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

John P. Glaser, PhD Vice President and CIO Partners HealthCare

March 5, 2009

# 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 14 patients with life-threatening or serious ADEs outpatient care

1000 women with a marginally360 who will not receive appropriate follow-upabnormal mammogramcare

1000 patients who qualified for 380 will not have a LDL-C, within 3 years, on secondary prevention of high record cholesterol

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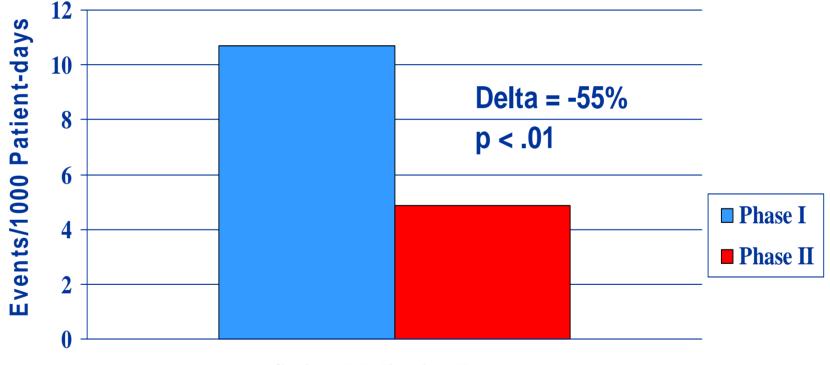
# Impact of LMR Results Manager

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

etest,George He	rbert Walker v Q S PG AMS		BM949 3/3
1489887 (BWH)	10/01/1921 (84 yrs.) M		BIMA
1	Select Desktop Pt Chart: Smart Form Oncology	Custom Reports Admin Sign Results ? R	esource Popup
imattView 2	Web Page Dialog		🛛 र को हो
ilter by	W	larning	gement
CAD D		YDROCHLOROTHIAZIDE	e goal (based on
		rgy Intervention	easurements)
roblems I	Alert Message	Keep New Order - select reason(s)	a-blocker therapy, ations are: Allergy to
AD-related		O Patient does not have this allergy, will	JPD on Problem List
🕢 🛞 <u>Myocardia</u>		D/C pre-existing allergy	Ip Me Choose)
S/p cardia			(Help Me Choose)
S/p transie		Reasons for override:	
Elevated o	The patient has a probable allergy: Sulfa.	Patient has taken previously without	CHLOROTHIAZIDE) = 1 Tablet(s) SL QD x
Coronary	Reaction(s): Itching, Rash.	allergic reaction	e i rabielle/ SE QD X
Diabetes r		Low risk cross sensitivity, will monitor	
M-related		No reasonable alternatives	eeks
Myocardia		Other	t t
S/p transie	Therapeutic Dur	plication Intervention	lehab <u>(Help Me</u>
Elevated c	Alert Message	Keep New Order - select reason(s)	ssure Specialist (Help
Coronary		O Will D/C pre-existing drug	ssure specialist (neip
Diabetes n		O win b/c pre-existing drug	ood Pressure"
ther		Reasons for override:	uctions
😢 🕑 Essentia	Patient is currently on ZESTORETIC	Pt on long term therapy with combination	cription"
😧 🛞 Weakne	(LISINOPRIL/HYDROCHLOROTHIAZIDE) 10-		
2 (2) Hepatitis	12.5 SL QD . Both drugs are	Transitioning from 1 drug to the other	Me Choose)
2 @ Urinary t	Hydrochlorothiazide containing medications and should not be used together.	New evidence supports duplicate therapy	CHLOROTHIAZIDE)
2 @ * Trache	and should not be used together.	of this type	a 1 Tablet(s) SL QD x
Total hip		Advice from a consultant	
2 3 Total kne		Other	(S
Lead pol	Drug - Lab	Contraindication	
Attention	Alert Message	Keep New Order - select reason(s)	ts eks
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	HYDROCHLOROTHIAZIDE is contraindicated	Reasons for override:	-4 weeks
Paresthe			in 2-4 weeks
🐮 🙆 <u>Paresthe</u>	INTOKOCHLOKOTHIAZIDE IS contraindicated		e in Z-4 Weeks
	INTERCORDOROTHIAZIDE IS CONTraindicated		s in 2-4 weeks

## Serious Medication Error Rates Before and After CPOE



**Serious Medication Errors** 

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**

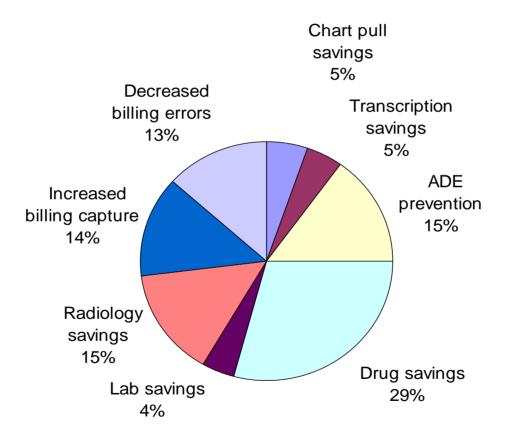
More Effective <sup>1</sup>	Year 1	Year 2	Year 3	Year 4	Year 5
EMR Investment	\$40,700	\$5,700	\$5,700	\$5,700	\$5,700
Savings/Opportunities <sup>2</sup>	\$11,498	\$22,995	\$22,995	\$22,995	\$22,995
Net	-\$29,202	\$17,295	\$17,295	\$17,295	\$17,295
Cumulative Net	-\$29,202	-\$11,907	\$5,388	\$22,683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

Less Effective <sup>1</sup>	Year 1	Year 2	Year 3	Year 4	Year 5
EMR Investment	\$40,700	\$5,700	\$5,700	\$5,700	\$5,700
Savings/Opportunities <sup>2</sup>	\$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

<sup>1</sup> More effective model uses top documented physician savings/opportunities; less effective model achieves least savings/opportunities

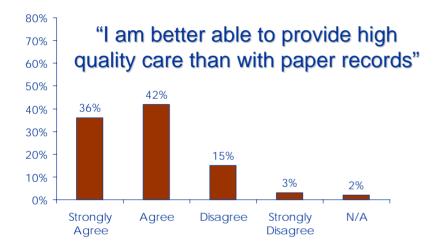
<sup>2</sup> Only half of benefits achieved in first year

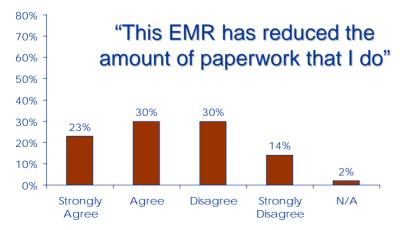
### **EHR Benefits**

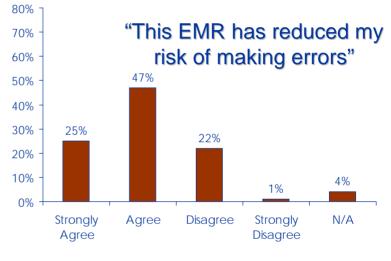


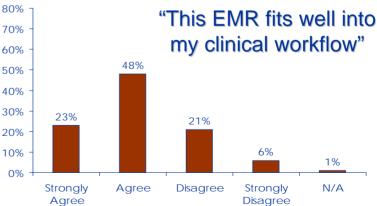
Wang, et. al. A Cost-Benefit Analysis for Ambulatory-Care Electronic Medical Records in Primary Care. American Journal of Medicine 2003

### **EHR Physician Satisfaction**

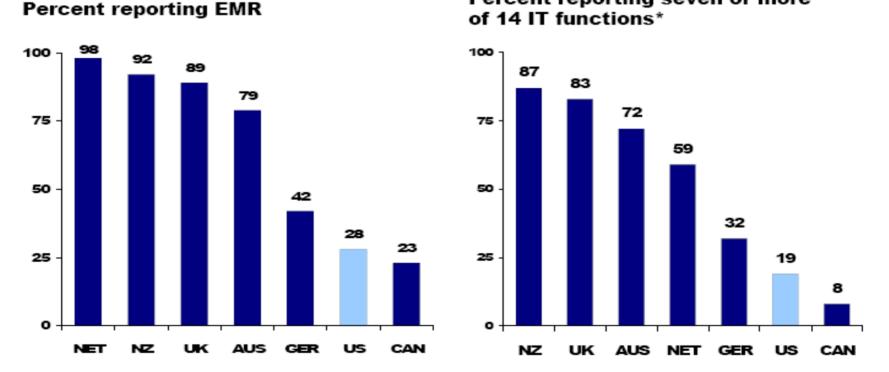








# **US EMR Adoption**



\* 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.

Courtesy of The Commonwealth Fund. Used with permission.

Percent reporting seven or more

### **Effectiveness of Use**

#### Percent of Prescriptions Written by Computer

96 % 100% 84 % 83 % 75 % 80% 72 % 60% 40% 20% 0% PCHI MGH NWH BWH/FH NSMC Massachusetts General Hospital (MGH) Newton-Wellesley Hospital (NWH) Brigham and Women's/Faulkner Hospital (BWH/FH) North Shore Medical Center (NSMC) Partners Community HealthCare, Inc. (PCHI)

Higher values are better performance

# 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

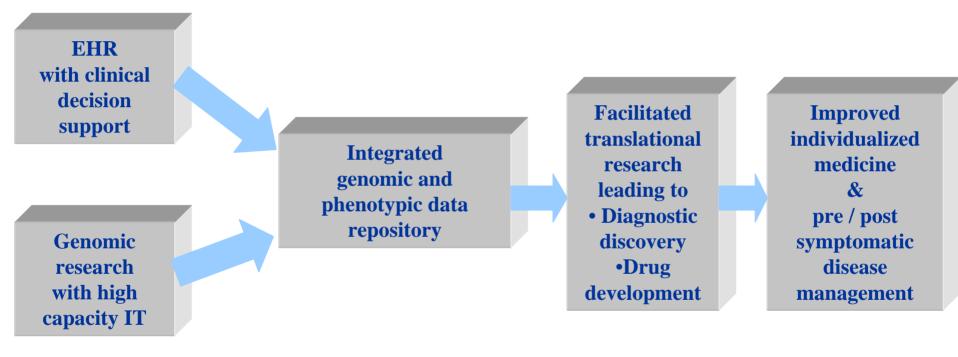
- \$31B in physician and hospital financial incentives for EHR adoption
  - \$40K to \$60K/physician
  - \$2M-\$11M/hospital
- Incentives require "meaningful use"
  - ePrescribing
  - Clinical data exchange
  - Quality measures reporting
- \$300M for states to develop interoperability and adoption plans
- 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**

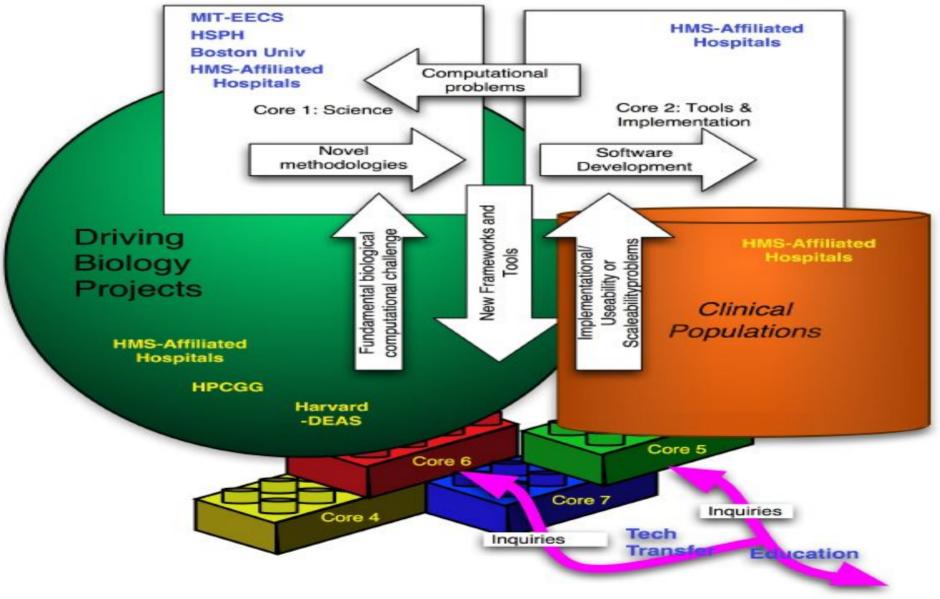
#### Research

- 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?

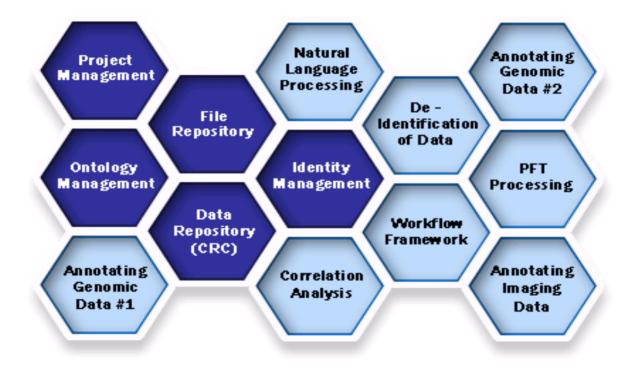
### **A Vision for Personalized Medicine**



## Informatics for Integrating Biology and the Bedside (I2B2)



#### i2b2 Hive



# Extraction of Structure from Notes

Errogrammer's file Editor - [050210_10290/MinDemit.List]	X
SOCIAL HISTORY: The stient is married with four grown daughters, uses tobacco, has wine Smoker	Rep
PRINCIPAL DIAGNOSIS: LEFT LOWER LOBE PHEUNOHIA	
SOCIAL HISTORY: The patient is a nonsmoker. No alcellol Non-Smoker SOCIAL HISTORY: Negative for tobacco, alcohol, and Norug abuse.	-
SOCIAL HISTORY. INegative for tobacco, alconol, and IV Jug abuse.	ed with
BRIEF RESUME OF HOSPITAL COURSE: 63 yo woman with COPD, 50 pack-yr tobacco (quit 3 wks ago), Past Smo	oker
SOCIAL HISTORY: The patient lives in rehab, married. Unclear smoking history from the admission note	
HOSPITAL COURSE: It was recommended that she receive We also added form of Lactobacillus acidor Hard to pick population of her gut.	ł Lactinax, oral
SH: widow,lives alone,2 children,no tob/alcohol. Hard to pick	2

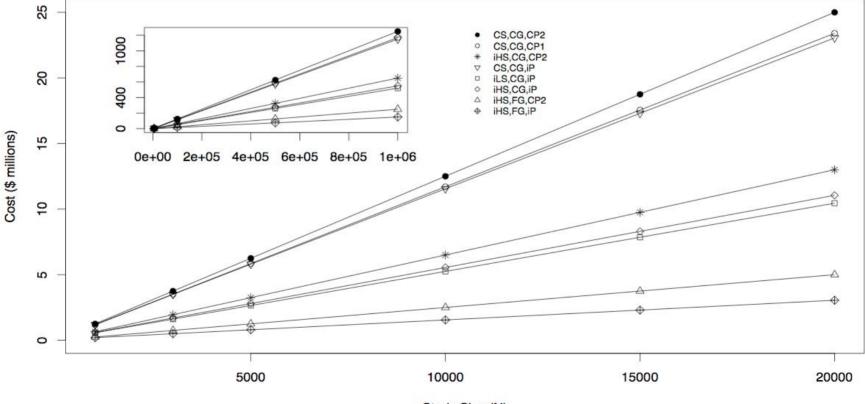
#### **Tissue Sample Collection**

#### Tissue Banking Advancing Cancer Care



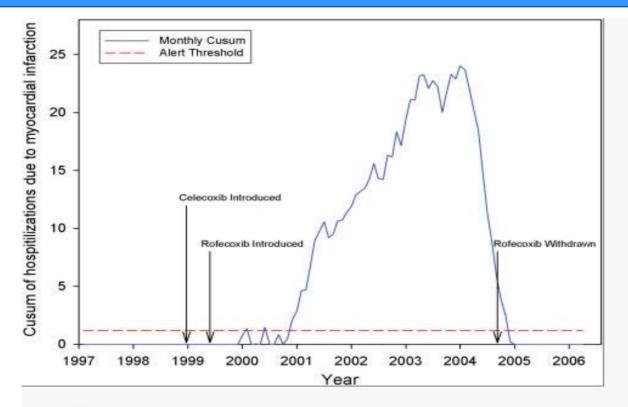
Courtesy of Dana-Farber Cancer Institute. Used with permission.

# Costs of "High Throughput" Clinical Research



Study Size (N)

# Post Market Medication Surveillance

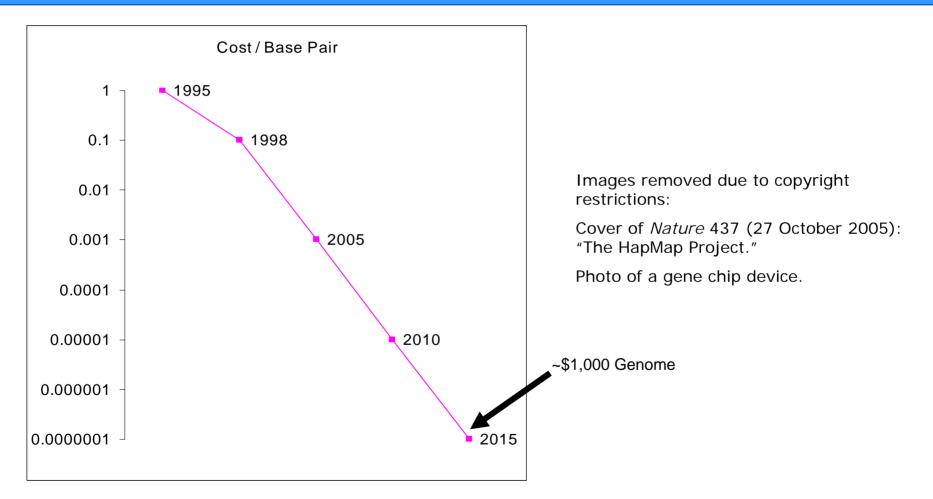


#### Figure 1

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. © 2007 Brownstein et al; license CC BY.

### Underlying Drivers Point to Accelerated Growth



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

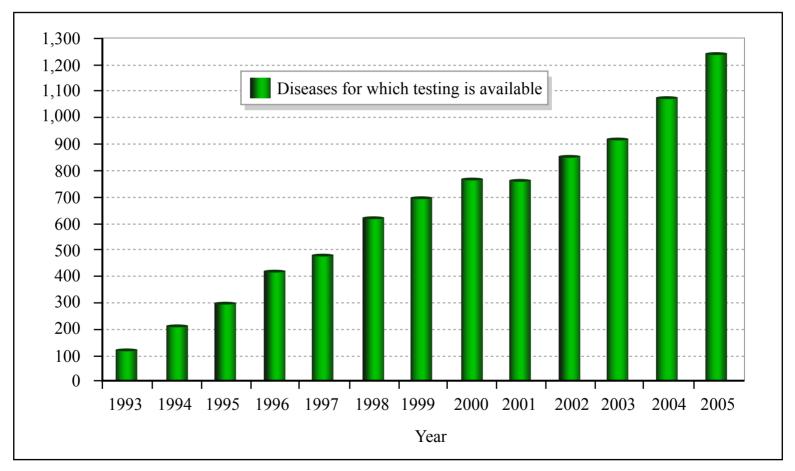
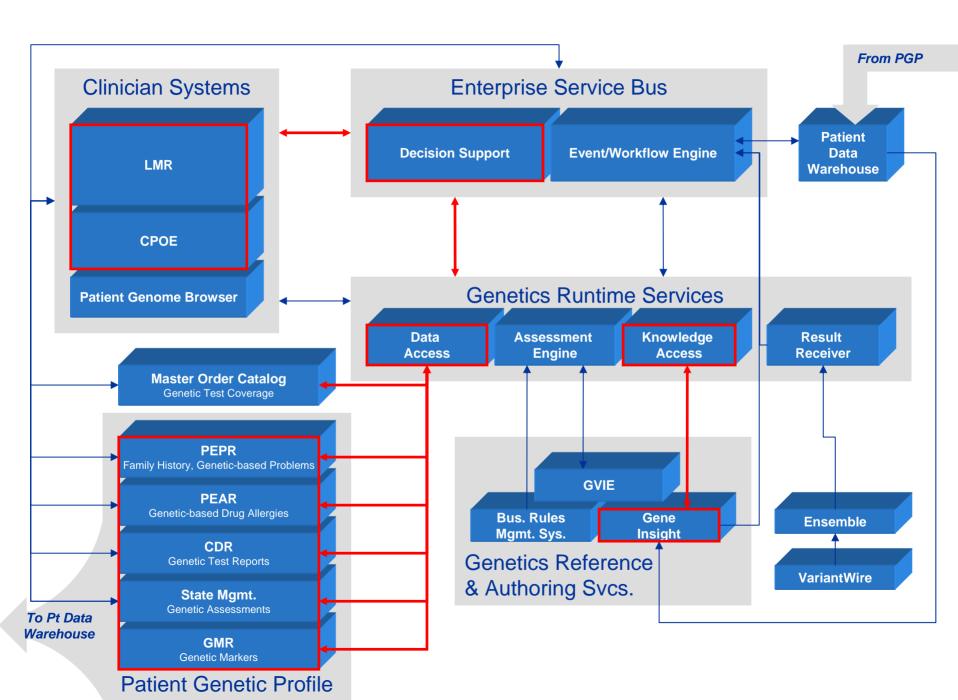


Figure by MIT OpenCourseWare. See Hudson, K., et al. "Oversight of US Genetic Testing Laboratories." *Nature Biotechnology* 24 (2006): 1083-1090.

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



# Personalized Medicine Adoption Challenges

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

## Access to Your Medical Record

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	BUN	160 (#) 50 (#)	mg/dL mg/dL	9-25	10/12/2006	
i						
i i	BUN	50 (#)	mg/dL	9-25	10/12/2006	
i i	BUN Carbon Dioxide	50 (#) 24	mg/dL mmol/L	9-25 23-32	10/12/2006 10/12/2006	
i i i	BUN Carbon Dioxide Potassium	50 (#) 24 3.9	mg/dL mmol/L mmol/L	9-25 23-32 3.5-5.0	10/12/2006 10/12/2006 10/12/2006	
i i i i	BUN Carbon Dioxide Potassium Sodium	50 (#) 24 3.9 135 (#)	mg/dL mmol/L mmol/L mmol/L	9-25 23-32 3.5-5.0 136-142	10/12/2006 10/12/2006 10/12/2006 10/12/2006	
i i i i i	BUN Carbon Dioxide Potassium Sodium Creatinine	50 (#) 24 3.9 135 (#) 2.5 (#)	mg/dL mmol/L mmol/L mmol/L mg/dL %	9-25 23-32 3.5-5.0 136-142 0.7-1.3	10/12/2006 10/12/2006 10/12/2006 10/12/2006 10/12/2006	
i i i i i i	BUN Carbon Dioxide Potassium Sodium Creatinine Hgb A1C	50 (#) 24 3.9 135 (#) 2.5 (#) 8.9 (#)	mg/dL mmol/L mmol/L mmol/L mg/dL % mg/dL	9-25 23-32 3.5-5.0 136-142 0.7-1.3 4.2-5.8	10/12/2006 10/12/2006 10/12/2006 10/12/2006 10/12/2006 10/12/2006	
i i i i i i i i	BUN Carbon Dioxide Potassium Sodium Creatinine Hgb A1C Glucose Cholesterol	50 (#) 24 3.9 135 (#) 2.5 (#) 8.9 (#) 150 (#)	mg/dL mmol/L mmol/L mg/dL % mg/dL mg/dL	9-25 23-32 3.5-5.0 136-142 0.7-1.3 4.2-5.8 54-118	10/12/2006 10/12/2006 10/12/2006 10/12/2006 10/12/2006 10/12/2006 10/12/2006	
<i>i i i i i i i i i i</i>	BUN Carbon Dioxide Potassium Sodium Creatinine Hgb A1C Glucose	50 (#) 24 3.9 135 (#) 2.5 (#) 8.9 (#) 150 (#) 230 (#)	mg/dL mmol/L mmol/L mmol/L mg/dL % mg/dL	9-25 23-32 3.5-5.0 136-142 0.7-1.3 4.2-5.8 54-118 140-199	10/12/2006 10/12/2006 10/12/2006 10/12/2006 10/12/2006 10/12/2006 10/12/2006 10/12/2006	

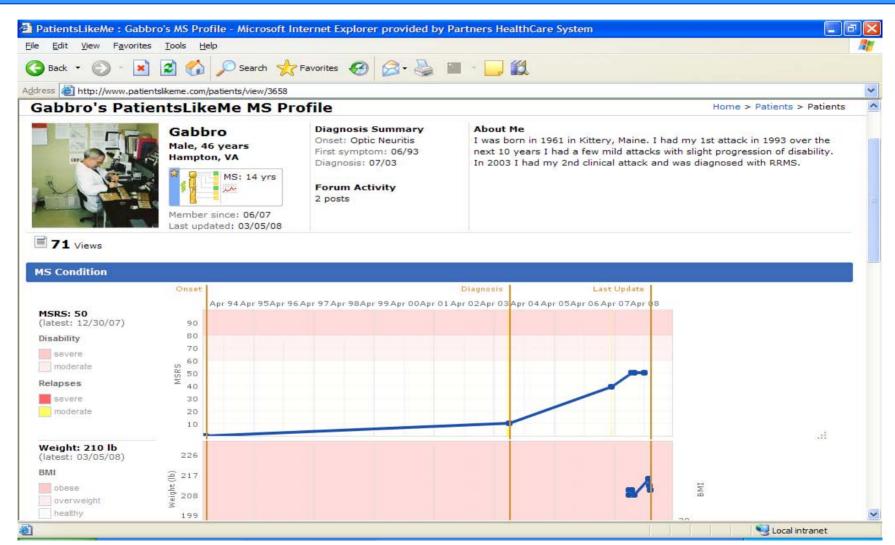
Courtesy of American TeleCare. Used with permission.

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# **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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