

## Unification of CytometryML, DICOM and Flow Cytometry Standard

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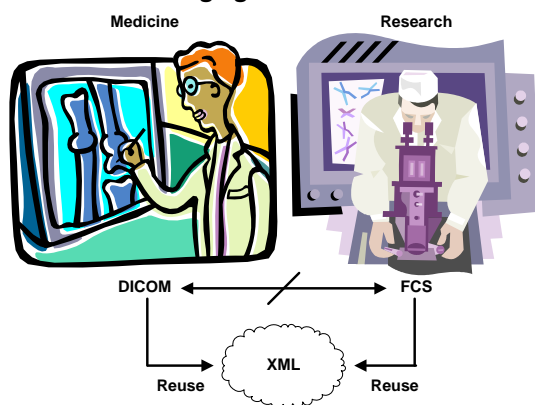
Pathology Informatics  
 Boston

Health Information Technology (HIT) Standards  
 Committee Meeting, Top Three Findings  
 Implementation Starter Kit Hearing

Goal is to achieve higher levels of health  
 information exchange by

1. Creating clear interoperability standards
2. Disseminating knowledge of increasing  
 availability of tools and utilities
3. Clarifying the requirements of Meaningful  
 Use for each stage of compliance

### Bridging two standards



### Reuse Existing Standards by Translation into XML

- DICOM) (<http://medical.nema.org/>)
  - Pathology Standard for Digital Microscopy
- \* Supplements (Bruce Beckwith et al.):
  - 122: Specimen Module and Revised Pathology SOP (Service-Object-Pair) Classes
    - Specimen, Bar Code, Sampling, Staining
  - 145: Whole Slide Microscopic Image IOD (Information Object Definition) and SOP Classes
    - ❖ Includes images, Image pyramid storage, Pixel Matrix (x,y,z), focus, Optical Path (incomplete), etc.

### Reuse Continued

- DICOM Part 18 Web Access to DICOM Persistent Objects (WADO) & its Supplement 148 Web Access to DICOM Persistent Objects”, WADO to Web Services (Out for comment).
  - Retrieval into XML by generic mechanism for transposing DICOM Header information from binary to XML
  - Metadata or extract of them based on XPath
- XML data types for DICOM Persistent Objects

### Reuse Continued

- Flow Cytometry Standard, FCS 3.1.
  - New names for the data-types were created and data-types from other CytometryML schemas were reused.
  - ZIP data file format
  - Instrument Description

### Gating-ML

<http://flowcyt.sourceforge.net/gating/>

- Gating (Geometric structures for scene segmentation)
- Compensation (Reading values to specific measurements)
- Transformations (linear, log, combinations)

### Why Extensible Markup Language (XML)?

- Since the DICOM and FCS data representations (syntax) are unique, special interface software must be written to interface each to the other and to other software and to hardware.
- XML is ubiquitous
  - XHTML (Web applications) is XML.
  - A very large amount of data is stored in XML.
  - XML has been interfaced to virtually all commercial software including databases and can be used in forms and documents.

### DICOM Reuse in CytometryML

<http://www.newportinstruments.com/>

- Nomenclature, design, documentation, and data-types.
- Tables provide the composition of DICOM data structures (sequences). These become XML complexTypes.
- Individual data elements often become XML simpleTypes, which can either be elements and/or attributes.

### DICOM Reuse in CytometryML Cont.

- The documentation for individual DICOM elements becomes XML documentation elements.
- New cytometry data-types are composed in part of DICOM types.
- CytometryML consists of 74 schema
  - Most of which have been validated and are used
  - 14 XML test documents

### Example

```
<annotation><documentation>An identifier of the of
the order for the Study. From Table C.7-3
GENERAL STUDY MODULE ATTRIBUTES in the draft
supplement 122.</documentation></annotation>
<complexType name="Accession_Number_Type">
<simpleContent>
<extension base="dicom:Short_String_Type">
<attribute name="Tag" type="dicom:Tag_Type"
use="optional" fixed="00080050"/>
<attribute name="VR" type="dicom:VR_Type"
use="optional" fixed="SH"/>
</extension>
</simpleContent>
</complexType>
```

### DICOM Organization

1 Patient (Medical Record)

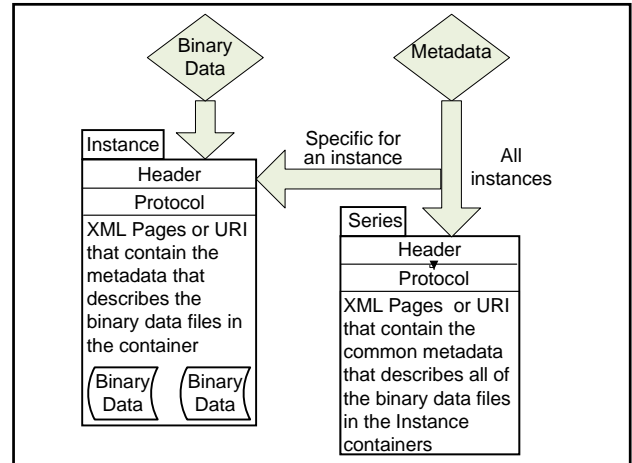
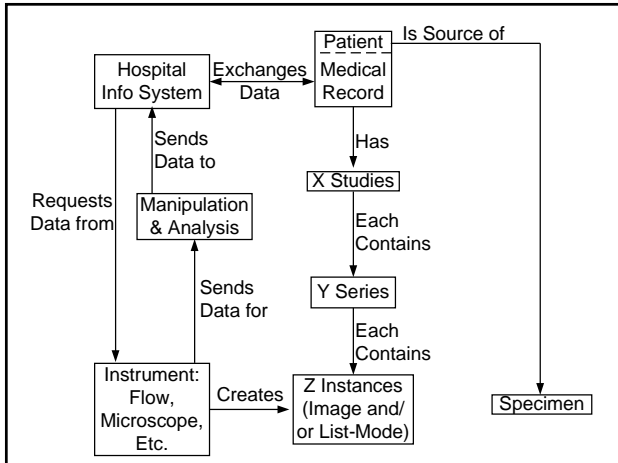
X Studies

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Y Series

Z Instances

The items below the line are the part of the CytometryML schemas that will be discussed.

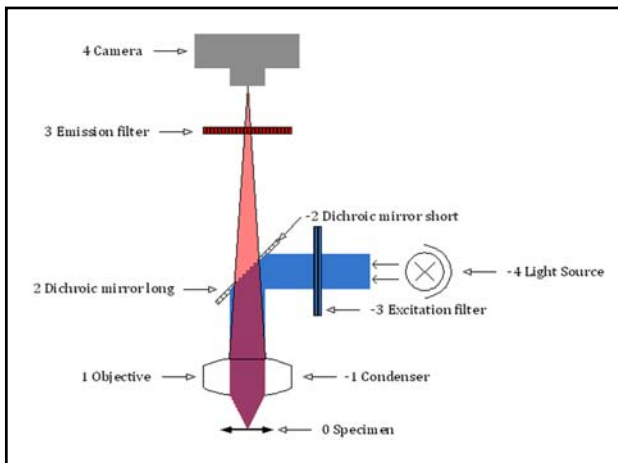


**Channel\_Info Elements (simplified)**

Elements	Example of Values
Analyte Reporter	Anti5Brdu
Parameter	FL1-A
Channel Number	3
Measurement	Fluorescence
Long Name	AlexaFluor
Optical Path	Described below
Statistics	CV= 3.0%
Quality Assurance	Bead-based alignment setup

**Optical Path Definition**

- Positions of excitation optical elements have negative values;
- Positions of imaging elements have positive values.
- The position of the slide or flow cell that holds the specimen is 0.
- The optics go in a positive direction towards the detector and a negative direction towards the light source.



**Conclusions**

- ❖ Maximizing reuse including
  - ❖ Designs
  - ❖ Documentation
- Will**
- ❖ Improve International Medical Informatics
  - ❖ infrastructure and
  - ❖ facilitate interoperability
- ❖ Increasing safety and minimizing development costs

### Conclusions...

- ❖ It has been possible with XML Schema Definition Language (XSDL) 1.1 to
  - ❖ maximize readability,
  - ❖ create a modular structure, and
  - ❖ strongly typed, reusable data-types.

### Conclusions...

- Much of FCS & a significant part of DICOM relevant to pathology has been translated into XSDL and then into XML.

### Hopes

- ❖ This infrastructure improvement should benefit the patients while significantly decreasing health care costs.
- ❖ The combination of the knowledge of pathologists and cytometrists should exceed the sum of its parts.

### Future

- DICOM should be extended in XML and evolve into an XML based standard.
1. Make XML be a DICOM Coding Scheme