Interoperability-Integration: Where are we on the continuum?

Meghan M. Dierks, MD, FACS
Harvard Medical School
Division of Clinical Informatics
Beth Israel Deaconess Medical Center
Framing the Issues

- Four important concepts
- Four different dimensions of interoperability
- Four patient safety scenarios when we fail along one or more dimension
- How far away are we from achieving our goals?
Interoperability should always be measured or assessed with respect to a specific function or task.

Interoperability should be thought of as a falling along a continuum.

Function-by-function, task-by-task basis, two or more systems can anywhere from ‘incompatible’ to ‘fully integrated’.

Because of the diversity of data, functions and uses, systems can simultaneously exist in both states … leading to hidden vulnerabilities.
Framing the Issues

Four Dimensions of Interoperability

- Data Interoperability
- Communication Interoperability
- Semantic Interoperability
- Workflow interoperability
Data Interoperability

What is It?

- Agreement/consistency in formatting, storage, querying and synchronization of data
Data Interoperability

Examples

- Do two systems mutually understand what characters cause terminations or truncations?

- Do two different information systems share the same formatting for dates and times "2011-04-01" ISO 8601 standard versus “Apr 1, 2011”?

- Do they format medical record numbers (mrns) as a string or as a numeric, and within a single system, is there consistency in the length of the mrn (e.g., ‘0009387’ vs. ‘09387’)?

- Do two different information systems or applications apply the same default values and/or permitted values for individual field elements (e.g., both constrain age < 120 years and non-zero and positive values for weight fields)?
A (new) Automated Microbiology System performs and sends results on 30 Identification/Susceptibility tests to the Laboratory Information System (LIS).

The (old) LIS is configured to expect/accept only 20 results.

Data on items 21-30 are stored to unallocated memory, which cannot be retrieved and reported out the clinician or patient’s electronic record.
Communication Interoperability

What is It?

- Consistency in transmission and reception of messages between nodes
Communication Interoperability

Examples

- Does a Hospital Information System’s CPOE module share the same format for addresses with a Radiology Information System (RIS) so that the CPOE knows where to send a message for an order?

- Do these systems have the same rules for acknowledging that a message has been received completely?

- Do the systems have the same rules for timeouts and retransmission of a receipt has not been detected?

- At the message structure level, do the systems share an understanding of when the message begins and ends?

- Do the systems have a mutually accepted understanding of when a message has errors in it and when it should be rejected?
Communication Interoperability

Patient Safety Issues – Scenario 2

A clinician orders a CPOE system sends an ‘Order message’ to the pharmacy requesting a STAT dose of intravenous lorazepam for seizure control.

The Pharmacy Information System (Rx System) the message is not received due to a transient network issue.

The standard calls for the CPOE system to wait for an acknowledgement (an HL7 ACK message), and display a message to the user that the order transaction was not completed, but this does not happen.

The clinician is not aware that the order has never been received, and there is a delay in treating the patient.
Semantic Interoperability

What is It?

- Agreement/consistency between systems on the *meaning* of communicated information
Semantic Interoperability

Examples

- Rx Norm (National Library of Medicine sponsored normalization of clinical drugs)
- International Classification of Diseases Version 9 - ICD-9-CM
- Systemized Nomenclature of Medicine - SNOMED® CT
- Laboratory Observations Identifiers Names and Codes or LOINC
- Medical Dictionary for Regulatory Activities (MedDRA), a medical terminology used by the regulated biopharmaceutical industry to code and classify adverse event information for pre-marketing to post-marketing data reporting activities
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Key element of clinical decision support and safety-critical alerts and reminders
A clinical decision support application is designed to screen a patient’s active medication list for concurrent nephrotoxin exposure risk when a clinician orders a contrast enhanced imaging study.

The system screens using a conventional drug dictionary, which does not have a mapping to NKTR-061, an investigational formulation of the aminoglycoside amikacin.

Without an explicit ‘understanding’ that NKTR-061 is a member of the aminoglycoside category, the decision support application does not detect the concurrent use of a potentially nephrotoxic medication and the alert is not triggered.
Workflow Interoperability

What is It?

- Agreement/consistency* on how the technology supports/shapes workflow:
  - Processing or sequencing tasks between participants according to a set of procedural rules
  - Formatting or displaying information
  - User interfaces
  - Penetration of decision support

* n.b.: clinicians make significant assumptions about ‘universality’ of workflow that is supported by IT
Workflow Interoperability

Examples

- Semi-automation of workflow involving in Indium-labeled leukocyte scintigraphy
  - Processes and information need to be coordinated and passed across CPOE, Radiology Information System for scheduling and Modality Work List generation, Laboratory Information System phlebotomy scheduling, isotope inventory management, ordering etc.

- Semi-automation of workflow around antimicrobial approval
  - All systems/subsystems (CPOE, LIS, telecom/pager) must have a shared model of the work process and the rules conditions necessary before passing information/status to the next system and step in the process.
Workflow Interoperability

Patient Safety Issues – Scenario 4

A clinician requests that hard copies of a digital mammogram be printed for use in the operating room to guide a biopsy. The default behavior for most printers is ‘scale to fit’ (i.e., fitting the image as well as can be achieved into the space available on the film) versus producing a ‘true-size’ copy.

Image is printed without explicit labeling of ‘scale to fit’.

The clinician does not realize that the distance between nipple and lesion measured using the ‘scale to fit’ image is less than the actual anatomic distance.

This results in uncertainty and multiple failed passes as the surgeon tries to gauge the appropriate depth of penetration for the needle and under-sampling of the target lesion.
Framing the Issues

Four Important Concepts - REFRESH

- Interoperability should always be measured or assessed with respect to a *specific function or task*.
- Interoperability should be thought of as a *falling along a continuum*.
- Function-by-function, task-by-task basis, two or more systems can anywhere from ‘incompatible’ to ‘fully integrated’.
- Because of the diversity of data, functions and uses, systems can simultaneously exist in both states … leading to *hidden* vulnerabilities.
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Four Biggest Challenges

- Latent (hidden) interoperability failures – failures within specific functions – that may not be obvious to the user

- Assumptions that users make about the ‘integrity’ (the completeness of the integration) of the components

- Asynchronous evolution of interfaced or inter-dependent components – legacy components

- Balancing need for standardization and innovation/customization
Thank You

Meghan M. Dierks, MD, FACS

mdierks@bidmc.harvard.edu