



Content-ion over Data Quality

Understanding eHealth Exchange Content Testing



Speakers



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Introduction

- The eHealth Exchange (eHX) is a network of exchange partners that securely share clinical information across the U.S. under a common framework
 - Managed by



- Participants:
 - 59 Regional and State HIEs
 - 75% of U.S. Hospitals
 - 4 Federal agencies: VA, DoD, CMS, SSA
- *Carequality also falls under The Sequoia Project umbrella*

Source: <https://sequoiaproject.org/ehealth-exchange/about/>

Introduction



- Prior to February 2018, testing was focused on transport (DIL Testing).



- As of last February 2018, the Content Testing program was launched.



Introduction



- Key Deadlines to be aware of:
 - All “new” exchange partners as of Feb. 2018 must follow the new content testing process
 - If you were already in production, or in the process of onboarding prior to Feb. 2018, you have until February 2019 to begin your testing process.
 - Once you start the testing process – you have 18 months to complete it.
- Planning / Budgeting
 - It’s important to assess NOW the # of documents you’ll need to test – as that will drive the amount of effort required

Let's dive into the details



Background – Content Problems

- Documents shared via eHX are mostly C-CDAs
 - Type: Mostly Continuity of Care Documents (CCDs)
- Pain Points: **TACO** Problems 🌮
 - **T**erminology Inconsistent terminology usage
 - **A**mbiguity Specification is open to interpretation
 - **C**omplexity C-CDA Spec is difficult, lacks examples
 - **O**ptionality Inconsistent implementations across vendors

Source: <https://sequoiaproject.org/ehealth-exchange/testing-overview/content-testing/>

TACO Problems 🌮



- **Terminology:**
 - “You’re sending local codes for your labs. My system doesn’t know what to do with these, we need SNOMED or LOINC!”
- **Ambiguity:**
 - “Which <id> element means what again?” (ex. Payer Section!)
- **Complexity:**
 - “What is the scopingEntity of your participant’s participantRole?”
- **Optionality:**
 - “Spec says there SHOULD be <insert element> here. Your system doesn’t create it. My system expects it and errors if it’s not there!”



Content Testing to the rescue!

- eHX implemented “Content Testing” in February 2018 to address these issues
 - Prerequisite for all new participants
 - Existing participants must submit a test by February 2019
 - eHX is becoming the de-facto “standard” spec. & MU interpretation!
- eHX is providing an automated testing tool (ITP) for:
 - C-CDA R1.1 & R2.1
 - HITSP C-32

Source: <https://sequoiaproject.org/ehealth-exchange/testing-overview/content-testing/>



What does Content Testing Do?

- Checks Compliance With:
 - HL7 DSTU C-CDA Specification R1.1/R2.1, and
 - Meaningful Use 3 / Promoting Interoperability (2015 Edition)
- Lays the groundwork to encourage (or require) additional document types
 - H&P, Summary of Care (etc.)
 - Support more use cases

Source: eHealth Exchange Content Testing Program Guide v1.0

What do I need to test as a Participant?





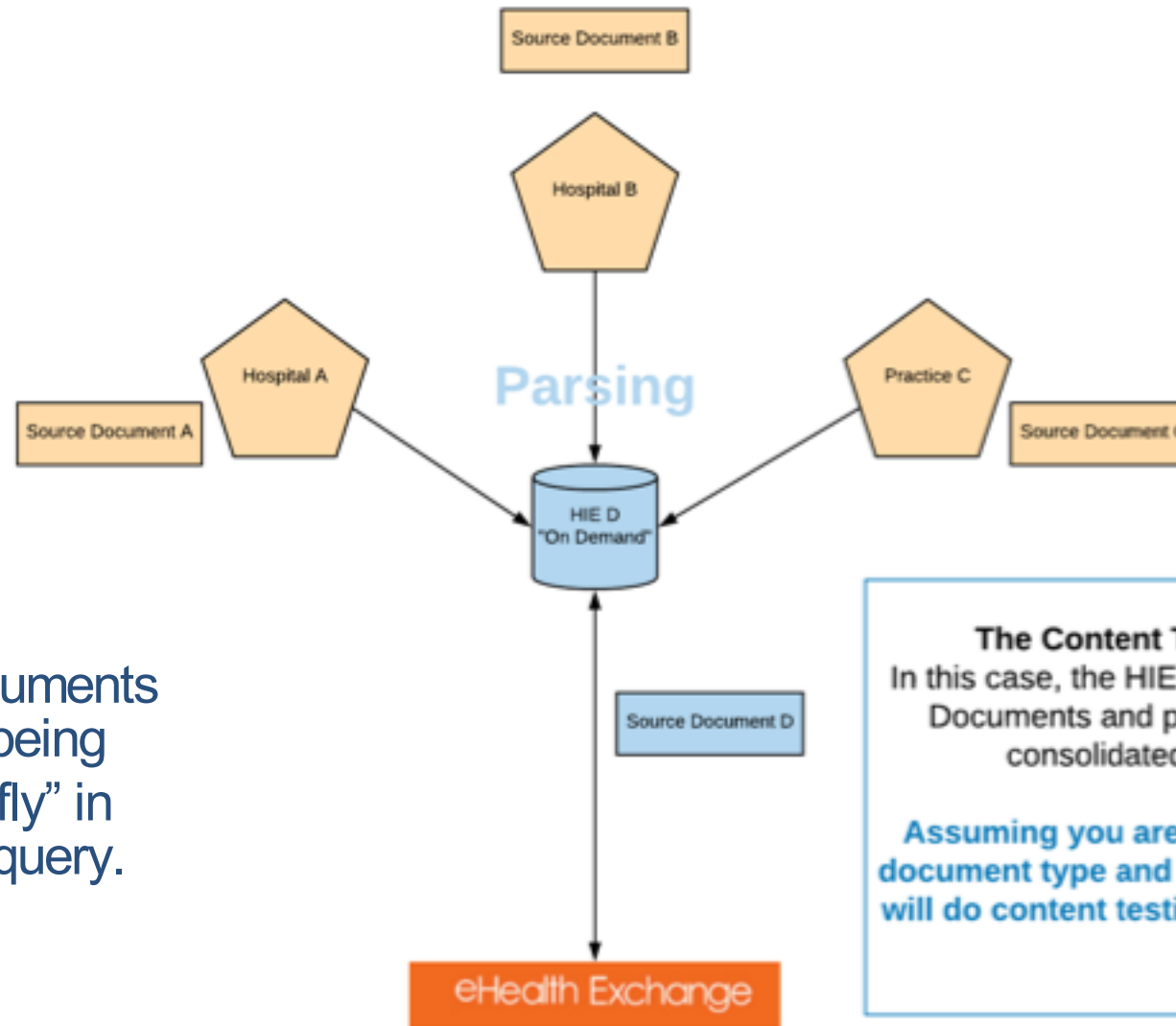
What do I need to test?

- Participants must test:
 - **Document Source** - at least one sample for each
 - ex: HIE generated, Hospital A, Provider Office B
 - **Document Type** – at least one for each supported
 - ex: CCD, Transition of Care
 - **Document Version** – at least one for each supported
 - ex: C-32, C-CDA R1.1, C-CDA R2.1

Source: <https://sequoiaproject.org/ehealth-exchange/testing-overview/content-testing/>

What if I only support On-Demand Documents?

- Many participants only support “on-demand” Documents:
 - 1) The HIE accepts data from many sources in many formats
HL7v2, C32, CCDA, manual entry, etc
 - 2) Parses and stores it discreetly in your CDR
 - 3) Builds an On-Demand CCDA in response to eHX queries
- In these cases, the math is simple -
 - If only On-Demand documents are exchanged, then only On-Demand documents need to be tested (far fewer)



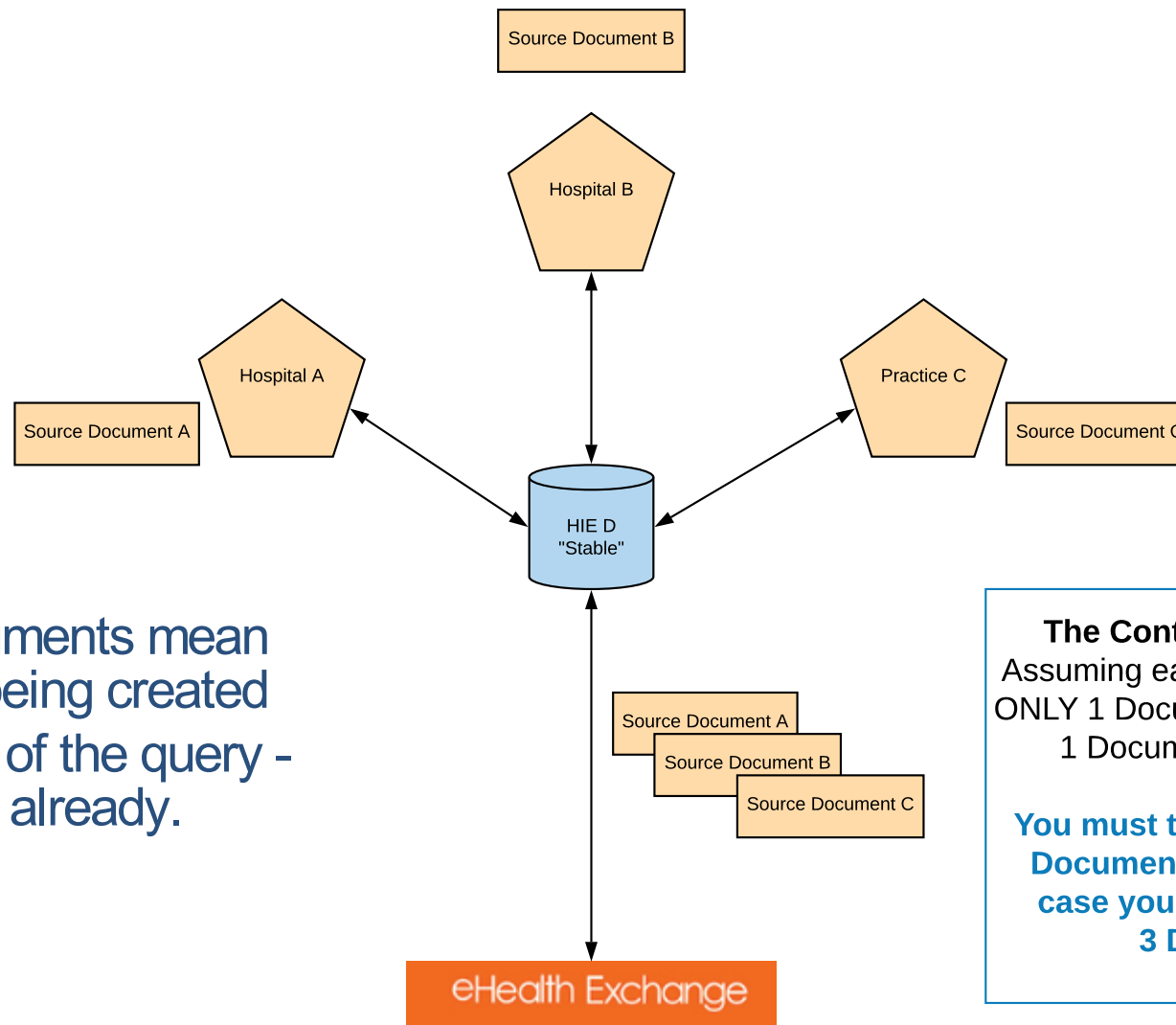
“On-demand” Documents mean they are being created “on the fly” in response to the query.

The Content Testing Math:
In this case, the HIE is parsing incoming Documents and producing a single consolidated document.
Assuming you are producing only 1 document type and 1 version, then you will do content testing for 1 document.



What if I support Stable Documents?

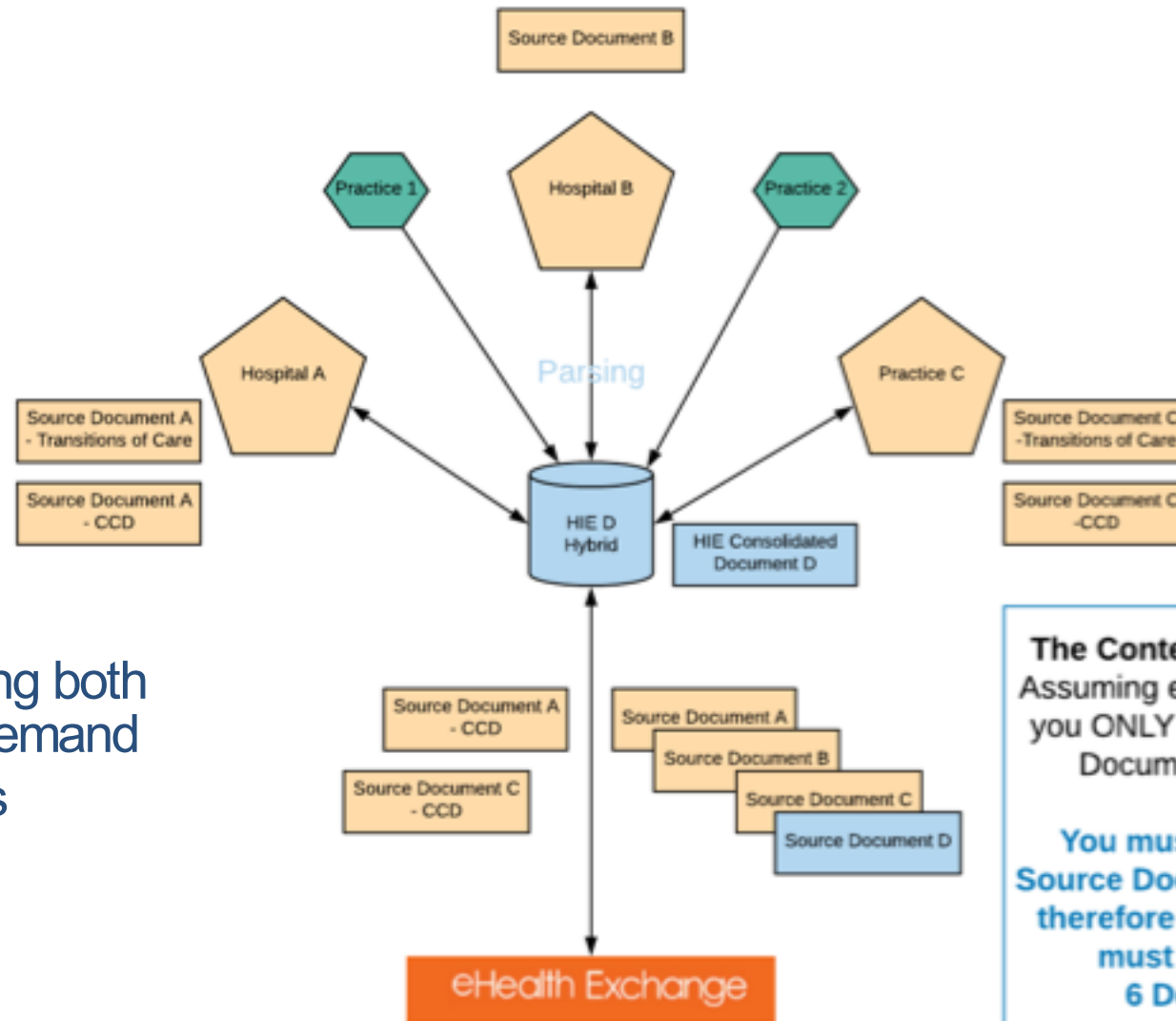
- Stable Documents are defined as:
 - Static Documents that have been pre-generated and are stored and retrieved upon query
- HIEs that retrieve, or retrieve and store; and then pass along documents authored by their data sources are using Stable Documents.
- The math can get “big” if you are dealing with multiple document types and/or versions.



“Stable” Documents mean they are not being created at the moment of the query - they exist already.

The Content Testing Math:
Assuming each Source sends you ONLY 1 Document Type and ONLY 1 Document Version, then

You must test for each Source Document - therefore in this case you must content test 3 Documents.



You might be doing both
Stable and On-Demand
Documents

The Content Testing Math:
Assuming each Source sends
you ONLY 1 Version of each
Document Type, then

**You must test for each
Source Document and Type-
therefore in this case you
must content test
6 Documents.**

What does a Certified Vendor need to test?





What does your Vendor need to test?

- Certified eHX Vendors must test ability to **create** and **receive** documents
- Vendors must submit at least one sample:
 - Of each supported **Document Type**
 - ex: CCD, Transition of Care
 - For each supported **Document Version**
 - ex: C-32, C-CDA R1.1, C-CDA R2.1

Source: <https://sequoiaproject.org/ehealth-exchange/testing-overview/content-testing/>

Content Testing Case Studies

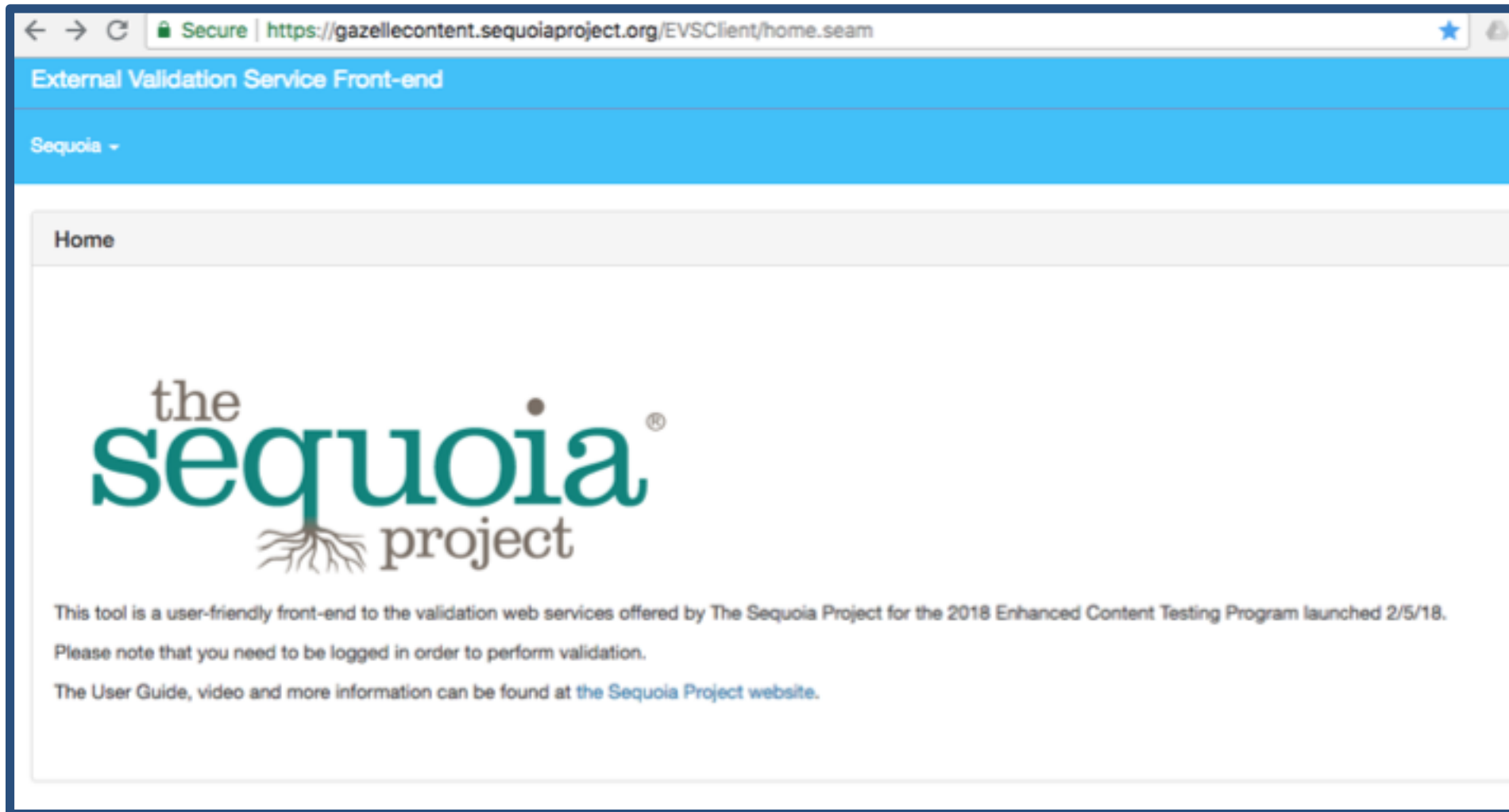




Case Study 1: Introduction to the Process

- Let's look at eHX's Content Testing Tool
 - The Content Testing Tool is web-based
- Upload C-CDAs and/or C32s one at a time
 - Once a document is uploaded, it can't be taken back (no PHI!)
- Swat errors until you pass

- Apply through eHX & log in with provided credentials



- Pick a file and “tell” the validator what type of document it is

The screenshot shows a web browser window with the URL `https://gazellecontent.sequoiaproject.org/EVSCClient/cda/validator.seam?extension=C-CDA&standard`. The page title is "External Validation Service Front-end" and the user is logged in as "Sequoia". The main heading is "Validate CDA documents".

The "Validation" section contains a text field labeled "File being validated : Sample_CCDA_R2.1__104_ERRORS.xml" with a red arrow pointing to it. Below this field is a checkbox labeled "Show Content".

The "Select a validator:" section has two options:

- schematron :** A dropdown menu with "Please select..." selected. Below it, the text "calls Gazelle web services for schematron validation" is visible.
- and / or:** A dropdown menu with "HL7 - C-CDA R2.1 - Meaningful Use Stage 3" selected. A red arrow points to this dropdown.

At the bottom of the form are two buttons: "Validate" and "Reset".

Validate CDA documents

Information

File Name Sample_CCDA_R2.1_104_ERRORS.xml 
OID : 1.3.6.1.4.1.12559.11.28.14049
Schematron : N/A (Version N/A)
Schematron Validation ... N/A
Validation Date : 7/31/18 10:21:21 PM (CEST GMT+0200)
Model Based Validator : HL7 - C-CDA R2.1 - Meaningful Use Stage 3 (Version N/A)
Model Based Validation... **FAILED**   
Permanent link : <https://gazellecontent.sequolaproject.org/EVSClient/detailedResult.seam?type=CDA&oid=1.3.6.1.4.1.12559.11.28.14049>
Data Visibility : Private - Owned By jhdowning / Zen

[Make this result public](#) [share this result](#) [Validate again](#) [Perform another validation](#)

Validation Results

Model based validation **Scorecard**

Well-formedness PASSED

The document you have validated is supposed to be a well-formed document. The validator has checked if it is well-formed, results of this validation are gathered in this section.

The document is well-formed

Schema Validation detailed Result PASSED

Your document has been validated with the appropriate schema, here is the detail of the validation outcome.



The document is valid regarding the schema

Gazelle Objects Checker validator results FAILED

Summary of checks **102** **54** **207**

Severity

Errors 102
Warnings 54
Infos 0
Unknowns 0
Reports 200
 Type
Closed 0
Mandatory 40
Cardinality 100

Test	coda212896	E - 1
Location	/ClinicalDocument/component/structuredBody/component[1]/section/entry[2]/act/entryRelationship[3]/observation 	
Description	In Allergy - Intolerance Observation (V2), the code of /h7:observation(h7:templateId/@root='2.16.840.1.113883.10.20.22.4.7')/h7:author/h7:assignedAuthor/h7:code SHALL be from the valueSet 2.16.840.1.114222.4.11.1066 (flexibility : 2018-02-01T00:00:00) (Item : CONF:1098-31671)[Constraint...][Assertion...]	
Type	Vocabulary	
Test	coda213162	E - 2
Location	/ClinicalDocument/component/structuredBody/component[1]/section/entry[2]/act/entryRelationship[3]/observation/entryRelationship[3]/observation 	
Description	In Severity Observation (V2), the code of /h7:observation(h7:templateId/@root='2.16.840.1.113883.10.20.22.4.8')/h7:value SHALL be from the valueSet 2.16.840.1.113883.3.88.12.3221.6.8 (flexibility : 2018-02-01T00:00:00) (Item : CONF:1098-7356)[Constraint...][Assertion...]	
Type	Vocabulary	
Test	coda212256	E - 3



Validate CDA documents

Information

File Name: Sample_CCDA_R2.1__104_ERRORS.xml 
OID: 1.3.6.1.4.1.12559.11.28.14049
Schematron: N/A (Version N/A)
Schematron Validation ...: N/A
Validation Date: 7/31/18 10:21:21 PM (CEST GMT+0200)
Model Based Validator: HL7 - C-CDA R2.1 - Meaningful Use Stage 3 (Version N/A)
Model Based Validation...: **FAILED**   
Permanent link: <https://gazellecontent.sequoiaproject.org/EVSCClient/detailedResult.seam?type=CDA&oid=1.3.6.1.4.1.12559.11.28.14049>
Data Visibility: Private - Owned By jhdowning / Zen

Make this result public

share this result

Validate again

Perform another validation

Validation Results

Model based validation

Scorecard

Well-formedness **PASSED**

The document you have validated is supposed to be a well-formed document. The validator has checked if it is well-formed, results of this validation are gathered in this section.

The document is well-formed

Schema Validation detailed Result **PASSED**

Your document has been validated with the appropriate schema, here is the detail of the validation outcome.

The document is valid regarding the schema

Make this result public

share this result

Validate again

Perform another validation

Validation Results

Model based validation

Scorecard

Well-formedness **PASSED**

The document you have validated is supposed to be a well-formed document. The validator has checked if it is well-formed, results of this validation are gathered in this section.

The document is well-formed

Schema Validation detailed Result **PASSED**

Your document has been validated with the appropriate schema, here is the detail of the validation outcome.

The document is valid regarding the schema

Gazelle Objects Checker validator results **FAILED**

Summary of checks

102

54

2927

Severity

Errors 102

Warnings 54

Infos 0

Unknowns 0

Reports 200


Test

Location

Description

Type

coda212896

/ClinicalDocument/component/structuredBody/component[1]/section/entry[0]/act/entryRelationship[0]/observation 

In Allergy - Intolerance Observation (V2), the code of /hl7:observation[hl7:templateId/@root="2.16.840.1.113883.10.20.22.4.7"/]hl7:author/hl7:assignedAuthor/hl7:code SHALL be from the valueSet 2.16.840.1.114222.4.11.1066 (flexibility : 2018-02-01T00:00:00) (Item : CONF:1098-31671)[Constraint...][Assertion...]

Vocabulary

E - 1

Test

Location

Description

coda213162

/ClinicalDocument/component/structuredBody/component[1]/section/entry[0]/act/entryRelationship[0]/observation/entryRelationship[0]/observation 

In Severity Observation (V2), the code of /hl7:observation[hl7:templateId/@root="2.16.840.1.113883.10.20.22.4.8"/]hl7:value SHALL be from the valueSet 2.16.840.1.114222.4.11.1066 (flexibility : 2018-02-01T00:00:00) (Item : CONF:1098-31671)[Constraint...][Assertion...]

E - 2



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```
<entryRelationship typeCode="SUBJ">  
  <observation classCode="OBS" moodCode="EVN">
```

(1/357) ↓

Test	ccda212896	E - 1
Location	/ClinicalDocument/component/structuredBody/component[1]/section/entry[0]/act/entryRelationship[0]/observation	
Description	In Allergy - Intolerance Observation (V2), the code of /hl7:observation[hl7:templateId/@root='2.16.840.1.113883.10.20.22.4.7']/hl7:author[hl7:assignedAuthor/hl7:code SHALL be from the valueSet 2.16.840.1.114222.4.11.1066 (flexibility : 2018-02-01T00:00:00) (Item : CONF:1098-31671)[Constraint...] [Assertion...]	

```
<!-- ** Allergy observation (V2) ** -->  
<templateId extension="2014-06-09" root="2.16.840.1.113883.10.20.22.4.7" />  
<templateId root="2.16.840.1.113883.10.20.22.4.7" />  
<!-- <id root="4adc1020-7b14-11db-9fe1-0800200c9a66"/>-->  
<id root="4ADC1020-7B14-11DB-9FE1-0800200C9A66" />  
<code code="ASSERTION" codeSystem="2.16.840.1.113883.5.4" />  
<!-- Observation statusCode represents the status of the act of observing -->  
<statusCode code="completed" />  
<effectiveTime>  
  <!-- The low value reflects the date of onset of the allergy -->  
  <!-- Based on patient symptoms, presumed onset is May 1, 1998 -->  
  <low value="19980501" />  
  <!-- The high value reflects when the allergy was known to be resolved (and will generally be absent) -->  
</effectiveTime>  
<value code="419199007" codeSystem="2.16.840.1.113883.6.96" codeSystemName="SNOMED CT" displayName="Allergy to substance" xsi:type="CD" />  
<author typeCode="AUT">  
  <templateId root="2.16.840.1.113883.10.20.22.4.119" />  
  <time value="199805011145-0800" />  
  <!-- <assignedAuthor><id extension="222223333" root="2.16.840.1.113883.4.6"/><code code="207KA0200X" displayName="Allergy" codeSystem="2.16.840.1.113883.6.101" /></assignedAuthor>  
<assignedAuthor>  
  <id extension="555555555" root="2.16.840.1.113883.4.6" />  
  <code code="163W00000X" codeSystem="2.16.840.1.113883.5.53" codeSystemName="Health Care Provider Taxonomy" displayName="Registered nurse" />  
<addr>  
  <streetAddressLine>1004 Healthcare Drive </streetAddressLine>  
  <city>Portland</city>  
  <state>OR</state>
```

Case Study 1: Introduction to the Process



Takeaways:

- Most CCDAs will fail the first time
 - Bark worse than bite; Each instance of an error is separately reported
- Tool has easy click-to-navigate UI
- Some possible bugs with code sets
 - Zen has reported to eHealth Exchange team

Case Study 2: Solving a Content Problem

The image shows a side-by-side comparison of XML code and its validation results. On the left, an XML snippet is displayed with a red arrow pointing to the `<effectiveTime>` element. On the right, the 'Gazelle Objects Checker validator results' page shows a 'FAILED' status with a summary of checks (185 errors, 7 warnings, 0 infos, 0 unknowns, 0 reports, 200 type errors, 110 cardinality errors, 53 mandatory errors, 12 vocabulary errors, 35 datatype errors, 138 context errors, 44 value errors, and 0 reset filters). Three specific validation errors are listed:

- Severity:** Errors 185, Warnings 7, Infos 0, Unknowns 0, Reports 0, Type 200, Cardinality 110, Mandatory 53, Vocabulary 12, Datatype 35, Context 138, Fixed Value 44, Reset filters 0.
- Test cdc11431:** Location: /ClinicalDocument; Description: In Continuity of Care Document (CCD), /hi7:ClinicalDocument[hi7:templateId/@root='2.16.840.1.113883.10.20.22.1.2']/hi7:documentationOf/hi7:serviceEvent/hi7:effectiveTime SHALL contain at least ONE hi7:high item : conf-B455; Type: Cardinality.
- Test cdc112619:** Location: /ClinicalDocument/component/structuredBody/component[12]/section/entry[0]/observation; Description: In Cognitive Status Problem Observation, in /hi7:observation[hi7:templateId/@root='2.16.840.1.113883.10.20.22.4.73'], the element(s) hi7:value SHALL not have nullFlavor (mandatory) (Item : conf-14349); Type: Mandatory.
- Test cdc112480:** Location: /ClinicalDocument/component/structuredBody/component[12]/section/entry[1]/observation; Description: In Functional Status Problem Observation, in /hi7:observation[hi7:templateId/@root='2.16.840.1.113883.10.20.22.4.68'], the element(s) hi7:code SHALL not have nullFlavor (mandatory) (Item : conf-14314); Type: Mandatory.

Case Study 2: Solving a Problem

The screenshot displays a validation tool interface with several key components:

- Top Left:** A green box labeled "PASSED" is visible, along with text indicating a validation outcome.
- Top Right:** An XML code editor shows a snippet of code. A red arrow points to the `<high nullFlavor="UNK"/>` tag within an `<effectiveTime>` element.
- Center:** A red arrow points to the text "1) Feedback".
- Bottom Center:** A red arrow points to the text "2) Resolution".
- Bottom Right:** A red arrow points to the text "3) Validation".
- Bottom Left:** A table of test results is shown. A red arrow points to the first row, which has a red bar on the left with the number "185" and a green bar with "7". The table columns include "Test Location", "Description", and "Type".
- Bottom Right:** A "Summary of checks" table is displayed. A red arrow points to the "Errors" row, which has a red bar on the left with the number "184" and a green bar with "7". The table columns include "Severity", "Errors", "Warnings", "Infos", "Unknowns", "Reports", "Type", and "Cardinality".

Test Location	Description	Type
ccda11431	/ClinicalDocument In Continuity of Care Document (CCD), /hl7:ClinicalDocument[hl7:templateId/@me SHALL contain at least ONE hl7:high (Item : conf-8455)[Constraint...] [Ass	Cardinality
ccda112619	/ClinicalDocument/component/structuredBody/component[12]/section/entry[0] In Cognitive Status Problem Observation, in /hl7:observation[hl7:templateId/@r (mandatory) (Item : conf-14349)[Constraint...] [Assertion...	Mandatory

Severity	Errors	Warnings	Infos	Unknowns	Reports	Type	Cardinality
✓	184	7	0	0	200	✓	109

Case Study 2: Solving a Content Problem



Takeaways:

- Solution - Modify C-CDA generator to include an effectiveTime <high>!
- Rinse-and-repeat to ferret out problems in your document generation
 - If you generated the document, these likely mean code changes
 - Which may mean involving vendors!
 - If you didn't generate the document, work with your document sources
 - There are on-the-fly solutions available as well (see FAQ)

FAQ

FAQ



- Is this the same as DIL testing?
 - No.
 - DIL testing is (was) transport-testing, which is still important.
 - It's being replaced by “Interoperability Testing Platform” (ITP)

- Is this the same as ITP Testing?
 - No.
 - Content testing is one component of ITP testing, in addition to transport and security testing.

FAQ



- We're already eHX participants. Do we need to do this?
 - Yes.
 - Existing participants have until February 2019 to formally test
 - These tests don't need to pass right away;
 - Participants have 18 months to fix and re-test
 - You can use the tool without starting the clock!
- We're considering joining eHX. Do we need to do this?
 - Yes.
 - New participants must also pass these tests within 18 months of onboarding

FAQ



- Do these rules apply to documents we didn't originate?
 - Yes.
 - Documents made available on the exchange must pass these tests!

- My documents won't pass these tests. What can I do?

Consultants like Zen can help!

Strategies and Tools



- Zen has solutions that modify messages “inflight” to perform certain transport & content repairs.
 - Fixable examples include security related issues and content that can be resolved via mapping or data transformations
- Zen Pulsar – our IHE Test Gateway testing service
 - Develop, test and monitor your own Gateway by leveraging Zen’s Stargate Gateway.
- Zen Data Quality as a Service Offering
 - Content Analysis and Data Quality Scoring



Strategies and Tools

- 3rd Party Data Quality Tools
 - Data Scoring Tools like **iQHD (Stella Technology)** to more quickly identify content issues and provide easily understandable scorecards to data sources. Zen is using this tool in our Data Quality as a Service Offering
 - Data Quality Uplifting tools like **Diameter Health** to address semantic normalization issues (uplift local lab codes to LOINC)



Audience Questions

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What do I need to test?

- Example Scenario: HIE - Stable Documents Model
 - Two sources whose documents we intend to share over eHX:
 - **Hospital A (HA) sends us:**
 - CCDs; C-CDA R1.1 and R2.1
 - Transition of Care documents; C-CDA R2.1 only
 - **Clinic B (CB) sends us:**
 - CCDs; C-CDA R1.1 only
- We must test at least **4** documents:
 - **HA** CCD R1.1, CCD R2.1, ToC R2.1
 - **CB** CCD R1.1

Critical Assumption: "Stable" Documents

Simplify Interoperability

