Ensuring Quality Terminology Mappings in Distributed SOA Environments

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Outline

- Data standardization
  - Goals
- Standard terminologies
  - Necessity of terminology mapping
  - Challenges in terminology mapping
- Data standards mapping
  - Approach
  - Terminology services
  - SOA advantages

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Data Standardization

Any meaningful exchange of utterances depends upon the prior existence of an agreed upon set of semantic and syntactic rules

ISO TR9007:1987 *Information Processing Systems – Concepts and Technology for the Conceptual Schema and the Information Base*

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Data Standardization

- Syntax standardization
  - EDI exchange formats
  - ADT
  - HL7 Version 2
  - Standard XML Schemas (HL7 MIF, XMI, LexGrid)
  - VHIM Templates
- Semantic standardization
  - LOINC
  - SNOMED CT
  - ICD-9/10
  - NDF-RT
- Information modeling is a critical aspect in defining our syntactic rules as a basis of communication
  - Context of use

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Version 2 HL7 Lab Result Message

```
MSH|^~\&||||19941122100053||ORU^M01|
EVN|M01|199411181141|
PID|||661041||GARDNER^REED^M|
PV1||I|E7^703^^LDS|
OBR||^A000520|LYTES^Serum Electrolytes|
OBX|1|NM|NAS^Serum Sodium|1|138|mmol/L|
OBX|2|NM|K^Serum Potassium|1|3.2|mmol/L|
OBX|3|NM|CL^Serum Chloride|1|114|mmol/L|
OBX|4|NM|CO2^Serum CO2|1|24|mmol/L|
```

Segment

Data Field

Component

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Slide Courtesy of Health Level Seven, Inc.

So if we are all using standards, what is the problem?

- Site 1:

  OBX|1|CE|ABO^ABO GROUP||O^Type O|

- Site 2:

  OBX|1|CE|BLDTYP^ABO GROUP||TYPEO^Type O|

- Site 3:

  OBX|1|CE|ABOTYPE^ABO GROUP||OPOS^Type O|

You and I may know that these are similar results, but our computers will not.

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Slide Courtesy of Health Level Seven, Inc.

Data Standardization - Semantic

- Site 1:

  OBX|1|CE|883-9^ABO Type||58460004^Group O|

- Site 2:

  OBX|1|CE|883-9^ABO Group||58460004^Group O|

- Site 3:

  OBX|1|CE|883-9^Blood Type||58460004^Group O|

Agree on standard data sets (coding systems) for clinical observations.

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Health Data Standards

- Vital component of today's healthcare computing environment
- Standardize the *meaning* of data
- Data comparability and interoperability are absolute requirements to achieve healthcare's desired future state
- Necessary binding to information model components
- Provides consistency in data
  - Analysis
  - Exchange
  - Collection
  - Comparison
  - Consistency
  - Quality
- Enables computerized decision support

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Data Standardization

Without Data Standardization…

- Health Data is *non*-comparable
- Aggregation is difficult if not impossible
- Health Systems *cannot* Interchange Data
- Secondary Uses (Research, Efficiency) are *not* possible
- Linkage to Decision Support Resources *not* Possible

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Data Standardization

- Should not direct the process on how clinical information is captured
  - Data standards may not be complete
  - Alternate representations or local terms
  - Institutional knowledge

- Translation process for alternate representations:
  - Collection
  - Comparison
  - Analysis (aggregation)
  - Exchange (reporting)
  - Other human languages (e.g., translating English “surface forms” to French ones)

- Necessary to map from ***source*** interface data sets to ***target*** data standards

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Standard Terminologies

- The nice thing about standards is that there are so many to choose from. - Various
- Many different terminology data standards fit for different purposes
- No single data standard is appropriate for use over all of healthcare
- Often, significant overlap in domain content
- What to use when?

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Standard Terminologies

- US national initiatives to coordinate data standard use
- Office of the National Coordinator on Health Information Technology (ONCHIT)
- National Committee on Vital and Health Statistics (NCVHS)
- Consolidated Health Informatics (CHI)
- Health Information Technology Standards Panel (HITSP)
- National Library of Medicine (NLM)

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Standard Terminologies

Standard	*Domain*
ICD-9-CM	Coding for reimbursement, diagnosis coding
CPT-4	Coding for reimbursement, procedure coding
HL7	Inter-application messaging, demographics, units, etc.
SNOMED CT	Clinical data such as diagnosis, procedures, anatomy, nursing
LOINC	Laboratory test results
NCPDP SCRIPT	Drug ordering messaging
NDF-RT and RxNorm	Medications
IEEE 1073	Instrument data exchange

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Standard Terminologies

- Interchange of clinical information required using these standards

- Necessary to map local and interface terminologies to the specified data standards

  Problem: How to ensure mapping is consistent and predictable?

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Data Mapping

- The creation of associations between the names/codes/phrases of different terminologies
- "*Mapping is employed to translate clinical data into alternative representations without compromising the primary clinical mission*." Dr. James Campbell
- Data Mappings are:
  - Critical for advancing federal projects such as the NHIN prototypes and quality/outcomes analysis
  - Can be created and maintained using sophisticated tools
  - But cannot today be fully automated

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Mapping Complexity

- Source/target differences in:
  - Scope of code sets
  - Granularity of elements
  - Authors' "world view"
  - Objective (use case)
- Local idiosyncrasies – "plague"
- Map terminology updates/revisions

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Mapping Complexity

- Challenges in mapping from interface terminologies to standard terminologies
- Variable concept granularity, divergent terminology models, differences in scope and purpose and lexical variations
- Knowledgeable users required for human review of mapping results (thousands of potential matches)
- Terminology version considerations
- Expertise in maintaining disparate terminology sources

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Standards Mapping - Approach

- Mapping to data standards involves significant infrastructure capabilities
- Obtaining the most recent versions of the relevant data standards
- Filtering through the (numerous) potential matches
  - May need to construct filtering routines
  - How to manage target-specific algorithms
- Managing mappings over multiple versions of interface and standard data sets
- Domain expertise needs to be coordinated
  - Efficient resource management
  - Consistent approach

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Standards Mapping – SOA Approach

- The ability to consistently map terminology content
  - Necessary function for data standardization.

- Define mapping algorithms to identify *best match**es*** for interface terms
  - Word order normalization
  - Stemming
  - Synonymy
  - Abbreviations and acronyms
  - Spelling correction
  - Focused target subsets, e.g., *findings* within SNOMED CT

- Terminology Services
  - Expose terminology mapping algorithms to interfaces via SOA protocols
  - Maintain standard data sources on machinery dedicated to the task
  - Versioning

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Terminology Services

- Terminology systems vary considerably in both content, structure, and purpose.
- Requirements of terminology vary widely
- Implementation decisions of terminology vary widely
- Storage formats may differ (relational database, XML, ...)

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Terminology Services

- Benefits for terminology and terminology software developers
  - Basic functional requirements clearly specified
  - Implementation can be agnostic to database and software implementations
  - A common entry point – you don't have to sell the idea – you sell your enhancements, performance, etc.
- Define the functional requirements of a set terminology service operations to allow the representation, access, and maintenance of terminology content either locally, or across a federation of service nodes

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Terminology Services - Advantages

- No need to force a common terminological structure on terminology developers
- Decouples *terminology* from the *terminology service*
- Terminology users can use whatever technology appropriate for their needs
- Provides a common interface and reference model for understanding
  - I know what you mean by Code System
  - I know what to expect when I execute the **mapConcept()**
- Client software doesn't have to know about specific terminology data structures and/or how to access them.
- Server software can plug and play with many clients

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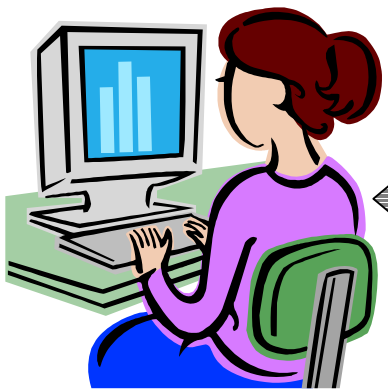
SOA Mapping Approach

Identify interface terms to be mapped to standard

Term plus "context" is packaged as XML and sent to remote server

TermWorks identifies potential matches



Mapping Expert

Web-based Data Collection Tools

Web

Service

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Terminology Service

Domain expert selects from filtered list of standard concepts.

Results formatted in XML and transmitted

Data Standards Mapping

- Service Oriented Architecture (SOA) is a paradigm for organizing and utilizing distributed capabilities that may be *under the control of different ownership domains*. OASIS Reference Model for Service Oriented Architecture 1.0 - (*emphasis Galen Mulrooney)*

- Business perspective definition: Set of services that a business wants to *expose to its customers and partners or other portions of the organization*. Source: IBM – (*Galen Mulrooney)*

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SOA Architecture Principles

- **Service Abstraction**
  - Beyond what is described in the service contract, services hide logic from the outside world
- **Service Reuse**
  - Logic is divided into services with the intention of promoting reuse
- **Service Autonomy**
  - Services have control over the logic they encapsulate
- **Service Optimization**
  - All else equal, high-quality services are generally considered preferable to low-quality ones
- **Service Discovery**
  - Services are designed to be outwardly descriptive so that they can be found and assessed via available discovery mechanisms

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http://en.wikipedia.org/wiki/Service-oriented_architecture

SOA Principles Applied to Mappings

- Service Abstraction
  - Not necessary to understand how mapping routines are implemented
- Service Reuse
  - Common set of distributed algorithms can be accessed independently by many organizations
  - Predictable mapping results for inter and intra organizational maps
- Service Autonomy
  - Mapping routines can be improved with minimal user impact
- Service Optimization
  - Mapping algorithms may be targeted to specific data standards
  - Up-to-date versions of target standards available to distributed environments and systems
- Service Discovery
  - Expose select mapping routines as appropriate to customer domains

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Impact

- Data is standardized
  - Standard terminologies
- Access to standard data is standardized
  - Terminology Services
- Management of terminology support (including tools development, maintenance and versioning) is centralized
  - Terminology service instance
- Management of terminology services is outsourced
  - Terminology service instance

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Standards Mapping – Next Steps

- Align data standards requirements with terminology mapping algorithms
  - Improve specificity when mapping to standards
- Improve interface terminology standards (consistent and broad representation in clinical applications)
- Improve mapping algorithms
  - Classifications and inferencing
  - Conceptual mapping
  - Rules-based / context sensitive
- Integrate mapping algorithms into Terminology Service Standards
  - HL7/OMG HSSP activities
  - Consistent *standard* SOA interaction

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Summary

- Terminology services accessible in a SOA framework allow us to optimize mappings to standard data sets, and provide consistent mapping result across organizations as the standardized content evolves

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Thank You!

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