

# FAST CDA: FHIR Tool Stack for CDA

Oliver Egger, ahdis ag



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## **2015 - founder ahdis**

2003 - 2014 visionary AG, docbox

2002 - 2003 Ecofin Research & Consulting AG

1994 - 2001 SPEAG

## **2016 - lecturer BFH Bern, ZHAW Winterthur**

Medical informatics, Interoperability

## **HL7.ch**

Technical Manager, member hl7 since 2009

## **IHE Suisse**

Deputy Technical Manager since 2016, member since 2015

## **Dipl. Inf. ETH, ETH Zürich, 1996**

IHE XDS Advanced Training, 2015

Certified HL7 CDA Specialist, 2015

# FAST CDA: FHIR Tool Stack for CDA

- CDA – Clinical Document Architecture
- FHIR Logical model for CDA
- Validate and convert CDA documents with the FHIR Validator
- Applying FHIRPath expressions to CDA documents
- FHIR Mapping Language: Mapping from CDA to FHIR and back
- Publishing new CDA Implementation Guides with IG Publisher based on HL7 Template ITS and validate CDA documents
- Q&A and Lets' Build

# CDA – Clinical Document Architecture

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*Kopfzeile des Absenders des Dokumentes*

RoDiag  
Radiologieinstitut  
Röntgenstr. 1  
8888 Musterhausen  
*Dokumentempfänger*

Musterhausen, 03.10.2007/Sk  
*Dokumentdatum / -ersteller  
(z.B. Kurzzeichen der MPA)*

## ZUWEISUNG ZUR RADIOLOGISCHEN DIAGNOSTIK

*Dokumentart*

**Betrifft:** MUSTER Max, 12.12.1938, Leidensweg 10, 9999 Specimendorf  
Tel. P: 032 685 12 34 G: 032 123 77 88

*Patientenstammdaten, ev. Angaben zum Kostenträger*

## Gewünschte Untersuchung

*Spezifizierung der gewünschten Untersuchung*

## Dringlichkeit / Wunschtermin

*Angaben zum gewünschten Termin*

## Fragestellung

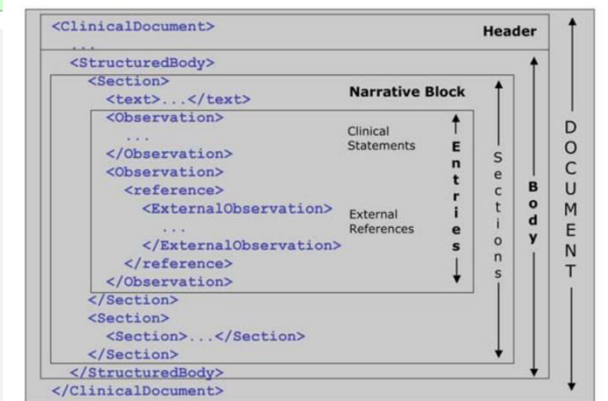
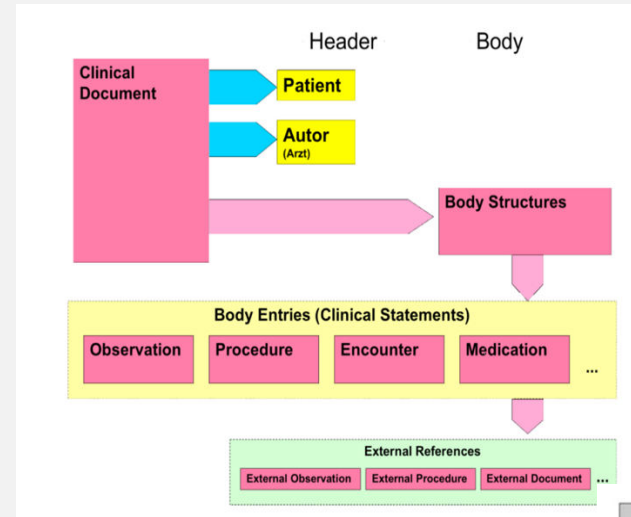
*Grund für die Durchführung der Untersuchung und Angaben zum aktuellen Leiden resp. zum Grund der Untersuchung*

## Angaben zum Patienten

*Erfolgte Voruntersuchungen  
Befundkopie – Empfänger*

## Klinische Angaben

*Beschreibung des aktuellen Leidens  
Schwangerschaft ja / nein  
Laborwerte (Quick / Tc, Kreatinin)*



# CDA projects in Europe?

- Austria: ELGA with 7 IG's
- Denmark: DK APD, DK PCD, PHRM-DK, DKQFDD, DK-QRD
- Italy: 5 IG's published, 4 IG's in ballot
- Switzerland: eHealth Suisse 3 IG's
- Europe: CDA IPS, Electronic Health Record Exchange Format

and many more in Finland, Netherlands, Germany, Norway ...

<http://www.hl7.eu/download/eun-09-2019.pdf>

# Logical models based on StructureDefinitions

- StructureDefinitions can also be used to define any arbitrary structures that are a directed acyclic graph with typed nodes, where the primitive types are those defined by the FHIR specification.
- This technique has many uses
  - Describing any arbitrary content model
  - Describing existing HL7 content models (e.g. v2, CDA) using FHIR
  - Describing common design patterns used in FHIR
  - Defining a content model to support the mapping language

<http://hl7.org/fhir/structuredefinition.html#logical>

# FHIR Logical model for CDA

- supports the CCDA on FHIR guide, and other CDA/FHIR mapping projects
- Presented by Grahame at FHIR DevDays in 2016
- <https://github.com/HL7/cda-core-2.0>
- IG Publisher generates then the model:
- <http://build.fhir.org/ig/HL7/cda-core-2.0/branches/master/index.html>
- **Note:** no official release yet



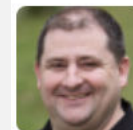
**ahenket**

26 commits 5,970 ++ 3,484 --



**seanmcilvenna**

18 commits 4,448 ++ 31,243 --



**grahamegrieve**

16 commits 143,028 ++ 90,580 --

# V3 Datatypes

AD: PostalAddress

ANY: DataValue

BL: Boolean

CD: ConceptDescriptor

CE: CodedWithEquivalents

CO: CodedOrdinal

CR: ConceptRole

CS: CodedSimpleValue

CV: CodedValue

ED: EncapsulatedData

EIVL\_TS: EventRelatedPeriodicInterval

EN: EntityName

EN: EntityName

II: InstanceIdentifier

INT: IntegerNumber

IVL INT: Interval

IVL PQ: Interval

IVL TS: Interval

MO: MonetaryAmount

PIVL TS: PeriodicIntervalOfTime

PQ: PhysicalQuantity

PQR: PhysicalQuantityRepresentation

QTY: Quantity

REAL: RealNumber

RTO PQ PQ: Ratio

SC: CharacterStringWithCode

ST: CharacterString

SXCM TS: GeneralTimingSpecification

SXPR TS: Component part of GTS

TEL: TelecommunicationAddress

TS: PointInTime



# Datatypes: ANY – CD - CE

Text Summary

Differential Table

This structure is derived from Base

Name	Flags	Card.	Type
ANY		1..*	
... nullFlavor		0..1	code

This structure is derived from ANY

Name	Flags	Card.	Type
CD		1..*	
... code		0..1	string
... codeSystem		0..1	string
... codeSystemName		0..1	string
... codeSystemVersion		0..1	string
... displayName		0..1	string
... valueSet		0..1	string
... valueSetVersion		0..1	string
... originalText		0..1	http://hl7.org/fhir/cda/StructureDefinition/ED
... qualifier		0..*	http://hl7.org/fhir/cda/StructureDefinition/CR
... translation		0..*	http://hl7.org/fhir/cda/StructureDefinition/CD

Text Summary

Differential Table

Snapshot Table

All

This structure is derived from CD

Name	Flags	Card.	Type	Description & Constraints ?
CE		1..*		
... qualifier		0..0		

Text Summary

Differential Table

Snapshot Table

All

This structure is derived from CD

Name	Flags	Card.	Type
CE		1..*	
... nullFlavor		0..1	code
... code		0..1	string
... codeSystem		0..1	string
... codeSystemName		0..1	string
... codeSystemVersion		0..1	string
... displayName		0..1	string
... valueSet		0..1	string
... valueSetVersion		0..1	string
... originalText		0..1	http://hl7.org/fhir/cda/StructureDefinition/ED
... translation		0..*	http://hl7.org/fhir/cda/StructureDefinition/CD

# CDA classes

## ClinicalDocument

Act

Authenticator

Author

AuthoringDevice

Authorization

AssignedAuthor

AssignedCustodian

AssignedEntity

AssociatedEntity

Birthplace

Component2

ComponentOf

Consent

Criterion

Custodian

CustodianOrganization

DataEnterer

Device

DocumentationOf

EncompassingEncounter

Encounter

Entity

ExternalAct

ExternalDocument

ExternalObservation

ExternalProcedure

Guardian

HealthCareFacility

Informant

InformationRecipient

InfrastructureRoot

InFulfillmentOf

IntendedRecipient

LabeledDrug

...

# CDA classes

Text Summary Differential Table Snapshot Table All				
This structure is derived from Base				
Name	Flags	Card.	Type	Description & Constraints ?
ClinicalDocument		1..1		
classCode		1..1	code	<b>Binding:</b> v3 Code System ActClass (extensible) <b>Fixed Value:</b> DOCCLIN
moodCode		1..1	code	<b>Binding:</b> v3 Code System ActMood (required) <b>Fixed Value:</b> EVN
realmCode		0..*	http://hl7.org/fhir/cda/StructureDefinition/CS	
typeId		0..1	http://hl7.org/fhir/cda/StructureDefinition/II	
templateId		0..*	http://hl7.org/fhir/cda/StructureDefinition/II	
code		1..1	http://hl7.org/fhir/cda/StructureDefinition/CE	<b>Binding:</b> http://terminology.hl7.org/ValueSet/v3-DocumentType (extensible)
title		0..1	http://hl7.org/fhir/cda/StructureDefinition/ST	
effectiveTime		1..1	http://hl7.org/fhir/cda/StructureDefinition/TS	
confidentialityCode		1..1	http://hl7.org/fhir/cda/StructureDefinition/CE	
languageCode		0..1	http://hl7.org/fhir/cda/StructureDefinition/CS	<b>Binding:</b> V3 Value SetHumanLanguage (required)
setId		0..1	http://hl7.org/fhir/cda/StructureDefinition/II	
versionNumber		0..1	http://hl7.org/fhir/cda/StructureDefinition/INT	
copyTime		0..1	http://hl7.org/fhir/cda/StructureDefinition/TS	
recordTarget		1..*	http://hl7.org/fhir/cda/StructureDefinition/RecordTarget	
author		1..*	http://hl7.org/fhir/cda/StructureDefinition/Author	
dataEnterer		0..1	http://hl7.org/fhir/cda/StructureDefinition/DataEnterer	

# CDA & FHIR Logical Model

- attributes
- type attributes in xml
- text in xml elements
- CDA narrative vs xhtml
- V3 classes with id element and extension attribute
- foreign namespaces
- choice elements from CDA schema
- granularity of model (e.g. EntryRelationship as Element and not as only type)

# CDA and FHIR Validator

```
java -jar org.hl7.fhir.validation.cli.jar -version 4.0.1 -ig package.tgz  
resources/examples/cda-original.xml
```

```
*FAILURE* validating resources/examples/cda-original.xml:  error:26 warn:0 info:0
```

```
Error @ ClinicalDocument.relatedDocument[0].typeCode (line 80, col35) : The value provided  
( 'RPLC' ) is not in the value set http://terminology.hl7.org/ValueSet/v3-ParticipationType  
( http://terminology.hl7.org/ValueSet/v3-ParticipationType, and a code is required from this  
value set) (error message = Unknown Code http://terminology.hl7.org/CodeSystem/v3-ParticipationType#RPLC in http://terminology.hl7.org/CodeSystem/v3-ParticipationType)
```

```
Error @ ClinicalDocument.author[0].time.value (line 40, col29) : if a date has a time, it  
must have a timezone
```

# Convert CDA to JSON Logical Model representation

```
java -jar org.hl7.fhir.validation.cli.jar -version 4.0.1 -ig package.tgz -convert  
-output resources/examples/cda-original.json resources/examples/cda-original.xml
```

```
<section>  
  <code code="10153-2" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC"/>  
  <title>Past Medical History</title>  
  <text>  
    <list>  
      <item>  
        <content ID="a1">Asthma</content>  
      </item>  
    </list>  
  </text>  
</section>
```

```
<entry>  
  <observation classCode="COND" moodCode="EVN">  
    <code code="195967001" codeSystem="2.16.840.1.113883.6.96">  
      <originalText>  
        <reference value="#a1"/>  
      </originalText>  
    </code>  
    <statusCode code="completed"/>  
    <effectiveTime value="1950"/>  
  </observation>  
</entry>
```

```
"section": {  
  "code": {  
    "code": "10153-2",  
    "codeSystem": "2.16.840.1.113883.6.1",  
    "codeSystemName": "LOINC"  
  },  
  "title": {  
    "dataString": "Past Medical History"  
  },  
  "text": "<div xmlns=\"http://www.w3.org/1999/xhtml\"><ul><li><span id=\"a1\">Asthma</span></li></ul></div>",  
  "entry": [  
    {  
      "observation": {  
        "classCode": "COND",  
        "moodCode": "EVN",  
        "code": {  
          "code": "195967001",  
          "codeSystem": "2.16.840.1.113883.6.96",  
          "codeSystemName": "SNOMED CT",  
          "displayName": "Asthma",  
          "originalText": {  
            "reference": {  
              "value": "#a1"  
            }  
          }  
        }  
      }  
    }  
  ]  
}
```

# Applying FHIRPath expressions to CDA documents

- [FHIRPath](#) is a path based navigation and extraction language, somewhat like XPath.
- Operations are expressed in terms of the logical content of hierarchical data models, and support traversal, selection and filtering of data.
- Its design was influenced by the needs for path navigation, selection and formulation of invariants in both HL7 Fast Healthcare Interoperability Resources ([FHIR](#)) and HL7 Clinical Quality Language ([CQL](#)).

# Applying FHIRPath expressions to CDA documents

```
<recordTarget>
  <patientRole>
    <id extension="12345" root="2.16.840.1.113883.19.5"/>
    <patient>
      <name>
        <given>Henry</given>
        <family>Levin</family>
        <suffix>the 7th</suffix>
      </name>
      <administrativeGenderCode code="M" codeSystem="2.16.840.1.113883.5.1"/>
      <birthTime value="19320924"/>
    </patient>
  </patientRole>
</recordTarget>
```

```
java -jar org.hl7.fhir.validation.cli.jar -version 4.0.1 -ig package.tgz -fhirpath
recordTarget.patientRole.patient.name.given.dataString resources/examples/cda-original.xml
```

```
.. definitions from hl7.fhir.r4.core#4.0.1
```

```
(v4.0.1)
```

```
+ .. load IG from package.tgz
```

```
...evaluating recordTarget.patientRole.patient.name.given.dataString
```

```
Henry
```



# FHIRPath expressions to CDA documents

## FHIRpath fhir path implementation in js

Examples:

recordTarget.patientRole.patient.name.given.dataString

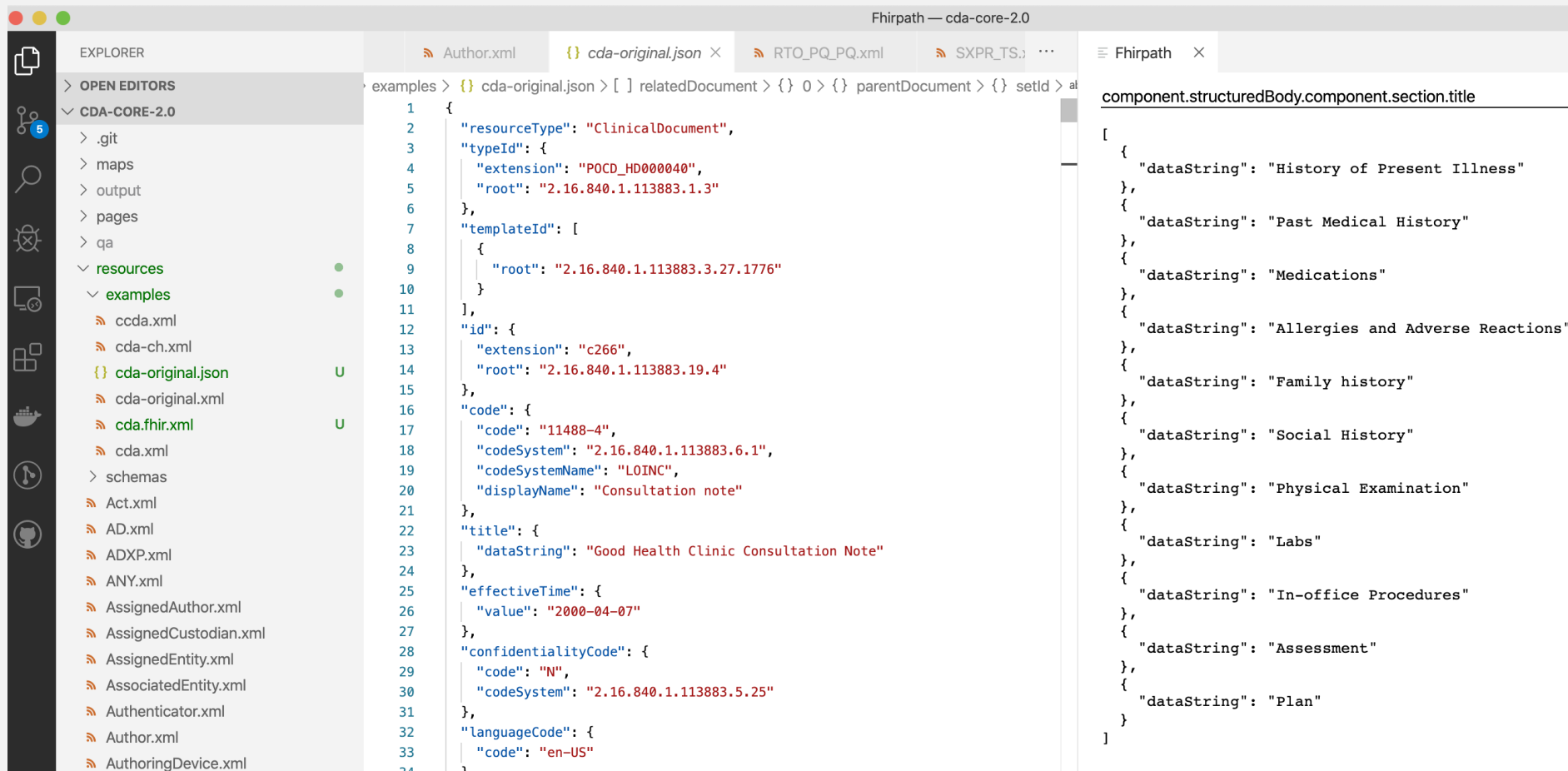
Save as

```
1 {
2   "resourceType": "ClinicalDocument",
3   "typeId": {
4     "extension": "POCD_HD000040",
5     "root": "2.16.840.1.113883.1.3"
6   },
7   "templateId": [
8     {
9       "root": "2.16.840.1.113883.3.27.1776"
10    }
11  ],
12  "id": {
13    "extension": "c266",
14    "root": "2.16.840.1.113883.19.4"
15  }
```

```
1 [
2   "Henry"
3 ]
```

<https://niquola.github.io/fhirpath-demo/#/>

# FHIRPath expressions with VS Code - FHIR tools



<https://marketplace.visualstudio.com/items?itemName=Yannick-Lagger.vscode-fhir-tools>

# Mapping from CDA to FHIR

- Logical Model is a description of CDA
  - no API
  - datatypes are equivalent to FHIR
  - no FHIR resources
  - no query possibilities
- Use-Case: Extract information from CDA in FHIR resources or represent FHIR resources in CDA
- FHIR documents can represent the same information as a CDA. For limitations of this approach see paper of Marten Smits et al in: [A comparison of two Detailed Clinical Model representations: FHIR and CDA](#)

# FHIR Mapping Language

The mapping language describes how one set of Directed Acyclic Graphs (an instance) is transformed to another set of directed acyclic graphs. It is not necessary for the instances to have formal declarations and/or be strongly typed - just that they have named children that themselves have properties.

<https://www.hl7.org/fhir/mapping-language.html>

# FHIR Mapping Language - example

```
group ClinicalDocumentBundle
  input source : ClinicalDocument as source
  input target : Bundle as target

  id: for source.id make target.identifier
  type: for source make target.type = "document"

  effectiveTime: for source.effectiveTime make target.timestamp

  composition: for source make target.entry as e first, e.resource = create("Composition") as
    | composition then ClinicalDocumentComposition(source, composition, target)
endgroup
```

# FHIR Mapping Language - example

```
map "http://hl7.org/fhir/cda/mapping/ClinicalDocumentToFHIR" = "CDA Document to FHIR"

uses "http://hl7.org/fhir/cda/StructureDefinition/ClinicalDocument" alias ClinicalDocument as source

uses "http://hl7.org/fhir/StructureDefinition/Bundle" alias Bundle as target
uses "http://hl7.org/fhir/StructureDefinition/Composition" alias Composition as produced
uses "http://hl7.org/fhir/StructureDefinition/Patient" alias Patient as produced
uses "http://hl7.org/fhir/StructureDefinition/Practitioner" alias Practitioner as produced
uses "http://hl7.org/fhir/StructureDefinition/Organization" alias Organization as produced

uses "http://hl7.org/fhir/cda/StructureDefinition/AssignedAuthor" alias AssignedAuthor as queried
uses "http://hl7.org/fhir/cda/StructureDefinition/AssignedEntity" alias AssignedEntity as queried
uses "http://hl7.org/fhir/cda/StructureDefinition/CustodianOrganization" alias CustodianOrganization as queried
uses "http://hl7.org/fhir/cda/StructureDefinition/Section" alias Section as queried
uses "http://hl7.org/fhir/cda/StructureDefinition/PatientRole" alias PatientRole as queried

imports "http://hl7.org/fhir/cda/mapping/cdaToFhirTypes"
```

# FHIR Mapping Language - example

```
java -jar org.hl7.fhir.validation.cli.jar -version 4.0.1 -ig package.tgz -transform
http://hl7.org/fhir/cda/mapping/ClinicalDocumentToFHIR -ig maps -log test.txt -output
resources/examples/ccda-fhir.xml resources/examples/ccda.xml
```

```
Start Transform http://hl7.org/fhir/cda/mapping/ClinicalDocumentToFHIR
```

```
Group : ClinicalDocumentBundle; vars = source variables [source: (ClinicalDocument)], target
variables [target: (Bundle)], shared variables []
```

```
...
```

```
...success
```

# FHIR Mapping Language - example

```
<Bundle xmlns="http://hl7.org/fhir">
  <identifier>
    <system value="urn:ietf:rhc:3986"/>
    <value value="urn:oid:2.16.840.1.113883.3.4808"/>
    <assigner>
      <display value="DCI"/>
    </assigner>
  </identifier>
  <type value="document"/>
  <timestamp value="2016-04-14T09:50:27"/>
  <entry>
    <resource>
      <Composition>
        <language value="en-US"/>
        <extension url="http://hl7.org/fhir/cda/StructureDefinition/templateID">
          <valueIdentifier>
            <system value="urn:ietf:rhc:3986"/>
            <value value="urn:oid:2.16.840.1.113883.10.20.22.1.2"/>
          </valueIdentifier>
        </extension>
        <status value="final"/>
      </Composition>
    </resource>
  </entry>
</Bundle>
```



# FHIR Mapping Language - example

```
<type>
  <coding>
    <system value="http://loinc.org"/>
    <code value="34133-9"/>
    <display value="Summarization of Episode Note DCI"/>
  </coding>
</type>
<subject>
  <reference value="Patient/7b21b923-13f1-4a0b-882a-36ca5fcd6d10"/>
</subject>
<date value="2016-04-14T09:50:27"/>
<author>
  <reference value="Practitioner/c8ed707a-bb39-4336-a004-b399a13e79a0"/>
</author>
<title value="DCI Continuity of Care Document"/>
<confidentiality value="R"/>
<custodian>
  <reference value="Organization/2848bd77-7a99-4c99-b34c-9517cc49768a"/>
</custodian>
<section>
  <title value="Problems"/>
  <code>
    <coding>
      <system value="http://loinc.org"/>
      <code value="11450-4"/>
      <display value="Problem List"/>
    </coding>
```

# Q&A and Lets' Build

- Please join for hands-on!

 DevDays  HL7<sup>®</sup> FHIR<sup>®</sup>



[www.devdays.com](http://www.devdays.com)