

Interoperability Progress and Remaining Data Quality Barriers of Certified Health Information Technologies

S73 – Interoperability

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Twitter: #AMIA2018

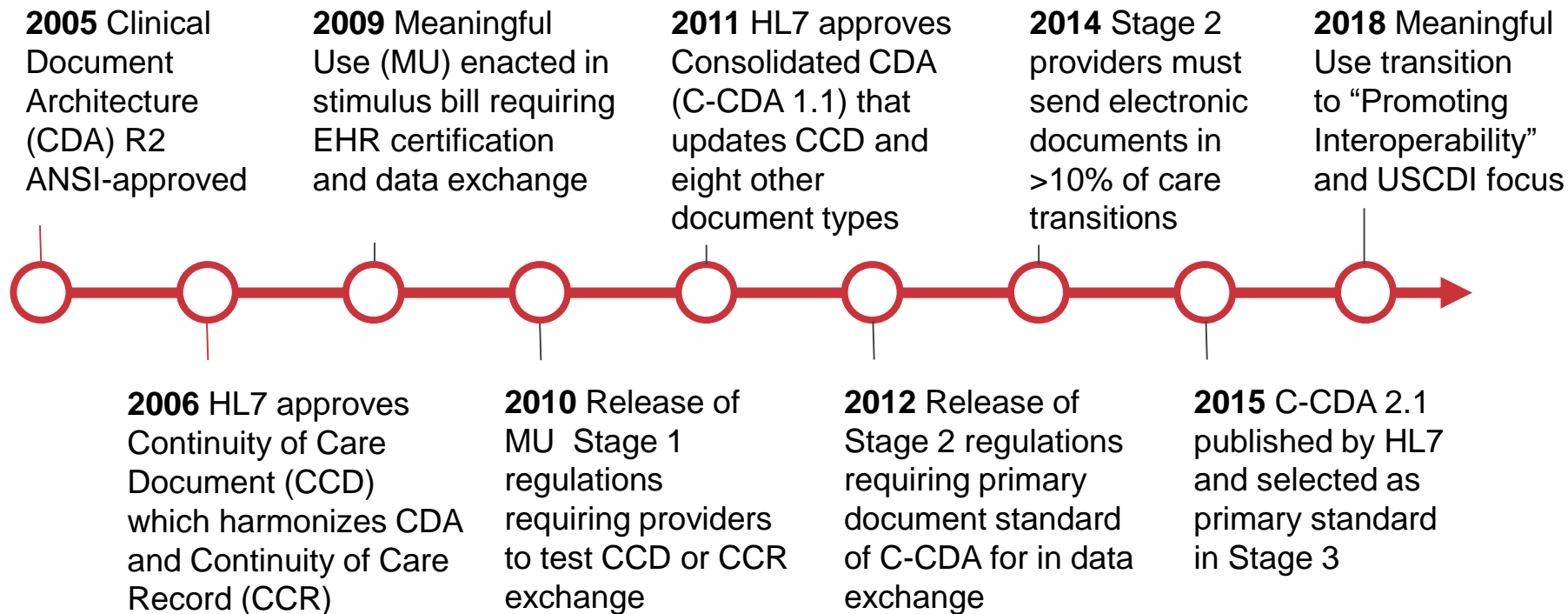


I disclose the following relevant relationship with commercial interests:

- Salary and equity interest in Diameter Health, Inc.

- Federal regulations (“Meaningful Use”) have promoted the wide adoption of electronic health records (EHRs)
- Since the first stage of Meaningful Use, EHRs have been required to be capable of exporting care summaries (“clinical documents”)
- The most recent stage of Meaningful Use requires the use of the HL7 C-CDA 2.1 conformant documents
- Previous research have found issues in relating to interoperability of EHR clinical documents. This research examines the most recent implementation
- VA has a strong, vested interest in data quality

How Did We Get Here?



Dual Role of Clinical Documents

Robust, Machine-Computable Data to Support :

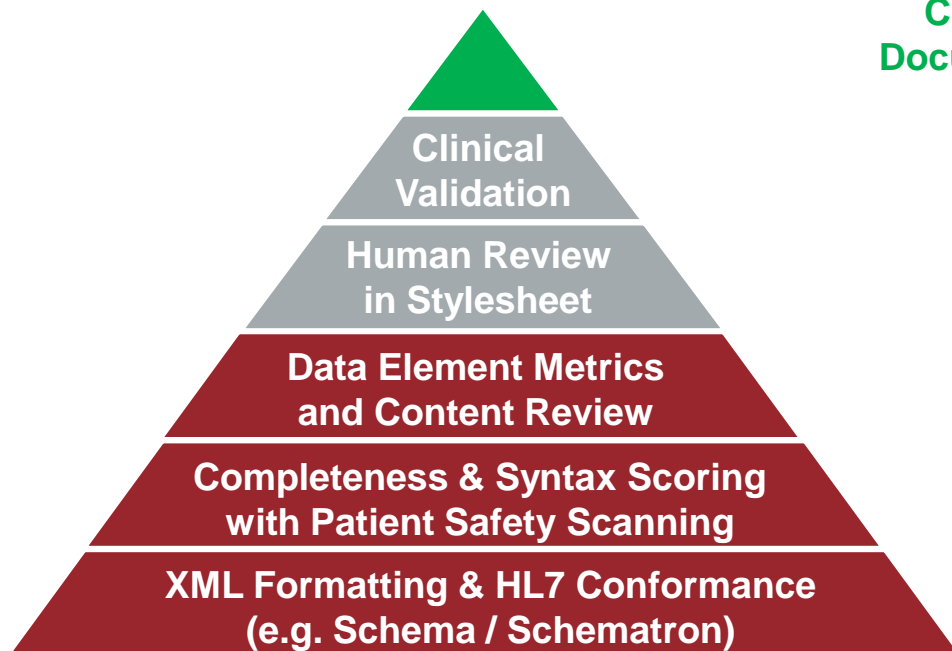
- Data Interoperability & Integration
- Clinical Decision Support
- Analytics & Secondary Use

Clean, Usable Human Readable Contents

- Clinician Usage
- Patient Access to Information

- 400+ C-CDA samples from 52 EHR and Health IT systems in public repository by the Office of National Coordinator for Health IT
 - Original: <https://github.com/siteadmin/2015-ccda-certification-samples>
 - Formatted: <https://github.com/jddamore/ccda-samples>
 - Most documents on the same 4 clinical test scenarios
- Examine clinical documents using several tools:
 - HL7 Schematron evaluation (open-source)
 - Parsing using Model Driven Health Tools (open-source)
 - Semantic Evaluation using Diameter Health Analyze (proprietary)
- In addition, manual examination was performed

Components of Data Quality



Clinical Usability of both Human Readable Documents and Machine-Computable Contents

Human Review (Narrative Focus)


- Clinician validation
- Readable Scoring
- Terminologist review
- Interoperability expert review

Automated Tools (Machine-Readable Focus)

- Diameter Health
- Model Driven Health Tools (MDHT)
- Altova
- VA internal development

Schema, Schematron, Semantic Interoperability

Illustrative lab result from C-CDA 2.1



```
<observation classCode="OBS" moodCode="EVN">
  <templateId root="2.16.840.1.113883.10.20.22.4.2" />
  <templateId root="2.16.840.1.113883.10.20.22.4.2" extension="2015-08-01" />
  <id root="963f3543-3266-41ea-b9d4-ddaf254c567f" />
  <code nullFlavor="UNK" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC" />
  <text>
    HbA1c(human readable reference)
  </text>
  <statusCode code="completed" />
  <effectiveTime value="20181106111205-0800" />
  <value xsi:type="PQ" value="10.2" unit="%" />
</observation>
```

Tooling may still want to identify that no structured code provided even when possible

Schema <templateId> before <id> before <code>

Schematron When a lab result, use LOINC as the codeSystem

Improving Data Quality

2014, stage 2 MU data

Research and applications



OPEN ACCESS

Are Meaningful Use Stage 2 certified EHRs ready for interoperability? Findings from the SMART C-CDA Collaborative

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ABSTRACT

Background and objective Upgrades to electronic health record (EHR) systems scheduled to be introduced in the USA in 2014 will advance document interoperability between care providers. Specifically, the second stage of the federal incentive program for EHR adoption, known as Meaningful Use, requires use of the Consolidated Clinical Document Architecture (C-CDA) for document exchange. In an effort to examine and improve C-CDA based exchange, the SMART (Substitutable Medical Applications and Reusable Technology) C-CDA Collaborative brought together a group of certified EHR and other health information technology vendors.

Materials and methods We examined the machine-readable content of collected samples for semantic

In our study, we apply the operational definition of semantic interoperability to assess structured data within Consolidated Clinical Document Architecture (C-CDA) documents, which certified electronic health record (EHR) systems must produce to satisfy federal regulation of EHR adoption. We study core variation in document samples to examine if reliable semantic interoperability is possible.

EHR adoption and Meaningful Use

EHR use in the USA has risen rapidly since 2009 with certified EHRs now used by 78% of office-based physicians and 85% of hospitals.^{3, 4} Meaningful Use (MU), a staged federal incentive program enacted as part of the American Recovery



2018, stage 3 MU data

Interoperability Progress and Remaining Data Quality Barriers of Certified Health Information Technologies

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Abstract

The Consolidated Clinical Document Architecture (C-CDA) is the primary standard for clinical document exchange in the United States. While document exchange is prevalent today, prior research has documented challenges to high quality, effective interoperability using this standard. Many electronic health records (EHRs) have recently been certified to a new version of the C-CDA standard as part of federal programs for EHR adoption. This renewed certification generated example documents from 52 health information technologies that have been made publicly available. This research applies automated tooling and manual inspection to evaluate conformance and data quality of these testing artifacts. It catalogs interoperability progress as well as remaining barriers to effective data exchange. Its findings underscore the importance of programs that evaluate data quality beyond schematron conformance to enable the high quality and safe exchange of clinical data.

- Breadth and structure of information has increased as part of HealthIT certification
- Schematron errors, key patient safety and data quality issues have decreased

Data Issues Still Exist

Panel A: Inaccurate Drug Terminology

“1191” is RxNorm code for aspirin, not gimeracil

```
<participant typeCode="CSM">
  <participantRole classCode="MANU">
    <playingEntity classCode="MMAT">
      <code code="1191" codeSystem="2.16.840.1.113883.6.88"
        displayName="gimeracil" codeSystemName="RxNorm">
        <originalText>
          <reference value="#ALGSUB_2"/>
        </originalText>
      </code>
      <name>gimeracil</name>
    </playingEntity>
  </participantRole>
</participant>
```

Panel B: Wrong Unit in Vital Sign

194 “lb” in narrative but 194 “kg” in machine readable

```
<td>
  <content ID="VitWt16" />194 lb
</td>

<code codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC"
  displayName="Weight" code="29463-7" />
<text>
  <reference value="#VitWt16" />
</text>
<statusCode code="completed" />
<effectiveTime value="20170109" />
<value xsi:type="PQ" value="194" unit="kg" />
```

Panel C: Inaccurate Medication Dose

1 “mg” of Tylenol should instead be 1 “{tablet}”

```
<doseQuantity value="1.0" unit="mg"/>
<consumable>
  <manufacturedProduct classCode="MANU">
    <templateId root="2.16.840.1.113883.10.20.22.4.23" extension="2014-06-09"/>
    <templateId root="2.16.840.1.113883.10.20.22.4.23"/>
    <id root="2.16.840.1.113883.3.3619.17.1" extension="64"/>
    <manufacturedMaterial>
      <code code="209459" codeSystem="2.16.840.1.113883.6.88" codeSystemName="RxNorm"
        displayName="Tylenol Extra Strength 500 mg oral tablet"/>
    </manufacturedMaterial>
  </manufacturedProduct>
</consumable>
```

Panel D: Missing Result Information

No LOINC code or unit for “WBC,” white blood cell count

```
<code codeSystemName="LOINC" codeSystem="2.16.840.1.113883.6.1"
  nullFlavor="NA" displayName="WBC" />
<text>
  <reference value="#LabResult11" />
</text>
<statusCode code="completed" />
<effectiveTime value="20120810" />
<value xsi:type="PQ" value="6.7" />
<interpretationCode code="N" codeSystem="2.16.840.1.113883.5.83" />
<referenceRange>
  <observationRange>
    <value xsi:type="ST">(4.3-10.8 10+3/u1)</value>
  </observationRange>
</referenceRange>
```

Rules for Data Quality

[illegible]

Medication	Directions	Start Date	End Date
Ceftriaxone 100 MG/ML Injectable Solution	BID	June 22, 2015	June 30, 2015
Acetaminophen 500 MG Oral Tablet [Tylenol]	For 10 days As needed	June 22, 2015	July 1, 2015
1 mL darbepoetin alfa 0.5 MG/ML Prefilled Syringe	Once a week	June 22, 2015	Unknown

Ceftriaxone 100 MG/ML Injectable Solution 2 times a day	Ordered: 6 Jul 2015 Confir, SCH	Start: 22-Jun-2015 End: 30-Jun-2015 Generic: Ceftriaxone Sodium
Tylenol Cof Caplet Extra Strength 500 mg oral tablet 1 unit(s) orally once a day, as needed. Quantity: 10	Ordered: 6 Jul 2015 Confir, SCH	Start: 22-Jun-2015 End: 2-Jul-2015 Generic: Substitution Allowed Comments: Do not use with any other product containing acetaminophen to prevent possible liver damage.
Aranesp (darbepoetin alfa) 0.5 mg/mL prefilled syringe 1 unit(s) injectable once a week	Ordered: 6 Jul 2015 Confir, SCH	Start: 22-Jun-2015 Generic: Substitution Allowed Comments: It is very important that you take or use this exactly as directed. Do not skip doses or discontinue unless directed by your doctor. Keep in refrigerator. Do not freeze.

Medication	Directions	Start Date	Status	Indications	FIR Instructions
Ceftriaxone 100MG/ML	BID	June 22, 2015	Active	Fever	-none-
Tylenol 500mg	For 10 days As needed	June 22, 2015	Active	Fever	-none-
Darbepoetin 0.5 MG/ML	Once a week	June 22, 2015	Active	Anemia	-none-

Medication	Code	Code System	Start Date	Stop Date	Route	Directions	Status	FIR Instructions
Ceftriaxone 100 MG/ML	209490	Reflexis	6/22/2015	6/30/2015	INTRAMUSCULAR INJECTABLE	1 Unit Two times daily	Inactive	
Tylenol 500mg	209490	Reflexis	6/22/2015	7/2/2015	ORAL	For 10 days, starting from 6/22/2015 1 unit as needed	Inactive	
Aranesp 0.5 MG/ML	731241	Reflexis	6/22/2015		INTRAMUSCULAR INJECTABLE	1 Unit Once a week	Active	

Medication	Directions	Start Date	End Date
Ceftriaxone 100 MG/ML Injectable Solution [209090]	Two Times Daily	6/22/2015	6/23/2015
Tylenol 500 MG Oral Tablet [209490]	For 10 days As needed	6/22/2015	7/2/2015
Darbepoetin Alfa 0.5 MG/ML Prefilled Syringe [731184]	Once a week	6/22/2015	Unknown

Medication	Directions	Start Date	Status
Tylenol Extra Strength 500 mg tablet 1 unit(s) by mouth	1 unit(s) by mouth as directed	07/25/2017	Inactive
ceftriaxone 100 gram solution for injection 1 unit(s) intramuscular inject twice a day	1 unit(s) intramuscular inject twice a day	07/25/2017	Active
Aranesp 100 mg/mL (En polystyrene) injection syringe 1 unit(s) intramuscular inject weekly	1 unit(s) intramuscular inject weekly	07/25/2017	Active

Medication	Directions	Start Date
Ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	two times daily	June 22, 2015
Aranesp 0.5 MG per 1 ML Prefilled Syringe	as needed	June 22, 2015
Tylenol 500 MG Oral Tablet		June 22, 2015

Medication	Directions	Start Date	End Date	Status
Aranesp 0.5 MG/ML	Inject 1 unit once a week	06/22/2015	N/A	Active
Ceftriaxone 100MG/ML	Inject 1 unit two times daily	06/22/2015	06/30/2015	Completed
Tylenol Oral Tablet 500 MG	Take 1 unit orally for 10 days starting from 6/22/2015 as needed	06/22/2015	07/02/2015	Completed

Aranesp (darbepoetin Alfa) 500 MG/ML Injectable Solution Prefilled Syringe INJECT 1 ML Weekly Quantity: 4	Davis, M.D. Albert	Start: 26-Aug-2016 End: 1 ML Syringe
Ceftriaxone Sodium 100 GH Injection Solution Reconstituted INJECT 1 ML Twice daily Quantity: 18	Davis, M.D. Albert	Start: 26-Aug-2016 End: 4-Sep-2016 Status: Complete
Tylenol Extra Strength 500 MG Oral Tablet TABS 1 TABLET Every 6 Hours Quantity: 40	Davis, M.D. Albert	Start: 26-Aug-2016 End: 5-Sep-2016 Status: Complete

Medication	Directions	Start Date	End Date	Status
Tylenol Extra Strength 500 mg Oral Tablet 1 unit(s) orally every 6 hours as needed. Quantity: 40	As needed	6/22/2015	7/2/2015	Completed
Ceftriaxone 100 MG/ML Injectable Solution	Inject 1 unit two times daily	6/22/2015	6/30/2015	Completed
Aranesp 0.5 MG/ML	Inject 1 unit once a week	6/22/2015	6/30/2015	Completed

Medication	Directions	Start Date	End Date
Ceftriaxone 100 MG/ML Injectable Solution [209090]	Two Times Daily	6/22/2015	6/23/2015
Tylenol 500 MG Oral Tablet [209490]	For 10 Days As needed	6/22/2015	7/1/2015
1 mL darbepoetin alfa 0.5 MG/ML Prefilled Syringe [731184]	Once a week	6/22/2015	Unknown

Code System	Code	Medication	Instructions	Date Started	Status
Reflexis	209490	Tylenol 500 MG Tablet	Take 1 Tablet oral (every day), PRN (as needed) for 10 days	06/22/2015	completed
Reflexis	309090	Ceftriaxone 100 Gram Reconst Sol	Take 1 injection bid (twice a day) for 8 days	06/22/2015	completed
Reflexis	731241	Aranesp (En polystyrene) 500 MG/ML Syringe	Take 1 injection eqk (every week)	06/22/2015	active

Medication	Directions	Start Date	End Date
Ceftriaxone 100 MG/ML Injectable Solution [209090]	Two Times Daily	6/22/2015	6/23/2015
Tylenol 500 MG Oral Tablet [209490]	For 10 days As needed	6/22/2015	7/2/2015
Darbepoetin Alfa 0.5 MG/ML Prefilled Syringe [731184]	Once a week	6/22/2015	Unknown

Date	Name	Dose	Route	Frequency	Stop End Date
6/22/2015	Aranesp 0.5 MG/ML Prefilled Syringe	1	Injectable	Once a week	
6/22/2015	Ceftriaxone 100 MG/ML Injectable Solution	1	Injectable	Two times daily	
6/22/2015	Tylenol 500 MG Oral Tablet	1	Oral	As needed	

Medication	Strength	Directions	Start Date	End Date	Status
Tylenol Extra Strength	500 mg	take 1 tablet (500 mg) by oral route every 3 hours as needed	6/22/2015		Active
Aranesp (En polystyrene)	100 mg/mL	1 mL by Injection route 1 time per week	6/22/2015		Active
Ceftriaxone	100 g	1 Unit by Injection route 2 times per day for 3 day	6/22/2015	6/30/2015	Suspended

Medication	Directions	Start Date	End Date
Tylenol Extra Strength 500 MG Oral Tablet	For 10 days as needed	2015-06-22	2015-07-02
Aranesp 500 MCG in 1 ML Prefilled Syringe	Once a week	2015-06-22	
Ceftriaxone 100 MG/ML Injectable Solution	As Needed	2015-06-22	

Reflexis	Code	Code System	Start Date	Stop Date	Route	Directions	Status	FIR Instructions
Reflexis	209490	Reflexis	6/22/2015	7/2/2015	ORAL	For 10 days, starting from 6/22/2015 1 unit as needed	Inactive	
Reflexis	309090	Reflexis	6/22/2015	6/30/2015	INTRAMUSCULAR INJECTABLE	1 Unit Two times daily	Inactive	
Reflexis	731241	Reflexis	6/22/2015		INTRAMUSCULAR INJECTABLE	1 Unit Once a week	Active	

Medication	Directions	Start Date	End Date
Ceftriaxone Sodium	Two times daily	6/22/2015	6/30/2015
Aranesp	Once a week	6/22/2015	
Tylenol Extra Strength	As needed	6/22/2015	7/2/2015

Medication	Directions	Start Date	End Date
Ceftriaxone 100 MG/ML Injectable Solution [209090]	Two Times Daily	6/22/2015	6/23/2015
Tylenol 500 MG Oral Tablet [209490]	For 10 Days As needed	6/22/2015	7/1/2015
Aranesp 0.5 MG/ML [731241]	Once a week	6/22/2015	Unknown

Date	Medication	Dose	Unit	Route	Frequency	Status
6/22/2015	ceftriaxone (as ceftriaxone sodium) 100 GH per 100 ML Injectable Solution	1	Units	Injectable	twice a day	Active
6/22/2015	Tylenol Extra Strength 500 MG Oral Tablet	1	Units	by mouth	as needed	Active
6/22/2015	Aranesp 500 MCG per 1 ML Prefilled Syringe	1	Units	Injectable	1x Weekly	Active

Medication	Instructions	Date	Provider
ARANESP (ALBUMIN FREE) 500 MCG/0.5 ML INJ SYR	1 injection once a week	2015/06/22	
TYLENOL EXTRA STRENGTH TABS	1 tablet by mouth as needed	2015/06/22 - 2015/07/02	
CEFTRIAZONE SODIUM 100 GPH INJ SOLA	1 injection two times daily	2015/06/22 - 2015/06/30	

Medication	Brand Name	Code	Code System	Dose	Route	Frequency	Status	Start Date	Ordering Provider
ARANESP (ALBUMIN FREE) 500 MCG/0.5 ML INJ SYR	ARANESP	245173	REFLEXIS	1	SUBCUTANEOUS	ONCE WEEKLY	Active	2015/06/22 00:00:00	
TYLENOL EXTRA STRENGTH TABS	TYLENOL	209490	REFLEXIS	1	ORAL	AS NEEDED	Active	2015/06/22 00:00:00	
CEFTRIAZONE SODIUM 100 GPH INJ SOLA	CEFTRIAZONE	209090	REFLEXIS	1	INTRAMUSCULAR INJECTABLE	TWICE A DAY	Active	2015/06/22 00:00:00	

Medication	Strength	Directions	Start Date	End Date	Status
Tylenol Extra Strength	500 mg	take 1 tablet (500 mg) by oral route every 3 hours as needed	6/22/2015		Active
Aranesp (En polystyrene)	100 mg/mL	1 mL by Injection route 1 time per week	6/22/2015		Active
Ceftriaxone	100 g	1 Unit by Injection route 2 times per day for 3 day	6/22/2015	6/30/2015	Suspended

Medication	Directions	Start Date	Status
CefTRIAZONE Sodium 100 GM SOLR	Injectable twice daily for 7 days	20150622	Posted
Aranesp (Albumin Free) 500 MCG/ML SYR	Take once a week	20150622	Posted
Tylenol Extra Strength 500 MG TABS	Take 1 tablet by mouth once per day	20150622	Posted

Code	Medication	Directions	Start Date	End Date	Status
Reflexis	Tylenol 500 mg oral caplets	1 As Needed PRN	06-22-2015	07-02-2015	Active
Reflexis	ceftriaxone 100 gram injection	1 Unit Twice A Day PRN	06-22-2015	06-30-2015	Active
Reflexis	Aranesp (En polystyrene) 500 mg/mL injection syringe	1 Unit Every Week PRN	06-22-2015	06-22-2015	Active

Medication	Directions	Start Date	End Date
Ceftriaxone 100 MG/ML Injectable Solution	BID	June 22, 2015	June 30, 2015
Acetaminophen 500 MG Oral Tablet [Tylenol]	For 10 days As needed	June 22, 2015	July 1, 2015
1 mL darbepoetin alfa 0.5 MG/ML Prefilled Syringe	Once a week	June 22, 2015	Unknown

Medication	Directions	Start Date
Ceftriaxone 100 MG/ML	Two times daily	June 22, 2015
Tylenol 500mg	As needed	June 22, 2015
Aranesp 0.5 MG/ML	Once a week	June 22, 2015

Medication	Directions	Start Date	Last Modified Date
ceftriaxone 10 gram [ceftriaxone sodium] 10 GH per 100 ML Injectable Solution	1 unit intramuscular inject	June 22, 2015	June 01, 2017
Tylenol Extra Strength 500 mg [Tylenol] 500 MG Oral Tablet	1 tablet by mouth	June 22, 2015	June 01, 2017
Aranesp (En polystyrene) 500 mg/mL (En polystyrene) injection syringe	1 unit intramuscular inject 1x week	June 22, 2015	June 01, 2017

Medication	Directions	Start Date
ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	1 unit 2 times daily	2015-06-22
Tylenol	1 unit as needed	2015-06-22
Aranesp	1 unit once a week	2015-06-22

Medication	Directions	Start Date
ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	1 unit 2 times daily	2015-06-22
Tylenol	1 unit as needed	2015-06-22
Aranesp	1 unit once a week	2015-06-22

Medication	Directions	Start Date
1 mL darbepoetin alfa 0.5 MG/ML Prefilled Syringe	1 Unit Once a week	06/22/2015
Acetaminophen 500 MG Oral Tablet [Tylenol]	1 Unit For 10 days as needed	06/22/2015
Ceftriaxone 100 MG/ML Injectable Solution	1 Unit Two Times daily	06/22/2015

Medication	Directions	Start Date	Status
CefTRIAZONE Sodium 100 GM SOLR	Injectable twice daily for 7 days	20150622	Posted
Aranesp (Albumin Free) 500 MCG/ML SYR	Take once a week	20150622	Posted
Tylenol Extra Strength 500 MG TABS	Take 1 tablet by mouth once per day	20150622	Posted

Medication	Directions	Start Date	Status
CefTRIAZONE Sodium 100 GM SOLR	Injectable twice daily for 7 days	20150622	Posted
Aranesp (Albumin Free) 500 MCG/ML SYR	Take once a week	20150622	Posted
Tylenol Extra Strength 500 MG TABS	Take 1 tablet by mouth once per day	20150622	Posted

Medication	Directions	Start Date	Status
ceftriaxone 10 gram solution for injection	Injectable twice daily for 7 days	20150622	Posted
Aranesp 500 mg/mL (En polystyrene) injection syringe	Take once a week	20150622	Posted
Tylenol Extra Strength 500 mg tablet	1 pill by mouth weekly as directed	20150622	Posted

Medication	Directions	Start Date	Status	Indications	FIR Instructions
Ceftriaxone	BID	June 22, 2015	Active	Fever	-none-
Tylenol 500mg	For 10 days As needed	June 22, 2015	Active	Fever	-none-
Darbepoetin 0.5 MG/ML	Once a week	June 22, 2015	Active	Anemia	-none-

Medication	Directions	Start Date	Status	Indications	FIR Instructions
Ceftriaxone	BID	June 22, 2015	Active	Fever	-none-
Tylenol 500mg	For 10 days As needed	June 22, 2015	Active	Fever	-none-
Darbepoetin 0.5 MG/ML	Once a week	June 22, 2015	Active	Anemia	-none-

Medication	Directions	Start Date	Status	Indications	FIR Instructions
Ceftriaxone	BID	June 22, 2015	Active	Fever	-none-
Tylenol 500mg	For 10 days As needed	June 22, 2015	Active	Fever	-none-
Darbepoetin 0.5 MG/ML	Once a week	June 22, 2015	Active	Anemia	-none-

Medication	Directions	Start Date	Status	Indications	FIR Instructions
Ceftriaxone	BID	June 22, 2015	Active	Fever	-none-
Tylenol 500mg	For 10 days As needed	June 22, 2015	Active	Fever	-none-
Darbepoetin 0.5 MG/ML	Once a week	June 22, 2015	Active	Anemia	-none-

Medication	Directions	Start Date	Status	Indications	FIR Instructions
Ceftriaxone	BID	June 22, 2015	Active	Fever	-none-
Tylenol 500mg	For 10 days As needed	June 22, 2015	Active	Fever	-none-
Darbepoetin 0.5 MG/ML	Once a week	June 22, 2015	Active	Anemia	-none-

Medication	Directions	Start Date
ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	1 unit 2 times daily	2015-06-22
Tylenol	1 unit as needed	2015-06-22
Aranesp	1 unit once a week	2015-06-22

Medication	Directions	Start Date
ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	1 unit 2 times daily	2015-06-22
Tylenol	1 unit as needed	2015-06-22
Aranesp	1 unit once a week	2015-06-22

Medication	Directions	Start Date
ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	1 unit 2 times daily	2015-06-22
Tylenol	1 unit as needed	2015-06-22
Aranesp	1 unit once a week	2015-06-22

Medication	Directions	Start Date
ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	1 unit 2 times daily	2015-06-22
Tylenol	1 unit as needed	2015-06-22
Aranesp	1 unit once a week	2015-06-22

Medication	Directions	Start Date
ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	1 unit 2 times daily	2015-06-22
Tylenol	1 unit as needed	2015-06-22
Aranesp	1 unit once a week	2015-06-22

Medication	Directions	Start Date
ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	1 unit 2 times daily	2015-06-22
Tylenol	1 unit as needed	2015-06-22
Aranesp	1 unit once a week	2015-06-22

Medication	Directions	Start Date
ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	1 unit 2 times daily	2015-06-22
Tylenol	1 unit as needed	2015-06-22
Aranesp	1 unit once a week	2015-06-22

Medication	Directions	Start Date
ceftriaxone (as ceftriaxone sodium) 10 GH per 100 ML Injectable Solution	1 unit 2 times daily	2015-06-22
Tylenol	1 unit as needed	2015-06-22
Aranesp	1 unit once a week	2015-06-22

Conclusions & Discussion

Progress

- More tools available today than ever before
- More data in documents, expanding scope of USCDI
- Fewer technical errors in XML validation

Opportunities

- Need for automated tooling to go beyond schematron
- Data quality/veracity/hygiene extends beyond EHR certification
- Significant implementation variation still exists
- Variability of human readable portions may introduce a significant cognitive burden for multi-source information exchange

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Thank you!

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