Healthcare IT:
Potential and Peril

Thomas Miller
CEO, Workflow & Solutions Division
Siemens Healthcare
The Task I Was Given

"We are expecting pathologists to be the integrators of data to improve patient care ...  

... speak about **overcoming the computer technology barriers** that we face every day."

But, since being given this assignment, a couple of things have changed that could dramatically effect Healthcare Information Technology (HIT)
Healthcare Information Technology in the Context of the Present Crisis

New York Times, February 28, 2009

How High Could It Go?

Health care spending has swelled since the 1960s, with the bulk of the spending coming from private insurance companies and federal programs.

TOTAL NATIONAL HEALTH CARE SPENDING
Adjusted for inflation

PUBLIC:

Medicare and Medicaid

Private insurers

Other

Personal out-of-pocket spending

Out-of-pocket spending includes co-payments and deductibles. Other includes spending for the Department of Defense, Veterans Affairs, children's health and other programs.

Source: Centers for Medicare and Medicaid Services, Office of the Actuary

OPTION A: FLEE
OPTION B: STAND STILL AND GET SWEPt OUT TO SEA.
OPTION C: LEARN TO SURF.

ECONOMY

Source: THE NEW YORK TIMES
The combination of Healthcare Reform and the impact of the economic downturn have created a Perfect Storm in Healthcare.

The Impact on Hospitals:

- The average total margin* decline has accelerated:
  - 7% in beginning of 2007, 4% in Q2 of 2008, to 0% in Q3 of 2008
  - Bottom 25% has average total margin of under -7%
- The number of hospitals with negative total margin has accelerated:
  - Under 15% in the beginning of 2007 to 50% at the end of Q3 2008
- Liquidity at a historic low of an average of 110 days cash on hand:
  - 25% of hospitals have less than, on average, 57 days cash on hand
- Capital Plans have been frozen or cancelled**
  - 56% of hospitals reconsidering/postponing new capacity/renovations
  - 45% reconsidering clinical technology/equipment
  - 39% reconsidering information technology projects
- Total procedures have only decreased slightly but mix has changed
  - Hospital diagnostic imaging procedures declined 15% from 10/08 to 12/09
  - Cardiovascular admissions continue a year long declining trend
  - "Unavoidable" care such as orthopedic surgery continues to increase

*Hospitals in the USA use "margins" rather than "profit" because many are not-for-profit organizations therefore "total margin" is excess revenue derived from operations plus non-operating margins primarily from investments

**American Hospital Association TrendWatch, January 2008

“
You never want a serious crisis to go to waste.
”

Rahm Emanuel,
White House Chief of Staff
"The Economic Case for Healthcare Reform"

Proposal to reduce the annual growth rate in healthcare costs by 1.5% by eliminating inefficiencies and enacting broad measures

- Payment systems should reward providers for quality of care, rather than volume of care.
- Current treatment information should be disseminated to patients and providers.
- Standardized performance measures should be developed to evaluate hospitals and physicians.
- Fragmentation of health care among multiple providers should be reduced through bundled payments or standardized billing.
- Data systems should be modernized in efforts to detect fraud and abuse in the Medicare and Medicaid programs.
- Patients given a greater role in their treatment strategies.
- Effective, high-value technology should be rewarded.
Healthcare Reform in the ARRA has HIT in a Central Role

The Institute of Medicine’s **five** Criteria for Healthcare Reform:

1. Coverage must be universal
2. Not tied to a job
3. Affordable for individuals
4. Affordable for society
5. Should provide access to **high quality care** for everyone

- Healthcare Reform taken up as one of the administration’s top priorities with **$149 billion** for healthcare in ARRA.
- HIT hailed as **key** to Healthcare Reform – cure-all for high costs and quality issues.
- The most ambitious of plans: **Electronic Medical Records for all Americans within five years...**
The ARRA investment in HIT is not small...

...it would extend 67 miles into the atmosphere.

...weighs 2,040,800 pounds.

$20 billion in $20 bills...

If you stacked $20 billion in $20 bills...
The Two Large Questions:

Will the stimulus package ("HITECH") accelerate widespread adoption of Healthcare Information Technology?

Will the technology thus adopted fulfill the expectations of increasing quality and decreasing the cost of care?
"This is their new big carrot and stick method."
### Medicare Physician Payout and Penalty Timeline

<table>
<thead>
<tr>
<th>Performance Year -&gt; Starting Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>Total</th>
<th>Fee Schedule Penalties</th>
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<tr>
<td>2011</td>
<td>$18K</td>
<td>$12K</td>
<td>$8K</td>
<td>$4K</td>
<td>$2K</td>
<td>0</td>
<td>$44K</td>
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<tr>
<td>2012</td>
<td>$18K</td>
<td>$12K</td>
<td>$8K</td>
<td>$4K</td>
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<td>$44K</td>
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<td>2013</td>
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<td>$15K</td>
<td>$12K</td>
<td>$8K</td>
<td>$4K</td>
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<td>$39K</td>
<td>No Reduction</td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td></td>
<td>$12K</td>
<td>$8K</td>
<td>$4K</td>
<td></td>
<td>$24K</td>
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<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td>$0</td>
<td>$0</td>
<td></td>
<td>$0</td>
<td>99% (1% Reduction)</td>
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<tr>
<td>2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0</td>
<td></td>
<td>$0</td>
<td>98% (2% Reduction)</td>
</tr>
<tr>
<td>2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0</td>
<td>97% * (3% Reduction)</td>
</tr>
</tbody>
</table>

* Secretary may continue annual decrease to 95% if less than 75% of professionals have adopted Physicians who provide services designated by the Secretary as health professional shortage areas will receive a 10% increase over payment amounts defined above.
### Medicare Hospital Payout and Penalty Timeline

<table>
<thead>
<tr>
<th>Performance Year -&gt; Starting Year</th>
<th>FY11</th>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16</th>
<th>Total</th>
<th>Market Basket Penalties</th>
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<tbody>
<tr>
<td>FY11</td>
<td>$2,114K</td>
<td>$1,586K</td>
<td>$1,057K</td>
<td>$528K</td>
<td>0</td>
<td>0</td>
<td>$5,287K</td>
<td>No Penalty</td>
</tr>
<tr>
<td>FY12</td>
<td>$2,114K</td>
<td>$1,586K</td>
<td>$1,057K</td>
<td>$528K</td>
<td>0</td>
<td></td>
<td>$5,287K</td>
<td>No Penalty</td>
</tr>
<tr>
<td>FY13</td>
<td>$2,114K</td>
<td>$1,586K</td>
<td>$1,057K</td>
<td>$528K</td>
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<td></td>
<td>$5,287K</td>
<td>No Penalty</td>
</tr>
<tr>
<td>FY14</td>
<td></td>
<td>$1,586K</td>
<td>$1,057K</td>
<td>$528K</td>
<td></td>
<td></td>
<td>$3,172K</td>
<td>No Penalty</td>
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<tr>
<td>FY15</td>
<td></td>
<td></td>
<td>$1,057K</td>
<td>$528K</td>
<td></td>
<td></td>
<td>$1,586K</td>
<td>¾ of increase reduced by 33.33%</td>
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<tr>
<td>FY16</td>
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<td></td>
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<td>$0</td>
<td></td>
<td></td>
<td>$0</td>
<td>¾ of increase reduced by 66.66%</td>
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<tr>
<td>FY17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0</td>
<td>¾ of increase reduced by 100%</td>
</tr>
</tbody>
</table>

**Factor for Year 1 – Year 5 Payouts:**
- Year 1 – 100%, Year 2 – 75%, Year 3 – 50%, Year 4 – 25%, Year 5 - 0%
Is the Current Incentive Plan Adequate to Spur Action? And will this result in true Transformation?

- Administration Believes Incentive Scheme Will Motivate Adoption of EMR
  - To Qualify, hospitals and physicians must:
    - Be a "meaningful user" of the EMR – "meaningful use defined as:
      - Using a **Certified EMR in a meaningful manner** *(Note – Criteria to be set by 12/31/09)*
      - Demonstrate EMR can provide electronic exchange of health information to improve quality and care coordination
      - Able to report on clinical quality measures as specified by the Secretary and demonstrate requirements are met
        *(Note – Secretary of HHS to provide additional information and clarification on the final definition of “meaningful use”)*

- The Danger: The “Just Enough” Syndrome
  - No upfront money to purchase systems
  - A 500-bed hospital will spend $10 million to install a system and receive $6.1 million in incentives.
    - If the hospital did not install by 2015, it would see a $3.2 million reduction (average) in Medicare payments, depending upon volume.
  - An three-physician practice will spend an estimated $173,500 - $296,000 to implement an EMR and individual physicians will receive $44,000 in incentive payments
    - If we simply convert paper records to electronic form, we will have only reduced paper and improved file storage.
      - No measurable improvement in quality or coordination of care
      - Automation of inefficient processes results in replication and expense

The Real Peril: Hospitals and physicians could do “just enough” to meet minimal ‘meaningful’ use requirements without any real transformation

Sources: Rock and a Hard Place: An Analysis of the $36 Billion Impact From Health IT Stimulus Funding, PricewaterhouseCoopers LLP Health Research Institute, April 2009: HealthLeaders, April 16, 2009
“The hard part is that we just can’t drop a computer on every doctor’s desk…

…(this) is a very technical task.”

David Brailer
Former Coordinator
National Health Information Technology

“Yes, we can” claims Sam’s Club/Wal-Mart!

eClinical Works Doctor’s Office
Computer solutions

A turnkey EMR that could save you up to 50% more.

Discover the benefits of electronic medical records (EMR), practice management and e-prescribing all in one cost-effective solution.

Sam’s Club® has joined with eClinicalWorks and Dell to provide a turnkey EMR and practice management solution at an outstanding value exclusively for Sam’s Club Plus® Members.

Read on for details!

What does the package include?

• Front-office management
  patient registration and appointment scheduling
• Mid-office management
  electronic medical records
• Back-office management
  electronic billing

Why choose eClinicalWorks, Dell and Sam’s Club?

Best value! Sam’s Club offers outstanding savings on both the hardware and software. This offering is designed specifically for Sam’s Club Members.

Dell Latitude XT: 3.5 lbs. Thin and light notebook computer
12.1 inch widescreen, resolution 1280 x 800

Electronic Medical Records:
Update patient information and utilize clinical decision support features
The Two Large Questions:

- Will the stimulus package incent physicians to adopt Healthcare Information Technology?
- Will the technology thus adopted fulfill the expectations of increasing quality and decreasing the cost of care?
Solving the HIT Problem: An Engineering Approach

<table>
<thead>
<tr>
<th>Existing Designs</th>
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<tbody>
<tr>
<td>Design Criteria</td>
</tr>
<tr>
<td>Technical Considerations</td>
</tr>
<tr>
<td>Recommendations</td>
</tr>
</tbody>
</table>
Existing designs have obviously not been very successful

- To date, only 1.5% of US hospitals have a comprehensive EMR (active in all clinical units)
- 9.1% have a basic system (active in at least one clinical unit)
- CPOE is active in 17% of hospitals
- 17% of physician practices have some form of EMR
- Previous studies found widely varying ranges of implementation, ranging from 5 to 59%, attributable to lack of standard definition of an EMR.

Source: Use of Electronic Health Records in U.S. Hospitals, NEJM, March 2009
"The reason that HIT systems are too expensive... 
...is that they cost too much"
– Tom Miller
How Relevant is the UK’s “Connecting for Health” Experience?

- UK’s National Health Service’s Connecting for Health agency will spend £331m less than anticipated this year.
- £586m of capital expenditure was expected this year, compared to the budgeted £917m.
- The fourth consecutive year the program will underspend.
- The program has spent only £3.5bn of the £12.7bn allocated over ten years.

Is this a sign of efficiency? Or…

- The Program has been notoriously behind schedule since its launch in 2005.
- Email, PACS and electronic prescriptions are implemented.
- The acute care system – either Cerner or iSoft, is a priority for 2009.
- The care record, the core part of the program, is now four years behind schedule.
- Contracts stipulated that IT vendors would be paid only for work completed and the slow progress made the program an unreasonable business proposition.
  - Accenture withdrew in 2005.
  - Fujitsu’s contract was terminated in 2008.
  - Contracts of BT Global Services, which delivers iSoft, are now under review.
PCC - ESTABLISHED - PROBLEM FOCUSED

Adm: 02/25/02 4EA MED

Jun 12,2002@12:48

Ceftazidime

Warfarin (Coumadin) Na img Tab Take One-half Tablet by Mouth Every Day

Warfarin

Insulin Reg Human U/Ml Inj Novolin R Inject Free Text Number Of Units Needed Under The Skin Four Times A

Insulin Reg Human U/Ml Inj Novolin R Inject Free Text Number Of Units Needed Under The Skin Three Times A

Problem list: (Active & Verified)

Coronary Artery Disease

Reason for Visit:

Today's vitals:

BP:  P:  R:  WT:  T:  HT:

Pain Score: 0 (02/13/2002 11:12)

EXAM:

Recent Lab Results:

GLUCOSE: 101.0 mg/dl 2/6/2002@11:24 serum

CREAT: pending mg/dl 3/1/2001@08:37 serum

K: 4.2 mmol/L 2/6/2002@11:24 serum

CO2: 25.0 mmol/L 2/6/2002@11:24 serum

SGPT: 21.0 U/ml 2/6/2002@11:24 serum

ALK PHO: 95.0 U/ml 2/6/2002@11:24 serum

CA: 9.9 mg/dl 9/21/1999@10:04 serum

WBC: 23.5 K/mm³ 5/18/2001@10:21 blood

HCT: 33.4 % 5/18/2001@10:21 blood

MCV: 75.0 cmm 5/18/2001@10:21 blood

PLT: 40.0 K/mm³ 5/18/2001@10:21 blood

T.CHOLESTEROL: 198 (JAN 14, 2000)

dLDL-C: 145.0 mg/dl 1/14/2000

HEMOGLOBIN: HGBA1C: 5.0 % 11/30/2000@09:39 blood

<No encounter information entered>
VA program to schedule patient appointments on verge of collapse

By Bob Brewin

An eight-year-old, $167 million project to develop a core computer application to schedule patient appointments at hospitals run by the Veterans Affairs Department has all but collapsed, and senior executives are worried about the repercussions it could cause on the Hill and in the White House, according to an internal memo obtained by Nextgov.

The Replacement Scheduling Application Development Program, which VA began building in 2001, "still has not developed a single scheduling capability it can provide to the field, nor is there any expectation of delivery in the near future," wrote Dr. Michael Kussman, undersecretary for health at the Veterans Health Administration, in a March 20 memo to Stephen Warren, acting assistant secretary for information and technology.

The scheduling application is a core piece of VA’s new HealtheVet, a vast medical platform that will include patient enrollment and scheduling systems, a data repository, electronic health records, a pharmacy system, a workload management system, and a way for patients to manage their medical records and personal information. VA plans to use the system to replace its aging Veterans Health Information System and Technology Architecture (VistA), the Government Accountability Office reported on June 20, 2008.

The botched effort comes on the heels of another scheduling program – a five-year, $75 million failed project started in 2001. That program, the Scheduling Replacement Project, was started by IT

- VA Scheduling System project initiated in 2001 has not yet resulted in any usable scheduling functionality
- $167 million spent to date
- Not expected to yield any capabilities, according to a memo by Dr. Michael Kussman, undersecretary for health at Veterans Health Administration
  - Kussman has now resigned
- Issues deemed so significant that project has been suspended
Anecdotal Evidence: Implemented Correctly, HIT Can Transform Healthcare

- **42%** reduction in avoidable adverse drug events (ADE) using barcode technology to help clinicians prevent medication errors

- **$500,000 in annual savings** by reducing number of undocumented medications and increasing charge capture

- **54% reduction** in time to care with laboratory results availability

- **62% reduction** in time to care with radiology results availability

- **83% reduction** in time to care with medication availability

- Hospital reduced time to collect and document vital signs by **86.2%**

- In one unit, total time to collect and document vital signs reduced from **7.04 to 1.51 minutes per patient** and from **10.3 to 2 minutes per patient** in second unit

- Reduced manual steps from **39 to 21**

- Congestive Heart Failure HIT-based workflow improved percentage of patients receiving discharge instructions from **23% to 77%**

- Eligible patients who received angiotensin converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) increased from **63% to 100%**

- Compliance in assessing CHF patients for LVSD increased from **91% to 98%**


Greenwood LeFlore Hospital, 2009

Driving ROI and Improving Patient Care through Performance Management.
Customer Case Study: Denver Health and Hospital Authority

Soarian Clinicals Outcomes at Two Hospitals
Design Criteria: Speed
Design Criteria: Productivity

Persuasive
Net savings from digitising health systems
US, $bn

Cumulative:
- inpatient
- outpatient

Annual:
- inpatient
- outpatient

Source: RAND Corporation
The adoption of HIT will only reduce costs if it changes human activity and workflow.

**Workflow**: a series of activities to produce a pre-determined result.

Metrics are always **time**, **cost**, and **quality**. Default: **Optimize Time**.

**Industrial workflows are:**
- Linear
- Unidirectional
- Continuous
- Have limited complexity

**Healthcare workflows are:**
- Non-linear
- Multi-directional
- Interrupt-driven
- Have unlimited complexity
Deliver More Efficient and More Effective Care

Do the Right Thing

Improving healthcare

Do It Efficiently
Design Criteria: Adherence to Care Standards While Coordinating Care Workflow

Performance Parameters:
- Door to needle time: < 25 min.
- Symptom to needle time: 107 min.
Seemingly Limitless Workflows to Automate

Live Soarian workflows automate all Joint Commission Core Measures

- 23hr Observation Manager
- Acute Myocardial Infarction
- Admission Assessment Completion
- Admission Manager
- Advance Directive
- Adverse Drug Event – INR & Coumadin
- Allergy Assessment Tracking
- Assessment Manager
- Bed Cleaning Manager
- Central Scheduling Script Manager
- Clinical Letter
- Clinic Visit Notification

246 live workflows across our Global customer base
St. Luke’s, Bethlehem, PA, is so confident of its surgeons’ skills that it offers a guarantee – surgery is free if prostatectomy results in complications or hospital re-admission!
In the Simplest Form, HIT Must Ensure the Basics of Quality Care

### The Rights

<table>
<thead>
<tr>
<th>Medication Administration</th>
<th>Laboratory Testing</th>
<th>Information Technology</th>
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</thead>
<tbody>
<tr>
<td>Right Patient</td>
<td>Right Lab Test</td>
<td>Right Information</td>
</tr>
<tr>
<td>Right Time/Frequency</td>
<td>Right Patient</td>
<td>Right Person</td>
</tr>
<tr>
<td>Right Dose</td>
<td>Right Time</td>
<td>Right Context of Care</td>
</tr>
<tr>
<td>Right Route</td>
<td>Right Indicators</td>
<td>Right Time</td>
</tr>
<tr>
<td>Right Drug</td>
<td>Right Diagnostic Decision</td>
<td>Right Patient</td>
</tr>
</tbody>
</table>
Design Criteria: Maintain Clinician Flexibility
Meaningful use of electronic health records systems starting in 2011…

- A single physician must coordinate care with an average of 229 physicians across 117 practices
- For every 100 Medicare beneficiaries, there are 99 physicians across 53 practices
- Care providers in physician offices, hospitals, long-term care facilities, pharmacies, labs, and rehab centers must share access to patient information in context

What if the systems don’t talk to each other and speak the same language?
Interoperability Math: It gets impossible really fast!

The number of interfaces to be built, tested, maintained, and updated are governed by the simple formula:

\[
N = \frac{N^2 - N}{2}
\]

N = 1000
Interoperability and
The OpenLink Engineer Problem:

The University of Pennsylvania Health System currently has 27 different ways to designate male / female.

Source: Information Technology: Not a Cure for the High Cost of Healthcare, Knowledge@Wharton, June 2009
Design Criteria: Patient Safety

Which of these is the most deadly?

- 862 accidental shooting deaths annually
- 3,500+ accidental drowning deaths annually
- 195,000 deaths resulting from medical errors annually

Sources: CDC Center for Injury Prevention and Control, May 2009; HealthGrades Patient Safety in American Hospitals, 2004
Design Criteria: Data Security
Design Criteria – The ‘omics’ Revolution

The road to commoditisation
DNA sequencing and growth in DNA data
Log scales

Sequencing cost per base pair, $ Base pairs*

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<tr>
<th>Year</th>
<th>1971</th>
<th>80</th>
<th>90</th>
<th>2000</th>
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<tr>
<td>Cost</td>
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<td>$1,000</td>
<td>$100</td>
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<td>$10^{9}</td>
<td>$10^{8}</td>
<td>$10^{7}</td>
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<tr>
<td></td>
<td>$10^{6}</td>
<td>$10^{5}</td>
<td>$10^{4}</td>
<td>$10^{3}</td>
<td>$10^{2}</td>
</tr>
</tbody>
</table>

Source: Raymond Kurzweil
*Growth in Genbank DNA sequence data
HIT will have to accommodate the “Personalized Genome Industry”
The system must identify small variations that are potentially very significant!
Design Criteria – Managing the Data Tsunami

Gordon Moore's original graph of "Moore's Law" © Intel

<table>
<thead>
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<th>Year</th>
<th>Number of Components per Integrated Circuit</th>
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<tr>
<td>1978/1</td>
<td>0.20</td>
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<tr>
<td>1979</td>
<td>0.33</td>
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<td>1981/2</td>
<td>1.00</td>
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</tr>
<tr>
<td>2005</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td></td>
</tr>
</tbody>
</table>
Design Criteria: Patient Involvement and Expectations

Patients select a physician or hospital by reading other’s opinions and share their own - Empowering Patient Self-Management
Anna McNeill Whistler posed for the painting, Whistler's Mother, at the age of 67 in 1871. She posed sitting because she was too frail to stand.

At the age of 72, Sophia Loren, posing in the 2007 edition of the famous Pirelli calendar, the oldest model in its history.
Design Criteria: The Personalized Medicine Revolution

**Past**

- ‘Reactive’ Medicine
  - Wait for symptoms or gross evidence of disease
  - Anatomic and functional imaging
  - One size fits all therapy

**Future**

- Personalized Medicine
  - Predictive
  - Preventive
  - Personalized

- Earlier Detection
- More Specific Biomarkers
- More Rapid Drug Development
- Knowledge-driven Healthcare
- Individualized Therapy
As Our Knowledge and Understanding of the Complexities of Disease Evolves, Personalized Medicine is Unavoidable

Breast Cancer Workflow Studies: Personalized Medicine Is a Reality Today

Asymptomatic patients (75-90%)

Symptomatic (palpable) patients (10-25%)

Screening Mammo

Calc

Abnormal

Mass

Normal

Diagnostic Mammo

W/Mag View + Spot compression

Abnormal

Normal

Diagnostic exam

W/Hand-held Ultrasound MRI

Biopsy Exam

Malignant

Benign

Routine follow-up

Normal

Monitor

HER-2/New level

HER-2/New decreasing

HER-2/New increasing

Herceptin treatment

Treatment plan B

Treatment plan C

...
Information Integration Required for: Individualized Standards of Care
The Technological Choices we make now have a high degree of persistence

<table>
<thead>
<tr>
<th>Microsoft owns 11,000+ healthcare patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method/System for Defining Semantic Categories/Actions</td>
</tr>
<tr>
<td>Master Patient Index</td>
</tr>
<tr>
<td>Embedded Decision Support</td>
</tr>
<tr>
<td>13 Patents related to Interoperability</td>
</tr>
<tr>
<td>Federated sensing, analysis, summarization, sharing of healthcare data</td>
</tr>
</tbody>
</table>

“Let’s remember HIT is not like railways, where gauges had to match perfectly for interoperability.”

Peter Neupert
Corporate Vice President
Microsoft Health Solutions Group
Technical Considerations: Integrated Workflow Engines
Active Workflow Status

**Workflow:** ER Stroke

**Patient Name:** Bloom, Valerie S  **Current Location:** Radiology

- **Elapsed Time Since Workflow Started:** 46 min
- **Elapsed Time Since Symptom Onset:** 2 hrs 24 min
- **Estimated Time Needed to Complete Workflow:** 45 min
- **Elapsed Time Since Symptom Onset at Estimated Completion:** 3 hrs 9 min

**Workflow Currently Waiting On...**
- Waiting 14 min for Bloom, Valerie S to go "Exam 2"
- Waiting 30 min for Receipt of Lab Results for Order 103640

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**Workflow:** ER Stroke

**Patient Name:** McDonald, Hugh K  **Current Location:** Exam 3

- **Elapsed Time Since Workflow Started:** 30 min
- **Elapsed Time Since Symptom Onset:** 55 min
- **Estimated Time Needed to Complete Workflow:** 1 hr 2 min
- **Elapsed Time Since Symptom Onset at Estimated Completion:** 1 hr 57 min

**Workflow Currently Waiting On...**
- Waiting 14 min for McDonald, Hugh K to go "Radiology"
- Waiting 20 min for Message reply from 6105554721@txt.att.net
Technical Considerations: Section of Standardized Ontologies
Clinical Knowledge Is Multidimensional and Fractal

- Implementation does not scale – can’t do it one at a time
- Medicine has indefinitely many “niches” within “niches” within “niches” and grows combinatorically
- One size does not fit all
Conditions

Patient

[Diagram showing a tree structure with multiple branches and boxes, possibly indicating various conditions or diagnoses related to a patient.]
Different stages and severities
Different treatments

Patient
Different responses
Different findings

Patient
A combinatorial problem cannot be managed with a linear technology

Localization adds additional dimensions
Different insurance
Different organizations
Different providers
Different social issues
Different genetics
Different guidelines
Technical Considerations: Modeling Medical Knowledge and Practice

Mitigate the combinatorial explosion

- Model at optimal granularity
  - Associative reasoning
  - Composition
  - Context
  - Constraints

Maximize re-use and maintainability

- Change the ontology, rather than the code
- All changes in exactly one place
- Common knowledge representation for enterprise
OWL

- W3C Standard for Ontologies and the Semantic Web
- Next generation to Ontology (SNOMED) and GRAIL (GALEN)
- Unifies vocabulary, concept and relationship representations

Users:
- National Cancer Institute Thesaurus
- National Center for Biomedical Ontologies
- ICNP
- Anesthesia Patient Safety Association
- Pharmaceutical Industry
- Genomic bioinformatics

- Fractal
- Compositional
- Highly structured
- Modular
- Rigorous
- Standard
From Situations…

1. Identify all condition-situations implied by patient-situation

2. Draw consequences from all condition-centered situations
   - Infer new conditions
   - Request assessments
   - Suggest interventions
   - Resolve goals

3. Update patient-centered situation


... to Actions

Pulse > x
Blood pressure < y
Age > z

Assert on patient-situation

Find implied condition-situations

Classify implied condition-situations

Present all actions suggested by situations

Action 1
Action 2
Action 3
Advice for Mr. Obama

“"I'm absolutely confident that there's going to be low-hanging fruit ... the issue of health IT -- I don't think there's any dispute ... if we digitalize our health care system, we're going save money over the long term and we're going to reduce error and save lives.”

- President Barack Obama, March 5, 2009
Combine “Wild West” and Dictatorial Management Approaches

David Blumenthal, National Coordinator, HIT
Get Some Geeks – Healthcare IT Geeks!
Architecture Is Everything

- Fast
- Interoperable
- Scale-able
- Secure
- Able to provide decision support
- Able to capture and direct activity
- Able to capture and assimilate new knowledge
Slow the Hell Down
Let’s make sure that we do it right!
We will restore science to its rightful place and wield technology's wonders to raise health care’s quality and lower its cost.

*US President Barack Obama*

*January 20, 2009*
Questions?

Thank You!