From Integration to Interoperability: The Role of Public Health Systems in the Emerging World of Health Information Exchange

Noam H. Arzt, PhD
American Public Health Association
Annual Meeting
Session 3219.2
October 27, 2008
Presenter Disclosures

(1) The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:

No relationships to disclose
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- Integration
- Interoperability
- Implications for Public Health
Public Health Systems
Evolution

- Began as program-specific, stovepipe systems, often PC- or mainframe-based
- Evolved into more robust specialized systems
- In some cases became integrated systems, either patient-centric or case-centric
# Sample CDC Applications

<table>
<thead>
<tr>
<th>CASA</th>
<th>Clinic Assessment Software Application (1992)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIMS</td>
<td>Laboratory Information Management System</td>
</tr>
<tr>
<td>VACMAN</td>
<td>Vaccine Management System</td>
</tr>
</tbody>
</table>
Two Types of Integration

Application Integration

- Presenting a unified view of data to a user through an application
- Forming valid relationships between data sources

Data Integration

User Access Through Public Health-Provided Application

Integrated System

User Access Through Local Application Within the Organization
Case Study: NYC MCI

- LeadQuest and CIR developed independently
- Integrated by sharing a Master Patient Index
- Other systems may join in the future
- Both Data and Application Integration
# Improvement in NYC

## Table 1

<table>
<thead>
<tr>
<th></th>
<th>Within system</th>
<th>Between system</th>
<th>Within and between system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CIR</td>
<td>LQ</td>
<td>MCI</td>
</tr>
<tr>
<td>Pre-MCI, N</td>
<td>2,426,369</td>
<td>2,184,216</td>
<td>4,086,865*</td>
</tr>
<tr>
<td>Post-MCI, N</td>
<td>2,065,230</td>
<td>2,021,635</td>
<td>2,977,290</td>
</tr>
<tr>
<td>Merged, N</td>
<td>361,139</td>
<td>162,581</td>
<td><strong>1,109,575</strong></td>
</tr>
<tr>
<td>Merged, %</td>
<td>14.9</td>
<td>7.4</td>
<td>27.1</td>
</tr>
<tr>
<td>Human review, N</td>
<td>74,798</td>
<td>56,747</td>
<td>95,886</td>
</tr>
<tr>
<td>Human review, %</td>
<td>3.1</td>
<td>2.6</td>
<td>2.3</td>
</tr>
</tbody>
</table>

*This number represents the sum of records in each data system after MCI’s internal de-duplication, ie, 2,065,230 + 2,021,635 = 4,086,865.
CIR = Citywide Immunization Registry; LQ = Lead Quest; MCI = Master Child Index.

## Table 2

<table>
<thead>
<tr>
<th>Birth cohort</th>
<th>CIR</th>
<th>LQ</th>
<th>Integration merges</th>
<th>LQ records merged with CIR records, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1996 (no vital records)</td>
<td>851,460*</td>
<td>1,235,734*</td>
<td>494,595†</td>
<td>40.0</td>
</tr>
<tr>
<td>1996</td>
<td>157,818</td>
<td>133,368</td>
<td>105,280</td>
<td>78.9</td>
</tr>
<tr>
<td>1997</td>
<td>159,194</td>
<td>126,373</td>
<td>100,336</td>
<td>79.4</td>
</tr>
<tr>
<td>1998</td>
<td>154,415</td>
<td>124,180</td>
<td>99,236</td>
<td>79.9</td>
</tr>
<tr>
<td>1999</td>
<td>146,339</td>
<td>116,795</td>
<td>94,532</td>
<td>80.9</td>
</tr>
<tr>
<td>2000</td>
<td>150,899</td>
<td>107,048</td>
<td>87,802</td>
<td>82.0</td>
</tr>
<tr>
<td>2001</td>
<td>151,601</td>
<td>95,044</td>
<td>79,979</td>
<td>84.1</td>
</tr>
<tr>
<td>2002</td>
<td>148,015</td>
<td>74,622</td>
<td>63,228</td>
<td>84.4</td>
</tr>
<tr>
<td>2003</td>
<td>142,675</td>
<td>7,985</td>
<td>6,437</td>
<td>80.6</td>
</tr>
<tr>
<td>1996–2003</td>
<td>1,210,956*</td>
<td>785,685*</td>
<td><strong>636,830†</strong></td>
<td>81.1</td>
</tr>
</tbody>
</table>

Enterprise-wide Integration

- Three models: Centralized (RI, MO), Cooperative (NYC, UT), Distributed (*de facto* for most)
- Can be implemented agency-wide or on a sub-organizational level
- Success will vary by Organizational, Technical, and Process attributes
Key Challenges

- **Central Model**: Security, privacy, and ownership concerns

- **Distributed Model**: Technical readiness and data use limitations
Enterprise-wide Integration

- **Centralized Model**
  - Mandated in most instances
  - Participation by some programs may be mandated...
  - ...but usually not across the board

- **Cooperative Model**
  - Usually voluntary by default

- **De-centralized Model**
  - Participation by some programs may be mandated...
  - ...but usually not across the board

**Voluntary** vs. **Mandated**
From Integration to Interoperability

“Interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchanged.”

HL7 EHR Interoperability Working Group
HL7 Definition Key Aspects

- Technical Interoperability
  - Structure, syntax, reliable communication
- Semantic Interoperability
  - Full meaning preserved
- Process Interoperability
  - Integration of systems into work flow
Technical Interoperability: System-to-system Messaging

- Public health systems have been engaged in data exchange for years (mostly to them)
- Though flat file formats still dominate, HL7 messaging is beginning to gain steam
## Semantic Interoperability: VT Health Info Tech Plan

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
</table>
Level I: Hospital Outpatient Procedures (CPT4)  
Level II: Products, supplies and other services |
| Centers for Disease Control and Prevention (CDC) Race and Ethnicity Code Sets | These code sets are based on current federal standards.                                                                                   |
| College of American Pathologists Systematized Nomenclature of Medicine Clinical Terms (SNOMED CT®) | This is the standard coding used for a wide variety of medical and health care terms.                                                        |
| International Classification of Diseases, Ninth Edition, Clinical Modifications (ICD-9-CM) | This is the standard coding used for diagnoses and procedures by hospitals:  
Volume 1 & 2: Hospital diagnoses  
Volume 3: Inpatient hospital procedures |
| International Classification of Diseases, 10th revision, Related Health Problems (ICD-10 CM) | This revision to ICD-9-CM contains a number of important improvements. This standard is not yet widely implemented. |
| Logical Observation Identifiers Names and Codes (LOINC®) | This is the standard coding for laboratory and clinical observations used by health care systems and messaging (like HL7). |
| National Library of Medicine (NLM) Unified Medical Language System (UMLS) RxNorm | This is the standard for coding the names of drugs and dose forms.                                                                           |
| National Drug Code (NDC) | This is a universal product identifier for human drugs.                                                                                       |
Process Interoperability: Peer-to-Peer EHR Exchange

- No central data server required, but directory server (of providers, not patients) can be used to facilitate communications
- Each system communicates as needed with neighboring systems
- Data is displayed within each users “local” system, or stored locally

Physician initiates query for records knowing other relevant providers → Physician’s EMR sends query to Directory to obtain electronic addresses of other providers → Directory provides necessary electronic contact information → Physician’s EMR uses contact information to query other providers’ systems directly
Data-centered or Document-centered?

- **Data Storage Strategy:**
  - **Data-centered:** systems store data in a conventional relational database (RDBMS) with tables and rows; use SQL to access
  - **Document-centered:** data stored in a formatted document for retrieval as a unit; meta-data saved to facilitate search and retrieval
Data-centered or Document-centered? (continued)

- Interoperability Strategy:
  - **Data-centered**: traditional structures to represent the data set being transported (a row in a file for a record; delimited or fixed length fields within the record)
  - **Document-centered**: data is pre-arranged in a document format which is structured

  *e.g.*, X12 or HL7 messages

  *e.g.*, CCR, CCD
## Data-centered or Document-centered?

(continued)

<table>
<thead>
<tr>
<th>Data Storage</th>
<th>Data-centered</th>
<th>Document-centered</th>
</tr>
</thead>
<tbody>
<tr>
<td>May be difficult to extract discreet data from clinical documents and assemble into the desired message or file format. Receiving data-centered messages and storing them in the databases as clinical documents is less challenging.</td>
<td>Relatively easy to extract documents, transport them as such, and store them as documents in the destination system.</td>
<td></td>
</tr>
<tr>
<td>Relatively easy to extract data and assemble in the desired message or file format. Interface engines exist which facilitate parsing data from databases into clinical messages and vice versa.</td>
<td>Relatively easy to extract data and assemble in the desired document format. May prove more challenging to parse clinical documents back into discreet data elements for storage in the destination system, depending on the form of clinical document used.</td>
<td></td>
</tr>
</tbody>
</table>
Impact on Public Health

- Data-centered approaches still dominate in intra-organization interoperability but this may change
- Public health/PHIN still seems to be message-centric (i.e., data-centric)
- EHR-S/HIEN world seems to be moving to document-centric (IHE, CDA)
- By default, HITSP ISs are document-centered
Implications for Public Health
Benefits to Public Health of HIE Participation

- Many of public health’s data trading partners will choose to interoperate with an HIEN and reduce (or eliminate!) superfluous connections.
- Public health can gain access to data and trading partners who previously might not have participated in its initiatives.
- Better to be an insider than an outsider: Public health risks being left out as the medical community moves ahead.
What Can Public Health Contribute to HIE?

- “Quick start” by leveraging existing activities, including interfaces to labs
- **Existing data**, including consolidated data and population-based data
- **Expertise**: de-duplication, database management, web applications, data exchange including HL7
- **Existing relationships** with many relevant stakeholders: providers, hospitals, payers, professional associations
- **Governance**: experience in negotiating and implementing data sharing agreements
Risks to Public Health

- Public health applications targeted at these users may have slower uptake as organizations encourage (or require) users to stay with institutionally-supported applications
- Pressure will build for providers to interoperate solely through HIENs
- Public health systems run the risk of becoming focused as data repositories as users over time lose access to their distinctive features
- While many specialized features are part of the approved HL7 EHR specification they are not required for CCHIT certification
Three Imperatives for Public Health:

1. Embrace emerging national standards for system interoperability

2. Enable “special functions” of public health systems to be accessed directly by user systems

3. Organize an informatics focus in the agency to engage in and support local, regional and national initiatives.
Additional Information

HLN’s “Insights” at
http://www.hln.com/resources/index.php

HLN’s “Evolution of Public Health Information Systems: Enterprise-wide Approaches” at

HLN’s “Guide to Immunization-related Electronic Data Exchange” at
Contact Information

Noam H. Arzt
President, HLN Consulting, LLC
858-538-2220 (Voice)
858-538-2209 (FAX)
arzt@hln.com
http://www.hln.com/noam/