



# DICOM Educational Conference Brisbane, Australia

SEPTEMBER 24-25, 2018

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CHANGE HEALTHCARE

# DICOMWeb<sup>™</sup> and FHIR<sup>®</sup>

DICOM EDUCATIONAL CONFERENCE  
SEPTEMBER 2018

## About Me

- Elliot Silver
  - Sr. Analyst, Standards & Interoperability; Change Healthcare, Imaging & Workflow Solutions
  - Over 12 years in Medical Imaging software product development
  - Co-chair, DICOM WG-20/HL7 II joint workgroup (Integration of Information Systems/Imaging Integration)
    - Contributed to FHIR Imaging resources
  - Past co-chair, IHE IT Infrastructure Technical Committee
  - M.Sc. Computer Science, University of Victoria (Canada); B.Sc. University of Guelph (Canada)

# Formalities

- DICOM® is a registered trademark of NEMA; DICOMWeb™ is a trademark of NEMA.
- FHIR® and the FLAME DESIGN are registered trademarks of HL7 and used with the permission of HL7.

# What is the HL7 FHIR Standard?

- Result of HL7 Fresh Look task force
  - “What would healthcare exchange look like if we started from scratch using modern approaches?”
- Addresses perceived deficiencies in existing HL7 standards
  - V2: Product of a by-gone era
  - V3: Too complex, little traction
  - CDA: Too much variability
- FHIR targets
  - Broader sharing across organizations
  - Mobile, web, cloud environments
  - Integration in days, not months

# What is HL7 FHIR?

- **F**ast
  - Focus on design and implementation efficiency
- **H**ealthcare
  - Don't try to cover other domains
- **I**nteroperable
  - Systems should just work together
- **R**esources
  - Fundamental building blocks

```
<Patient xmlns="http://hl7.org/fhir">
  <id value="31415"/>
  <identifier>
    <use value="usual"/>
    <label value="MRN"/>
    <system value="http://www.goodhealth.org/ids/mrs"/>
    <value value="123456"/>
  </identifier>
  <name>
    <family value="Levin"/>
    <given value="Henry"/>
  </name>
  <gender value="male"/>
  <birthDate value="1932-09-24"/>
  <careProvider>
    <reference value="Organization/2"/>
    <display value="Good Health Clinic"/>
  </careProvider>
  <active value="true"/>
</Patient>
```

# Advantages of FHIR

- HTTP and REST
- Improved interoperability
  - Profiles
  - Capabilities
  - Extensibility
- Data element-level access (not document)
- Query model (not stream)



# Marching Towards Standardization

- Targeting releases every ~18 months
- (Draft) Standard for Trial Use
  - No normative content
- Release 4
  - Partial normative components: XML/JSON; REST API; Infrastructure; Patient, Observation resources
- Resources assigned a FHIR Maturity Model level
  - FMM 0 (draft) through 5 (normative candidate)

Release	Publication Date
Draft 1	2012/05
DSTU 1	2014/09
DSTU 2	2015/10
STU 3	2017/03
Release 4	2018/12 (est.)
Release 5	2020/09?



## Why DICOM and FHIR?

- Increasing need for integration of the imaging and information system workflows
  - Patient-centered care
  - Cross-institutional care
  - Enterprise imaging
  - Machine Learning/Artificial Intelligence

## Using FHIR

- [http://server/Patient?family=Menace&given=Dennis&\\_revinclude=ImagingStudy.patient](http://server/Patient?family=Menace&given=Dennis&_revinclude=ImagingStudy.patient)
  - Return all patients with given name Dennis, family name Menace, and any ImagingStudy resources referring to those patients
- <http://server/ImagingStudy?patient=998015&modality=CT&started=gt2008>
  - Return all ImagingStudy for a specific patient of CT modality started in 2008 or later
- More examples and exercises in later session

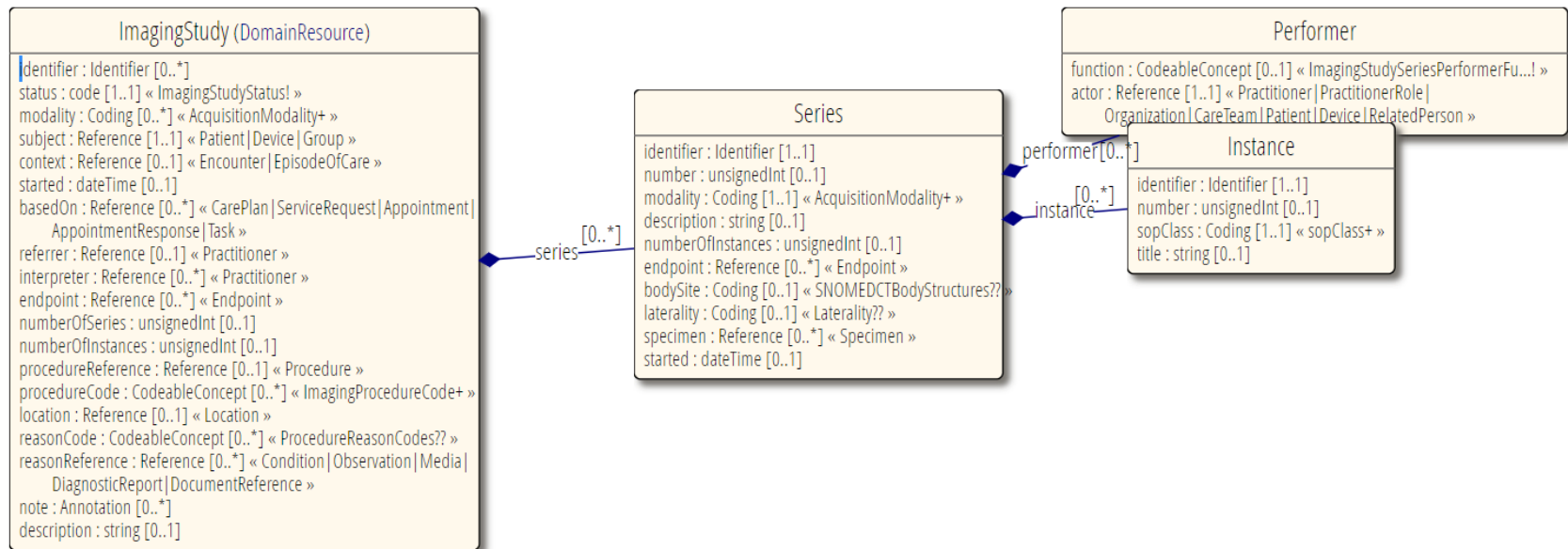
# Imaging-related Resources

Resource	Description
<b>ImagingStudy</b>	<b>Main DICOM Study/Series/Instance information; DICOMweb endpoints</b>
Media	Non-DICOM clinical image/audio/video; DICOMWeb renderings
Procedure	Planned or performed procedure details
ServiceRequest	Planned or actual order
Observation	Measurements, simple assertions
DiagnosticReport	Coded and textual findings and interpretation
Communication	Information exchange, e.g. critical results notification
Endpoint	Network endpoint, e.g., DICOMWeb server

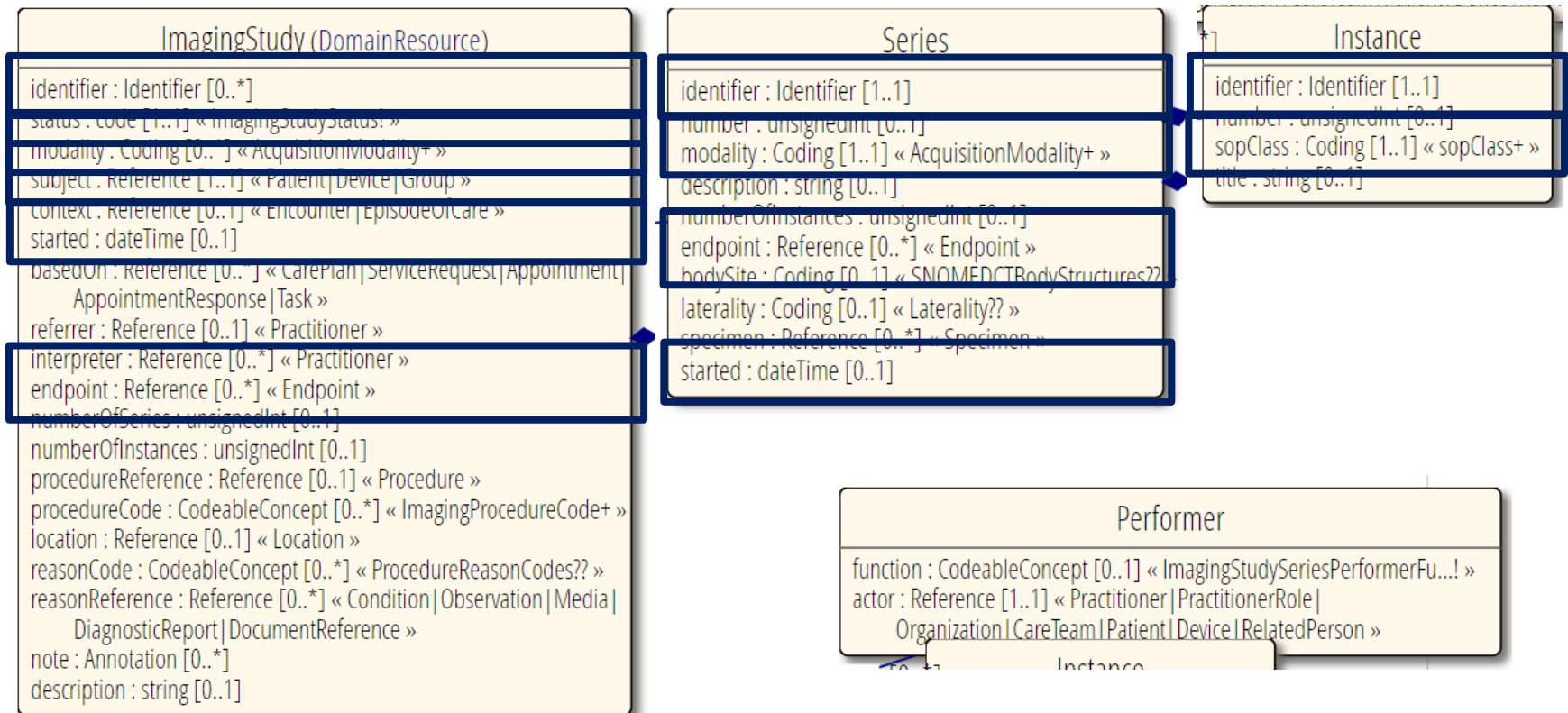
# ImagingStudy Design

- Goals:
  - DICOM for imaging
  - FHIR for the non-imaging medical record
  - Clear division of responsibilities/minimize overlap
  - Enable use of imaging information by non-DICOM systems
  - Encourage web access (DICOMWeb)
- Assumptions:
  - Images reside on a DICOM archive
  - Images accessed through WADO-RS or WADO-URI
- Key use cases:
  - “Simple” image display
  - Analytics and summary information
  - Enable advanced uses (QIDO-RS)

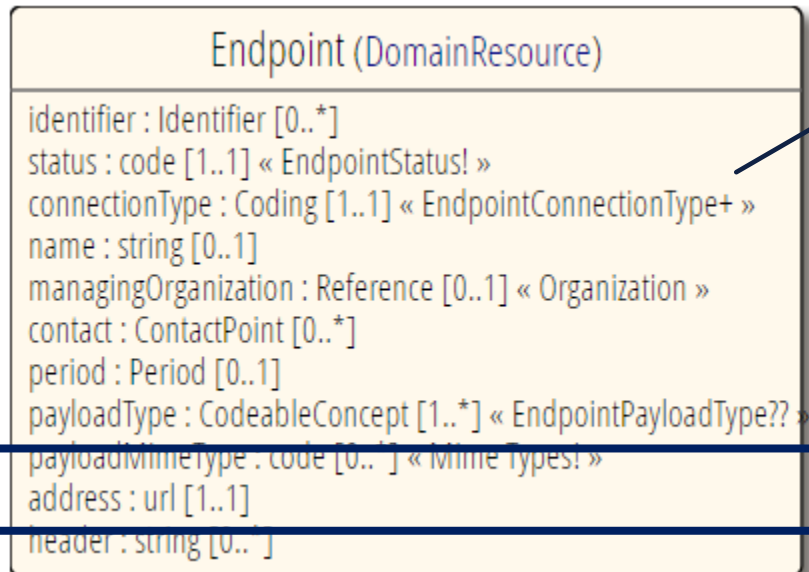
# FHIR ImagingStudy Structure



# FHIR ImagingStudy Structure



# Endpoint Resource



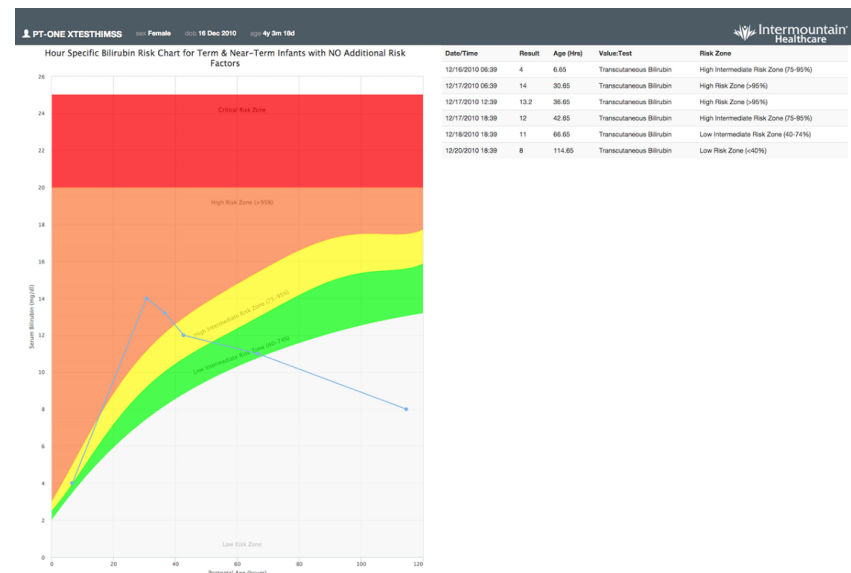
- Imaging Types:
- dicom-wado-uri
  - dicom-wado-rs
  - dicom-qido-rs

Based on the type, the base URL can be combined with the UIDs to form a request for retrieval

`http://server.org/wadors/studies/1.2.3/series/4.5.6/instances/7.8.9`

# SMART-on-FHIR

- FHIR standardizes (EMR) data access
- SMART-on-FHIR adds:
  - UI plug-in model
  - Authentication and launch context
- Enables:
  - App stores
  - Best of breed
  - Narrow market solutions (e.g. specialist, departmental)



Intermountain Healthcare "Bilirubin Chart" App. Image credit: SMARTHealthIT.org



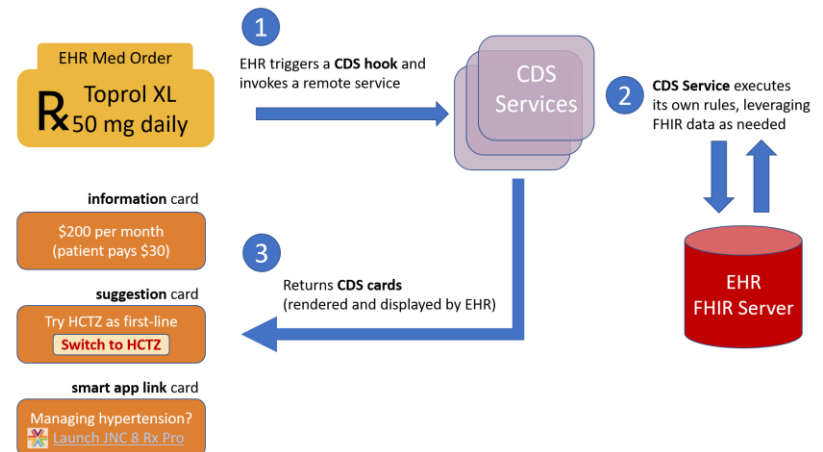
# SMART-on-FHIR



Boston Children's Hospital "Pediatric Growth Chart" App. Image credit: Cerner

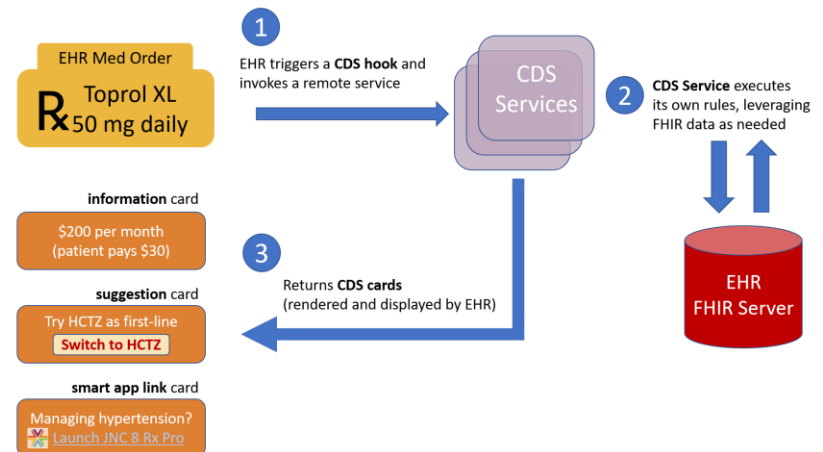
# CDS Hooks

- Defines an API for invoking CDS services from a hosting app (typically an EMR)
- Open hook event list
  - Basic events defined
- Supporting FHIR resources:
  - Hook standard context resources
  - Service-specific “pre-fetched” context
  - Service queried content



# CDS Hooks

- Types of responses:
  - Information only card
  - Suggestion card
  - App launch card
- Suggestion contains text and computable representation.



# FHIRCast

- Simplified, web-aware context switching
- Reduces need for per application pair integration APIs.
- Applications use FHIR subscriptions to receive notification of context switch
- Open context events list
  - Basic context events defined, including switch-imaging-study

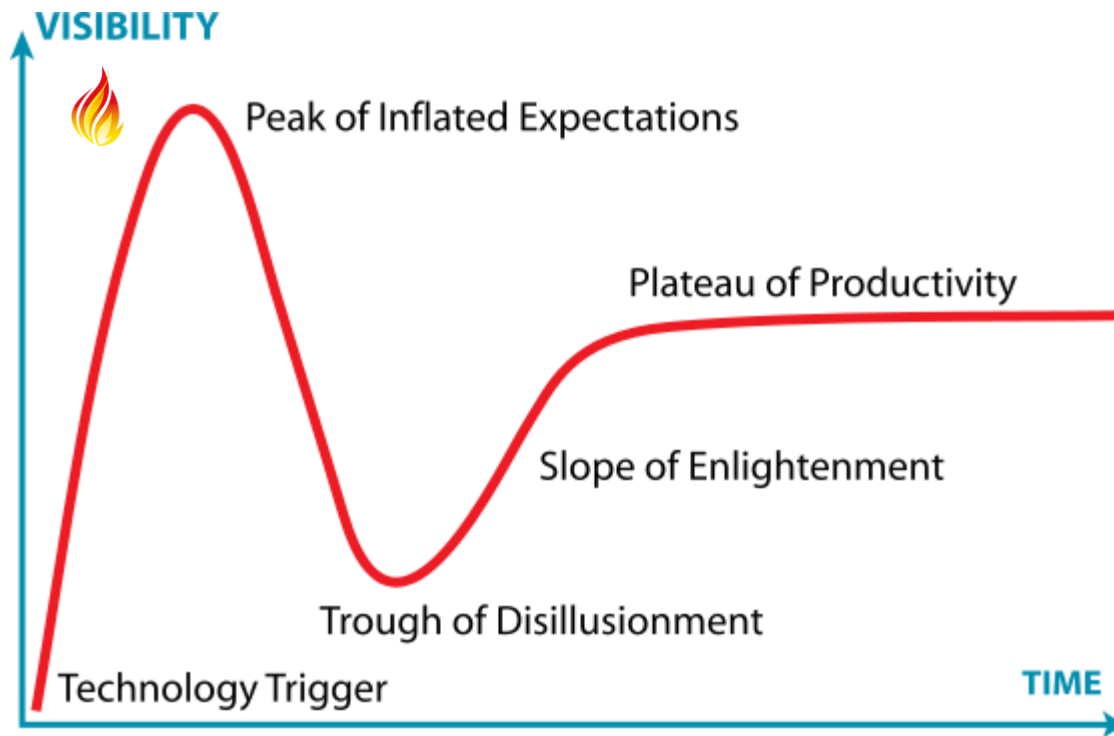
## Improvements on alternatives:

SMART-on-FHIR	Only supports launch, not follow context
HL7 CCOW	Requires separate Context Manager; two-phase commit

## Evolution of HL7 Standards vs. DICOM

<b>HL7 FHIR</b>	<b>DICOMWeb</b>
HL7 V2, V3 does not address evolving environment	Traditional DICOM networking (DIMSE) does not address evolving environment
Add new REST-based capabilities	Add new REST-based capabilities
<b>New modern data model</b>	<b>Maintain existing data model</b>
Potential information loss of on round-tripping between standards	Full fidelity on round-tripping
Questionable access to historical data	Full access to historical data
Complex to add FHIR interfaces to existing systems	Simpler to add DICOMweb interfaces to existing systems
<b>Revolution</b>	<b>Evolution</b>

# Great expectations



Gartner Hype Cycle. Image credit: Wikipedia

## Conclusion

- FHIR is the emerging standard from HL7
- DICOM and HL7 are working together
  - Bringing imaging information to the widest audience
  - Respecting each other's strengths
  - DICOM used for imaging-centric activities
  - FHIR used for information-centric activities
- FHIR enables new capabilities
  - Greater range of devices
  - Query model
  - Greater interoperability
  - SMART-on-FHIR
  - CDS Hooks
  - FHIRCast

# Questions?

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- HL7® FHIR®  
<http://hl7.org/fhir/>
- DICOMweb™  
Standard  
<http://diciomstandard.org/current/output/html/part18.html>