09, July 09 |

Procedures

| CPT/... | Description | Last Performed | History |
|---------|------------------------------|----------------|--|
| 99213 | Office/outpatient visit, est | 2009-09-23 | April 08, July 08, October 08, January 09, April 09, July 09 |
| 99212 | Office/outpatient visit, est | 2009-08-24 | April 08, July 08, October 08, January 09, April 09, July 09 |
| 73560 | X-ray exam of knee, 1 or 2 | 2009-08-24 | April 08, July 08, October 08, January 09, April 09, July 09 |
| 83036 | Glycosylated hemoglobin test | 2009-08-14 | April 08, July 08, October 08, January 09, April 09, July 09 |

Lab Results

| Test | Last Result | Last Performed | History |
|----------|-------------|----------------|--|
| MALBRATI | 5.0 | 2008-06-27 | April 08, July 08, October 08, January 09, April 09, July 09 |
| CHOL/HDL | 6.3 | 2008-06-27 | April 08, July 08, October 08, January 09, April 09, July 09 |
| LDL | 147.0 mg/dl | 2009-08-14 | April 08, July 08, October 08, January 09, April 09, July 09 |
| HDL | 33.0 mg/dL | 2009-08-14 | April 08, July 08, October 08, January 09, April 09, July 09 |

9/15/10

Similarity Info for patient 100256 - Mozilla Firefox: IBM Edition

File Edit View History Bookmarks Tools Help

http://localhost:8080/Sharp Demo/similar.jsp?patient=100256

Most Visited IBM Lenovo ThinkPad W50... IBM

IBM Analytics for Collaborative Care Solution

Change Patients

Patient Summary
Similar Patients
Physician Referral

Patient: 100256

Sex: Male
Age: 50
Location:

Overview Details Comparison

You are viewing the 99 most similar patients

Patient Filter (overall similarity >= 0.00) :

Done

9/15/10

Similarity Info for patient 100256 - Mozilla Firefox: IBM Edition

http://localhost:8080/Sharp Demo/similar.jsp?patient=100256

IBM Analytics for Collaborative Care Solution

Change Patients

Patient Summary
Similar Patients
Physician Referral

Patient: 100256

Sex: Male
Age: 50
Location:

Overview Details Comparison

You are viewing 22 out of 99 similar patients ([remove filter](#))

| Patient MRN | Overall Similarity | ICD9 | Medications | Procedures | Labs | Age/Sex | Comorbid (HCC) |
|-------------|--------------------|------|-------------|------------|------|---------|----------------|
| 108600 | | | | | | | |
| 100317 | | | | | | | |
| 103962 | | | | | | | |
| 094868 | | | | | | | |
| 002889 | | | | | | | |
| 025942 | | | | | | | |
| 029109 | | | | | | | |
| 039760 | | | | | | | |
| 113951 | | | | | | | |
| 012305 | | | | | | | |
| 056378 | | | | | | | |
| 114020 | | | | | | | |
| 064736 | | | | | | | |
| 105053 | | | | | | | |

Measure 1: MALBRATI Measure 2: CHOL/HDL

Insufficient info for this lab

Similarity Info for patient 100256 - Mozilla Firefox: IBM Edition

http://localhost:8080/Sharp Demo/similar.jsp?patient=100256

IBM Analytics for Collaborative Care Solution

Change Patients

Patient Summary | Similar Patients | Physician Referral

Patient: 100256

Sex: Male
Age: 50
Location: [REDACTED]

Overview | Details | Comparison

Current Patient
100256

Similar Patients

- 108600 (M, 41)
- 100317 (M, 52)
- 103962 (M, 51)
- 094868 (M, 42)
- 002889 (M, 51)
- 025942 (M, 56)
- 029109 (M, 51)
- 039760 (M, 38)
- 113951 (M, 54)
- 012305 (M, 70)
- 056378 (M, 52)
- 114020 (M, 63)
- 064736 (M, 51)
- 105053 (M, 73)
- 032059 (M, 50)
- 045109 (M, 51)
- 060199 (M, 52)
- 021353 (M, 47)
- 038120 (M, 51)
- 066808 (M, 46)
- 079654 (M, 55)

Diagnoses ICD9 HCC

| ICD9 | Condition | Last Diagnosis | History |
|-------|--------------------------|----------------|--|
| 71596 | Osteoarthros Nos-L/Leg | 2009-09-23 | April 08, July 08, October 08, January 09, April 09, July 09 |
| V4365 | Joint Replaced Knee | 2009-09-23 | April 08, July 08, October 08, January 09, April 09, July 09 |
| 25000 | Dmii Wo Cmp Nt St Uncntr | 2009-08-14 | April 08, July 08, October 08, January 09, April 09, July 09 |
| 22800 | Hemangioma NOS | 2009-04-15 | April 08, July 08, October 08, January 09, April 09, July 09 |

Medications

| Ingredients | Dosage | Last Prescribed | History |
|-------------|--------|-----------------|--|
| Glyburide | 5MG | 2009-09-24 | April 08, July 08, October 08, January 09, April 09, July 09 |
| Niacin | 1000MG | 2009-09-22 | April 08, July 08, October 08, January 09, April 09, July 09 |
| Ibuprofen | 800MG | 2009-09-21 | April 08, July 08, October 08, January 09, April 09, July 09 |
| Simvastatin | 20MG | 2009-09-21 | April 08, July 08, October 08, January 09, April 09, July 09 |

Procedures

| CPT/... | Description | Last Performed | History |
|---------|------------------------------|----------------|--|
| 99213 | Office/outpatient visit, est | 2009-09-23 | April 08, July 08, October 08, January 09, April 09, July 09 |
| 99212 | Office/outpatient visit, est | 2009-08-24 | April 08, July 08, October 08, January 09, April 09, July 09 |
| 73560 | X-ray exam of knee, 1 or 2 | 2009-08-24 | April 08, July 08, October 08, January 09, April 09, July 09 |
| 83036 | Glycosylated hemoglobin test | 2009-08-14 | April 08, July 08, October 08, January 09, April 09, July 09 |

Lab Results

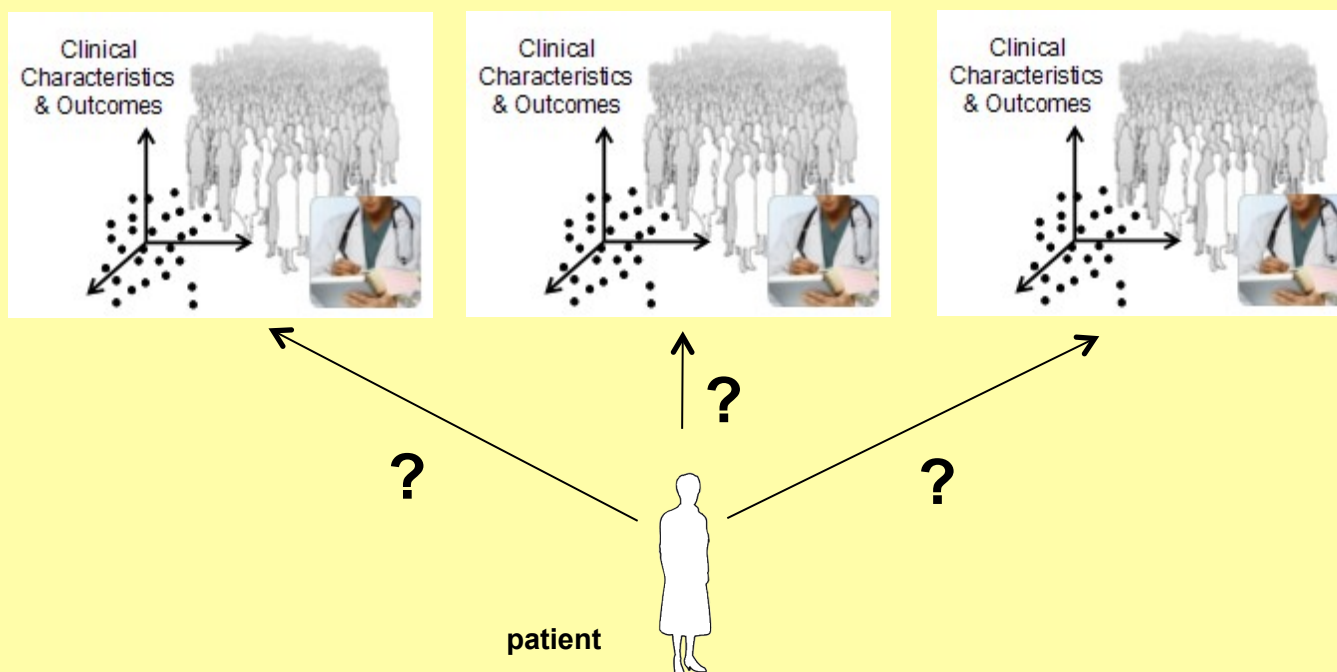
| Test | Last Result | Last Performed | History |
|----------|-------------|----------------|--|
| MALBRATI | 5.0 | 2008-06-27 | April 08, July 08, October 08, January 09, April 09, July 09 |
| CHOL/HDL | 6.3 | 2008-06-27 | April 08, July 08, October 08, January 09, April 09, July 09 |
| TRIG | 420.0 mg/dl | 2009-08-14 | April 08, July 08, October 08, January 09, April 09, July 09 |
| GLYCO | 7.0 % | 2009-08-14 | April 08, July 08, October 08, January 09, April 09, July 09 |

9/15/10

Physician Outcome Model

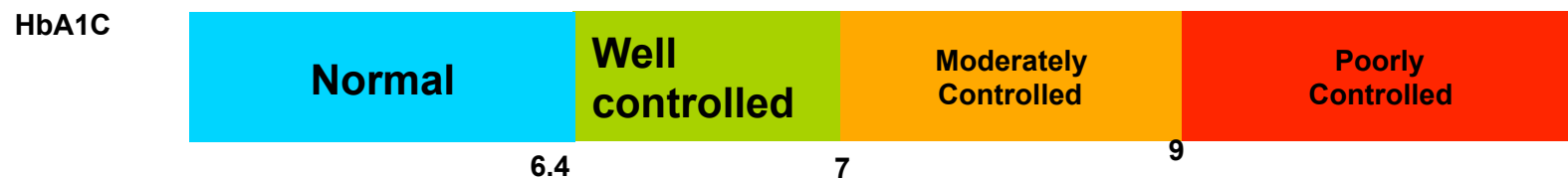
Objective: predict the likely outcome of a (patient, physician) pair based on population medical records, to provide decision support for physician referral and organizing physicians into collaborative pods

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



Problem Formulation

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

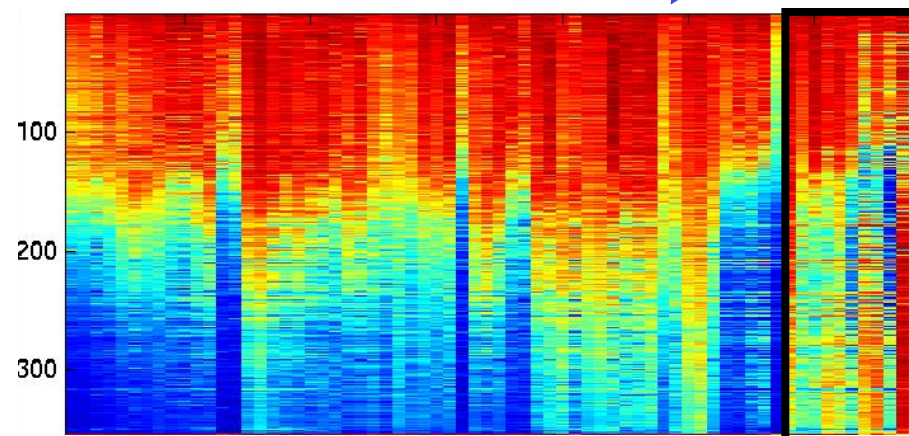


- Initial model focus:
 - Positive outcome: range change closer to normal
 - Negative outcome: range change further away from normal

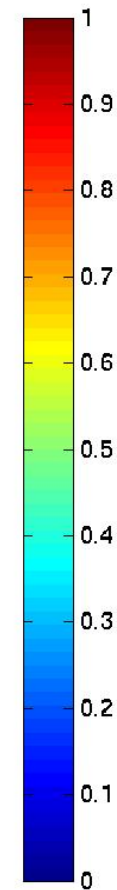
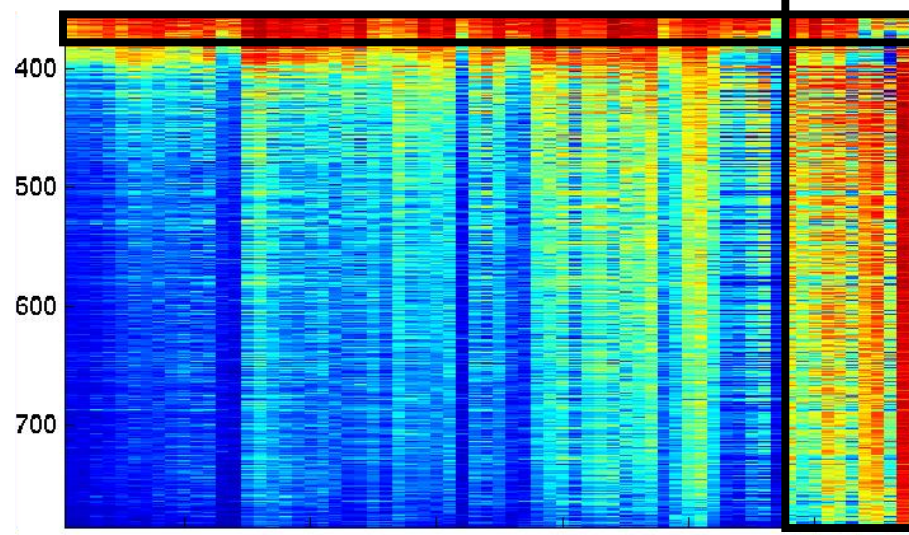
Using dataset with minimum 10 patients per physician

Predicted probability of good outcome for each (patient, physician) pair

Patients well managed by assigned physician



Patients suboptimally managed by assigned physician



Physicians

Physician referrals for 100256 - Mozilla Firefox: IBM Edition

File Edit View History Bookmarks Tools Help

http://localhost:8080/Sharp Demo/referral2.jsp?patient=100256

Most Visited IBM Lenovo ThinkPad W50... IBM

IBM Analytics for Collaborative Care Solution

[Change Patients](#)

Patient Summary

Similar Patients

Patient Referral

Patient: **100256**

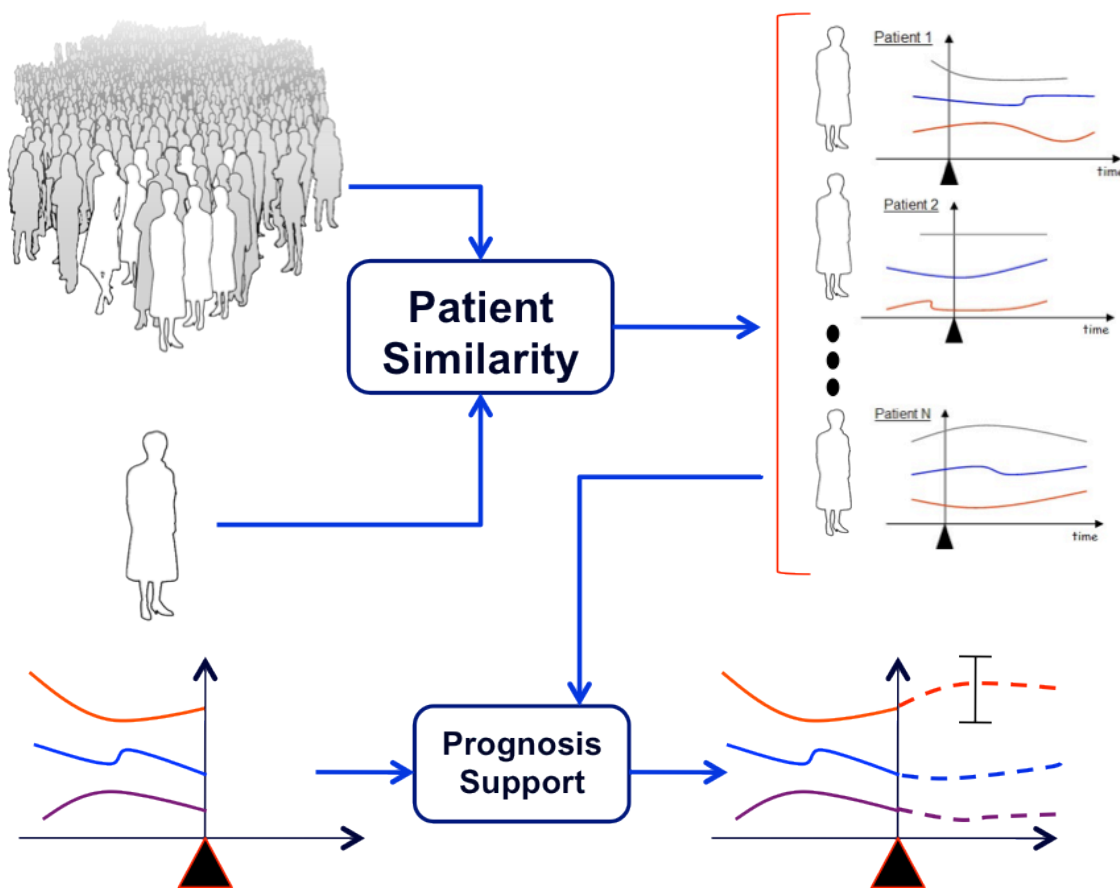
Sex: **Male**
Age: **50**
Location:

Required Specialty: **PCP**

| Rating | Physician | Office Location |
|--------|-----------|-----------------|
| | 18921 | |
| | 12488 | |
| | 13974 | |
| | 13158 | |
| | 17659 | |
| | 19931 | |
| | 12552 | |
| | 18060 | |
| | 20157 | |
| | 15424 | |
| | 19958 | |
| | 13253 | |
| | 18513 | |
| | 19684 | |
| | 18803 | |
| | 14216 | |
| | 13505 | |
| | 20578 | |
| | 18410 | |
| | 19925 | |
| | 10000 | |

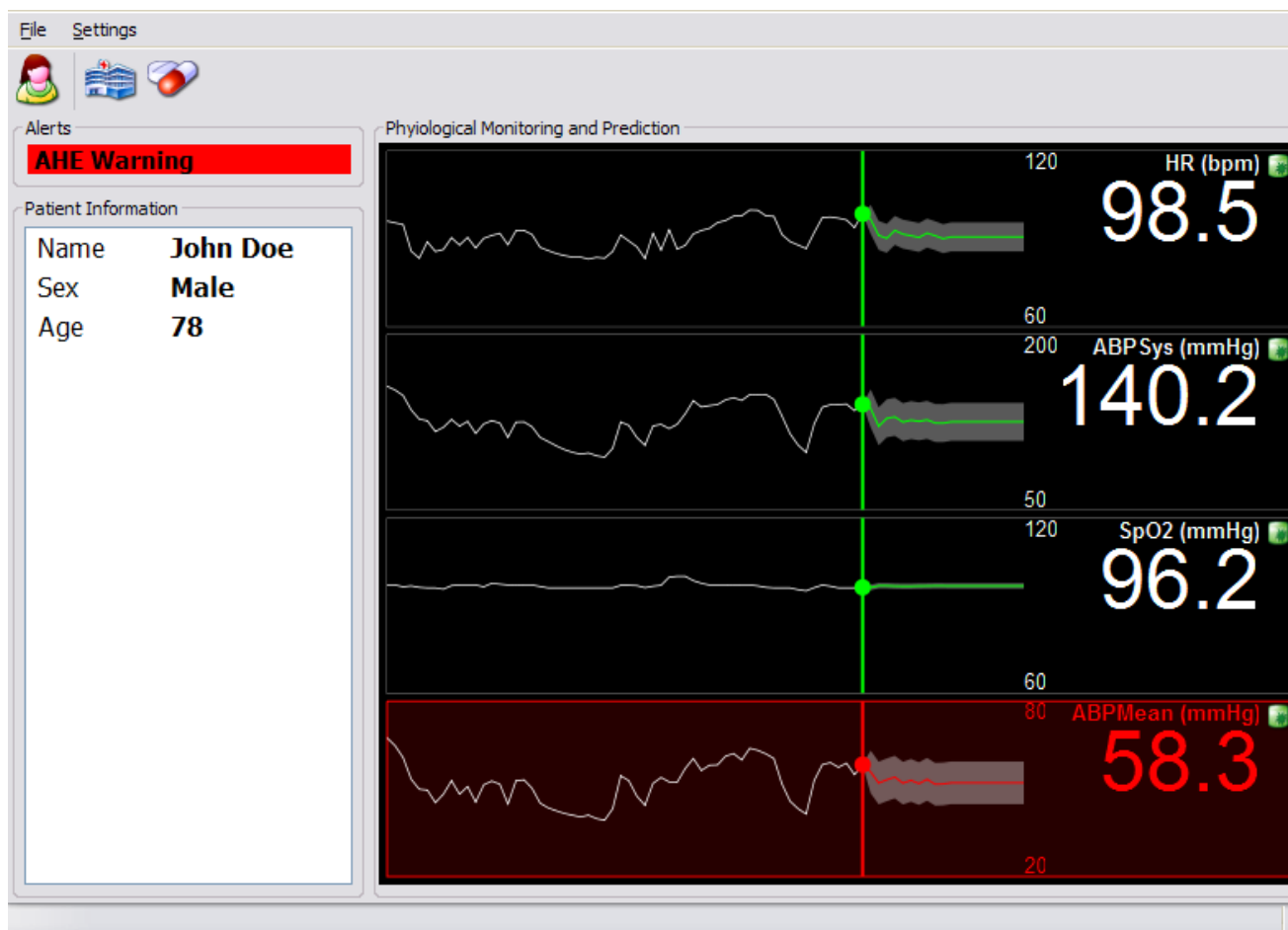
9/15/10

Patient Similarity for Near-Term Prognostication



- 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?

