HST.921 / HST.922 Information Technology in the Health Care System of the Future, Spring 2009
Harvard-MIT Division of Health Sciences and Technology
Course Directors: Dr. Steven Locke, Dr. Bryan Bergeron, Dr. Daniel Sands, and Ms. Mirena Bagur

The Future of HealthCare Information Technology

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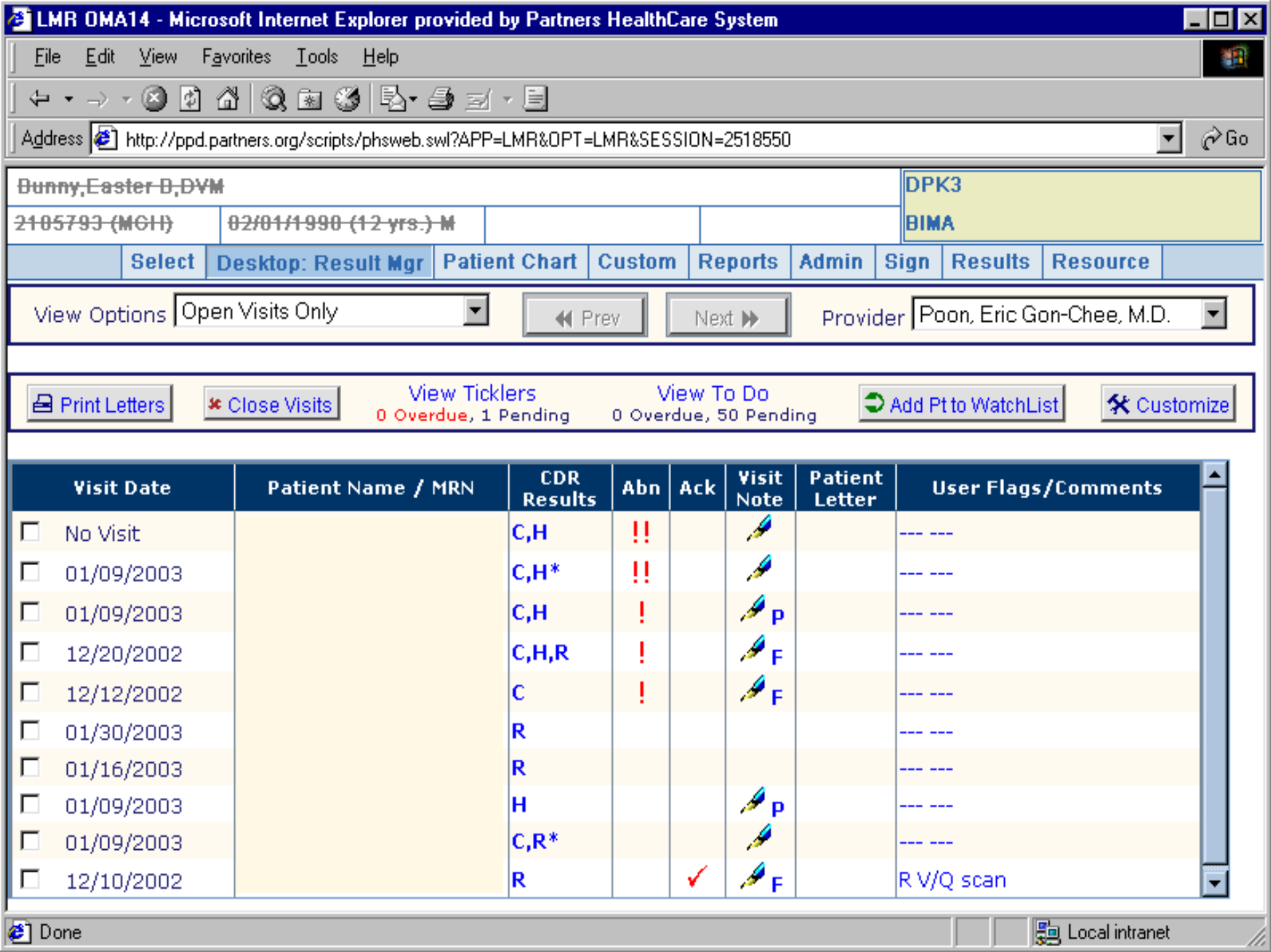
Three Major Components of the Future

- Interoperable electronic health records
- Personalized medicine
- Connected care

Scope of the Outpatient Care Problem

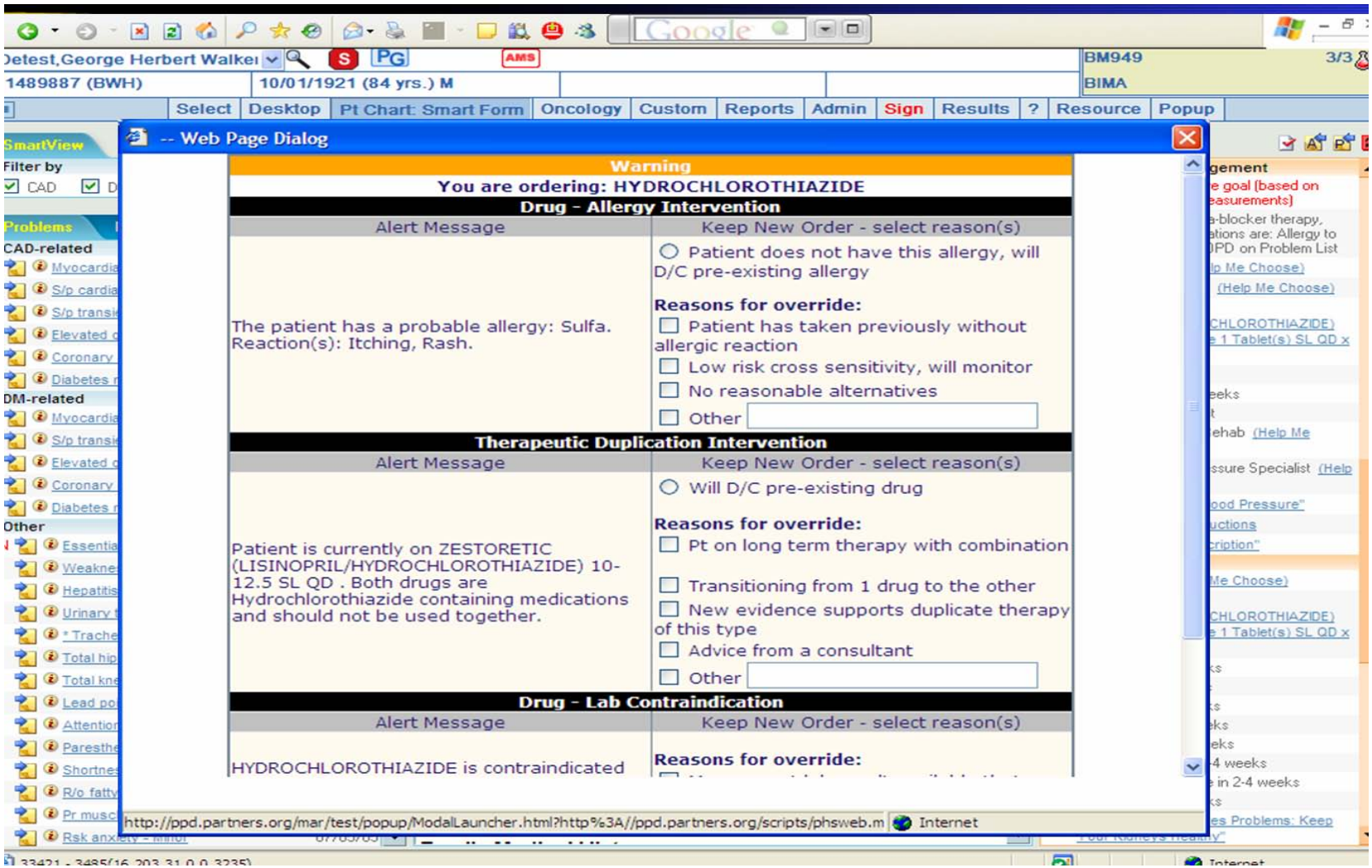
For Every:	There Appear to Be:
1000 patients coming in for outpatient care	14 patients with life-threatening or serious ADEs
1000 women with a marginally abnormal mammogram	360 who will not receive appropriate follow-up care
1000 patients who qualified for secondary prevention of high cholesterol	380 will not have a LDL-C, within 3 years, on record


LMR OMA14 - Microsoft Internet Explorer provided by Partners HealthCare System
File Edit View Favorites Tools Help
Address http://ppd.partners.org/scripts/phsweb.swl?APP=LMR&OPT=LMR&SESSION=2518550
Go
Bunny,Easter B,DVM
DPK3
2105793 (MGH)
02/01/1990 (12 yrs.) M
BIMA
Select
Desktop: Result Mgr
Patient Chart
Custom
Reports
Admin
Sign
Results
Resource
View Options
Open Visits Only
Prev
Next
Provider
Poon, Eric Gon-Chee, M.D.
Print Letters
Close Visits
View Ticklers
0 Overdue, 1 Pending
View To Do
0 Overdue, 50 Pending
Add Pt to WatchList
Customize
Visit Date
Patient Name / MRN
CDR Results
Abn
Ack
Visit Note
Patient Letter
User Flags/Comments
No Visit C,H !! --- ---
01/09/2003 C,H* !! --- ---
01/09/2003 C,H ! P --- ---
12/20/2002 C,H,R ! F --- ---
12/12/2002 C ! F --- ---
01/30/2003 R --- ---
01/16/2003 R --- ---
01/09/2003 H P --- ---
01/09/2003 C,R* --- ---
12/10/2002 R ✓ F R V/Q scan
Done
Local intranet

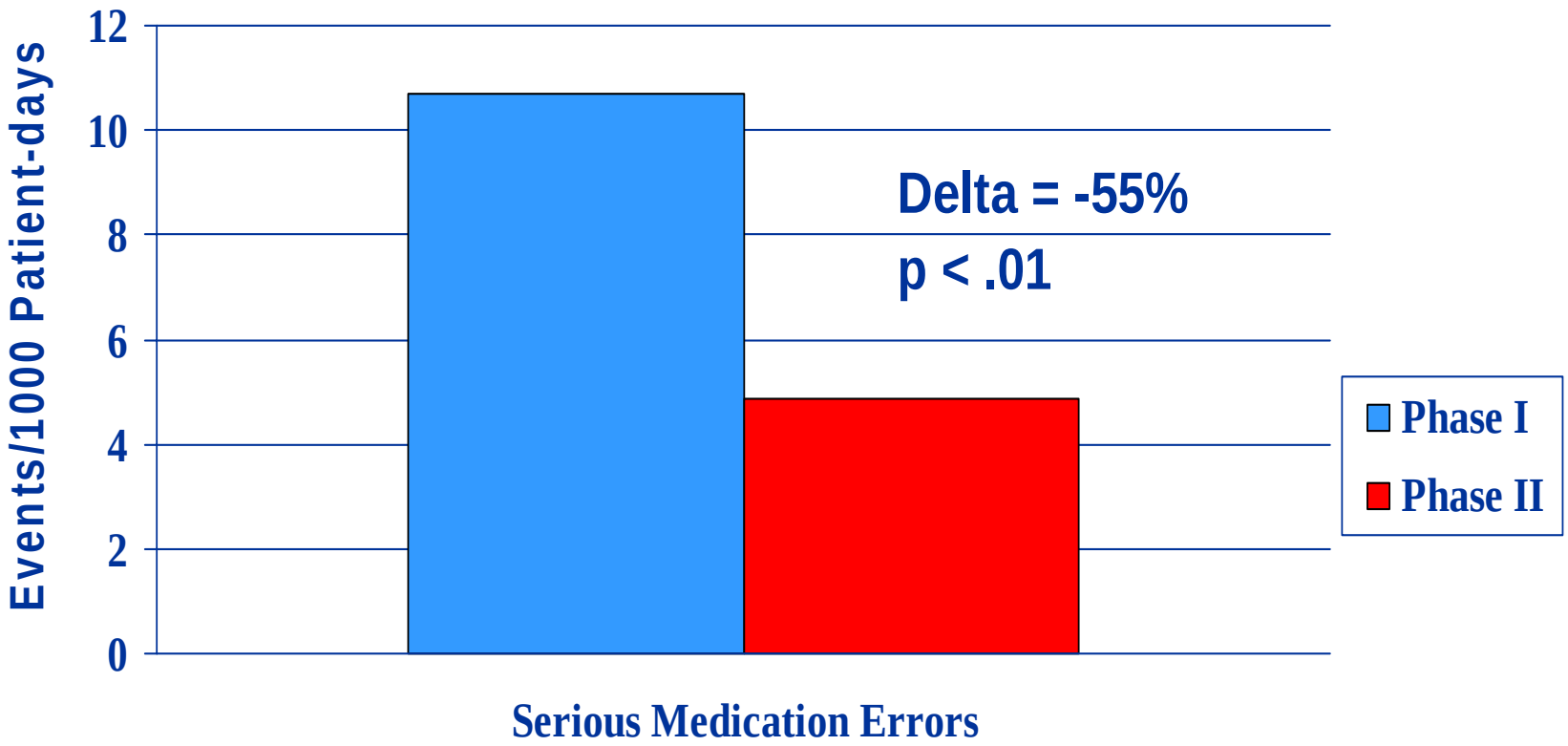
Impact of LMR Results Manager

Physician Users	355
Physician rating (1=Strongly agree, 5 = Strongly disagree) – care improvement	1.8
Physician rating – Reduce malpractice	2.1
Physician rating – Useful	1.9
Critically abnormal results highlighted per month	120
Sub-critical abnormal results highlighted per month	600

A Problematic Medication Order



Serious Medication Error Rates Before and After CPOE



Bates, Effect of Computerized Physician Order Entry and a Team Intervention on Prevention of Serious Medication Errors JAMA 1998.

The Impact of Clinical Data Exchanges Could be Significant

- Nationwide implementation of standardized healthcare information exchange could:
  - Save $337B over ten years
  - Achieve breakeven during year five of implementation
- At steady state, net benefit is estimated to be:

Providers	$34B	Radiology Centers	$8B
Payers	$22B	Pharmacies	$1B
Laboratories	$13B	Public Health	$0.1B

Source: Center for Information Technology Leadership, Partners HealthCare, 2004.

EHR Return on Investment

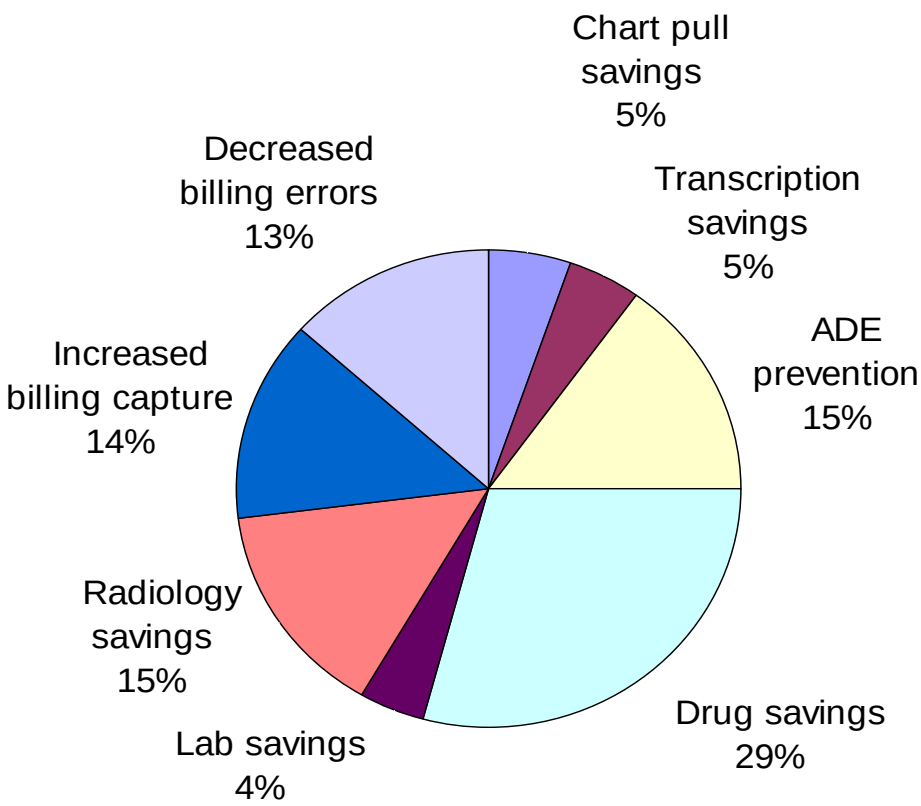
More Effective[1]	Year 1	Year 2	Year 3	Year 4	Year 5
EMR Investment	$40,700	$5,700	$5,700	$5,700	$5,700
Savings/Opportunities[2]	$11,498	$22,995	$22,995	$22,995	$22,995
Net	-$29,202	$17,295	$17,295	$17,295	$17,295
Cumulative Net	-$29,202	-$11,907	$5,388	$22,683	$39,978

Less Effective[1]	Year 1	Year 2	Year 3	Year 4	Year 5
EMR Investment	$40,700	$5,700	$5,700	$5,700	$5,700
Savings/Opportunities[2]	$6,325	$12,650	$12,650	$12,650	$12,650
Net	-$34,375	$6,950	$6,950	$6,950	$6,950
Cumulative Net	-$34,375	-$27,425	-$20,475	-$13,525	-$6,575

[1] More effective model uses top documented physician savings/opportunities; less effective model achieves least savings/opportunities

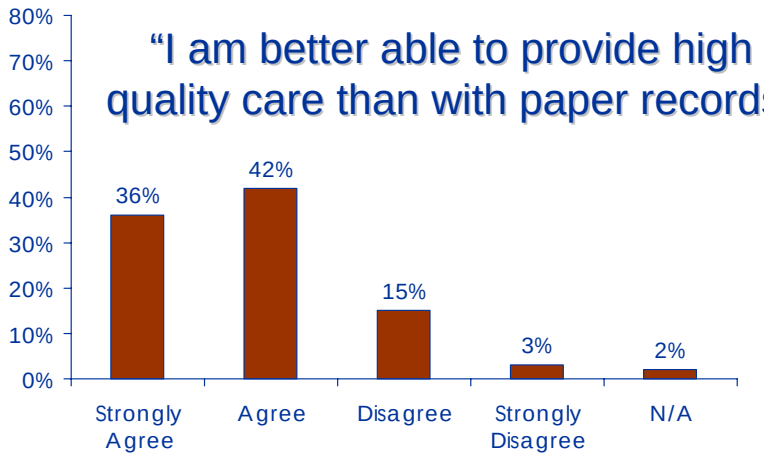
[2] Only half of benefits achieved in first year

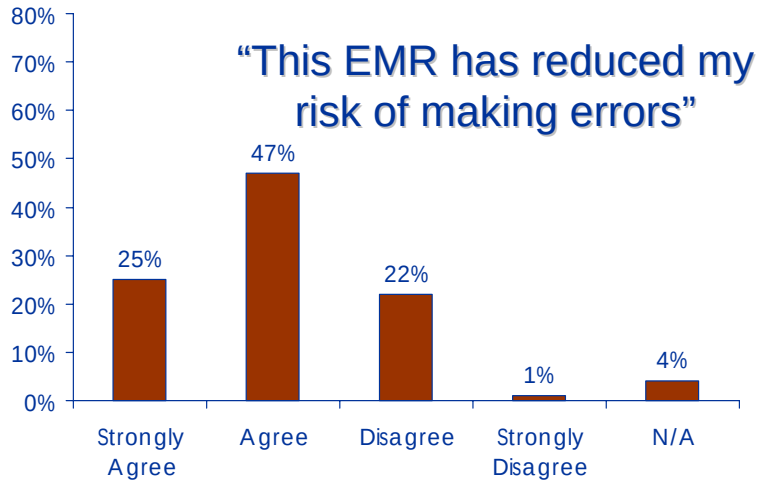
EHR Benefits

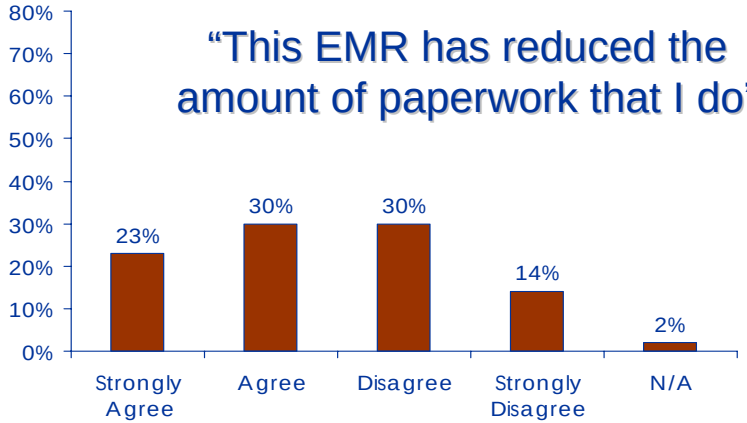


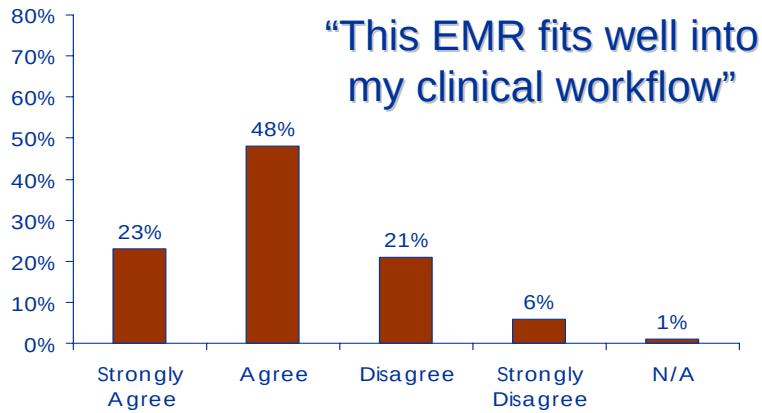
Wang, et. al. A Cost-Benefit Analysis for Ambulatory-Care Electronic Medical Records in Primary Care. American Journal of Medicine 2003

EHR Physician Satisfaction

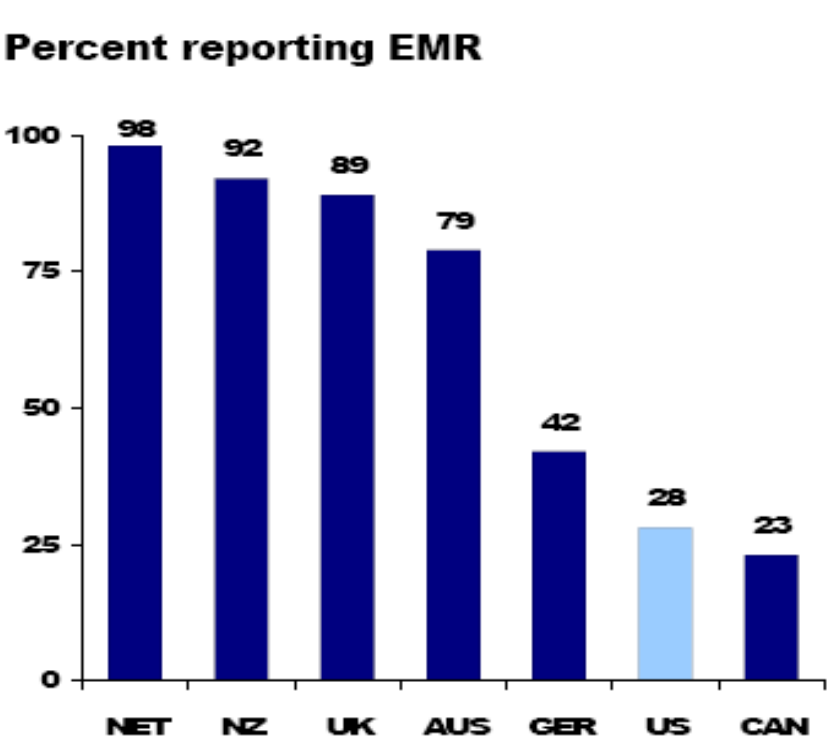


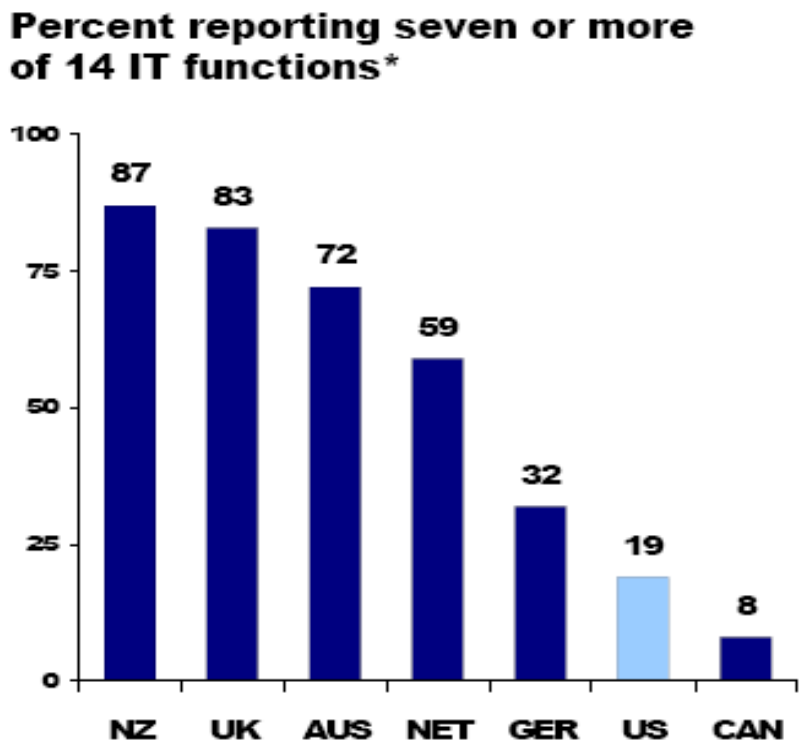






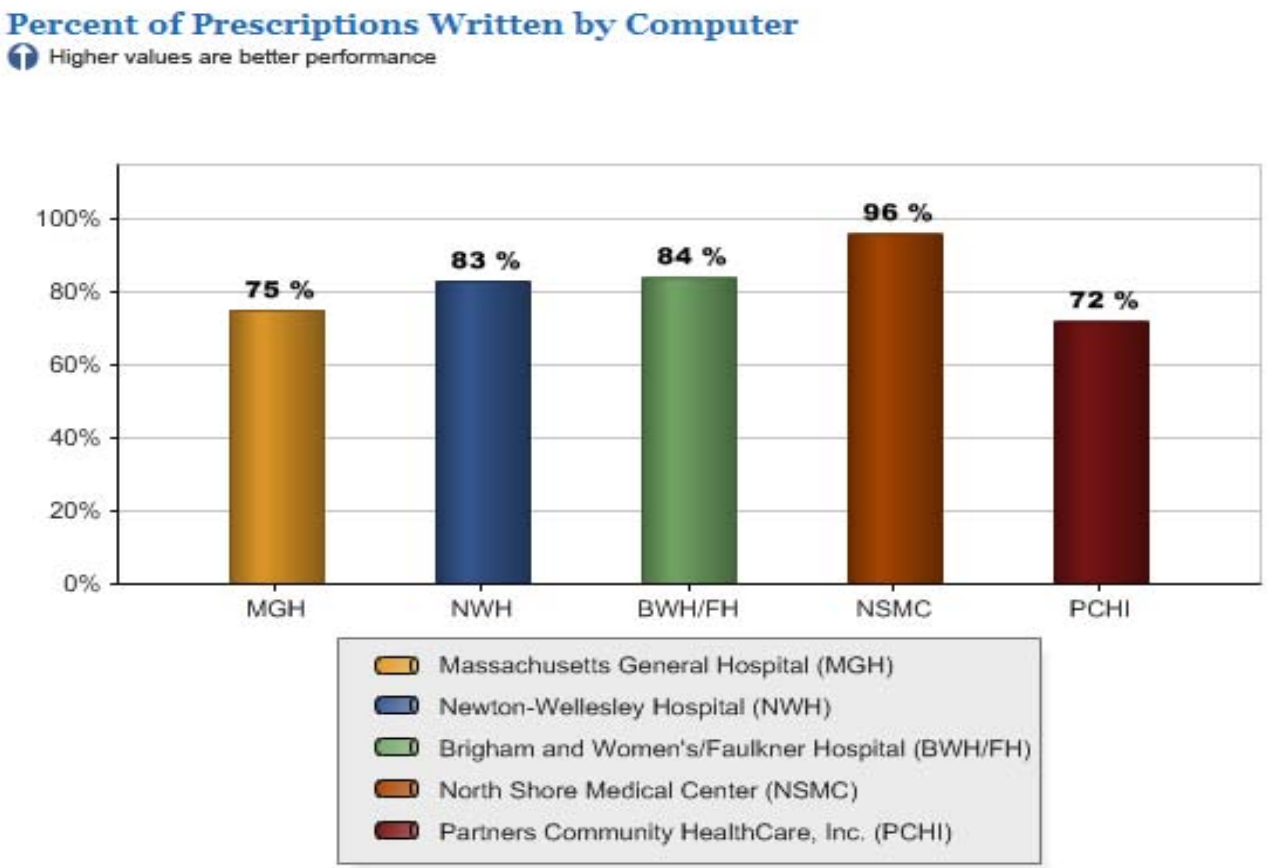
US EMR Adoption





* The 14 functions are: EMR, EMR access other doctors, outside office, patient; routine use electronic ordering tests, prescriptions, access test results, access hospital records; computer for reminders, Rx alerts, prompt test results; easy to list diagnosis, medications, patients due for care.
Source: Commonwealth Fund 2006 International Health Policy Survey of Primary Care Physicians.

Effectiveness of Use



Regional Interoperability Efforts are Struggling

The State Of Regional Health Information Organizations: Current Activities And Financing

Julia Adler-Milstein, Andrew P. McAfee, David W. Bates and Ashish K. Jha

Electronic clinical data exchange promises substantial financial and societal benefits, but it is unclear whether and when it will become widespread. In early 2007 we surveyed 145 regional health information organizations (RHIOs), the U.S. entities working to establish data exchange. Nearly one in four was likely defunct. Only twenty efforts were of at least modest size and exchanging clinical data. Most early successes involved the exchange of test results. To support themselves, thirteen RHIOs received regular fees from participating organizations, and eight were heavily dependent on grants. Our findings raise concerns about the ability of the current approach to achieve widespread electronic clinical data exchange.

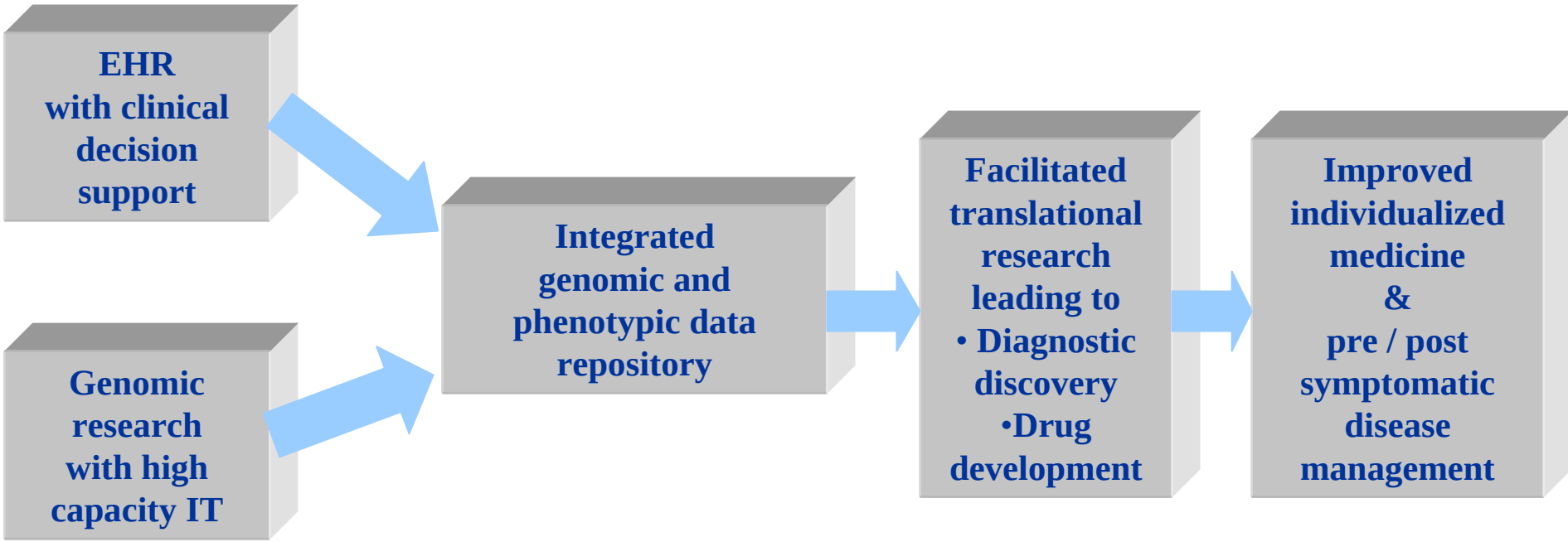
American Recovery and Reinvestment Act of 2009

- $31B in physician and hospital financial incentives for EHR adoption
  - $40K to $60K/physician
  - $2M-$11M/hospital
- Incentives require “meaningful use”
  - ePrescribing
  - Clinical data exchange
  - Quality measures reporting
- $300M for states to develop interoperability and adoption plans
- Loans/grants for physicians to cover EHR costs
- Health Information Extension Program to provide adoption assistance for small physician practices and hospitals

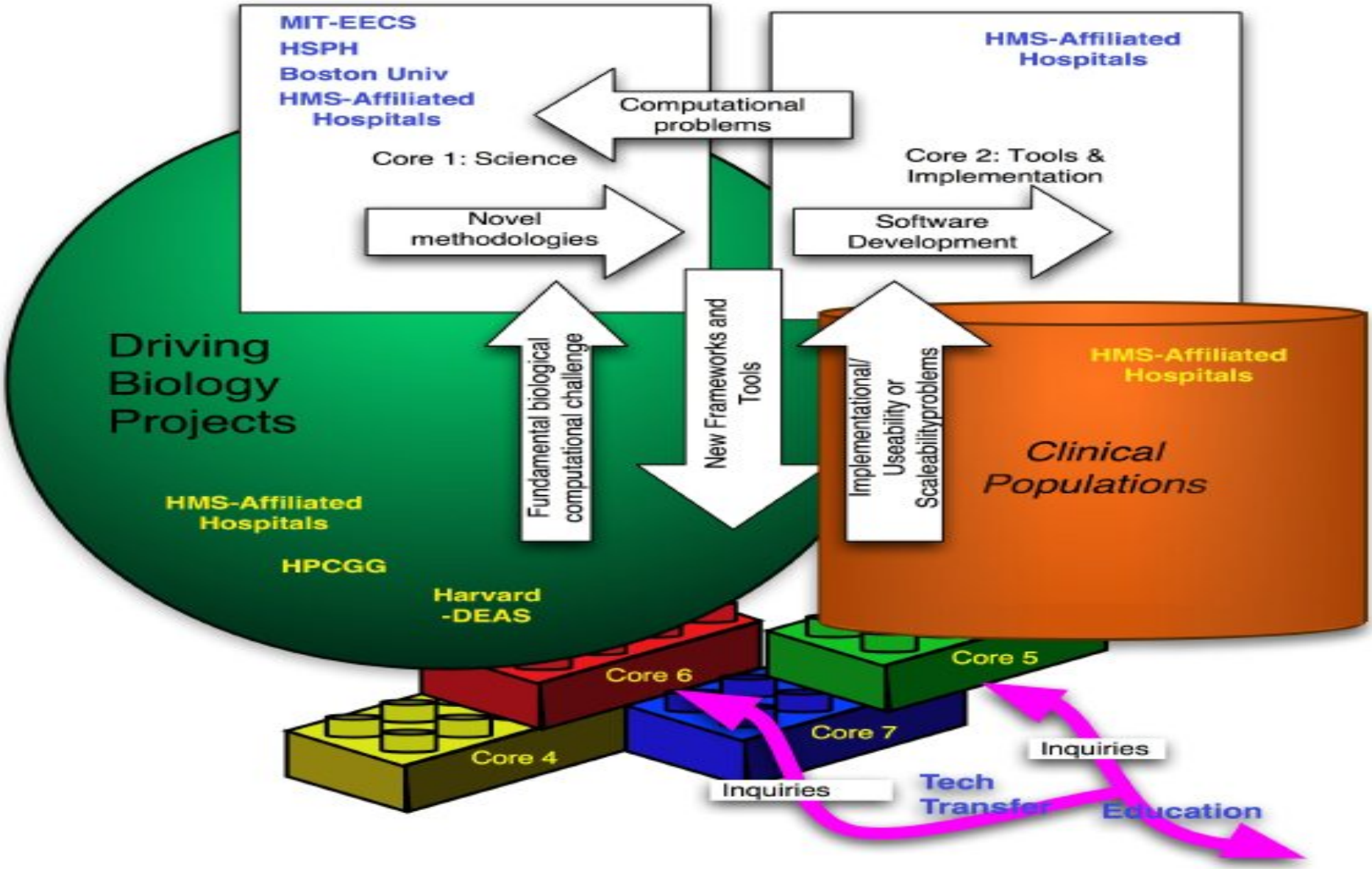
Clinical and Research Questions

- Research
  - Why do some patients with asthma respond to steroid treatment while others do not?
  - Why does a mutation in Huntington's gene cause a lethal defect?
  - Why do some patients with diabetes have few complications even with "poor" control whereas others with good control have severe complications?
- Clinical
  - Can I lower my cholesterol by diet alone of should I start on an anti-cholesterol drug now?
  - Will a third line anti-cancer drug be more effective as a first line drug with a patient with lung cancer?

A Vision for Personalized Medicine



Informatics for Integrating Biology and the Bedside (I2B2)

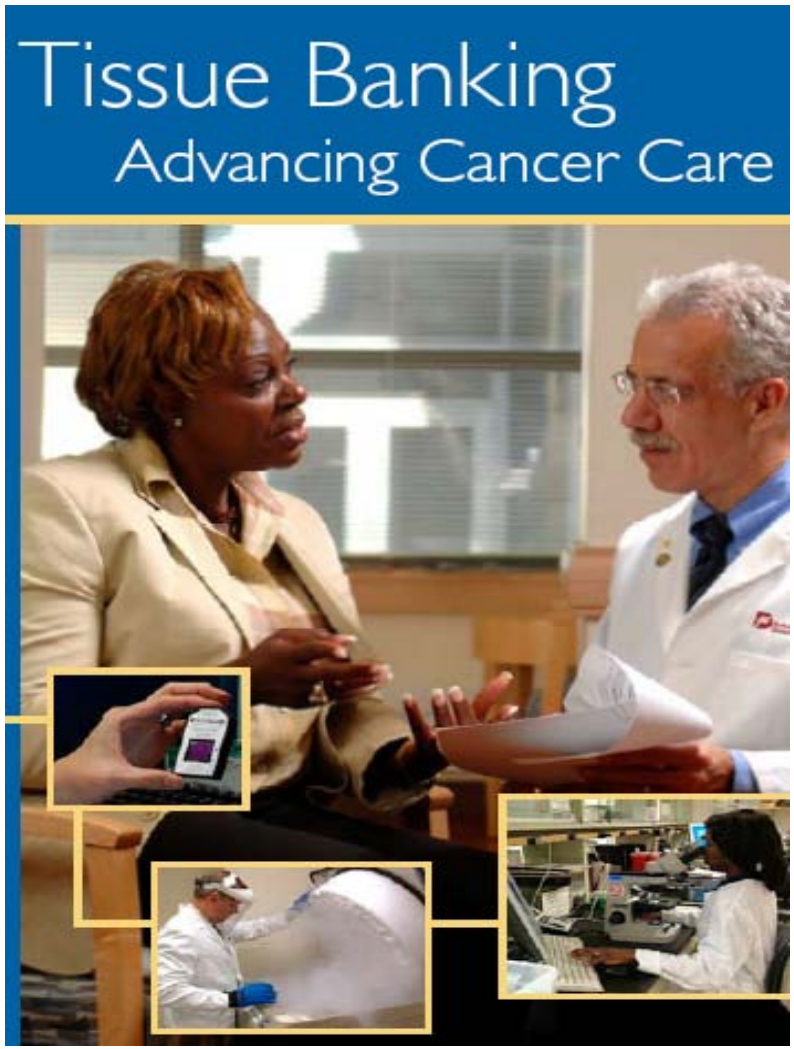


i2b2 Hive


Project Management
File Repository
Natural Language Processing
De - Identification of Data
Annotating Genomic Data #2
Ontology Management
Identity Management
PFT Processing
Data Repository (CRC)
Workflow Framework
Annotating Genomic Data #1
Correlation Analysis
Annotating Imaging Data

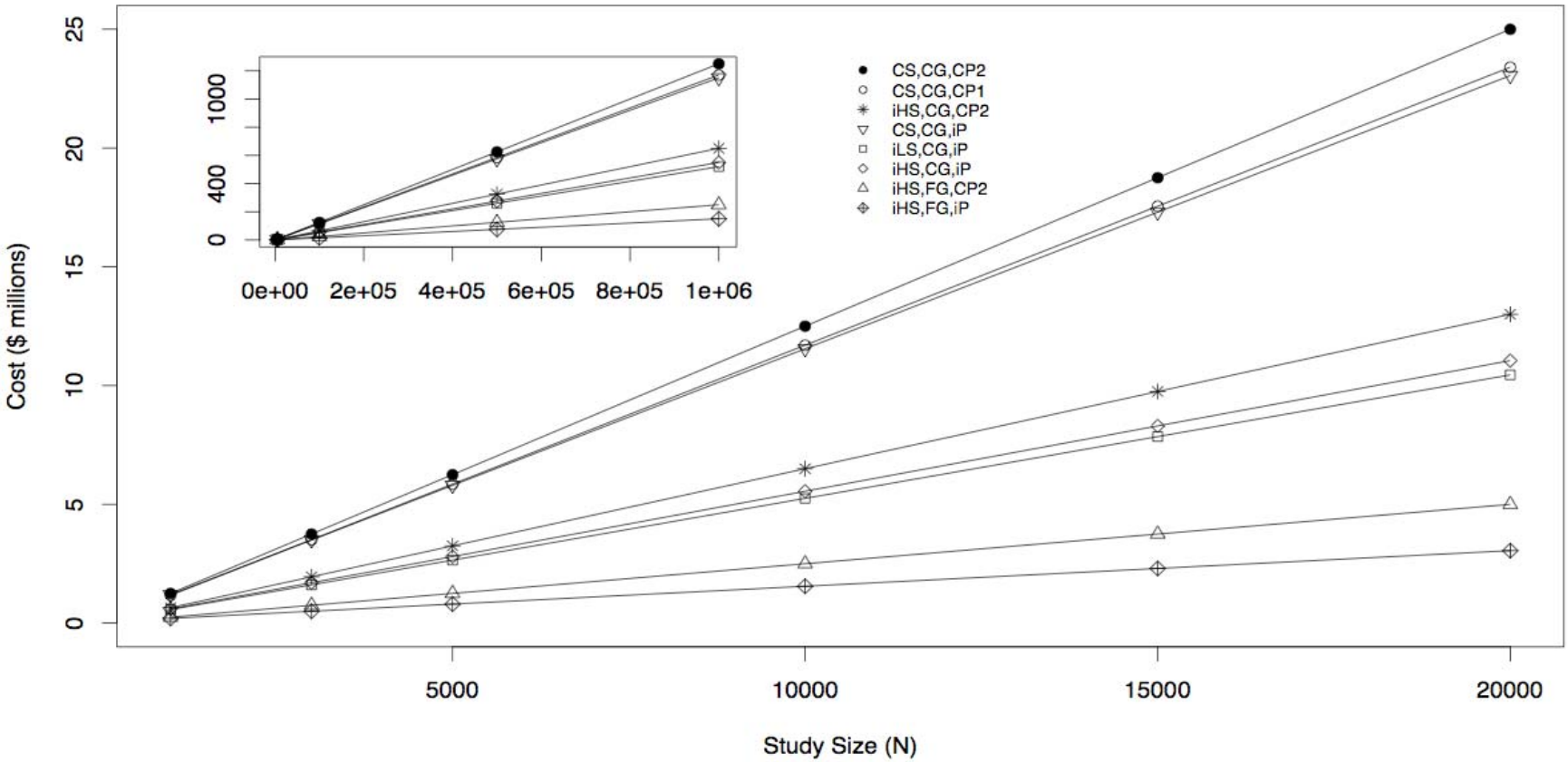
Extraction of Structure from Notes

Tissue Sample Collection



Courtesy of Dana-Farber Cancer Institute. Used with permission.

Costs of “High Throughput” Clinical Research



Post Market Medication Surveillance

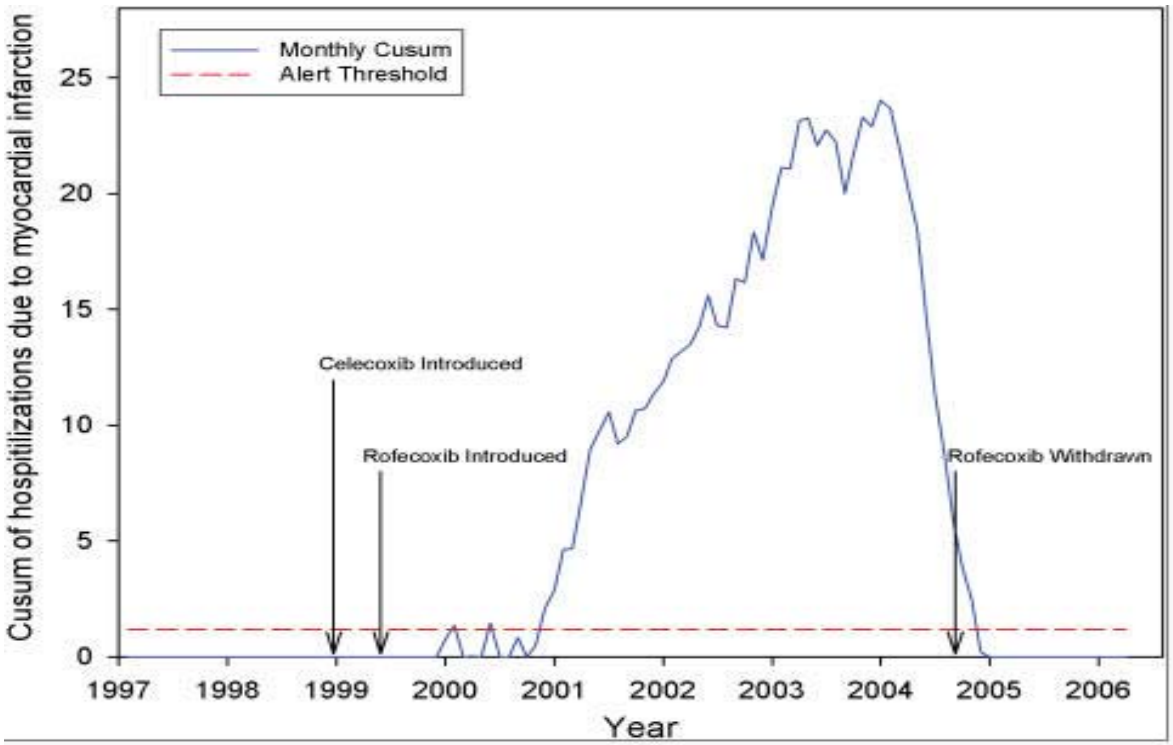
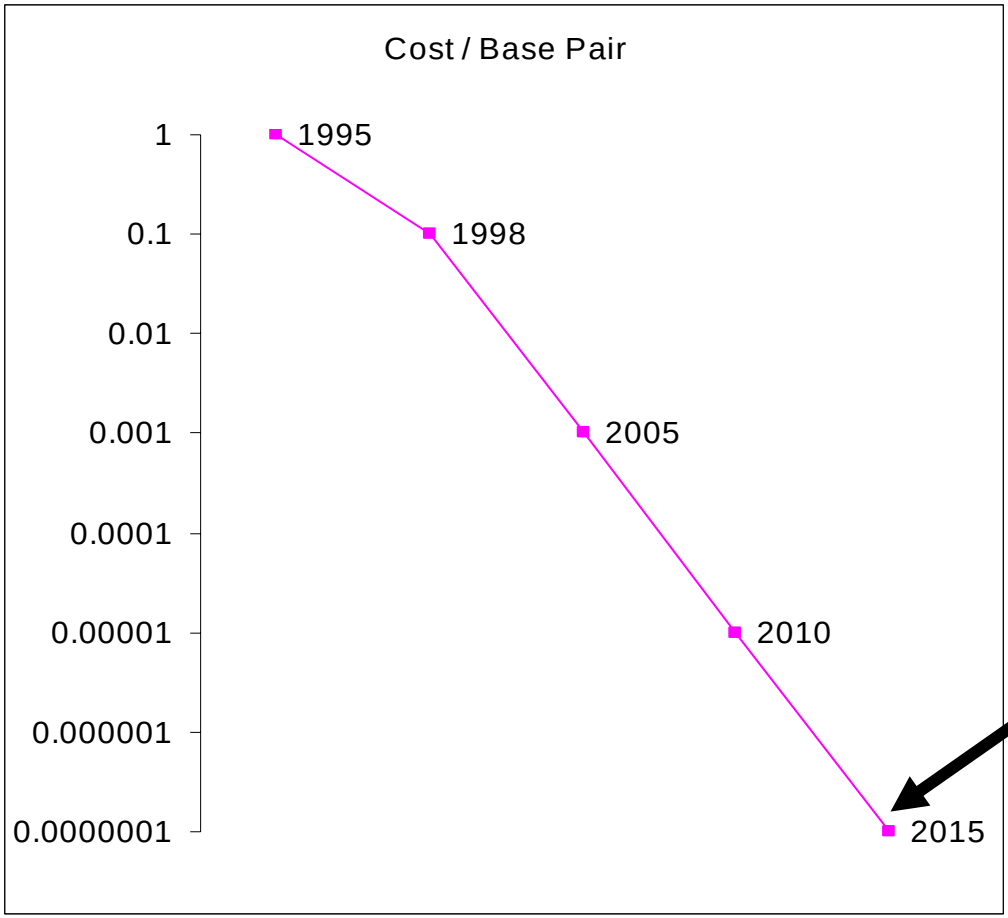


Figure 1

Cumulative sum (CUSUM) chart of monthly incidence of hospitalizations due to myocardial infarction from January 1, 1997 to March 30, 2006.

Source: Brownstein, J. S. et al. "The Tell-Tale Heart: Population-Based Surveillance Reveals an Association of Rofecoxib and Celecoxib with Myocardial Infarction." *PLoS ONE* 2(9): e840. doi:10.1371/journal.pone.0000840.

Underlying Drivers Point to Accelerated Growth



Images removed due to copyright restrictions:

Cover of *Nature* 437 (27 October 2005): "The HapMap Project."

Photo of a gene chip device.

Values in chart are approximately sourced from: Chan, E. Y. "Advances in sequencing technology." *Mutation Research* 57 (2005): 13-40.

Significant Growth in Genetic Tests

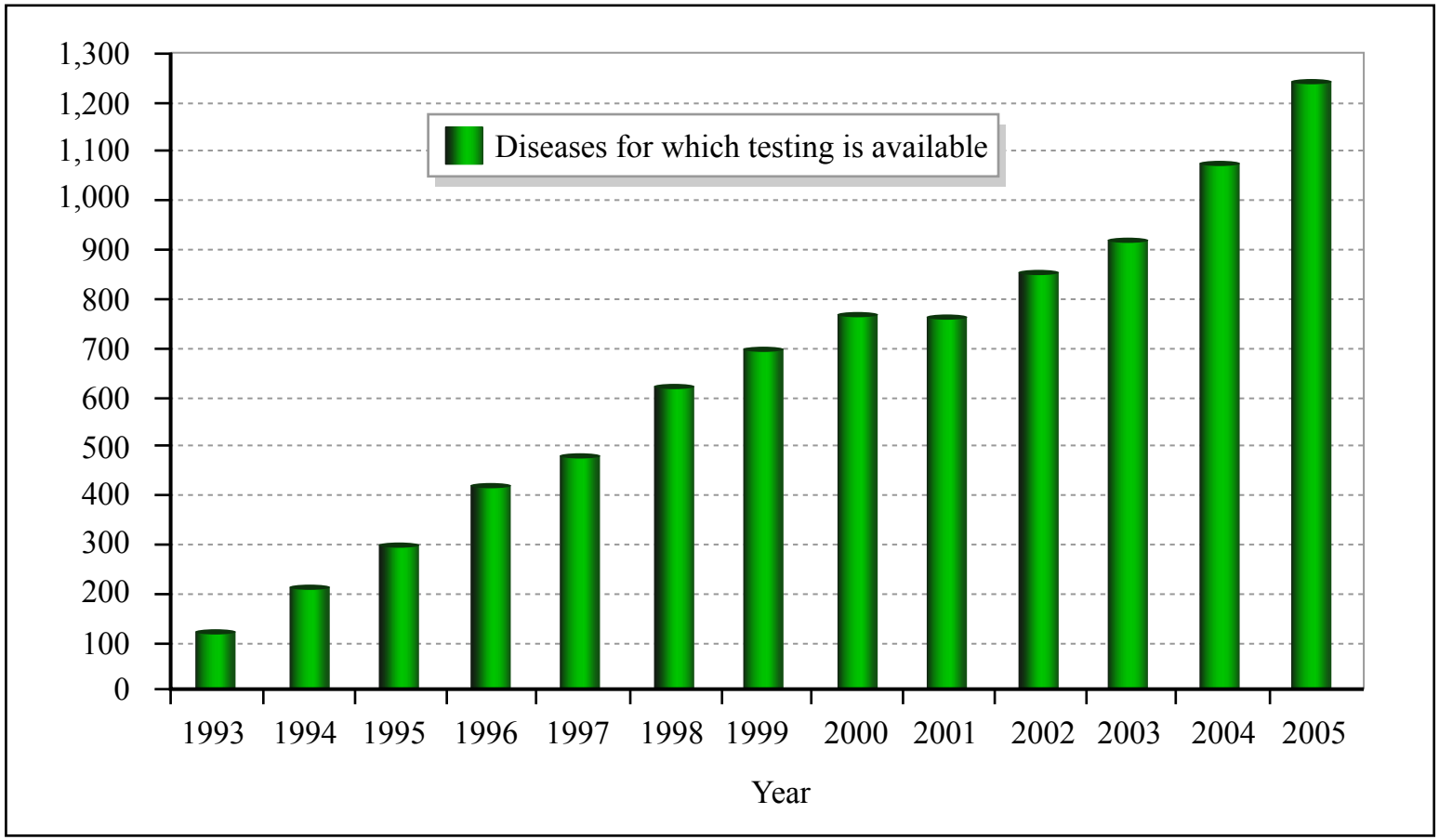
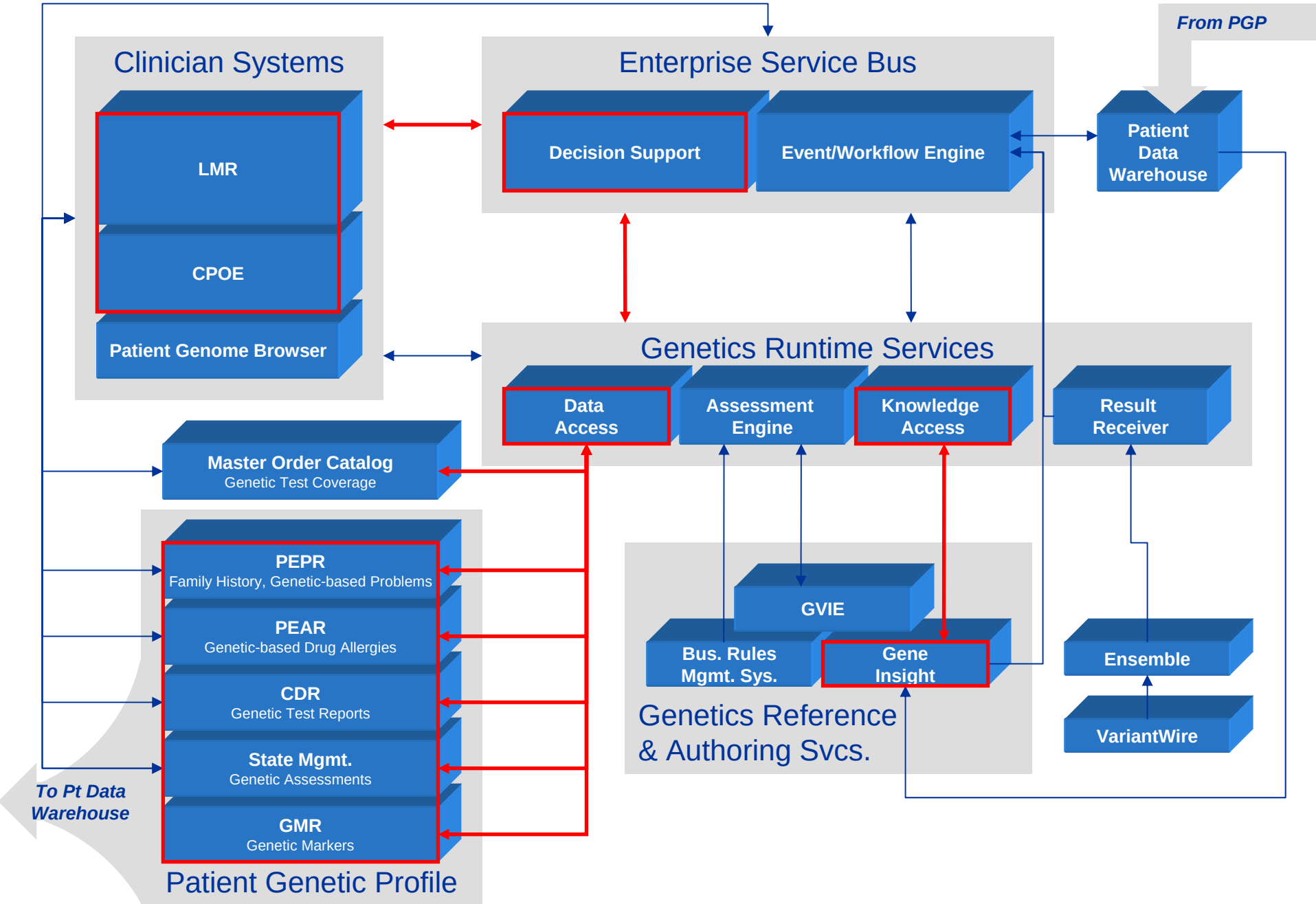


Figure by MIT OpenCourseWare. See Hudson, K., et al. "Oversight of US Genetic Testing Laboratories." *Nature Biotechnology* 24 (2006): 1083-1090.

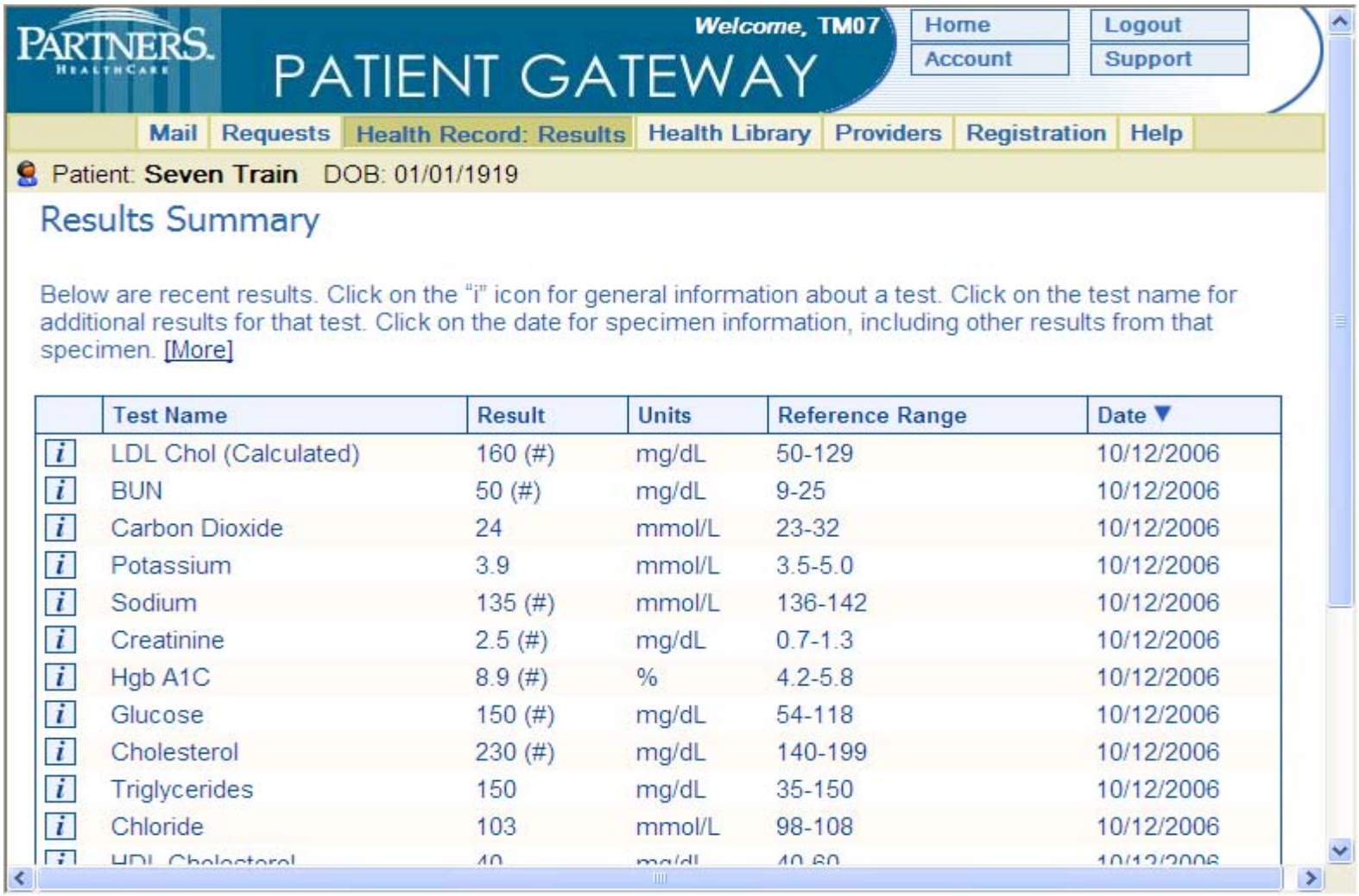
Data from Gene Tests database, 2005, http://www.genetests.org.


From PGP
Clinician Systems
LMR
CPOE
Patient Genome Browser
Enterprise Service Bus
Decision Support
Event/Workflow Engine
Patient Data Warehouse
Genetics Runtime Services
Data Access
Assessment Engine
Knowledge Access
Result Receiver
Master Order Catalog
Genetic Test Coverage
PEPR
Family History, Genetic-based Problems
PEAR
Genetic-based Drug Allergies
CDR
Genetic Test Reports
State Mgmt.
Genetic Assessments
GMR
Genetic Markers
Patient Genetic Profile
To Pt Data Warehouse
GVIE
Bus. Rules Mgmt. Sys.
Gene Insight
Genetics Reference & Authoring Svcs.
Ensemble
VariantWire

Personalized Medicine Adoption Challenges

- Medical science
- Clinical guidelines
- Retrofitting electronic health records
- Reimbursement
- Provider/patient education
- Privacy

Access to Your Medical Record



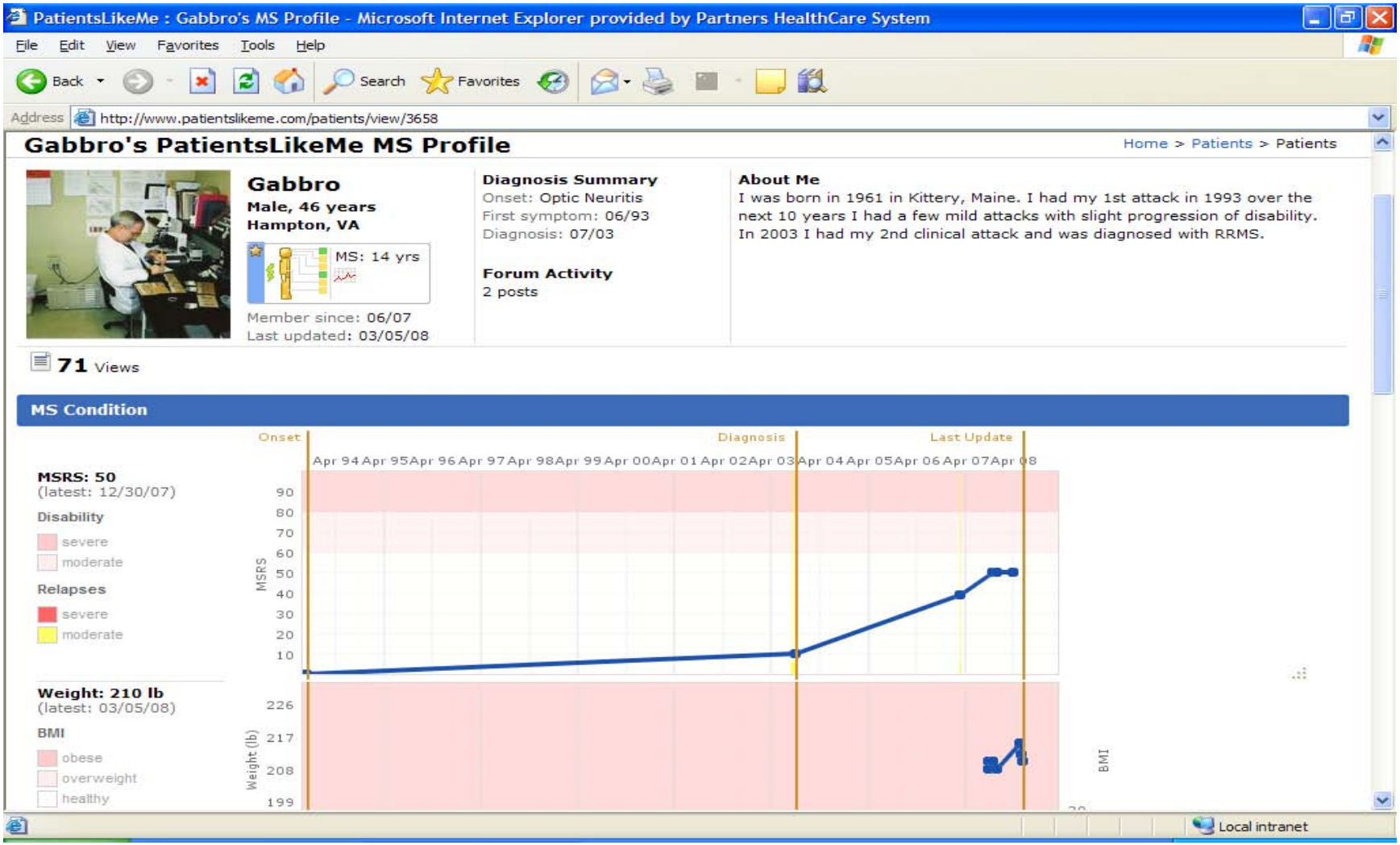
	Test Name	Result	Units	Reference Range	Date ▼
i	LDL Chol (Calculated)	160 (#)	mg/dL	50-129	10/12/2006
i	BUN	50 (#)	mg/dL	9-25	10/12/2006
i	Carbon Dioxide	24	mmol/L	23-32	10/12/2006
i	Potassium	3.9	mmol/L	3.5-5.0	10/12/2006
i	Sodium	135 (#)	mmol/L	136-142	10/12/2006
i	Creatinine	2.5 (#)	mg/dL	0.7-1.3	10/12/2006
i	Hgb A1C	8.9 (#)	%	4.2-5.8	10/12/2006
i	Glucose	150 (#)	mg/dL	54-118	10/12/2006
i	Cholesterol	230 (#)	mg/dL	140-199	10/12/2006
i	Triglycerides	150	mg/dL	35-150	10/12/2006
i	Chloride	103	mmol/L	98-108	10/12/2006
i	HDL Cholesterol	40	mg/dL	40-60	10/12/2006

Courtesy of American TeleCare. Used with permission.

Dermatology e-Visit

Screenshot and photo of RelayHealth® removed due to copyright restrictions. See http://www.relayhealth.com.

Web 2.0 Patient Communities



Courtesy of PatientsLikeMe. Used with permission.

Summary

- Responding to the needs of the healthcare sector will require that we focus on the following IT capabilities:
  - Interoperable electronic health records
  - Personalized medicine
  - Connected care
- We have some challenges and issues to address. However, the progress of the last five years should encourage us.

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