CDA Introduction

ART-DECOR Developer Day @ IHIC 2015
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HL7 International
Past chair HL7 Germany
HL7 Germany / Netherlands

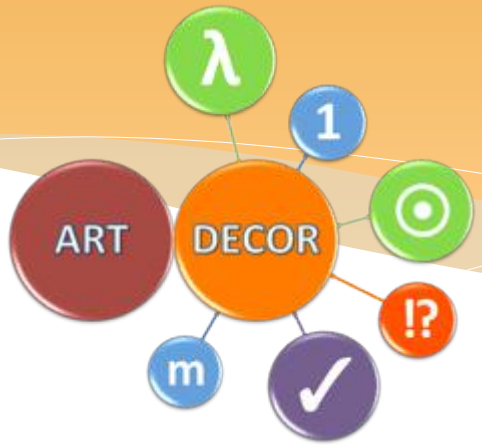
heitmann consulting and services
competence in Healthcare IT worldwide

Agenda

CDA Introduction

- Interoperability
- Clinical Document Architecture
- Header
- Body: Section and Entry
- Entry Inspection: The Module Principle
- Templates

Interoperabilitity and the Clinical Document Architecture



Interoperability

- Human
  - The “paper world” with documents, forms...
  - “Simple text”
- Application
  - Storage, management of clinical data
  - Context driven analysis
  - Reusability

not an evil, inevitable!

Implementing Interoperability: Clinical Document Architecture

HL7‘s answer since 2005

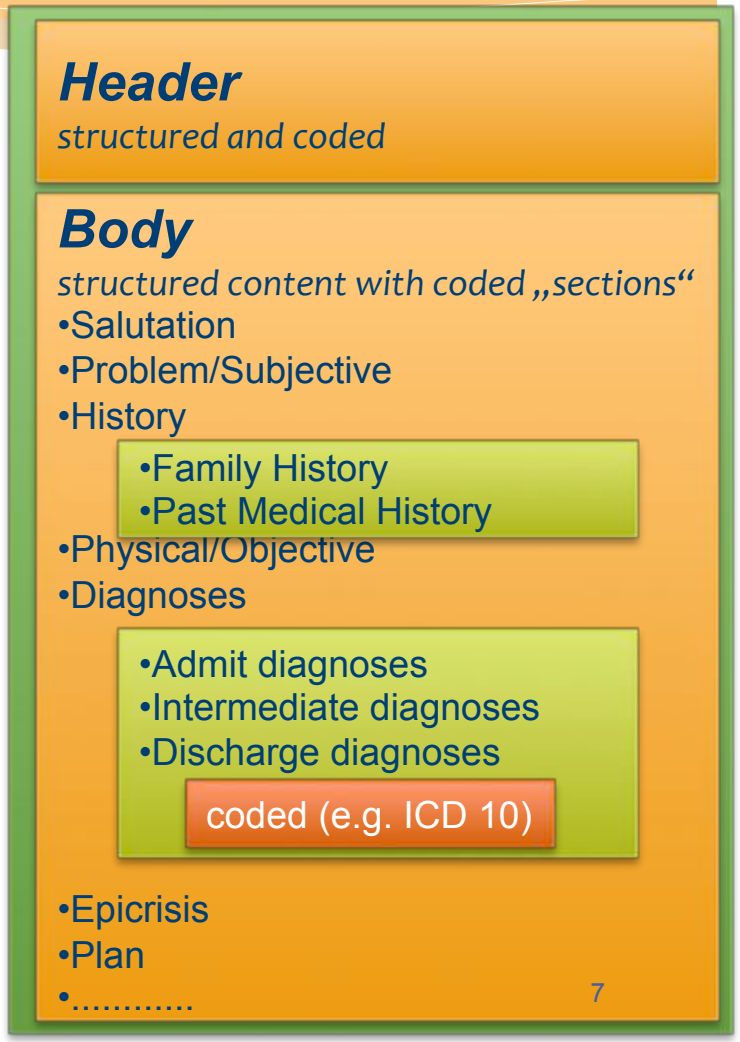
Implementing Interoperability: Clinical Document Architecture

- Clinical Document Architecture (CDA)
- An approved standard way to exchange dictated, scanned, or electronic reports on a patient between various health information technology systems and platforms

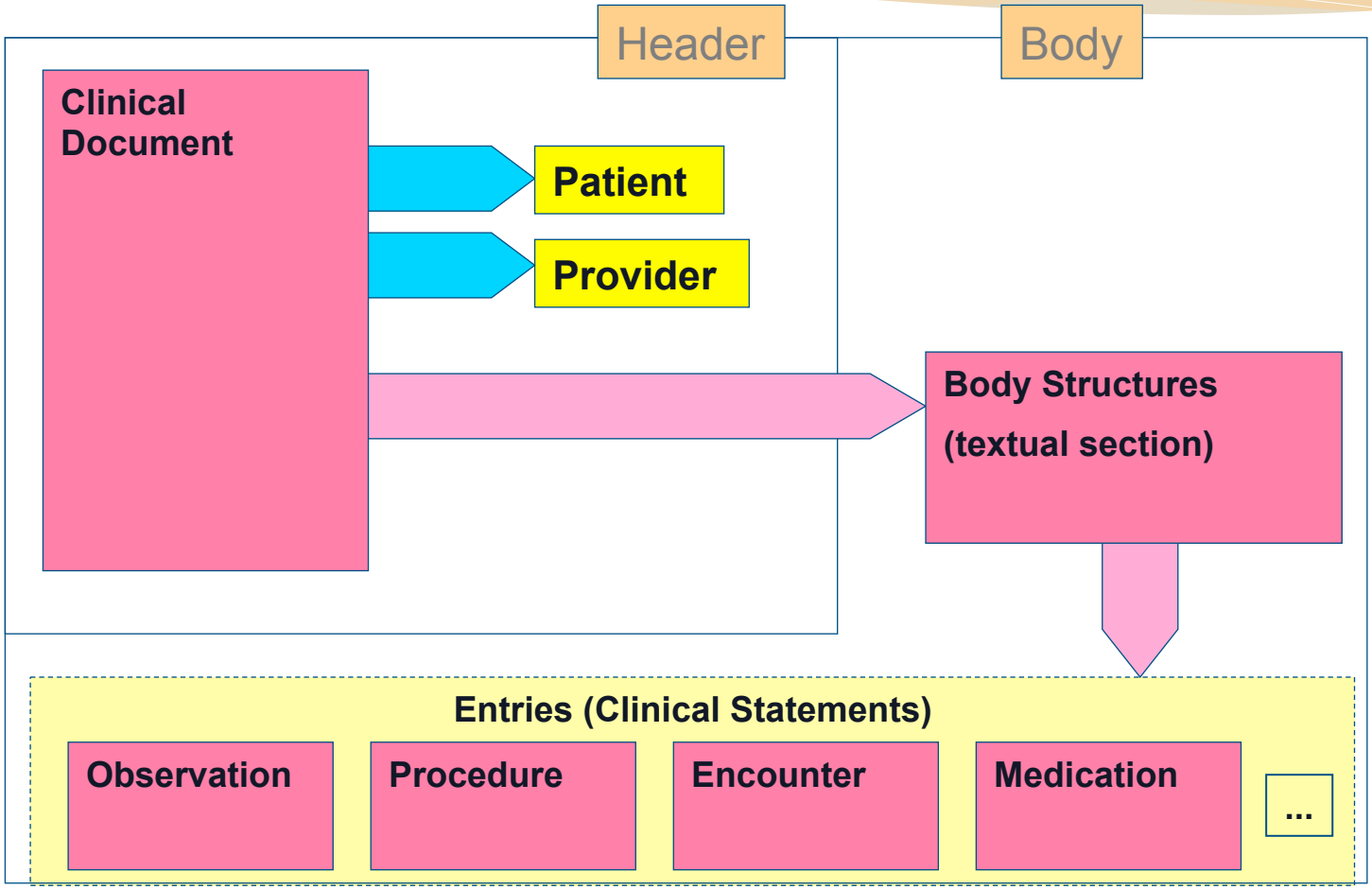
- Release 2 since 2005

Structure of a CDA Document

- Form
  - A header providing the context:
    - To facilitate the exchanges and the management of the documents, their compilation in the patient record
  - A body
    - clinical information, ordered into sections, paragraphs, lists, tables, …
- Encoding in XML
  - Comprehensive for the human…
  - …and for the computers
  - can be validated by a schema



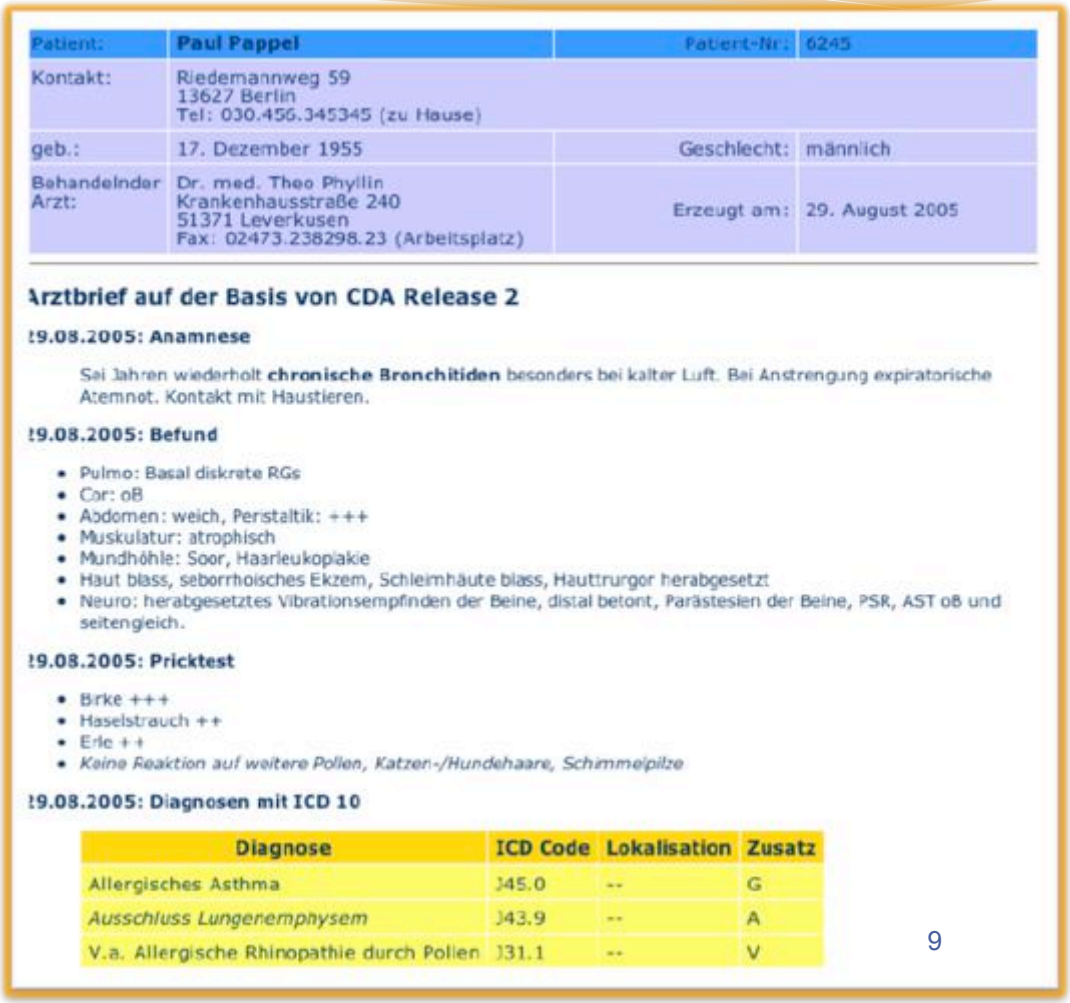
Structure of a CDA Document



CDA Header + Body Text

- (e.g. when transformed to HTML)

  “Human interoperability guaranteed”



Patient:	Paul Pappel	Patient-Nr:	6245
Kontakt:	Riedemannweg 59 13627 Berlin Tel: 030.456.345345 (zu Hause)		
geb.:	17. Dezember 1955	Geschlecht:	männlich
Behandelnder Arzt:	Dr. med. Theo Phyllin Krankenhausstraße 240 51371 Leverkusen Fax: 02473.238298.23 (Arbeitsplatz)	Erzeugt am:	29. August 2005

Arztbrief auf der Basis von CDA Release 2

29.08.2005: Anamnese

Sei Jahren wiederholt **chronische Bronchitiden** besonders bei kalter Luft. Bei Anstrengung expiratorische Atemnot. Kontakt mit Haustieren.

29.08.2005: Befund

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- Cor: oB
- Abdomen: weich, Peristaltik: +++
- Muskulatur: atrophisch
- Mundhöhle: Soor, Haarleukoplakie
- Haut blass, seborrhoisches Ekzem, Schleimhäute blass, Hauttrurgor herabgesetzt
- Neuro: herabgesetztes Vibrationsempfinden der Beine, distal betont, Parästesien der Beine, PSR, AST oB und seitengleich.

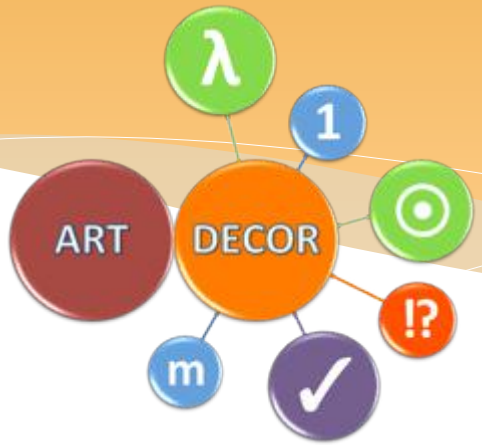
29.08.2005: Pricktest

- Birke +++
- Haselstrauch ++
- Erle ++
- *Keine Reaktion auf weitere Pollen, Katzen-/Hundehaare, Schimmelpilze*

29.08.2005: Diagnosen mit ICD 10

Diagnose	ICD Code	Lokalisation	Zusatz
Allergisches Asthma	J45.0	--	G
Ausschluss Lungenemphysem	J43.9	--	A
V.a. Allergische Rhinopathie durch Pollen	J31.1	--	V

CDA Header

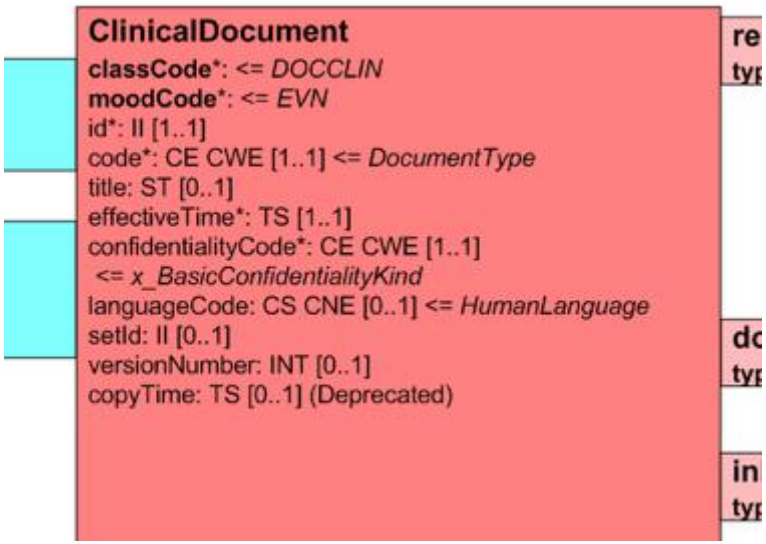


The Header: context of the document

- Identification of the document (ID, category/ type, title, date, version)
- Confidentiality, language
- “Manager” of the document
- Patient
- Author
- Responsible Parties
- …

ClinicalDocument

- Identification
- Classification
- Dates
- Language
- Versioning
- Relationships
- Participations



ClinicalDocument

- id
  - unique identification
  - OID concept
- code
  - Type of document
  - Specifies content
  - CE CWE [1..1]
  - Usually: LOINC codes

```
<code
code="34105-7"
codeSystem="2.16.840.1.113883.6.1"
displayName="Discharge Summarization Note"/>
```

ClinicalDocument.code

Code	Document-Type	Authoring Provider	Context
34133-9	Summarization of Episode Note	Practicioner	
18842-5	Discharge summarization note	Provider	
11490-0	Discharge summarization note	Physician	
34745-0	Discharge summarization note	Nurse	
34105-7	Discharge summarization note	Provider	Hospital
34106-5	Discharge summarization note	Physician	Hospital
18761-7	Transfer summarization note	Provider	
28616-1	Transfer summarization note	Physician	
28651-8	Transfer summarization note	Nurse	
18733-6	Ambulatory visit note		
18742-7	Arthroscopy report		
18743-5	Autopsy report		
18745-0	Cardiac catheterization report		
11488-4	Consultation note		
18747-6	CT report		
11520-4	Echocardiogram report		
15507-7	Emergency visit note		
11492-6	History and physical note		

ClinicalDocument

- title
  - additional information

```
<title>Patient Summary as of 24. October 2014</title>
```

- effectiveTime
  - creation of document (as printed on top)

```
<effectiveTime value="200601171415" />
```

- LanguageCode
  - ISO 639-1

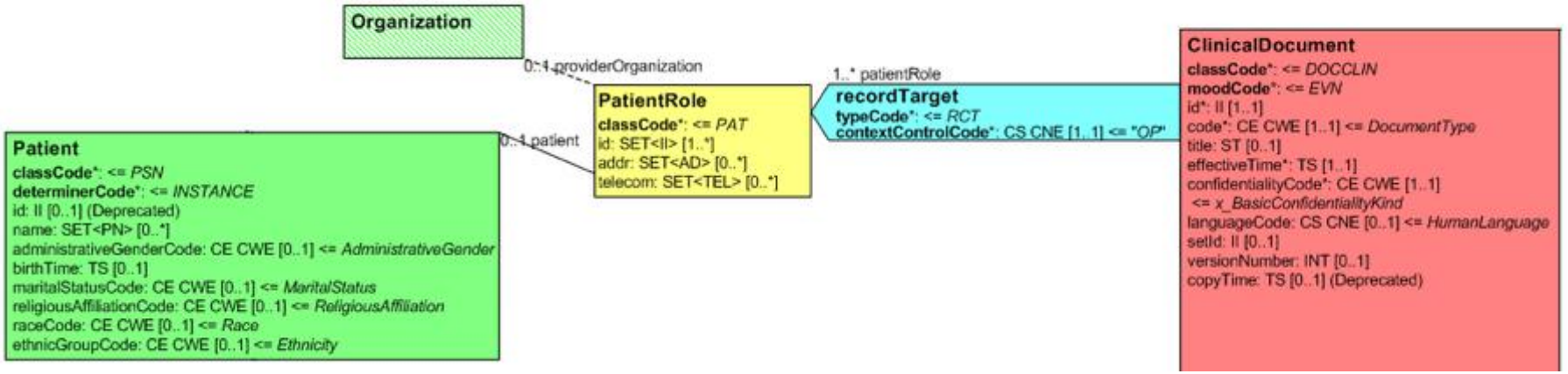
```
<languageCode code="de-DE"/>
```

ClinicalDocuments: involved Parties

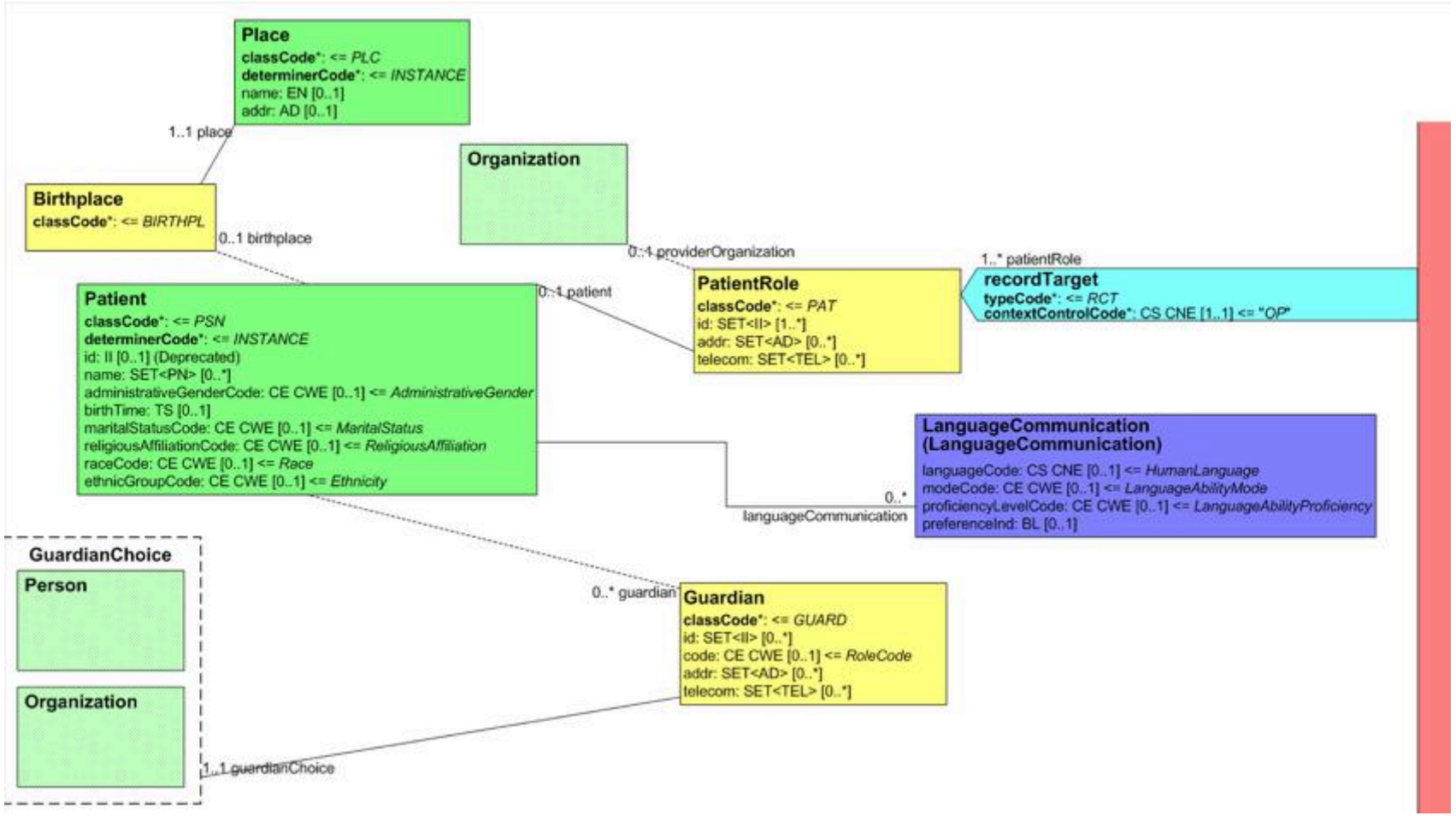
- **recordTarget:** Patient
- **author:** who has written the document
- **custodian:** organisation
- **informationRecipient:** intended receivers (as known at the time of creation of the document)
- **legalAuthenticator:** who has signed this document
- **authenticator:** other signing persons
- **dataEnterer:** transcriptionist
- **participant:** other assigned persons

recordTarget

- “Patient”



recordTarget (the real thing)

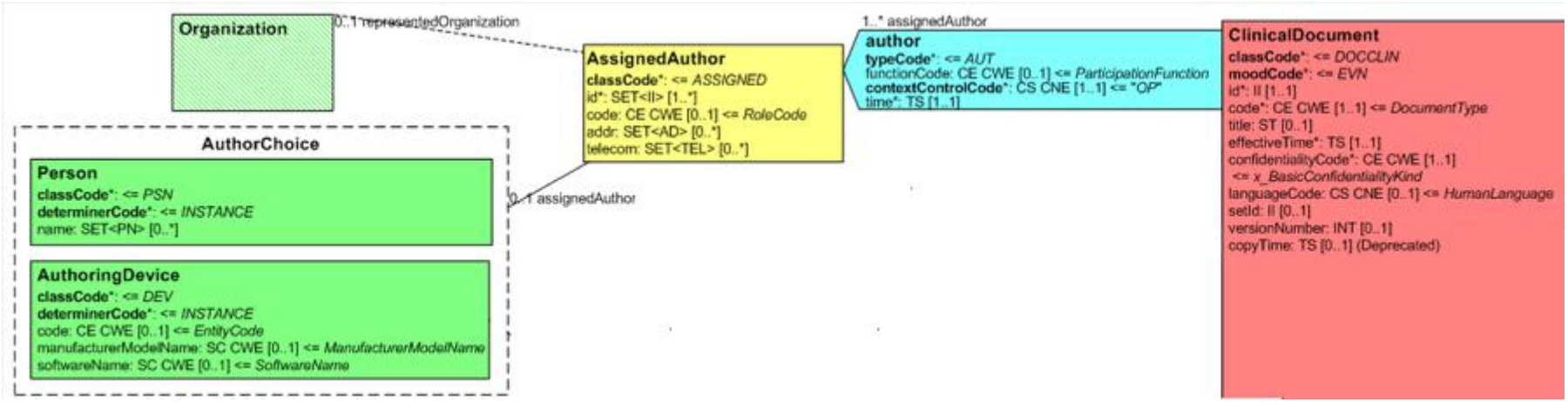


Patient Example XML


```
<recordTarget>
   <!--- Patient Data -->
   <patientRole>
      <id extension="6245" root="2.16.840.1.113883.19.3.933"/>
      <id extension="1543627549" root="1.2.276.0.76.4.1"/>
      <addr>
         <streetAddressLine>54 Main street</streetAddressLine>
         <postalCode>51371</postalCode>
         <city>Alphaville</city>
      </addr>
      <telecom value="tel:0221.444.5678"/>
      <patient>
         <name>
            <given>Paul</given>
            <family>Peterson</family>
         </name>
         <administrativeGenderCode code="M" codeSystem="2.16.840.1.113883.5.1"/>
         <birthTime value="19551217"/>
      </patient>
      <providerOrganization>
         <telecom use="WP" value="tel:02412127070"/>
         <telecom use="WP" value="fax:0241212707122"/>
         <addr>
            <streetAddressLine>12 Hospital street</streetAddressLine>
            <postalCode>51371</postalCode>
            <city>Alphaville</city>
            </addr>
      </providerOrganization>
   </patientRole>
</recordTarget
```

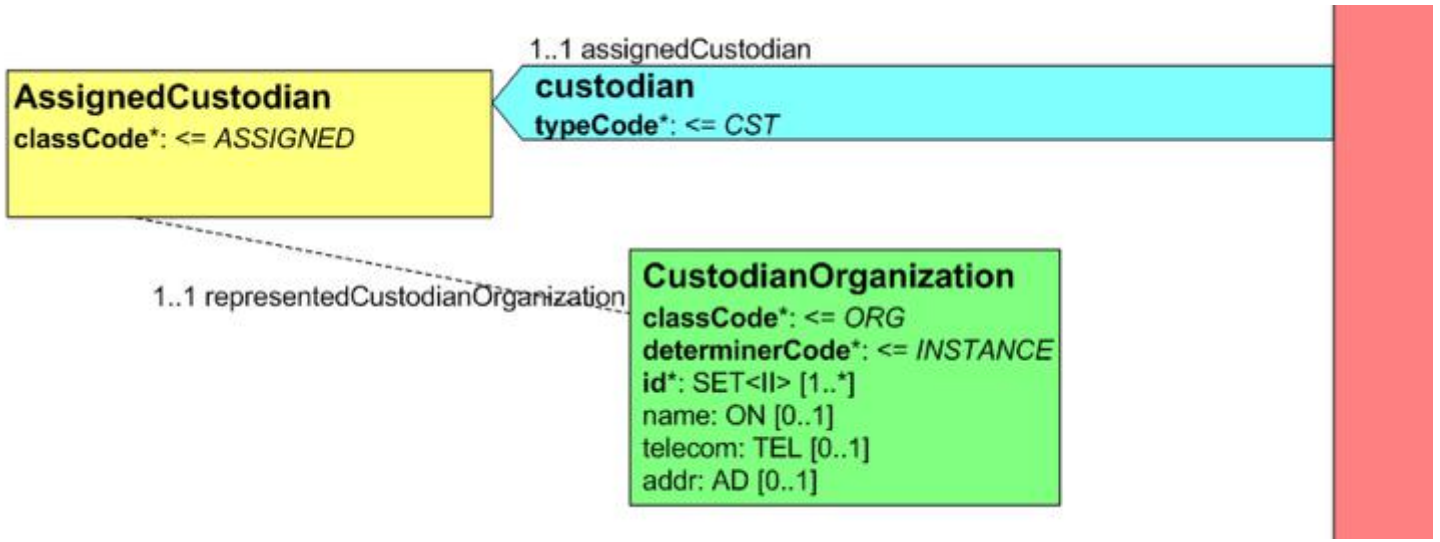
author

- Author: person or device



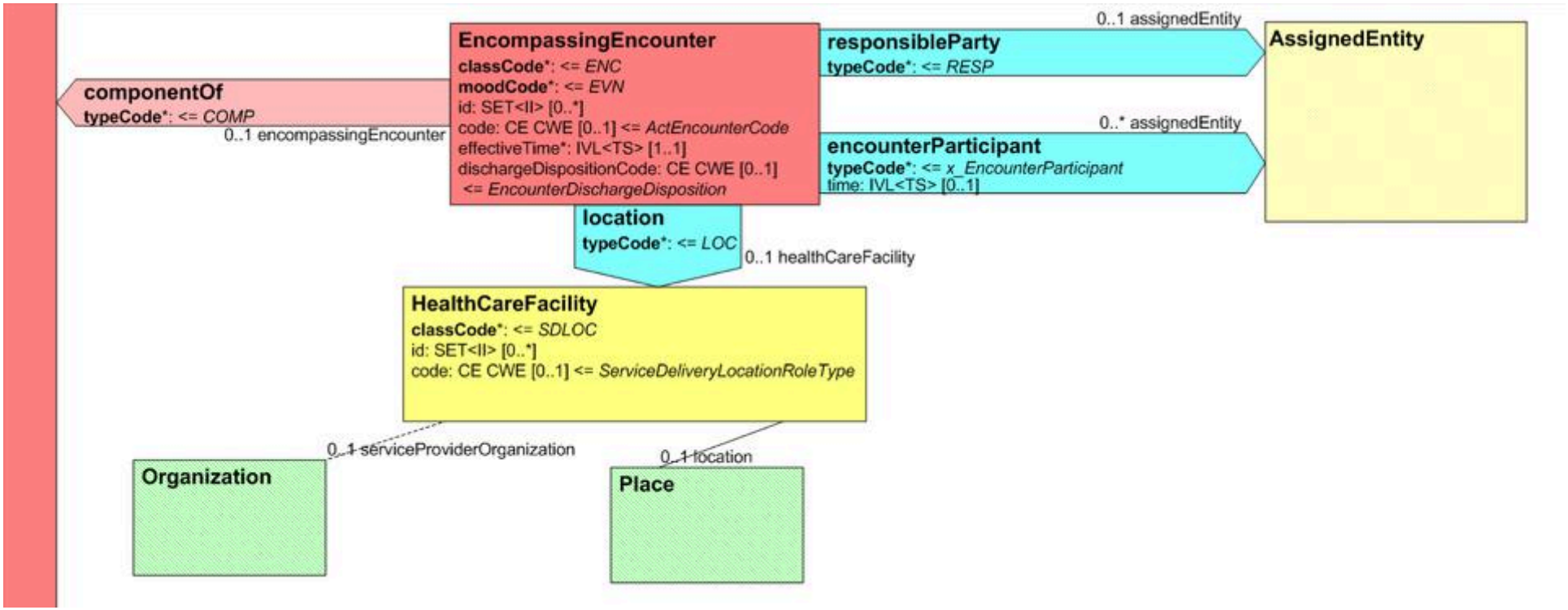
custodian

- Custodian

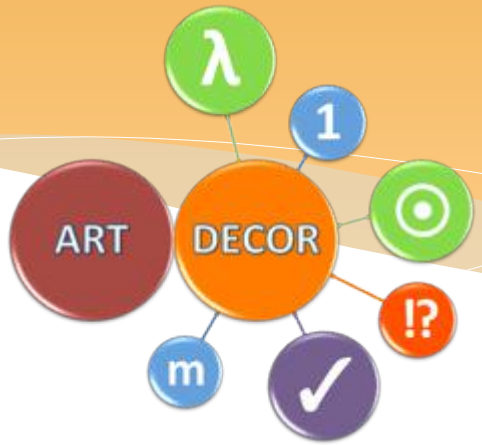


Visit Information

- Encompassing Encounter



CDA Body

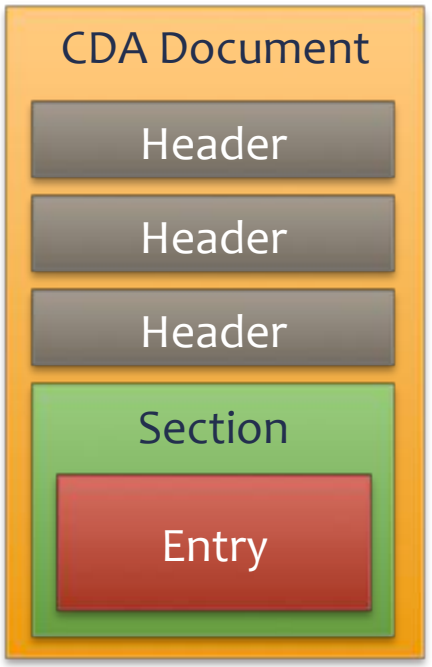


Body Overview

- Header ✔
- Body
  - Section
    - Entry
    - Entry
  - Section
    - Entry
  - Section

Human readable

Machine processable

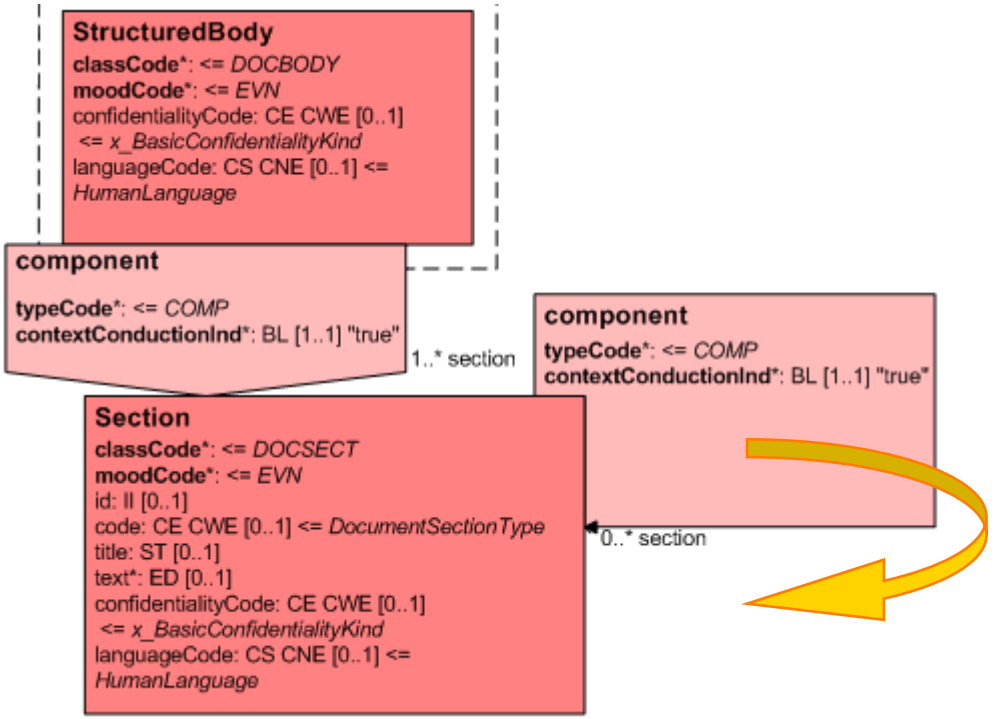


The Body: Component Model

- iterative definition
  - .title =heading
  - .text = paragraph

1.

2.
2.1
2.2



Section, mandatory parts

- title
- text
  - section
  - paragraphs
  - headings
  - tables
  - lists
  - revision marks (insert, delete)
  - …

narrative block

Formatting NarrativeBlock Content

- Section.text choice of
  - content
  - paragraph
  - linkHtml
  - sub / sup
  - br
  - footnote / footnoteRef
  - list
  - table

- table sequence of
  - caption
  - col / colgroup
  - thead
    - tr
      - th
  - tfoot
    - tr
      - td
        - …
  - tbody
    - tr
      - td

Example Table

- rendered with XSLT

Col 1	Col 2
1	aa
2	bb

```
<text>
  <table>
    <thead>
      <tr>
        <th>Col 1</th>
        <th>Col 2</th>
      </tr>
    </thead>
    <tbody>
      <tr>
        <td>1</td>
        <td>aa</td>
      </tr>
      <tr>
        <td>2</td>
        <td>bb</td>
      </tr>
    </tbody>
  </table>
</text>
```

Sections: "Levels"

CDA Release 2	
CDA Level 1	The [illegible] specification.
CDA Level 2	The CDA specification with section-level templates applied. "My discharge letter has the following structure"
CDA Level 3	The CDA specification with section-level (and optio[illegible]evel) templates "My discharge letter contains the following granular data"

Human interoperability

Application interoperability

CDA Sections: Level 2

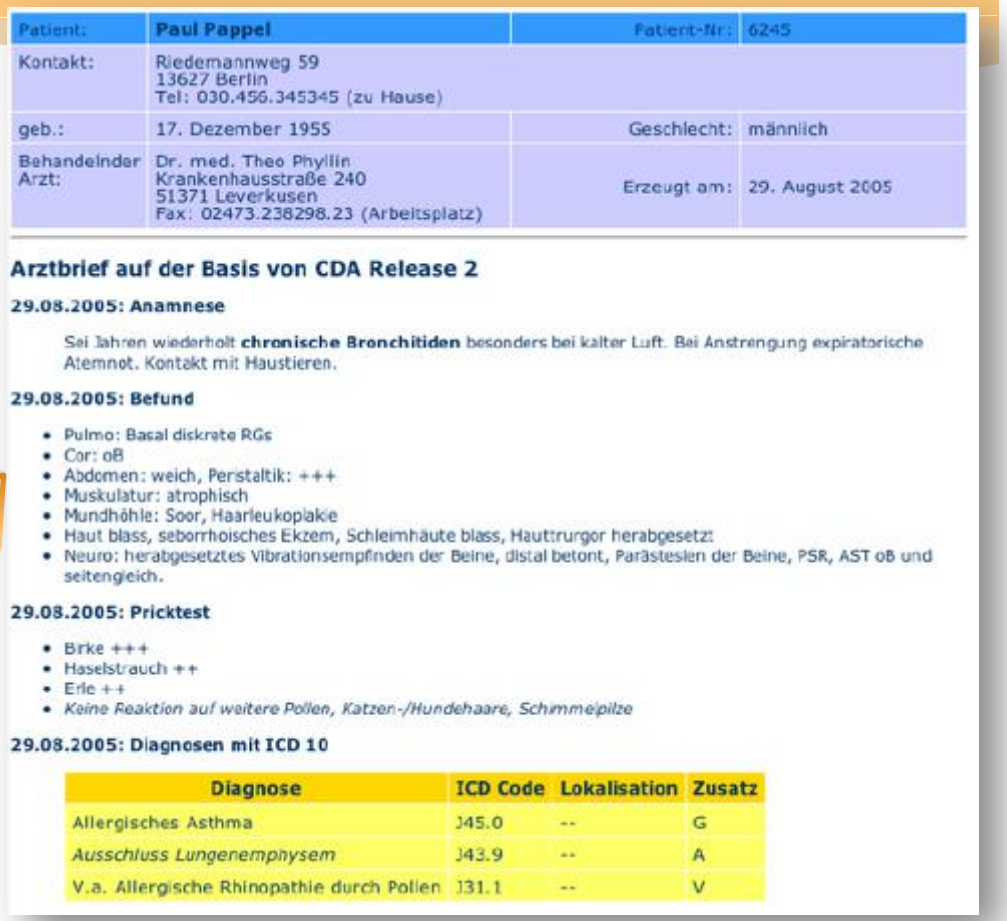
- Level 1: Human readable text
- Level 2: a code to indicate the nature of the section

```
<component>
  <!- History
  <section>
    <code code="10164-2"
          codeSystem="2.16.840.1.113883.6.1"
          codeSystemName="LOINC"/>
    <title>29.08.2005: History</title>
    <text>
      Onset of asthma in his teens. He was hospitalized twice
      last year, and already twice this year.
    </text>
  </section>
</component>
```

Header + Level 1 (+2)

- e.g. when transformed to HTML:

Human interoperability guaranteed



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V.a. Allergische Rhinopathie durch Pollen	J31.1	--	V

Section.code

- LOINC
- coding strength: CWE

Category	Example Code	Description
Anamnese	11348-0	History of past illness
Allergy	10155-0	History of Allergies
Diagnosis	29548-0	Diagnosis (Text; NAR)
Medication	10160-0	History of Medication Use
…		

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    - Entry
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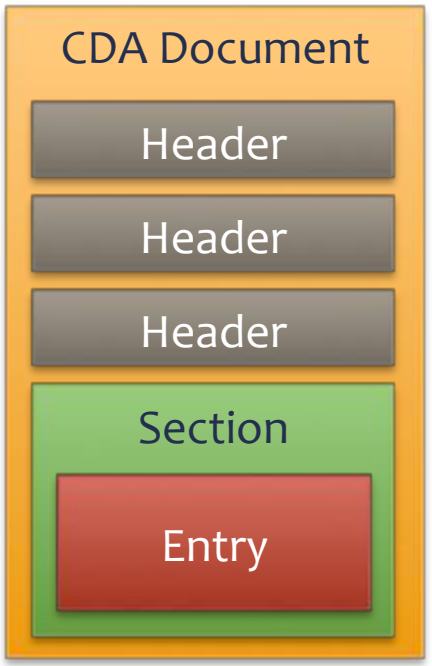


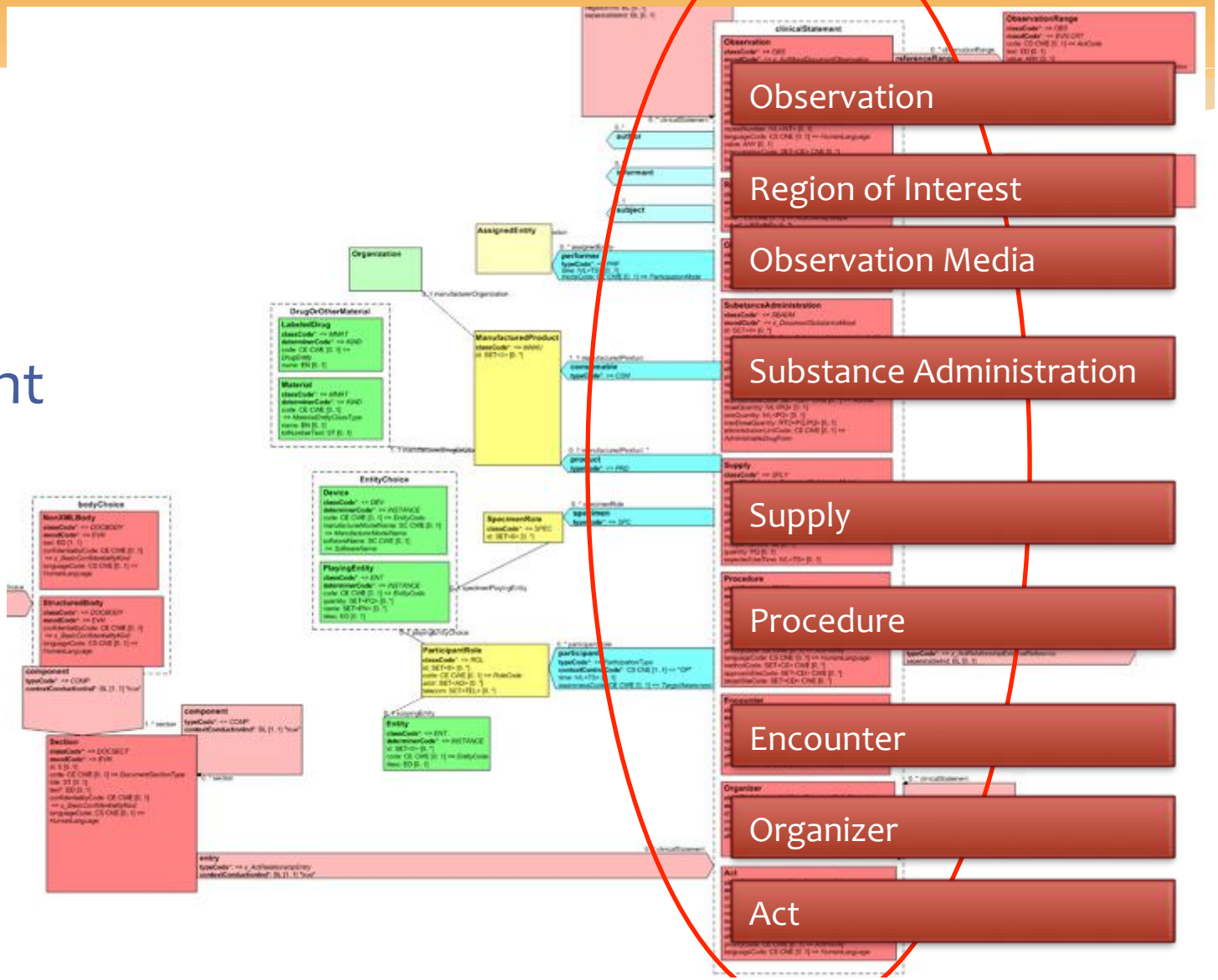
Entries: Computable Representations of Clinical Concepts

- Observation
- Procedure
- Substance Administration
- Supply
- Encounter

- Act
- Organizer

Entries

- Clinical context
- “Clinical Statement Pattern”

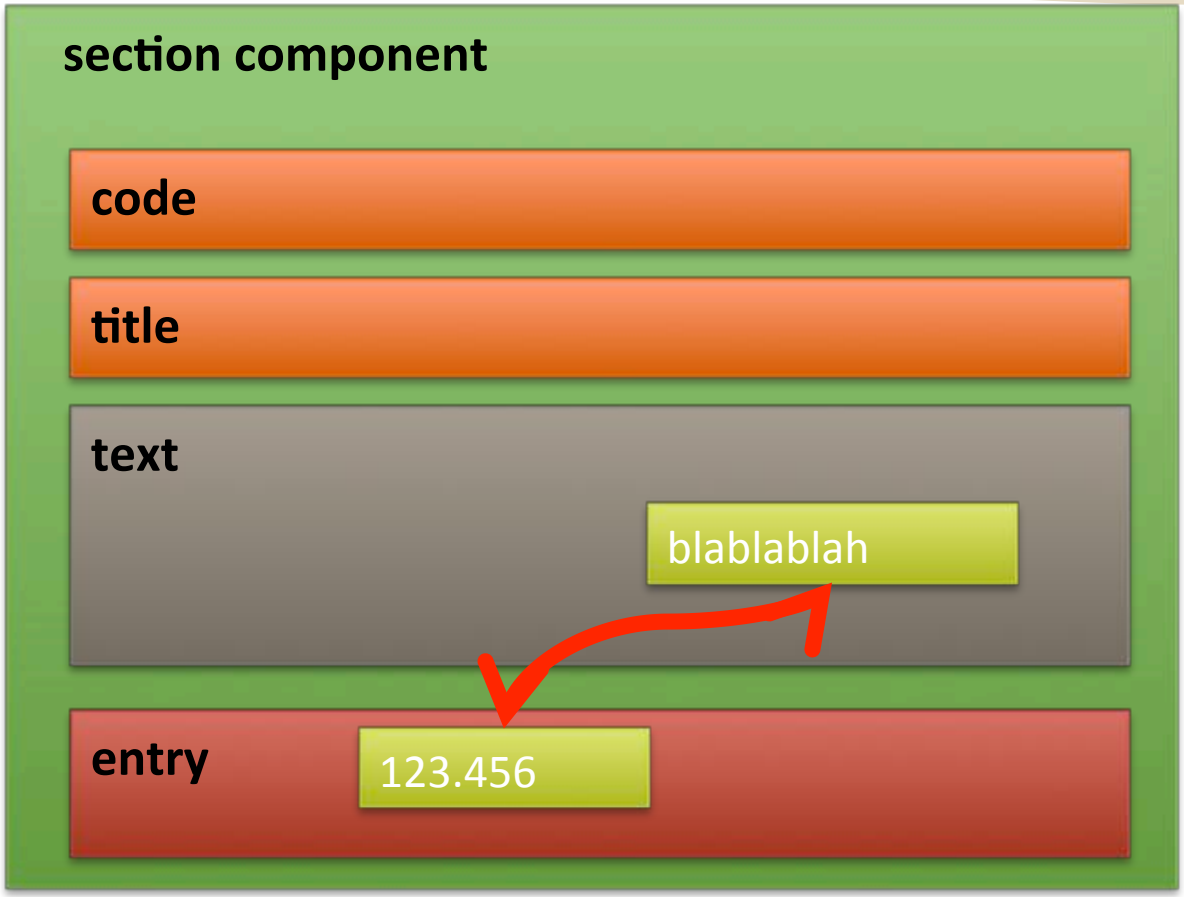


CDA sections: Level 3

- Level 3
  - Classes from the HL7 model (clinical statements)

```
<component>
  <section>
    <code code="10164-2" codeSystemName="LOINC"
          codeSystem="2.16.840.1.113883.6.1" />
    <title>29.08.2005: History</title>
    <text>
    ...
    </text>
    <entry typeCode="COMP">
      <observation>
        <code code="195967001"
          codeSystem="2.16.840.1.113883.6.96"
          codeSystemName="SNOMED CT"
          displayName="Asthma">
        </code>
      </observation>
    </entry>
  </section>
</component>
```

Referencing Entries



Text/Entry relationship: COMP vs DRIV

- The entry relationship is defaulted to **COMP** (component)
  - The narrative is the original authenticated content
  - The CDA entries are created by various techniques (e.g., natural language processing, a human coder, a structured data entry tool that outputs both entries and a text report)
- The entry relationship **DRIV** (is derived from) can be used in the special case where the narrative is fully derived from CDA Entries

Derivation of text from a Level 3 entry (DRIV)

Blood Pressure	120	80

Database	
…	…
systolicBP	int
diastolicBP	int
…	…

```
<section>
  <text>
    Blood pressure 120/80 mmHg
  </text>
  <entry typeCode="DRIV">
      Observation
      Systolic BP: 120 mm[Hg]
  </entry>
  <entry typeCode="DRIV">
      Observation
      Diastolic BP: 80 mm[Hg]
  </entry>
</section>
```

narrative is fully derived from the CDA entries

Derivation of text from a Level 3 entry (COMP)

Family History: Patient with onset of asthma in his teens

Database	
…	…
familyHistory	text
…	…

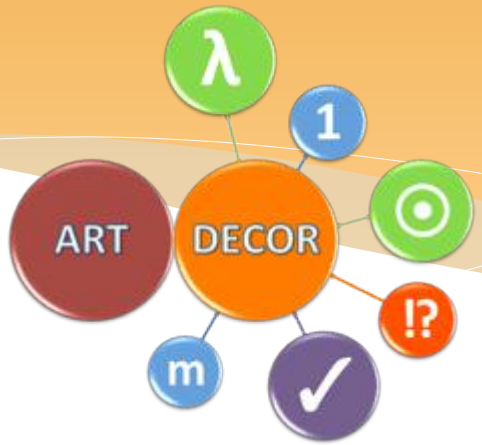
```
<section>
  <text>
    Patient with onset
    of asthma in his teens.
  </text>
  <entry typeCode="COMP">
```

Observation
asthma

```
  </entry>
</section>
```

narrative is the original authenticated content

Entry Inspection: The Module Principle



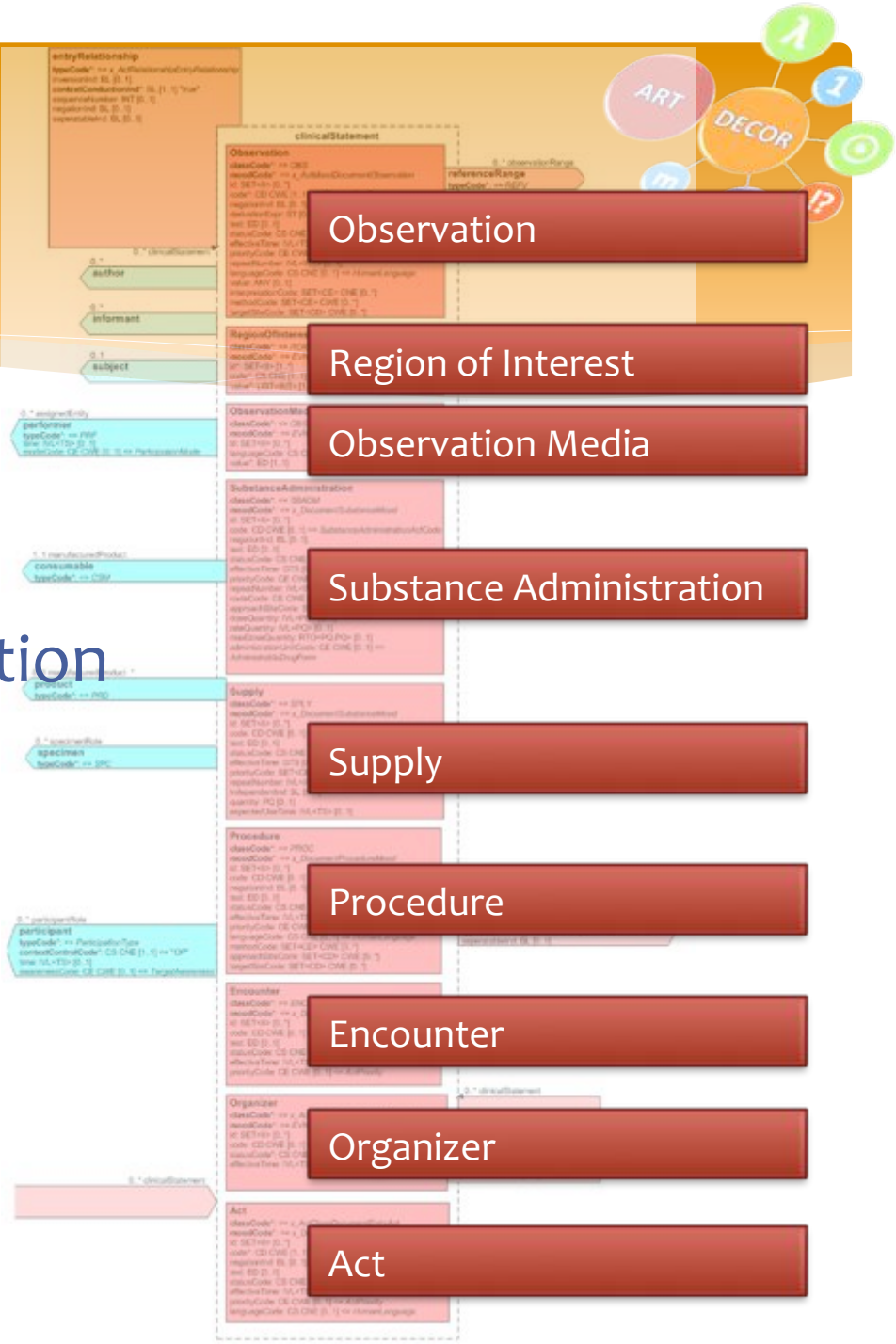
CDA Entries (Clinical Statements)

- Choice of Acts (from HL7's Reference Information Model)
- Relationships between Activities (Classes)
- Participations

Clinical Statement Pattern

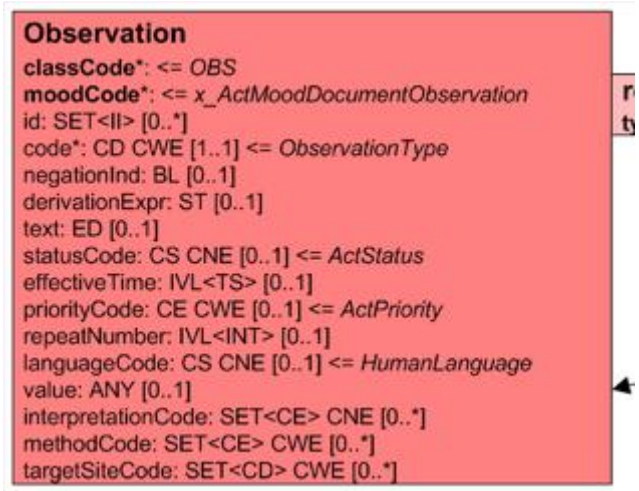
- Observation
- Procedure
- Substance Administration
- Supply
- Encounter

- Act
- Organizer



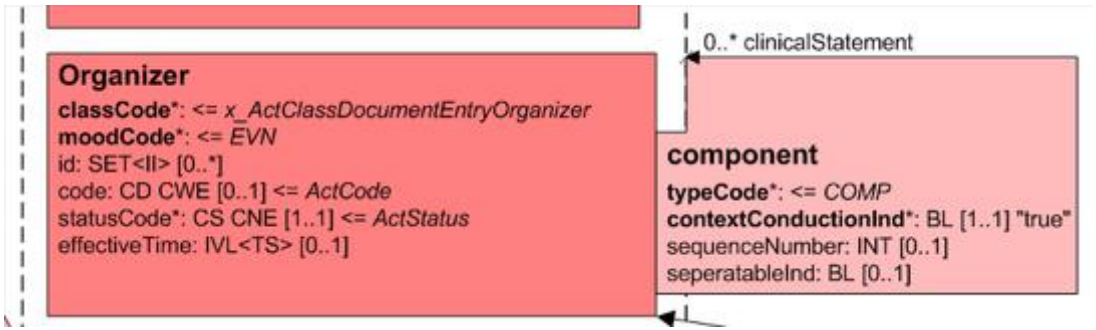
Clinical Statement Types

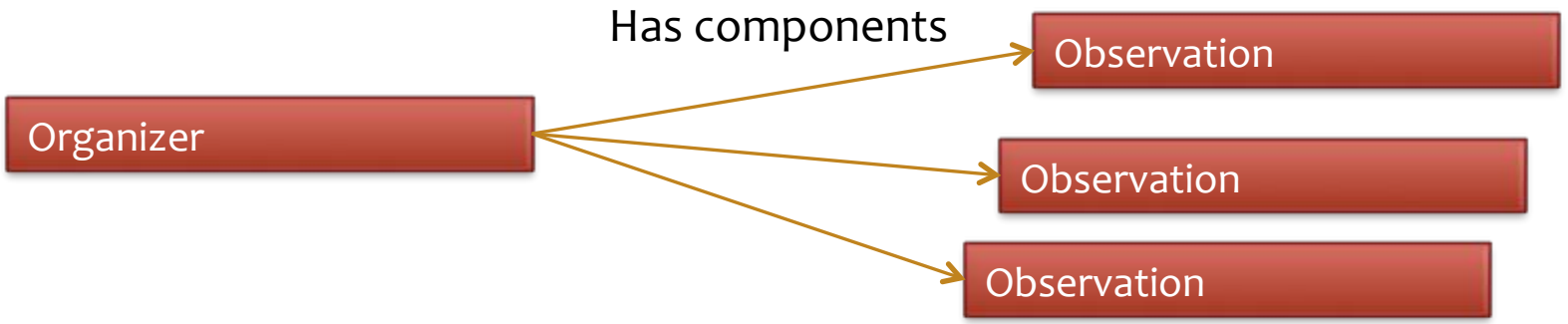
- Observation
  - A Finding, Result, Diagnosis etc.
  - Includes requesting, recommending, promising, refusing or setting a goal



Clinical Statement Types

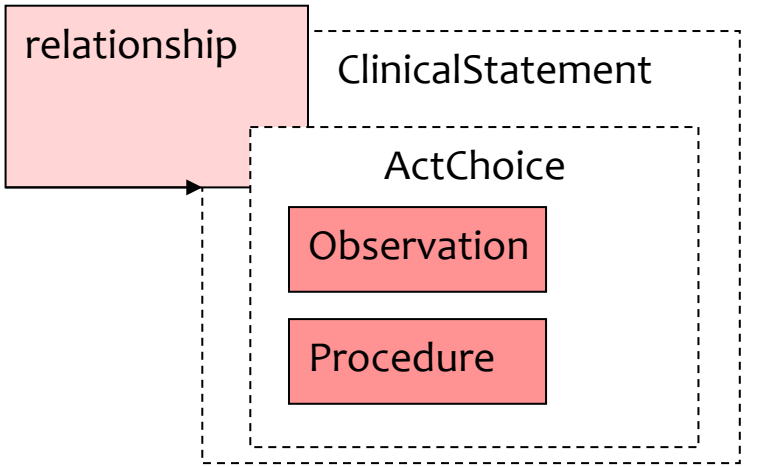
- Organizer relationships

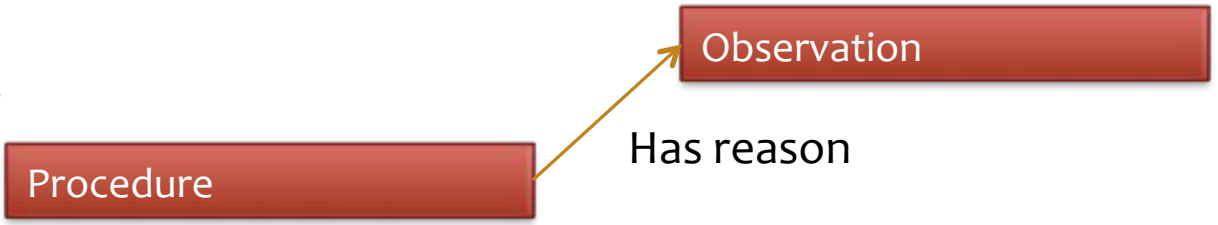




Clinical Statement Types

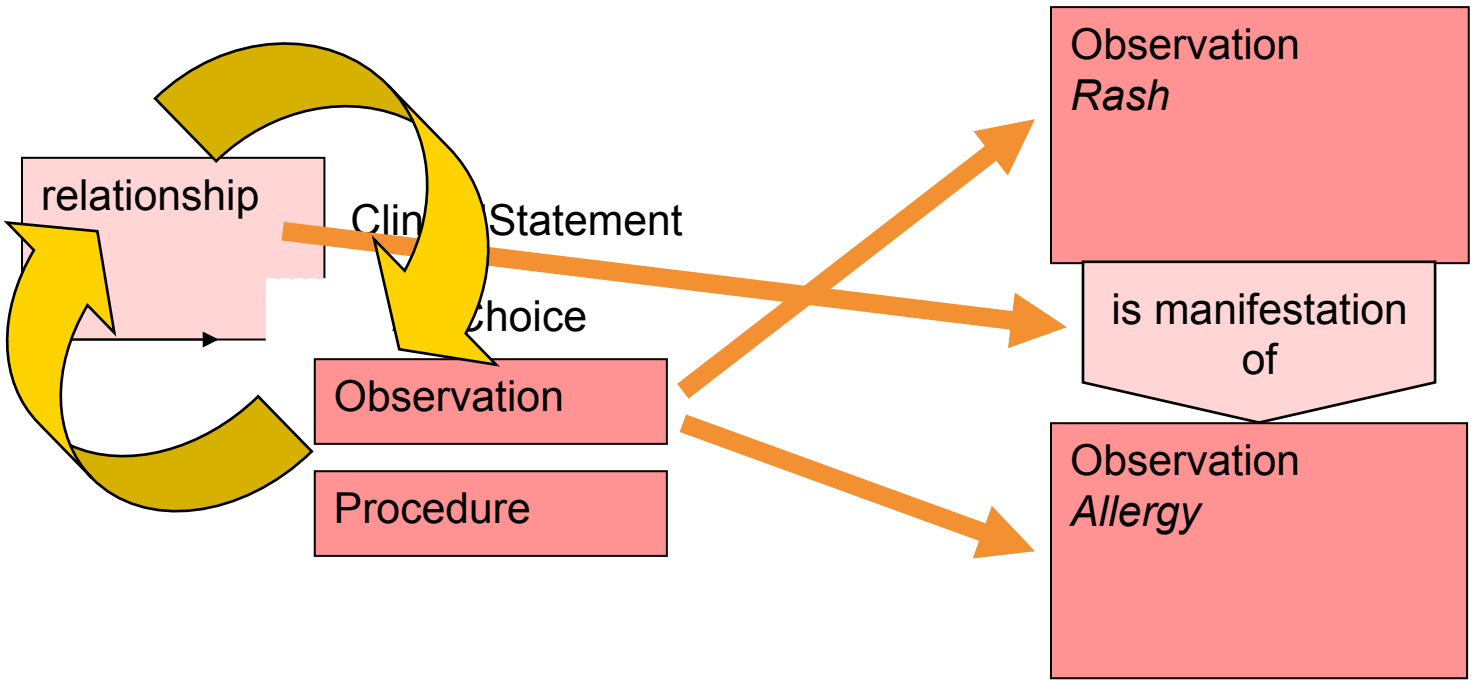
- Statement Relationship
  - A link between two or more Clinical Statements
  - Allows a relationship to be stated independently of the related Clinical Statements





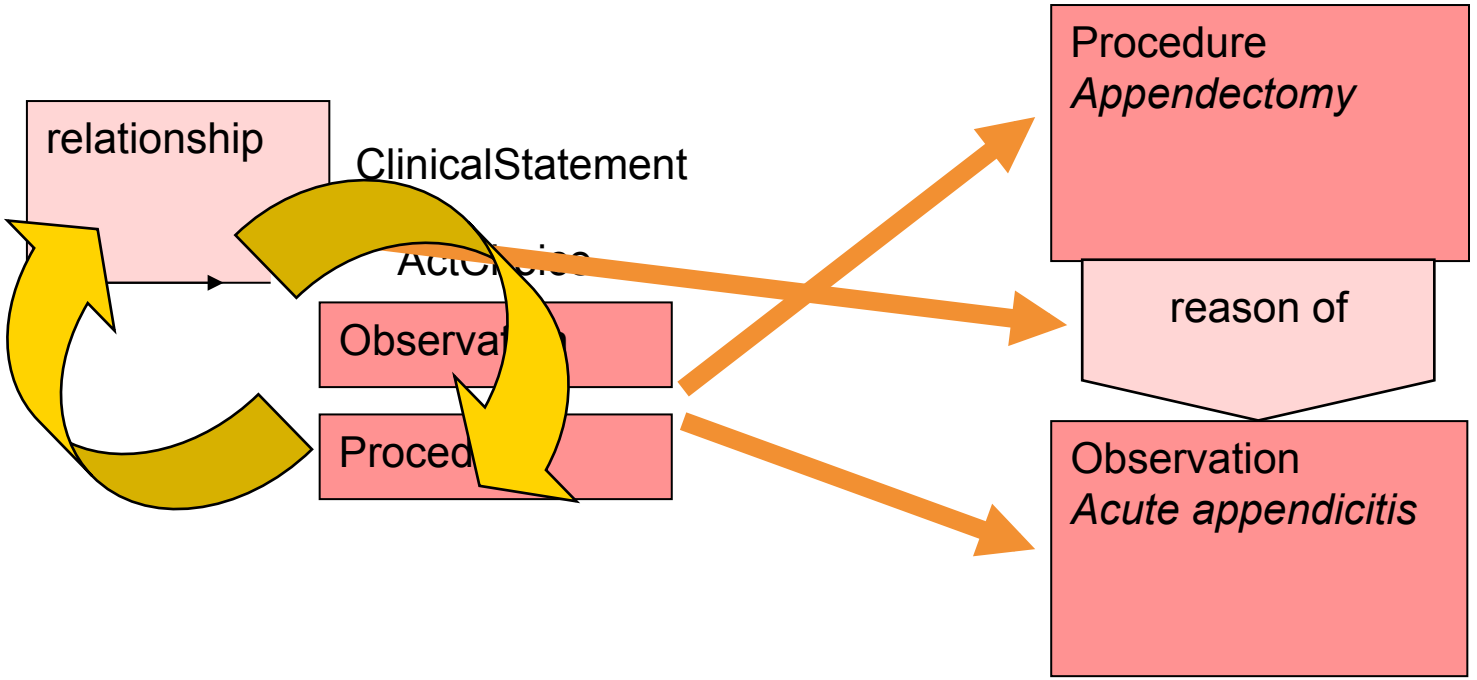
Composition example I

- Rash (skin) as a *manifestation* of an allergy



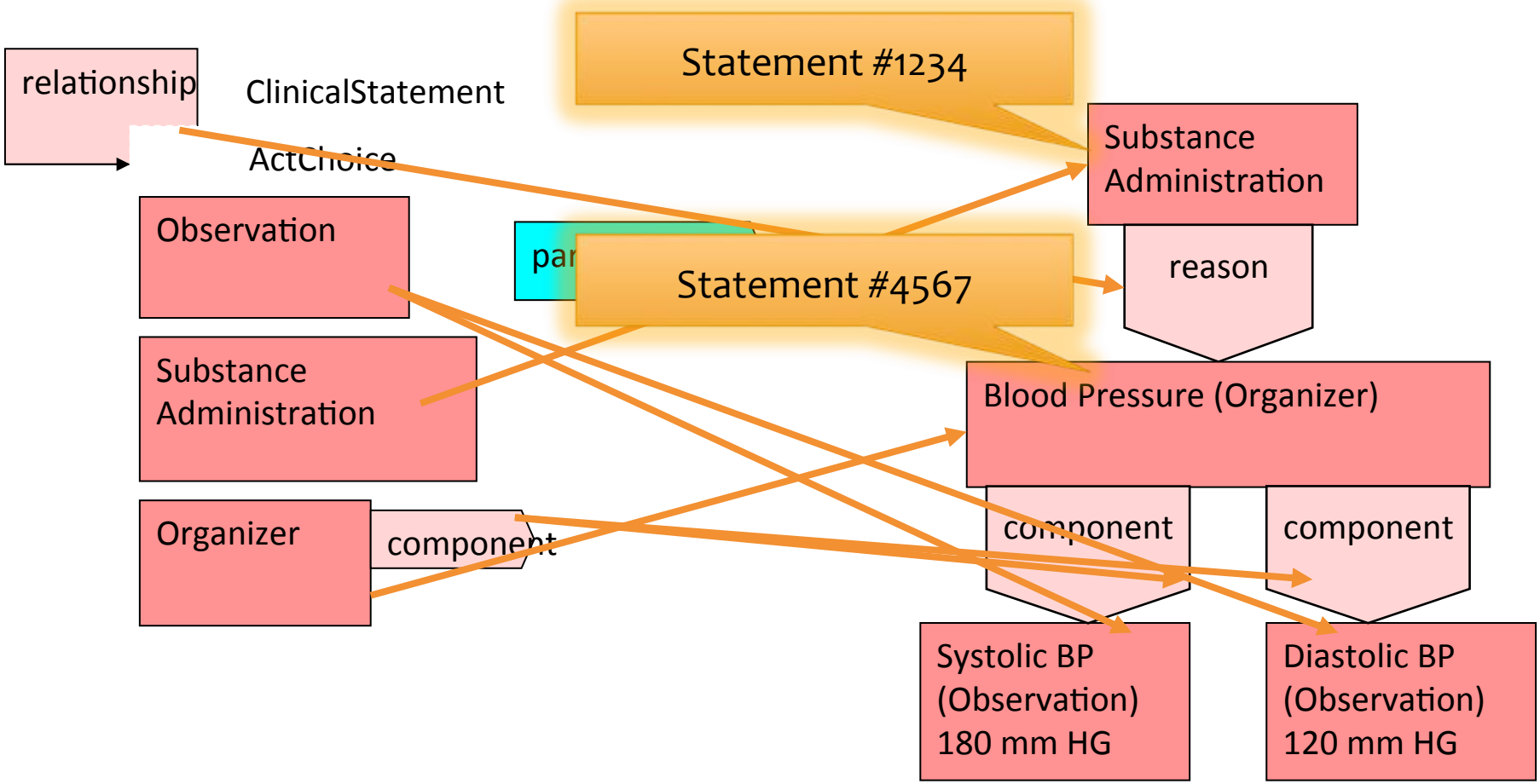
Composition example II

- An appendectomy (procedure) *because* of the (diagnosis) acute appendicitis



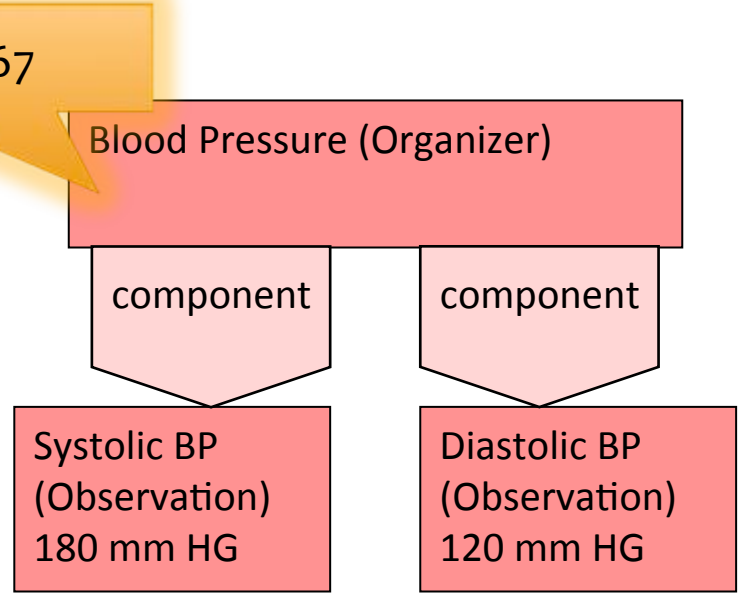
Composition example III

A Patient is given a medication because his blood pressure is found to be 180/120 mm[Hg].



Clinical Statement /recap

- Model deliberately broad and encompassing
- It would be possible to represent a particular statement in more than one way
- Therefore: constrain the Clinical Statement model!
- **Clinical Statement pattern**
- **→ Template**
- **→ re-usable block**



Example 1: APGAR score

- Apgar score
  - was devised in 1952 by **Dr. Virginia Apgar** as a simple and repeatable method to quickly and summarily assess the ***health of newborn children*** immediately after childbirth

Example 1: APGAR score

- Five criteria
- … Simple, on a scale from 0 to 2
- summing up the five values = su

– Appearance
– Pulse
– Grimace
– Activity
– Respiration

	Score of 0	Score of 1	Score of 2	Component of Acronym
Skin color	blue all over	blue at extremities body pink (acrocyanosis)	no cyanosis body and extremities pink	**A**ppearance
Pulse rate	absent	<100	>100	**P**ulse
Reflex irritability	no response to stimulation	grimace/feeble cry when stimulated	sneeze/cough/pulls away when stimulated	**G**rimace
Muscle tone	none	some flexion	active movement	**A**ctivity
Breathing	absent	weak or irregular	strong	**R**espiration

Example 1: APGAR score

- Method
  - The test is generally done at one and five minutes after birth
  - may be repeated later if the score is and remains low
- Interpretation
  - Scores 3 and below are generally regarded as critically low
  - 4 to 6 fairly low, and
  - 7 to 10 generally normal

Interspersed Exercise 1

- Prerequisites
  - Apgar score is scientifically validated
  - indicator of health condition of a newborn
- Exercise
  - Use the Clinical Statement model to represent Apgar score
  - Think about how to identify sum score and the five scales
  - Determine the properties of the class attributes

Interspersed Exercise 1

- Possible Solution

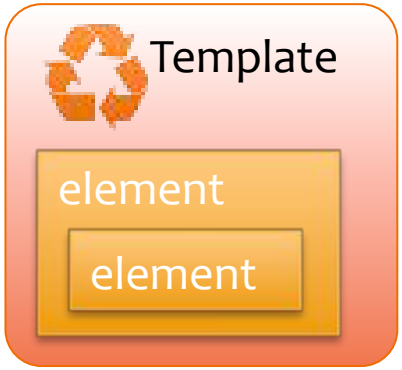
– Sum Score 0..10
  – Appearance 0..2
  – Pulse 0..2
  – Grimace 0..2
  – Activity 0..2
  – Respiration 0..2

Observation: *Agpar Sum Score*
code:
effectiveTime:
value:

component	component	component	component	component
Observation *Appearance* code: value:	Observation *Pulse* code: value:	Observation *Grimace* code: value:	Observation *Activity* code: value:	Observation *Respiration* code: value:

Template Creation

- We just created a template…
- Is this really so easy?



Exercise

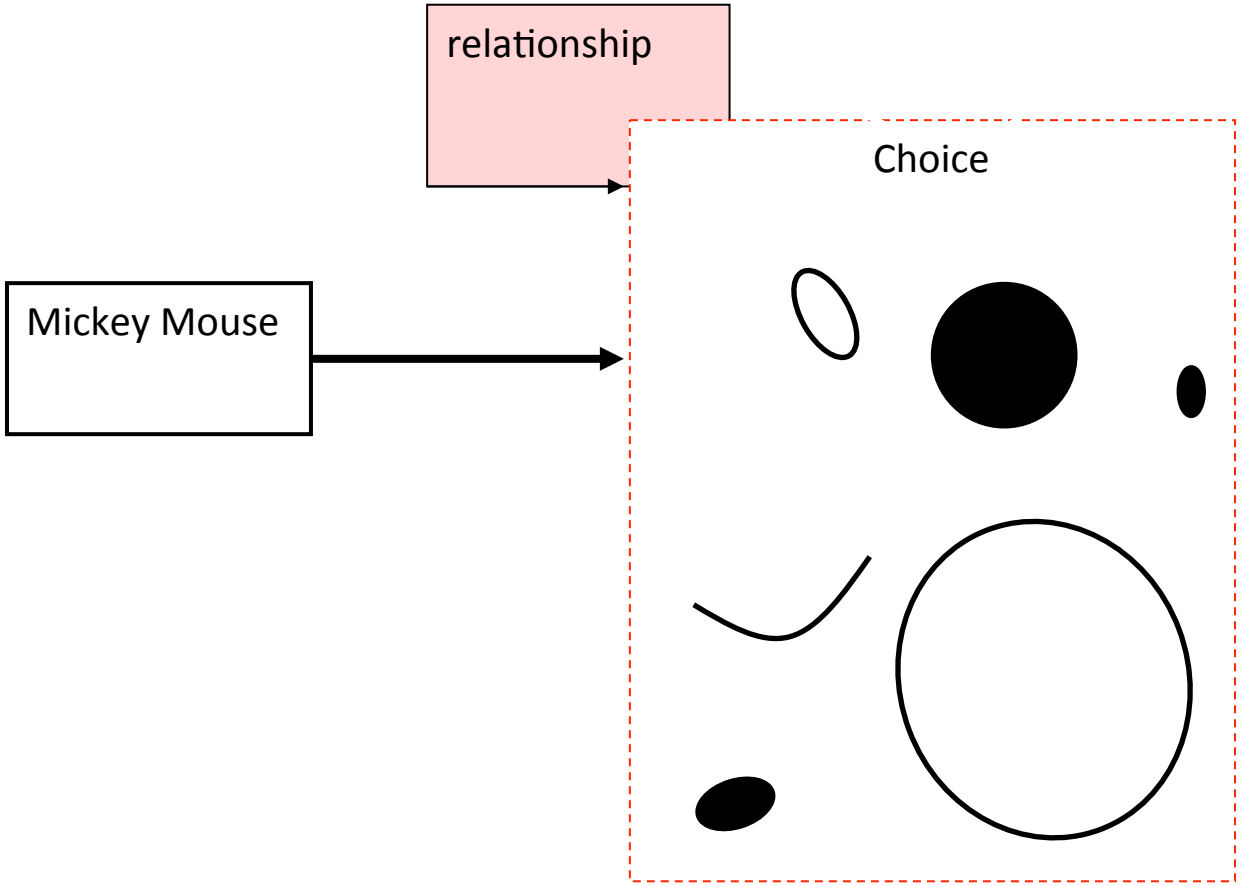
- Remember

  Mickey Mouse

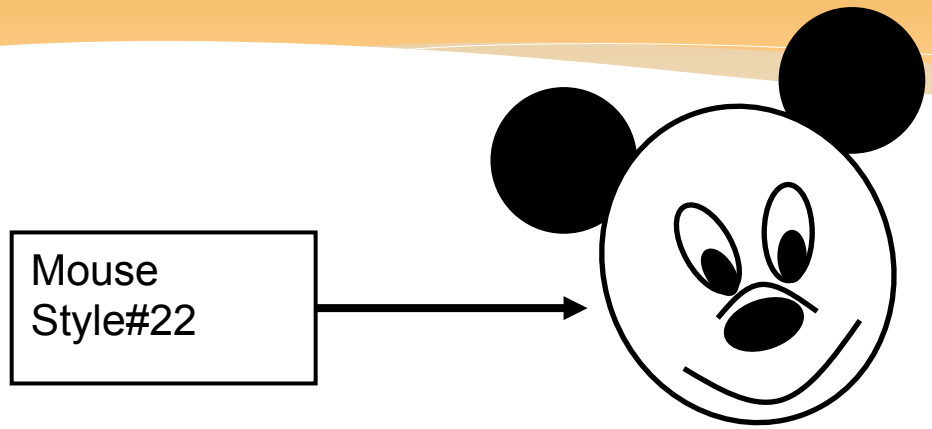
- Prerequisites
  - Pen and a piece of paper
  - Your memories and your drawing skills
- Exercise: draw the **face of Mickey Mouse**

Background Story

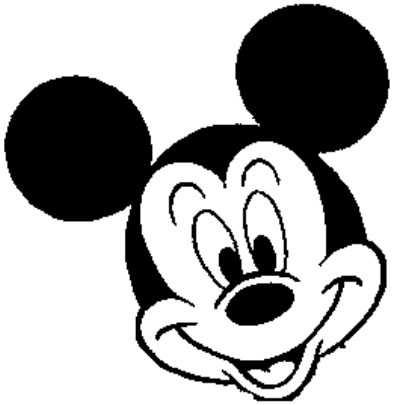
Mouse Statement



Template



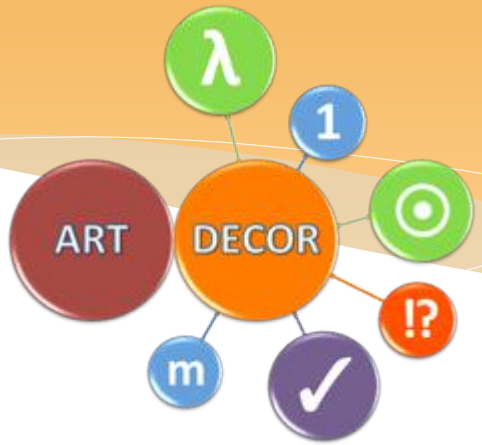
Modell



"Reality"

Mini Intro and Outro

Templates



...with CDA you aren't there yet...

Generic models

...need something

...to fill the gap

...to semantic interoperability

Templates

Generic vs specific definitions

- CDA is not a *highly* specified/differentiated model
  - "any" document definition
- Rule: the more general a model is the more you have to bridge the gap towards semantic interoperability
  - "any" document definition → "my" document definition

CDA & Implementation

- Re-usable generic blocks
  - Once you implemented a RecordTarget, re-use it in all document types
  - Choice of RIM favorite acts in it's finest purity
- Incremental Interoperability
  - allows for a migration phase
  - 'lowest common denominator'
    = human interoperability
  - Start with a simple CDA
  - Structured data elements are added over time

HL7 / CDA Templates

- A template is a set of further constraints on top of an underlying model
- Example: patient
  - **Model:** the patient shall have one or more identifications (id)
  - **Template:** our patients shall have exactly one Dutch national patient identifier

Patient
id: II 1..1
addr: AD 0..*
telecom: TEL 0..*

- Documentation of "rules" in HL7's Templates Exchange Format (DSTU)

Template (section level)

Allergies Section (entries optional)

Version	2012-01-12	Status	Draft
Version Label		Id	2.16.840.1.113883.10.20.22.2.6
Name	AllergiesSectionentriesoptional	Display Name	Allergies Section (entries optional)
Classification	cdasectionlevel	Open/Closed	open
Description	This section lists and describes any medication allergies, adverse reactions, idiosyncratic reactions, anaphylaxis/anaphylactoid reactions to food items, and metabolic variations o latex, iodine, tape adhesives) used to assure the safety of health care delivery. At a minimum, it should list currently active and any relevant historical allergies and adverse reactio		
Reference	conf-671		
Context	**		

Item	DT	Card	Conf	Description
<> cda:section				
<> cda:templateId	II	1..1	M	
@ root		1..1	F	2.16.840.1.113883.10.20.22.2.6
<> cda:code	CD	1..1	M	
@ code		1..1	F	48765-2
@ codeSystem		1..1	F	2.16.840.1.113883.6.1
@ displayName		1..1	F	Allergies, adverse reactions, alerts
<> cda:title	ST	1..1	M	
<> cda:text	ED	1..1	M	
<> cda:entry		0..*	R	contains : 2.16.840.1.113883.10.20.22.4.30 *Allergy Problem Act*

Consolidated CDA

Sample XML fragment


```
<observation classCode="OBS" moodCode="EVN">
  <templateId root="2.16.840.1.113883.10.20.22.4.4"/>
  <!-- Problem Observation template -->
  <id root="d11275e7-67ae-11db-bd13-0800200c9a66"/>
  <code code="409586006" codeSystem="2.16.840.1.113883.6.96"
      displayName="Complaint"/>
  <text>
  ...
  </text>
  <statusCode code="completed"/>
  <effectiveTime>
    <low value="1950"/>
  </effectiveTime>
  <value xsi:type="CD" code="195967001"
       codeSystem="2.16.840.1.113883.6.96"
       displayName="Asthma"/>
</observation>
```

Template (entry level)

Item	DT	Card	Conf	Description	Label
<> cda:observation					conf-622
@ classCode		1..1	F	OBS	conf-7318
@ moodCode		1..1	F	EVN	conf-7319
<> cda:templateId	II	1..1	M		conf-7317
@ root		1..1	F	2.16.840.1.113883.10.20.22.4.28	conf-10490
<> cda:code	CE	1..1	M		conf-7320
@ code		1..1	F	33999-4	
@ codeSystem		1..1	F	2.16.840.1.113883.6.1	
@ displayName		1..1	F	Status	
<> cda:statusCode	CS	1..1	M		conf-7321
@ code		1..1	F	completed	
@ codeSystem		1..1	F	2.16.840.1.113883.5.14	
@ displayName		1..1	F	Completed	
<> cda:value	CE	1..1	M		conf-7322
			CONF	code from value set: 2.16.840.1.113883.3.88.12.80.68 dynamic	

Value Set

AdministrativeGender

Version	07/24/2012	Status	
Version Label		Id	2.16.840.1.113883.1.11.1
Name	AdministrativeGender	Display Name	AdministrativeGender
Description	The gender of a person used for adminstrative purposes (as opposed to clinical gender)		
Source Codesystems	2.16.840.1.113883.5.1		2.16.840.1.113883.5.1

Values

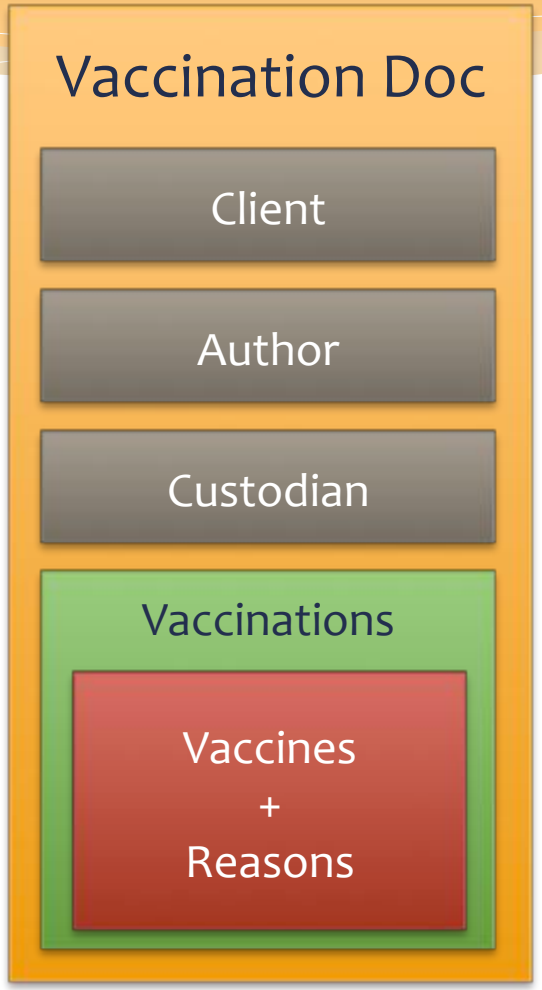
Level/Type	Code	Display Name	Codesystem
0-L	**M**	Male	2.16.840.1.113883.5.1
0-L	**F**	Female	2.16.840.1.113883.5.1
0-L	**UN**	Undifferentiated	2.16.840.1.113883.5.1

Template Types

- Document Level Template
- Header Constraints (Templates)
- Section Level Templates
- Entry Level Templates
- …

Templates: all together now

- Document Level Template
- Header Level Templates
- Section Level Template
- Entry Level Templates



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Thank you!
Questions?