Striving for Semantic Interoperability

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DISCLAIMER: The views and opinions expressed in this presentation are those of the author and do not necessarily represent official policy or position of HIMSS.
Conflict of Interest

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Agenda

• Learning Objectives & STEPS
• What is Interoperability? Technical vs Semantic
• History of C-CDA
• Challenges to Semantic Interoperability
• Business Use Case
• Clinical Use Case
• Findings from the Field (C-CDA Implement-a-thon)
• The Future, FHIR and beyond
Learning Objectives

• Explain the challenges to semantic interoperability
• Describe approaches to data exchange that support semantic interoperability
• Evaluate the role of vendors in semantic interoperability solutions
• Identify clinical and business use cases for solutions to semantic interoperability
• Assess ways to improve the consistency and usefulness of CCDA implementations
Steps:

- Data Reporting
- Enhanced Communication
- Data Sharing
- Operational Savings

ACO: Accountability Care Organization, as defined in Medicare Shared Savings Program
Building Interoperability

1857  Fail, Fail, Fail, Fail
1858  Success for 3 weeks
1866  First Permanent Telegraph

Cyrus West Field
Semantic Interoperability, Circa 1866

Do you speak English?

President Andrew Johnson, US

Technical but not semantic exchange

Louis-Napoléon Bonaparte, France

Je ne peux pas parler Anglais!
Defining Semantic Interoperability

Semantic interoperability, one definition:

“the ability to import utterances from another computer without prior negotiation, and have your decision support, data queries and business rules continue to work reliably against these utterances.”¹

Why it’s harder in healthcare:

- Financial transactions have a single, unifying concept (dollars)
- You don’t need to know every word to have a conversation (the average person knows about 45,000 words)
- In healthcare, there are more than 1,000,000 terms spread across multiple vocabularies (RxNorm, ICD-10, SNOMED, LOINC, CPT) with significant overlap between concepts

1. Dolin RH, Alschuler LA Approaching semantic interoperability in Health Level Seven. JAMIA 2011
Volume of Document Exchange

Since the beginning of this presentation:

>2,000 documents exchanged
(> 20 million / month)¹

All of them are available for viewing, but....

Very few can be automatically imported for use by decision support, business rule and data queries

¹. See Modern Healthcare Providers are sharing more data than ever. So why is everyone so unhappy? April 2015
How Did We Get Here?

2005 Clinical Document Architecture (CDA) R2 ANSI-approved

2009 Meaningful Use (MU) enacted in stimulus bill requiring EHR certification and data exchange

2011 HL7 approves Consolidated CDA (C-CDA 1.1) that updates CCD and eight other document types

2014 Stage 2 providers must send electronic documents in >10% of care transitions

2006 HL7 approves Continuity of Care Document (CCD) which harmonizes CDA and Continuity of Care Record (CCR)

2010 Release of MU Stage 1 regulations requiring providers to test CCD or CCR exchange

2012 Release of Stage 2 regulations requiring primary document standard of C-CDA for in data exchange

2015 C-CDA 2.1 published by HL7 and selected as primary standard in Stage 3

ANSI American National Standards Institute
CCD Continuity of Care Document
C-CDA Consolidated Clinical Document Architecture
CCR Continuity of Care Record
CDA Clinical Document Architecture
EHR Electronic Health Record
MU Meaningful Use
HL7 Health Level 7

Adapted from Source: MedTech Boston 2014
What is a C-CDA Document?

RecordTarget

This identifies patient and has demographic info.

StructuredBody

Sections break up different clinical content.

Section

This shows up for human display.

Text (unstructured and one per section)

Entry (machine readable content)

Entry (often multiple per section)

... (additional sections)

This machine readable content can be used for exchange & apps.

Sections can be added and re-used between different documents.
# Types of C-CDA Documents

<table>
<thead>
<tr>
<th>Document</th>
<th>1.1</th>
<th>2.1</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuity of Care Document (CCD)</td>
<td>✓</td>
<td>✓</td>
<td>Used since Stage 1 and primary document for MU exchange</td>
</tr>
<tr>
<td>Care Plan</td>
<td></td>
<td>✓</td>
<td>Care planning has been significantly uplifted in C-CDA 2.1</td>
</tr>
<tr>
<td>Consult Note</td>
<td>✓</td>
<td>✓</td>
<td>Mostly narrative text</td>
</tr>
<tr>
<td>Diagnostic Imaging Report</td>
<td>✓</td>
<td>✓</td>
<td>Mostly narrative text</td>
</tr>
<tr>
<td>Discharge Summary</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>History &amp; Physical</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Operative Note</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Procedure Note</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Progress Note</td>
<td>✓</td>
<td>✓</td>
<td>Mostly narrative text</td>
</tr>
<tr>
<td>Referral Note</td>
<td></td>
<td>✓</td>
<td>Mostly narrative text</td>
</tr>
<tr>
<td>Transfer Summary</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Unstructured Document</td>
<td>✓</td>
<td>✓</td>
<td>Not eligible for MU</td>
</tr>
</tbody>
</table>

MU: Meaningful Use program for Electronic Health Records
Based on HL7 C-CDA 1.1 & 2.1 Implementation Guides & Meaningful Use regulations
The SMART C-CDA Collaborative

1. OUTREACH
- 107 Vendors contacted
- 44 Responses
- 22 Technologies Represented
  - Most aligned with MU 2 requirements
- 10 Group Meetings

What's hard? How to improve?
- Via webinars & online discussions
- Ideas for C-CDA examples
- 40+ C-CDAs Posted
  - At github.com/chb/sample_cddas/
- >100,000 Lines XML examined
- >1,000 Aspects Heterogeneity observed

2. EVALUATION*

SMART C-CDA SCORECARD†
Number of Documents in Each Score Range

| % score | 1 | 2 | 3 | 3 | 3 | 1 | 3 | 6 |

MISSING DATA
- Medication Sig: 72%
- Allergy Severity: 55%
- Marital Status: 44%
- Result Interpretation: 44%
- Med Route: 28%

3. IMPROVEMENT
- 930 Minutes Spent with 11 Individual Vendors reviewing document quality

6 Key Challenges
1. Smoking history
2. Problem status & timing
3. Medication dose & timing
4. Medication allergies & reactions
5. Highly structured lab results
6. Highly structured vital signs

TERMINOLOGY
- 67% All Problems in SNOMED
- 53% Pre-Coordinated Meds in RxNorm
- 44% Codified Allergic Reactions
- 39% Uses UCUM for Results & Vitals

ERRORS
Example: Excess Precision
```
<effectiveTime value="20131202000000+500" />
```
- Trailing zeroes present when only date known
  - Did event really happen at stroke of midnight?

Full error list: bit.ly/smart-ccda-findings, pages 5–9

*Source: Single C-CDA from 18 MU2-compliant EHR/HIE technologies
†SMART C-CDA Scorecard: ccdascorecard.smartplatforms.org

© 2014 SMART Platforms. SMART Platforms Project is an ONC-funded research project at Harvard Medical School/Boston Children’s Hospital. SMART and Lantana collaborated with EMR/HIE vendors to perform a detailed review of vendors’ Meaningful Use Stage 2 Consolidated-CDA documents. More at smartplatforms.org/2013/07/introducing-the-smart-c-cda-collaborative/.
Challenges to Semantic Interoperability

The above sample will pass all HL7 schema/schematron tests, but it’s a dangerous example of poor semantic interoperability…

7982 is the RxNorm norm code for penicillin, not codeine!

Challenges to Semantic Interoperability

• How to reconcile machine readable entries and the human readable portion when...
  – Information conflicts?
  – There is content in one section but not the other?
• How to deal with unstructured or free-text information when terminologies are not used?
• How to manage terminologies with conceptual overlap?
• How to deal with missing information?
Business Use Case – HIE Value

**Post-office Model**  
(Don’t Check)

Relies on Receiver to Find Value Among Lots of Data

**Analytics+ Model**  
(Normalize, Analyze, De-duplicate, Prioritize)

Organization Creates Value and Helps Receiver Know What to Do
Business Use Case – HIE Value

Using Clinical Data For:

- Population Health
- Risk of Diabetes, Stroke, AMI
- Risk of Readmit and ER
- Utilization Benchmarking
- Market Share

“Cleaning and standardizing data is 90% of the work!”

Publishing Analytics & Results

Development, Validation and Deployment of a Real Time 30 Day Hospital Readmission Risk Assessment Tool in Maine Health Information Exchange (2015)

Risk Prediction of Emergency Department Revisit 30 Days Post Discharge: A Prospective Study (2014)

Online Prediction of Health Care Utilization in the Next Six Months Based on Electronic Health Record Information: A Cohort and Validation Study (2015)

Role of Technology & Vendors

• Open source tools exist for checking C-CDA, but…
  – Can’t be used with real patient data
  – Don’t support full terminologies which are necessary for semantic interoperability
  – Don’t examine free-text portion

• Vendors provide an array of services
  – Parsing and data normalization
  – Terminology management
  – Free-text and natural language processing
Progress

• There is anecdotal evidence of “information blocking” but most complaints focus on costs and closed APIs. API access is addressed in Meaningful Use Stage 3\(^1\)\(^-\)\(^2\).
• C-CDA is richer and more standardized than HL7 2.x standards and can be cheaper to setup.
• Any certified EHR, inpatient or ambulatory, can produce a C-CDA document. Most vendors can parse them (and there are open-source parsers).
• Certified EHRs must have the capability to import key fields into their system, although not automatically.

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Clinical Use Case – Allergy Lists
What’s an “allergy”?

• Allergist definition: specific type of immune reaction, Type I - Immediate Hypersensitivity

• Patient definition: something bad happened last time I was exposed and I think it will happen again

• PCP definition: somewhere in between, closer to the patient; and there is only one list anyway

• Most common entry in medical records: Drug Rash
  – Mechanism unknown, but it is not immune
Clinical Use Case – Allergy Lists
One individual with 3 lists

- List #1
  - Dicloxacillin - hives and swelling

- List #2
  - Oxacillin – hives and itching

- List #3
  - penicillin - rash and swelling
One individual with 3 lists: Why?

- Terminology implementation issues?
- Entry error?
- CCDA Implementation issues?
- Clinical reality?
Findings from the Field: 1st CCDA Implement-a-thon

- Able to exchange and parse CCDA documents
- All had some errors, many resolved in course of day
- Differences around code system mappings, including some creation of duplicates by receiving system
- UCUM errors were common

Source: HL7 C-CDA Implement-a-thon Orlando FL January 2016
Findings from the Field: 1st CCDA Implement-a-thon

- CCDS/CCD Scenario
- CCDS/CCD Discharge Summary
  - Not using Discharge Summary template
  - 3 different med lists not part of template
- Referral note
  - Most vendors not ready to test

Source: HL7 C-CDA Implement-a-thon Orlando FL January 2016
Findings from the Field: 1st CCDA Implement-a-thon

- Coding issues
  - Multiple code systems
  - Missing code systems
  - Multiple codes in one system
  - Drop-down list priorities
- Other issues
  - Display issues
  - Data element ID issues

Source: HL7 C-CDA Implement-a-thon Orlando FL January 2016
Future CCDA Implement-a-thons

- More Implement-a-thons planned in the future
- HL7 CCDA Companion Guide in development
FHIRE and the Future

• HL7 FHIRE can be used in 4 interoperability paradigms
  – REST
  – Messages (analogous to HL7 v2)
  – Documents
  – Services

• CDA on FHIRE has been created over the past 18 mo
• CCDA on FHIRE is in development
• FHIRE may be used to construct and deconstruct CDA
Striving for Semantic Interoperability

Interoperability is a journey.
Gathering Steam

“The issue of interoperability between electronic health records represents one of the most complex challenges facing the healthcare community.”

– Dr. Wergin, AAFP 2015

Congressional Republicans demanding Meaningful Use focus on interoperability over counting arbitrary measures.

– Mrs Ellmers, lead author 116 co-signed, Sept 2015
Thank You & Questions

Remind us to repeat questions before answering!

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