Health Information Exchange (HIE) Learning Series

HIE-104
Technology – a Deeper Dive

11/17/2014

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Acknowledgement

This course was originally developed for Planned Parenthood and funded by CalHIPSO from HITECH funds. The course is one of many educational materials produced by CalHIPSO in fulfillment of their role in educating stakeholders on health information technology.

CalEMSA expresses its appreciation to CalHIPSO for allowing it to use and modify the course content to fit the needs of this ***HIE Boot Camp***.

Agenda

- Course Overview / Purpose
- Data Representation
  - Triggered event transactions with HL7 v2.x
  - Care Summary data with CCDA and CCD
- National Strategies for Moving Health Data
  - Direct
  - Exchange
- HIE Services
  - Foundational Services
  - Added Services
- The California Trust Network - assuring data availability
- Considerations for your data exchange strategy
- Q&A

Course Overview/Purpose

The *Technology* course addresses the specific technologies used in the operation of HIEs. The course will discuss standards for representation of information, look at technology details of the national strategies for moving health data around, discuss key services that differentiate HIEs from each other, the California landscape of HIE, and finally discuss models for exchange which Planned Parenthood may want to consider as it develops its data exchange strategy.

Learning Objectives

At the conclusion of this HIE-104 course, participants will be able to:

- Identify the standards for representing both triggered event data and summary of care data;
- Recognize the characteristics of each national strategy for exchange; describe the technical capabilities of each.
- Differentiate between the HIE services and choose which will provide value to your HIE strategy.
- Understand the California exchange strategy and options for connecting to your local providers of care.
- Formulate your data exchange strategy.

Data Representation

- Triggered event transactions with HL7 v2.x

http://www.hl7.org/documentcenter/public_temp_C7FDD89D-1C23-BA17-0C2D990B02AEFC90/wg/conf/Msgadt.pdf

- Care Summary data with CCDA and CCD

http://www.hl7.org/implement/standards/product_brief.cfm?product_id=7

HL7 (Health Level 7)

HL7 is the ANSI-designated standards body for definition of message content.

- Two fundamental versions:
  - That used for triggered transactions such as ADT, Results, Prescriptions, Orders, and virtually all other transactions found in hospitals and ambulatory care (v2.3 – v2.6)
  - That used in the HITSP-defined messages for data exchange (v3.1)

Structure of 2.x Messages

- Each message is divided into segments
  - Each segment corresponds to one line of the message
  - All messages begin with a Message Header (MSH) segment
    - Gives general sender, receiver, and protocol information, including encoding data
    - Provides timestamps and acknowledgement instructions
    - Provides message control & sequencing

Structure of 2.x Messages

Encoding of the message is typically ASCII character set (as defined in ER/7) for HL7 v2.x with defined segments and fields:

- Example segments:
  - MSH: Message Header
  - PID: Patient Identification
  - PV1: Patient Visit
  - OBR: Observation Request
  - OBX: Observation Result
  - ORC: Order
  - Apprx. 170 others.

Structure of 2.x Messages

{ } Repetition [ ] Optionality <inset> Precedence

- Example message definition

```
ORU^R01  Observational Results (Unsolicited)          Chapter
MSH      Message Header                                 2
{
 [
  PID     Patient Identification                        3
  [PD1]   Additional Demographics                       3
  [{NK1}]         Next of Kin/Associated Parties        3
     [{NTE}]      Notes and Comments                    2
    [PV1          Patient Visit    3
      [PV2]]      Patient Visit - Additional Info       3
 ]
 {
  [ORC]   Order common                                  4
   OBR    Observations Report ID                        7
   {[NTE]}        Notes and comments                    2
     {
      [OBX]       Observation/Result                    7
       {[NTE]}    Notes and comments                    2
     }
   {[CTI]}        Clinical Trial Identification         7
 }
}
[DSC]    Continuation Pointer                           2
```


Structure of 2.x Messages

Trigger Events

- Based on activities in the health care world
- Activities create the need for information flow
- Activity is represented by a "trigger event" which is captured as part of the HL7 2.x message.
- Examples:
  - ADT^A01 - Admit a patient
  - ADT^A03 – Discharge a patient
  - OML^O21 - Order a lab test
  - ORU^R01 - Post a lab test result

Data Fields

- Building blocks of segments
- Define the information carried in the message
- Must be one of the predefined data types
- Examples:
  - MSH-3 - Sending application
  - PID-5 - Patient name
  - ORC-12 - Ordering provider

Data Types and Components

- Specify the exact format of data fields
- Can be complex
- Are a pre-defined set for all messages
- Examples:
  - ST - Data string
  - IS - Coded value
  - TS - Time stamp

Looking at an ADT Message

Patient ***William A. Jones, III*** was admitted on July 18, 1988 at 11:23 a.m. by doctor Sidney J. Lebauer (#004777) for surgery (SUR). He has been assigned to room 2012, bed 01 on nursing unit 2000.

```
MSH|^~\&|ADT1|MCM|LABADT|MCM|198808181126|SECURITY|
  ADT^A01|MSG00001|P|2.3.1|<cr>
EVN|A01|198808181123||<cr>
PID|1||PATID1234^5^M11^ADT1^MR^MCM~123456789^^^USSS
  A^SS||JONES^WILLIAM^A^III||19610615|M||C|1200 N
  ELM
  STREET^^GREENSBORO^NC^27401-1020|GL|(919)379-1212
  |(919)271-3434||S||PATID12345001^2^M10^ADT1^AN^A|
  123456789|987654^NC|<cr>
NK1|1|JONES^BARBARA^K|WI^WIFE|||NK^NEXT OF KIN<cr>
PV1|1|I|2000^2012^01||||004777^LEBAUER^SIDNEY^J.|||
  SUR|||ADM|A0|<cr>
```


Field Descriptions

Figure 3-2. PID attributes

SEQ	LEN	DT	OPT	RP#	TBL#	ITEM#	ELEMENT NAME
1	4	SI	O			00104	Set ID - Patient ID
2	20	CX	O			00105	Patient ID (External ID)
3	20	CX	R	Y		00106	Patient ID (Internal ID)
4	20	CX	O	Y		00107	Alternate Patient ID - PID
5	48	XPN	R	Y		00108	Patient Name
6	48	XPN	O			00109	Mother's Maiden Name
7	26	TS	O			00110	Date/Time of Birth
8	1	IS	O		0001	00111	Sex
9	48	XPN	O	Y		00112	Patient Alias
10	1	IS	O		0005	00113	Race
11	106	XAD	O	Y		00114	Patient Address
12	4	IS	B			00115	County Code
13	40	XTN	O	Y		00116	Phone Number - Home
14	40	XTN	O	Y		00117	Phone Number - Business
15	60	CE	O		0296	00118	Primary Language
16	1	IS	O		0002	00119	Marital Status
17	3	IS	O		0006	00120	Religion
18	20	CX	O			00121	Patient Account Number
19	16	ST	O			00122	SSN Number - Patient
20	25	DLN	O			00123	Driver's License Number - Patient
21	20	CX	O	Y		00124	Mother's Identifier
22	3	IS	O		0189	00125	Ethnic Group
23	60	ST	O			00126	Birth Place
24	2	ID	O		0136	00127	Multiple Birth Indicator
25	2	NM	O			00128	Birth Order
26	4	IS	O	Y	0171	00129	Citizenship
27	60	CE	O		0172	00130	Veterans Military Status
28	80	CE	O			00739	Nationality
29	26	TS	O			00740	Patient Death Date and Time
30	1	ID	O		0136	00741	Patient Death Indicator

Interface Dialogues - Lab/Rad

	Sender	Message	Order Control Code (ORC-1)	Application ACK (MSA-1)	Primary Data Elements	General ACK Message
CIS Initiated Order						
1	CIS	OML^O21^OML_O21	NW= New Order		CIS Placer Order Number	ACK^O21^ACK
2a	LIS	ORL^O22^ORL_O22	OK= Order accepted	AA= Application Accept	CIS Placer Order Number; LIS Filler Order Number; LIS Accession Number	ACK^O22^ACK
2b	LIS	ORL^O22^ORL_O22	DE= Data errors	AE= Application Error	CIS Placer Order Number	ACK^O22^ACK
Lab Initiated Order						
1	LIS	OML^O21^OML_O21	SN= Send order number		LIS Temp Placer Order Number; LIS Filler Order Number; LIS Accession Number	ACK^O21^ACK
2	CIS	ORL^O22^ORL_O22	NA= Number assigned		CIS Placer Order Number; LIS Filler Order Number; LIS Accession Number	ACK^O22^ACK
CIS Initiated Cancel						
1	CIS	OML^O21^OML_O21	CA= Cancel order request		CIS Placer Order Number/LIS Filler Order Number	ACK^O21^ACK
2a	LIS	ORL^O22^ORL_O22	CR= Canceled as requested	AA= Application Accept	CIS Placer Order Number/LIS Filler Order Number	ACK^O22^ACK
2b	LIS	ORL^O22^ORL_O22	UC= Unable to cancel	AA= Application Accept	CIS Placer Order Number/LIS Filler Order Number	ACK^O22^ACK
Lab Initiated Cancel						
1	LIS	OML^O21^OML_O21	OC= Order canceled		CIS Placer Order Number/LIS Filler Order Number	ACK^O21^ACK
Lab Initiated Status Change						
1	LIS	OML^O21^OML_O21	SC= Status changed: lab specimen is received and preprocessed by lab.		CIS Placer Order Number; LIS Filler Order Number; LIS Accession Number	ACK^O21^ACK
Results Reporting						
1	LIS	ORU^R01^ORU_R01	RE= Observations to follow		CIS Placer Order Number; LIS Filler Order Number; LIS Accession Number, OBR-25=F (Final results); results stored and verified. Can only be changed with a corrected result.	ACK^R01^ACK

Structure of HL7 3.1

- RIM: Reference Information Model
  - A large pictorial representation of all clinical domains.
  - Cornerstone of the Version 3 development process.
  - Complete explicit and normalized object model for healthcare shared between all domains.
  - Identifies the life cycle of a message or message groups.
  - ANSI-approved standard

HL7 3.1 – Important *Documents*

- CCDA – Consolidated Clinical Document Architecture

http://www.hl7.org/implement/standards/product_brief.cfm?product_id=7

- CCD – Continuity of Care Document

http://www.hl7.org/implement/standards/product_brief.cfm?product_id=6

Example of one CCDA Segment

Figure 2-13 Healthcare Provider Example

```
<!-- These examples assume the default namespace is 'urn:hl7-org:v3' -->
<documentationOf>
    <serviceEvent classCode="PCPR">
      <effectiveTime><low value="19650120"/><high
value="20070209"/></effectiveTime>
      <performer typeCode="PRF">
        <templateId root='2.16.840.1.113883.3.88.11.83.4'/>
        <templateId root='1.3.6.1.4.1.19376.1.5.3.1.2.3'/>
        <functionCode code='CP' displayName='Consulting Provider'
          codeSystem='2.16.840.1.113883.12.443' codeSystemName='Provider
Role'/>
          <originalText>Consulting Provider</originalText>
        <time>
          <low value=''/>
          <high value=''/>
        </time>
        <assignedEntity>
          <id root='2.16.840.1.113883.4.6'
            extension='NationalProviderID'/>
          <code code='200000000X'
            displayName='Allopathic and Osteopathic Physicians'
            codeSystem='2.16.840.1.113883.6.101'
            codeSystemName='ProviderCodes'/>
          <assignedPerson>
            <name>...</name>
          </assignedPerson>
          <sdtc:patient>
            <sdtc:id root='78A150ED-B890-49dc-B716-5EC0027B3983'
              extension='MedicalRecordNumber'/>
          </sdtc:patient>
        </assignedEntity>
      </performer>
    </serviceEvent>
</documentationOf>
```


CCDA – Consolidated Clinical Document Architecture

- Data is segregated into clinical Content domains or *Sections*:
  - Patient / Person
  - Healthcare Provider
  - Problems
  - Allergies
  - Medications
  - Procedures
  - Plan of Care
  - Family History
  - Pregnancy
  - Operative Note / Surgical Procedures Section
  - Approx. 60 others…

CCD – Continuity of Care Document

The CCD was a joint effort of HL7 and ASTM which had previously developed the unstructured CCR (Continuity of Care Record), and the effort was to align that "care summary" with the corresponding encoded CDA Sections.

Content sections included in the CCD:	
Advance Directive	Language Spoken (R)
Allergy / Drug Sensitivity	Medication – Prescription and Non-Prescription
Comment (R)	Person Information
Condition	Plan of Care
Encounter	Pregnancy
Healthcare Provider (R)	Procedure
Immunization	Support (R)
Information Source (R)	Vital Sign
Insurance Provider	Results

HITSP C32 - CCD

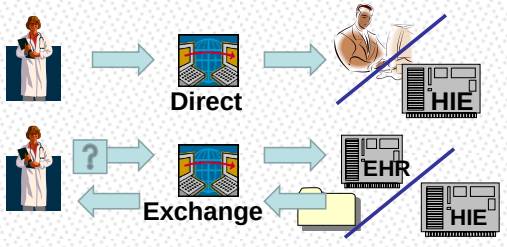
- Interoperability Workgroup Reference Implementation Specification (Completed Sept 2011; demonstrated at HIMSS Interoperability Showcase in Feb, 2012)
- Joint workgroup with Healtheway and the IWG to refine the C32 specification (Dec, 2012- May 2013)
  - Specification of the document header metadata
  - Harmonize with the CCDA document sections including metadata and key clinical content definitions
  - Provide clinical pointers on use cases – determination of depth of data content
  - Joint selection of CCHIT between Healtheway and IWG as the C32 / CCDA certification body
  - Release of the complete content dictionary for vendor development June, 2013

Microsoft Excel Worksheet

http://www.interopwg.org/documents/request.html

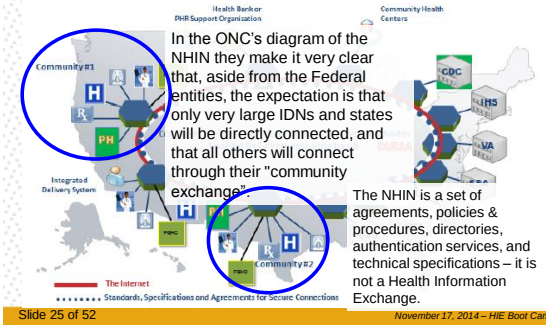
Segment 2: National Strategies

National strategies for moving clinical data between unrelated organizations:



NwHIN = eHealthExchange

"Network of Networks"
Nationwide Health Information Network (NHIN)



In the ONC's diagram of the NHIN they make it very clear that, aside from the Federal entities, the expectation is that only very large IDNs and states will be directly connected, and that all others will connect through their "community exchange".

The NHIN is a set of agreements, policies & procedures, directories, authentication services, and technical specifications – it is not a Health Information Exchange.

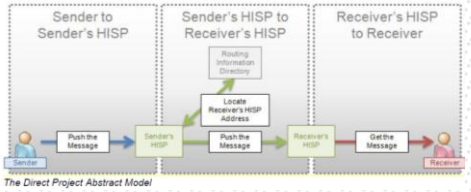
Direct

"The Direct Project specifies a *simple, secure, scalable, standards-based way for participants to send authenticated, encrypted health information directly to known, trusted recipients over the Internet."*

Quote taken from The Direct Project Overview, October, 2010:
http://wiki.directproject.org/file/view/DirectProjectOverview.pdf

Direct is simply a specialized form of email which is processed through a "Health Information Service Provider" (HISP) instead of a normal email route. Direct employs certificates and encryption to assure the confidentiality of the message.

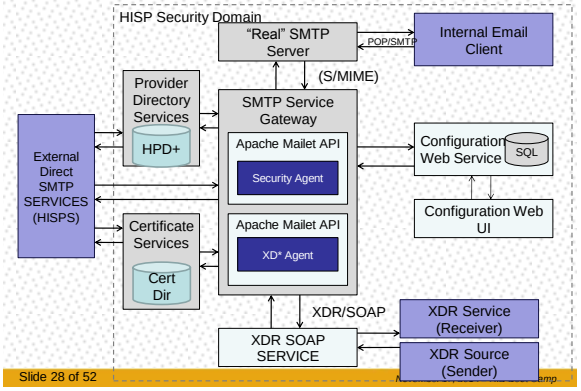
Direct Abstract Model



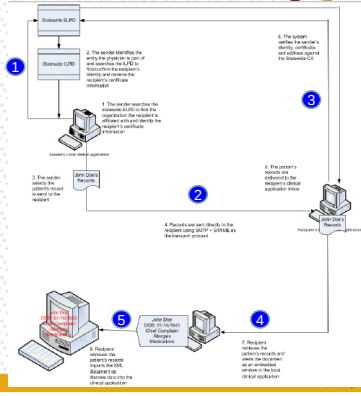
The Direct Project Abstract Model

- Direct is based on the simple concept that the receiver's address is known, and that the receiver has a need to know the ePHI that is pushed to them by the sender.
- Patient consent is not an issue with Direct
- Security, however, is paramount

Direct Service Diagram



Direct Work Flow



Exchange (Connect)

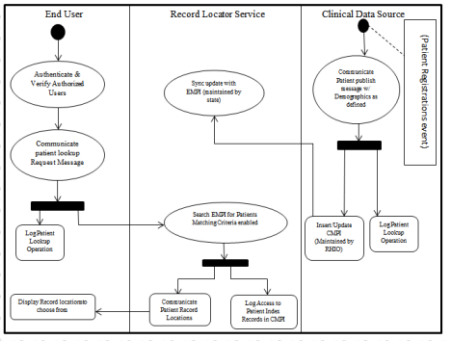
"CONNECT is an open source software solution that supports health information exchange – both locally and at the national level. CONNECT uses Nationwide Health Information Network standards and governance to make sure that health information exchanges are compatible with other exchanges being set up throughout the country."

Quote taken from About CONNECT, on the Connect Web Site:
http://www.connectopensource.org/about/what-is-connect

Exchange, in contrast to Direct, is a sophisticated services stack which is intended to employ several HITSP standards for health data exchange in a "pull" environment. Specifically, Exchange is the opposite of Direct in its method of operation – the requestor uses PIX/PDQ or XCPD to find a patient, and then through a query of the RLS requests certain documents.

http://healthewayinc.org/index.php/exchange

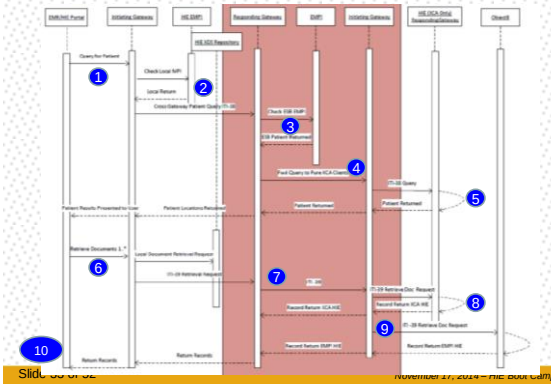
RLS Conceptual Flow



Exchange Interaction Model

- Requestor posts a request through their local gateway for a patient's information and supplies demographic information.
- The local gateway corresponds to the target gateway (or to several targets with XCPD).
- The target gateway(s) search their local MPIs to determine if any there is any match for the data.
- If one or more potential matches are found, that information is returned to the requestor.
- The requestor selects the patient they are interested in and asks what documents are available.
- The list of available documents is returned.
- The requestor selects one or more documents to be received.
- The responding gateway selects and returns the requested documents after verification of privilege.

Exchange Messaging Flow



Segment 3: HIE Services

HIE Services

- Foundational Services
- Transaction Services
- Interoperability Services
- Application Services
- Data Warehouse and Analytics

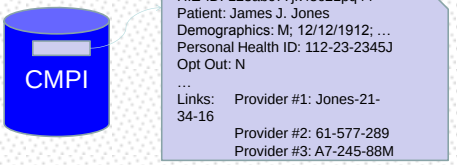
HIE Basic Technical Elements

HIE Foundational Services

- Community Master Patient Index (CMPI or EMPI)
- Record Locator Service (RLS)
- Master Provider Index (MPrI)
- Entity Directory (Hospitals, Med Groups, etc.)
- User Directory
- Other Directories (Clinics, Public Services, Registries, non-participant message destinations, etc.)
- Authentication / Authorization Methods
- ATNA-compliant Transaction and Use Logs

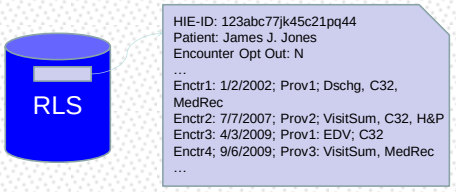
CMPI

CMPI – often called an "EnterpriseMPI" where the enterprise is the HIE, but with the advent of many IDNs who have their own "EMPI" a new term "CommunityMPI" is emerging to describe the HIE's aggregate MPI.

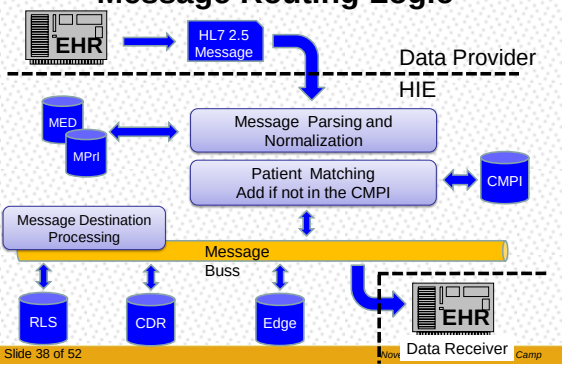


Record Locator Service (RLS)

The RLS is the next stop for most data coming into the HIE. It is used to locate the source of encounter information, and consequently is also a natural list of where encounters have occurred and, often, what kinds of data are available for the encounter.



Message Routing Logic



Transaction Services (Hospital & Ambulatory):

- Inbound Interfaces EHR→HIE
  - ADT: Encounters, discharges, demographic updates, MPI
- Outbound Interfaces HIE→EHR
  - Notifications: From Encounters
  - Care Reminders (triggered from clinical registries or HIE-based analytics)
- Bi-directional Interfaces EHR <-> HIE
  - Results: Labs, Radiology, Transcription, Vital Signs
  - Medications / Immunizations
  - Orders / Consult Requests
  - Physician messaging (with workflow integration)
  - Continuity of Care Document (CCD)

Interoperability Services

- Data parsing and translation
- Data Normalization
- Semantic Normalization
  - LOINC for Laboratory
  - RXNorm for Pharmacy
  - SNOMED for general medical terminology
  - ICD-10-CM for Diagnoses / ICD-10-PCS for Procedures
  - CPT for ambulatory services
- C32 parsing and storing of the discrete data (allowing analytic computability)

Application Services

- Results Distribution
- Consent Management (Opt-In, Opt-Out)
- Secure Clinician-Clinician Messaging / Referrals
- Gateways (NwHIN, other local HIEs, State HIEs, Direct HISP, Immunization Registry, Public Health)
- Portal to view the "Community Record"
  - Flow Sheets
  - "Mark and Transfer" – move certain data to the EHR
- "Break the Glass" for viewing of information marked *sensitive* or opted-out patients

Workflow Considerations

Workflow is likely the most important consideration for an HIE next to privacy and security – it may even trump cost.

- Notifications must be delivered to the provider's in-box or EHR-based worklist
- Clinical data reconciliation is a key service to promote physician adoption and use of the HIE
- Value is realized when difficult tasks are simplified
- Physicians need to be able to readily manage their patients within the context of their EHR
- Alerts / Reminders must be relevant and not "clutter" the physician workflow

Alberta NetCare *inside* EPIC

Specialty *Premium* Services:

- Data Warehouse / Data Analytics
- Physician EMR-Lite
- Full EMR with HIE or contracted Installation / Support
- Other Physician Products (eRx, practice management, home device monitoring)
- Patient Engagement:
  - Personal Health Record (PHR)
  - Patient messaging (bi-directional)
- Dictation Services
- Disease Registries
- Public Health and Immunization Reporting and Inquiry
- Advance Directives

Data Warehouse & Analytics Services

- Clinical Management
  - Clinical Quality Reporting
  - Clinical Disease Registries
  - Chronic Disease Management and Reporting
  - Immunization Registries
  - Syndromic Surveillance Reporting and Monitoring
  - Clinical Decision Support
- Management Analytics
  - Insurance Claims Analytics
  - Regional Population Analytics
  - Clinical Trials Data Base
  - Public Health Case Mgmt
  - ACO Metrics

California Trust Network: CAHIE

California Association of Health Information Exchanges

CAHIE's vision is to create a California trust framework that is based on national standards and protocols for trusted exchange and to create pathways to ensure that all providers can connect to and use Direct and Healtheway's eHealthExchange (formerly NwHIN).

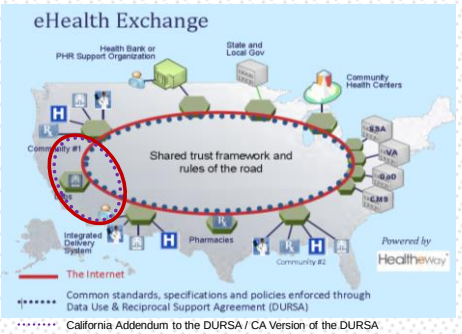
In short, CAHIE wants to functionally eliminate the interoperability white space in California.

Trust is the Foundation for Health Data Exchange

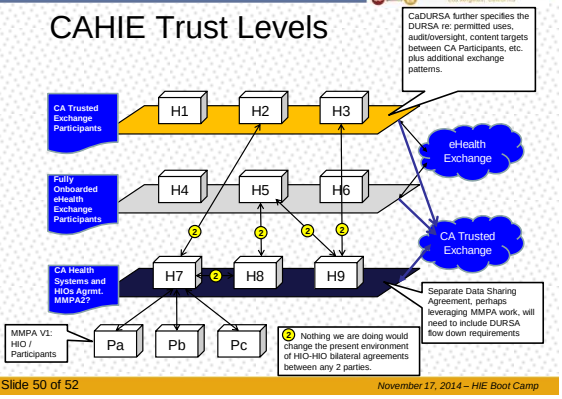
- Patients must trust the Providers to hold their data securely, and only share it when they find it necessary.
- Providers must trust other Providers to share relevant and accurate patient data.
- Providers and Patients must trust Plans in utilizing health information appropriately.
- Providers and Patients must trust Government entities to collect and hold only that data needed for population safety and health.
- Etc… **In short, all parties in the exchange must trust the other parties, or none of this works.**

California HIOs

California Trust Network



CAHIE Trust Levels



Considerations in Forming an HIE

- Dispersion of PP providers throughout CA
- Private HIEs vs Public HIEs
- Purpose for Connection (Use Cases)
- Patient Identification / Disambiguation
- Data Supplied vs Data Obtained
- Overlap of Services and Connections
- Meaningful Use:
  - MU2 Emphasizes Transfer of Care and specifies a significant portion of encounters
  - MU2 Requires that every certified EHR have the ability to participate in Direct (must have a Direct Client that connects to a HISP).

Questions???

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