

FHIR Questionnaires and Structured Data Capture

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Who am I?

- Brian Postlethwaite
- Senior Solutions Architect
Telstra Health Australia



- HL7 International Patient Administration co-chair
- HL7 FHIR Management Group member
- .NET fhir-net-api and fhir-net-web-api contributor
- Implementer of SDC!

- Working with FHIR since 2014!

What is going to be covered?

- Understand the basics of FHIR Questionnaires
- Understand how SDC extends this functionality
- Be able to validate a QuestionnaireResponse against a Questionnaire
- What tooling/projects are out there?
- What's changing in R5?

Uses of FHIR Questionnaires

- Assessments (Primary Care)
- Assessments (consumer)
- Surveys
- Gov't/Statutory forms
- Referral templates
- Admission forms
- Care Plans
- Research
- Oncology
- Pathology
- Public Health Reporting
- Insurance/Payments
- General data entry

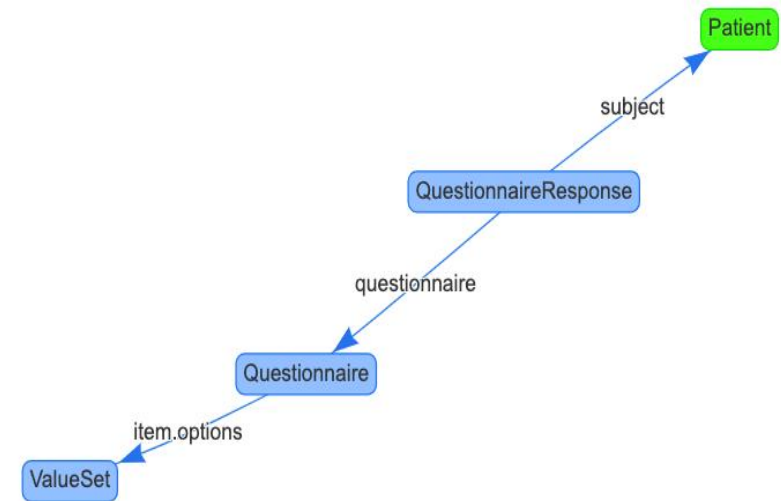
Workflow



- Locate questionnaire to use (for given context)
- Load/render questionnaire (and referenced content)
 - Pre-populate questionnaire with other data (e.g., patient demographics, observations etc)
- User enters data
 - Local validations may occur during data entry
- QuestionnaireResponse is validated by server
 - Errors/Warnings/issues reported to the user
- QuestionnaireResponse is saved to the target server
 - Data extracted into other resources

FHIR Questionnaire Artifacts

- Questionnaire Resource
 - Definitional Resource
 - Similar to StructureDefinition
 - May include ValueSet / Terminologies
- QuestionnaireResponse Resource
 - Record of responses
 - Structure mirrors Questionnaire items
- Other
 - Extensions, Operations, Profiles, Implementation Guides (incl SDC)



Note: DON'T Profile Questionnaire (normally)

Definition vs Entered Data

Questionnaire

- Metadata
- Items (nested)
 - LinkId
 - Text
 - Item Type
 - repeats
 - Data rules (validation)
 - Formatting hints

QuestionnaireResponse

- Context
- Items (nested)
 - LinkId
 - Text

LinkId joins answer to definition
MUST MATCH
(including the nesting depth)

Item-Type	Response Type	Definition
group	item(<i>Group</i>)	An item with children, may be repeating. Could be a section, table or other layout (e.g. tabs)
display	(<i>none</i>)	Just a label to be displayed (no answer to be collected)
boolean	valueBoolean	Yes/no answer (checkbox, radio group or similar)
decimal	valueDecimal	Real number answer (restricted textbox, slider, ...)
integer	valueInteger	Integer answer (restricted textbox, slider, ...)
date	valueDate	Date answer (restricted textbox, date picker ...)
dateTime	valueDateTime	Date and time answer (restricted textbox, date picker ...)
time	valueTime	Time only answer (hour:minute:second) answer independent of date (restricted textbox, ...)
string	valueString	Short free-text answer (single line textbox)
text	valueString	Longer free-text answer, potentially multi-paragraph (multi-line textbox)
url	valueUri	URL (website, FTP site, etc.) answer (restricted textbox)
choice	valueCoding	Coding drawn from a list of options (specified in either the option property, or via the ValueSet referenced in the options property) as an answer (radio buttons, checkboxes, combobox, autocomplete ...)
open-choice	valueCoding or valueString	Coding drawn from a list of options (as with the choice type) or a free-text entry in a string (similar controls to choice, except with ability to include textbox)
attachment	valueAttachment	Binary content such as a image, PDF, etc. as an answer (file selector ...)
reference	valueReference	A reference to another resource, e.g. practitioner, organization, etc. (resource finder?)
quantity	valueQuantity	Question with a combination of a numeric value and unit. ()

Interaction with terminologies

Questionnaire structure

- Item types
 - Choice, open-choice
- Valueset reference (canonical!)
 - Item.answerValueSet
- Answer options
 - valueCoding, initialSelected
- Repeat
- Control selection
 - Radio buttons, comboboxes, checkboxes, autocomplete
 - Consider the number of potential entries in the list

Extensions

- questionnaire-itemControl
- questionnaire-optionExclusive
- preferredTerminologyServer
- questionnaire-unitValueSet
- 11179-permitted-value-valueset
- 11179-permitted-value-conceptmap

Operations

- Use the ValueSet **\$expand** operation to either pre-load the values, or use the filter parameter for the auto-complete style usage

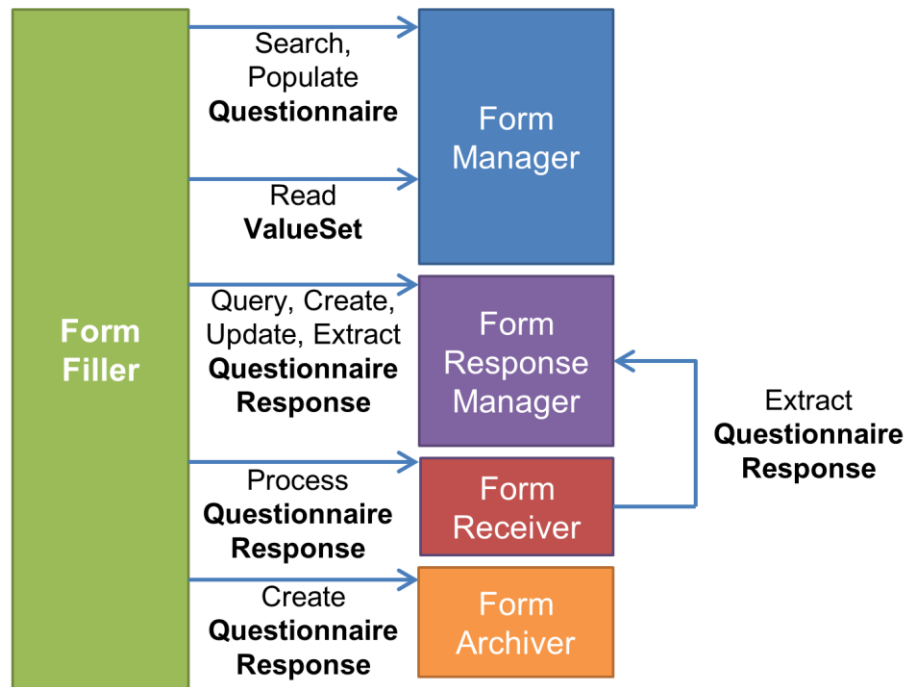
Dynamic Behaviour – Enable when

enableWhen	?! I	0..*	BackboneElement	Only allow data when + Rule: If the operator is 'exists', the value must be a boolean
question		1..1	string	Question that determines whether item is enabled
operator		1..1	code	exists = != > < >= <= QuestionnaireItemOperator (Required)
answer[x]	I	1..1		Value for question comparison based on operator Questionnaire Answer Codes (Example)
answerBoolean			boolean	
answerDecimal			decimal	
answerInteger			integer	
answerDate			date	
answerDateTime			dateTime	
answerTime			time	
answerString			string	
answerCoding			Coding	
answerQuantity			Quantity	
answerReference			Reference(Any)	
enableBehavior	I	0..1	code	all any EnableWhenBehavior (Required)

What's changing in R5?

- disabledDisplay added
 - hidden | protected
- answerConstraint added
 - optionsOnly | optionsOrType | optionsOrString
- Type: open-choice -> coding
(with answerConstraint = optionsOrString)

Structured Data Capture (SDC) Implementation Guide



- Extensions to the core HL7 definitions
 - Advanced Rendering
 - Advanced Form Behaviour
 - Adaptive Forms
 - Importing Data into Forms
 - Extraction of Data from Forms
- Close to publication (still)

<http://build.fhir.org/ig/HL7/sdc/>

Rendering & Behaviours walkthrough

- <http://hl7.org/fhir/questionnaire-profiles.html>
 - itemControl,.fhirtype, hidden, minOccurs, maxOccurs, regex, ...
- <http://build.fhir.org/ig/HL7/sdc/rendering.html>
- <http://build.fhir.org/ig/HL7/sdc/behavior.html>

FHIRPath Expressions

- Validation
- Pre-population & Initial Values
- Variables
- Calculated Fields
- EnableWhen
- answerExpression

<http://build.fhir.org/ig/HL7/sdc/expressions.html>

Demonstration – Basic samples

- Bit of Everything
- Groups
- Terminologies
- Enable When

<https://smartqedit4.azurewebsites.net/Questionnaire/pmstest>

<https://sqlonfhir-r4.azurewebsites.net/fhir/Questionnaire>

Validation



- FHIR json/xml valid (serialization)
- Core FHIR profile validation (*maybe local profiles too*)
- QuestionnaireResponse validation
 - Item Types/Datatypes (using linkId to match)
 - Terminology
 - Required Fields
 - Enable When should be considered
 - Repeating fields are per group repetition
 - answerOptions/Extensions/Complex Validation
 - Base Questionnaires through derivedFrom reference
 - Custom validation?
- OperationOutcome
 - Content/messages appropriate to display to users?
 - Location of issue – which control (via linkId)

Complex Validation



- Cross field validation
- Conditional rules
- Complex calculations
- Custom Error messages

- Core resources can be profiled with invariants
- Extension adds this capability to Questionnaires

Complex Validation (OperationOutcome)



```
{
  "resourceType": "OperationOutcome",
  "issue": [
    {
      "severity": "error",
      "code": "required",
      "details": {
        "text": "Mandatory field Severity is missing"
      },
      "expression": [
        "QuestionnaireResponse.item[0].item[0].item[3]"
      ]
    },
    {
      "severity": "error",
      "code": "invariant",
      "details": {
        "coding": [
          {
            "code": "past-only"
          }
        ],
        "text": "cannot be a future date"
      },
      "diagnostics": "answer.value <= today()",
      "expression": [
        "QuestionnaireResponse.item[0].item[0].item[5]"
      ]
    }
  ]
}
```

Questionnaire Renderers

Open Source

- <https://github.com/lhncbc/questionnaire-viewer>
USNLM (Paul Lynch)
- <https://github.com/clinical-cloud/QuestionnaireKit>
- <https://pub.dev/packages/faiadashu>
(<https://fhirfli.dev/>)

Commercial/Tech demos

- <https://fhirpower.bitrix24.site/>
NursIT Intitute (Stoyan Halaliev)
- <https://Smartqedit4.azurewebsites.net>
Telstra Health (Brian Postlethwaite)

Others

- <https://github.com/brianpos/fhir-q-render>
- <https://github.com/beda-software/sdc-ide>
- <https://github.com/ahdis/ng-fhir-sample>
(<https://ahdis.github.io/ng-fhir-sample/#/questionnaire/sdc-render>)
- <https://github.com/asbi-cds-tools/questionnaire-to-survey>
- <https://github.com/dermatologist/fhir-questionnaire-render-react>
- <https://github.com/gavinl/fhirq-renderer>
- <https://github.com/google/android-fhir/tree/master/datacapture>

<https://confluence.hl7.org/display/FHIRI/SDC+Implementations>

fhirpath tester

item.text

Extract Validate Parse GraphQL xml json ...

```
<string value="Informasjon" />
<string value="Opplysninger om den bestillingen
gjelder" />
<string value="Hvor skal bestillingen sendes" />
<string value="Bestilling" />
<string value="Innsending" />
```

```
{
  "resourceType": "Questionnaire",
  "id": "50",
  "meta": {
    "versionId": "8",
    "lastUpdated": "2019-11-30T04:19:17.413+11:0",
    "profile": [
      "http://ehelse.no/fhir/StructureDefinition/sdf-1"
    ],
    "tag": [
      {
        "system": "urn:ietf:bcp:47",
        "code": "nb-NO",
        "display": "Norsk bokmål"
      }
    ]
  },
  "language": "nb-NO",
  "contained": [
    {
      "resourceType": "ValueSet",
      "id": "8459"
    }
  ]
}
```

-- item

outputLocation show sourceLocation

Ln 1 Col 1 STU3

<https://github.com/brianpos/fhirpathtester>

Brian Postlethwaite

What did you learn?

- Questionnaire / QuestionnaireResponse
 - Basics
 - Data Types
 - Terminology Interactions
 - Advanced Validation
- Open Source / Existing tooling

Contact

- During DevDays, you can find / reach me here:
 - Via Whova App – Speaker’s Gallery
 - Email: brian_pos@hotmail.com
 - github: <https://github.com/brianpos>
- Other Relevant Sessions:
 - Building SDC Powered Applications
 - Tuesday 8th 1:00pm – 1:45pm
 - Live coding session to build a simple app from scratch using SDC, including \$populate and \$extract operations

Q&A

- Questionnaire / QuestionnaireResponse
 - Basics
 - Data Types
 - Terminology Interactions
- Structure Data Capture
 - Form prefill from other FHIR resources
 - Advanced Validation
 - Converting QuestionnaireResponse data into other resources
- Open Source / Existing tooling

*Where will you use
Questionnaires?*

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