Health Information Exchange (HIE): Nuts and Bolts

Atif Zafar, MD

AHRQ National Resource Center for Health IT

Advancing Excellence in Health Care

Presentation Outline

- Introduction to HIE Technologies
  - Data Repositories
  - Standards (coding and messaging)
  - Prototypical Data Sharing Models
  - Applications
- Strategies for building a HIE
  - Technical
  - Cultural
- The National Agenda for HIE
- Best Practices and Lessons Learned
- Discussion and Q&A

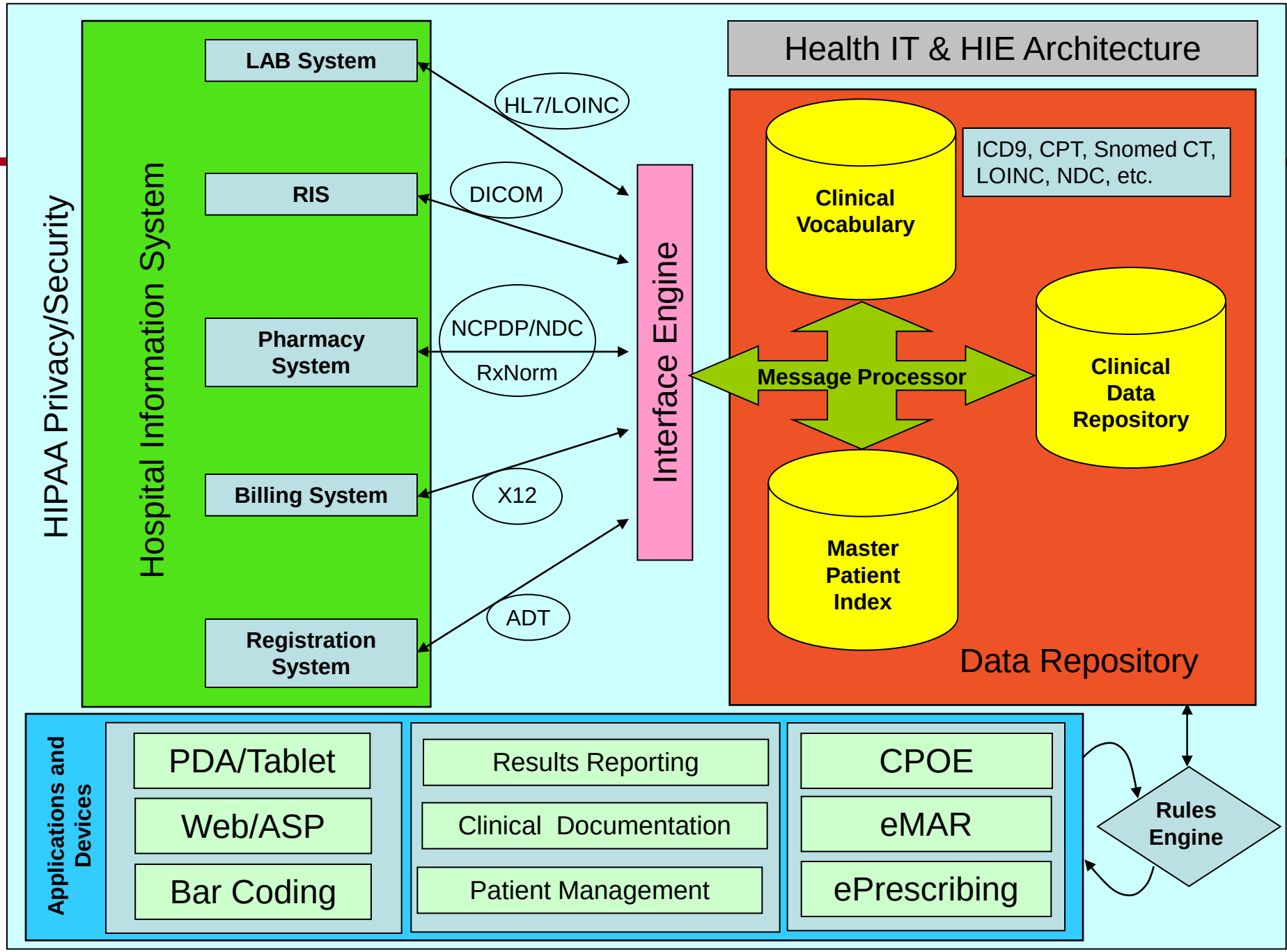
Introduction

- Health Information Technology (Health IT)
  - Umbrella term that refers to *many* types of technology solutions that assist with the care process:
    - EMR's and EHR's
    - ePrescribing
    - CPOE/CDS
    - eMARs and Bar Coding
    - Telemedicine
- Health Information Exchange (HIE)
  - Refers to electronic sharing of clinical and administrative information among otherwise competing institutions for *clinical care*, process improvement/simplification, research or reporting.

What are the components *Health IT*?

- Health IT is *very complex* with many cultural, technical, financial and logistical components
- This complexity can be simplified using the following framework:

  - Application Level:
    - CPOE, CDS, ePrescribing, eMAR, Results Reporting, Electronic Documentation, Interface Engines …
  - Communication Level:
    - Messaging Standards
      - HL7, ADT, NCPDP, X12, DICOM, UB92, HCFA, ASTM, EDIFACT, etc.
    - Coding Standards
      - LOINC, ICD-9, CPT, NDC, RxNorm, Snomed CT, etc.
  - Process Level:
    - HIE, MPI, HIPAA Security/Privacy …
  - Device Level:
    - Tablet PCs, ASP models, PDAs, Bar Coding, …


Health IT & HIE Architecture
HIPAA Privacy/Security
Hospital Information System
LAB System
RIS
Pharmacy System
Billing System
Registration System
HL7/LOINC
DICOM
NCPDP/NDC
RxNorm
X12
ADT
Interface Engine
Message Processor
Clinical Vocabulary
ICD9, CPT, Snomed CT, LOINC, NDC, etc.
Clinical Data Repository
Master Patient Index
Data Repository
Applications and Devices
PDA/Tablet
Web/ASP
Bar Coding
Results Reporting
Clinical Documentation
Patient Management
CPOE
eMAR
ePrescribing
Rules Engine

Introduction

- At the center of all of these technologies is just a *database* or *clinical data repository*.
  - The database stores many kinds of information:
    - Patient demographics
    - Diagnoses and Problem Lists
    - Medication History
    - Clinical Reports, Clinical Notes etc.
    - Results (labs, radiology, pathology etc.)
    - Visit history
    - Orders
  - This database can be quite rich and *used to identify patients* for clinical studies or provide clinical care.

Introduction

- This database:
  - Can be very simple
    - MS Access can be used to program a simple electronic health record
    - IU created a simple EMR for HIV Care in Kenya based on Access
    - Contained fields for data entry and a simple controlled vocabulary for data definitions along with a system for results reporting
  - Or can be very complex
    - Can use Microsoft SQL Server, Oracle etc.
    - Commercial products use these databases
  - Or can be based on open-source projects
    - MySQL/Postgres etc.
    - The new AMRS program (http://amrs.iukenya.org)

Introduction

- The database:
  - Can *also contain study related information*
    - Answer data from study questions
    - Registration data for patients in your study
    - Ancillary clinical data related to your study patients
  - The data entry tool can then provide some useful features
    - Real-Time Data validation (ensuring accuracy of entered data)
    - Easy data retrieval, status updates
    - Managing the problem of duplicate data entry
    - Automatic notifications (to PI etc.)

Introduction

- The database can be *centralized* or *distributed*.
  - Centralized Models
    - Aggregate data in one location (either in real time or in batch mode)
    - Need to *normalize* the data to a common vocabulary, units etc.
    - Need a master-patient index to aggregate data
    - Runtime is fast if the connection to a central server is fast
    - Data storage can be secure and be audited
    - In a *federated* model, data providers have access to servers
  - Distributed (or Switch) Models
    - Use a *Record Locator Service*, which is a “yellow pages” for data
    - At runtime, 2 processes occur, one to get the location and another to get the data

Introduction

- In order to understand the contents of the database you need a ***clinical vocabulary*** (usually built using *coding standards*)
  - Vocabulary contains many data type definitions:
    - Test Names (including *units* and *normal ranges*)
    - Medication Names
    - Diagnoses
    - Procedure Names
    - General Clinical Terms
      - Anatomic Locations
      - Complaints and Problems
      - Institution Specific names (biox = pulseox)

- The federal government is in the process of making national recommendations for use of specific standards
  - http://www.ansi.org/standards_activities/standards_boards_panels/hisb/faq_hitsp.aspx?menuid=3

Problems with the Data Sources

- One problem right now is that data is stored in *too many repositories* or "islands" of systems

- Difficult to "bridge" and combine because:
  - Contain different data at different levels of granularity
  - Each uses a different *code* to identify the same information.

- Many institutions do not capture all of the data of interest to clinicians.
  - Labs are sent to external reference laboratories
  - Patients fill their scripts at community pharmacies

The Role of Standards

- Fortunately, most of the informatics community has realized that the solution to the problem of bridging these data systems lies in the implementation of *Standards for Data Communication*.

- These standards permit data to be easily *translated* from one database system to another

Standards

- There are many many standards, each for a different purpose
  - Lab Data Communication
  - General Clinical Messaging
  - Radiology Image Transmittals
  - Diagnostic Coding
  - Procedure Coding
- Need to distinguish between ***coding standards*** and ***messaging standards***.

Standards

- Messaging Standards:
  - Communicate actual patient data
  - Combine a data element and a concept code in the same stream
  - Messages contain identifiers for patients, date and time, transaction type, service provider etc.
  - Examples: HL7, DICOM
- Coding Standards:
  - Represent *clinical knowledge* using codes
  - Contain *NO* patient data
  - Examples: LOINC, Snomed, ICD9, CPT, UMLS
  - These codes are *attached* to data elements to represent the semantics (meaning) of the message

Introduction

- Clinical Applications then sit on top of this database to make higher-level functions available to stakeholders:
  - Data Retrieval
  - Provider Order Entry
  - Decision Support
  - Electronic Prescribing
  - Electronic Patient Registration
  - Research and Data Mining
  - Clinical Messaging
  - Public Health
  - Accreditation and Compliance

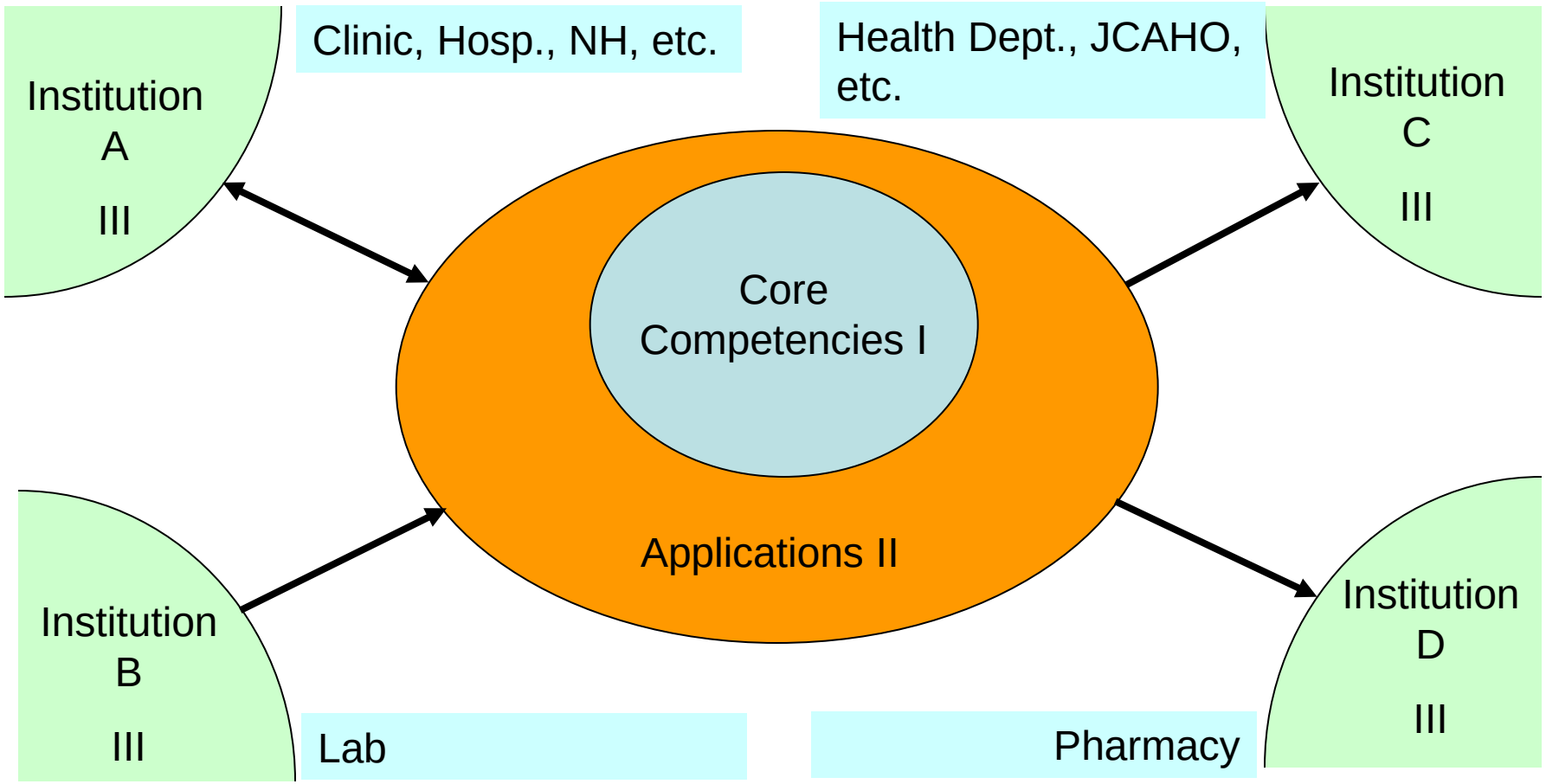
Questions you need to address

- Core Competencies
  - **Data Model / Data Repository / Clinical Vocabulary**
    - Minimum Data Set to be shared?
  - **Data sharing architecture**
    - Central vs. Switch Model?
    - Federated or Non-Federated?
  - **Security and Authentication Layer?**
  - **Messaging and Coding Standards**
    - Mapping Effort – who, how?
    - Message Processors – interface engines?
  - **Patient and Provider Identification**
    - Enterprise Master Patient/Provider Index?

Questions you need to address

- Business and Legal Components
  - HIPAA secure transactions
    - Patient authorization
  - Data Sharing and Data Use Agreements
    - Minimum Data Sets
    - Terms of Use
    - Arbitration and Grievance Processing
    - Security
  - Cost and Sustainability Model
    - Who pays?

Framework for HIE



Technical Strategies for Effective Health Information Exchanges

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Building a Repository

- Understand how is data *currently* captured, stored and shared in *your* setting.
  - ADT System (Admission/Discharge/Transfer)
  - Other clinical messaging (HL7)
  - Outpatient Registration System (IDX)
  - Lab System (LOINC)
  - Pharmacy System (NDC codes)
  - Billing System (ICD9/CPT)
  - Radiology System (RIS, PACS)
  - Emergency Room Registration System
- Enumerate your systems and describe the data input/output functions performed by each one

Building a Repository

- Ask how you can take advantage of what currently exists
  - Take advantage of the ADT System
  - Most hospitals will have this
  - You should start with this system *first*
  - Can go a long way towards helping you build a patient registry outside the hospital

ADT Messages

- ADT Messages:
  - Are a class of HL7 messages
  - 95% of community hospital vendors support this and most hospitals in the country will have this in place
  - Record Admission/Discharge/Transfer data, demographics as well as payments and clinical information (diagnoses – ICD-9)
  - Are unsolicited messages that are “broadcast” to the network when an “event” happens
  - A message processor usually “listens in” and processes messages relevant to it.
  - It then populates its internal patient registry with the latest demographic information

ADT Messages

- ADT Messages:
  - *VERY* useful if you currently have no way to capture electronic data
  - Can develop an interface to “listen in” to these messages, parse them and then extract the relevant
  - Other systems often generate other types of HL7 messages (ORU) after receiving ADT messages and **add relevant data**:
    - RIS/PACS -> Radiology Reports
    - Hospital Admissions -> Diagnoses, Discharge Summary etc.
    - Clinic Registration -> Chief Complaints

Decide on a common vocabulary

- Key to getting the data out of your system in a meaningful way
- Make sure your data model is robust
- Many “ways” to represent and define disease in systems:
  - For example, diabetes can be defined in any of the following ways:
    - fasting BS > 126
    - random BS > 200
    - person on insulin or other diabetic drug
    - person with a diagnosis (ICD 250.XX) of diabetes
    - person with a Hgb A1c > 8 or other value
- Representing data in the right way using the right codes is thus key to being able to get data out easily

“Sales Pitches” to get Buy-In from your stakeholders

Benefits to Providers

- Outpatient docs do not know what happened in the hospital to one of their patients
  - Medication Lists
  - Lab and test results
  - Diagnoses and Problems
  - Discharge Summary
- The ER does not know the history of a patient being seen by a primary care provider
  - Clinic Notes
  - Medication Lists
  - Diagnoses and Problems

Benefits to Providers

- A specialist does not know what tests were done on a referred patient
  - Referral Question – i.e. *why were they referred*?
  - Lab and test results
  - Radiology and Nuclear Medicine data
  - Medication Lists
  - Diagnoses
- A primary care provider does not know what a specialist did
  - Specialty care clinic notes
  - Follow-up recommendations

Benefits to Providers

- Other questions regarding usage:
  - Was the patient seen in other clinics or in other ERs recently and for what and what was done?
    - Patients move around a lot (esp. here in Indiana)
  - Which pharmacies are filling the prescriptions?
  - What appointments does the patient have that are upcoming or which appointments were missed?
- Prevention and Surveillance
  - Immunization and Disease Outbreaks
- Home Health Care

Benefits to Institutions

- Financial ROI
  - CITL estimates up to $77.8 Billion *annually* when implemented using the appropriate standards
    - Jan Walker et. al., “The value of Health Care Information Exchange and Interoperability”, *Health Affairs*, 19-Jan-05
  - But, Connecting for Health *disagrees!*
    - Says, $20K annual *loss* per doc in a small practice setting

Benefits to Institutions

- Financial ROI – types of data shared
  - Infection Control is a major burden
    - MRSA, VRE mainly but Hep B/C and HIV as well
    - Fixed DRGs for these for hospitals
    - Sharing data could help streamline hosp. costs
  - Eligibility information
    - Reduce manual labor
    - Massachusetts a good example of this

Benefits to Institutions

- Supports Practice of Medicine
  - Clinically relevant data is immediately accessible
  - Improves inter-provider communication
  - Helps with bio-surveillance (eg: PHIN)
- Promotes Standardization of Care
  - Reduces disparities in care
  - Helps detect undocumented issues
- Improves Safety and Quality of Care
  - Enhances patient satisfaction
  - Reduces need for repeat testing
  - Helps with medication reconciliation

Barriers to Health Information Exchange

- Organizational Risks
- Privacy
- Legal Environment
- Organizational Territorialism
- Competing Agendas
- Management Capability
- Executive Sponsorship
- Technology Costs
- Stakeholder Buy-in
- Cost and ROI still hotly debated

- http://content.healthaffairs.org/cgi/eletters/hlthaff.w5.10v1#272

What's Going on Nationally?

- Given the controversies about HIE, AHRQ funded 6 states to do *demo projects* to show the value of HIE ($5 million a site)
  - Called for 3 year rapid-cycle efforts at instantiating an HIE effort
  - Many of these states still have substantial barriers to overcome 1 year out!
- Many of the grantees in the AHRQ Health IT portfolio are doing HIE related projects:
  - http://healthit.ahrq.gov

What's Going on Nationally?

- What roadblocks are they facing?
  - Lack of knowledge about the details
    - Yes, the devil is in the details
  - Lack of stakeholder buy-in
  - Limited information on a viable financial model so not supported by administrators and decision makers
  - Lack of viable technical solutions
    - Many questions about the best data sharing model, which standards to use, legal climate etc.

What's Going on Nationally?

- However, there are a few shining stars
  - Taconic IPA in New York
  - Veterans Administration (VISTA)
  - Indiana (done this for 30+ years!)
  - Cincinnati HealthBridge
  - Inland NW in Seattle
  - RMD Networks' efforts in Colorado
  - Kryptiq efforts in Oregon

What's Going on Nationally?

- Who else is funding?
  - Big player is the eHealthInitiative®
    - http://www.ehealthinitiative.org
  - $2 Million awarded to 9 communities in 2004
    - http://ccbh.ehealthinitiative.org/communities/funded.mspx

Other non-profits

- Markle Foundation (RWJ)
  - Engaging the most prominent national experts
  - Creating “usable” products
    - New Toolkit: The Common Framework
      - http://www.connectingforhealth.org/commonframework/
    - Sample architectural specifications
      - **Record Locator Service Software and Technologies**
        - » Available Q1 2006
        - » Freely available
        - » Licensing terms (binary or opensource) still unclear
  - Involved with federal efforts in helping define national standards

- Website:
  - http://www.markle.org/markle_programs/healthcare/index.php

Notable Federal Efforts

- Katrina has put HIE into high gear
  - Many “paper records underwater”
  - Prescription Drug Histories of prime importance
    - RxHub, SureScripts got together and provided these
  - VA was a shining example of successful HIEI
- ONCHIT (http://www.hhs.gov/healthit/)
  - Standards Harmonization
  - NHIN
  - Privacy/Security
- ePrescribing for Medicare Part D
  - http://www.camgma.com/news/eprescribing%2003-2005.htm
- CCHIT Certification of EHRs
  - http://www.cchit.org/publiccomment1.htm

Lessons Learned

Culture and Workflow Change
(Remember: Culture change = Advertising+Support)

- Solution: *Do not underestimate* the training required in order to address culture change. In most cases you will need full-time support staff for this. You may have to spend up to 20% of your IT budget on training alone.
  - Need for Upfront, Ongoing and Retraining
  - Use of "surrogate" trainers - the Cleveland Clinic CPOE example.
    - EX: Train those that work the closest with the individuals who are resistant and use these "surrogates" to monitor, train and support these resistant providers. Need to first find out who these people are so do a workflow observation.
  - "Catch-on" features - advertise them well and to everyone!
  - Ensure that the "vocabulary" is as close to that of a user as possible so that a seamless transition occurs between the paper and electronic worlds.
  - Make sure to pilot test and troubleshoot the system before going live and go live in stages (by care units, staff types, institutions etc.)
    - Make sure you can anticipate user questions, understand the full closed-loop system, train the support people first and have contingency plans ready in case of disaster and continuously benchmark the system (use/acceptance, %orders etc.)
- The culture change can take years to develop so don't rush it - work more closely with the enthusiasts and early adopters (20%) and let them blaze the trail for the others to follow, i.e. **START SMALL**!

Technology: Security

- Problem: Lack of trust in data security is a huge barrier to adoption of HIT systems.
  - Many providers still worry about what will happen if the system goes down or is hacked? Do you need paper backups? Redundant servers ($$$)?
  - Vendors advertise that they are “HIPAA compliant” but don’t let that fool you. A lot of burden for HIPAA compliance is actually on *your* shoulders and the vendor can do nothing about that.
    - Vendors are responsible for making sure *their application* is HIPAA compliant (uses login/passwords, has automatic signouts, uses secure messaging (https, SSL, etc.) and is backed up.
    - But they have no control over *your network architecture!*
  - Your institutional policies and procedures need to be HIPAA compliant, and in most cases they will be
  - For small practices this could be a problem. May need to invest in security tools and personnel.

Technology: Security

- Caveats:
  - Firewalls (hardware or software) are *overrated*.
    - They prevent most known ways of hacking but new ways are found every day.
    - Need competent people watching the firewall most of the time in order for this to work properly.
    - CISCO Systems estimates this can cost upwards of $20K/month!
  - Beware of software that “open up ports on your system” without you knowing that it is happening!
    - Providers like to install all kinds of health related software on their systems that can potentially open up the system for hackers!
  - Wireless networks are inherently insecure. Don’t install them unless absolutely necessary and then consult a security advisor to ensure it is safe. Some common sense, easy to use ways to do this well exist.

Technology: Security

- Solution: Understand your network security architecture
  - Do you have security personnel?
  - Do you use secure communications channels?
    - SSL Certificates
    - https (128-bit encryption)
    - VPNs (Virtual Private Networks) - quite safe
    - **Peer-to-Peer connections (safest)**
  - Do you have a firewall, virus protection and intrusion detection capabilities and competent people to oversee them?
  - Educate the users well! This takes a lot of time, effort *and patience* for the docs to "accept" the security equation.

- Solution: For small practices an ASP model may be more attractive

Technology: Security

- Solution: Use common-sense measures to prevent problems
  - Logoff when you leave a terminal
  - Use good “password hygiene”:
    - Use number/letter combinations
    - Change your password often
    - Do not reuse a password
    - Don’t give your passwords out to others
    - Don’t have passwords written down.
    - Use easy to remember passwords.
  - Be sure you understand your institution’s policies and procedures, including the reporting chain of command, disaster plans etc.
  - Use security hardware: RSA keys/tokens, biometrics (quirky)

Technology: Repository Design

- Problem: Representing clinical data in a coded manner in a database is not a trivial task. There are many ways to do the same thing and many standards for representing clinical data
  - Ex: ICD9, CPT, Snomed CT, LOINC, NDC, etc.
  - You need to be aware of the different ways people say the same thing and build your repository to accommodate those ways to expressing information
  - This makes sure that a provider does not inadvertently order the wrong test or the wrong medication

- Solution: You need a master synonym dictionary for clinical terms. Many vendors do this for you already but you need to be able to customize it to your settings. Work with your providers to define these additional terms.

Technology: Repository Design

- Problem: Getting data out of the system is also a big problem in many systems. You need to make sure you can get data out easily - its usually required for many purposes such as benchmarking, research, administrative reporting etc.

- Solution: As you look towards planning your system deployment and testing/benchmarking it, you should think of adding *instrumentation metrics* right into your system from the start.
  - For example, have built-in fields for indicators such as:
    - # orders completed online
    - Averages for clinical endpoints such as Hgb A1c, Blood pressure, etc.
    - Demographics etc.
  - Work with your vendor at the outset to define and enable automatic data capture within these areas because you will undoubtedly need them later.

Technology: Performance

- Problem: System performance is a big factor in acceptance. A slow system will never be acceptable.
- Solution: Pilot testing will help iron out some of the performance issues:
  - Database performance
    - Remember that with some database back-ends unless the configuration is done correctly they will be very slow for very quirky and technical reasons, despite having fast servers and wide network bandwidths
    - Problems result from the use of inefficient caches, need to look-up a result every time instead of caching frequently used results, etc.
      - http://www-rohan.sdsu.edu/doc/oracle/server803/A54638_01/evalchar.htm
    - Avoid a transaction based database configuration - ensure it is patient based or encounter based in order to optimize performance.
  - Network Performance
    - Firewalls are notoriously slow and sometimes network IP packets are broken down in front of the firewall and reconstituted on the other end (a la Star Trek transporter paradigm).
    - Needless to say this can be very slow and can be turned off for intranet devices but you need to explicitly configure the firewall that way.

Technology: Standards

- Problem: The key thing to remember about standards is that they are not standard!
  - Many “acceptable” ways of representing data within HL7 messages - some “mischievous”
    - EX: Putting lab results in the “message” section of an HL7 stream
    - Putting the result data and units together in one field instead of in separate fields
    - Different institutions may use different “versions” which may need to be accounted for (i.e. v2.4 vs. v2.5 of HL7).
  - Interface Engines will typically *not* pick up these errors - need human intervention which is costly
    - Regenstrief has 2-3 FTEs dedicated to address mapping problems alone!
    - A change in reporting units by one lab (from mg/dl to mg/L) resulted in 20,000 exceptions being generated! Someone had to manually look at all of these results and check what was wrong!
    - May need face-to-face contact to address some problems.
  - There are no standards for certain types of data:
    - Problem Lists
    - Allergy information

Technology: Standards

- Solution: Don't underestimate the effort needed for conformance testing.
  - Will need at least 1-2 FTEs to make sure that standards are working.
  - For the small practice EHRs make sure that your vendor has done the conformance testing and is able to report out the most common problems
  - Use HL7 Lint (a freeware application available from Regenstrief)
    - http://www.regenstrief.org/loinc/download/
    - Picks up misplaced *unit* fields but is being extended to support other types of errors
  - Be firm with the entities supplying data into your system - make sure they comply with the correct formulations of standards and that they report any aberrations to you in a timely manner - you really need open and frequent communication for this to work

Technology: Procurement

- Vendor Selection:
  - This is a big part of any EHR Implementation process
  - Take your time doing this - do it right, or else …
    - $20M system put in at a famous institution, few months later was shut off.
  - A good place to start is the AAFP website:
    - http://www.aafp.org/fpm/20050200/55howt.html
    - Defines 12 common-sense steps with some tools you can use right away
      - Includes an RFP process and site visits
      - Provides checklists and tools for you, including vendor rating forms
  - Others have similar tools (eg: http://www.communityclinics.org/files/797_file_DTM_6.pdf)
  - Make sure you are able to compare different vendors side by side using the *same* metrics - this can be tricky as vendors don't often report the same performance metrics.
  - Also make sure that you don't just listen to a vendors' demo but develop your own use cases and ask the vendor to demo how their product will work given your demo cases!

Technology: Standards

- Solution: Keep abreast of what is happening nationally:
  - The ONCHIT Standards Harmonization Effort
    - HHS has sought to contract with non-for-profit collaborative to look at the feasibility and effectiveness of a process for widespread EHR interoperability
    - http://www.hhs.gov/healthit/documents/RFPfactsheet.pdf
  - The new final rule for Foundation Standards for ePrescribing under Medicare
    - http://www.ehealthinitiative.org/initiatives/policy/administration.mspx
  - CCHIT is working on an EHR "certification process"
  - This will include the following areas:
    - Incorporation of Common Use Cases
    - Development of Detailed Methodology and Performance Criteria
    - Certification Application Process
    - Test Execution
    - Certification Results
    - Certification Maintenance/Re-certification
  - http://www.cchit.org/files/Certification%20Process%20Narrative.pdf
    http://www.himss.org/Content/Files/HIMSSPulseonPP/pulseonpp_20050616.html

Q&A

Thank You!

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