

NOW / NEXT

Writing FHIR APIs

Avery Allen

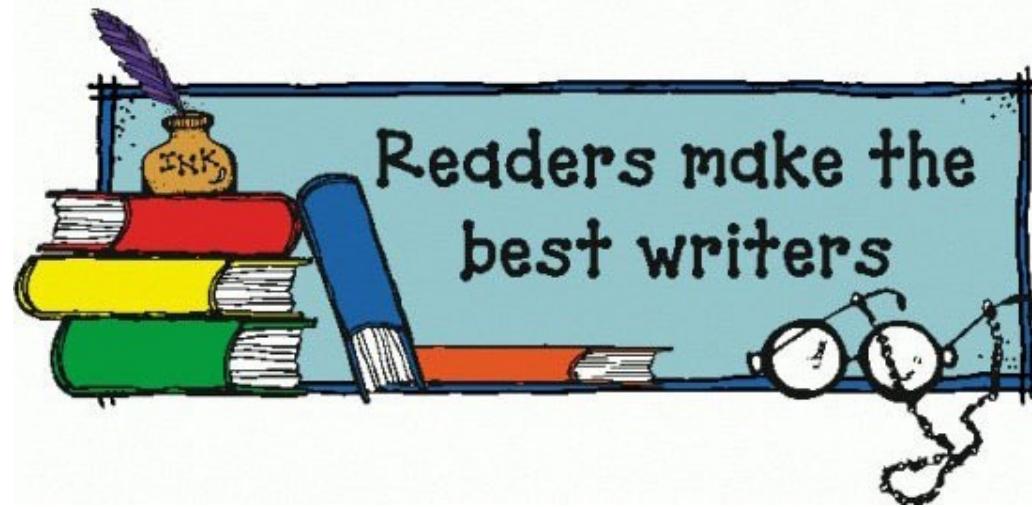
Associate Senior Software Engineer

Example Scenarios

- **Record** an *allergy* indicating hives as a reaction to Diphenhydramine
- **Schedule** an *appointment* for a patient
- **Update** a patient's epilepsy *condition* with a note
- **Create** a discharge summary *note*
- **Document** a patient-reported *medication*

Prerequisites

- Core FHIR Concepts
- Calling Secured FHIR Services
- Know your friends
 - <http://hl7.org/fhir/dstu2/>
 - <http://hl7.org/fhir/r4/>
 - <http://fhir.cerner.com/>



Security

- OAuth 2 required
- App must be registered in the code console
 - Details: <http://fhir.cerner.com/authorization/#registration>



OAuth Scopes

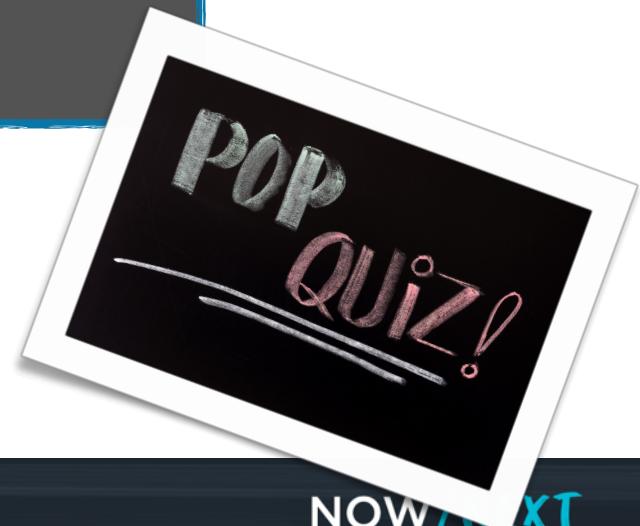
- **[patient|user]/Resource.write**
- Examples:
 - patient/MedicationStatement.write
 - user/Appointment.write
- Must be
 - granted in app registration
 - requested during authorization

Scope Quiz: Sufficient Scopes?

- Action: Creating a MedicationStatement
- Scopes:

```
openid  
profile  
launch  
patient/Patient.read  
patient/AllergyIntolerance.read  
patient/AllergyIntolerance.write
```

```
patient/DiagnosticReport.read  
patient/Observation.read  
patient/Encounter.read  
patient/MedicationStatement.read  
patient/MedicationOrder.read  
patient/DocumentReference.write
```

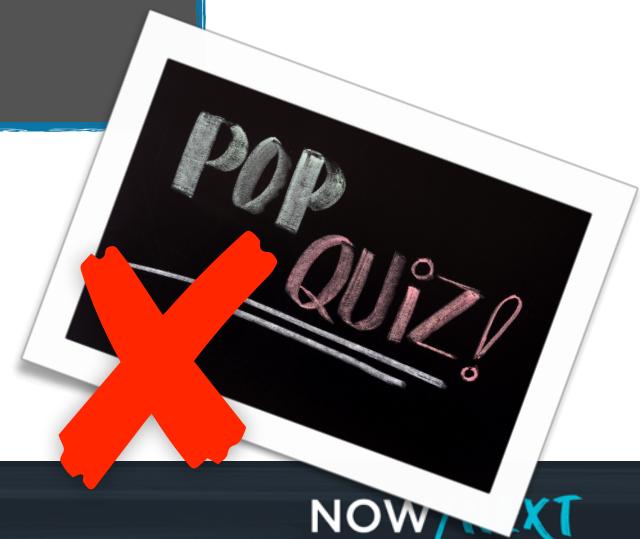


Scope Quiz: Sufficient Scopes?

- Action: Creating a MedicationStatement
- Scopes:

```
openid  
profile  
launch  
patient/Patient.read  
patient/AllergyIntolerance.read  
patient/AllergyIntolerance.write
```

```
patient/DiagnosticReport.read  
patient/Observation.read  
patient/Encounter.read  
patient/MedicationStatement.read  
patient/MedicationOrder.read  
patient/DocumentReference.write
```

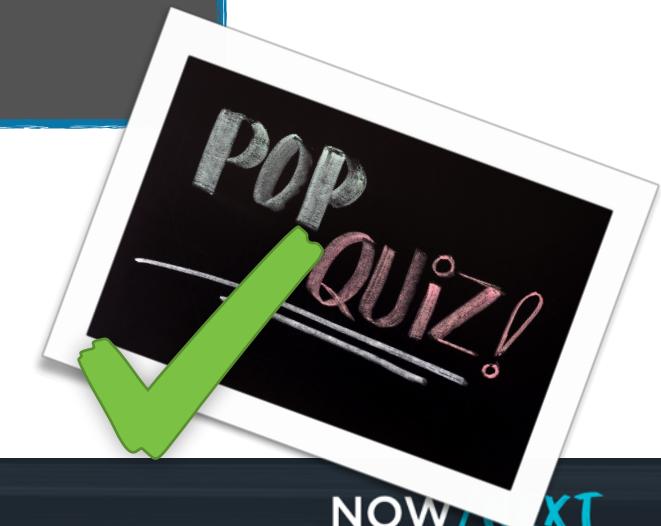


Scope Quiz

- Action: Creating a MedicationStatement
- Scopes:

```
openid  
profile  
launch  
patient/Patient.read  
patient/AllergyIntolerance.read  
patient/AllergyIntolerance.write  
patient/MedicationStatement.write
```

```
patient/DiagnosticReport.read  
patient/Observation.read  
patient/Encounter.read  
patient/MedicationStatement.read  
patient/MedicationOrder.read  
patient/DocumentReference.write
```



HTTP Verbs

- **POST** - create a new resource instance
 - *POST <base url>/AllergyIntolerance*
- **PUT** - update the entire body of an existing resource instance
 - *PUT <base url>/AllergyIntolerance/123456*
- **PATCH** - update specific fields of an existing resource instance
 - *PATCH <base url>/Encounter/123456*

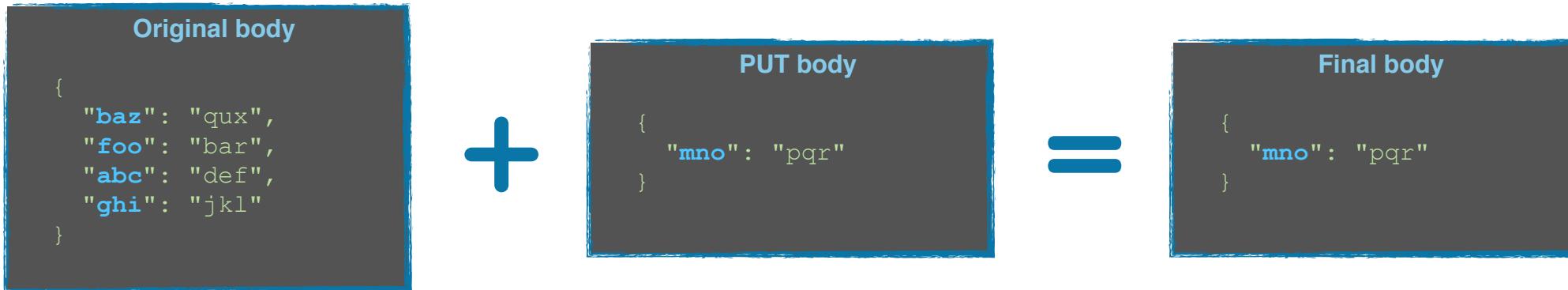
HTTP Verbs

- **POST** - create a new resource instance
 - POST <base url>/AllergyIntolerance



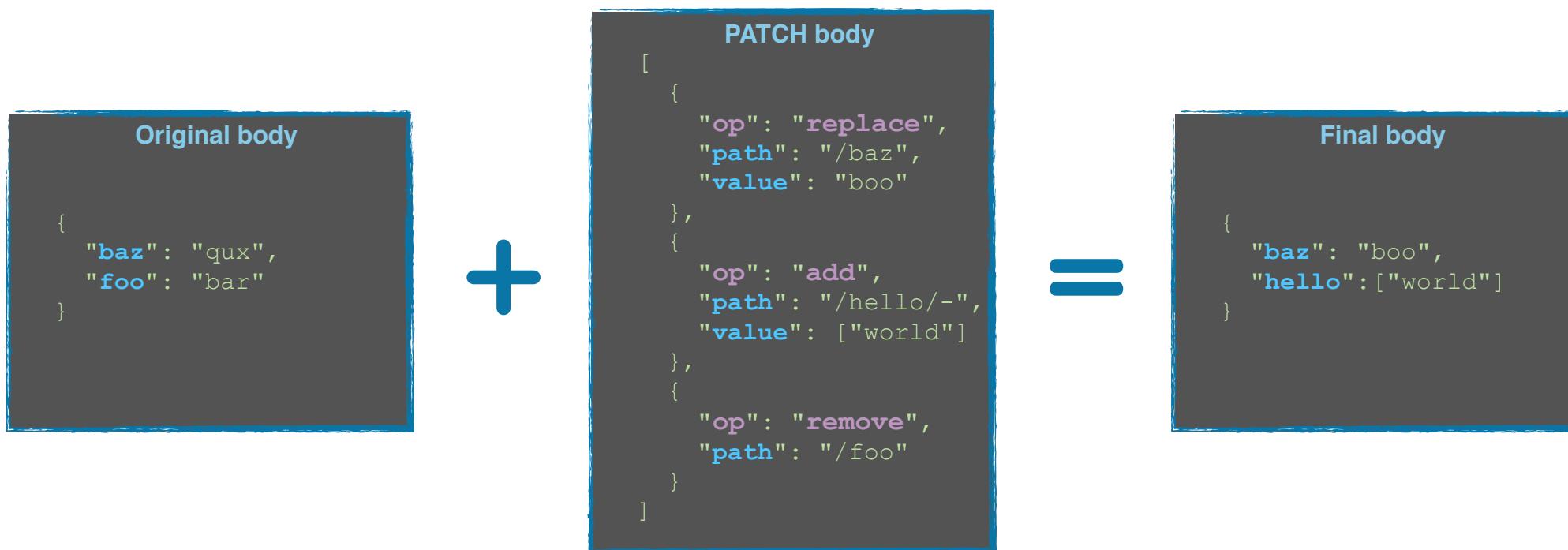
HTTP Verbs

- **PUT** - update the entire body of an existing resource instance
 - PUT <base url>/AllergyIntolerance/123456
 - Logically replace the existing version with a new one



HTTP Verbs

- **PATCH (R4)** - update one or more specific fields in a resource
 - PATCH <base url>/AllergyIntolerance/123456
 - Body follows JSON Patch spec



HTTP Verbs

- The availability of resources and actions varies between the DSTU2 and R4 implementations
- Check fhir.cerner.com for details about what is available for each
 - Note: Current development work is focused on R4 with no new resources or actions planned for DSTU2

Request Considerations

Body - Meta

 Meta	Σ	Element	Metadata about a resource
└  versionId	Σ	0..1 id	Version specific identifier
└  lastUpdated	Σ	0..1 instant	When the resource version last changed

- in particular...
 - **meta.versionId**
 - **meta.lastUpdated**
- *ignored* on writes
 - populated by server

Body - PUTs && Omissions

- On an PUT...
 - **GET** the original resource entry
 - Make content updates
 - Send full retrieved body + changes
 - Missing fields == nulling out or removing data

Body - Modifiers

- Modifier elements change interpretations
 - Requests with unsupported modifiers will be rejected
- Supported example: **status**
- Unsupported examples:
 - **implicitRules** - uri of some implicit rules required to understand the resource's content or context
 - **modifierExtensions** - modifies the meaning of a resource or attribute

Name	Flags	Card.	Type	Description & Constraints
Resource Name			Base Type	Definition
nameA	Σ	1..1	type	description of content
nameB[x]	?!	Σ	0..1	description SHALL at least have a value

• ?! : This element is a modifying element - see [Modifier Elements](#)

Request Headers

- **Authorization** - OAuth 2 Bearer token (JWT)
 - Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...
- **Content-Type** - media type of request body
 - *DSTU2* Content-Type: application/json+fhir
 - *R4* Content-Type: application/fhir+json
- **Accept** - media type you understand for response
 - *DSTU2* Accept: application/json+fhir
 - *R4* Accept: application/fhir+json

PUTting it together

Request Headers

```
Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...
Content-Type: application/json+fhir
Accept: application/json+fhir
```

PUT

```
https://fhir-ehr.sandboxcerner.com/dstu2/0b8a0111-e8e6-4c26-a91c-5069cbc6b1ca/
AllergyIntolerance/6167733
```

Body

```
{
  "resourceType": "AllergyIntolerance",
  "id": "6167733",
  "patient": {
    "reference": "Patient/1316020"
  },
  ...
}
```

What about resource contention?

Optimistic Locking

- **If-Match** - *update request header* indicating the update should be made **If** the version **Matches**
 - **If-Match:** w/"<version id>"
- The version id can be found in one of two ways
 - Captured from the **ETag** write response header when performing a previous write operation
 - **ETag:** w/"6167741"
 - GETting the resource first to find the **meta.versionId** value

Request Headers

```
Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...
Content-Type: application/json+fhir
Accept: application/json+fhir
If-Match: w/"6197741"
```

PUT

```
<base url>/AllergyIntolerance/6167733
```

Ready to go!

NOW/NEXT

Successful Responses

Successful Create

Status

201 Created

Response Headers

Location: <base url>/Appointment/34567

Etag: w/"0"

Successful Update

Status

200 OK

Response Headers

Etag: w/"1"

Create/Update Example

Create AllergyIntolerance

Request Headers

Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...
Content-Type: application/json+fhir
Accept: application/json+fhir

POST

<https://fhir-ehr.sandboxcerner.com/dstu2/0b8a0111-e8e6-4c26-a91c-5069cbc6b1ca/AllergyIntolerance>

Body

```
{  
  "resourceType": "AllergyIntolerance",  
  "patient": {  
    "reference": "Patient/1316020"  
  },  
  ...  
}
```

Response

Status

201 Created

Response Headers

Location: <https://fhir-ehr.sandboxcerner.com/dstu2/0b8a0111-e8e6-4c26-a91c-5069cbc6b1ca/AllergyIntolerance/6167733>

Etag: w/"1"

Retrieve AllergyIntolerance

Request Headers

Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...

Accept: application/json+fhir

GET

`https://fhir-ehr.sandboxcerner.com/dstu2/0b8a0111-e8e6-4c26-a91c-5069cbc6b1ca/
AllergyIntolerance/6167733`

Response Status

200 OK

Response Body

```
{  
  "resourceType": "AllergyIntolerance",  
  "id": "6167733",  
  "meta": {"versionId": "2", ...}  
  ...  
}
```

Update AllergyIntolerance

Request Headers

```
Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...
Content-Type: application/json+fhir
Accept: application/json+fhir
If-Match: W/"2"
```

PUT

```
https://fhirehr.sandboxcerner.com/dstu2/0b8a0111-e8e6-4c26-a91c-5069cbc6b1ca/AllergyIntolerance/6167733
```

Request Body

```
{  
  "resourceType": "AllergyIntolerance",  
  "id": "6167733",  
  "patient": {  
    "reference": "Patient/1316020"  
  },  
  ...  
}
```

Reply

Status

200 OK

Response Headers

Etag: W/"3"

Failure Responses

Are you lost?

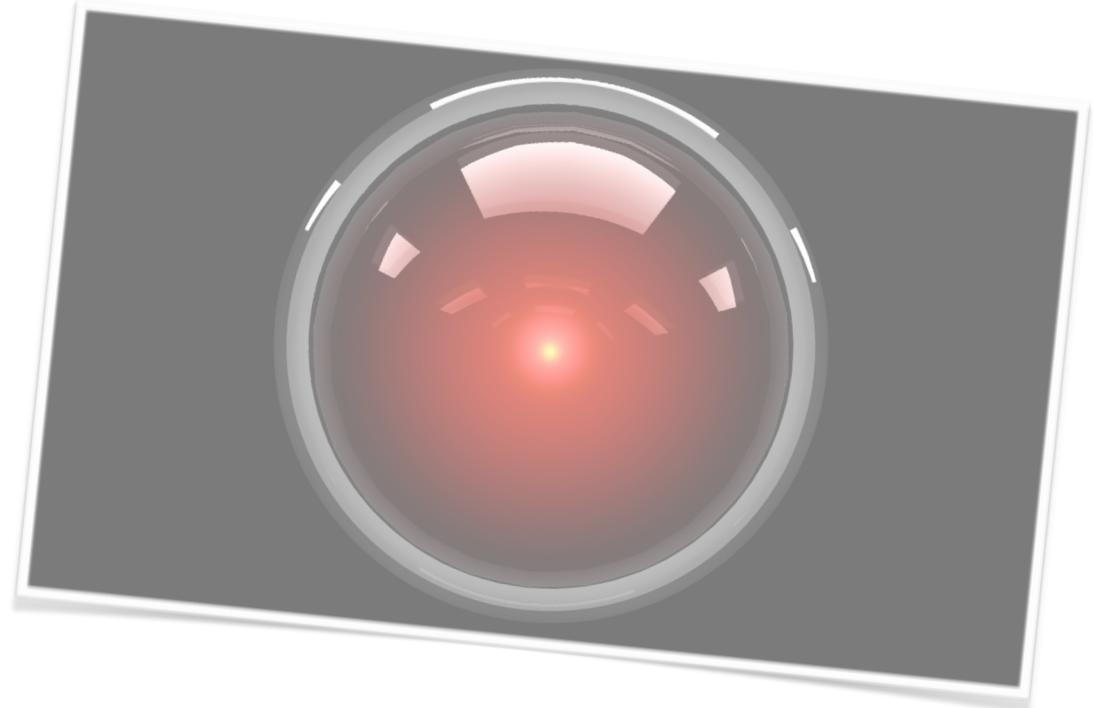
- 404 Not Found

Communication Breakdown

- **415 Unsupported Media Type** - Content-Type not json
- **406 Not Acceptable** - Accept header not json
- **400 Bad Request** - invalid json, field invalid or required field missing
- **422 Unprocessable Entity**
 - couldn't process your json body
 - implicit rules / modifier extensions

“I’m sorry Dave”

- **401 Unauthorized** - missing/expired/invalid Authorization token
- **403 Forbidden** - required scope(s) not in token



Playing Nicely with Others

- **412 Precondition Failed** - no If-Match header provided for an update
- **409 Conflict** - If-Match version out of date

Oops

- 500 Internal Server Failure - Sorry! We're working on it

Processing Failures

- **OperationOutcome**
 - **severity** - error, warning,...
 - **type** - code for what failed
 - **details** - more info, human readable text
 - **location** - which field? (DSTU2 only, XPath)
 - **expression** - which field? (R4 only, FHIRPath)
- troubleshooting: **x-request-id** response header

Example Failure

- Status: 422 Unprocessable Entity

```
DSTU2 OperationOutcome
{
  "resourceType": "OperationOutcome",
  "issue": [
    {
      "severity": "error",
      "code": "business-rule",
      "details": {
        "coding": [
          {
            "system": "http://hl7.org/fhir/operation-outcome",
            "code": "MSG_PARAM_INVALID",
            "display": "Parameter 'wasNotTaken' content is invalid"
          }
        ],
        "text": "a value of true for wasNotTaken is not supported."
      },
      "location": [
        "/f:MedicationStatement/f:wasNotTaken"
      ]
    }
  ]
}
```

Let's back up a minute...

... and talk about PATCH

R4

- Officially supported in R4 Spec
- Allows updates to individual resource fields
 - Doesn't require sending the entire existing resource body
 - Currently supported in:
 - Patient
 - Encounter
 - Appointment

- Allows adding, replacing, or removing data from individual fields or lists
 - Not every field is modifiable
 - There may be additional constraints for a given field
 - Refer to fhir.cerner.com for specifics for individual fields

Request Headers

- **Authorization** - OAuth 2 Bearer token (JWT)
 - Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...
- **If-Match** - The current resource version
 - If-Match: W/"5"
- **Content-Type** - media type of request body
 - Content-Type: application/json-patch+json
- **Accept** - media type you understand for response
 - Accept: application/fhir+json

Body - PATCHs & Omissions

- On an PATCH...
 - Send a list of PATCH operations listing the operations you want to perform
 - Fields without a corresponding operation are ignored
 - Multiple fields can be modified at once
 - There may be constraints limiting which fields may be modified together

Body - PATCH Operations

R4

- List of PATCH operation definitions
- A PATCH operation contains:
 - **op** - the operation to be performed (**add, remove, replace, test**)
 - **path** - the JSON Path to the field to be modified
 - **value** - the value to add, replace, or test at the field indicated by the path

Body - Adding items to a list

R4

- **op: "add"**
 - indicates the operation is to add a value
- **path: "/generalPractitioner/-"**
 - indicates that the value is to be appended to the list of GPs
- **value: {reference: ...}**
 - the FHIR Reference to be added to the list of GP references

PATCH Patient Request

```
[  
  {  
    "op": "add",  
    "path": "/generalPractitioner/-"  
    "value": {  
      "reference": "Practitioner/1234"  
    }  
  }  
]
```

GET Patient Resource

```
{  
  ...  
  "generalPractitioner": [ {  
    "id": "CI-54321-1",  
    "reference": "Practitioner/1234",  
    "display": "Name, Practitioner"  
  } ]  
  ...  
}
```

Body - Removing an item

- **op: "remove"**
 - indicates the operation is to remove a list item
- **path: "/generalPractitioner/1"**
 - indicates that 1st value is to be removed from the list of GPs
- **value:**
 - Not provided
- An additional **test** operation must be provided to test that the id of the reference to be removed matches the expected value
 - This is to prevent removing the wrong value

PATCH Patient Request

```
[  
  {  
    "op": "remove",  
    "path": "/generalPractitioner/1"  
  },  
  {  
    "op": "test",  
    "path": "/generalPractitioner/1/id",  
    "value": "CI-54321-1"  
  }  
]
```

Body - Modifying a list item

R4

- **op: "replace"**
 - indicates the operation is to replace an existing list value
- **path: "/generalPractitioner/2"**
 - indicates that the 2nd item is to be replaced with a different value
- **value: {reference: ...}**
 - the replace FHIR reference value
- An additional **test** operation must be provided to test that the id of the reference to be replaced matches the expected value
 - This is to prevent replacing the wrong value

PATCH Patient Request

```
[  
  {  
    "op": "replace",  
    "path": "/generalPractitioner/2"  
    "value": {  
      "reference": "Practitioner/1234"  
    }  
  },  
  {  
    "op": "test",  
    "path": "/generalPractitioner/2/id",  
    "value": "CI-11111-1"  
  }  
]
```

Body - Modifying an item within a list

R4

- **op: "replace"**
 - indicates the operation is to replace an existing list value
- **path: "/address/2/city"**
 - indicates that city in the 2nd address is to be replaced with a different value
- **value: "St. Louis"**
 - the replace city string value
- An additional **test** operation must be provided to test that the id of the reference to be replaced matches the expected value
 - This is to prevent replacing the wrong value

PATCH Patient Request

```
[  
  {  
    "op": "replace",  
    "path": "/address/2/city",  
    "value": "St. Louis"  
  },  
  {  
    "op": "test",  
    "path": "/address/2/id",  
    "value": "CI-33321-0"  
  }  
]
```

Demo

Writing FHIR APIs

Resource specifics

AllergyIntolerance

Summary

- **Purpose:** A record of a clinical assessment of an allergy or intolerance; a propensity, or a potential risk to an individual, to have an adverse reaction on future exposure to the specified substance, or class of substance.
- **Actions:** create, update
- **Consumers:** Practitioners, Systems

Capture...

- onset date/time
- recorded date/time
- recorder
- patient
- reporter
- substance
- status
- criticality
- type (allergy/intolerance)
- category (med/food/environment)
- note
- reaction

AllergyIntolerance.reporter

-  reporter	Σ	0..1	Reference(Patient RelatedPerson Practitioner)	Source of the information about the allergy
--	----------	------	---	---

- Millennium captures
 - patient
 - *relationship type* of related person (contained)
 - *role type* of practitioner (contained)

AllergyIntolerance.reporter (Patient)



Contained Resources

- Used to include other resources in the primary resource body
- Contained resources do **not** have external existence
- Reference relatively by '#<id>'

AllergyIntolerance.reporter (RelatedPerson)

```
{  
...  
  "contained": [  
    {  
      "resourceType": "RelatedPerson",  
      "id": "123",  
      "relationship": {  
        "coding": [  
          {  
            "system": "http://hl7.org/fhir/v3/RoleCode",  
            "code": "SIGOTHR"  
          } ]  
        }  
      } ],  
...  
  "reporter": {  
    "reference": "#123"  
  }  
...  
}
```

AllergyIntolerance.reporter (Practitioner)

```
{  
  ...  
  "contained": [  
    {  
      "resourceType": "Practitioner",  
      "id": "123",  
      "practitionerRole": [  
        {  
          "role": {  
            "coding": [  
              {  
                "system": "http://hl7.org/fhir/v2/0286",  
                "code": "RP"  
              } ]  
            }  
          }]  
    }],  
    ...  
    "reporter": {  
      "reference": "#123"  
    }  
    ...  
  }  
}
```

AllergyIntolerance.substance

 substance	Σ	1..1	CodeableConcept	Substance, (or class) considered to be responsible for risk AllergyIntolerance Substance and Negation Codes (Example)
---	----------	------	-----------------	--

- RxNorm for specific medical substances
- SNOMED CT
 - non-medical
 - negations
 - NKA - No Known Allergies
 - NKMA - No Known Medication Allergies

AllergyIntolerance.substance (example)

```
"substance": {  
    "coding": [  
        {  
            "system": "http://snomed.info/sct",  
            "code": "256349002",  
            "display": "Peanut - dietary (substance)"  
        }  
    ]  
}
```

AllergyIntolerance.reaction.manifestation



Clinical symptoms/signs associated with the Event
[SNOMED CT Clinical Findings \(Example\)](#)

- Options
 - codified (SNOMED CT)
 - freetext

AllergyIntolerance.reaction.manifestation (codified)

DSTU2

```
"reaction": [
  {
    "manifestation": [
      {
        "coding": [
          {
            "system": "http://snomed.info/sct",
            "code": "39579001",
            "display": "Anaphylactic reaction"
          }
        ]
      }
    ]
  }
]
```

AllergyIntolerance.reaction.manifestation (freetext)

```
"reaction": [
  {
    "manifestation": [
      {
        "text": "Hives"
      }
    ]
  }
]
```

AllergyIntolerance.note



note

0..1 Annotation

Additional text not captured in other fields

- Create
- Update
 - add a note if no current note
 - single note cannot be modified or replaced
 - limitation of DSTU2, resolved in R4

AllergyIntolerance.note (example)

```
"note": {  
    "authorReference": {  
        "reference": "Practitioner/21500971"  
    },  
    "time": "2015-10-14T13:13:20-06:00",  
    "text": "Patient complains of discomfort"  
}
```

Full Example

```
{  
  "resourceType": "AllergyIntolerance",  
  "category": "medication",  
  "criticality": "CRITL",  
  "recordedDate": "2017-02-28T15:03:00-06:00",  
  "status": "active",  
  "type": "allergy",  
  "onset": "2015-12-15T00:00:00Z",  
  "patient": {  
    "reference": "Patient/1316020"  
  },  
  "reporter": {  
    "reference": "Patient/1316020"  
  },  
  "recorder": {  
    "reference": "Practitioner/1316007"  
  },  
  "reaction": [ {  
    "manifestation": [  
      {  
        "text": "Hives"  
      }]  
  }],  
  ...  
}
```

```
...  
  "note": {  
    "authorReference": {  
      "reference": "Practitioner/41562141"  
    },  
    "time": "2017-02-28T09:03:00Z",  
    "text": "Note 1"  
  },  
  "substance": {  
    "coding": [  
      {  
        "system": "http://www.nlm.nih.gov/research/  
umls/rxnorm",  
        "code": "3498"  
      }]  
    }  
  }
```

Demo

Appointment

Summary

- **Purpose:** Information about a planned meeting that may be in the future or past.
- **Actions:** create, update
- **Consumers:** Practitioners, Systems

Capture...

- time slot id
 - type (i.e. clinical specialty)
 - start/end
 - location
- status
- patient

Workflow

- Search for Slot by...
 - Slot type (clinical specialty)
 - Practitioner id or Location id
 - Start date/time
- Choose desired Slot
- Create Appointment using Slot id

Appointment.status

...  status ?! Σ 1..1 code

proposed | pending | booked | arrived | fulfilled |
cancelled | noshow
[AppointmentStatus \(Required\)](#)

- Set to *proposed* for a new Appointment
 - "status": "proposed"
- Set to *arrived* or *cancelled* for an existing Appointment
 - "status": "cancelled"
 - "status": "arrived"

Appointment.[start|end]

 start	Σ	0..1	instant	When appointment is to take place
 end	Σ	0..1	instant	When appointment is to conclude

- Handled by selecting a Slot
 - Will be populated on a GET
 - No need to populate separately

Appointment.participant

L	 participant	I	1..*	BackboneElement	Participants involved in appointment <i>Either the type or actor on the participant MUST be specified</i>
---	---	---	------	-----------------	--

- **Participant** - specify the patient
- **Status** - needs-action
- **Type (e.g. primary/secondary)** - leave unset
- **Required** - leave unset or specify required

Appointment.participant (example)

```
"participant": [
  {
    "actor": {
      "reference": "Patient/123",
      "display": "Last Name, First"
    },
    "status": "needs-action"
  }
]
```

Full Example

```
{  
  "resourceType": "Appointment",  
  "slot": [ {  
    "reference": "Slot/21265426-633867-3120917-20"  
  } ],  
  "participant": [  
    {  
      "actor": {  
        "reference": "Patient/3886413",  
        "display": "PATIENT, TEST"  
      },  
      "required": "required",  
      "status": "needs-action"  
    }  
  ],  
  "status": "proposed"  
}
```

Demo

Condition

Summary

- **Purpose:** Used to record detailed information pertinent to a clinician's assessment and assertion of a particular aspect of a person's state of health. Examples of condition include problems, diagnoses, concerns, issues.
- **Actions:** create, update
- **Consumers:** Practitioners, Systems

Capture...

- verification status
- severity
- onset date/time
- abatement
- notes
- patient
- encounter
- practitioner who asserted
- identification of issue
- clinical status
- category (diagnosis / problem)

Condition.category

- category Σ 0..1 CodeableConcept

complaint | symptom | finding | diagnosis
Condition Category Codes (Preferred)

- diagnosis
 - system: <http://hl7.org/fhir/condition-category>
- problem
 - system: <http://argonaut.hl7.org>

Condition.category (example)

```
{  
  "category": {  
    "coding": [  
      {  
        "system": "http://argonaut.hl7.org",  
        "code": "problem",  
        "display": "Problem"  
      }  
    ]  
  }  
}
```

Condition.code



Σ 1..1 CodeableConcept

Identification of the condition, problem or diagnosis
[Condition/Problem/Diagnosis Codes \(Example\)](#)

- SNOMED CT
- ICD-10-CM
- ICD-9-CM
- freetext

Condition.code (example)

```
{  
...  
  "code": {  
    "coding": [  
      {  
        "system": "http://hl7.org/fhir/sid/icd-9-cm",  
        "code": "345.0",  
        "display": "Generalized nonconvulsive epilepsy",  
        "userSelected": true  
      }  
    ]  
  }  
...  
}
```

Condition.dateRecorded

dateRecorded Σ 0..1 date When first entered

- only for diagnoses (not problems)
 - both have onset date/time

Condition.abatement[x]

 abatement[x]	Σ	0..1	If/when in resolution/remission
 abatementDateTime		dateTime	
 abatementQuantity		Age	
 abatementBoolean		boolean	

- Boolean/DateTime supported
- only for problems (not for diagnoses)
 - both have clinical status (e.g. resolved)

Condition.notes

L  notes

Σ 0..1 string

Additional information about the Condition

- Create
- Update
 - add a note if no current note
 - note cannot be modified or replaced
 - limitation of DSTU2, resolved in R4

Condition.notes (example)

```
{  
  "notes": "Information related to condition"  
}
```

Full Example

```
{  
  "resourceType": "Condition",  
  "patient": {  
    "reference": "Patient/1316020"  
  },  
  "code": {  
    "text": "Freetext Condition"  
  },  
  "category": {  
    "coding": [  
      {  
        "system": "http://argonaut.hl7.org",  
        "code": "problem"  
      }  
    ]  
  },  
  "clinicalStatus": "resolved",  
  "verificationStatus": "differential",  
  "abatementDateTime": "2017-01-01T00:00:00Z"  
}
```

DocumentReference

Summary

- **Purpose:** Used to describe a document that is made available to a healthcare system. A document is some sequence of bytes that is identifiable, establishes its own context (e.g., what subject, author, etc. can be displayed to the user), and has defined update management.
- **Actions:** create
- **Consumers:** Practitioners, Systems

Capture...

- patient
- type
- author
- creation date/time
- document status (final)
- description/title
- content
- encounter

DocumentReference.relatesTo

 relatesTo	?! Σ	0..*	BackboneElement	Relationships to other documents
 code	Σ	1..1	code	replaces transforms signs appends
 target	Σ	1..1	Reference(DocumentReference)	DocumentRelationshipType (Required) Target of the relationship

- unsupported modifier element

DocumentReference.type

 type	Σ	1..1	CodeableConcept	Kind of document (LOINC if possible) Document Type Value Set (Preferred)
---	----------	------	-----------------	---

- LOINC (e.g. discharge summary, consult note)
- Mapped values in sandbox - <http://fhir.cerner.com/millennium/dstu2/infrastructure/document-reference/#terminology-bindings>
 - Additional LOINCs mapped by request

DocumentReference.type (example)

```
{  
  "coding": [  
    {  
      "system": "http://loinc.org",  
      "code": "34840-9"  
    }  
  ]  
}
```

DocumentReference.author

- ↗ author	Σ	0..*	Reference(Practitioner Organization Device Patient RelatedPerson)	Who and/or what authored the document
------------	---	------	---	---------------------------------------

- optional; defaults to principal in token

DocumentReference.author (example)

```
{  
  "author": [  
    {  
      "reference": "Practitioner/2150097"  
    }  
  ]  
}
```

DocumentReference.status



status

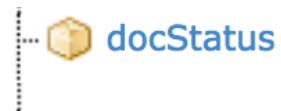
?! Σ 1..1 code

current | superseded | entered-in-error

[DocumentReferenceStatus \(Required\)](#)

- status of the DocumentReference resource
 - "status": "current" for new documents

DocumentReference.docStatus



Σ

0..1

CodeableConcept

preliminary | final | appended | amended | entered-in-error
CompositionStatus (Required)

- Status of the *document itself*
- must be 'final'
 - e.g. "docStatus": "final"

DocumentReference.context.period.end



Σ 0..1 Period

Time of service that is being documented

- date/time marking the end of what's documented
- if absent, will be backfilled with DocumentReference.indexed (i.e. when document was created)



Σ 1..1 instant

When this document reference created

DocumentReference.context.period (example)

```
{  
  "context": {  
    "period" : {  
      "end": "2015-08-20T09:10:14Z"  
    }  
  }  
}
```

DocumentReference.content.attachment

 content	Σ	1..*	BackboneElement	Document referenced
 attachment	Σ	1..1	Attachment	Where to access the document
 Attachment	ΣI		Element	Content in a format defined elsewhere <i>If the Attachment has data, it SHALL have a contentType</i>
 contentType	Σ	0..1	code	Mime type of the content, with charset etc. MimeType  (Required)
 language	Σ	0..1	code	Human language of the content (BCP-47) Language  (Required)
 data	Σ	0..1	base64Binary	Data inline, base64ed
 url	Σ	0..1	uri	Uri where the data can be found
 size	Σ	0..1	unsignedInt	Number of bytes of content (if url provided)
 hash	Σ	0..1	base64Binary	Hash of the data (sha-1, base64ed)
 title	Σ	0..1	string	Label to display in place of the data
 creation	Σ	0..1	dateTime	Date attachment was first created

DocumentReference.content.attachment

- must be XHTML, UTF-8 encoded
- contentType
 - application/xhtml+xml; charset=utf-8
- data
 - Base64-encoded

DocumentReference.content.attachment.data

- Validate your XHTML
 - http://validator.w3.org/#validate_by_upload+with_options
 - <https://html5.validator.nu/>

DocumentReference.content.attachment.data conversion

- Sanitization
 - CSS, Javascript
 - Applet, iframe, link, script, and style tags will be removed completely
 - Other tags (a, button, form, frame, frameset, input, object, option, select, textarea) may be removed but the text within will remain.
- Images
 - can be inlined, but not external references
 - Formatting may require tweaking

DocumentReference.content.attachment.data (example)

```
{  
  "content": [  
    {  
      "attachment": {  
        "contentType": "application/xhtml+xml; charset=utf-8",  
        "data": "PCFET0NUWVBFIGh0bWwNCiAgU1lTVEVNI..."  
      }  
    }  
  ]  
}
```

Full Example

```
{  
  "resourceType": "DocumentReference",  
  "subject": {  
    "reference": "Patient/53663272"  
  },  
  "type": {  
    "coding": [  
      {  
        "system": "http://loinc.org",  
        "code": "34840-9"  
      }  
    ]  
  },  
  "author": [  
    {  
      "reference": "Practitioner/21500981"  
    }  
  ],  
  "indexed": "2015-11-18T18:00:00Z",  
  "status": "current",  
  "docStatus": {  
    "coding": [  
      {  
        "system": "http://hl7.org/fhir/  
composition-status",  
        "code": "final"  
      }  
    ]  
  },  
  "description": "Rheumatology Note",  
  "content": [  
    {  
      "attachment": {  
        "contentType": "application/xhtml+xml; charset=utf-8",  
        "data": "PCFET0NUWVBFIGh0bWwNCiAgU1lTVEVNI..."  
      }  
    },  
    "context": {  
      "encounter": {  
        "reference": "Encounter/4208059"  
      },  
      "period": {  
        "end": "2015-08-20T09:10:14Z"  
      }  
    }  
  ]  
}
```

Demo

NOW/**NEXT**

MedicationStatement

Summary

- **Purpose:** A record of a medication that is being consumed by a patient. A MedicationStatement may indicate that the patient may be taking the medication now, or has taken the medication in the past or will be taking the medication in the future.
- **Actions:** create, update
- **Consumers:** Practitioners, Systems

Capture...

- patient
- status
- effective date range
- note
- medication
- dosage
- route
- quantity

MedicationStatement.status

status

?! Σ 1..1 code

active | completed | entered-in-error | intended

[MedicationStatementStatus \(Required\)](#)

- **Create** - must be active
- **Update** - must be completed
 - only supported change for Update action

MedicationStatement.wasNotTaken

└─  **wasNotTaken**

?! Σ 0..1 boolean

True if medication is/was not being taken

- unsupported modifier

MedicationStatement.medication[x]



- `CodeableConcept`
- single-ingredient
- options
 - RxNorm
 - freetext

MedicationStatement.medicationCodeableConcept (example)

```
{  
  "medicationCodeableConcept": {  
    "coding": [  
      {  
        "system": "http://www.nlm.nih.gov/research/umls/rxnorm",  
        "code": "2551",  
        "display": "Ciprofloxacin"  
      }  
    ],  
    "text": "ciprofloxacin"  
  }  
}
```

MedicationStatement period

- interval of time that patient has asserted taking the med
- options:
 - effectivePeriod
 - dosage.timing.repeat.boundsPeriod
 - if both populated, must be the same

MedicationStatement.effectivePeriod

 effective[x]	Σ	0..1	Over what period was medication consumed?
 effectiveDateTime		dateTime	
 effectivePeriod		Period	

MedicationStatement.dosage.timing.repeat.bounds (spec)

L	dosage	Σ	0..*	BackboneElement	Details of how medication was taken
	- text	Σ	0..1	string	Reported dosage information
	- timing	Σ	0..1	Timing	When/how often was medication taken
	- repeat	ΣI	0..1	Element	When the event is to occur <i>Either frequency or when can exist, not both</i> <i>if there's a duration, there needs to be duration units</i> <i>if there's a period, there needs to be period units</i> <i>If there's a periodMax, there must be a period</i> <i>If there's a durationMax, there must be a duration</i> Length/Range of lengths, or (Start and/or end) limits
	- bounds[x]	Σ	0..1		
	- boundsQuantity			Duration	
	- boundsRange			Range	
	- boundsPeriod			Period	

MedicationStatement.dosage.timing.repeat.bounds

- Either...
 - the outer bounds for start and/or end limits of the timing schedule (Period)
 - the length of timing schedule (Quantity)

MedicationStatement.dosage.timing.repeat.boundsPeriod

```
{  
  "boundsPeriod": {  
    "start": "2014-11-03T14:38:00.000-05:00"  
  }  
}
```

MedicationStatement.dosage.timing.repeat.boundsQuantity

```
{  
  "boundsQuantity": {  
    "value": 10,  
    "unit": "days",  
    "system": "http://unitsofmeasure.org",  
    "code": "d"  
  }  
}
```

Full Example

```
{  
  "resourceType": "MedicationStatement",  
  "patient": {  
    "reference": "Patient/4766007"  
  },  
  "status": "active",  
  "medicationCodeableConcept": {  
    "text": "FHIR Test Medication"  
  },  
  "dosage": [ {  
    "timing": {  
      "code": {  
        "coding": [ {  
          "system": "http://hl7.org/fhir/v3/vs/GTSAbbreviation",  
          "code": "BID" } ],  
        "text": "BID"  
      }  
    },  
    "quantityQuantity": {  
      "value": 60.0,  
      "units": "mg",  
      "system": "http://unitsofmeasure.org",  
      "code": "mg" } }  
  ]  
}
```

Try it out!

Hands on exercises

- http://bit.ly/chc_learning_lab

Thank you!