Using LOINC to Foster Integration of Clinical Data: Lessons Learned at the Veteran's Administration

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Acknowledgement

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The nice thing about standards is that there are so many to choose from.

Outline of Presentation

- History of LOINC
- LOINC structure
- LOINC: codification methods and organizations
- VA experience with LOINC
- Examples from the literature
- Future of LOINC
LOINC

- Logical
- Observation
- Identifiers
- Names and
- Codes

Coding for medical information

LOINC: history and perspective
Initial and Early Players

- Indiana University/Regenstrief
- University of Utah: LDS Hospital and ARUP
- Mayo Medical Laboratories
- University of Washington
- Quest Diagnostics
- International Federation of Clinical Chemistry

Correct Pronunciation
History of LOINC

- 1980: issue of standards ASTM organization
  - Medical record content
  - Instrument interface
  - Computer to computer connectivity
- Proposal by Dr. Clem McDonald and Dr. Arden Forrey
- LOINC committee Regenstrief under Dr. McDonald in February 1994
History continued

- March 1995 for review as: Laboratory Observations, Identifiers, Names and Codes
- First version release April 1995
- October 1997 change name as: Logical Observations Identifiers Names and Codes, HL7 adopted and incorporated
- January 2000: Veterinary specific terms
- June 2002: AVMA support: SNOMED, LOINC and HL7
- March 2003: Germany adopted LOINC
- June 2004: Web site www.loinc.org
- December 2005: LOINC 2 to include medical records, scheduling, ‘Clinical Structured Product Labeling’
- January 2006: www.regenstrief.org/loinc
- January 2009: RELMA in separate languages
- April 2009: LOINC and SNOMED-CT
- February 2010: version 2.27
Why and what is LOINC?

- Facilitate exchange and pooling of results
  - Clinical care
  - Outcomes management
  - Research
- Used as a Universal ID for the OBX-3 field in a HL7 ORU message

Reference Laboratories

- LabCorp: committed to industry and regulatory standards for data transmission including HL7, LOINC, and ASTM
- ARUP: provides LOINC codes with our test result detail to assist our clients in mapping our results to their internal codes and to provide them with data for their research and tracking
- Mayo Medical Laboratories: been systematically assigning LOINC codes to its assays
### Scope of Problem: Hemoglobin

<table>
<thead>
<tr>
<th>Language</th>
<th>Term</th>
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<tbody>
<tr>
<td>German</td>
<td>Hämoglobin</td>
</tr>
<tr>
<td>French</td>
<td>l'hémoglobine</td>
</tr>
<tr>
<td>Hebrew</td>
<td>המוגלובין</td>
</tr>
<tr>
<td>British</td>
<td>Haemoglobin</td>
</tr>
<tr>
<td>Dutch</td>
<td>Hemoglobine</td>
</tr>
<tr>
<td>Chinese</td>
<td></td>
</tr>
<tr>
<td>Greek</td>
<td>αιμοσφαιρίνη</td>
</tr>
<tr>
<td>Vulcan</td>
<td>Khafyarek</td>
</tr>
<tr>
<td>Klingon</td>
<td>‘Iw (blood)</td>
</tr>
</tbody>
</table>

### LOINC structure

- Codes are unique
- Not hierarchal
- Format nnnnn-m (m is a check digit)
- Corresponds to panel or single test
- Includes
  - Short name
  - Long name
  - Synonym
LOINC specifications

- Component - what is measured, evaluated, or observed
- Kind of property - characteristics of what is measured, such as length, mass, volume, time stamp and so on
- Time aspect - interval of time over which the observation or measurement was made
- System - context or specimen type within which the observation was made
- Type of scale - the scale of measure. The scale may be quantitative, ordinal, nominal or narrative
- Type of method - procedure used to make the measurement or observation

LOINC: advantages to use

- Communication between and among Health Delivery Networks
  - Laboratories (Reference laboratories)
  - Health facilities
  - Public health
  - Data portals
- Assists to aggregate health records
- Transfer of payment claims
- Reduction of errors improved quality of healthcare
Transthyretin (Prealbumin)

<table>
<thead>
<tr>
<th>LOINC</th>
<th>COMPONENT</th>
<th>SYSTEM</th>
<th>TIME ASPECT</th>
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<tr>
<td>10465-3</td>
<td>Amyloid.prealbumin Ag</td>
<td>Tiss</td>
<td>Pt</td>
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<tr>
<td>13973-3</td>
<td>Prealbumin/Protein.total</td>
<td>CSF</td>
<td>Pt</td>
</tr>
<tr>
<td>13979-0</td>
<td>Prealbumin/Protein.total</td>
<td>Ser/Plas</td>
<td>Pt</td>
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<tr>
<td>13985-7</td>
<td>Prealbumin/Protein.total</td>
<td>Urine</td>
<td>Pt</td>
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<tr>
<td>13991-5</td>
<td>Prealbumin/Protein.total</td>
<td>Urine</td>
<td>24H</td>
</tr>
<tr>
<td>14014-5</td>
<td>Thyroxine.prealbumin bound</td>
<td>Ser/Plas</td>
<td>Pt</td>
</tr>
<tr>
<td>14015-2</td>
<td>Thyroxine.prealbumin bound/Prealbumin</td>
<td>Ser/Plas</td>
<td>Pt</td>
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<td>14338-8</td>
<td>Prealbumin</td>
<td>Ser/Plas</td>
<td>Pt</td>
</tr>
<tr>
<td>17810-3</td>
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<td>Body fld</td>
<td>Pt</td>
</tr>
<tr>
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<td>Prealbumin</td>
<td>CSF</td>
<td>Pt</td>
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<td>2877-9</td>
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<td>BldCo</td>
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<td>Pt</td>
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<tr>
<td>6793-4</td>
<td>Prealbumin</td>
<td>Ser/Plas</td>
<td>Pt</td>
</tr>
</tbody>
</table>

Clinical LOINC

- **Name**
- **Type of property**
- **Timing**
- **Body system**
- **Scale**
- **Method**
Standards, how they connect

- HL7
- ICD
- LOINC
- NLT
- CPT
- SNOMED
- UMLS
- MESH
- DICOM
- HITSP

LOINC International Languages

- Chinese
- Estonian
- French
- German
- Korean
- Portuguese
- Spanish
HL7

- Founded in 1987
- ASNI-accredited standards organization
- Provides standards for interoperability
  - Improve care delivery
  - Optimize workflow
  - Reduce ambiguity
  - Enhance knowledge transfer
- Included groups
  - Healthcare providers
  - Government agencies
  - Vendor community
  - Patients

SNOMED

- History of over 40 years
- Current version is SNOMED-CT
- Developed by College of American Pathologists
- April 2007: International Health Terminology Standards Organization (IHTSDO)
- Concept oriented hierarchical structure
**LOINC versus SNOMED**

- If an observation is a question, and the observation value is an answer:
  - LOINC provides the code for the QUESTION
  - SNOMED (and others) provide the code for the answer

**Clinical Vocabularies**

<table>
<thead>
<tr>
<th></th>
<th>Content Based</th>
<th>Concept Based</th>
<th>Content Permanence</th>
<th>Multiple Hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMLS</td>
<td>++++</td>
<td>Y</td>
<td>N/?</td>
<td>N?</td>
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<tr>
<td>MESH</td>
<td>++</td>
<td>Y</td>
<td>?</td>
<td>Y</td>
</tr>
<tr>
<td>ICD</td>
<td>++</td>
<td>?</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>SNOMED</td>
<td>++++</td>
<td>Y</td>
<td>Y/?</td>
<td>Y</td>
</tr>
<tr>
<td>GALEN</td>
<td>?</td>
<td>Y</td>
<td>?</td>
<td>Y</td>
</tr>
<tr>
<td>LOINC</td>
<td>++</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
HITSP

- Healthcare Information Technology Standards Panel formed in Fall 2005
- Partnership between private and public
- Integrate and harmonize standards
- Common lab orders LOINC presented at 11/05/2009 meeting

Cooperative Terminology Development
NLM February 2009

- LOINC
- NPU
- SNOMED-CT

- Operational trial of prospective divisions of labor in the generation of laboratory test terminology content
LOINC experience in the VA

How do facilities share data

- Result name
- Result reference ranges
- ‘Best practice’ local defined
- Could not share data
- Longitudinal care
Standardization Problem

- VA computer system in operation in early 1980s
- DHCP: Decentralized Hospital Computer Program
- Currently, 129 databases with little standardization of laboratory test name
- How to improve quality and standardize practice

LOINC initiative

- How do we monitor care for HCV patients?
- 1999 changes to software in VA system
- Initially: 40 tests specific to HCV
- Roll-out of LOINC codes 2001
- LOINC for the purpose of interoperability
- Codes determined centrally and sent to each site
Progression of LOINC

- More tests added by field
- After first set LOINC terms, additional determined by site
- Loss of coding standardization (XXX for site)
- Decided to centralize LOINC terms
  - Sites may suggest alternative LOINC code
  - Provide information to justify use of a different code
  - Code change after review by central organization

Issues with using LOINC

- NLT codes
  - Decision Support System (DSS)
  - LMIP (workload)
  - Site specific
- ‘Test codes’ provided by reference laboratories
- SNOMED-CT for interoperability
Literature

Five examples
- VA for the monitoring of complex care
- Clinical use
- Adaptation to Nursing Clinical terms
- Documents in the EHR
- Use in Public Health

Example of capability
- Nation's largest public integrated health care system
- VA largest single provider of health care to HIV-positive patients in the United States
- 1992, the Immunology Case Registry (ICR) is a national-level administrative database
- Monitor health care service utilization
- Provides an opportunity to monitor and improve the quality of clinical care for HIV-positive patients receiving VA care
- Journal of Clinical Epidemiology, Volume 54, Issue 12, Pages S12-S15
Evaluation of the Clinical LOINC

- Test the adequacy of LOINC
- 1,096 items from 35 standardized assessment instruments compared to the elements of the LOINC
  - Component: 100%
  - Property: 87.8%
  - Timing: 82.9%
  - System/sample: 100%
  - Scale: 92.6%
  - Method: 97.6%

Update on Logical Observation Identifier Names and Codes (LOINC)

- Provide comprehensive set of nursing measurements in LOINC
  - Performs exercises
  - Exercises safely
  - Independent with exercise
  - Mobile with assistance
- Require the creation of a great deal of LOINC content
- Work is currently in progress to translate nursing goals into LOINC format
LOINC codes for hospital information systems documents: a case study

- Coverage of LOINC codes for document types in a German HIS
- Analyzed document types that occurred more than 10 times in approximately 1.3 million documents
- Done by two physicians adjudication by a third
- 93% of our local HIS documents had local document types that could be assigned a LOINC code


LOINC in Public Health

- LOINC codes not assigned in a systematic or hierarchical way
- Some laboratories assign different LOINC numbers for the ‘same test’
- Assigned based on specimen type (16974-8 and 29327-4), same test on different fluid
- Distinct LOINC codes assigned based on method
- Distinct LOINC codes based on result formatting
- White paper: ELR, LOINC, SNOMED, and Limitations in Public Health, WHP 0042-A, 2005
What is the future of LOINC

Half Full

Half Empty

Future of LOINC

- Government Mandate
- Interoperability
- Reimbursement
- Quality Measure
- Complexity/Simplicity
- Care model
- EHR
- Research
Government Mandate

- 2003 Federal government: software to exchange health laboratory information must use LOINC
- CDC PHIN specifies that the format and content for ELR of reportable diseases
  - HL7 v2.3
  - LOINC
  - SNOMED
- HIPAA: Health Insurance Portability and Accountability Act of 1996

Interoperability

- Government to government
- Private to private
- Private to government
- Government to private

- Biggest impact in government sector
Geisinger's Community Lab Interface

Translation Using LOINC®

RESULTS

Scenario #1 – Comprehensive Metabolic Panel shared between two facilities

Hospital B LIS → LOINC Table → Hospital A EHR

Scenario #2 – Thyroid Stimulating Hormone shared between three facilities

Hospital B LIS → LOINC Table → LOINC Table → Hospital A EHR

Reimbursement

- CPT codes
- Work to develop cross-walk
- Little emphasis or need to granulate
- LOINC may provide too much detail
Quality Measure

- NCQA
- JCAHO
- Pay for performance

Results versus intervention
- PAP smears
- Mammograms
- Lipid panels versus intervention
- Hemoglobin A1c versus treatment

Complexity/Simplicity

- Numerous coding schemes
- Many reference laboratories have their own test names codes
- LOINC is complete but COMPLEX
### Hemoglobin Fields

<table>
<thead>
<tr>
<th>Extracted Test Name</th>
<th>HGB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station Specimen Index</td>
<td>673-1694-70-0</td>
</tr>
<tr>
<td>Site LOINC extracted</td>
<td>30313-1</td>
</tr>
<tr>
<td>Site LOINC Short Name</td>
<td>Hgb BldA-mCnc</td>
</tr>
<tr>
<td>Site Specimen</td>
<td>Blood</td>
</tr>
<tr>
<td>Battery Code 673-5697</td>
<td>673-5697</td>
</tr>
<tr>
<td>NLT</td>
<td>83020.0000</td>
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<tr>
<td>NLT Prefix</td>
<td>Hemoglobin</td>
</tr>
<tr>
<td>NLT Prefix</td>
<td>83020</td>
</tr>
<tr>
<td>NLT Suffix</td>
<td>0000</td>
</tr>
<tr>
<td>Reference High</td>
<td>$5(SEX=M:17,1:15)</td>
</tr>
<tr>
<td>Reference Low</td>
<td>$5(SEX=M:13,1:12)</td>
</tr>
<tr>
<td>Data Type</td>
<td>NUMERIC</td>
</tr>
<tr>
<td>VISN</td>
<td>08</td>
</tr>
</tbody>
</table>
Care Model

- Fragmented
- Centralized

Depending upon future of healthcare may and deployment of the EHR may need the functionality of LOINC
Research

- Mainly informatics articles
- Some Quality literature
- Good method for information exchange
- International appeal
- Other major codification paradigm is SNOMED-CT

Questions Comments