FHIR Questionnaires, Maps, and Simplifier

University of Victoria

Lloyd McKenzie
May 17, 2023

Who am I?

- Name: Lloyd McKenzie

- Company: Gevity

- Background:
    - One of FHIR's 3 initial editors
    - Co-chair FHIR Management Group and FHIR-Infrastructure
    - HL7 Fellow
    - Lead for both the ONC and international FHIR SDC projects
    - lloyd@dogwoodhealthconsulting.com

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

HL7 International

FHIR

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
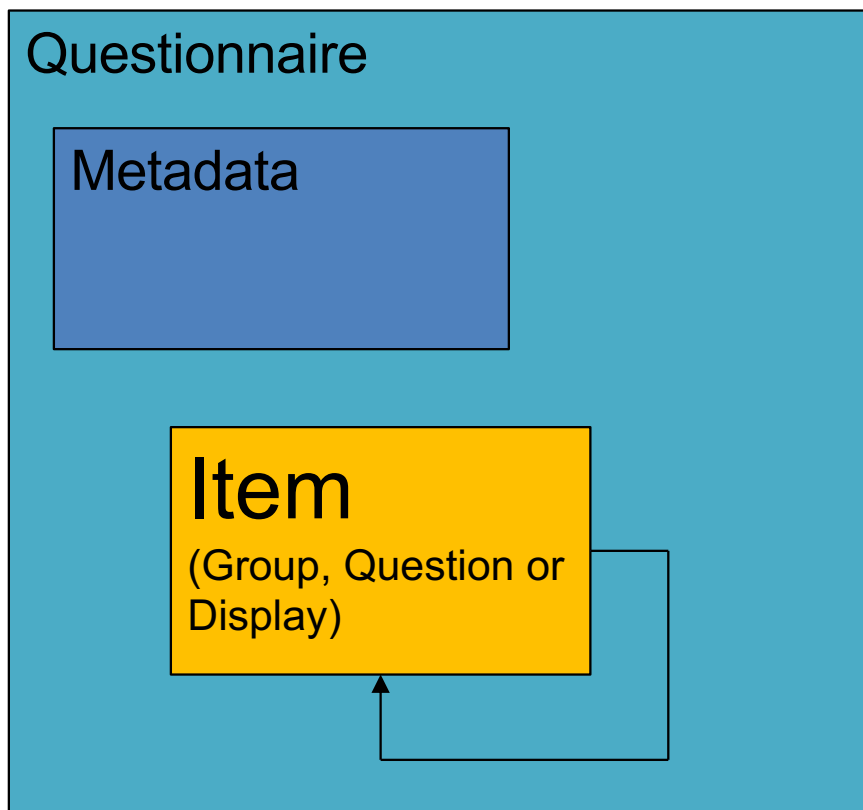- Very simple data model

Forms for display

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
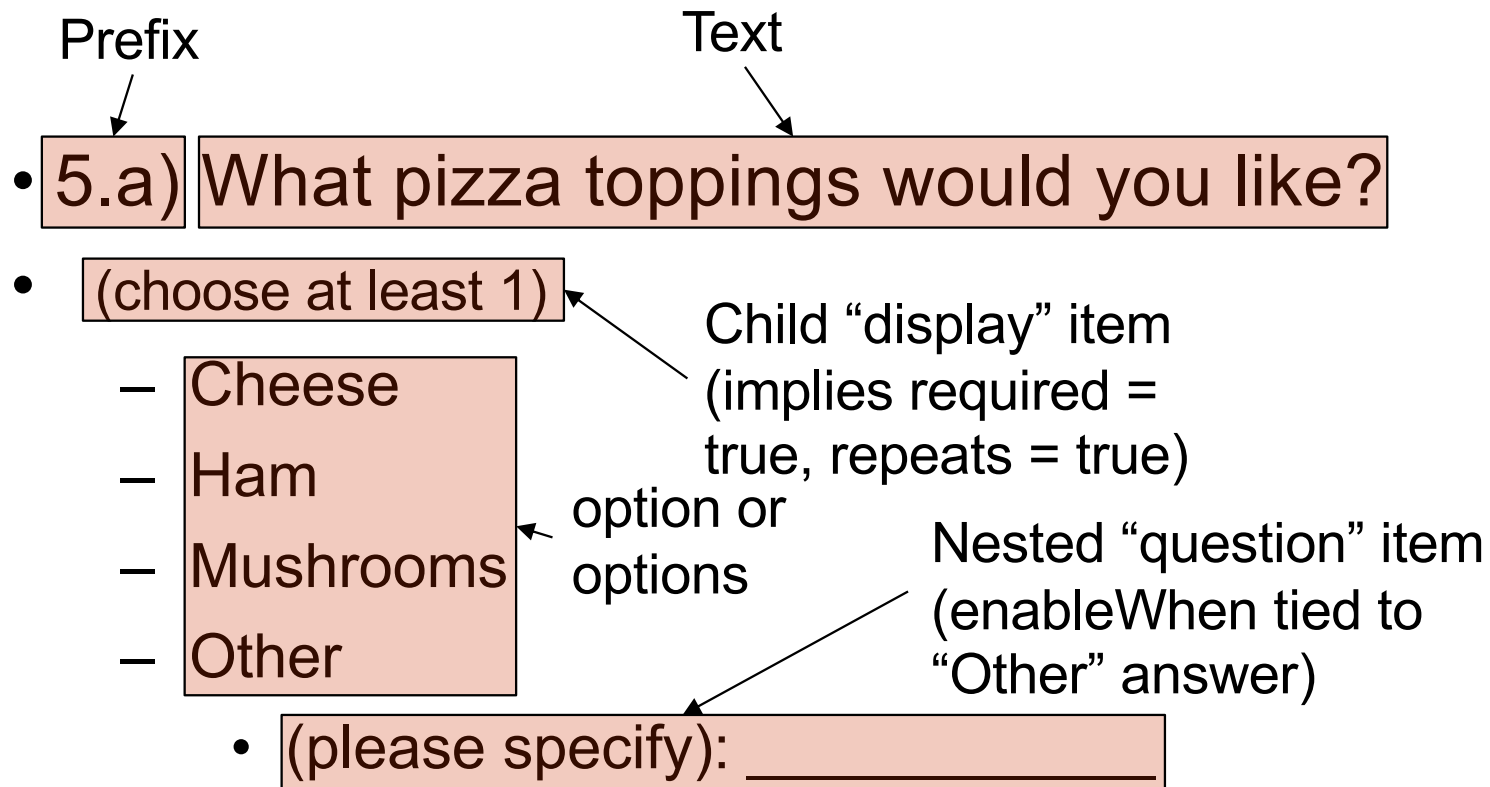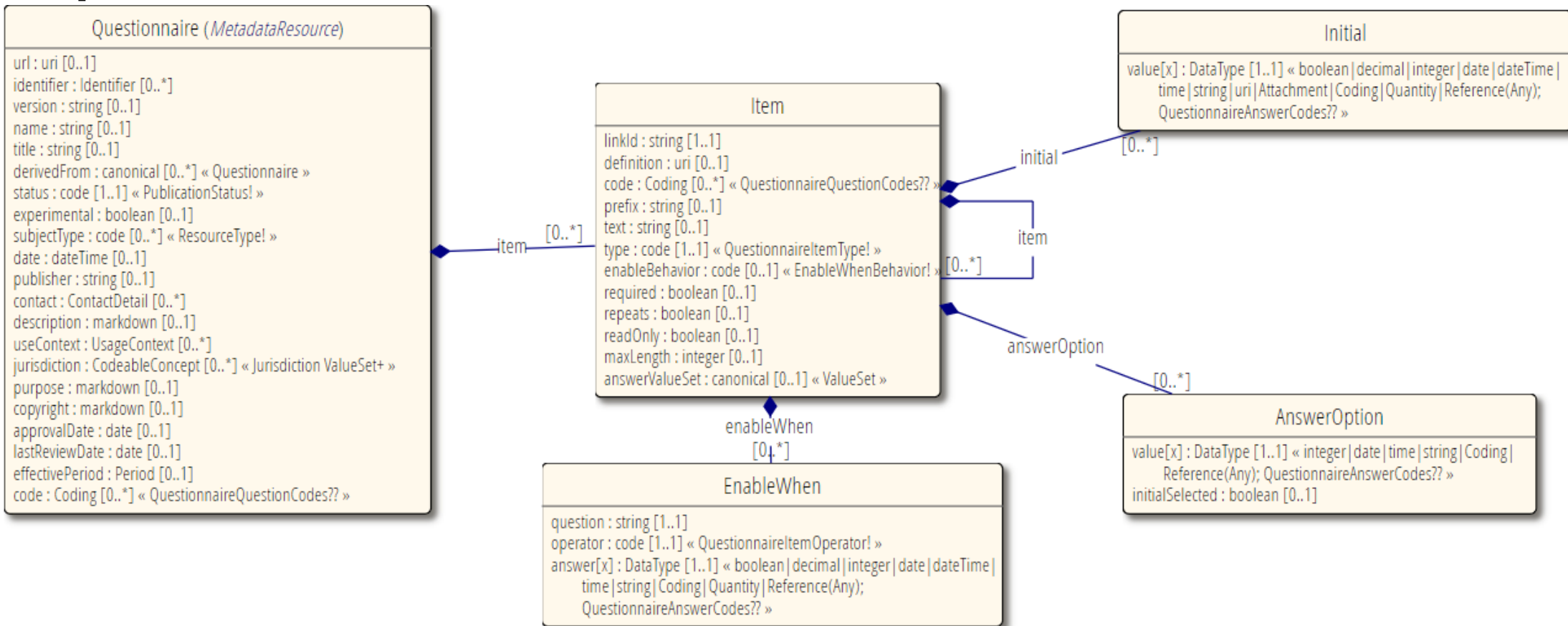
Structure of a Questionnaire

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

HL7
International

FHIR®

Anatomy of a Question

Prefix

Text

- 5.a) What pizza toppings would you like?

- (choose at least 1)

  Child "display" item (implies required = true, repeats = true)

  - Cheese
  - Ham
  - Mushrooms
  - Other

  option or options

  Nested "question" item (enableWhen tied to "Other" answer)

  - (please specify): _____

HL7 International

FHIR®

Questionnaire

Linking Questionnaire to QuestionnaireResponse

Questionnaire

QuestionnaireResponse

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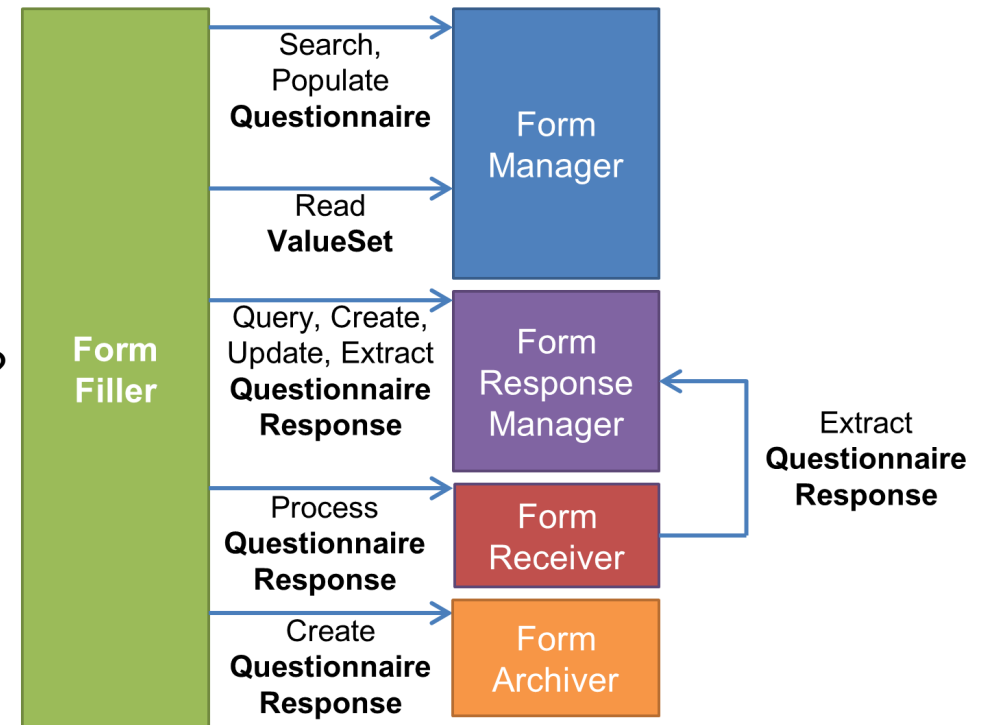
```
<item>
  <linkId value="G1"/>
  <text value="Test questions"/>
  <item>
    <linkId value="Q1"/>
    <text value="What is your name?"/>
    <answer>
      <valueString value="Sir Lancelot of Camelot"/>
    </answer>
  </item>
  <!-- ... -->
</item>
<item>
  <linkId value="G1"/>
  <text value="Test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

```xml
<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

```xml
</item>
```

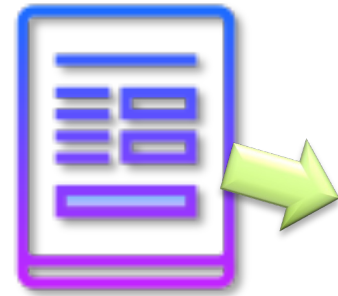# Pre-population – FHIRPath based

- 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
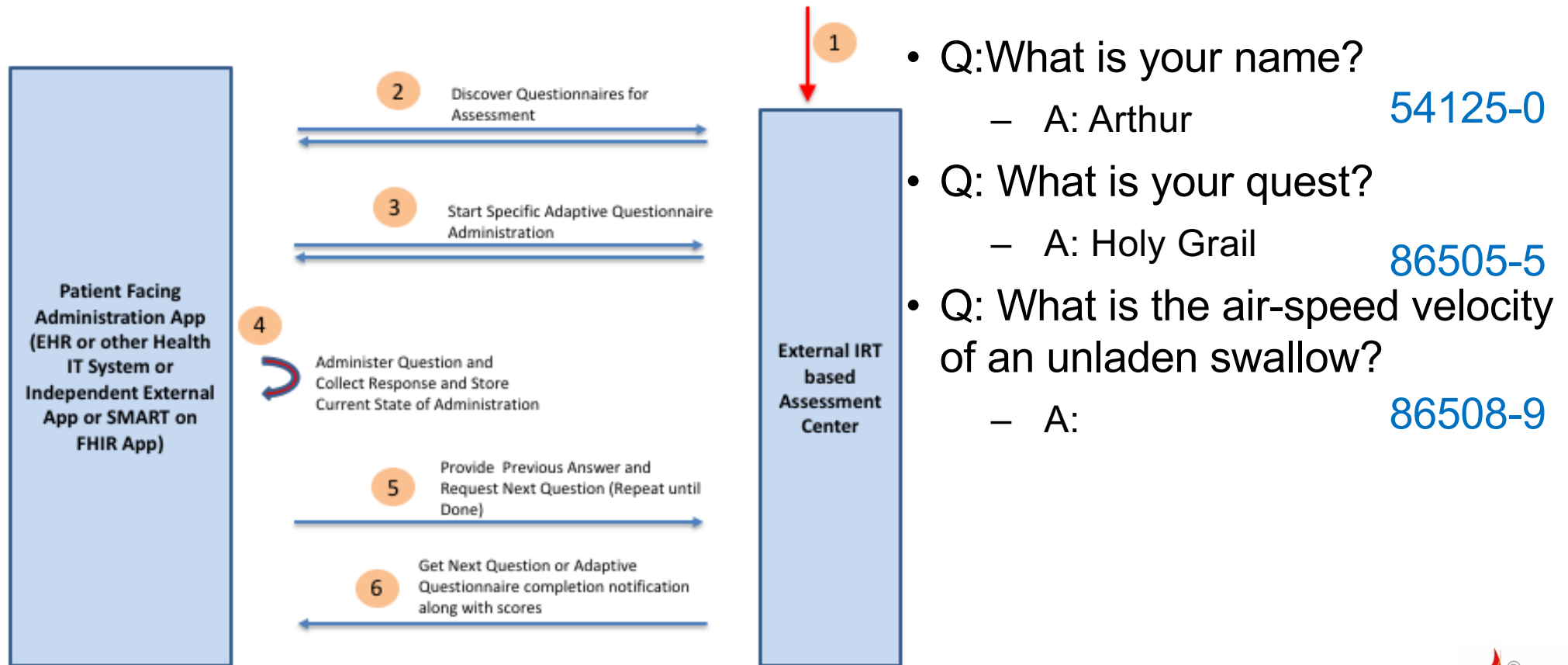
Conversion/Mapping to other resources

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

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