

Writing via FHIR APIs

Avery Allen

Associate Senior Software Engineer

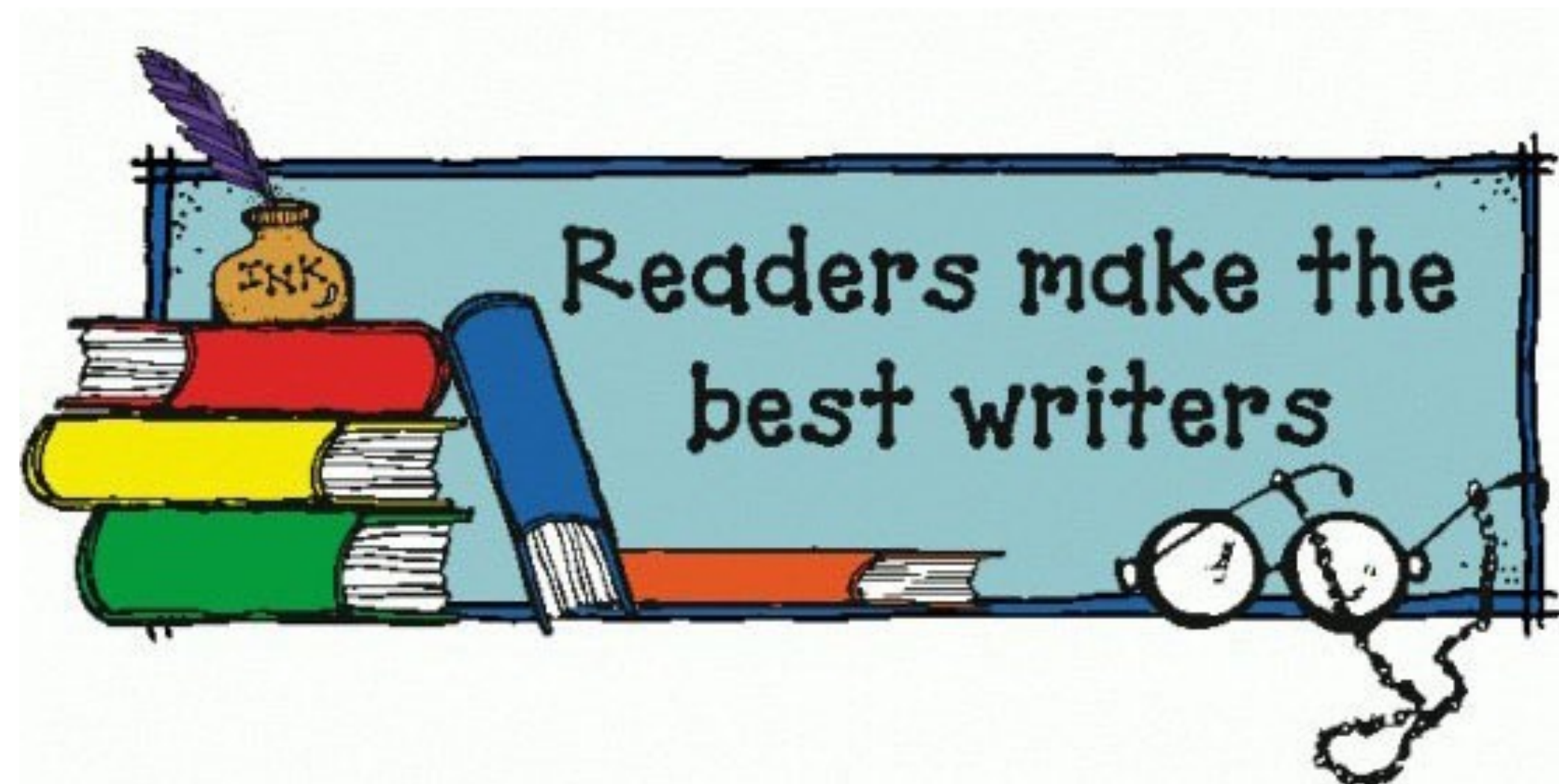
11-12-20

Example Scenarios

- **Register** a new *patient*
- **Record** an *allergy* indicating hives as a reaction to Diphenhydramine
- **Update** a patient's epilepsy *condition* with a note
- **Create** a discharge summary *note*
- **Document** a patient-reported *medication*
- <http://fhir.cerner.com/millennium/overview/>

Prerequisites

- Core FHIR Concepts
- SMART on FHIR Authorization
- Know your friends
 - <http://hl7.org/fhir/dstu2/>
 - <http://hl7.org/fhir/r4/>
 - <http://fhir.cerner.com/>



Create with POST

Example - Create with POST

Request Headers

Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...

Content-Type: application/json+fhir

Accept: application/json+fhir

POST

`https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/AllergyIntolerance`

Body

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

Example - Create with POST

Request Headers

Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...

Content-Type: application/json+fhir

Accept: application/json+fhir

POST

https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/AllergyIntolerance

Body

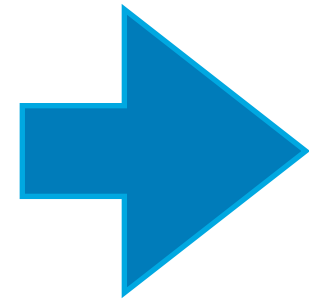
```
{
  "resourceType": "AllergyIntolerance",
  "patient": {
    "reference": "Patient/1316020"
  },
  ...
}
```


HTTP Verb

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



Example - Create with POST



Request Headers

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

POST

<https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/AllergyIntolerance>

Body

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


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`

Authorization Header - OAuth Scopes

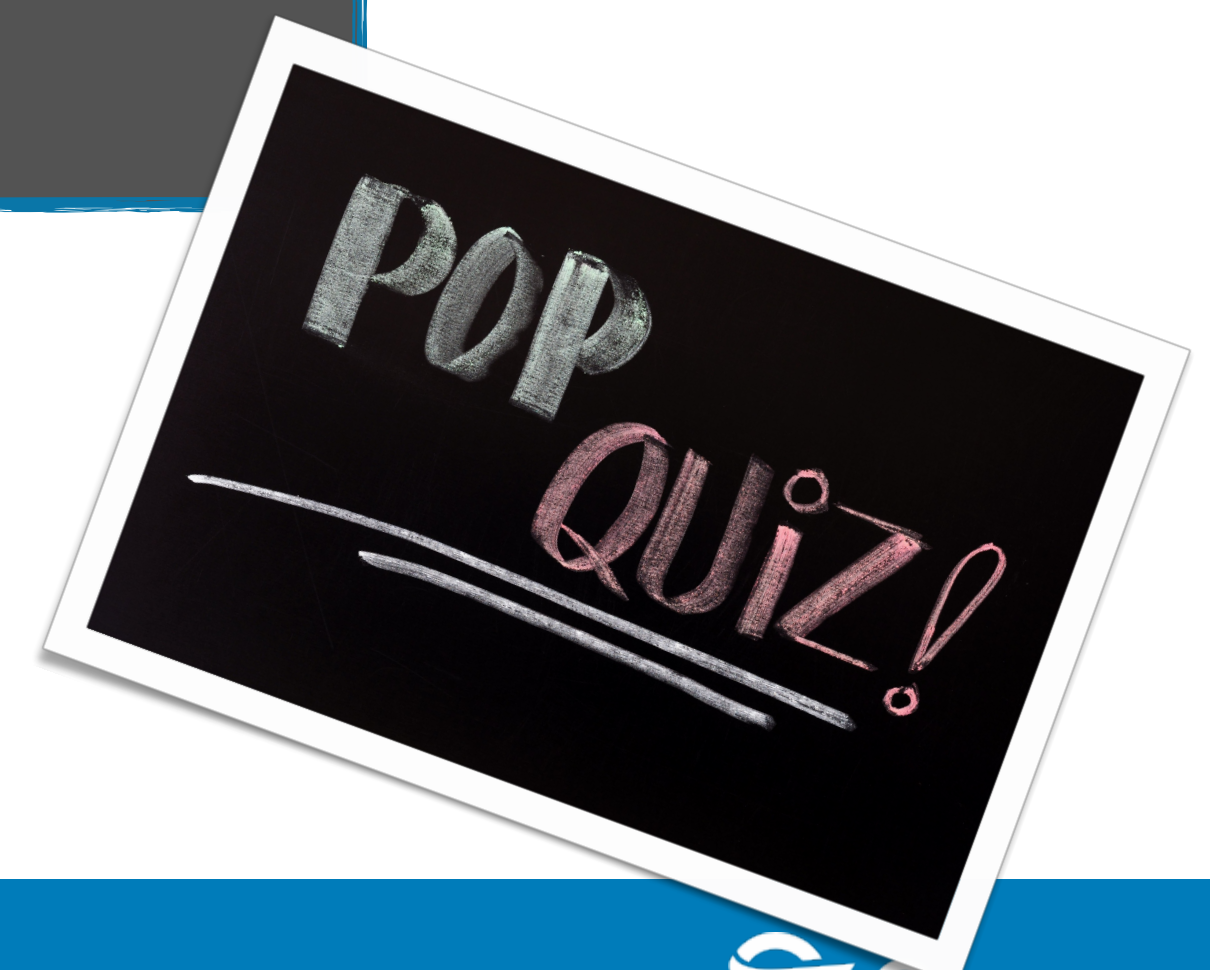
- *[patient|user]/Resource.write*
- Examples:
 - patient/MedicationOrder.write
 - user/Appointment.write
- Must be
 - granted in app registration
 - requested during authorization

Scope Quiz: Sufficient Scopes?

- **Action:** Creating a MedicationOrder
- **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
```

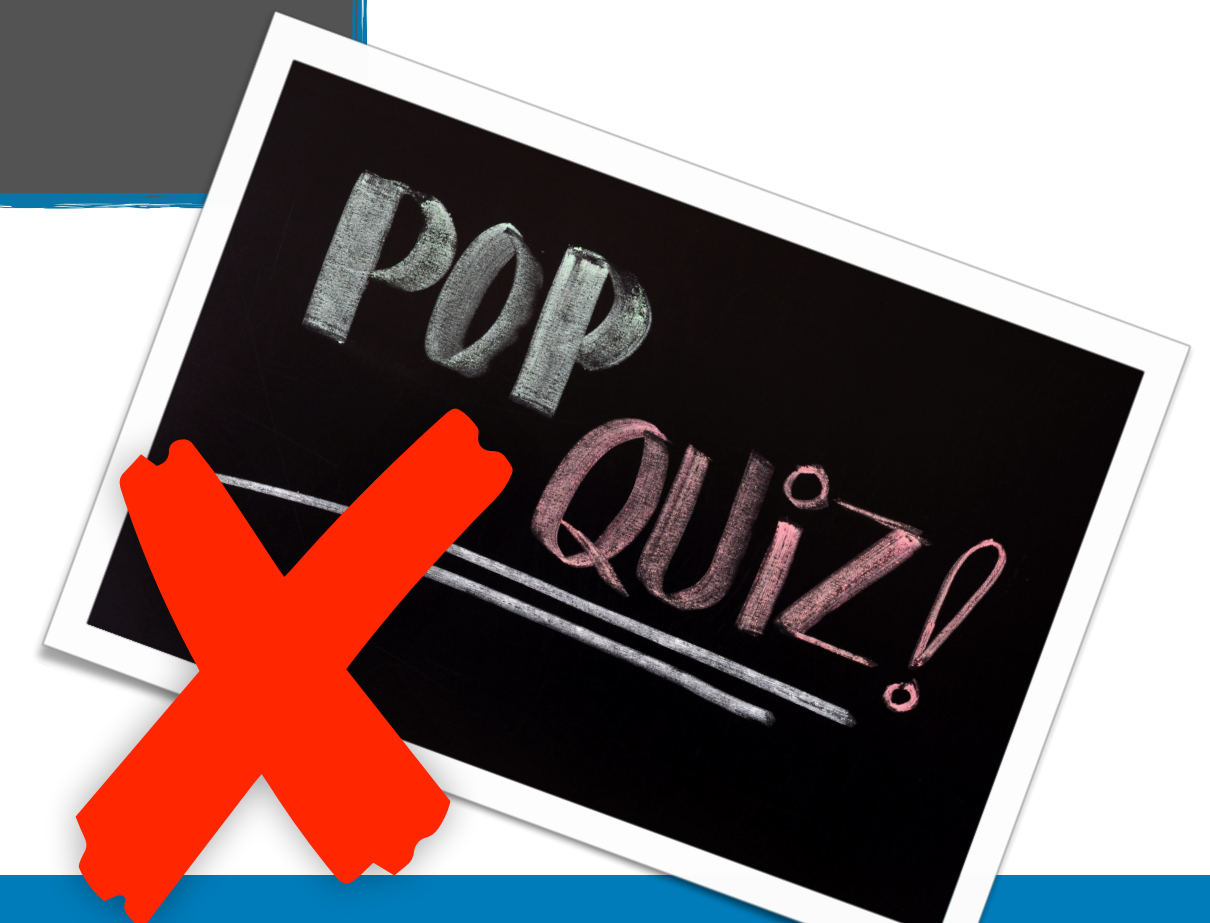


Scope Quiz: Sufficient Scopes?

- **Action:** Creating a MedicationOrder
- **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
```

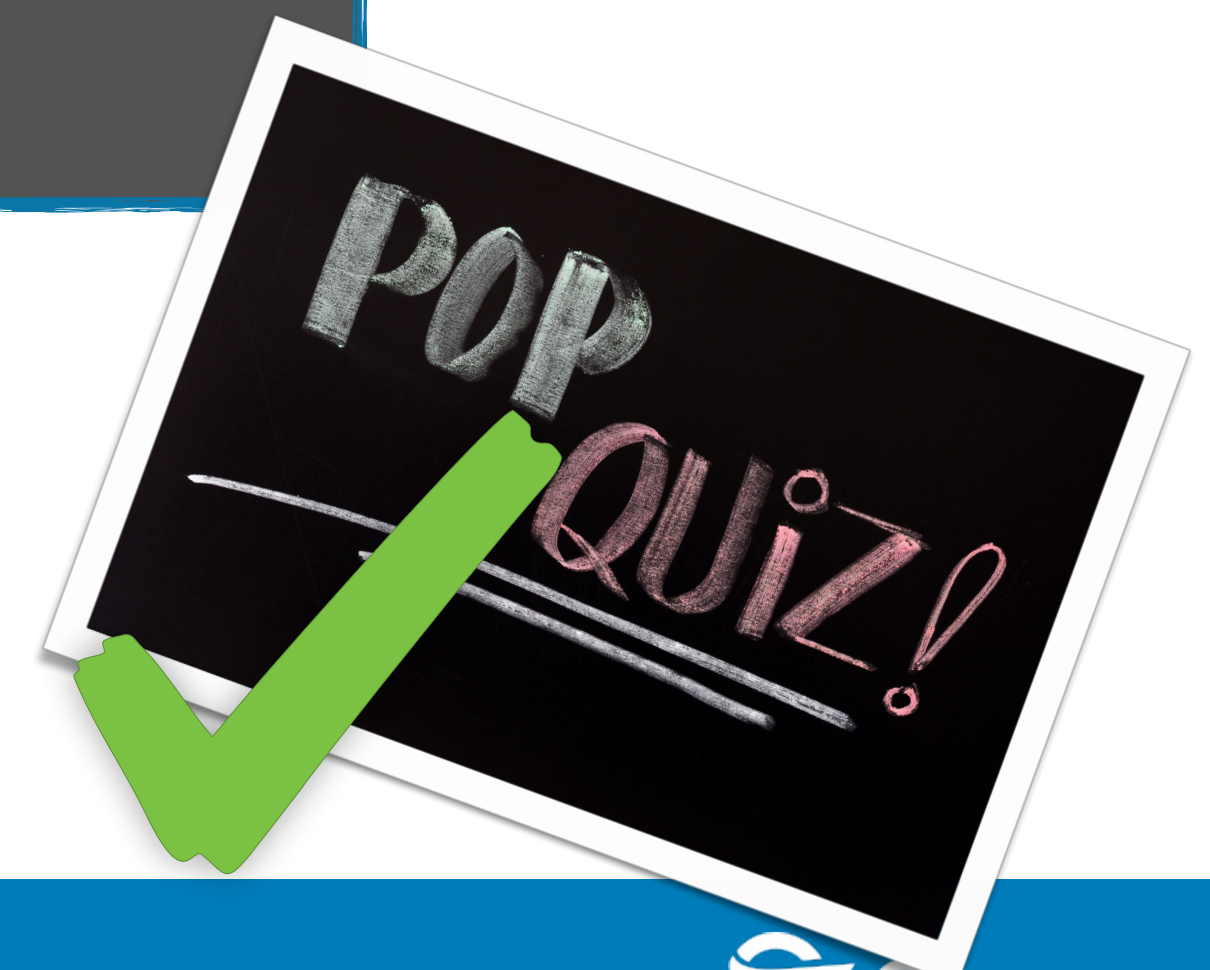


Scope Quiz: Sufficient Scopes?

- **Action:** Creating a MedicationOrder
- **Scopes:**

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

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



Example - Create with POST

Request Headers

Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...

Content-Type: application/json+fhir

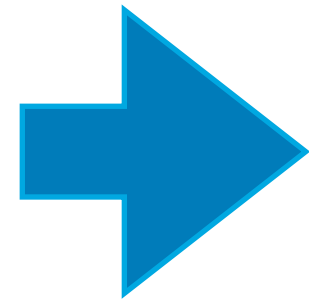
Accept: application/json+fhir

POST

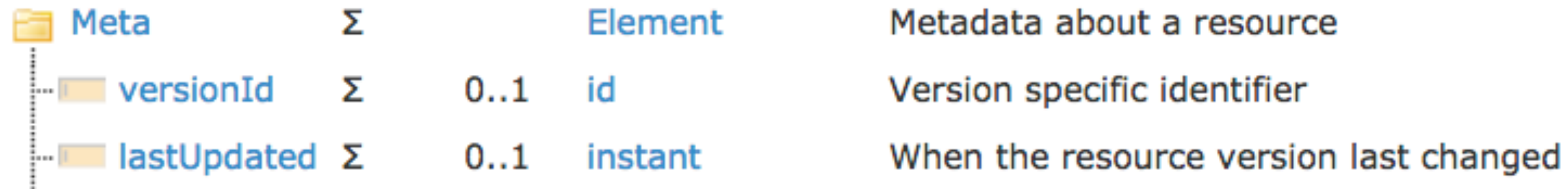
https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/AllergyIntolerance

Body

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



Body - Meta



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





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				

Example - Create with POST

Request Headers

Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...

Content-Type: application/json+fhir

Accept: application/json+fhir

POST

https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/AllergyIntolerance

Body

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


Create - Success Response

Status

201 Created

Response Headers

Location: <base url>/AllergyIntolerance/34567

Etag: W/"0"

Create Demo

Update with PUT

Example - Update with PUT

Request Headers

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

PUT

```
https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/  
AllergyIntolerance/6167733
```

Request Body

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

Example - Update with PUT

Request Headers

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

PUT

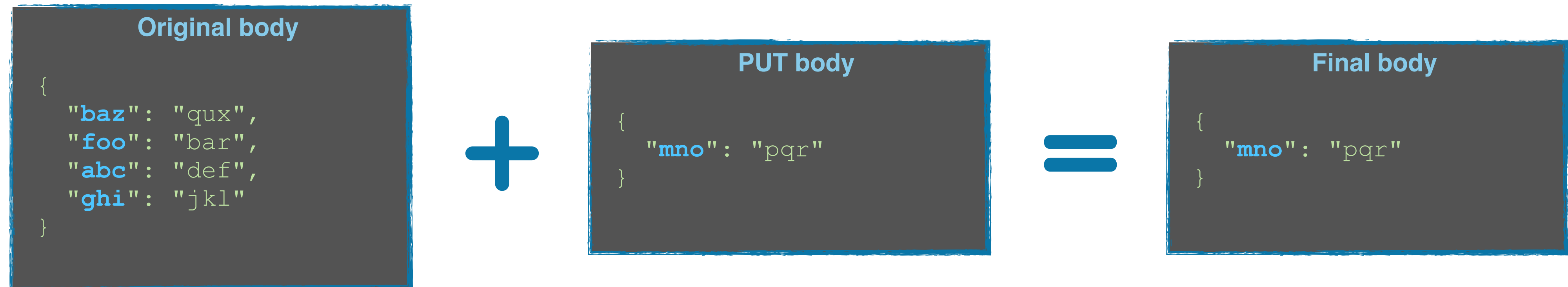
https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/
AllergyIntolerance/6167733

Request Body

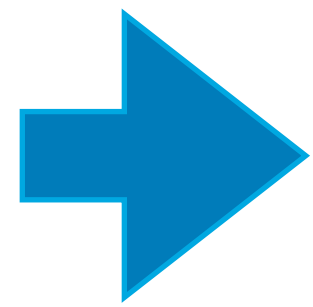
```
{  
  "resourceType": "AllergyIntolerance",  
  "id": "6167733",  
  "patient": {  
    "reference": "Patient/1316020"  
  },  
  ...  
}
```

HTTP Verb

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



Example - Update with PUT



Request Headers

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

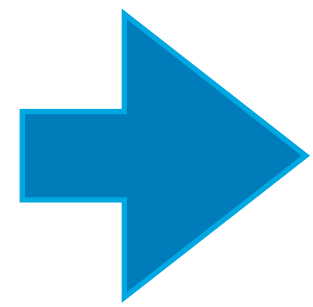
PUT

https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/
AllergyIntolerance/6167733

Request Body

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

Example - Update with PUT



Request Headers

Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...

Content-Type: application/json+fhir

Accept: application/json+fhir

If-Match: W/"2"

PUT

https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/
AllergyIntolerance/6167733

Request Body

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

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/"2"
- 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/"2"
```

PUT

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

Example - Update with PUT

Request Headers

Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...

Content-Type: application/json+fhir

Accept: application/json+fhir

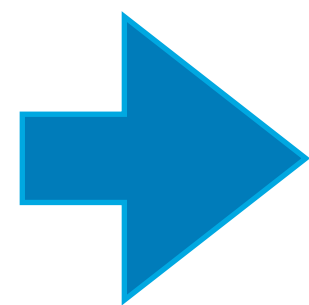
If-Match: W/"2"

PUT

https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/
AllergyIntolerance/6167733

Request Body

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



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
 - Exceptions are documented on fhir.cerner.com

Example - Update with PUT

Request Headers

Authorization: Bearer eyJraWQiOiIyMDE3LTA5LT...

Content-Type: application/json+fhir

Accept: application/json+fhir

If-Match: W/"2"

PUT

https://fhir-ehr-code.cerner.com/r4/ec2458f2-1e24-41c8-b71b-0e701af7583d/
AllergyIntolerance/6167733

Request Body

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

PUT Update - Success Response

Status

200 OK

Response Headers

Etag: W/"1"

Allergy Update Demo

Update with PATCH

A bit about PATCH...

- 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
 - Coverage
 - MedicationRequest

PATCH

- 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

- 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

- `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

- `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

- `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"
  }
]
```


Patient Patch Demo

Failure Responses

What happens when things go wrong?

Are you lost?

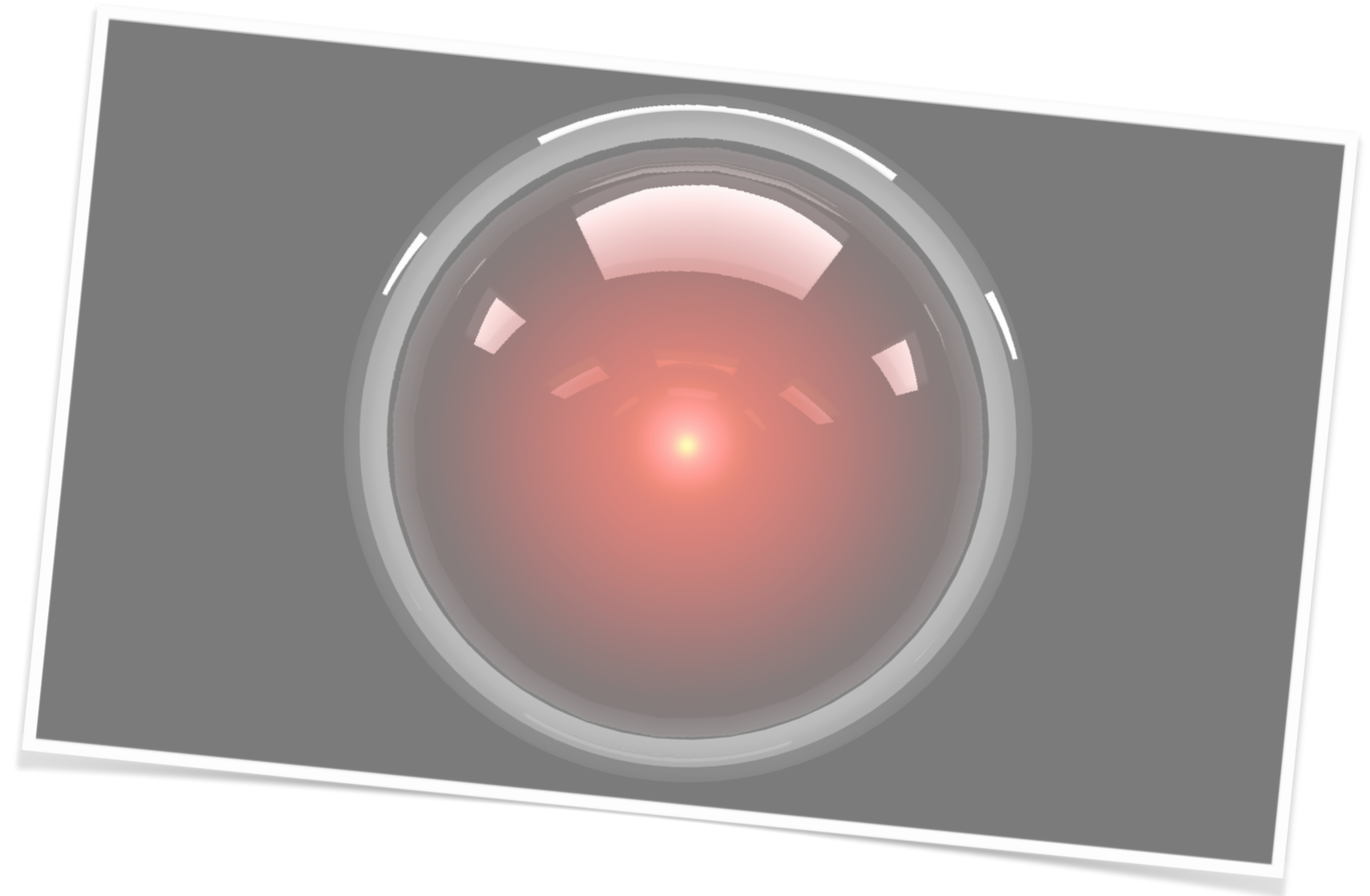
- **404 Not Found**

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)

Example Operation Outcome

- Status: 422 Unprocessable Entity

R4 OperationOutcome

```
{
  "resourceType": "OperationOutcome",
  "issue": [
    {
      "severity": "error",
      "code": "business-rule",
      "details": {
        "coding": [
          {
            "system": "http://terminology.hl7.org/CodeSystem/operation-outcome",
            "code": "MSG_PARAM_INVALID",
            "display": "Parameter 'AllergyIntolerance.category[0]' content is invalid"
          }
        ],
        "text": "The value for AllergyIntolerance.category[0] is not supported."
      },
      "diagnostics": "AllergyIntolerance.category[0]: must be one of environment, food, or medication",
      "expression": [
        "AllergyIntolerance.category[0]"
      ]
    }
  ]
}
```

Try it out yourself!

Hands on exercises

- http://bit.ly/chc_learning_lab

Thank you!