

XML and Clinical Information Systems

Centre for Health Informatics

Prof John Chelsom

Runs: 3 hours
Tutor: Prof John Chelsom
Mode of attendance: Classroom

Learning Objectives

This session provides an overview of XML and how it can be used in clinical information systems

Specific learning objectives are to:

- 1 Understand the history and scope of XML standards
- 2 Become familiar with the three key components of XML
- 3 See how XML is used to represent electronic health records
- 4 Identify the major published XML vocabularies for EHR

XML and Clinical Information Systems

- XML and Clinical Information Systems
- Representing Structured Data in XML
- Validation and Transformation of XML
- Electronic Health Records in XML
- References and Further Reading

Information Sources

- Sources are listed in the references at the end of these slides



Some definitions and descriptions have been taken from quoted resources.

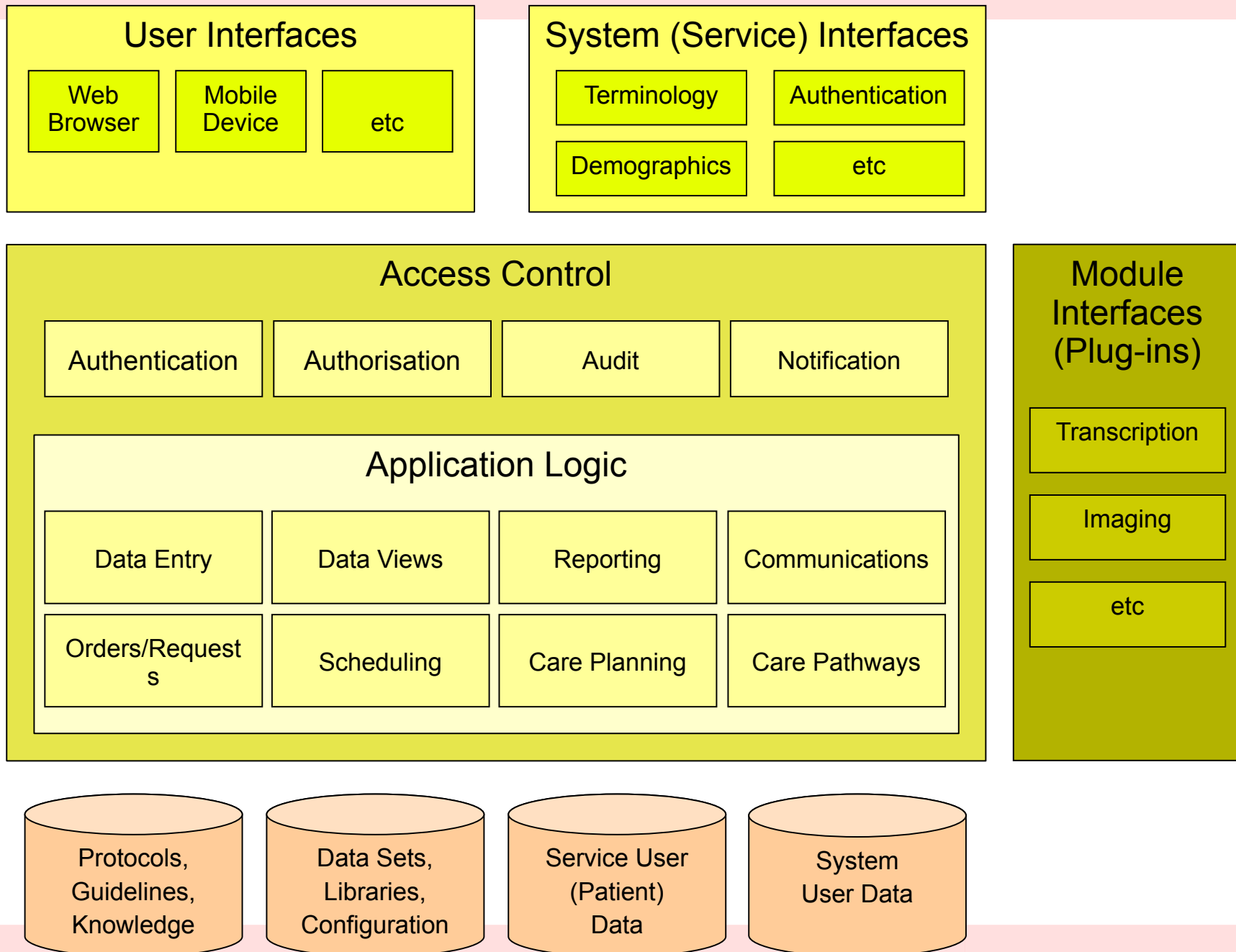
Retrieved October 2010.

Where consensus on definitions or descriptions is required, these have been taken from Wikipedia.

Retrieved October 2010.

XML and Clinical Information Systems

Clinical Information Systems



Open Health Informatics

- Open Health Informatics is a term used to describe an approach to implementing Clinical Information Systems using
 - Open standards
 - Open source software
 - Open systems interfaces
 - Open development processes
- XML is an open standard for structured data representation which underpins many other (healthcare) standards
- It is a key enabler of open system interfaces
- (and there is a wealth of open source software for creating, managing and processing XML)

Its Not What You Say....

Don't let children breathe your smoke. Children exposed to passive smoking experience more serious illnesses such as pneumonia, middle ear infections and asthma attacks. Babies exposed to passive smoking are at great risk of SIDS (Sudden Infant Death Syndrome). You can quit smoking. Call Quitline 131848, talk to your doctor or pharmacist, or visit www.quitnow.info.au

Its How You Say It!

Don't let children breathe your smoke. Children exposed to passive smoking experience more serious illnesses such as pneumonia, middle ear infections and asthma attacks. Babies exposed to passive smoking are at greater risk of SIDS (Sudden Infant Death Syndrome). You can quit smoking. Call Quitline 131 848, talk to your doctor or pharmacist, or visit www.quitnow.info.au

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You can quit smoking. Call Quitline 131 848, talk to your doctor or pharmacist, or visit www.quitnow.info.au

DON'T LET CHILDREN BREATHE YOUR SMOKE
Health Authority Warning

Quitline
131 848

Children exposed to passive smoking experience more serious illnesses such as pneumonia, middle ear infections and asthma attacks. Babies exposed to passive smoking are at greater risk of SIDS (Sudden Infant Death Syndrome).
You CAN quit smoking. Call Quitline 131 848, talk to your doctor or pharmacist, or visit www.quitnow.info.au

- Adding proper structure and present; you are saying makes it easier to understand
- This is as true for machines as it is for humans

Documents, Content and Markup

- Electronic information is usually handled in 'files'
 - managed by the computer file system
- We will use the more generic term 'document', rather than 'file'
 - that's what the XML standard calls them
- An electronic document contains the information
 - we will call the information in a document its 'content'
- And can contain additional codes with instructions on how to understand the content
 - Those additional codes are called 'markup'

(Don't let children breathe your smoke.) – [this is the main message we are trying to get across!]



Children exposed to passive smoking experience more serious illnesses such as pneumonia, middle ear infections and asthma attacks.



Babies exposed to passive smoking are at greater risk of SIDS (Sudden Infant Death Syndrome).



You (can) – [emphasis on this word] quit smoking. Call (Quitline 131 848) – [this is a phone number], talk to your doctor or pharmacist, or visit (www.quitnow.info.au) – [this is a URL]

What Is XML?

The **eXtensible Mark-up Language** is a language for marking up electronic documents so that their structure

- is separated from content
 - using a defined syntax for marking up structure
- is logical
 - not presentation-oriented
- can be processed easily
 - transformation
 - formatting
- can be verified against a set of rules
 - the rules are expressed in a schema (later session)
- can be openly published and distributed
 - an open standard, not 'owned' by a single vendor

Documents and Data

XML can be used equally for

- '*documents*'

papers, abstracts, case histories, articles, chapters, books, diagrams, discharge summaries, referral letters, health records...

- '*data*'

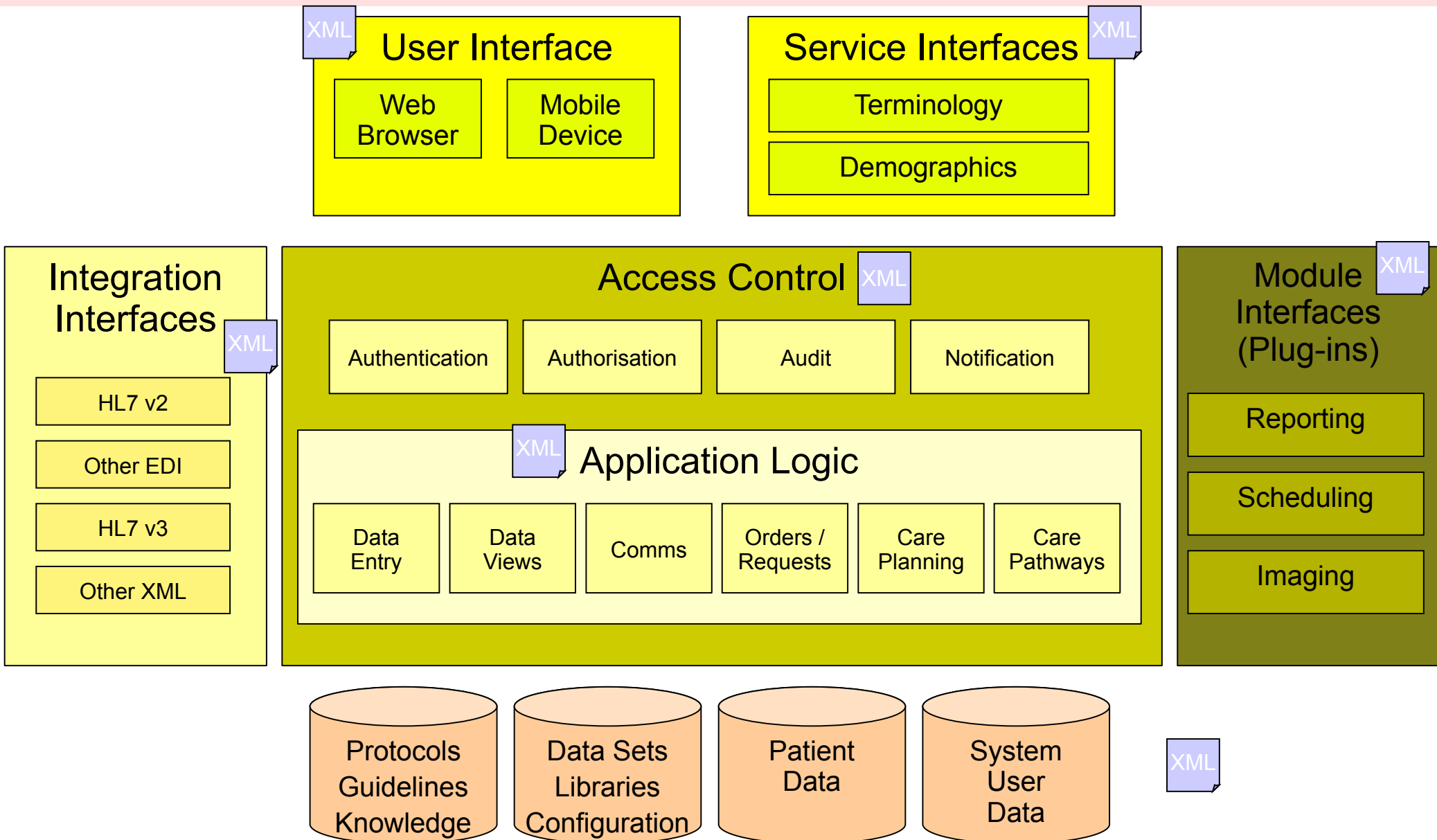
measurements, test results, payment requests, processing instructions, statistics, configuration files, parameters, messages

Content Marked up in XML

- XML markup is placed around and within the content (data) in the same document (file)
- The XML markup makes the data easier for machines to process and *understand*

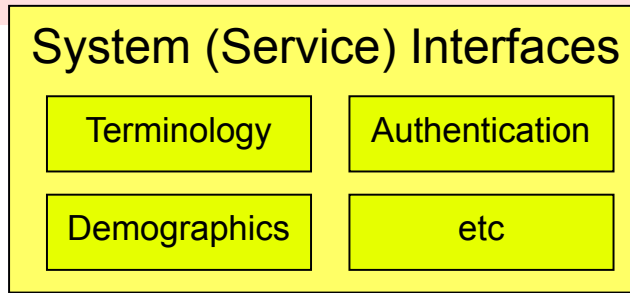
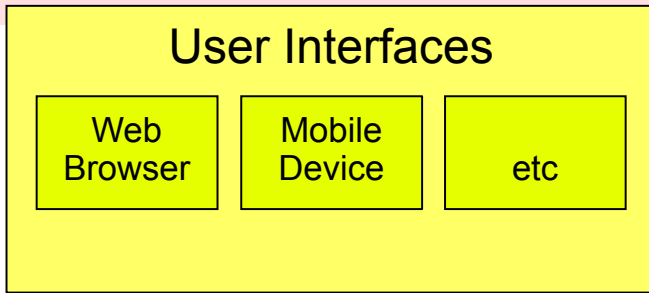
```
<healthWarning>  
<mainMessage>Don't let children breathe your smoke.</mainMessage>  
<p>  
Children exposed to passive smoking experience more serious illnesses such as pneumonia,  
middle ear infections and asthma attacks.  
</p>  
<p>  
Babies exposed to passive smoking are at greater risk of SIDS (Sudden Infant Death  
Syndrome).  
</p>  
<p>  
You <emph>can</emph> quit smoking. Call <phone>Quitline 131 848</phone>, talk to  
your doctor or pharmacist, or visit <url>www.quitnow.info.au</url>  
</p>  
</healthWarning>
```

XML in the CIS Architecture



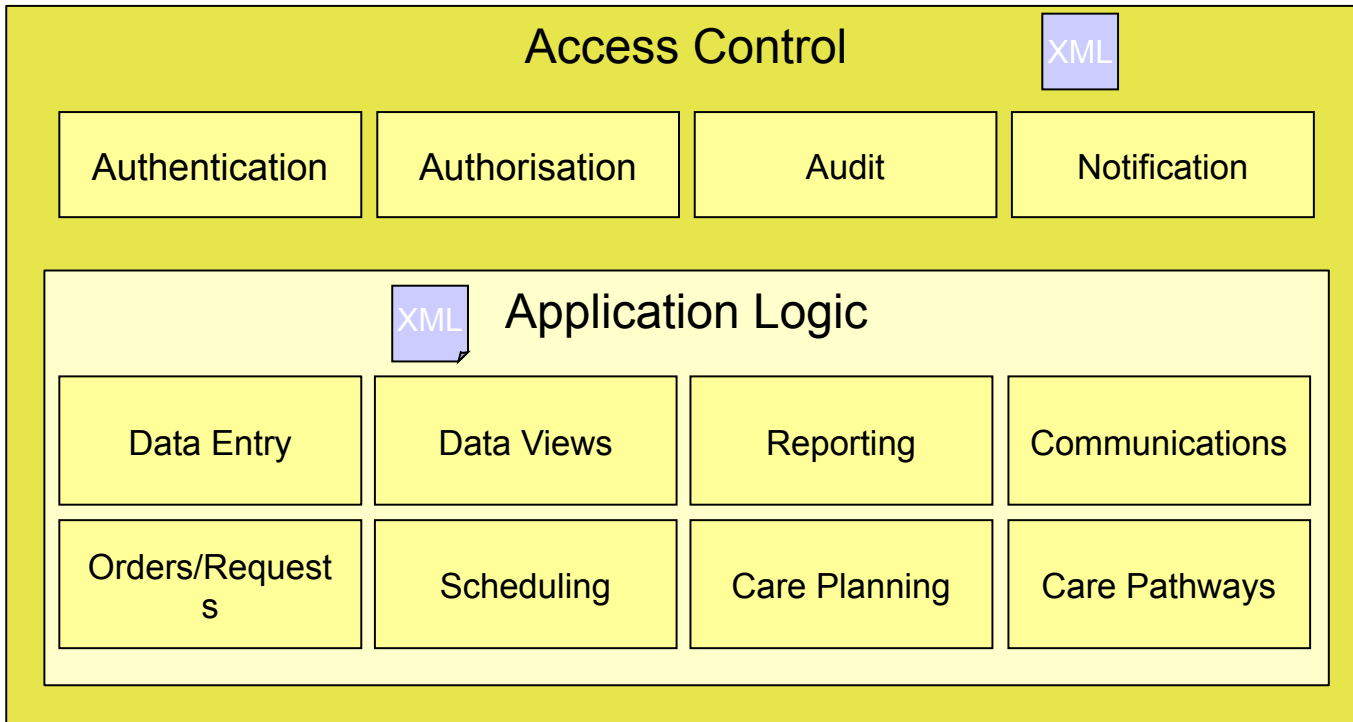
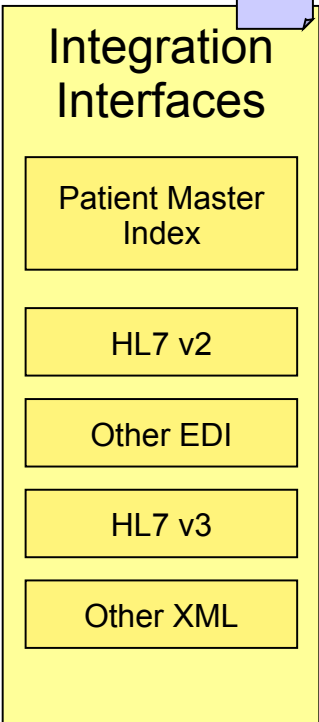
Clinical Information Systems

XML

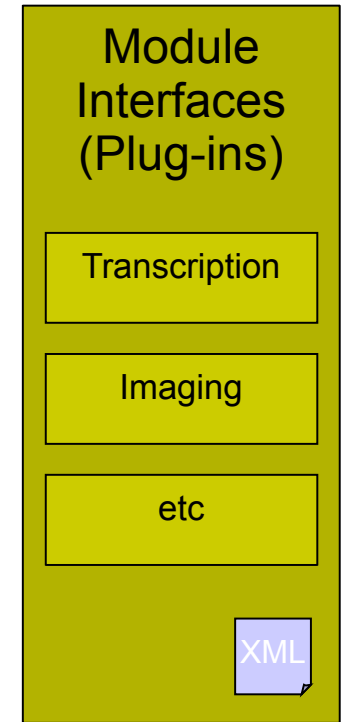


XML

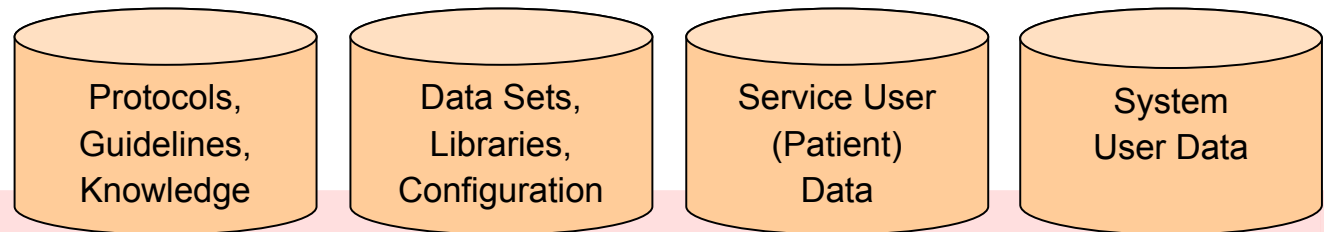
XML



XML



XML



XML

Representing Structured Data in XML

An XML document

- Should have an XML declaration (discussed later)
- Every XML document has **exactly one** root element
- Every element has a start tag ...
- ...and an end tag

- Here is (almost) the simplest XML document with the root element called record

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
```

```
<record>
```

```
...document content goes here...
```

```
</record>
```

Element with text content

- Start and end tags contain text for the element
 - `<record>` is a start tag
 - `</record>` is an end tag
- XML uses Unicode text encoding – the standard containing characters of all languages
- Usually UTF-8 encoding (256 ASCII characters plus tens of thousands of others)

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
```

```
<record>
```

```
This document contains the health record for Joe Biggs
```

```
</record>
```

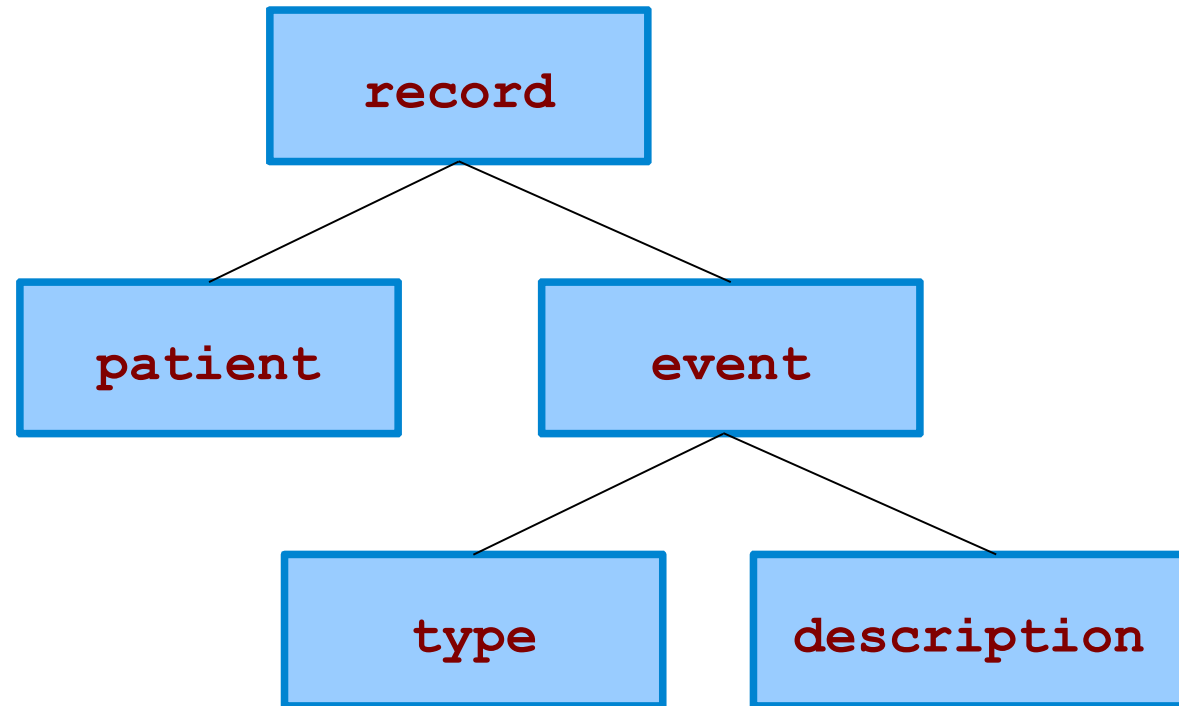
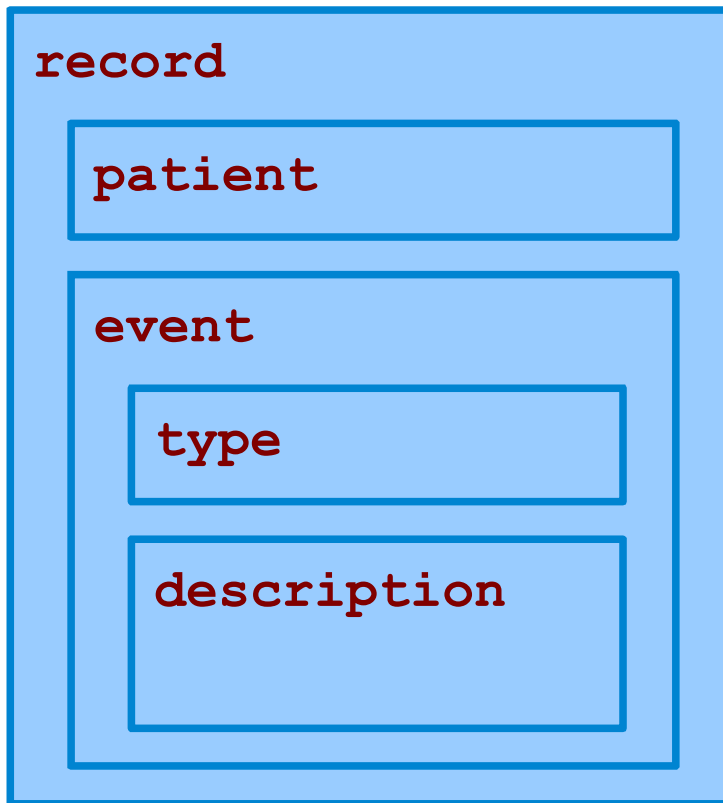
Element within Elements

```
<record>
  <patient>Joe Biggs</patient>
  <event>
    <type>Referral</type>
    <description>
      This 48 year old male presented with a rash on his
      knee.
    </description>
  </event>
</record>
```

- Elements must be nested, one inside another
- The boundaries of elements cannot overlap
- An element can contain any number of elements within it

Elements Denote Logical Structure

- Can think of structure as containers
- Or as a hierarchy
 - parent nodes with children (siblings)



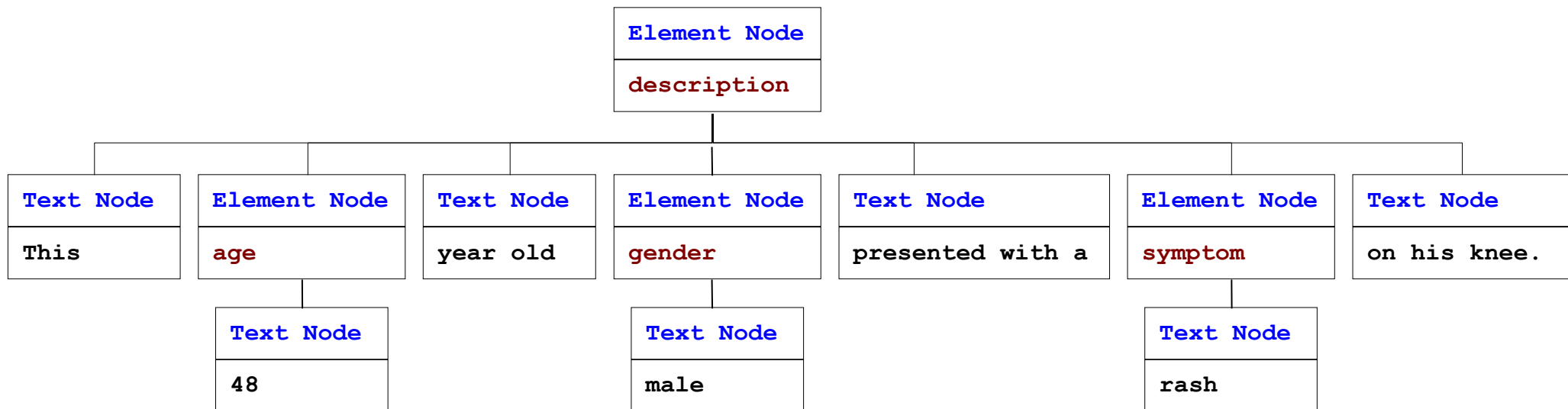
Element with Mixed Content

- Element contains text and other elements

```
<description>
```

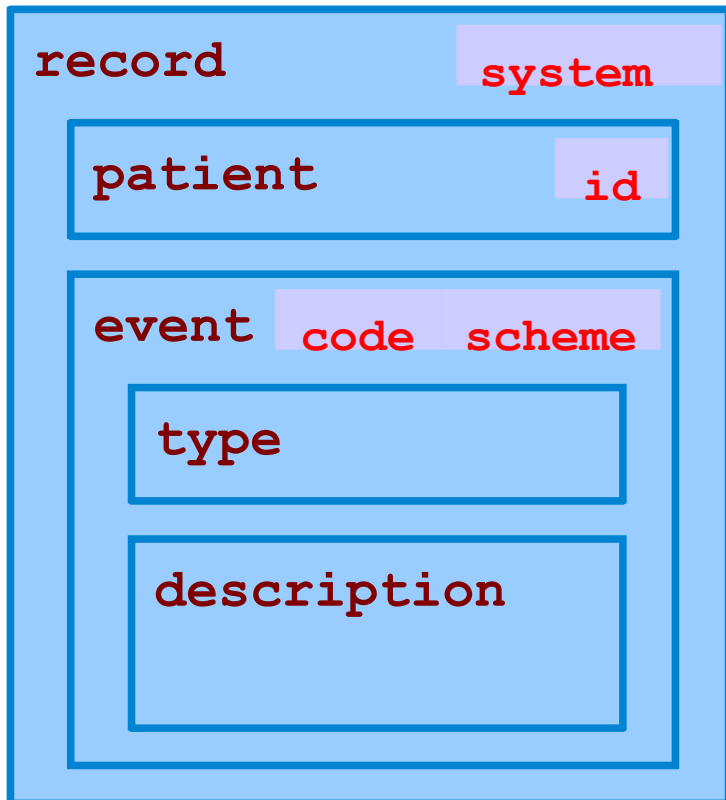
```
  This <age>48</age> year old <gender>male</gender>  
  presented with a <symptom>rash</symptom> on his  
  knee.
```

```
</description>
```



Elements with attributes

- Additional information associated with elements
- For documents attributes are not considered part of the normal text content



- If you take an object-oriented view of the XML data model
- XML elements correspond to classes/instances
- XML attributes correspond to properties of objects
- But remember that the basic XML data model is not a perfect object model

Attributes at work

```
<record system="CR1">
  <patient id="1234567890">Joe Biggs</patient>
  <event code="cghwhw" scheme="myCodes">
    <type>Referral</type>
    <description>
      This <age units="years">48</age> year old
      <gender>male</gender> presented with a
      <symptom code="hdgswi">rash</symptom> on his knee.
    </description>
  </event>
</record>
```

- Name/value pairs inside the element start tag
- Attribute values must be quoted with " " or ' '
- Spaces and special characters are supported

Empty Elements

- Have no content
 - may have attributes (usually do)
- Syntax
 - `<empty/>`
 - or `<empty></empty>`
 - or `<empty name="value"/>` (empty element with attributes)

```
<paragraph>  
  See <cite id="c1"/> for details.  
</paragraph>
```

- In this case, `cite` may have content generated by processing the document and finding information at the target specified in the `id` attribute

XML Processing Instructions

- Like comments, but for processors, not humans
- Syntax `<?target instruction?>`
- The target must be a valid XML name

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>  
<?mso-application progid="Word.Document"?>  
<wordDocument>  
...  
</wordDocument>
```

- Is that `<?xml` markup a processing instruction?

XML Declaration

- Declaration at head of document which specifies XML version, character encoding, and optionally some other things
- `<?xml` - allows parsers to interpret this as a declaration. Only place it is used.
- Processors can infer the character encoding from `<?xml`

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<book Author="Fred" PubDate="2000-04-01">
  <title>All About XML</title>
  <chapter Number="1">
    <paragraph type="block">
      Extensible Mark-up Language
    </paragraph>
  </chapter>
</book>
```

Why Use XML in Healthcare Systems?

- XML is a very useful way to represent healthcare information, because
 - Information used in healthcare can be highly structured (e.g. laboratory test results) or unstructured (e.g. referral letter)
 - XML provides a consistent way to represent both structured and unstructured data
 - Healthcare data can be generated by many different systems and devices
 - XML is a standard data format that is easily generated by almost any type of system or device
 - Healthcare data are often stored persistently and transferred between systems
 - XML can be stored in databases and also used directly as a message format for communication between systems

Semantic Structure

```
<labReport patientId="1234567890" specimenID="750853">
  <testResult date="2005-01-25-T12:15:37-09:00">
    <test>
      <testCode scheme="myCodes">42Hxx</testCode>
      <testName>Potassium</testName>
    </test>
    <measurement>
      <measurementValue>7.0</measurementValue>
      <units>mmol/L</units>
    </measurement>
    <referenceRange>
      <highValue>5.3</highValue>
      <lowValue>3.5</lowValue>
    </referenceRange>
  </testResult>
</labReport>
```

- Structured markup conveys meaning of data elements
- Clinical coding can be carried within the markup
- Various published standards can be used as the 'vocabulary' of elements to mark up the structure

Presentation Structure

```
<html>
  <h3>Lab Report</h3>
  <table>
    <thead>
      <title>Test Result</title>
    </thead>
    <tbody>
      <tr><td></td><th colspan="2">patientId 1234567</th>
        <th colspan="2">Specimen Id 1750853</th></tr>
      <tr><th>Potassium</th> <th colspan="2">Measurement</th>
        <th colspan="2">Reference Range</th></tr>
      <tr><td></td><td>Value</td><td>Units</td>
        <td>High Value</td><td>Low Value</td>
      </tr>
      <tr><td></td><td>7.0</td><td>mmol/L</td>
        <td>5.3</td><td>3.5</td></tr>
    </tbody>
  </table>
</html>
```

- Structure is used to define style of presentation only
- A common (XML) example is xHTML
- Some semantic information can be inferred from the structure

This document contains the same data as the previous one, but less information

Unstructured Information

```
<html>
  <p>Lab Report - Test Result</p>
  <p>For patient Id 1234567</p>
  <p>Specimen Id 1750853</p>
  <p>Potassium is 7.0 mmol/L</p>
  <p>(reference range: high 5.3,
    low 3.5)</p>
</html>
```

- Information captured as 'free text'
- Contains no useful structure
- Likely to exist in 'chunks' within other structured data

```
<doc>
  Lab Report - Test Result. For
  patient Id 1234567. Specimen
  Id 1750853. Potassium is 7.0
  mmol/L (reference range: high
  5.3, low 3.5)
</doc>
```

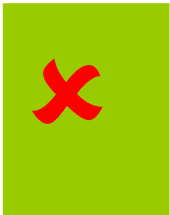
XML in Healthcare

- XML is used for
 - Storing and exchanging health records
 - Representing security and access control information
 - Configuration of systems, data sets, etc
 - Representing clinical knowledge
 - Both structured and unstructured information

Validation and Transformation of XML

Well-formed XML

- A well-formed XML document follows the syntax rules of XML and has...
 - a root element
 - matched start and end tags for all elements
 - Except empty elements with correct syntax
 - all attribute values quoted



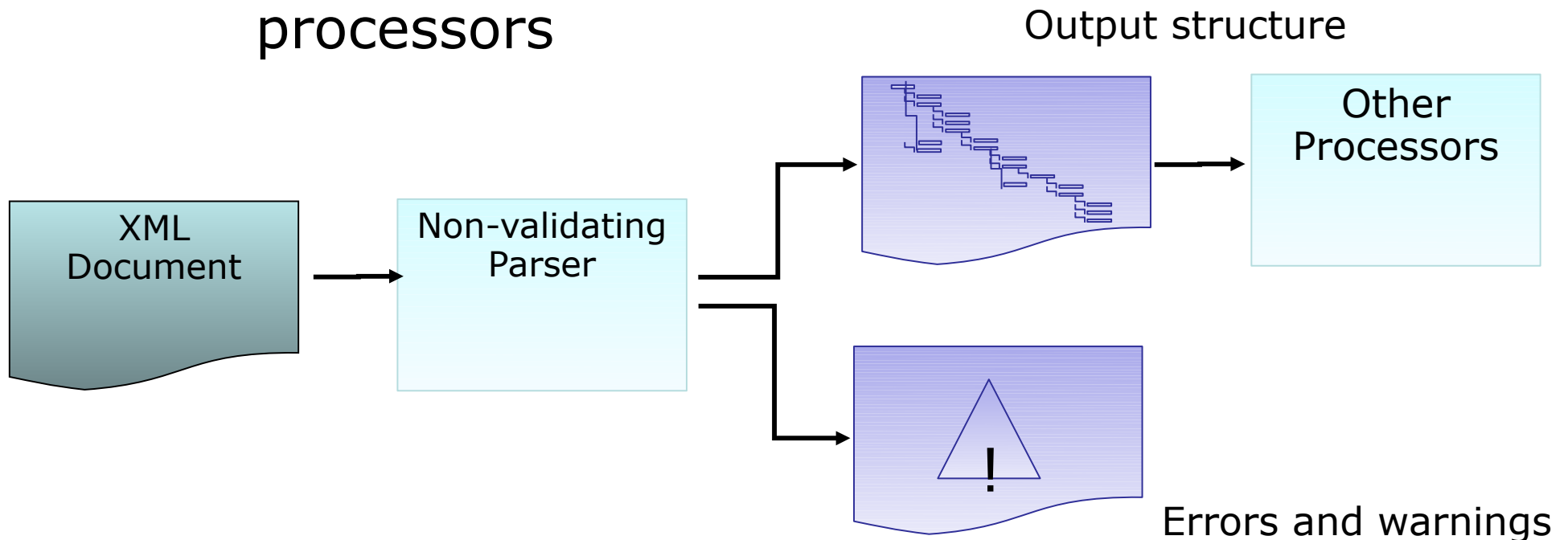
```
<book ISBN="1-2-3" Author=Fred PubDate="2000-04-01">
  <title>All About XML</title>
  <chapter Number="1">
    <title>What's in a Name?</title>
    <paragraph type="block">
      The <term abbrev="XML">Extensible
      Mark-up Language</term> should
      really have been called <abbrev>EML.
    </paragraph>
  </blob>
</book>
```

What is Parsing?

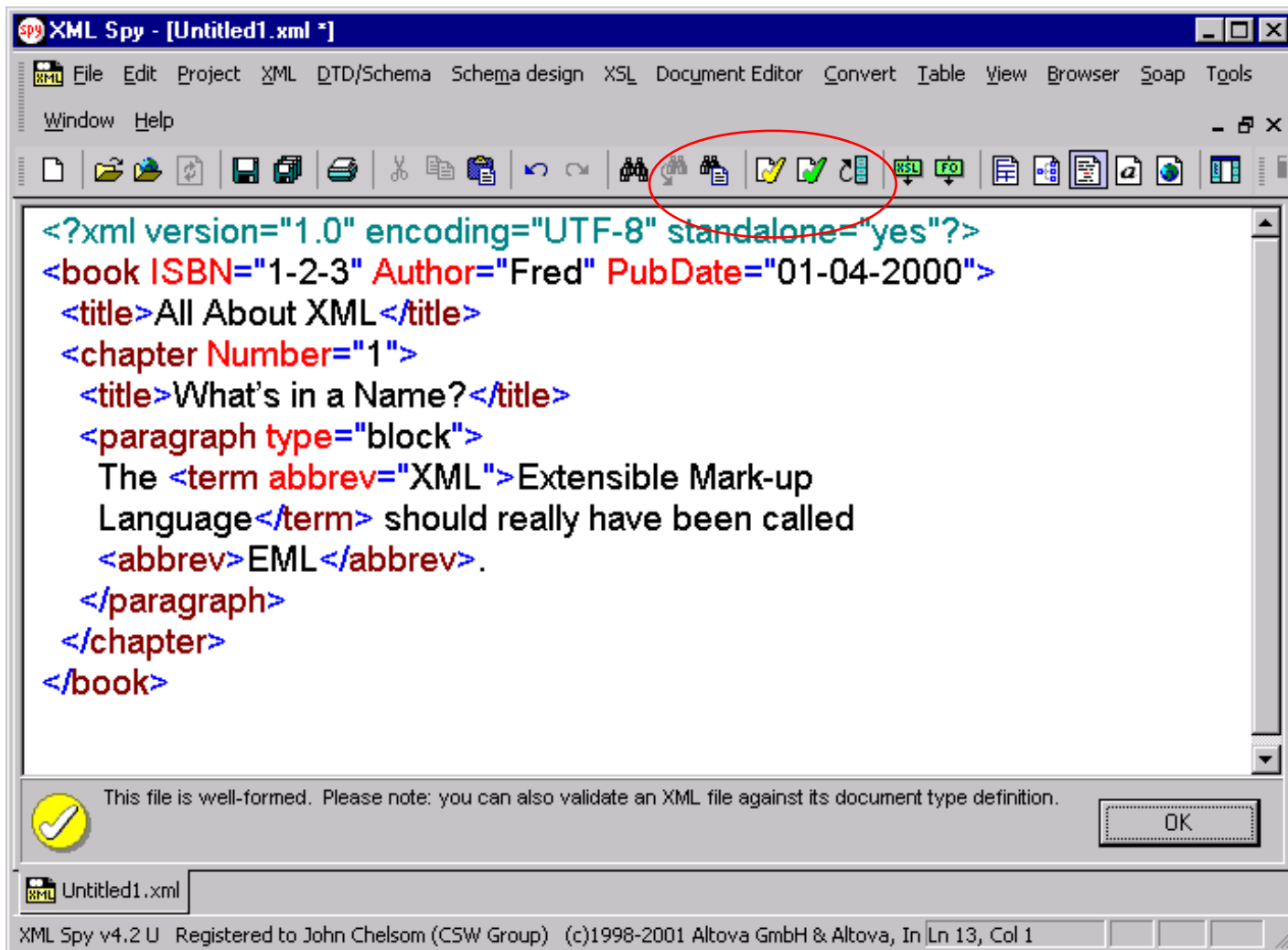
- Parsing = Checking the syntax of a statement
- Two forms of parser
 - Non-validating parser checks the structure is well-formed
 - Validating parser checks the structure matches a schema that defines
 - the mark-up that can be used for elements and attributes
 - the way in which they fit together (i.e. logical structure)

Non-validating parser

- Checks to see if document is well-formed
- Input is an XML document
- Outputs warnings and builds output tree
 - which can be passed on to other XML processors



Non-validating parser



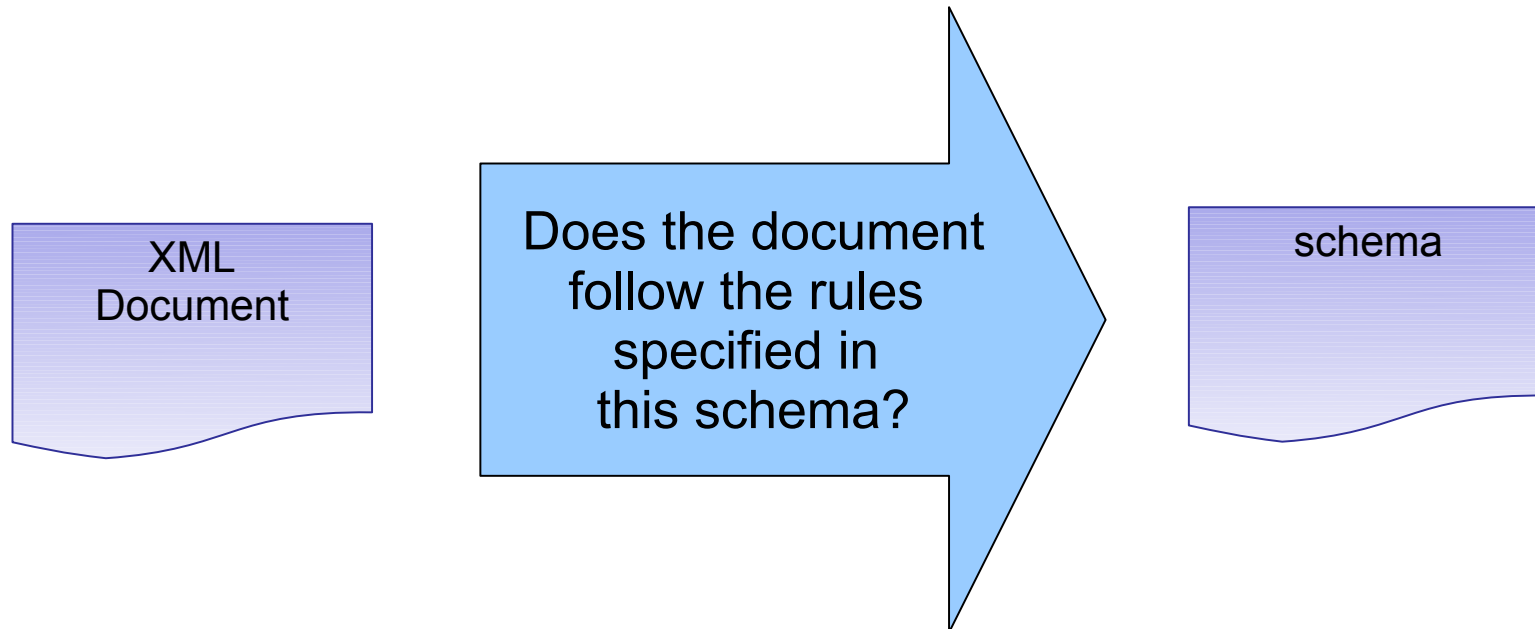
- Checks to see if document is well-formed
- Input is an XML document
- Outputs warnings and builds output tree
- which can be passed on to other XML processors

Introduction to Schema

- Schema: a set of rules which govern the elements and attributes which an XML document can or must have
 - e.g. a schema could contain the list of XHTML tags and define rules such as “an ‘img’ tag has no child elements and must have a ‘src’ attribute”

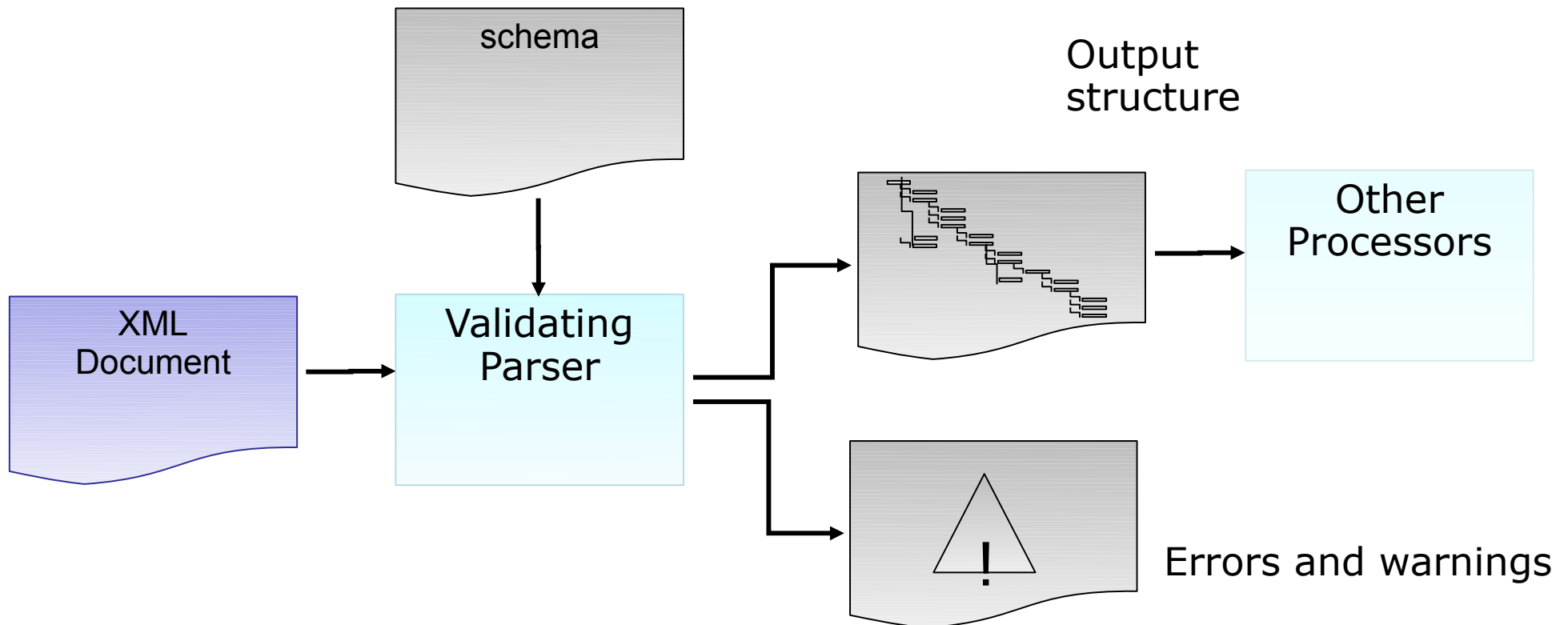
Validation

- A document which conforms to a schema (i.e. meets all the rules within it) is said to be valid
 - not the same as being 'well-formed'!

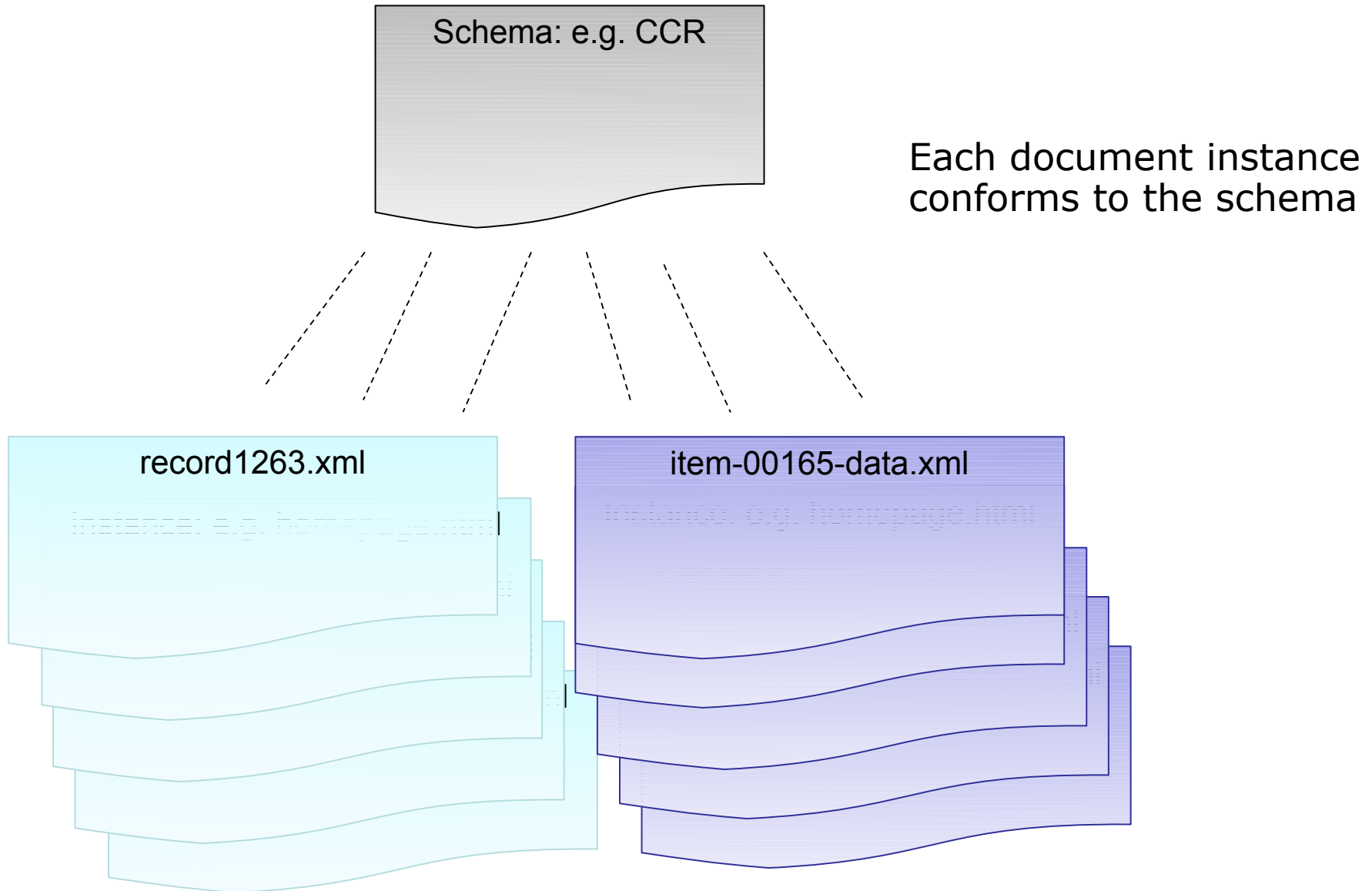


Validating Parser

- Checks to see if document is **well-formed** and **valid**
- Input is a **schema** and an **XML document instance**
- Outputs **errors/warnings** and builds **output tree**
 - which can be passed on to other XML processors

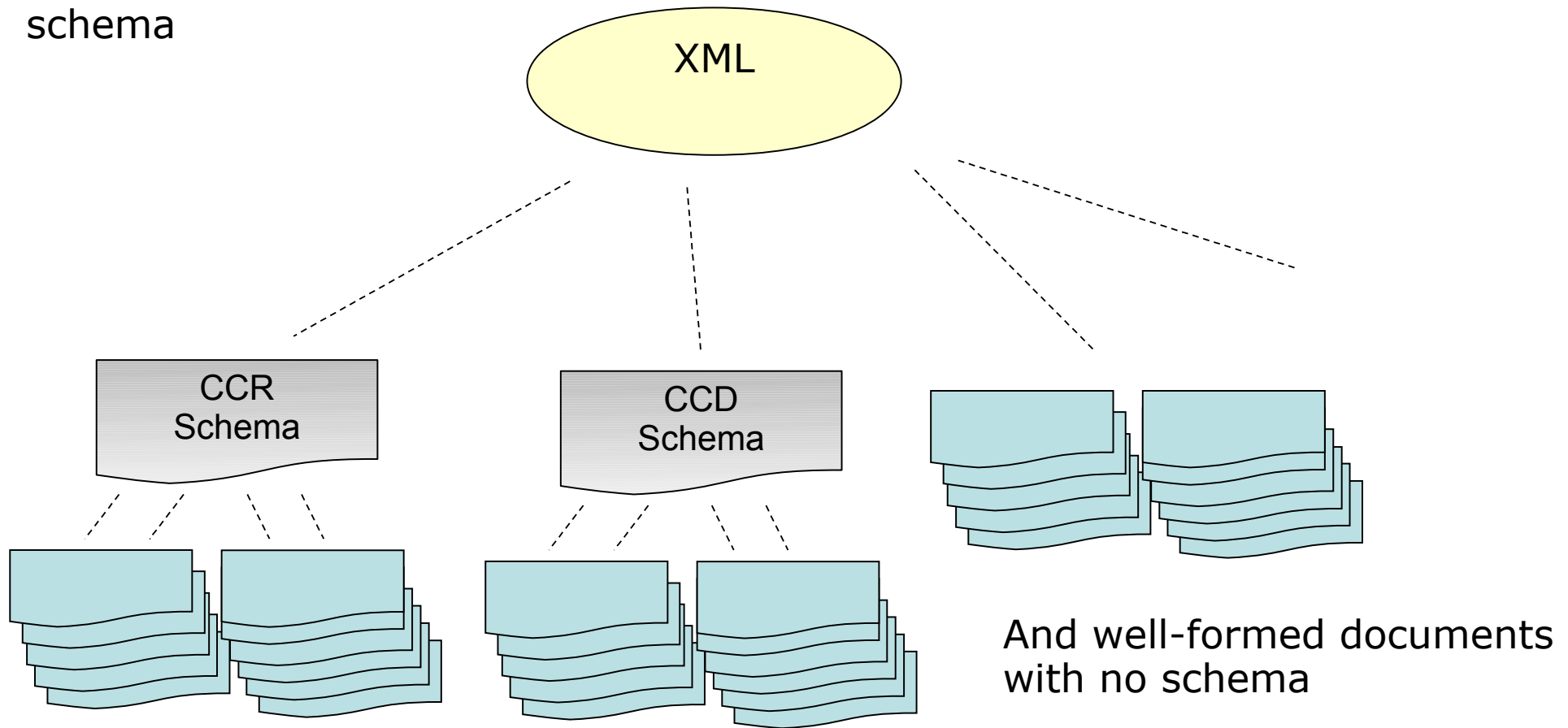


One Schema, Many Documents



XML is used for many schemas

XML is used to define schema



XML is also used to mark up document instances

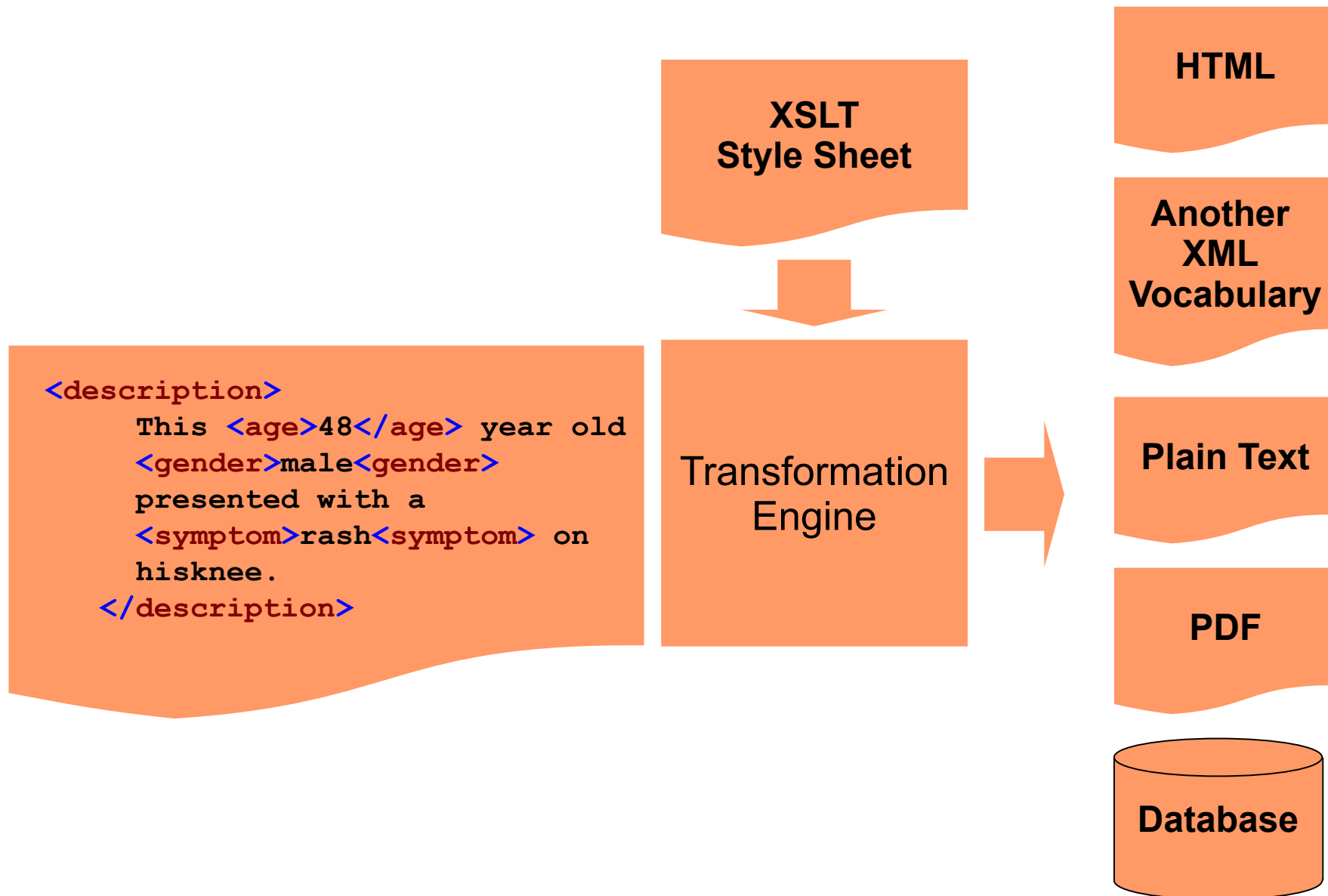
Several Different Schema Languages

Nothing is ever very simple with XML, especially when it comes to Schema

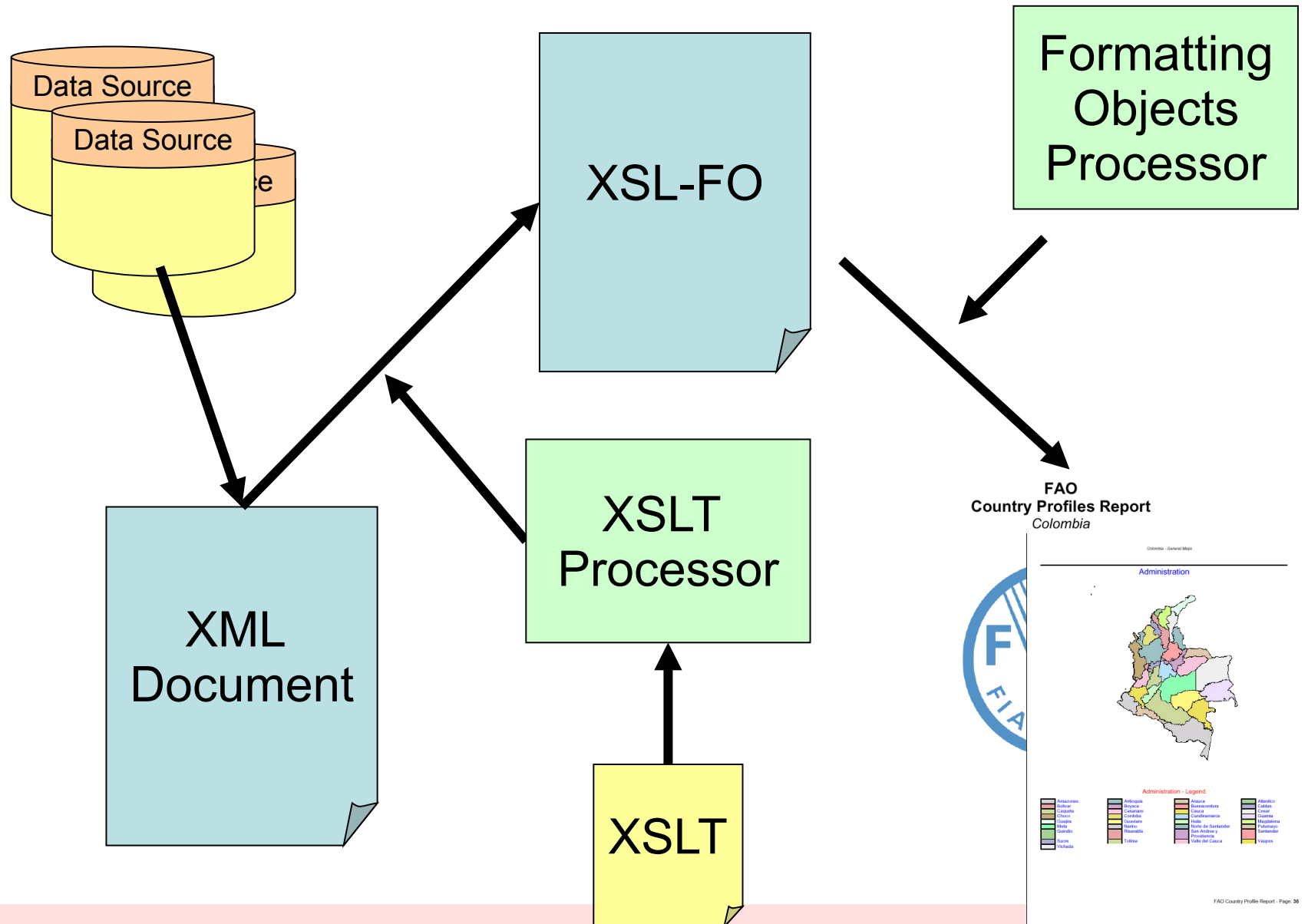
There are several different ways to define an XML Schema

- Document Type Definitions (DTDs)
- RELAX NG
- W3C XML Schema
- Others...
 - Schematron
 - etc

XML is Easy To Transform

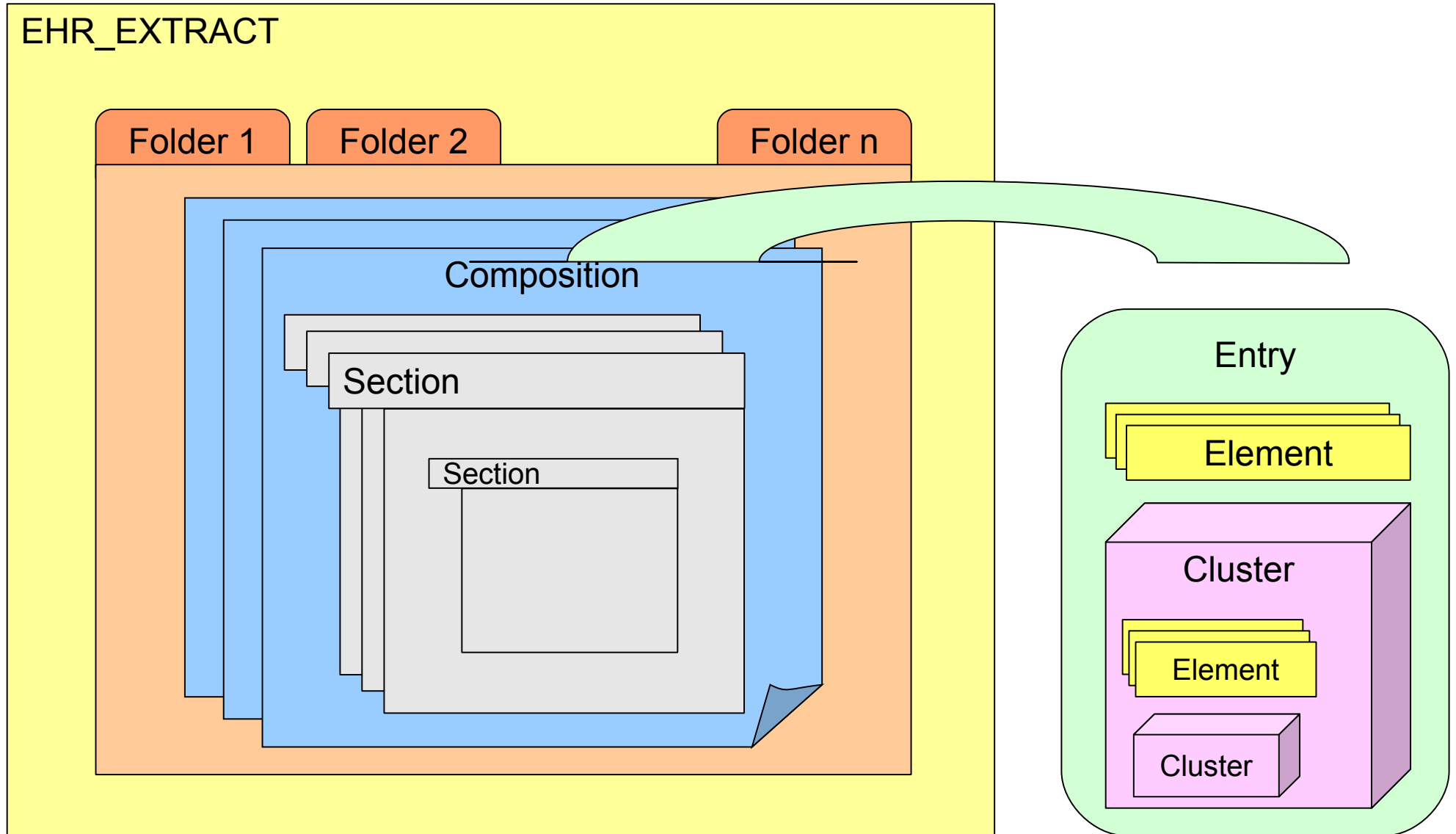


Generating Paginated Output



Electronic Health Records in XML

EN 13606 EHR Model



Definition of EHR_EXTRACT

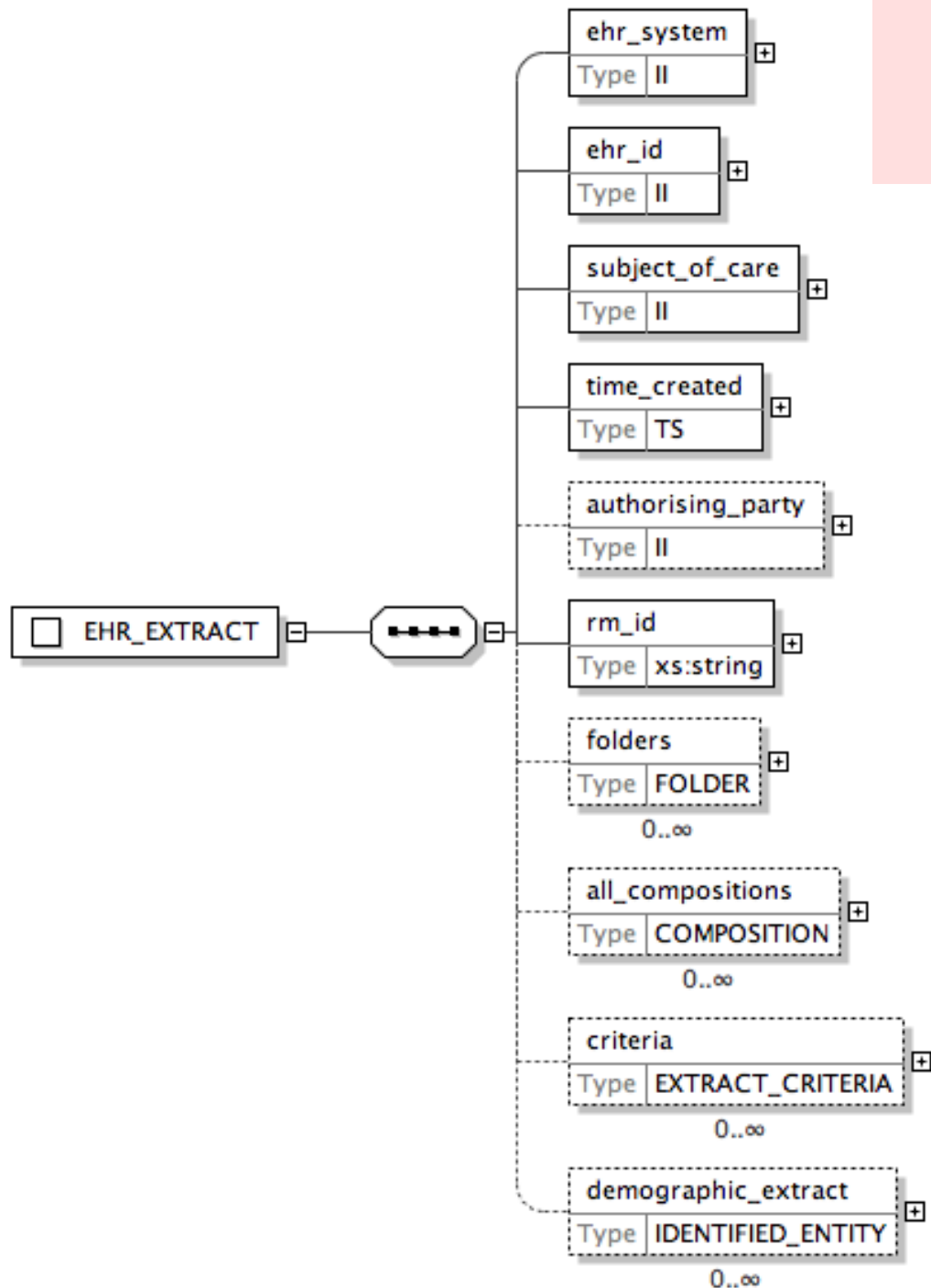
EHR HIERARCHY COMPONENT	DESCRIPTION	EXAMPLES
EHR_EXTRACT	The top-level container of part or all of the EHR of a single subject of care, for communication between an EHR Provider system and an EHR Recipient.	(Not applicable)
FOLDER	The high level organisation within an EHR, dividing it into compartments relating to care provided for a single condition, by a clinical team or institution, or over a fixed time period such as an episode of care.	Diabetes care, Schizophrenia, Cholecystectomy, Paediatrics, St Mungo's Hospital, GP Folder, Episodes 2000-2001, Italy.
COMPOSITION	The set of information committed to one EHR by one agent, as a result of a single clinical encounter or record documentation session.	Progress note, Laboratory test result form, Radiology report, Referral letter, Clinic visit, Clinic letter, Discharge summary, Functional health assessment, Diabetes review.
SECTION	EHR data within a COMPOSITION that belongs under one clinical heading, usually reflecting the flow of information gathering during a clinical encounter, or structured for the benefit of future human readership.	Reason for encounter, Past history, Family History, Allergy information, Subjective symptoms, Objective findings, Analysis, Plan, Treatment, Diet, Posture, Abdominal examination, Retinal examination.
ENTRY	The information recorded in an EHR as a result of one clinical action, one observation, one clinical interpretation, or an intention. This is also known as a clinical statement.	A symptom, an observation, one test result, a prescribed drug, an allergy reaction, a diagnosis, a differential diagnosis, a differential white cell count, blood pressure measurement.
CLUSTER	The means of organising nested multi-part data structures such as time series, and to represent the columns of a table.	Audiogram results, electro-encephalogram interpretation, weighted differential diagnoses.
ELEMENT	The leaf node of the EHR hierarchy, containing a single data value.	Systolic blood pressure, heart rate, drug name, symptom, body weight.

EN 13606 EHR Model in XML

- We can create our own vocabulary to represent the model in XML

```
<?xml version="1.0" encoding="UTF-8"?>
<ehr_extract>
  <folder>
    <composition>
      <section>
        <entry>
          <element>Some data here</element>
          <cluster>
            <element>Some data here</element>
          </cluster>
        </entry>
      </section>
    </composition>
  </folder>
</ehr_extract>
```

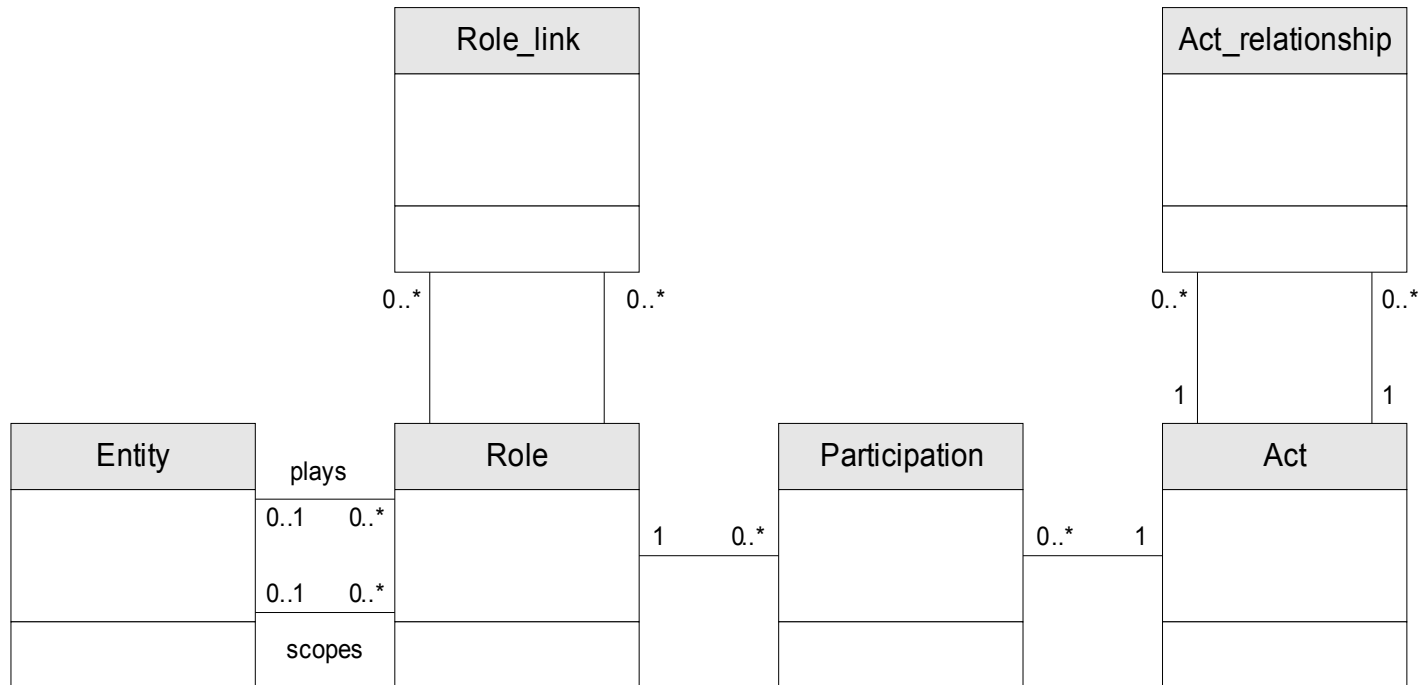

EN 13606 Schema



Health Level 7 (HL7) www.hl7.org

- HL7 is an ANSI-accredited Standards Developing Organization operating in the healthcare arena
 - “a framework (and related standards) for the exchange, integration, sharing, and retrieval of electronic health information.”
- Object modelling is fundamental in the HL7 V3 methodology
 - captures the critical data and semantics associated with a healthcare activity.
- The HL7 methodology uses key elements of the Unified Modelling Language – **UML**.
- Reference Information Model (RIM)
 - The HL7 information model from which all other information models and messages are derived
 - HL7 defines generic healthcare information classes at the Reference Information Model (RIM) level

HL7 Logical Model



- HL7 – Reference Information Model
 - Has six core classes

HL7 Message – Content

```
<observationEvent>
  <id root="2.16.840.1.113883.19.1122.4" extension="1045813"
    assigningAuthorityName="GHH LAB Filler Orders"/>
  <code code="1554-5" codeSystemName="LN"
    codeSystem="2.16.840.1.113883.6.1"
    displayName="GLUCOSE^POST 12H CFST:MCNC:PT:SER/PLAS:QN"/>
  <statusCode code="completed"/>
  <effectiveTime value="200202150730"/>
  <priorityCode code="R"/>
  <confidentialityCode code="N"
    codeSystem="2.16.840.1.113883.5.25"/>
  <value xsi:type="PQ" value="182" unit="mg/dL"/>
  <interpretationCode code="H"/>
  <referenceRange>
    <interpretationRange>
      <value xsi:type="IVL_PQ">
        <low value="70" unit="mg/dL"/>
        <high value="105" unit="mg/dL"/>
      </value>
      <interpretationCode code="N"/>
    </interpretationRange>
  </referenceRange>

```

.....

Problems With HL7

- problems of documentation
- the steep learning curve
- problems of implementation (lack of v3 systems)
- problems of quality of the HL7v3 artefacts and methods
- external problems concerning the relationship of the HL7 V3 corpus to the outside world
- problems of internal consistency of the HL7 RIM
- software problems- is HL7 V3 able to support the economic production of maintainable, reusable and extendible software?
- functional problems concerning the fitness of v3 for its claimed purposes
- technical problems concerning the quality of HL7v3 with respect to accepted practice in information modelling, object-orientation, software engineering and data management.
- problems of usability of the V3 domain models (RMIMs etc)
- problems of appropriateness
- terminology problems relating to the ability of HL7 V3 to integrate properly with clinical terminologies such as SNOMED CT;
- problems with the HL7 business model
- problems with HL7 governance processes

Prof Barry Smith, University of Buffalo
<http://hl7-watch.blogspot.com>

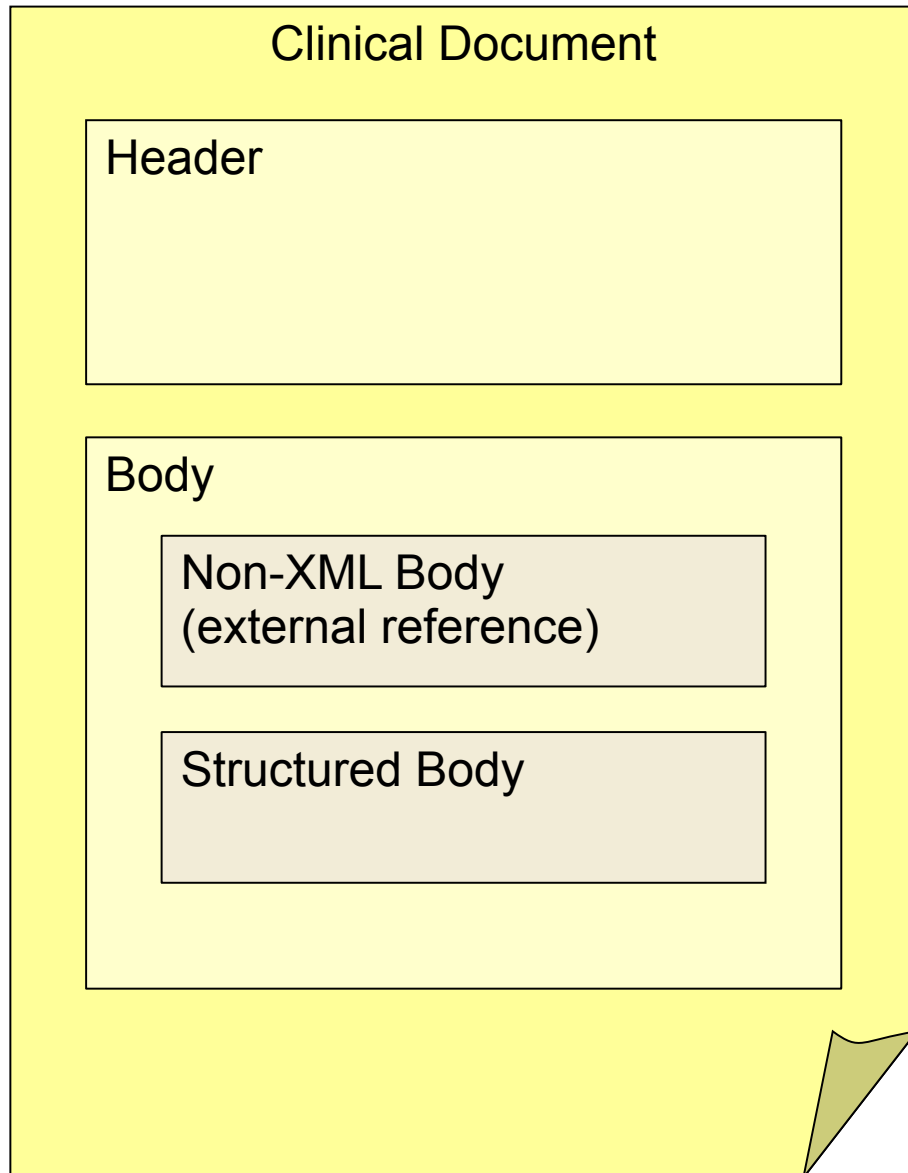
Bring on HL7 CDA

- HL7 v3 messages and development process has been criticised for being too complex and focussed primarily on messaging for integration of structured clinical information, in an environment where much information is of a much more unstructured nature.
- The HL7 Clinical Document Architecture (CDA) provides a more flexible framework for representing both structured and unstructured information using a document-based, rather than message-based, container.

Clinical Document Architecture

- HL7 CDA can model many types of clinical documents
 - With structured and unstructured representations
- Two releases of the standard
 - ANSI/HL7 CDA R1.0-2000
 - ANSI/HL7 CDA R2.0-2005
- A specification for document exchange using
 - XML
 - the HL7 Reference Information Model (RIM)
 - Version 3 methodology
 - and vocabulary (SNOMED, ICD, local,...)

CDA – Logical Structure



At a minimum, CDA documents contain a CDA header comprised of the required information elements as defined by the CDA Specification, and a body.

The body may consist of a resolvable reference to an external “blob” (e.g. tiff image, MS Word file, etc.) or employ the simple XHTML-like encoding scheme of the CDA Narrative Block that offers minimal but consistent structure for the capture of encounter information.

CDA – Simple XML Example

Patient: Henry Levin , the 7th

MRN: 123

Birthdate: September 24, 1932

Sex: Ma

Consultant:

Created On: Oct

Clinical Document

History of Present Illness

Henry Levin, the 7th is a 67 year old male referred for further a management. Onset of asthma in his teens. He was hospitalized and already twice this year. He has not been able to be weaned o the past several months.

Authored by: Robert Dolin , MD on April 7, 2000

Healthcare Providers

Bernard Wiseman , Sr. ()
21 North Ave
Burlington, MA 01803
WP: (999)555-1212

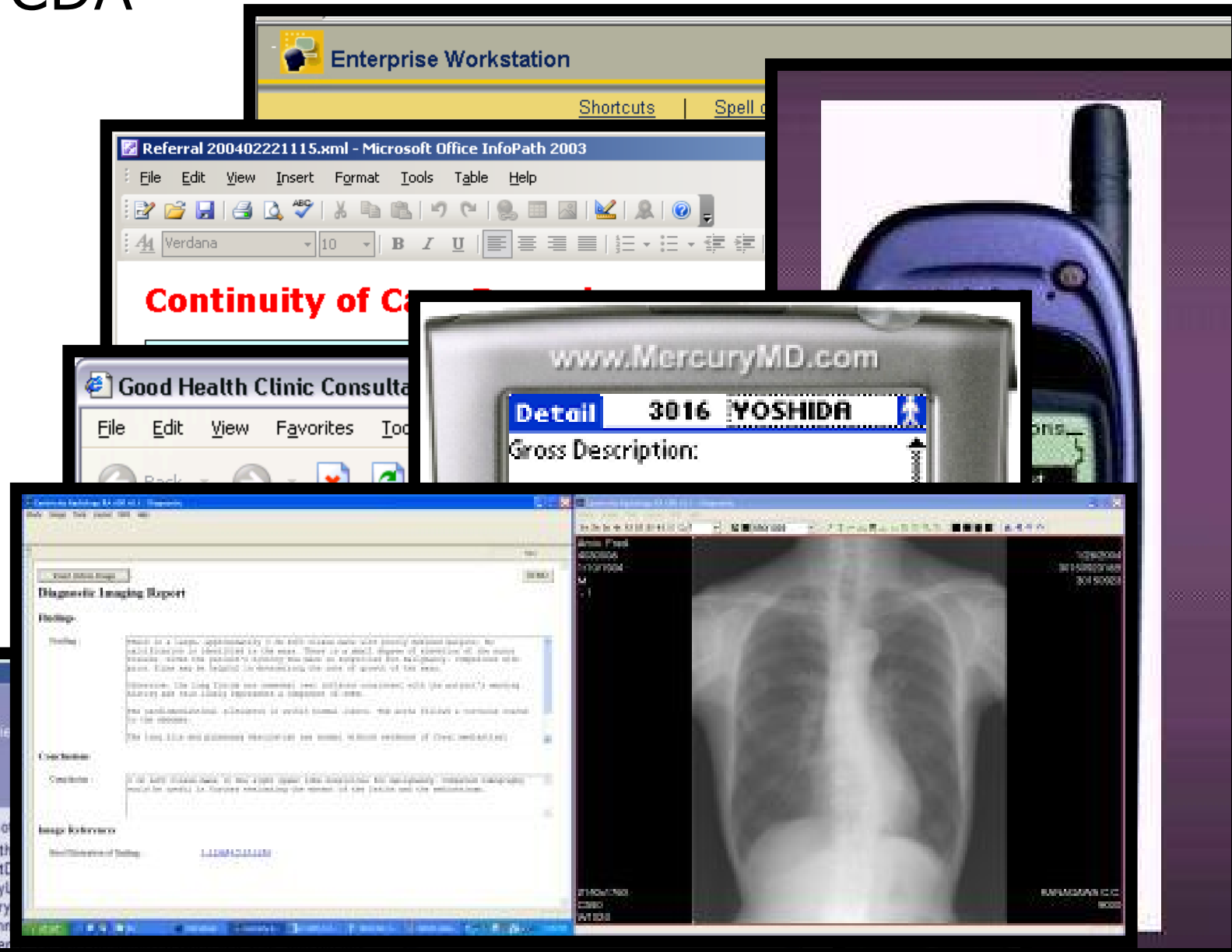
Support Providers

Insurance Information

```
-<ClinicalDocument xsi:schemaLocation="urn:hl7-org:v3 CDA.xsd">
- <!--
.....
CDA Header
.....
-->
<typeId root="2.16.840.1.113883.1.3" extension="POCD_HD000040"/>
<id root="2.16.840.1.113883.19.4" extension="c266"/>
<code code="11488-4" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC" displayName="Consultation note"/>
<effectiveTime value="20051014224411-0500"/>
<confidentialityCode code="N" codeSystem="2.16.840.1.113883.5.25"/>
+ <recordTarget></recordTarget>
- <author>
  <time value="2000040714"/>
  - <assignedAuthor>
    <id extension="KP00017" root="2.16.840.1.113883.19.5"/>
    - <assignedPerson>
      - <name>
        <given>Robert</given>
        <family>Dolin</family>
        <suffix>MD</suffix>
      </name>
    </assignedPerson>
    - <representedOrganization>
      <id root="2.16.840.1.113883.19.5"/>
    </representedOrganization>
    </assignedAuthor>
  </author>
+ <custodian></custodian>
+ <documentationOf></documentationOf>
- <!--
.....
CDA Body
.....
-->
- <component>
- <structuredBody>
  - <component>
    - <section>
      <code code="10164-2" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC"/>
      <title>History of Present Illness</title>
      - <text>
        - <content styleCode="Bold">
          Henry Levin, the 7
          <sup>th</sup>
        </content>
        is a 67 year old male referred for further asthma management. Onset of asthma in his
        <content revised="delete">twenties</content>
        <content revised="insert">teens</content>
        . He was hospitalized twice last year, and already twice this year. He has not been able to be weaned off steroids for the past several months.
      </text>
    </section>
  </component>
</structuredBody>
</component>
</ClinicalDocument>
```

CDA: A Document Exchange Specification

- This is a CDA
- and this
- and this
- and this
- and this
- and this
- and this



Problems with HL7 CDA

- HL7 has been criticised for being overly complex and not suitable for real world modelling of electronic health records
- Specific criticisms include
 - Repeated use of overly abstract data structures
 - Underspecified implementation, including lack of a normative schema
 - Ambiguous data types: Data can be represented in multiple ways in a CDA document.
 - Steep and long learning curve
- As a result, alternative standards have been created to represent health records (especially personal health records) as XML
 - CCR
 - CCD
 - Dossia

Standards Rivals to HL7 CDA

- Large scale Personal Health Records initiatives in the US have looked for simpler modelling techniques than HL7
- Google Health supports a subset of the Continuity of Care Record (CCR) developed by the ASTM
- The Continuity of Care Document (CCD) was developed by HL7 and ASTM, as a constraint of the CDA
- Microsoft HealthVault claims to support a subset of both CCR and CCD
- CDA and CCR are often seen as competing standards
- CCD brings the HL7 and ASTM standards making bodies into collaborative standards development
- The Dossia PHR initiative is run by major US employers, providing portable health records for their employees
- Dossia is open source and includes its own XML representation

Continuity of Care Record

ASTM Committee E31 on Healthcare Informatics develops standards related to the architecture, content, storage, security, confidentiality, functionality, and communication of information used within healthcare and healthcare decision making, including patient-specific information and knowledge.

<http://www.astm.org/COMMIT/COMMITTEE/E31.htm>

- The Continuity of Care Record was developed by ASTM Committee E31

Scope of the CCR

The primary use case for the CCR is to provide a snapshot in time containing the pertinent clinical, demographic, and administrative data for a specific patient.

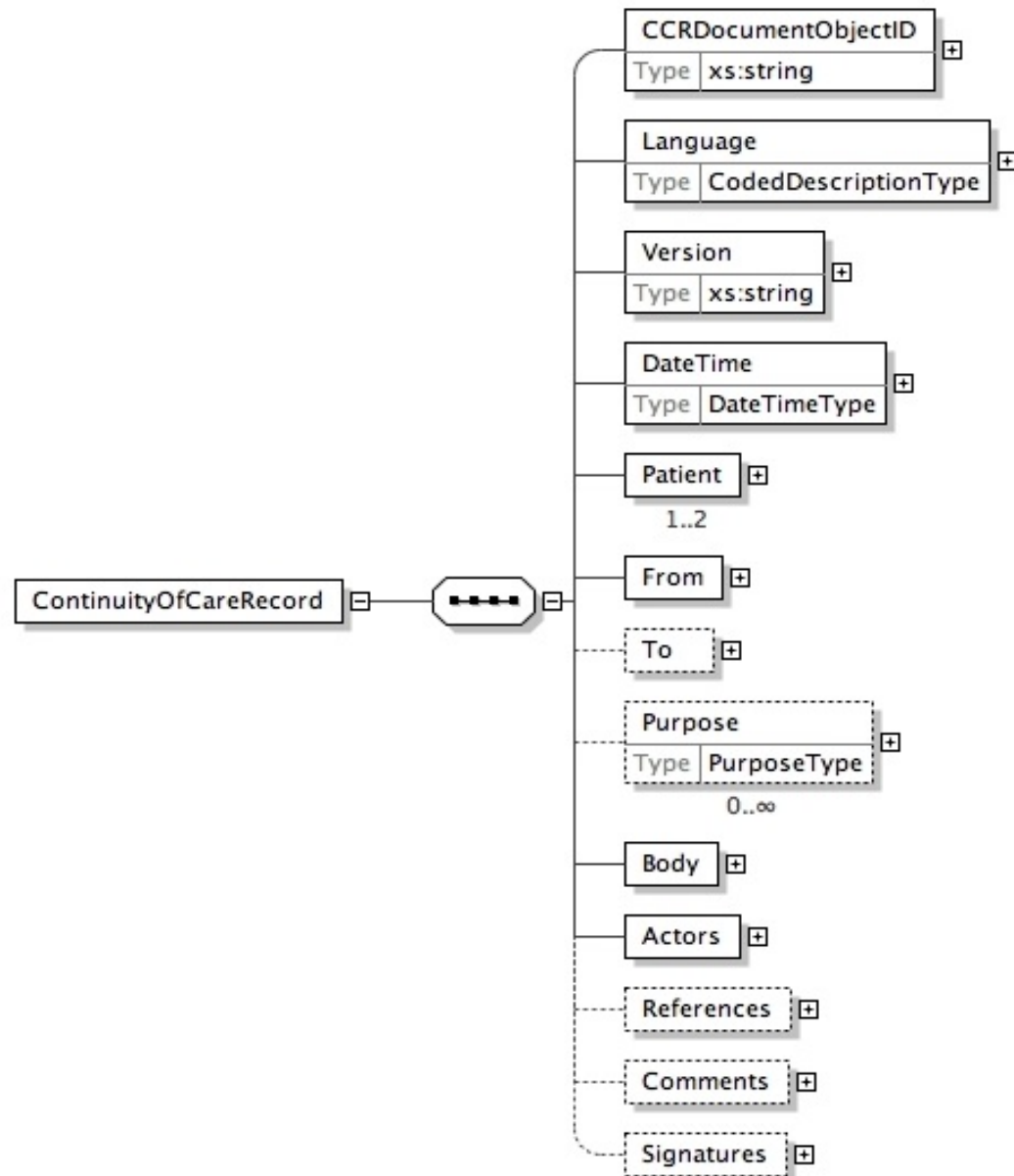
- The Continuity of Care Record (CCR) is a core data set of the most relevant administrative, demographic, and clinical information facts about a patient's healthcare, covering one or more healthcare encounters
- It provides a means for one healthcare practitioner, system, or setting to aggregate all of the pertinent data about a patient and forward it to another practitioner, system, or setting to support the continuity of care.
- The CCR data set includes a summary of the patient's health status (for example, problems, medications, allergies) and basic information about insurance, advance directives, care documentation, and the patient's care plan.

CCR Structural Design

- The following summary of the CCR structure is taken from the CCR Specification
 - The CCR is an XML document that is defined as a Document Object.
 - The CCR Document Object is constructed from a set of discrete XML building blocks, which are defined as Data Objects.
 - The Data Objects are contained within Sections, such as Medications, Immunizations, Problems, and Procedures, in the CCR Document Object.
 - Each discrete Medication, Immunization, Problem, Procedure represents a discrete data object within the CCR.
 - A Medication List or Problem List, therefore, represents a list of discrete Data Objects, within a specific Section and within the CCR Document Object (the CCR itself).

CCR Top Level Structure

- Root document element is ContinuityOfCareRecord
- CCRDocumentObjectID
 - Identifier for the document
- Language, Version, DateTime
 - Meta data about the record
- Patient
 - References actor representing the patient







Google Health

Firefox File Edit View History Bookmarks Tools Window Help
Google Health
https://www.google.com/health/p/
Most Visited Rail Enquiries Google BBC Wikipedia Google Analytics FTP Team Ivan Eleven Informatics Google Webmaster Co-op Bank Movie Database
Do you want Firefox to remember this password? Remember Never for This Site Not Now
john.chelsom@googlemail.com | [New Features](#) | [Take our survey!](#) | [Settings](#) | [Help](#) | [Sign out](#)

Google Health BETA Search the web
[Read about health topics »](#)

- john.chelsom**
- [Notices](#)
 - [Drug interactions](#)
 - [Profile details](#)
 - [Age, sex, height...](#)
 - [Conditions](#)
 - [Medications](#)
 - [Allergies](#)
 - [Procedures](#)
 - [Test results](#)
 - [Immunizations](#)
 - [Add to this profile](#)
 - [Import medical records](#)
 - [Explore health services](#)
 - [Share this profile](#)
 - [See who has access](#)
 - [Medical contacts](#)
 - [Find a doctor](#)
- Caring for someone?
[Add a profile for them](#)

-  **[Add to this Google Health profile](#)**
Learn about your health issues and find helpful resources
-  **[Import medical records](#)**
Copy and get automatic updates of your records
-  **[Explore online health services](#)**
Find online tools for managing your health
-  **[Find a doctor](#)**
Search by name, location, and specialty

Profile summary [Print](#)

[Age, sex, height...](#)
47 years old
Male
161 pounds
5 feet 9 inches
23.8 body mass index (BMI)

[Procedures](#)
Appendectomy

Developers API

The screenshot shows a Firefox browser window displaying the Google Health Data API developer page. The browser's address bar shows the URL <http://code.google.com/apis/health/>. The page title is "Google Health Data API - Google Code". The browser's menu bar includes "File", "Edit", "View", "History", "Bookmarks", "Tools", "Window", and "Help". The browser's toolbar shows various icons for navigation and search. The page content includes a search bar with the text "e.g. 'ajax apis' or 'open source'", a navigation menu with links for "Home", "Docs", "FAQ", "Articles", "Group", and "Terms", and a main heading "Google Health Data API". The main content area is divided into several sections: "What is the Google Health Data API?", "How do I start?", "Create New Medical Records", "Read Profile Data", "Google Data Protocol", "CCR Standard", "Become a third-party service, a data provider, or both:", "Featured Video", "Google Data APIs Blog", and "Community".

Google Health Data API

Home Docs FAQ Articles Group Terms

What is the Google Health Data API?

The Google Health Data API allows applications to view and send health data in the form of Google Data feeds. Here are some of the things you can do and what you should know:

- Create New Medical Records**
Add medical information to a user's profile by [posting notices](#) containing CCR data. Notices are messages that can contain certain XHTML elements, CCR data, or both. For example, notices might be sent to remind users to pick up a prescription, or they might contain lab results.
- Read Profile Data**
With the right permissions, your application can [read a user's profile](#) or [query for medical records](#) that match particular criteria. Use the results to provide personalized functionality based on the data.
- Google Data Protocol**
The Health Data API uses the same underlying [protocol](#) as the other Google Data APIs. If you're already familiar with it, see the [Getting Started Guide](#).
- CCR Standard**
The API supports a [subset of the CCR](#) ("Continuity of Care Record"), a standard format for transferring snapshots of a patient's medical history.

How do I start?

1. Read our [Getting Started Guide](#).
2. Follow the developer [Best Practices](#).
3. Get familiar with the [Google Data Protocol](#).
4. Join the [developer forum](#). Become a member of the community to start asking questions!
5. Ready to start coding? Read the Health Data API [Developer's Guide](#) and take a look at our [sample code](#).

Become a third-party service, a data provider, or both:

[Third-party Services Overview](#): offer personalized functionality based on the data in a user's Google Health profile.

[Data Providers Overview](#): organizations that provide primary health information that can be imported to a user's profile.

Have you already implemented our APIs? Take our [survey](#) and let us know how it went!

Featured Video

The featured video is a YouTube video showing a man speaking on stage. The video player includes a play button, a progress bar, and a volume control icon. The video title is "Date of Birth no longer sent in CCR?".

Google Data APIs Blog

[Friends, Activites and You - Become a Socialite the .NET Way](#)
Mar 5, 2009
Posted by Frank Mantek, Google Data APIs Team The new .NET SDK has been released and

Community

Community [Date of Birth no longer sent in CCR?](#)

Google CCR Reference

Google Health Data API [Home](#) [Docs](#) [FAQ](#) [Articles](#) [Group](#) [Terms](#)

Health Data API
[Getting Started](#)
[Developer's Guide \(v2.0\)](#)
[Reference Guide \(v2.0\)](#)
[API Changelog](#)
[Libraries and Code](#)
Previous Versions
CCR Reference
[<Actor> \(Body\)](#)
[<Actor> \(Footer\)](#)
[<ActorObjectID> \(Footer\)](#)
[<Actors>](#)
[<ActorID>](#)
[<ActorRole>](#)
[<Alert>](#)
[<Alerts>](#)
[<Body>](#)
[<CCRDDataObjectID>](#)
[<CCRDDocumentObjectID>](#)
[<Code>](#)
[<CodingSystem>](#)
[<DateOfBirth>](#)
[<DateTime>](#)
[<Description>](#)
[<Direction>](#)
[<Directions>](#)
[<Dose>](#)
[<ExactDateTime>](#)
[<Form>](#)
[<Frequency>](#)
[<Fulfillment>](#)
[<FulfillmentHistory>](#)
[<Function>](#)

Google Health Data API CCR Reference

Google supports a subset of the [Continuity of Care \(CCR\)](#) standard. This "CCR Reference" documents only those aspects of the CCR standard that Google supports.

A CCR entry has three components: a "Header," a "Footer" and one component that is the **<Body>** element. The first two sections of this document describe the **Header** and the **Footer**. The third section contains an alphabetical reference for all the remaining supported CCR elements, including **<Body>**.

- [Header](#)
- [Footer](#)
- [CCR Reference](#)

New **Mapping CCR Elements to the Google Health UI**

For information on how specific CCR elements map to the Google Health UI, see each section under [Mapping CCR Elements to the Google Health UI](#):

- [Allergies](#)
- [Conditions](#)
- [Immunizations](#)
- [Medications](#)
- [Procedures](#)
- [Test Results](#)
- [Age, sex, height \(Demographics\)](#)

Below is the tree diagram for supported CCR elements. In this diagram, elements to the right on a particular branch in the tree are extensions of the elements to their left.

Note: Click on an element name in this diagram to jump to its entry in the reference section.

```
graph LR; CCRDocumentObjectID --> Language; CCRDocumentObjectID --> Version; CCRDocumentObjectID --> DateTime; CCRDocumentObjectID --> FunctionalStatus; CCRDocumentObjectID --> Problems; CCRDocumentObjectID --> SocialHistory; FunctionalStatus --> Function; Problems --> Problem; SocialHistory --> SocialHistory; Function --> Type; Function --> Description; Function --> Status; Problem --> DateTime; Problem --> Description; Problem --> Status; Problem --> Source; SocialHistory --> Type;
```

Continuity of Care Document

The Continuity of Care Document (CCD) specification is an XML-based markup standard intended to specify the encoding, structure and semantics of a patient summary clinical document for exchange.

The CCD specification is a constraint on the HL7 Clinical Document Architecture (CDA) standard. The CDA specifies that the content of the document consists of a mandatory textual part (which ensures human interpretation of the document contents) and optional structured parts (for software processing).

The structured part is based on the HL7 Reference Information Model (RIM) and provides a framework for referring to concepts from coding systems such as from SNOMED and LOINC.

http://en.wikipedia.org/wiki/Continuity_of_care_document

- The Continuity of Care Document was developed by HL7 with input from ASTM Committee E31

Dossia

Dossia is a Personal health record service offered by some of the largest employers in the United States.

Dossia differs from traditional tethered PHR services, by providing user access to health information regardless of health plan, employer or physician. Users also have the ability to download their full record, in electronic form, at any time.

<http://en.wikipedia.org/wiki/Dossia>

- www.dossia.org
- Uses open source software
 - Published API and XML Schema



AT&T
Applied Materials
BP America
Cardinal Health
Intel
Pitney Bowes
sanofi-aventis
Walmart
Abraxis BioScience
Vanguard Health Systems

Pros and Cons of CCR/CCD/Dossia

- Advantages of CCR, CCD, Dossia:
 - focussed on practical needs of EHR/PHR
 - XML-based, so can be easily transformed
 - developed in conjunction with supporting software
 - reference implementations in widespread use
- Disadvantages of CCR, CCD, Dossia:
 - although 'standards' they have a proprietary feel about them
 - reference implementations are not rigorous in their support
 - not seen as being easy to extend
 - compete with each other (technically, politically)

References and Further Reading

References

Dolin RH, Alschuler L, Boyer S et al. (2006). HL7 Clinical Document Architecture, Release 2. J Am Med Inform Assoc. 13(1):30-9.

Further Reading

For XML standards see <http://w3.org>

For good tutorials on XML see <http://w3schools.com>

For list of XML editors see
http://en.wikipedia.org/wiki/Comparison_of_XML_editors