Australia's National Science Agency

FHIR Questionnaires Kick Off

FHIR in Queensland Health Connectathon | Oct 2025

Track Goals and Learning Outcomes

Learning Outcomes

- Explore example implementations of Questionnaires and SDC
- Explore Smart Forms solution architecture
- Explore SDC-related concepts like SMART App Launch and FHIRPath

Track Goals

- Hands on building of a FHIR SDC Questionnaire
- Explore and build out potential QH use cases where FHIR Questionnaires can add value

Track Information

https://go.csiro.au/FwLink/fiqh-track2

Access to:

- chat.fhir.org stream for collaboration
- Specification information
- Testing tools/resources
- Testing scenarios

FHIR Questionnaires and SDC

- Standards-based way to represent forms and surveys in healthcare
- **Structured Data Capture (SDC)** enhances the base Questionnaire resource with extra functionality:
  - Pre-population
  - Extraction and write-back
  - Advanced rendering e.g. markdown, HTML
  - Input validation
  - Calculations
- Results are communicated using **QuestionnaireResponse** resource

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What is a Questionnaire

- **Metadata**

Questionnaire
id: mbs715
version: 1.0.0
name: MBS715
title: Aboriginal and Torres Strait Islander Health Check
status: active
publisher: CSIRO
date: 2022-02-09
copyright: …
…

https://www.hl7.org/fhir/questionnaire.html

What is a Questionnaire

- Metadata
- **Form Items**

```
Questionnaire
 title: Aboriginal and Torres Strait Islander health check
 …
 item
  linkId: 5b78369f-9007-44d0-b3fd-4d95851b17b5
  text:
  type: group
   item
    linkId: num-of-children
    text: Number of children
    type: string |choice |integer |boolean |date |…
    required: true
    repeats: false
   …
```

https://www.hl7.org/fhir/questionnaire.html

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What is a Questionnaire

- Metadata
- **Form Items**

Structured Data Collection Profile

Questionnaire extensions

- questionnaire-itemControl
  - choice
    - check-box
    - radio-button
    - drop-down
    - autocomplete
  - integer
    - slider
    - spinner
- choice-orientation
  - horizontal
  - vertical

http://hl7.org/fhir/uv/sdc/

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What is a Questionnaire

- Metadata
- Form Items
- **Value Sets**

```
Questionnaire
  …
  item
    …
      item
        linkId: gender
        text: Gender
        type: choice
        answerOption:
          valueCoding
            code: male, display: Male, system: http://hl7.org/…
            code: female, display: Female, system: http://hl7.org/…
            …
```

What is a Questionnaire

- Metadata
- Form Items
- **Value Sets**

```
Questionnaire
  …
  extension
    url: http://hl7.org/fhir/StructureDefinition/preferred-terminology-server
    valueUrl: https://r4.ontoserver.csiro.au/fhir
  …
  item
    …
      item
        linkId: relationship-to-child
        text: Relationship to child
        type: choice
        answerValueSet:
          http://snomed.info/sct?fhir_vs=refset/32570591000036107
```

What is a Questionnaire

- Metadata
- Form Items
- Value Sets
- **Pre-population**

```
Questionnaire
 ...
 extension
  url: http://hl7.org/fhir/.../sdc-questionnaire-launchContext
  extension
   url: name, valueId: patient
   url: type, valueId: Patient
 ...
   item
    extension
     url: http://hl7.org/fhir/.../sdc-questionnaire-initialExpression
     valueExpression
      language: text/fhirpath
      expression: %patient.gender
```

What is a Questionnaire

- Metadata
- Form Items
- Value Sets
- Pre-population
- **Calculations**

```
Questionnaire
  …
  item
    type: group
    extension
      url: http://hl7.org/fhir/StructureDefinition/variable
      valueExpression:
        name: v-weight
        language: text/fhirpath
        expression: item.where(linkId='examination')
                          .item.where(linkId='weight').answer.value
```

What is a Questionnaire

- Metadata
- Form Items
- Value Sets
- Pre-population
- **Calculations**

```
Questionnaire
  …
  item
    …
    item
      linkId: bmi
      extension
        url: http://hl7.org/.../sdc-questionnaire-calculatedExpression
        valueExpression:
          language: text/fhirpath
          expression: (%weight/((%height/100).power(2))).round(1)
```

What is a Questionnaire

- Metadata
- Form Items
- Value Sets
- Pre-population
- Calculations
- **Extraction**

```
Questionnaire
 contained
  resourceType: Observation
  id: BmiObservationTemplate
  …
 …
 item
  …
  item
   linkId: bmi
   extension
    url:  http://hl7.org/.../sdc-questionnaire-templateExtract
    extension
     url: template
     valueReference:
      reference: #BmiObservationTemplate
```

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SDC Workflow and roles

Functionality	Relevant SDC Extension
SDC Form Designer	System responsible for creating and editing form designs
SDC Form Filler	System responsible for capturing user form input to produce partially or fully completed forms
SDC Form Fill Manager	Repository for accessing form definitions. May also perform pre-population
SDC Form Manager	Repository for maintaining form definitions. (Builds on SDC Form Fill Manager.)
SDC Form Response Manager	Searchable repository for storage and retrieval of completed and partially completed forms.
SDC Form Receiver	Write-only destination to which forms are sent for processing
SDC Form Archiver	Write-only system responsible for archiving completed forms as well as works in progress

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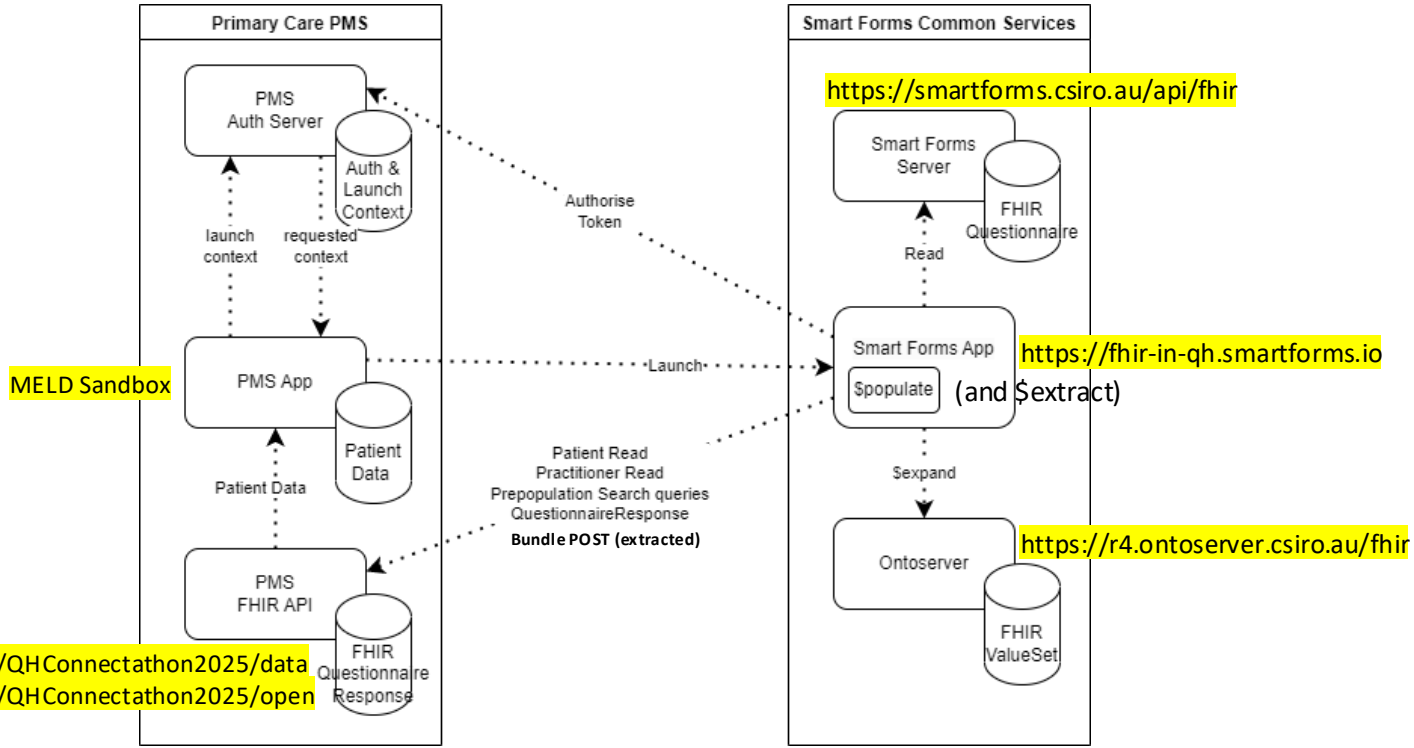
Smart Forms Architecture



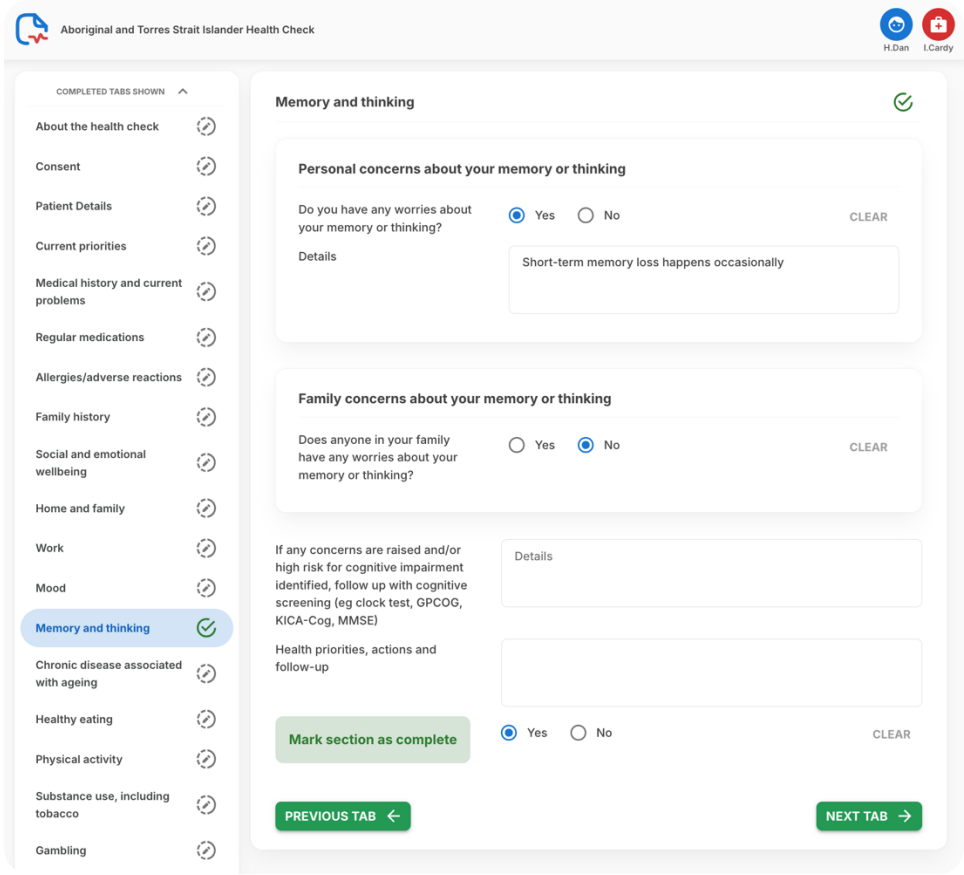
SDC Workflow and roles

Functionality	Relevant SDC Extension
SDC Form Designer	System responsible for creating and editing form designs **e.g. Aidbox Form Builder, NLM Form Builder, Smart Forms Playground**
SDC Form Filler	System responsible for capturing user form input to produce partially or fully completed forms **e.g. Smart Forms App/Renderer https://fhir-in-qh.smartforms.io**
SDC Form Fill Manager	Repository for accessing form definitions. May also perform pre-population **e.g. Smart Forms Server https://smartforms.csiro.au/api/fhir**
SDC Form Manager	Repository for maintaining form definitions. (Builds on SDC Form Fill Manager.) **e.g. Smart Forms Server https://smartforms.csiro.au/api/fhir**
SDC Form Response Manager	Searchable repository for storage and retrieval of completed and partially completed forms. **e.g. MELD Sandbox FHIR API** https://gw.interop.community/QHConnectathon2025/data
SDC Form Receiver	Write-only destination to which forms are sent for processing **e.g. MELD Sandbox FHIR API** https://gw.interop.community/QHConnectathon2025/data
SDC Form Archiver	Write-only system responsible for archiving completed forms as well as works in progress

SMART App Launch Overview

Smart Forms

- An open-source, web-based FHIR-powered forms app
- Integrates with EHRs (Electronic Health Record) via SMART on FHIR to perform data population/extraction
- Primary use case is for practitioners to conduct health assessments digitally in a seamless and secure manner
- Renderer component is available as a JavaScript/React library on NPM



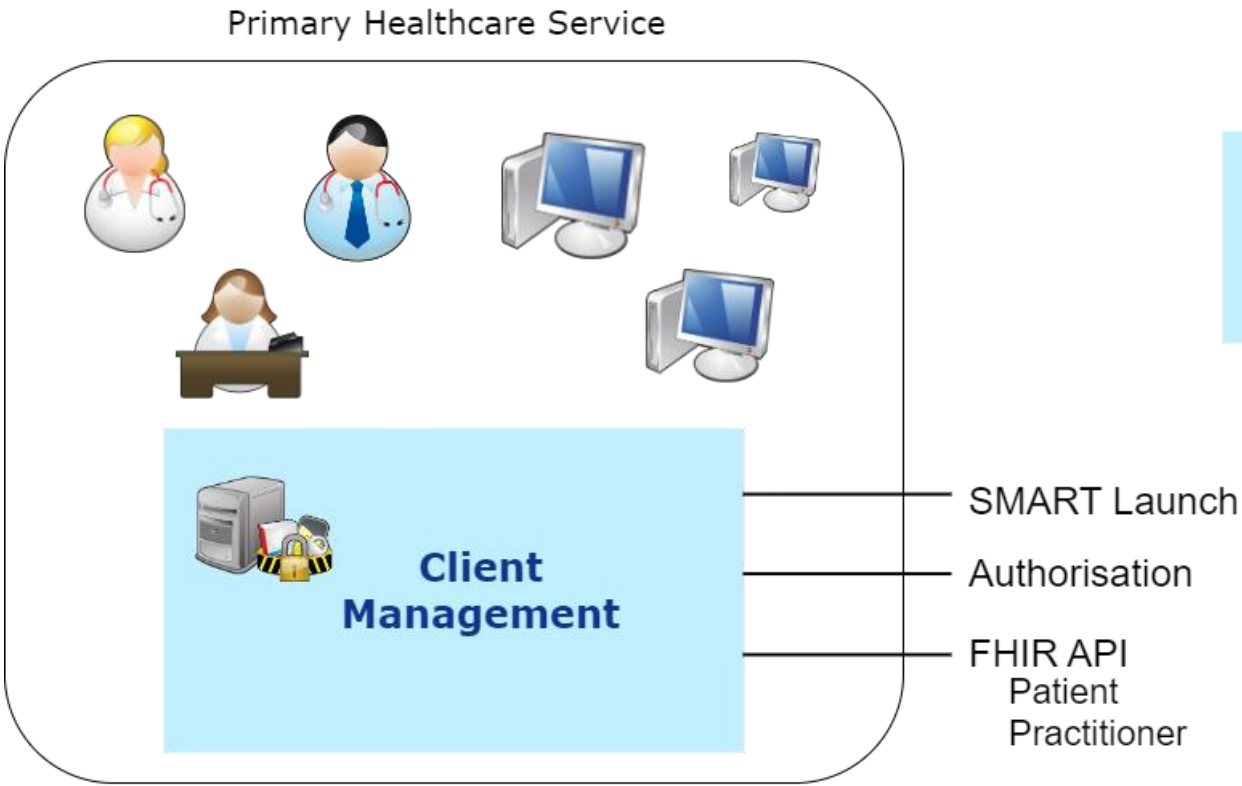
SMART App Launch

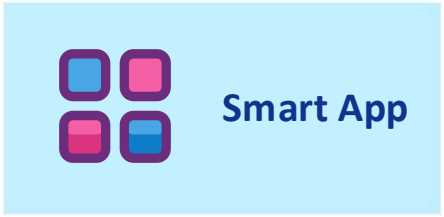
- Provides a consistent approach to security and data requirements for healthcare apps
- Defines a workflow that an application can use to:

i. Securely request access to data

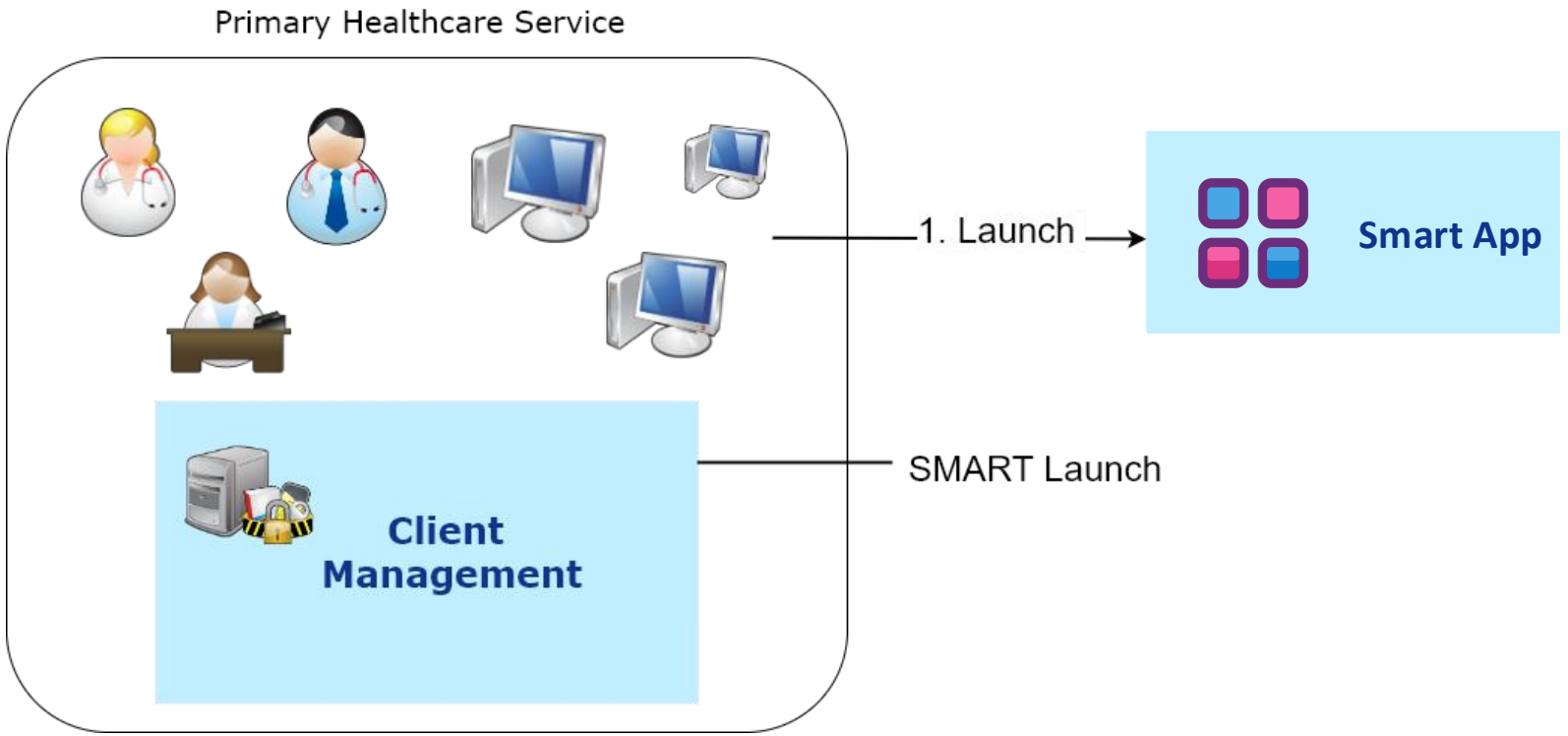
ii. Receive and use that data

SMART App Launch flow

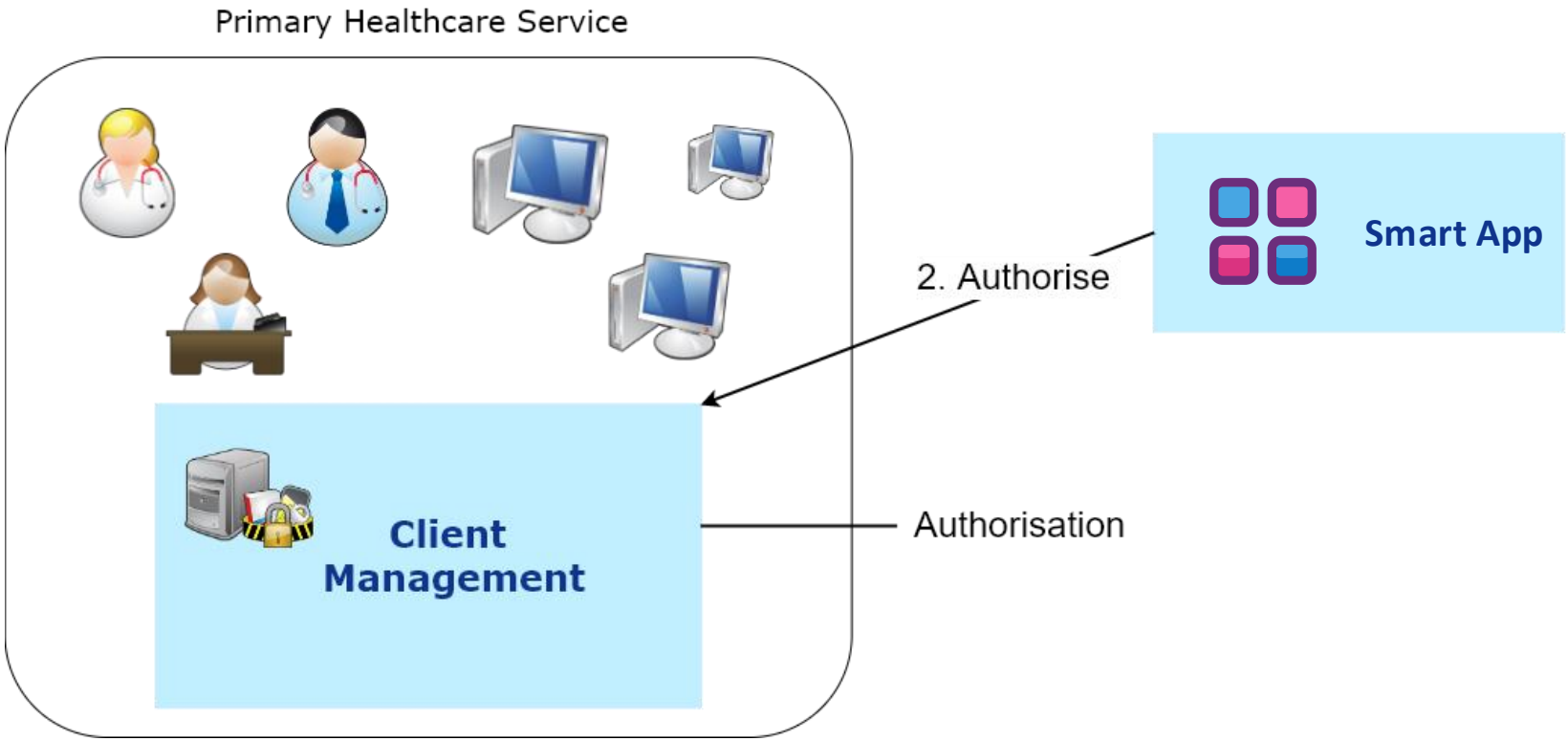




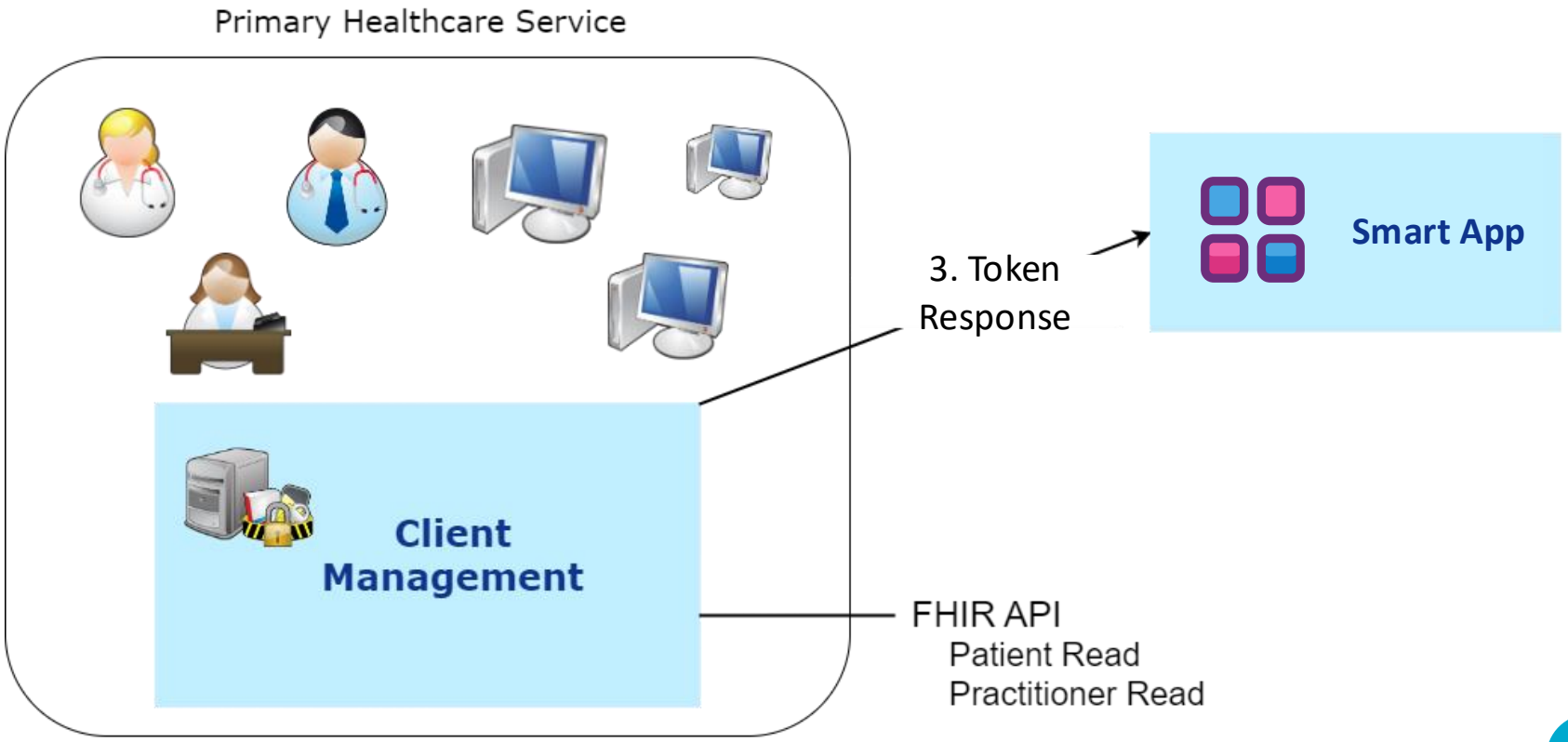
App Launch


Primary Healthcare Service
1. Launch
Smart App
SMART Launch
Client Management

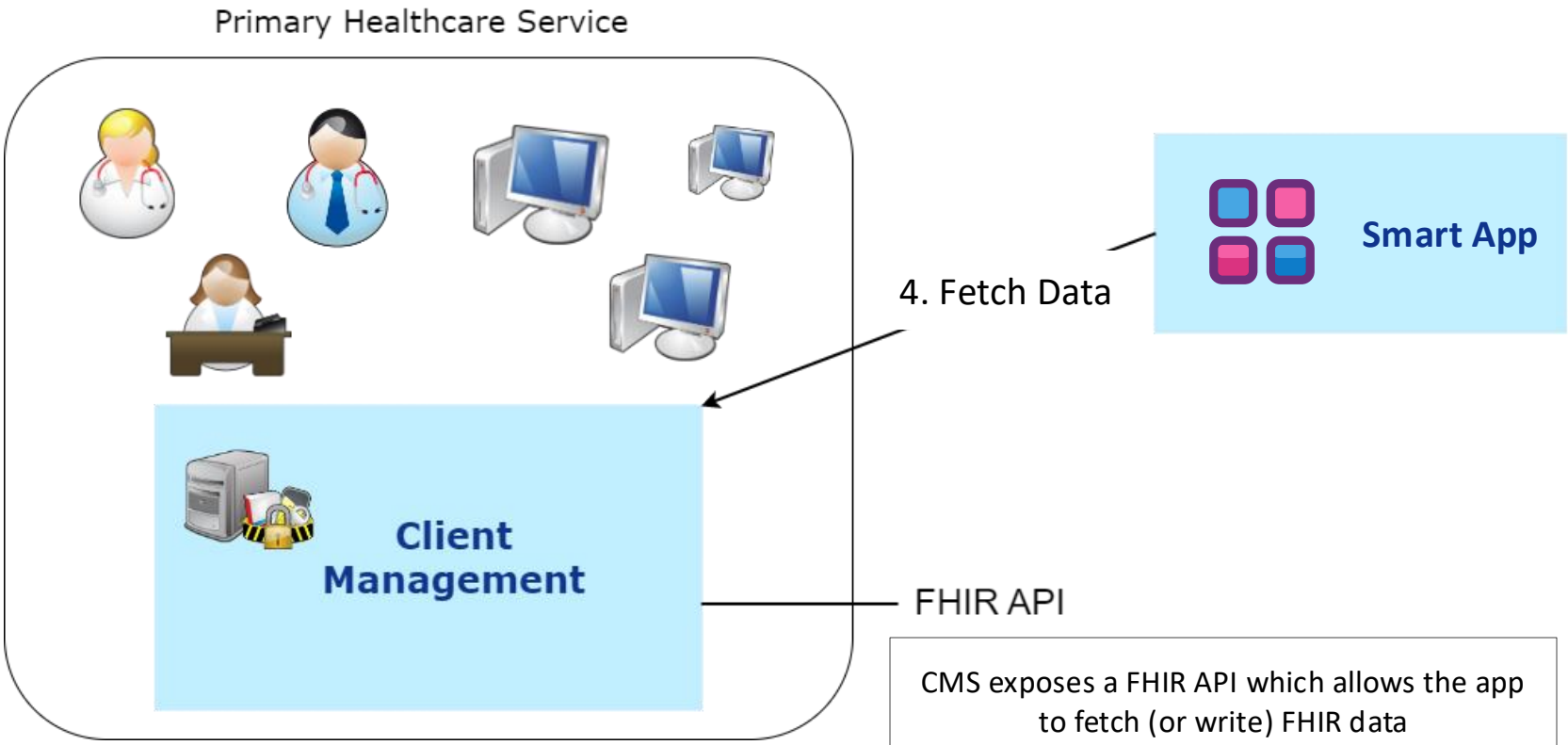
Authorisation – OAuth2



Token Response

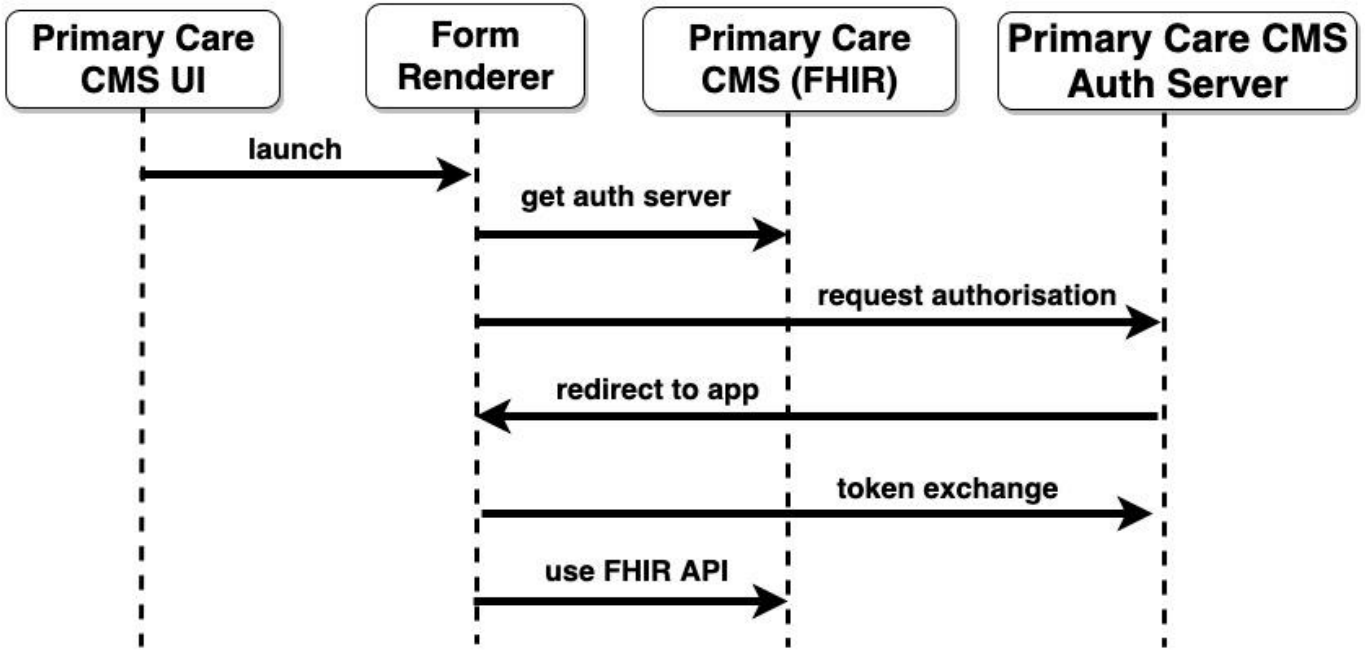


Data exchange

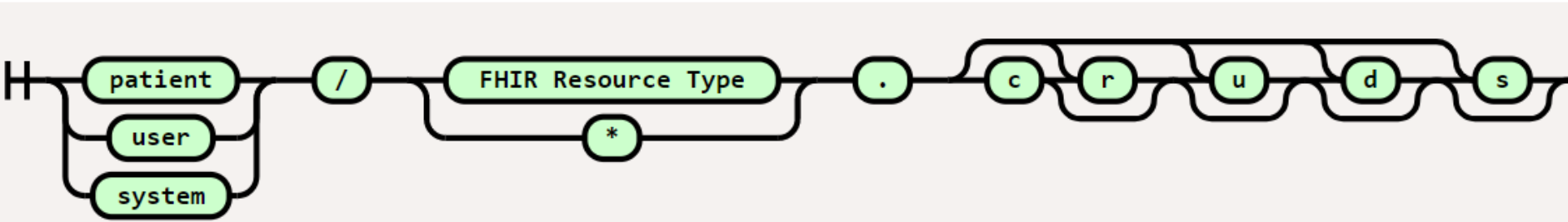


CMS exposes a FHIR API which allows the app to fetch (or write) FHIR data

App Launch Sequence



Authorization Scopes



Read/Search all resources for current patient

- patient/*.rs

Create/Update/Delete QuestionnaireResponse for current patient

- patient/QuestionnaireResponse.cud

All operations on Patient resources the current user can access

- user/Patient.cruds

Read any resource the system can access

- system/*.r

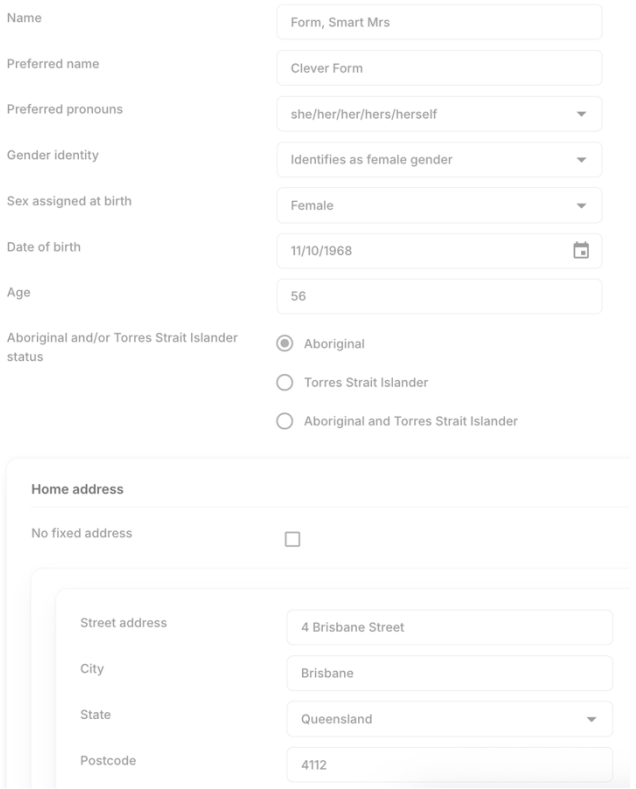
SMART on FHIR JS Library

- Docs: https://docs.smarthealthit.org/client-js/
- GitHub: https://github.com/smart-on-fhir/client-js

Structured Data Capture

Pre-population

- Form pre-population allows re-use of existing data
- Retrieve patient data from FHIR APIs provided by the clinical system
  - E.g. GET Patient/{patient_id} returns a **Patient resource** stored in **%patient**. To pre-populate the patient's gender, **%patient.gender** is used in an initialExpression.



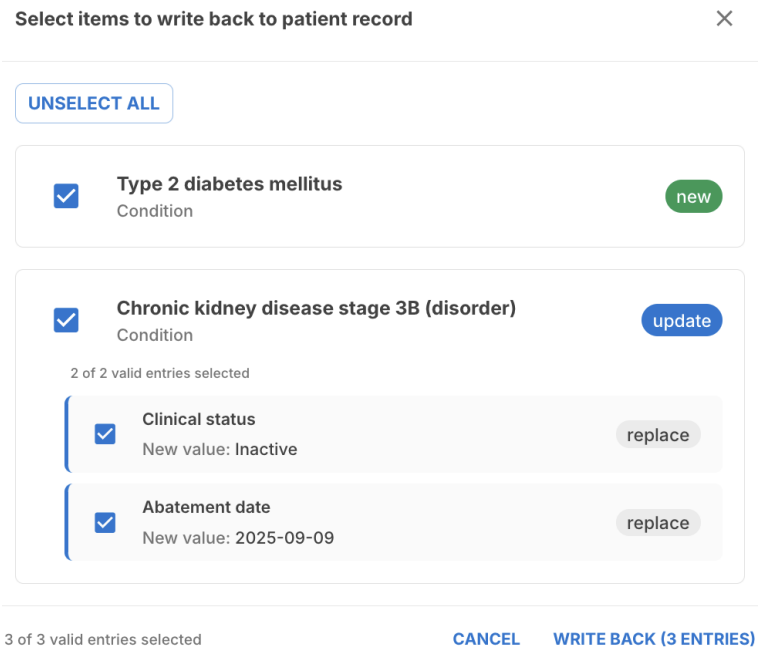
Pre-populated patient details section from the MBS715 Aboriginal and Torres Strait Islander Health Check form

Pre-population

- There are three ways in SDC to perform pre-population:
  - Observation-based
  - Expression-based
  - StructureMap-based – requires FHIR Mapping Language (FML) knowledge

Extract + Write back

- Form extraction converts captured data back into FHIR resources
- Write back FHIR resources into the clinicial system via FHIR APIs
  - E.g. POST Condition writes a **new Condition resource**.
  - E.g. PUT Condition replaces an **existing Condition resource**.
  - E.g. PATCH Condition adds/replaces specific fields in an **existing Condition resource**.



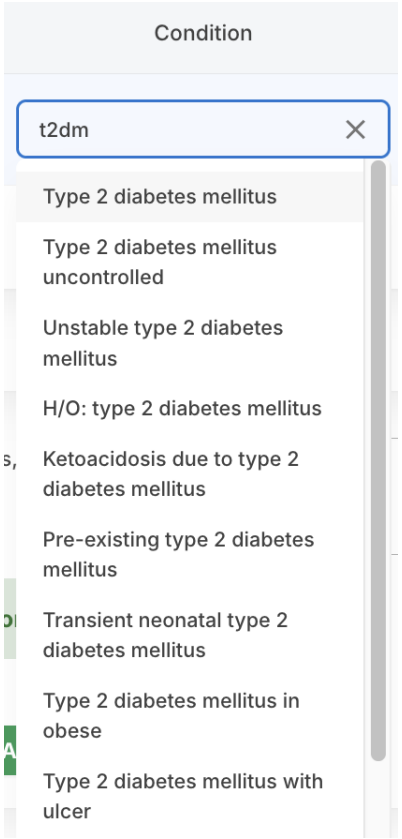
Confirmation screen for extracted Medical History items to be written back into the clinical system

Extract + Write back

- There are four ways in SDC to perform extraction:
  - Observation-based
  - Definition-based
  - Template-based
  - StructureMap-based – requires FHIR Mapping Language (FML) knowledge

Terminology usage

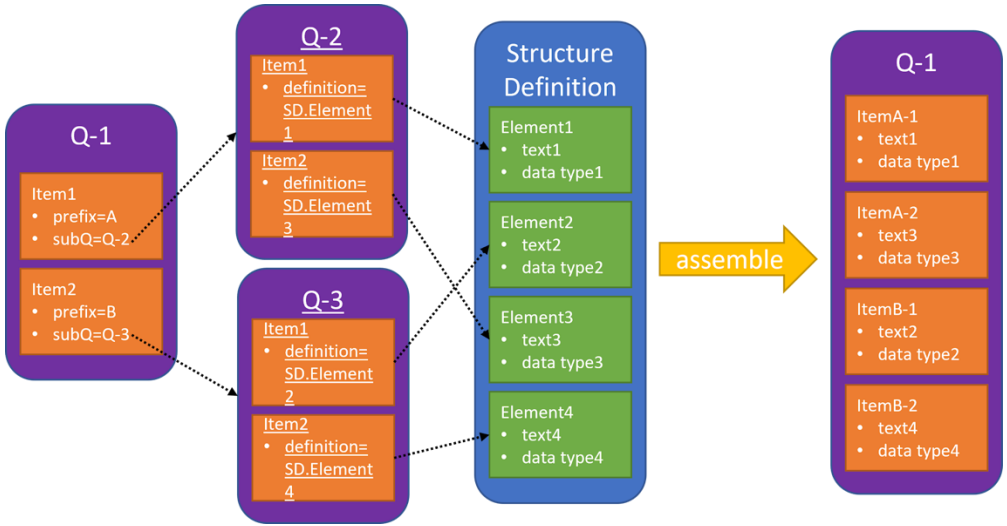
- Choice items draw possible answers from a list of possible options e.g. radio button, checkbox, dropdown, autocomplete
- Open-choice are like choice items, but also allows a free-text entry
- Base Questionnaire contains two ways to define option values in choice/open-choice items
  - AnswerOption – define options at item level (integer, string, date, time, codings)
  - AnswerValueSet – coded values from a ValueSet, by providing a ValueSet URL



“Autocomplete” choice item for problem list items

Modular Forms

- How can designers encourage re-use with forms?
  - Composition with sub-forms
  - Create forms referencing only data elements
  - $assemble to instantiate the full-blown Questionnaire



SDC Features (not an exhaustive list)

Functionality	Relevant SDC Extension
Data Pre-population	**initialExpression**
Data Extraction	Observation-based: **observationExtract** Template-based: **templateExtract** StructureMap-based: **targetStructureMap**
Conditional rendering	**enableWhen** (Questionnaire) /**enableWhenExpression**
Calculations	**calculatedExpression, cqf-expression**
ValueSet expansion	**answerValueSet** (Questionnaire)
Text-rendering behaviour e.g. XHTML, markdown, CSS styles	**rendering-xhtml, rendering-markdown, rendering-style**
Item-rendering behaviour	**itemControl** e.g. **gtable, grid, page, autocomplete, check-box, radio-button, slider, etc**
Input validation	**maxLength, minLength, minValue, maxValue, maxDecimalPlaces, regex, etc**

FHIRPath usage in SDC

FHIRPath usage - Pre-population example

- **launchContext**
- x-fhir-query
- **initialExpression**

```
Questionnaire
  …
  extension
    url: http://hl7.org/fhir/.../sdc-questionnaire-launchContext
    extension
      url: name, valueId: patient
      url: type, valueId: Patient
  …
      item
        extension
          url: http://hl7.org/fhir/.../sdc-questionnaire-initialExpression
          valueExpression
            language: text/fhirpath
            expression: %patient.gender
```

FHIRPath usage - Pre-population example

- **launchContext**
- **x-fhir-query**
- **initialExpression**

```
Questionnaire
  …
  extension
    url: http://hl7.org/fhir/.../sdc-questionnaire-launchContext
    …
  extension
     url: http://hl7.org/fhir/.../variable
     valueExpression
       name: ObsBodyHeight
       language: application/x-fhir-query
       expression: Observation?code=8302-2&_count=1&_sort=-date&patient={{%patient.id}}
  …
      item
        extension
          url: http://hl7.org/fhir/.../sdc-questionnaire-initialExpression
          valueExpression
            language: text/fhirpath
            expression: %ObsBodyHeight.entry.resource.value.value
```

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FHIRPath usage - Pre-population example

- X-FHIR-Query: FHIR search string
- More reading: https://hl7.org/fhir/uv/sdc/expressions.html#x-fhir-query-enhancements
- Example:

X-FHIR-Query	
Variable	ObsBodyHeight
Expression	Observation?**code=8302-2**&**_count=1**&**_sort=-date**&**patient={{%patient.id}}**
Example FHIR Query	https://gw.interop.community/QHConnectathon2025/open/Observation?code=8302-2&_count=1&_sort=-date&patient=smart-1577780&_format=json
Result	Bundle containing a single weight Observation with **valueQuantity**

FHIRPath usage - Pre-population example

- FHIRPath: FHIR search string
- More reading: https://hl7.org/fhir/fhirpath.html
- Example:

FHIRPath	
Expression	%ObsBodyHeight.entry.resource.value.value
Result	151.13

- Value.value is equivalent to valueQuantity.value.
- Example: FHIRPath-Lab

Questions so far?

Testing Scenarios

Testing Scenarios

- **GitHub link:** https://github.com/fongsean/questionnaire_track_fhir_in_qh?tab=readme-ov-file#testing-scenarios
- **Testing Scenarios:**
  1. BMI Calculator Questionnaire (Beginner-friendly)
  2. QH Adult Sepsis Risk Screening Questionnaire
  3. Exploring Queensland Health Use Cases for FHIR Questionnaires
- **Show and Tell!**
  - Day 2 closing - 3:30 – 4:30 PM
  - Volunteer-based
  - What did you accomplish? What have you learned in the two days?