HL7 FHIR & NMDP

Bob Milius

FHIR Topics

- What I learned from FHIR Connectathons
  - Creating resource instances
  - Creating transactions
- FHIR for Architects
- Where does FHIR fit in NMDP?
- Biomarker Proposal

HL7 Working Group Meeting & FHIR Connectathon

May 7-13, 2016 Montreal, Canada

Bob Milius

Bioinformatics Research

Lunch & Learn June 16, 2016

Health Level 7 International

- Non-profit, ANSI-accredited healthcare Standards Developing Organization (SDO)

- *"HL7 provides standards for interoperability that improve care delivery, optimize workflow, reduce ambiguity and enhance knowledge transfer among all of our stakeholders, including healthcare providers, government agencies, the vendor community, fellow SDOs and patients"*

What HL7 is and isn't

- Does NOT dictate how to build applications or present data
- NOT a software application

- IS a framework to enable independent systems to communicate with each other
- IS a "book of rules" with thousands of pages

HL7 Work Groups

- Anatomic Pathology
- Anesthesia
- Application Implementation and Design
- Architectural Review
- Arden Syntax
- Attachments
- Biomedical Research Integrated Domain Group
- Board Motions
- Child Health
- Clinical Decision Support
- **Clinical Genomics**
- Clinical Interoperability Council
- Clinical Quality Information
- Clinical Statement
- Community Based Collaborative Care
- Conformance & Guidance for Implementation/Testing
- Domain Experts Steering Division
- Education
- Electronic Health Records
- Electronic Services and Tools
- Emergency Care
- FHIR Governance Board
- FHIR Infrastructure
- FHIR Management Group
- Financial Management
- Foundation and Technology Steering Division
- Governance and Operations
- Health Care Devices
- Healthcare Standards Integration
- HL7 Foundation Task Force / Advisory Council
- HL7 Membership and Strategic Resources Committee
- Imaging Integration
- Implementable Technology Specifications
- Infrastructure and Messaging
- International Council
- International Mentoring Committee
- Learning Health Systems
- Mobile Health
- Modeling and Methodology
- Nomination Committee
- Orders and Observations
- Organizational Relations
- Patient Administration
- Patient Care
- Pharmacy
- Policy Advisory Committee
- Process Improvement
- Project Services
- Public Health and Emergency Response
- Publishing
- Recognition and Awards
- Regulated Clinical Research Information Management
- Security
- Services Oriented Architecture
- Structure and Semantic Design Steering Division
- Structured Documents
- Technical and Support Services Steering Division
- Technical Steering Committee
- Templates
- Terminology Authority
- US Realm Steering Committee
- Vocabulary

62 active groups, Sep 2015

HL7 Working Group Meetings

- When?
  - September (Plenary)
  - January
  - May (International)
- What happens?
  - Focused Standards Development
  - WG to WG communication
  - Face-to-face networking
  - Education
  - No abstracts/posters
  - No vendor booths

HL7 WGM - Montreal

- May 7-8 : FHIR Connectathon
- May 9-13 : Working Group Meeting
  - Clinical Genomics Working Group
- May 13 : Clinician on FHIR Connectathon

HL7® FHIR®

- **F**ast **H**ealthcare **I**nteroperability **R**esources
  - hl7.org/fhir
- Newest standard being developed by HL7
  - Immense interest!
  - Argonaut – vendor initiated project
  - Sync For Science (S4S)
    - https://www.healthit.gov/buzz-blog/health-innovation/nih-and-onc-launch-the-sync-for-science-pilot/
- Industry standard (for trial use)
  - Strandard for Trial Use (STU) 3 ballot in Aug
- Aligns with REST services (and other model)
  - XML, JSON
- Three Connectathons a year, 12 so far (4 years)

Resources

- "Resources" are:
  - Small logically discrete units of exchange
  - Defined behaviour and meaning
  - Known identity / location
  - Smallest unit of transaction
  - "of interest" to healthcare

  - V2: Sort of like Segments
  - V3: Sort of like CMETs

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Support “Common” Scenarios

- Inclusion of content in core specification is based on “80%” rule
  - Only include data elements we are confident that most (~80%) of normal implementations using that resource will make use of
  - Other content in extensions
  - Easy to say, governance challenge to achieve
- Resources are simple and easy to understand & use

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FHIR solutions

Resources

+

Extensions

=

Solution

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Leveraging Existing Resources some examples…

- Patient
- Specimen
- Observation
- Diagnostic Report
- Family Member History
- Organization
- Documents
- Bundles
- Message Headers
- Code Systems
- Value Sets

88 resources in current specification

3.0 Resource Index

Categorized | Alphabetical

This page is provided to help find resources quickly. There is also a more detailed classification, ontology, and description.

Clinical

General:

- AllergyIntolerance 1
- Condition (Problem) 2
- Procedure 1
- FamilyMemberHistory 1
- ClinicalImpression 0
- DetectedIssue 1

Care Provision:

- CarePlan 1
- CareTeam 0
- Goal 1
- Protocol 0
- ReferralRequest 1
- ProcedureRequest 1
- NutritionOrder 1
- RiskAssessment 0
- VisionPrescription 0

Medication & Immunization:

- Medication 1
- MedicationOrder 1
- MedicationAdministration 1
- MedicationDispense 1
- MedicationStatement 1
- Immunization 1
- ImmunizationRecommendation 1

Diagnostics:

- Observation 3
- DiagnosticReport 3
- DiagnosticOrder 1
- Specimen 1
- Sequence 0
- BodySite 0
- ImagingStudy 2
- ImagingManifest 1

Identification

Individuals:

- Patient 3
- Practitioner 1
- PractitionerRole 0
- RelatedPerson 1

Groups:

- Organization 1
- HealthcareService 1
- Group 1

Entities:

- Location 1
- Substance 1
- Person 1
- Contract 0

Devices:

- Device 1
- DeviceComponent 1
- DeviceMetric 1

Workflow

Patient Management:

- Encounter 1
- EpisodeOfCare 1
- Communication 1
- Flag 1
- Appointment 1
- AppointmentResponse 1
- Schedule 1
- Slot 1

Workflow:

- Task 0
- Order 0
- OrderResponse 0
- CommunicationRequest 1
- DeviceUseRequest 0
- DeviceUseStatement 0
- ProcessRequest 0
- ProcessResponse 0
- SupplyRequest 0

Decision Support/Quality Measurement:

- ActivityDefinition 0
- DecisionSupportServiceModule 0
- DecisionSupportRule 0
- GuidanceResponse 0
- Library 0
- OrderSet 0
- Measure 0
- MeasureReport 0

http://hl7-fhir.github.io/resourcelist.html

Patient Resource Structure

Structure | UML | XML | JSON | Turtle | All

Structure

Name	Flags	Card.	Type	Description & Constraints
Patient			DomainResource	Information about an individual or animal receiving health care services
identifier	Σ	0..*	Identifier	An identifier for this patient
active	?! Σ	0..1	boolean	Whether this patient's record is in active use
name	Σ	0..*	HumanName	A name associated with the patient
telecom	Σ	0..*	ContactPoint	A contact detail for the individual
gender	Σ	0..1	code	male | female | other | unknown AdministrativeGender (Required)
birthDate	Σ	0..1	date	The date of birth for the individual
deceased[x]	?! Σ	0..1		Indicates if the individual is deceased or not
deceasedBoolean			boolean	
deceasedDateTime			dateTime	
address	Σ	0..*	Address	Addresses for the individual
maritalStatus		0..1	CodeableConcept	Marital (civil) status of a patient Marital Status Codes (Required)
multipleBirth[x]		0..1		Whether patient is part of a multiple birth
multipleBirthBoolean			boolean	
multipleBirthInteger			integer	
photo		0..*	Attachment	Image of the patient
contact	I	0..*	BackboneElement	A contact party (e.g. guardian, partner, friend) for the patient *SHALL at least contain a contact's details or a reference to an organization*
relationship		0..*	CodeableConcept	The kind of relationship PatientContactRelationship (Extensible)
name		0..1	HumanName	A name associated with the contact person
telecom		0..*	ContactPoint	A contact detail for the person
address		0..1	Address	Address for the contact person
gender		0..1	code	male | female | other | unknown AdministrativeGender (Required)
organization	I	0..1	Reference(Organization)	Organization that is associated with the contact
period		0..1	Period	The period during which this contact person or organization is valid to be contacted relating to this patient
animal	?! Σ	0..1	BackboneElement	This patient is known to be an animal (non-human)
species	Σ	1..1	CodeableConcept	E.g. Dog, Cow AnimalSpecies (Example)
breed	Σ	0..1	CodeableConcept	E.g. Poodle, Angus AnimalBreeds (Example)
genderStatus	Σ	0..1	CodeableConcept	E.g. Neutered, Intact GenderStatus (Example)
communication		0..*	BackboneElement	A list of Languages which may be used to communicate with the patient about his or her health
language		1..1	CodeableConcept	The language which can be used to communicate with the patient about his or her health Language (Required)
preferred		0..1	boolean	Language preference indicator
careProvider		0..*	Reference(Organization | Practitioner)	Patient's nominated primary care provider
managingOrganization	Σ	0..1	Reference(Organization)	Organization that is the custodian of the patient record
link	?!	0..*	BackboneElement	Link to another patient resource that concerns the same actual person
other	?!	1..1	Reference(Patient)	The other patient resource that the link refers to
type	?!	1..1	code	replace | refer | seealso - type of link

Patient Resource UML

5.1.2 Resource Content

Structure | UML | XML | JSON | Turtle | All

UML Diagram

Patient Resource XML Template

```
<Patient xmlns="http://hl7.org/fhir">
 <!-- from Resource: id, meta, implicitRules, and language -->
 <!-- from DomainResource: text, contained, extension, and modifierExtension -->
 <identifier><!-- 0..* Identifier An identifier for this patient --></identifier>
 <active value="[boolean]"/><!-- 0..1 Whether this patient's record is in active use -->
 <name><!-- 0..* HumanName A name associated with the patient --></name>
 <telecom><!-- 0..* ContactPoint A contact detail for the individual --></telecom>
 <gender value="[code]"/><!-- 0..1 male | female | other | unknown -->
 <birthDate value="[date]"/><!-- 0..1 The date of birth for the individual -->
 <deceased[x]><!-- 0..1 boolean|dateTime Indicates if the individual is deceased or not --></dec
eased[x]>
 <address><!-- 0..* Address Addresses for the individual --></address>
 <maritalStatus><!-- 0..1 CodeableConcept Marital (civil) status of a patient --></maritalStatus
>
 <multipleBirth[x]><!-- 0..1 boolean|integer Whether patient is part of a multiple birth --></mu
ltipleBirth[x]>
 <photo><!-- 0..* Attachment Image of the patient --></photo>
 <contact>  <!-- 0..* A contact party (e.g. guardian, partner, friend) for the patient -->
  <relationship><!-- 0..* CodeableConcept The kind of relationship --></relationship>
  <name><!-- 0..1 HumanName A name associated with the contact person --></name>
  <telecom><!-- 0..* ContactPoint A contact detail for the person --></telecom>
  <address><!-- 0..1 Address Address for the contact person --></address>
  <gender value="[code]"/><!-- 0..1 male | female | other | unknown -->
  <organization><!-- 0..1 Reference(Organization) Organization that is associated with the co
ntact --></organization>
  <period><!-- 0..1 Period The period during which this contact person or organization is valid
to be contacted relating to this patient --></period>
 </contact>
 <animal>  <!-- 0..1 This patient is known to be an animal (non-human) -->
  <species><!-- 1..1 CodeableConcept E.g. Dog, Cow --></species>
  <breed><!-- 0..1 CodeableConcept E.g. Poodle, Angus --></breed>
  <genderStatus><!-- 0..1 CodeableConcept E.g. Neutered, Intact --></genderStatus>
 </animal>
 <communication>  <!-- 0..* A list of Languages which may be used to communicate with the patien
t about his or her health -->
  <language><!-- 1..1 CodeableConcept The language which can be used to communicate with the pat
ient about his or her health --></language>
  <preferred value="[boolean]"/><!-- 0..1 Language preference indicator -->
 </communication>
 <careProvider><!-- 0..* Reference(Organization|Practitioner) Patient's nominated primary care p
rovider --></careProvider>
 <managingOrganization><!-- 0..1 Reference(Organization) Organization that is the custodian of t
he patient record --></managingOrganization>
 <link>  <!-- 0..* Link to another patient resource that concerns the same actual person -->
  <other><!-- 1..1 Reference(Patient) The other patient resource that the link refers to --></ot
her>
  <type value="[code]"/><!-- 1..1 replace | refer | seealso - type of link -->
 </link>
</Patient>
```

Simple example: Patient.xml

```
<Patient>
    <name>
        <family value="Doe"/>
        <given value="John"/>
    </name>
    <gender value="male"/>
    <birthDate value="1974-12-25"/>
</Patient>
```

Many tools to connect to a FHIR server

- Postman (Google Chrome add-on)
- curl (command line)
- Programming language, e.g., python
- Web client (e.g., HAPI FHIR server)
  - http://fhirtest.uhn.ca/
- clinFHIR
  - http://clinfhir.com/
- etc…

POST http://fhirtest.uhn.ca/baseDstu3/Patient Params Send Save

form-data x-www-form-urlencoded raw binary XML (text/xml)

```xml
<Patient>
    <name>
        <family value="Doe"/>
        <given value="John"/>
    </name>
    <gender value="male"/>
    <birthDate value="1974-12-25"/>
</Patient>
```

Using Postman to POST a Patient to http://fhirtest.uhn.ca/baseDstu3/Patient

Body Cookies Headers (12) Tests Status: 201 Created Time: 511 ms

Pretty Raw Preview JSON


```
{
  "resourceType": "OperationOutcome",
  "text": {
    "status": "generated",
    "div": "<div xmlns=\"http://www.w3.org/1999/xhtml\"><h1>Operation Outcome</h1><table border=\"0\"><tr><td
        style=\"font-weight: bold;\">INFORMATION</td><td>[]</td><td><pre>Successfully created resource &quot
        ;Patient/99611/_history/1&quot; in 248ms</pre></td>\n\t\t\t\t\t\t\n\t\t\t\t\t\n\t\t\t</tr>\n\t\t</table
        >\n\t</div>"
  },
  "issue": [
    {
      "severity": "information",
      "code": "informational",
      "diagnostics": "Successfully created resource \"Patient/99611/_history/1\" in 248ms"
    }
  ]
}
```

Using Postman to GET a Patient

Body | Cookies | Headers (11) | Tests | Status: 200 OK | Time: 83 ms

Pretty | Raw | Preview | XML

```xml
<Patient xmlns="http://hl7.org/fhir">
    <id value="99611"/>
    <meta>
        <versionId value="1"/>
        <lastUpdated value="2016-06-15T17:08:27.279-04:00"/>
    </meta>
    <text>
        <status value="generated"/>
        <div xmlns="http://www.w3.org/1999/xhtml">
            <div class="hapiHeaderText"> John

                <b>DOE </b>
            </div>
            <table class="hapiPropertyTable">
                <tbody>
                    <tr>
                        <td>Date of birth</td>
                        <td>
                            <span>25 December 1974</span>
                        </td>
                    </tr>
                </tbody>
            </table>
        </div>
    </text>
    <name>
        <family value="Doe"/>
        <given value="John"/>
    </name>
    <gender value="male"/>
    <birthDate value="1974-12-25"/>
</Patient>
```

Extra info generated by the server

What was sent to the server

http://fhirtest.uhn.ca/baseDstu3/Patient/99611/_history/1?_format=xml

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Body | Cookies | Headers (11) | Tests | Status: 200 OK | Time: 83 ms

Pretty | Raw | Preview | XML

```xml
<Patient xmlns="http://hl7.org/fhir">
    <id value="99611"/>
    <meta>
        <versionId value="1"/>
        <lastUpdated value="2016-06-15T17:08:27.279-04:00"/>
    </meta>
    <text>
        <status value="generated"/>
        <div xmlns="http://www.w3.org/1999/xhtml">
            <div class="hapiHeaderText"> John

                <b>DOE </b>
            </div>
            <table class="hapiPropertyTable">
                <tbody>
                    <tr>
                        <td>Date of birth</td>
                        <td>
                            <span>25 December 1974</span>
                        </td>
                    </tr>
                </tbody>
            </table>
        </div>
    </text>
    <name>
        <family value="Doe"/>
        <given value="John"/>
    </name>
    <gender value="male"/>
    <birthDate value="1974-12-25"/>
</Patient>
```

What was sent to the server

http://fhirtest.uhn.ca/baseDstu3/Patient/99611/_history/1?_format=xml

cURL command to POST a Patient

```
$ curl -X POST -d @Patient.xml -H "Content-Type: text/xml" http://fhirtest.uhn.ca/baseDstu3/Patient

{
    "resourceType":"OperationOutcome",
    "text":{
        "status":"generated",
        "div":"<div xmlns=\"http://www.w3.org/1999/xhtml\"><h1>Operation Outcome</h1><table
border=\"0\"><tr><td style=\"font-weight: bold;\">INFORMATION</td><td>[]</td><td><pre>Successfully
created resource &quot;Patient/99802/_history/1&quot; in
256ms</pre></td>\n\t\t\t\t\t\t\n\t\t\t\t\n\t\t\t</tr>\n\t\t</table>\n\t</div>"
    },
    "issue":[
        {
            "severity":"information",
            "code":"informational",
            "diagnostics":"Successfully created resource \"Patient/99802/_history/1\" in 256ms"
        }
    ]

$
```

Python3 code to POST a Patient

```
import requests
url = 'http://fhirtest.uhn.ca/baseDstu3/Patient'
headers = {'content-type': 'text/xml'}
with open("Patient.xml", "r") as myfile:
    xml=myfile.read()
r = requests.post(url, data=xml, headers=headers)
print('text =', r.text)
print('URL =', r.url)
print('response headers =', r.headers)
```

Running the Python code

```
$ python3 Patient.py
text =
{
    "resourceType":"OperationOutcome",
    "text":{
        "status":"generated",
        "div":"<div xmlns=\"http://www.w3.org/1999/xhtml\"><h1>Operation Outcome</h1><table border=\"0\"><tr><td
style=\"font-weight: bold;\">INFORMATION</td><td>[]</td><td><pre>Successfully created resource
&quot;Patient/99803/_history/1&quot; in 29ms</pre></td>\n\t\t\t\t\t\n\t\t\t\t\n\t\t\t</tr>\n\t\t</table>\n\t</div>"
    },
    "issue":[
        {
            "severity":"information",
            "code":"informational",
            "diagnostics":"Successfully created resource \"Patient/99803/_history/1\" in 29ms"
        }
    ]
}

URL = http://fhirtest.uhn.ca/baseDstu3/Patient

response headers = {'Connection': 'close', 'ETag': 'W/"1"', 'Transfer-Encoding': 'chunked', 'Server': 'Apache-
Coyote/1.1', 'Last-Modified': 'Tue, 21 Jun 2016 19:15:49 GMT', 'X-FHIR-Request-Validation':
'{"resourceType":"OperationOutcome","text":{"status":"generated","div":"<div
xmlns=\\"http://www.w3.org/1999/xhtml\\"><h1>Operation Outcome</h1><table border=\\"0\\"><tr><td style=\\"font-
weight: bold;\\"...', 'Content-Type': 'application/json+fhir;charset=UTF-8', 'Date': 'Tue, 21 Jun 2016 19:15:49 GMT',
'Location': 'http://fhirtest.uhn.ca/baseDstu3/Patient/99803/_history/1', 'Content-Location':
'http://fhirtest.uhn.ca/baseDstu3/Patient/99803/_history/1', 'Content-Encoding': 'gzip', 'X-FHIR-Response-
Validation': '{"resourceType":"OperationOutcome","text":{"status":"generated","div":"<div
xmlns=\\"http://www.w3.org/1999/xhtml\\"><h1>Operation Outcome</h1><table border=\\"0\\"><tr><td style=\\"font-
weight: bold;\\"...', 'X-Powered-By': 'HAPI FHIR 1.6-SNAPSHOT REST Server (FHIR Server; FHIR 1.4.0/DSTU3)'}
```

FHIR Connectathon

- Opportunity to for developers to connect their products
  - Clients
  - Servers
- Learn how FHIR works from a hands-on view.
- 12th Connectathon
  - 3 times a year for 4 years

11th FHIR Connectathon – Jan 2016

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May 2016 FHIR Connectathon Themes

- C-CDA on FHIR
- CDS Enablement Services
- CDS Hooks
- Conditional Reference
- CQF on FHIR
- Data Access Framework
- Declarative Mapping
- **FHIR Genomics**
- Structured Data Capture
- Financial
- Lab Orders
- PATCH proposal
- Patient track
- Provider Directories & Scheduling
- SMART-ca on FHIR
- Terminology Services
- Workflow

http://wiki.hl7.org/index.php?title=FHIR_Connectathon_12

May 2016 FHIR Connectathon Clinical Genomics Track

- Eight scenarios
  - Register a new sequence and observation
  - Clinical sequencing – germline testing
  - Family member history
  - Clinical and research data warehouses
  - **HLA Typing**
  - Species Identification
  - Comprehensive Pathology Report
  - Sequence Quality

http://wiki.hl7.org/index.php?title=201605_FHIR_Genomics_on_FHIR_Connectathon_Track_Proposal

FHIR Genomics - Connecta

projects.iq.harvard.edu/fhirgenomics

HARVARD UNIVERSITY HARVARD.EDU

FHIR Genomics Active specification

Jump to HL7 Staging Build or STU 3 Candidate/Connectathon 12 or DSTU2

Home Links Publications Contributors Contact

View-Download-Launch

Use Cases | FHIR Genomics Briefing | Tutorial Jan 2016 | Webinar Dec 2015 | Connectathon 12 Reference Server

Twitter

FhirGenomics Akana blog describes on FHIR Genomics / HL7 tutorial. t.co/5dWkKoOv7c
4 months 5 days ago.

FhirGenomics A couple perspectives... t.co/2Gb0UrbHP0
4 months 3 weeks ago.

FhirGenomics The Precision Medicine Task Force will continue work from this Fall: t.co/IadIt7ZS2p t.co/zNN88kbIcW
4 months 3 weeks ago.

FhirGenomics FHIR: The Last, Best Chance To Achieve Interoperability? t.co/SL6oc4qMlx
4 months 3 weeks ago.

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fhirgenomics.org

Building a Typing Report with FHIR Resources & Profiles

Informed by MIRING & HML

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Resources

Patient/Donor
Observation
Genetics Profile
Specimen
Sequence (DNA)

What I learned: #1

- How do I create multiple resources that references each other?
  - One at a time?
    - Order is important
  - Several at once?
    - Bundle
      - Different kinds of resource bundles
    - What if one or more references another in the bundle?
      - Tag each resource with a UUID
    - What if I want to make sure that all are created, or if one fails then none are created?
      - Transaction Bundle

Transaction Bundle - XML

```
<Bundle>
  <type value="transaction"/>

  <entry>
    <fullUrl value="urn:uuid:9e928bfa-f811-4af5-97c5-1ede3d84afc3"/>
    <resource>
      <Patient> ... </Patient>
    </resource>
    <request>
      <method value="POST"/>
      <url value="Patient"/>
    </request>
  </entry>

  <entry>
    <fullUrl value="urn:uuid:c92d42e9-3468-416a-9d03-de586f3c7c4b"/>
    <resource>
        <Specimen>
            <subject>
                <reference value="urn:uuid:9e928bfa-f811-4af5-97c5-1ede3d84afc3"/>
            </subject>
           ...
        </Specimen>
    </resource>
    <request>
      <method value="POST"/>
      <url value="Specimen"/>
    </request>
  </entry>

</Bundle>
```

Patient/Donor

Specimen

What I learned: #2

- How do I upload the bundle?
- First thought – use baseurl/resourcename
  - baseurl/Bundle
  - e.g. http://fhirtest.uhn.ca/baseDstu3/Bundle
  - The bundle was created on the server, and I could retrieve it, but it did not execute it (individual resources were not created)
- After digging into the documentation,
  - Use the base url
  - e.g., http://fhirtest.uhn.ca/baseDstu3

POST http://fhirtest.uhn.ca/baseDstu3 Params

Body Cookies Headers (12) Tests

Pretty Raw Preview JSON


```
{
  "resourceType": "Bundle",
  "id": "cf78d888-867c-402d-bc09-4aa5bdcf1a94",
  "type": "transaction-response",
  "link": [
    {
      "relation": "self",
      "url": "http://fhirtest.uhn.ca/baseDstu3"
    }
  ],
  "entry": [
    {
      "response": {
        "status": "201 Created",
        "location": "Patient/99612/_history/1",
        "etag": "1",
        "lastModified": "2016-06-16T10:24:33.359-04:00"
      }
    },
    {
      "response": {
        "status": "201 Created",
        "location": "Specimen/99613/_history/1",
        "etag": "1",
        "lastModified": "2016-06-16T10:24:33.380-04:00"
      }
    }
  ]
}
```


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GET http://fhirtest.uhn.ca/baseDstu3/Specimen/99613/_history/1?_format=xml Params

Authorization Headers Body Pre-request Script Tests

Type No Auth

Body Cookies Headers (11) Tests

Pretty Raw Preview XML

```xml
<Specimen xmlns="http://hl7.org/fhir">
    <id value="99613"/>
    <meta>
        <versionId value="1"/>
        <lastUpdated value="2016-06-16T10:24:33.359-04:00"/>
    </meta>
    <subject>
        <reference value="Patient/99612"/>
    </subject>
</Specimen>
```

Created transaction bundle that creates and links

- Patient
- Specimen from that Patient
  - collected as a buccal swab
  - points to Patient
- Sequence from that Specimen
  - single DNA sequence
  - uses HLA-A*01:01:01:01 from IPD-IMGT/HLA as reference
  - G->T substitution at position 5 (I made this up)
  - points to Patient and Specimen
- Observation with genomics extensions that includes
  - LOINC for HLA-A high resolution,
  - targeting the HLA-A gene,
  - source is "germline",
  - resulting in a single allele assignment HLA-A:01:01:01:01, (even though there is novel variation)
    - not a genotype
  - points to Patient, Sample, and Sequence
- Sent to a Cerner's sandbox server which successfully executed it.
  - http://cerner-genomics.herokuapp.com/baseDstu3/

Patient/Donor
Specimen
Sequence
Sequence
Sequence
Sequence
Exon sequencing
Genetics Profile
Observation
Genetics Profile
Observation
Individual alleles
Genetics Profile
Observation
Genotype for one gene/locus
HLA Results Profile
Diagnostic Report

HL7 WGM - Montreal

- May 7-8 : FHIR Connectathon
- May 9-13 : Working Group Meeting
  - Clinical Genomics Working Group
    - Preparing for FHIR STU3 Ballot
    - V2 Lite for Genetic Test Reports
    - Information modeling
    - Joint meetings with other work groups
- May 13 : Clinicians on FHIR Connectathon
  - clinFHIR (http://clinfhir.com)