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

<table>
<thead>
<tr>
<th>For Every:</th>
<th>There Appear to Be:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 patients coming in for outpatient care</td>
<td>14 patients with life-threatening or serious ADEs</td>
</tr>
<tr>
<td>1000 women with a marginally abnormal mammogram</td>
<td>360 who will not receive appropriate follow-up care</td>
</tr>
<tr>
<td>1000 patients who qualified for secondary prevention of high cholesterol</td>
<td>380 will not have a LDL-C, within 3 years, on record</td>
</tr>
<tr>
<td>Visit Date</td>
<td>Patient Name / MRN</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>No Visit</td>
<td></td>
</tr>
<tr>
<td>01/09/2003</td>
<td></td>
</tr>
<tr>
<td>01/09/2003</td>
<td></td>
</tr>
<tr>
<td>12/20/2002</td>
<td></td>
</tr>
<tr>
<td>12/12/2002</td>
<td></td>
</tr>
<tr>
<td>01/30/2003</td>
<td></td>
</tr>
<tr>
<td>01/16/2003</td>
<td></td>
</tr>
<tr>
<td>01/09/2003</td>
<td></td>
</tr>
<tr>
<td>01/09/2003</td>
<td></td>
</tr>
<tr>
<td>12/10/2002</td>
<td></td>
</tr>
</tbody>
</table>
## Impact of LMR Results

### Manager

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician Users</td>
<td>355</td>
</tr>
<tr>
<td>Physician rating (1=Strongly agree, 5 = Strongly disagree) – care improvement</td>
<td>1.8</td>
</tr>
<tr>
<td>Physician rating – Reduce malpractice</td>
<td>2.1</td>
</tr>
<tr>
<td>Physician rating – Useful</td>
<td>1.9</td>
</tr>
<tr>
<td>Critically abnormal results highlighted per month</td>
<td>120</td>
</tr>
<tr>
<td>Sub-critical abnormal results highlighted per month</td>
<td>600</td>
</tr>
</tbody>
</table>

CIO Magazine Awards Submission, Partners, 2006
A Problematic Medication Order
Serious Medication Error Rates Before and After CPOE

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:

<table>
<thead>
<tr>
<th>Category</th>
<th>Net Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providers</td>
<td>$34B</td>
</tr>
<tr>
<td>Radiology Centers</td>
<td>$8B</td>
</tr>
<tr>
<td>Payers</td>
<td>$22B</td>
</tr>
<tr>
<td>Pharmacies</td>
<td>$1B</td>
</tr>
<tr>
<td>Laboratories</td>
<td>$13B</td>
</tr>
<tr>
<td>Public Health</td>
<td>$0.1B</td>
</tr>
</tbody>
</table>

Source: Center for Information Technology Leadership, Partners HealthCare, 2004.
# EHR Return on Investment

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>More Effective</strong>¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR Investment</td>
<td>$40,700</td>
<td>$5,700</td>
<td>$5,700</td>
<td>$5,700</td>
<td>$5,700</td>
</tr>
<tr>
<td>Savings/Opportunities²</td>
<td>$11,498</td>
<td>$22,995</td>
<td>$22,995</td>
<td>$22,995</td>
<td>$22,995</td>
</tr>
<tr>
<td>Net</td>
<td>-$29,202</td>
<td>$17,295</td>
<td>$17,295</td>
<td>$17,295</td>
<td>$17,295</td>
</tr>
<tr>
<td>Cumulative Net</td>
<td>-$29,202</td>
<td>-$11,907</td>
<td>$5,388</td>
<td>$22,683</td>
<td>$39,978</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Less Effective</strong>¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR Investment</td>
<td>$40,700</td>
<td>$5,700</td>
<td>$5,700</td>
<td>$5,700</td>
<td>$5,700</td>
</tr>
<tr>
<td>Savings/Opportunities²</td>
<td>$6,325</td>
<td>$12,650</td>
<td>$12,650</td>
<td>$12,650</td>
<td>$12,650</td>
</tr>
<tr>
<td>Net</td>
<td>-$34,375</td>
<td>$6,950</td>
<td>$6,950</td>
<td>$6,950</td>
<td>$6,950</td>
</tr>
<tr>
<td>Cumulative Net</td>
<td>-$34,375</td>
<td>-$27,425</td>
<td>-$20,475</td>
<td>-$13,525</td>
<td>-$6,575</td>
</tr>
</tbody>
</table>

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

- Chart pull savings: 5%
- Decreased billing errors: 13%
- Transcription savings: 5%
- Increased billing capture: 14%
- ADE prevention: 15%
- Radiology savings: 15%
- Drug savings: 29%
- Lab savings: 4%

EHR Physician Satisfaction

“I am better able to provide high quality care than with paper records”

- Strongly Agree: 36%
- Agree: 42%
- Disagree: 15%
- Strongly Disagree: 3%
- N/A: 2%

“This EMR has reduced the amount of paperwork that I do”

- Strongly Agree: 23%
- Agree: 30%
- Disagree: 30%
- Strongly Disagree: 14%
- N/A: 2%

“This EMR has reduced my risk of making errors”

- Strongly Agree: 25%
- Agree: 47%
- Disagree: 22%
- Strongly Disagree: 1%
- N/A: 4%

“This EMR fits well into my clinical workflow”

- Strongly Agree: 23%
- Agree: 48%
- Disagree: 21%
- Strongly Disagree: 6%
- N/A: 1%
US EMR Adoption

Percent reporting EMR

Percent reporting seven or more of 14 IT functions*

* 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.
Effectiveness of Use

Percent of Prescriptions Written by Computer
Higher values are better performance

- 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)
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

EHR with clinical decision support

Genomic research with high capacity IT

Integrated genomic and phenotypic data repository

Facilitated translational research leading to
• Diagnostic discovery
• Drug development

Improved individualized medicine & pre/post symptomatic disease management
Informatics for Integrating Biology and the Bedside (I2B2)
i2b2 Hive
Extraction of Structure from Notes

SOCIAL HISTORY: The patient is married with four grown daughters, uses tobacco, has wine.

SOCIAL HISTORY: The patient is a non-smoker. No alcohol.
SOCIAL HISTORY: Negative for tobacco, alcohol, and illegal drug abuse.

BRIEF RESUME OF HOSPITAL COURSE:
63 yo woman with COPD: 50 pack-yr tobacco (quit 3 wks ago).

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 Lactinax, oral form of Lactobacillus acidophilus to her population of her gut.

SH: widow, lives alone, 2 children, no tobacco/alcohol.

Hard to pick.
Tissue Sample Collection

Tissue Banking
Advancing Cancer Care

Courtesy of Dana-Farber Cancer Institute. Used with permission.
Costs of “High Throughput” Clinical Research
Figure 1

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

Underlying Drivers Point to Accelerated Growth


Images removed due to copyright restrictions:


Photo of a gene chip device.

~$1,000 Genome
Significant Growth in Genetic Tests


Clinician Systems

Patient Genome Browser

LMR

CPOE

Enterprise Service Bus

Decision Support

Event/Workflow Engine

Genetics Reference & Authoring Svcs.

Genetics Runtime Services

Data Access

Assessment Engine

Knowledge Access

Result Receiver

GVIE

Gene Insight


Ensemble

VariantWire

From PGP

To Pt Data Warehouse

Patient Genetic Profile

Patient Data Warehouse

To Pt Data Warehouse

From PGP

Genetic-based Drug Allergies

Genetic Test Reports

Genetic Assessments

Genetic Markers

Family History, Genetic-based Problems

Genetic Test Coverage

VariantWire

Result Receiver
Personalized Medicine Adoption Challenges

- Medical science
- Clinical guidelines
- Retrofitting electronic health records
- Reimbursement
- Provider/patient education
- Privacy
**Access to Your Medical Record**

Below are recent results. Click on the "i" icon for general information about a test. Click on the test name for additional results for that test. Click on the date for specimen information, including other results from that specimen. [More](#)

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Result</th>
<th>Units</th>
<th>Reference Range</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDL Chol (Calculated)</td>
<td>160 (#)</td>
<td>mg/dL</td>
<td>50-129</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>BUN</td>
<td>50 (#)</td>
<td>mg/dL</td>
<td>9-25</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>24</td>
<td>mmol/L</td>
<td>23-32</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>Potassium</td>
<td>3.9</td>
<td>mmol/L</td>
<td>3.5-5.0</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>Sodium</td>
<td>135</td>
<td>mmol/L</td>
<td>136-142</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>Creatinine</td>
<td>2.5 (#)</td>
<td>mg/dL</td>
<td>0.7-1.3</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>Hgb A1C</td>
<td>8.9</td>
<td>(%)</td>
<td>4.2-5.8</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>Glucose</td>
<td>150 (#)</td>
<td>mg/dL</td>
<td>54-118</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>230 (#)</td>
<td>mg/dL</td>
<td>140-199</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>150</td>
<td>mg/dL</td>
<td>35-150</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>Chloride</td>
<td>103</td>
<td>mmol/L</td>
<td>98-108</td>
<td>10/12/2006</td>
</tr>
<tr>
<td>HDL Cholesterol</td>
<td>40</td>
<td>mg/dL</td>
<td>40-60</td>
<td>10/12/2006</td>
</tr>
</tbody>
</table>
Web 2.0 Patient Communities
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.