Writing Data with FHIR

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TOMORROW. TODAY.

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*

AllergyIntolerance, Appointment, Condition, Note, Medication

Prerequisites

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

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Learning Lab pre-reqs
- Core concepts - last session
- More on OAuth tomorrow

Readers of the spec/documentation/FHIR Resources themselves will be most successful!

image credit: https://hunterswritings.files.wordpress.com/2013/03/reading_and_writers.jpg

Security

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

Image credit: https://cdn-images-1.medium.com/max/494/0*QWNG5EAnPSaUSAHH.png

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

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Image credit: http://healthbeginswithmom.com/wp-content/uploads/2014/01/popquiz.jpg

Scope Quiz: Sufficient Scopes?

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Scope Quiz

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- **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 **patient/MedicationStatement.write**

HTTP Verbs

- **POST** - create resource instance
  - *POST <base url>/AllergyIntolerance*
- **PUT** - update body of instance having the given id
  - *PUT <base url>/AllergyIntolerance/123456*

PUT can support creation, Millennium creates its own ids

HTTP Verbs

- **PATCH** *(STU3)* - update specific fields in a resource
  - *PATCH <base url>/AllergyIntolerance/123456*
  - Body follows JSON Patch spec
    - **original**: `{"baz": "qux", "foo": "bar"}`
    - **patch body**: `[{"op": "replace", "path": "/baz", "value": "boo"}, {"op": "add", "path": "/hello", "value": ["world"]}, {"op": "remove", "path": "/foo"}]`
    - **result**: `{"baz": "boo","hello": ["world"]}`

https://www.hl7.org/fhir/stu3/http.html#patch
http://jsonpatch.com/

Request Considerations

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TODAY.

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 - Updates && Omissions

- On an update…
  - Send full retrieved body + changes
  - Missing fields == nulling out or removing data

Body - Modifiers

- Modifier elements change interpretations

- Supported example: **status**
- Unsupported examples:
  - **implicitRules** - uri of some implicit rules required to understand the resource's content or context
  - **modifier extensions** - modifies the meaning of a resource or attribute

implicit rules - v2 messages often require implicit knowledge

modifier extension examples:
- instruction **not** to take a medication
- assert that a performer was **not** involved in a procedure

unsafe to ignore these

Request Headers

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

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"}, …`

with what we have so far…

What about resource contention?

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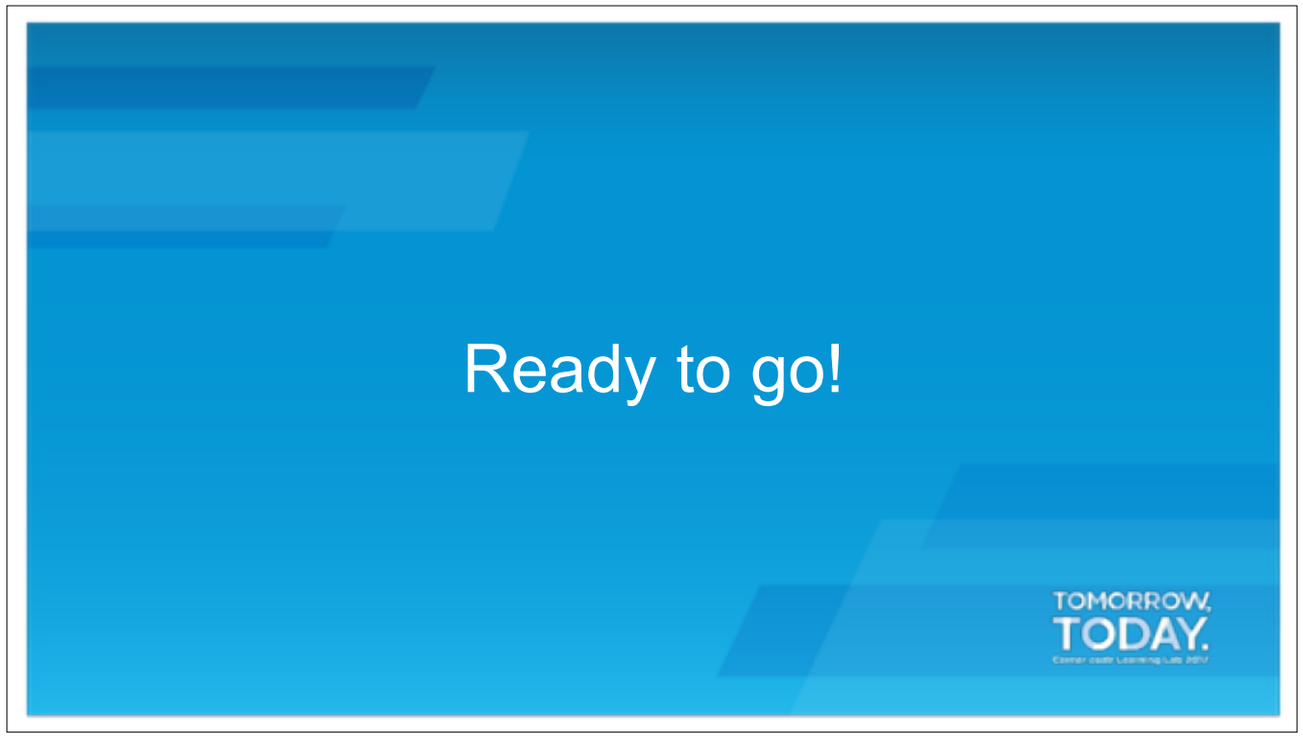
TODAY.

Optimistic Locking

- **ETag** - entity tag *write response header* indicating version
  - *e.g. ETag: W/"6167741"*
  - alternatively *W/"*[meta.versionId]*"*
- **If-Match** - *update request header* indicating the update should be made **If** the version **Match**es
  - *PUT <base url>/AllergyIntolerance/12345*
  - *If-Match: W/"6167741"*

Strong etags indicate byte-for-byte equivalence. “W”eak etags indicate semantic equivalence

ETags - https://tools.ietf.org/html/rfc7232#section-2.3
If-Match - https://tools.ietf.org/html/rfc7232#section-3.1



we are ready to start sending requests

Successful Responses

- **Successful Create**
  - *Status: 201 Created*
  - *Location: <base url>/Appointment/34567*
- **Successful Update**
  - *Status: 200 OK*

Yay happy path!

Success status + Location header


```
using AllergyIntolerance
```

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
- **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

later…

Response

- **Status:** 200 OK
- **Headers**
  - *Content-Type:* application/json+fhir
- **Body:** {"resourceType": "AllergyIntolerance", "id": "6167733", "meta": {"versionId": "**2**", "lastUpdated": "2017-02-28T21:08:25.000Z"}, "patient": {"reference": "Patient/1316020"},…

Note the version has changed

Update AllergyIntolerance

- Request **Headers**
  - *Authorization:* Bearer eyJraWQiOiIyMDE3LTA5LT…
  - *Content-Type:* application/json+fhir
  - *Accept:* application/json+fhir
  - *If-Match:* W/**"2"**
- **PUT** https://fhir-ehr.sandboxcerner.com/dstu2/0b8a0111-e8e6-4c26-a91c-5069cbc6b1ca/AllergyIntolerance/6167733
- **Body:** `{"resourceType": "AllergyIntolerance", "id": "6167733", "patient": {"reference": "Patient/1316020"}, …`

Specify correct If-Match version. No need to pass in meta.

Reply

- **Status:** 200 OK
- **Headers:**
  - *ETag*: W/"3"

Failure Responses

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As developers, we know the happy path isn’t the only result

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

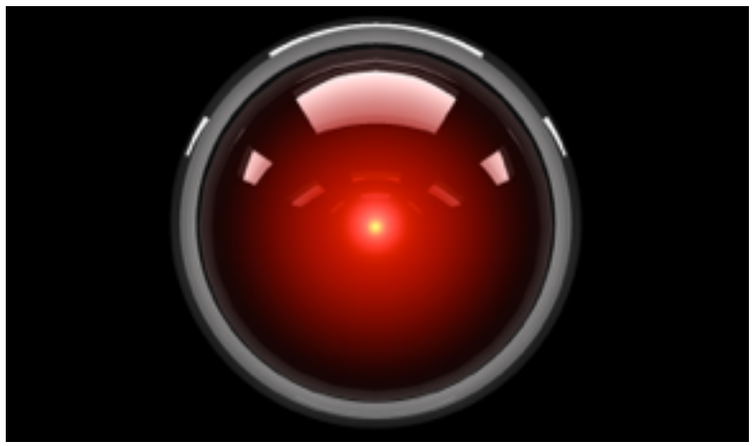

image credit: https://files.sugarcrm.com/blog/uploads/2017/01/BQQAj4R.png

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?
- troubleshooting: x-request-id response header

goal to return OperationOutcome for all failures

Example Failure

- **Status**: 422 Unprocessable Entity
- **Body**:


```
{
  "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"
      ]
    }
  ]
}
```


location - XPath to field
MedicationStatement.wasNotTaken can't be set to true. Time for more resource specifics.

Resource Specifics

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TODAY.

Resource specifics

- Touch on resources that support create/update
- Overview of resource
- Highlight special considerations (not every field)

https://hl7.org/fhir/DSTU2/allergyintolerance.html
http://fhir.cerner.com/millennium/dstu2/general-clinical/allergy-intolerance/

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)

because of not capturing the full related person or practitioner, we get into Contained here in a minute

AllergyIntolerance.reporter (Patient)

```
{
…
  "reporter": {
    "reference": "Patient/5366327"
  }
…
}
```

Contained Resources

- include other resources in the primary resource body
- contained resources do **not** have external existence
- reference relatively by '#<id>'

http://hl7.org/fhir/dstu2/references.html#contained

AllergyIntolerance.reporter (RelatedPerson)

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


significant other

AllergyIntolerance.reporter (Practitioner)

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


Referring Provider

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

manifestation	Σ	1..*	CodeableConcept	Clinical symptoms/signs associated with the Event SNOMED CT Clinical Findings (Example)

- Options
  - codified (SNOMED CT)
  - freetext

AllergyIntolerance.reaction.manifestation (codified)

```
"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 STU3

AllergyIntolerance.note (example)

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

Full Example (part 1/3)

```
{
  "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"
  },
…
```

Full Example (part 2/3)

```
…
  "reaction": [
    {
      "manifestation": [
        {
          "text": "Hives"
        }
      ]
    }
  ],
  "note": {
    "authorReference": {
      "reference": "Practitioner/41562141"
    },
    "time": "2017-02-28T09:03:00Z",
    "text": "Note 1"
  },
…
```

Full Example (part 3/3)

```
…
  "substance": {
    "coding": [
      {
        "system": "http://www.nlm.nih.gov/
research/umls/rxnorm",
        "code": "3498"
      }
    ]
  }
}
```

https://hl7.org/fhir/DSTU2/appointment.html
http://fhir.cerner.com/millennium/dstu2/scheduling/appointment/

Summary

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

Capture…

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

http://fhir.cerner.com/millennium/dstu2/scheduling/slot/

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"`

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
- No need to populate separately

Appointment.participant

participant	I	1..*	BackboneElement	Participants involved in appointment *Either the type or actor on the participant MUST be specified*

- 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"
}
```

https://www.hl7.org/fhir/DSTU2/condition.html
http://fhir.cerner.com/millennium/dstu2/general-clinical/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…

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

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

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]

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

in both you can state that there is a resolution, but abatement only for problems

Condition.notes

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 STU3

Condition.notes (example)

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


in STU3, will be an Annotation like AllergyIntolerance

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

https://www.hl7.org/fhir/dstu2/documentreference.html
http://fhir.cerner.com/millennium/dstu2/infrastructure/document-reference/

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/preliminary)
- description/title
- content
- encounter

DocumentReference.relatesTo

relatesTo	?! Σ	0..*	BackboneElement		Relationships to other documents
code	Σ	1..1	code		replaces | transforms | signs | appends DocumentRelationshipType (Required)
target	Σ	1..1	Reference(DocumentReference)		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 summery, 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

docStatus	Σ	0..1	CodeableConcept	preliminary | final | appended | amended | entered-in-error CompositionStatus (Required)

- Status of the *document itself*
- must be ‘final’ or ‘preliminary’ for new documents
  - e.g. `"docStatus": "final"`
- preliminary documents
  - stored in Millennium as “In Progress”
  - finalized in PowerChart
  - allows more detail to be added later

DocumentReference.context.period.end

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

Can capture contextual period as a different date range than when the document itself was created, but creation date is the default

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	Σ I		Element	Content in a format defined elsewhere *It the Attachment has data, it SHALL have a contentType*
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

Text should be UTF-8, then Base64 turns the binary UTF-8 data into encoded text

DocumentReference.content.attachment

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

Text should be UTF-8, then Base64 turns the binary UTF-8 data into encoded text

DocumentReference.content.attachment.data

- xhtml converted to RTF when stored in Millennium
- 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

Common Issues: https://connect.ucern.com/docs/DOC-631022

Special Formatting: Please do not use specialized formatting dependent on CSS or JavaScript. This will be stripped out of your document. It is also not recommended that you support multiple languages within your documents, as this has proven to be error prone with our current conversion tools.
- If special formatting is needed, we recommend that you post your formatted text as image files within the HTML.ML 1.0 strict as the document type to run your validation with.

DocumentReference.content.attachment.data (example)

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

Full Example (part 1/2)

```
{
  "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",
…
```

Full Example (part 2/2)

```
…
  "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"
    }
  }
}
```

http://hl7.org/fhir/dstu2/medicationstatement.html
http://fhir.cerner.com/millennium/dstu2/medications/medication-statement/

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]

medication[x]	Σ	1..1		What medication was taken
medicationCodeableConcept			CodeableConcept	
medicationReference			Reference(Medication)	

- 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

TOMORROW. TODAY.

Cerner Code Learning Lab 2017

effectivePeriod and dosage.timing.repeat.boundsPeriod

MedicationStatement.effectivePeriod

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

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

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	Σ I	0..1	Element	When the event is to occur *Either frequency or when can exist, not both* *if there's a duration, there needs to be duration units* *if there's a period, there needs to be period units* *If there's a periodMax, there must be a period* *If there's a durationMax, there must be a duration* 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

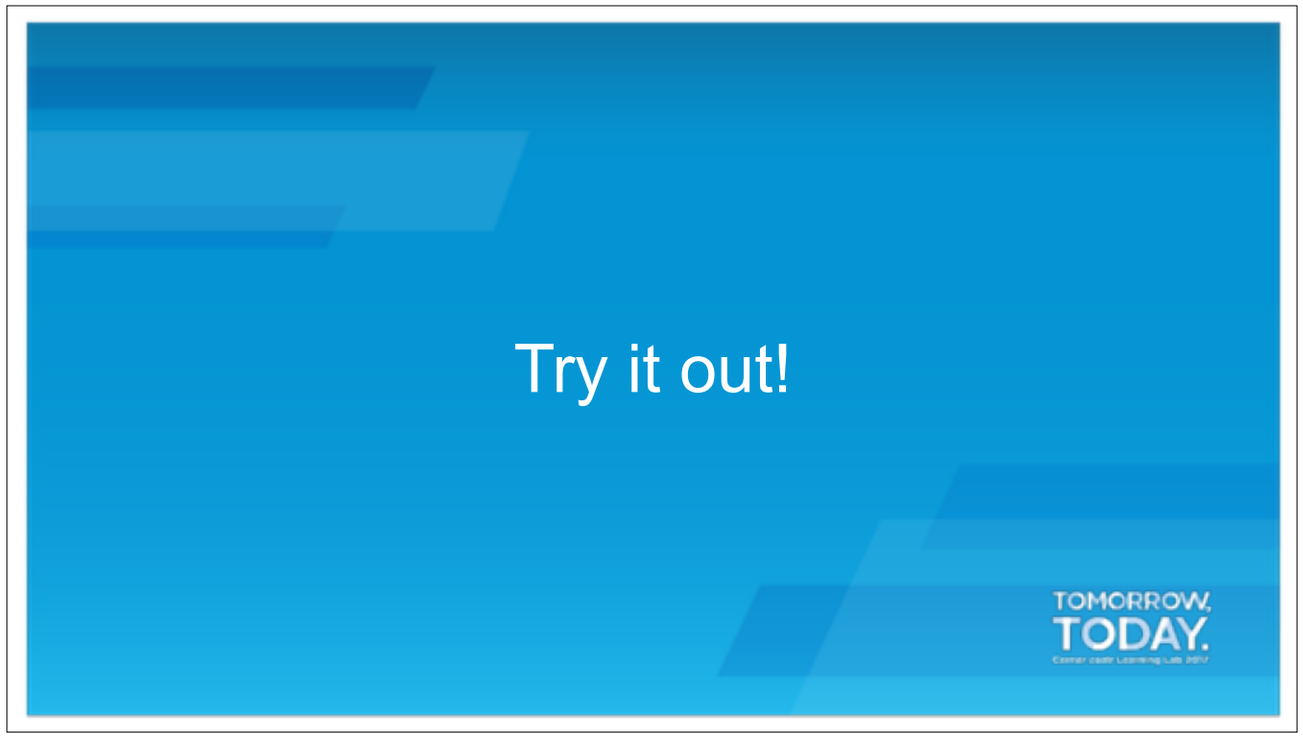
```
{
  "boundsQuantity": {
    "value": 10,
    "unit": "days",
    "system": "http://unitsofmeasure.org",
    "code": "d"
  }
}
```


Full Example (part 1/2)

```
{
  "resourceType": "MedicationStatement",
  "patient": {
    "reference": "Patient/4766007"
  },
  "status": "active",
  "medicationCodeableConcept": {
    "text": "FHIR Test Medication"
  },
…
```


Full Example (part 2/2)

```
…
  "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!
TOMORROW.
TODAY.

Hands on exercises

- http://bit.ly/chc_learning_lab

Thank you!

TOMORROW.
TODAY.