Toward Data and Knowledge Interoperability: The Clinical Decision Support Consortium

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Meaningful Use of Health IT

The Value of Healthcare Information Exchange and Clinical Decision Support

SOA at Partners Healthcare

- Smart Forms in the Longitudinal Medical Record
- The Clinical Decision Support Consortium

Issues and Limitations
Prone to error
Lots of information but no data
Limited decision support, or measurement
Does not integrate with eHealthcare...
Will not transform healthcare
Prices, efficiency and insurance administration are the most important reasons U.S. spending is higher than spending in other countries.
Background and Goal

- US Healthcare remains largely unwired, fragmented, variable in process and outcomes, with significant disparities, and unabated growth in expense
  - Despite increased efforts at improved quality, patient safety, cost containment, and HIT adoption
- HITECH Act (Health Information Technology for Economic and Clinical Health Act)
  - $19.2B net ($36B overall) over 6 years for HIT
  - Every American Citizen with EMR by 2014
- HIT adoption as a prelude to healthcare reform
- Healthcare reform as component of economic recovery
President Obama signed into law the American Recovery and Reinvestment Act (ARRA)

Feb 17, 2009

- Title IV of Division B of ARRA amends the Social Security Act by establishing **incentive payments to eligible professionals (EPs) and eligible hospitals to promote the adoption and meaningful use of interoperable health information technology and qualified EHRs.**

- These provisions, together with Title XIII of Division A of ARRA, may be cited as the “**Health Information Technology for Economic and Clinical Health Act**” or the “**HITECH Act.**”
Reforming health care
This is going to hurt
“These goals can be achieved only through the effective use of information to support better decision-making and more effective care processes that improve health outcomes and reduce cost growth.”

“Phased-in series of improved clinical data capture supporting more rigorous and robust quality measurement and improvement.”

Connecting for Health, Markle Foundation “Achieving the Health IT Objectives of the American Recovery and Reinvestment Act” April 2009
Entitlement Funds
- Medicare Payments
- Medicaid Payments

Appropriated Funds
- Healthcare Information Exchange
- EHR Adoption Loans
- HIT Extension Programs
- Workforce Training
- New Technologies
- R&D Grants
Goal

- 85% of patients with high blood pressure and cholesterol have it well controlled

Advanced care processes

- Use of evidence-based order sets
- Monitoring and addressing medication adherence
- Clinical decision support at the point of care
- Patient outreach and reminders
- Quality benchmarking and reporting

Clinical data capture (can be queried and trended)

- Systolic & diastolic blood pressure
- Medication and Problem list
- Laboratory tests and procedures
- Prescription fill histories
Health Care Reform – Can IT solve the problems?

"Who was first?"
EHRs and quality improvement

- **RAND: Systematic Review on health IT**
  - Increased adherence to guideline-based care: 5-66% (most clustering 12-20%)
  - Improved medication safety:
    - Serious medication errors: 55-86%
    - Improvements in dosing: 12-21%
  - Enhanced surveillance and monitoring

- **Comparisons of VHA vs. national healthcare system performance measures.**
  - VHA was:
    - 16% better on overall adjusted quality
    - 13% better on chronic disease care
    - 20% better on preventive care

- **VHA factors:** widespread EHR system adoption; PM program

How Does HIT Save Money?

- **EHR Effects**
  - Completeness, correctness, decision support, formulary, brand to generic, duplicate/redundant meds and tests, charge display
  - Workflow support, messaging (pt/provider), referral, A/R, team
- **CPOE Effects**
  - Reduction in hospitalization/LOS due to ADEs, clinical decision support
- **HIEI Effects**
  - Reduction in unnecessary and redundant tests and procedures
  - Labor cost savings
- **Telehealth Effects**
  - Reduction in patient transport, utilization of hospitals, and physician office visits
- **PHR Effects**
  - Administrative time savings
  - Reduction in hospitalizations and physician visit utilization
  - Improved medication safety
  - Reduction in redundant laboratory tests

www.citl.org
Net US could save $150B with HIT adoption, or approximately 7.5% of US Healthcare Expenditure

- The Value of Ambulatory Computerized Order Entry (ACPOE)
  - $44B US nationally; $29K per provider, per year
- The Value of HealthCare Information Exchange and Interoperability (HIEI)
  - $78B/yr
- The Value of IT-enabled Chronic Diabetes Management (ITDM)
  - $8.3B Disease Registries; Advanced EHR $17B
- The Value of Physician-Physician Tele-healthcare
  - >$20B*
- The Value of Personal Health Records
  - Approx. $20B
- The Value of Health IT in the Veteran’s Health Administration
  - Net $3B

www.citl.org
<table>
<thead>
<tr>
<th>Class</th>
<th>Medication (Rx) OE</th>
<th>Diagnostic (Dx) OE</th>
</tr>
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<tbody>
<tr>
<td>1: Basic Rx- only</td>
<td>Structuring data capture, passive references</td>
<td></td>
</tr>
<tr>
<td>2: Basic Rx-Dx</td>
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<td>Rx &amp; Order-specific decision support, with some patient data</td>
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<tr>
<td>3: Intermediate Rx-only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4: Intermediate Rx-Dx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5: Advanced Rx-Dx</td>
<td>Sophisticated Rx &amp; Order-specific decision support, with most patient data, EDI</td>
<td></td>
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</table>
National Annual Cost Saving Projections

- ADE Reductions
- Laboratory
- Radiology
- Medication

Billions

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost (Billions)</th>
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<tbody>
<tr>
<td>Basic Rx</td>
<td>$3.5B</td>
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<tr>
<td>Basic Rx-Dx</td>
<td>$4B</td>
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<tr>
<td>Int Rx</td>
<td>$19.5B</td>
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<tr>
<td>Int Rx-Dx</td>
<td>$26.3B</td>
</tr>
<tr>
<td>Adv Rx-Dx</td>
<td>$44B</td>
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</table>
The Nationwide Health Information Network

Health Bank or PHR Support Organization

Community Health Centers

Mobilizing Health Information Nationwide

Community #1

Integrated Delivery System

Community #2

The Internet

Standards, Specifications and Agreements for Secure Connections
HIEI – Healthcare Information Exchange and Interoperability

US health care system is too complex to model. CITL focused on data from doctor-patient encounter:

- Providers (hospitals, outpatient offices) & common care partners
- Includes clinical & administrative data

Excluded:
- Secondary transactions
- Transactions within organizations
<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Non-electronic data</td>
<td>No PC/information technology</td>
</tr>
<tr>
<td>2</td>
<td>Machine-transportable data</td>
<td>Fax/Email</td>
</tr>
<tr>
<td>3</td>
<td>Machine-organizable data</td>
<td>Structured messages, non-standard content/data</td>
</tr>
<tr>
<td>4</td>
<td>Machine-interpretable data</td>
<td>Structured messages, standardized content/data</td>
</tr>
</tbody>
</table>
## HIEI National Value

Value = Benefit - Cost

<table>
<thead>
<tr>
<th>Level</th>
<th>Value during 10-year Implementation</th>
<th>Value per year after Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 2</td>
<td>$141 B</td>
<td>$22 B</td>
</tr>
<tr>
<td>Level 3</td>
<td>-$34 B</td>
<td>$24 B</td>
</tr>
<tr>
<td>Level 4</td>
<td>$337 B</td>
<td>$78 B</td>
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</tbody>
</table>

Value of HIE standards is the difference between Level 3 & 4
A Roadmap for National Action on Clinical Decision Support

“to ensure that optimal, usable and effective clinical decision support is widely available to providers, patients, and individuals where and when they need it to make health care decisions.”

Clinical decision support has been applied to
- increase quality and patient safety
- improve adherence to guidelines for prevention and treatment
- avoid medication errors

Systematic reviews have shown that CDS can be useful across a variety of clinical purposes and topics, but dissemination is limited

EHRs have been limited in their ability to provide physician performance feedback on quality
Barriers to CDS

- Current adoption of advanced clinical decision support is limited due to a variety of reasons, including:
  - Limited implementation of EMR, CPOE, PHR, etc.
  - Difficulty developing clinical practice guidelines.
  - A lack of standards
  - Absence of a central knowledge resource.
  - Functional limitations of CDS in commercial EHRs.
  - Challenges in integrating CDS into the clinical workflow.
  - A limited understanding of organizational, and cultural issues relating to clinical decision support.
CDS has not been widely used...


...a recent systematic review in *Annals of Internal Medicine* found that 25% of all studies took place at the above institutions.
The Past: Multiple Self-Contained Applications

Example: CPOE Application 1
GUI and Workflow
LOGIC
Dictionaries And Rules
Patient Data

Example: CPOE Application 2
GUI and Workflow
LOGIC
Dictionaries And Rules
Patient Data

Example: CPOE Application 3
GUI and Workflow
LOGIC
Dictionaries And Rules
Patient Data

Applications Have:
- Different Presentation
- Different Logic
- Different Rules
- Different Dictionaries
- Different Databases
The Future: Shared Services and Data
...but Custom Presentation and Workflow
Why Shared Services and Data?

- Maintaining duplicative knowledge, rules, and patient data is **expensive**
  - People must manually keep knowledge-base and rules in sync
- Maintaining duplicative logic, rules, and patient data is **dangerous**
  - Clinical logic and rules can become outdated if poorly or inconsistently maintained
  - Users have fragmented, incomplete access to patient data
- **Sharing** logic, rules, and patient data...
  - Does not mean that all applications must look the same or share the same workflow
  - Makes future portals (mash-ups) easier to create
Increasing the level of enterprise integration is supported by core IT services that can be integrated with and/or accessed by site-based applications.

These IT services integrate and communicate with the site-based and enterprise applications via a **service-oriented architecture** made up of layered components.

This approach leverages:

- A common **technology infrastructure**;
- Common **data, terminology and rules** (especially those associated with allergies, problems and medications);
- **Shared clinical services** and applications; and
- **Customized views** and capabilities for specific user types.

### Overview of a Service-Oriented Architecture

- **Clinical Portals**
  - Physicians, Nurses, Researchers, Patients, Administrators
  - Provide customized access to relevant clinical applications and patient information based on end user roles and individual requirements.

- **Applications**
  - Order Entry, Clinical Documentation, Order Processing
  - Aggregate services into logical components that support specific functions

- **Services**
  - Clinical Decision Support, Event Scheduler, Notification, CDR access
  - Re-useable software modules that address specific clinical IT capabilities

- **Knowledge & Data**
  - Data Repositories, Controlled Medical Terminologies, Catalogues, Dictionaries and EMPI
  - Logic and tools that access data repositories for patient information, knowledge and terminology

- **Infrastructure**
  - Data Center, User Devices, Networks, Security
  - Technical foundation and support for clinical applications and end users
PHS mEHR

OETEST, BILBO

CBC (11/1/09 10:59 a.m.)

7.6
40.7
295

Chem7 (11/1/09 11:05 a.m.)

136
101
10
80

5.5
26
1.1

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Edited the note by dave kiernan
This is a note that was on the doc man queue of test, view --with a comment Editing the note to see what happens to the comments

Problems
Quadruplegia
Migraine
Headache

Allergies
NKA

20081108
20071106
20070222
20081108
20070612
20081223

Quadriplegia
Migraine
Low back pain
Migraine
Smoker
Headache

(617)732-6040
What is a Smart Form?

- Clinical documentation-based
- Actively engage user during workflow
- Organize relevant data
- Request new data
- Integrate decision support, ordering, patient education, and documentation

ClinicalTrials.gov Identifier: NCT00235040
CDS Integrated into the Clinical Workflow

- Alerts & Reminders
- Therapeutic Guidance
- Assessment, Risk Stratification, Therapeutic Response
- Follow-up/Monitoring (Quality Dashboard)

Smart Forms
A MedicaLogic Smart Form

HPI - Upper Resp Infections: Walter S. Caldwell

History of Present Illness - URI

- Referral source:
- Reason for visit:
- Chief Complaint:

Current Symptoms

- Cough
- Sore throat
- Nasal Congestion
- Ear pain
- Eye discharge
- Fever

Cough:
- productive
- non-productive
- deep
- barking
- weak
- worse in the morning
- worse at night

Duration: [ ]

# of URI in the past year: [ ]

Pattern:

Treatment:
- none
- Tylenol
- Advil
- Aspirin
- decongestant
- antihistamines
- humidifier

Comments:

For E&M evaluation, indicate level of detail:
- brief (1-3 elements)
- extended (4 or more elements)

HPI elements: location, quality, severity, duration, timing, context, modifying factors, and associated signs/symptoms

Prev Form (Ctrl+PgUp) | Next Form (Ctrl+PgDn) | Close

Now GE Office Centricity™
Assessment and recommendations generated from rules engine

- Lipids
- Anti-platelet therapy
- Blood pressure
- Glucose control
- Microalbuminuria
- Immunizations
- Smoking
- Weight
- Eye and foot examinations

No recent LDL measurement

Patient is on anti-platelet therapy

Blood Pressure is above goal (avg. over last 2 visits 130/80, goal < 130/80)

Patient is due for Pneumovax (older than 65, no record of prior vaccination)

Patient is due for Influenza Vaccine (high risk medical condition)

Patient may be Current Smoker, not thinking of quitting. Last counseled on 10/10/06.

Patient is overweight or obese (BMI 27.1 on 10/31/06, goal < 25)
**Rules**

If patient has DM then goal BP < 130/80

If the average of the blood pressure at the last 2 visits (in the last year) is above goal then return...
To assess, define, demonstrate, and evaluate best practices for knowledge management and clinical decision support in healthcare information technology at scale – across multiple ambulatory care settings and EHR technology platforms.

www.partners.org/cird/cdsc

AHRQ Contract #: 290-08-10010
Goal: To assess, define, demonstrate, and evaluate best practices for knowledge management and clinical decision support in healthcare information technology at scale – across multiple ambulatory care settings and EHR technology platforms.

Significance: The CDS Consortium will carry out a variety of activities to improve knowledge about decision support, with the ultimate goal of supporting and enabling widespread sharing and adoption of clinical decision support.
CDSC Conceptual Approach

CDSC Evidence-based Guidelines (e.g., DM, HTN, CAD)
Level 1

Translation

Level 2 and Level 3 Specifications

Dissemination

KM Portal and Repository

Collaboration

Refinement

CDS Services

EMR

End user access

Collaboration

Performance Measures

Provider Dashboard

Developer Dashboard
KM Portal: Gateway to Clinical Knowledge

Knowledge Management Portal

Search Term:

Specification Level:
- All Levels
- Level 1 - Unstructured
- Level 2 - Semi-Structured

Contributing Entity:
- All Contributing Entities
- GE Healthcare
- Kaiser Permanente Northwest

Content Type:
- Alert
- All Content Types
- Definition/Dictionaries

Clinical Domain:
- Aerospace Medicine
- All Clinical Domain
- Allergy and Immunology
- Anesthesiology
- Audiology
- Chiropractic Medicine

Intended Recipient Role:
- All Roles
- Nurse
- Patient

Clinical Information System:
- All Clinical Info Systems
- GE
- Meditech

Patient Population:
- Adolescent
- Adult
- All Patient Population

Date From: [ ] Date To: [ ]
CDS Services: ECRS Functionality

Enterprise CDS Framework

CDS Consumers
- External to PHS
- Internal, Cache
- Vendor, nonCache

Supporting Services
- CCD Factory
- Pt Data Access
- Classification Services
- Translation Services

Patient Data
Reference Data

ECRS
- Metadata Query
- Run Rules Controller
- Action
- Rule DB

Rule Authoring

Run Rules

Vendor Products

ORCHESTRATOR
CDS Service Calls

- **February**: Total calls: 49, Total success calls: 28, Total failure calls: [data not shown]
- **March**: Total calls: 28, Total success calls: 28, Total failure calls: [data not shown]
- **May**: Total calls: 28, Total success calls: 28, Total failure calls: [data not shown]
## Issues and Limitations

### Perceived Benefits
- Simpler software design and implementation, by decomposing complex problems into smaller, more manageable ones.
- Improved software reusability through enhanced reuse of existing IT resources.
- Improved adaptability to changing business requirements. (knowledge management)
- Cost savings consequent to the above benefits.

### Limitations
- Designed for independent re-usability from outset?
- Localization to context of consuming application
- Framework building and reference architecture
- Service orchestration and discovery
- Business case (traditional, as well as IT)
- Service-level agreements (and trust)
- Fair market economy

*Nadkarni PM, Miller RA J Am Med Inform Assoc. 2007;14:244–246.*
Thank you!

Where are we?

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