FHIR Questionnaires and Maps

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Credit

- These slides include content from Brian Postlethwaite
- With updates by Lloyd McKenzie

Forms in Healthcare

- Assessments (Primary Care)
- Assessments (consumer)
- “Patient Reported Outcomes”
- Case Report Forms
- Gov't/Statutory forms
- Referrals template
- Pre-determination/Claims Forms
- Admission forms
- Satisfaction survey
- Surgical checklists
- Public Health Reporting
- Insurance/Payments
- General data entry

Why use forms?

- AllergyIntolerance
- Condition
- Encounter
- FamilyMemberHistory
- MedicationStatement
- Observation
- Patient
- 100+ other resources

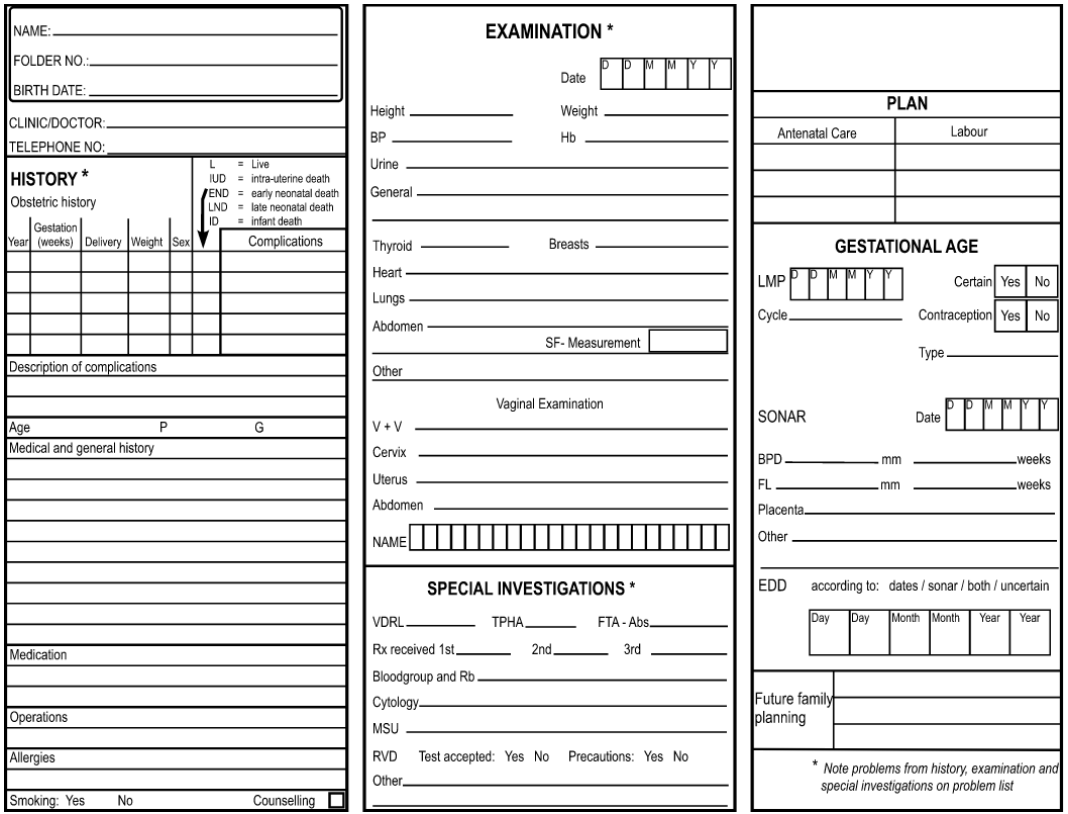
or

- QuestionnaireResponse

Forms provide:

- Tight control over user experience:
  - How questions are phrased
  - What answer choices are permitted
  - What gets asked when (and in what order)
  - User interface ‘appearance’
  - i.e. Consistency in data capture
- Full flexibility in what data is captured and how
- Very simple data model

Forms for display



NAME:
FOLDER NO.:
BIRTH DATE:
CLINIC/DOCTOR:
TELEPHONE NO:

HISTORY *
Obstetric history

L = Live
IUD = intra-uterine death
END = early neonatal death
LND = late neonatal death
ID = infant death

Year	Gestation (weeks)	Delivery	Weight	Sex		Complications

Description of complications

Age P G

Medical and general history

Medication

Operations

Allergies

Smoking: Yes No Counselling ☐

EXAMINATION *

Date D D M M Y Y

Height Weight
BP Hb
Urine
General

Thyroid Breasts
Heart
Lungs
Abdomen
SF- Measurement
Other

Vaginal Examination
V + V
Cervix
Uterus
Abdomen
NAME

SPECIAL INVESTIGATIONS *

VDRL TPHA FTA - Abs
Rx received 1st 2nd 3rd
Bloodgroup and Rb
Cytology
MSU
RVD Test accepted: Yes No Precautions: Yes No
Other

PLAN

Antenatal Care	Labour

GESTATIONAL AGE

LMP D D M M Y Y Certain Yes No
Cycle Contraception Yes No
Type

SONAR Date D D M M Y Y
BPD mm weeks
FL mm weeks
Placenta
Other

EDD according to: dates / sonar / both / uncertain

Day	Day	Month	Month	Year	Year

Future family planning

* *Note problems from history, examination and special investigations on problem list*

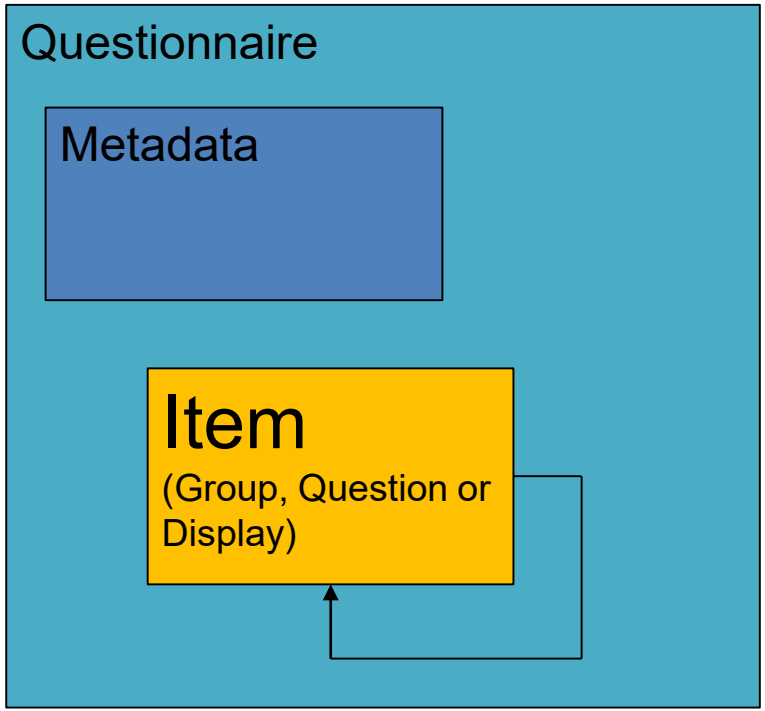
Why use anything other than Forms?

- Questionnaire responses aren't "standard"
  - Inconsistent over time (different form 'versions')
    - Forms change fairly often
  - Inconsistent across organizations
  - Meaning of elements influenced by previous questions
    - "Address" means different things depending where it appears on the form
- In general, can't query QuestionnaireResponse based on what the answers are

Common pattern

- Use forms to capture data
  - Especially when using ‘simple’ clients
  - Possibly use ‘population’ to suck in data from existing records
- Extract data from form into other resources
- Use Provenance to tracker where the data came from
- Primarily pass around other resources
  - Can pass around Provenance and original QuestionnaireResponse if needed

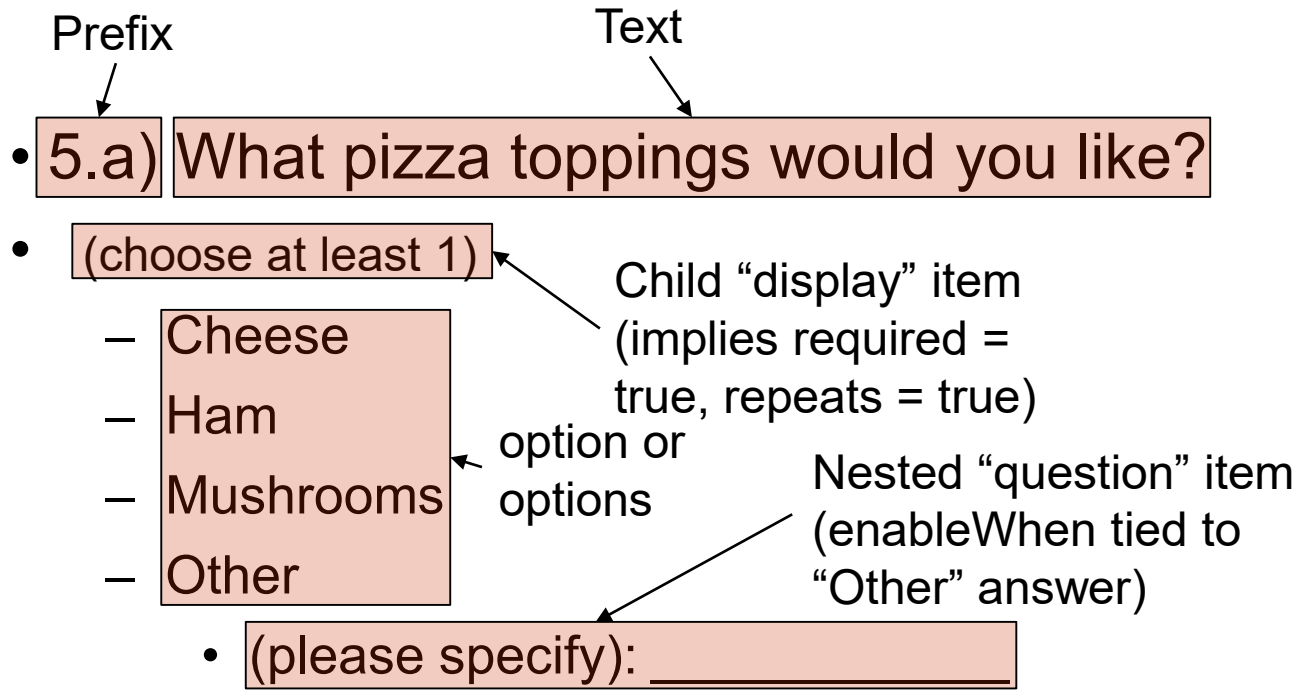
Structure of a Questionnaire



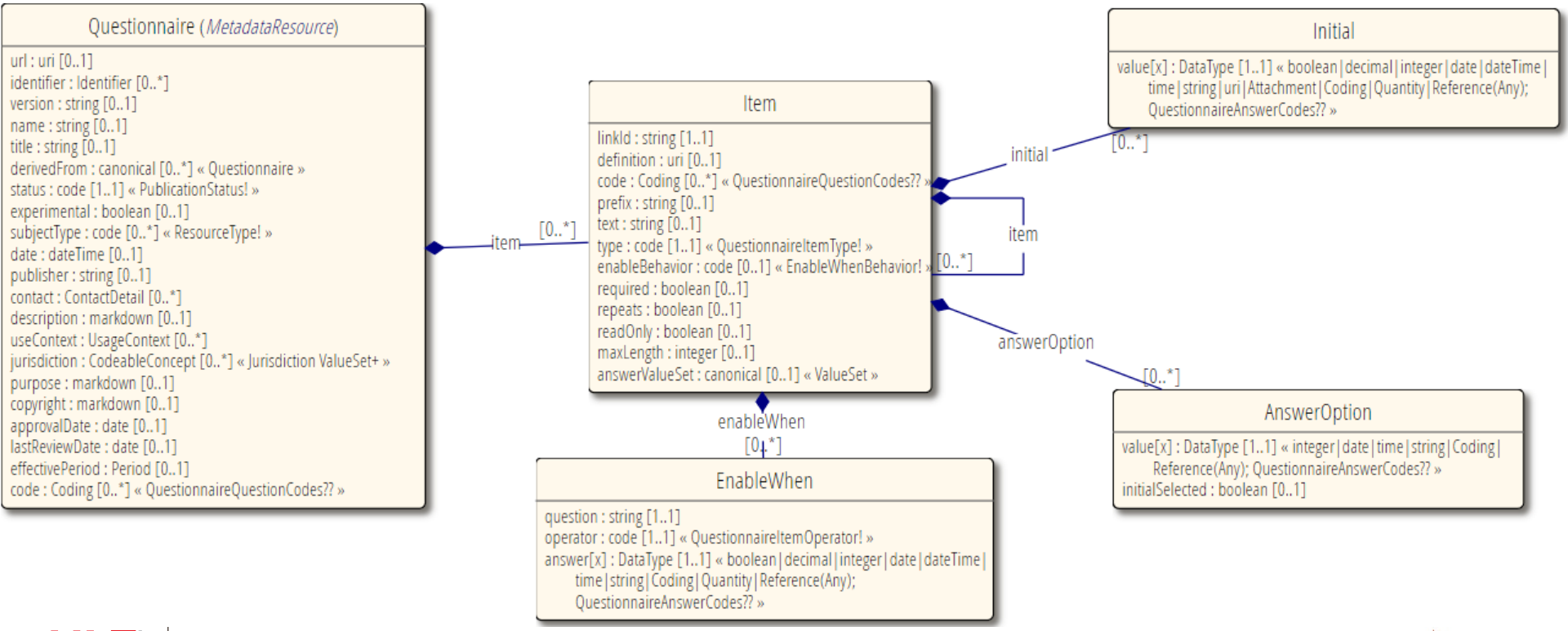
Types of item

- Groups
  - Organize content of questionnaire
  - Must have children
  - Can’t have answers
- Questions
  - Solicit information
  - Must have answers (but can be optional)
- Display
  - Additional text, no children, no answers

Anatomy of a Question



Questionnaire



Linking Questionnaire to QuestionnaireResponse

Questionnaire

```
<item>
  <linkId value="G1"/>
  <text value="Test questions"/>
  <type value="group"/>
  <repeats value="true"/>
  <item>
    <linkId value="Q1"/>
    <text value="What is your name?"/>
    <type value="string"/>
  </item>
  <item>
    <linkId value="Q2"/>
    <text value="What is your quest?"/>
    <type value="string"/>
  </item>
  <item>
    <linkId value="Q3"/>
    <text value="What is your favorite colour?"/>
    <type value="string"/>
  </item>
</item>
```

QuestionnaireResponse

```
<item>
  <linkId value="G1"/>
  <text value="Test questions"/>
  <item>
    <linkId value="Q1"/>
    <text value="What is your name?"/>
    <answer>
      <valueString value="Sir Lancelot of Camelot"/>
    </answer>
  </item>
  <!-- ... -->
</item>
<item>
  <linkId value="G1"/>
  <text value="Test questions"/>
  <item>
    <linkId value="Q1"/>
    <text value="What is your name?"/>
    <answer>
      <valueString value="Sir Robin of Camelot"/>
    </answer>
  </item>
  <!-- ... -->
</item>
```

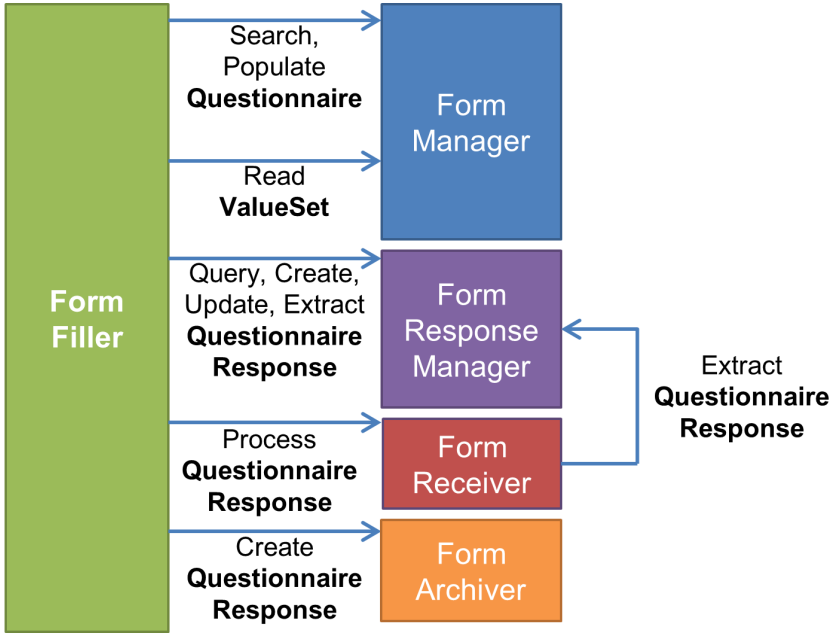
STRUCTURED DATA CAPTURE

What is Structured Data Capture (SDC)?

- Standardize/enhance capabilities of FHIR Questionnaires:
  - Workflow
  - Complex form rendering
  - Complex form behavior
  - Automatically populating forms
  - Automatically extracting data from completed forms
  - Adaptive forms

Complex workflow

- How do you find a form?
- How do you retrieve allowed values?
- How do you manage form completion?
- How do you submit a form?
- How do you ask someone to complete a form?
- How do you track whether they've filled it out?
- How do you derive one form from another?



Complex form rendering

- Have questions/instructions render the way you want
  - Pick at least one green option and no more than one red option
  - How are you feeling today?  is “great”,  is “horrible”
- Hide or mark certain questions as ‘read only’ (e.g. calculated score)
- Should questions be a grid or table? Should a question use a dropdown? Checkboxes? Radio buttons?
  - And within that, how wide should columns be, what should column headings be, what should the steps on a slider be, etc.
- Additional display guidance.
  - Social Security number: `nnn-nnn-nnn`

Complex form behavior

- EnableWhen questions based on expressions
  - If the total score from group 1 > 30, then display these additional cardiology questions
- EnableWhen options
  - Only display “pregnancy” in “reason for absence” if gender = F
- Constraints
  - Can have a maximum of 2 questions with an answer of “most preferred”

Complex form behavior (cont'd)

- Constrain values
  - 5-10 characters
  - January 1-March 30
  - YYYY-MM
  - Must be a JPG or PNG, < 500KB
  - Must be lb or kg
  - Minimum 3 choices, maximum of 5

Complex form behavior (cont'd)

- Constrain references
  - Answer must be Condition or "Diagnosis Observation"
  - Possible answers are: Observation?patient=$patient.id&code=12345-5&…
  - "Click here to create a new value" (launches new questionnaire)

Complex form behavior (cont'd)

- Perform calculations (e.g. scores)
  - Launch context – patient, encounter, etc.
  - Use CQL or FHIRPath for calculations
  - Variables, initial expressions
- Create forms constructed from other forms

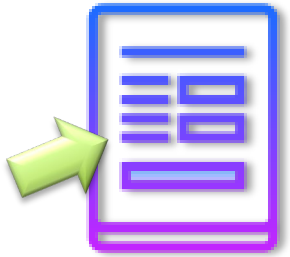
Pre-population

- Requires:
  - context/source
  - mapping
  - processing engine
  - Knowledge of source structures (particularly profiled scope)

Pre-population

- Current $populate Options:
  - Observation based
  - FHIRPath based
  - StructureMap based

Pre-population – Observation based



- Low flexibility of Questionnaire structure in mapping
- Source
  - Context may be provided in parameter, or SMART
  - Item.code for LOINC/SNOMED/other to search
  - Extension questionnaire-observationLinkPeriod to define range to check for last observation to read
- Mapping
  - Item.code for LOINC/SNOMED/other for the values to be extracted from the observation
  - Groups can be used for extracting observation components
  - If the system understands that codings like LOINC 21112-8 is patient.birthDate, then it may extract data like this also

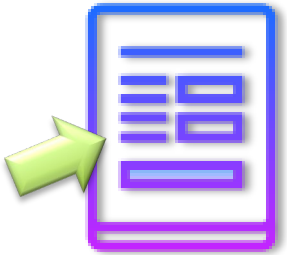
```
<item>
<extension url="http://hl7.org/fhir/StructureDefinition/questionnaire-observationLinkPeriod">
  <valueDuration>
    <value value="3"/>
    <system value="http://unitsofmeasure.org"/>
    <code value="mo"/>
  </valueDuration>
</extension>
<linkId value="code-pop-demo"/>
<code>
  <system value="http://loinc.org"/>
  <code value="29463-7"/>
  <display value="Body weight"/>
</code>
<code>
  <system value="http://loinc.org"/>
  <code value="3141-9"/>
  <display value="Body weight Measured"/>
</code>
<code>
  <system value="http://loinc.org"/>
  <code value="8341-0"/>
  <display value="Dry body weight Measured"/>
</code>
<text value="What is your current weight?"/>
<type value="quantity"/>
```

During the pre-population stage, this is the query that could be produced to extract the data:
(assuming that the date of 3 months ago was 2020-06-02)
[base]?Observation?subject=[questionnaire response subject id]
&code=http%3A//loinc.org|29463-7,http%3A//loinc.org|3141-9, http%3A//loinc.org|8341-0
&status=completed
&date=ge2020-06-02
&_sort=-date
&_count=1

```
</item>
```

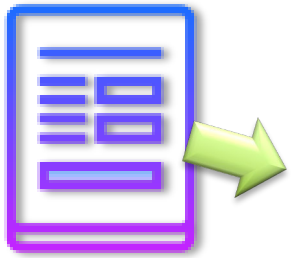
Pre-population – FHIRPath based

- Source
  - Context may be provided in parameter, or SMART
    - extension questionnaire-launchContext
    - Produces a bundle for processing
- Mapping
  - FHIR Path expressions for each property to map
    - extension “questionnaire-itemContext”
    - Extension “sdc-questionnaire-initialExpression”
  - Leverage variables to assist in calculations
    - Extension “variable” uses Expression datatype
- More Flexible, requires knowledge of FHIRPath and FHIR Queries to create the mappings



Conversion/Mapping to other resources

http://build.fhir.org/ig/HL7/sdc/extraction.html



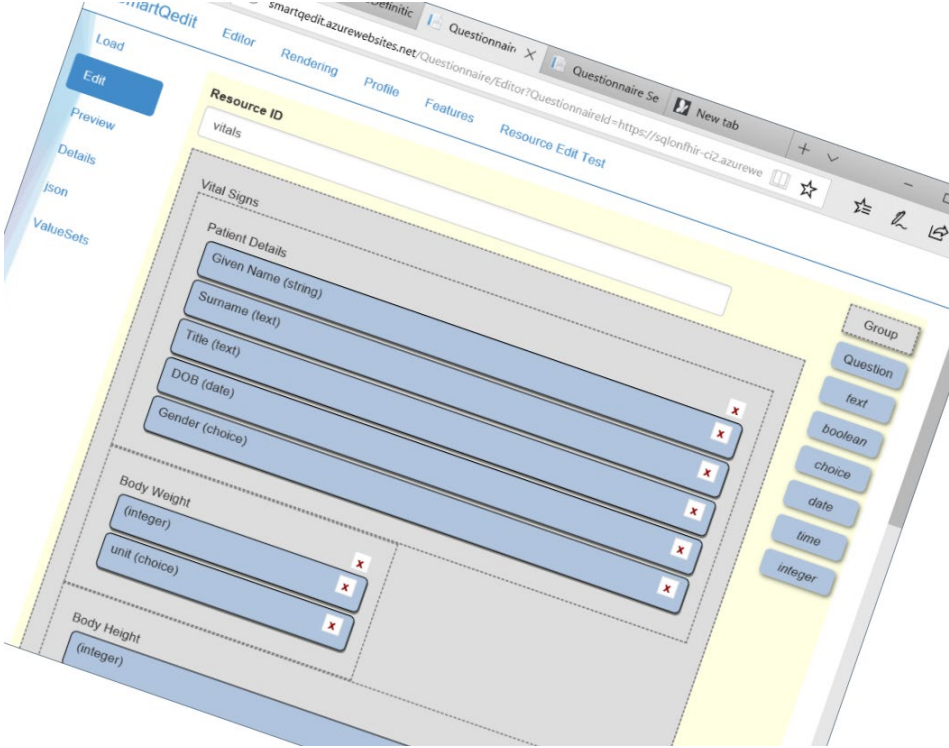
- Observation based extraction
  - Item.code for LOINC/SNOMED/other codings for the values to be extracted
  - groups can create components in the observation too
- Definition based extraction (http://hl7.org/fhir/questionnaire.html#2.38.5.4)
  - item.definition directly links to an element in a structure definition
    e.g. http://hl7.org/fhir/StructureDefinition/Observation#Observation.comment
  - Can link each item, supporting repeating items!
  - Caveat: can't do complex split/join/calculations, and shape of questionnaire must closely match StructureDefinition
- StructureMap based extraction
  - Explicit mappings for every property
  - Uses the FHIR mapping language, can be very complex but flexible, it is a transform language
  - Use the questionnaire-targetStructureMap extension on the questionnaire

Creating Questionnaires

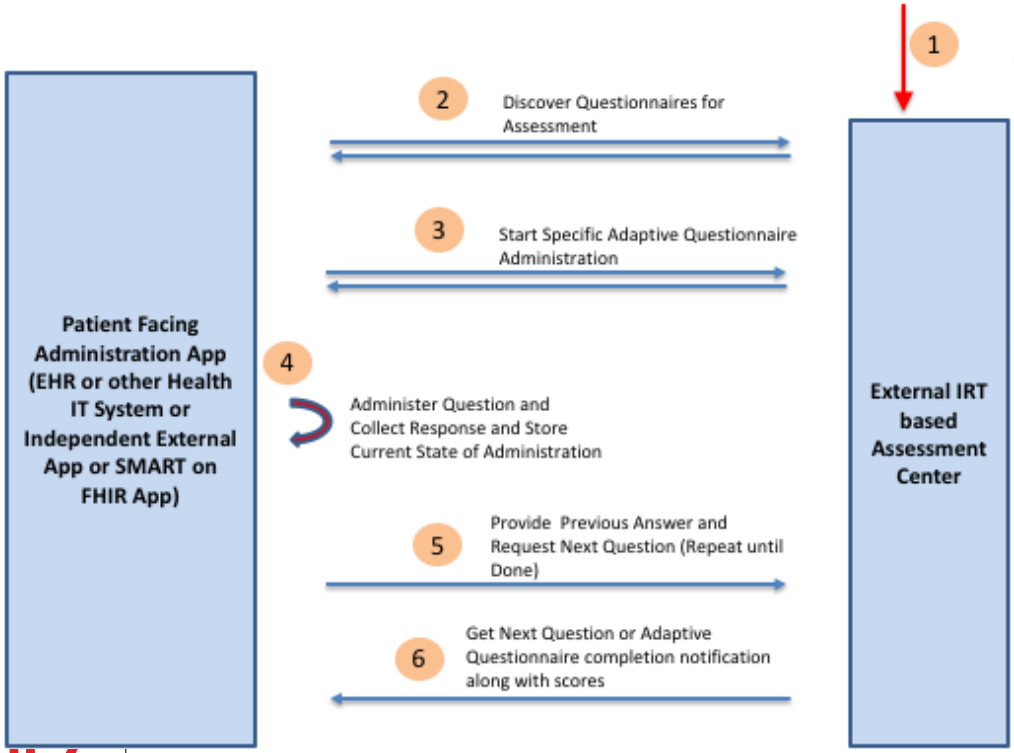
- Converting existing non FHIR definitions
- U.S National Library of Medicine's Form Builder for LHC-Forms/FHIR Questionnaire (STU3, R4)
- Grahame's editor
- SmartQ editor (DSTU2/STU3 only)

  http://smartqedit.azurewebsites.net
- Using text editor
- Others?

(or combination of the above)



Adaptive forms



- Q:What is your name?
  - A: Arthur 54125-0
- Q: What is your quest?
  - A: Holy Grail 86505-5
- Q: What is the air-speed velocity of an unladen swallow?
  - A: 86508-9

MORE ON MAPPING

FHIR provides 3 tools to support mapping

- Mappings in profiles
- Concept maps
- Structure Maps

Profile Mappings

```
"isModifier" : false,
"isSummary" : false,
"mapping" : [
  {
    "identity" : "workflow",
    "map" : "Request.identifier, Event.identifier"
  },
  {
    "identity" : "w5",
    "map" : "FiveWs.identifier"
  },
  {
    "identity" : "rim",
    "map" : ".id"
  }
```

14.43.6 Resource Profile: SDCTaskQuestionnaire - Mappings

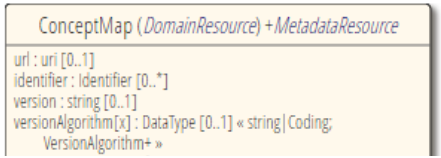
Page standards status: Draft

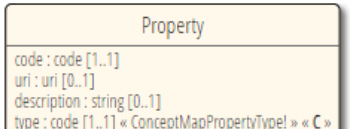
Mappings for the sdc-task resource profile.

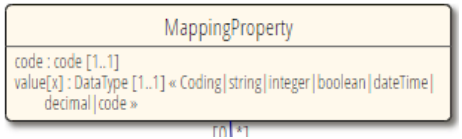
14.43.6.1 Mappings for Workflow Pattern (http://hl7.org/fhir/workflow)

SDCTaskQuestionnaire	
Task	Request, Event
identifier	Request.identifier, Event.identifier
instantiatesCanonical	Request.instantiatesCanonical, Event.instantiatesCanonical
instantiatesUri	Event.instantiatesUrl
basedOn	Request.basedOn, Event.basedOn
groupIdentifier	Request.groupIdentifier
partOf	Event.partOf
status	Request.status, Event.status
intent	Request.intent
priority	Request.priority
code	Request.code, Event.code
for	Request.subject, Event.subject
encounter	Request.context, Event.context
executionPeriod	Event.occurrence[x]
authoredOn	Request.authoredOn
requester	Request.requester

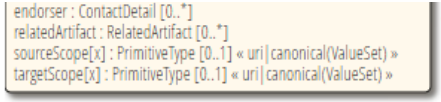
FHIR provides 3 tools to support mapping

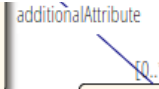


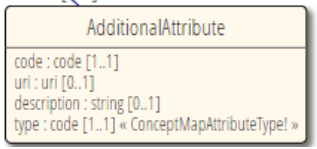


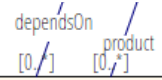


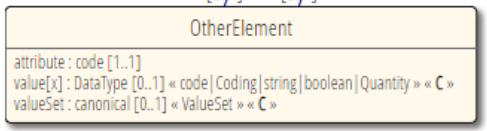
Code	System	Display	Definition	v2 map for AdministrativeGender	v3 map for AdministrativeGender
male	http://hl7.org/fhir/administrative-gender	Male	Male.	~M	~M
female	http://hl7.org/fhir/administrative-gender	Female	Female.	~F	~F
other	http://hl7.org/fhir/administrative-gender	Other	Other.	>A *(Source concept 'other' is broader than target concept 'Ambiguous' because target concept does not include 'Other')* >O *(Source concept 'other' is broader than target concept 'Other' because target concept does not include 'Ambiguous')*	<UN
unknown	http://hl7.org/fhir/administrative-gender	Unknown	Unknown.	~U	~UNK



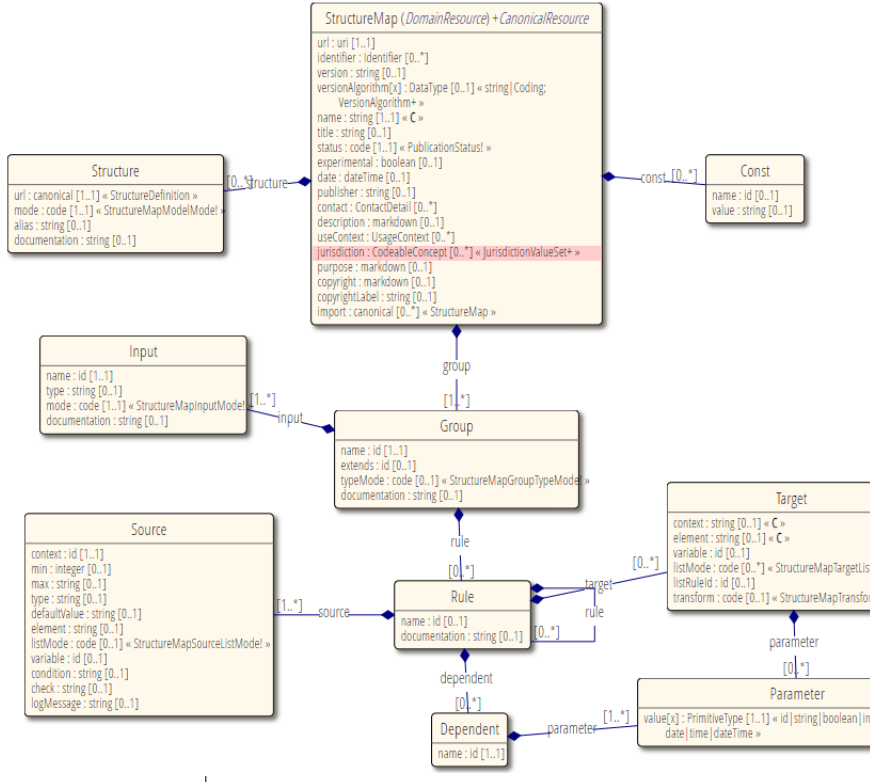








FHIR provides 3 tools to support mapping



14.103.1 StructureMap: SDOHCC StructureMap Hunger Vital Sign

Official URL: **http://hl7.org/fhir/uv/sdc/StructureMap/SDOHCC-StructureMapHungerVitalSign**	
Standards status: Trial-use	Maturity Level: 3

A map that converts an SDOCC hunger vital sign questionnaire to a Bundle of Conditions and Observations

```
map "http://hl7.org/fhir/uv/sdc/StructureMap/SDOHCC-StructureMapHungerVitalSign" = "SDOHCCStructureMap

// A map that converts an SDOCC hunger vital sign questionnaire to a Bundle of Conditions and Observat

uses "http://hl7.org/fhir/StructureDefinition/QuestionnaireResponse" alias questionnaireResponse as so
uses "http://hl7.org/fhir/StructureDefinition/Bundle" alias bundle as target
uses "http://hl7.org/fhir/StructureDefinition/Observation" alias observation as target
uses "http://hl7.org/fhir/StructureDefinition/Condition" alias sdohccCondition as target
uses "http://hl7.org/fhir/StructureDefinition/Observation" alias sdohccObservation as target

group sdohMapping(source src : questionnaireResponse, target bundle : Bundle) {
  src -> bundle.id = 'SDOHCC-BundleHungerVitalSignExample' "bundleId";
  src -> bundle.type = 'transaction' "bundleType";
  src.item as answerItem3 where linkId = '/88124-3' ->  bundle.entry as entry,  entry.resource = creat
c, answerItem3, observation3, entry);
  src.item where (linkId = '/88124-3') and (answer.value.code = 'LA19952-3') ->  bundle.entry as entry
nsformCondition(src, bundle, condition, entry);
}

group TransformObservation(source src : questionnaireResponse, source answerItem, target observation :
  src -> entry.request as request then {
    src -> request.method = 'POST' "obsnRequestMethod";
```

Questions / Discussion

- lloyd@dogwoodhealthconsulting.com
- http://hl7.org/fhir/uv/sdc

- Or, better yet, include the community and ask/discuss on http://chat.fhir.org