



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

# 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: ...

...

# 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**

...

# 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

# 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](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

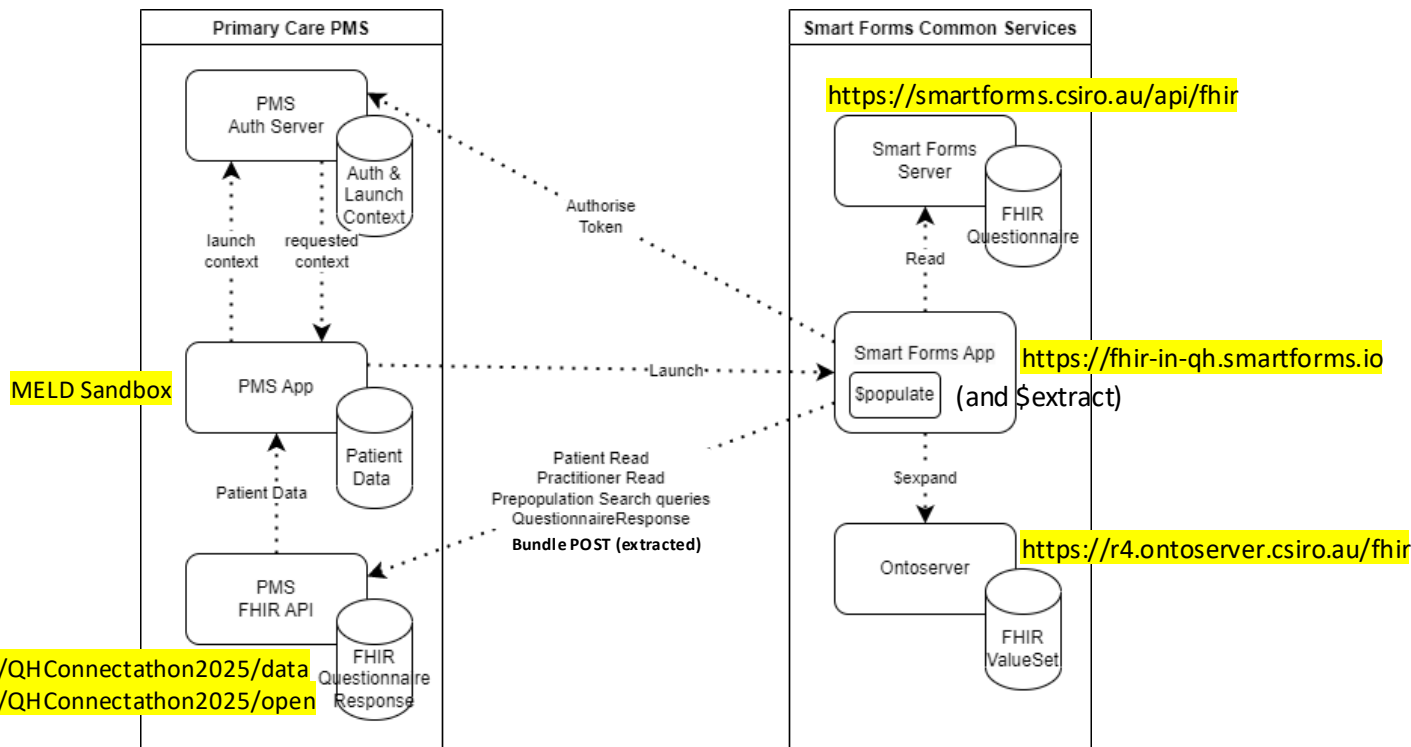
- Metadata
- Form Items
- Value Sets
- Pre-population
- Calculations
- **Extraction**

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

# 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

# Smart Forms Architecture



# SDC Workflow and roles

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

The screenshot displays the 'Aboriginal and Torres Strait Islander Health Check' application. The interface features a sidebar on the left with a list of assessment tabs: 'About the health check', 'Consent', 'Patient Details', 'Current priorities', 'Medical history and current problems', 'Regular medications', 'Allergies/adverse reactions', 'Family history', 'Social and emotional wellbeing', 'Home and family', 'Work', 'Mood', 'Memory and thinking' (highlighted with a green checkmark), 'Chronic disease associated with ageing', 'Healthy eating', 'Physical activity', 'Substance use, including tobacco', and 'Gambling'. The main content area is titled 'Memory and thinking' and contains three sections: 1. 'Personal concerns about your memory or thinking' with a question 'Do you have any worries about your memory or thinking?' (radio buttons for Yes/No, 'Yes' selected) and a text input field containing 'Short-term memory loss happens occasionally'. 2. 'Family concerns about your memory or thinking' with a question 'Does anyone in your family have any worries about your memory or thinking?' (radio buttons for Yes/No, 'No' selected). 3. A section for 'If any concerns are raised and/or high risk for cognitive impairment identified, follow up with cognitive screening (eg clock test, GPCOG, KICA-Cog, MMSE)' with a text input field. Below this is a 'Health priorities, actions and follow-up' section with another text input field. At the bottom of the main area are buttons for 'Mark section as complete', 'PREVIOUS TAB', and 'NEXT TAB'. The top right corner shows user avatars for 'H.Dan' and 'I.Cardy'.

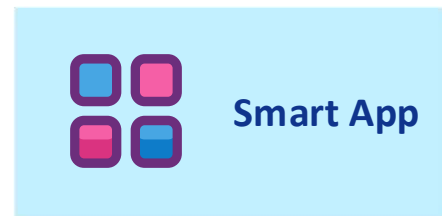
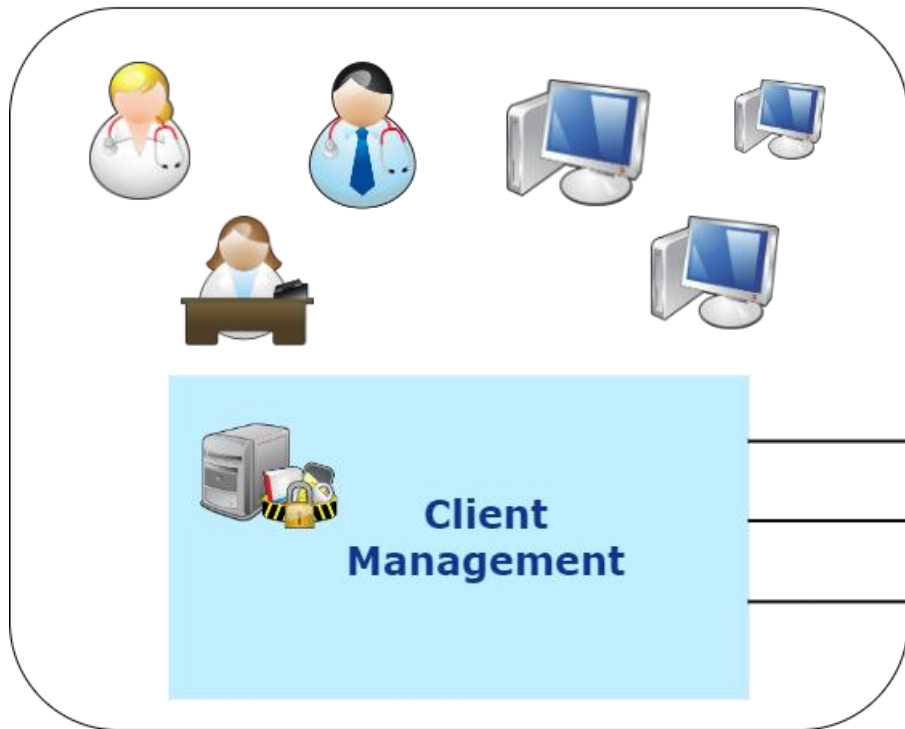
# SMART App Launch

- 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

Primary Healthcare Service

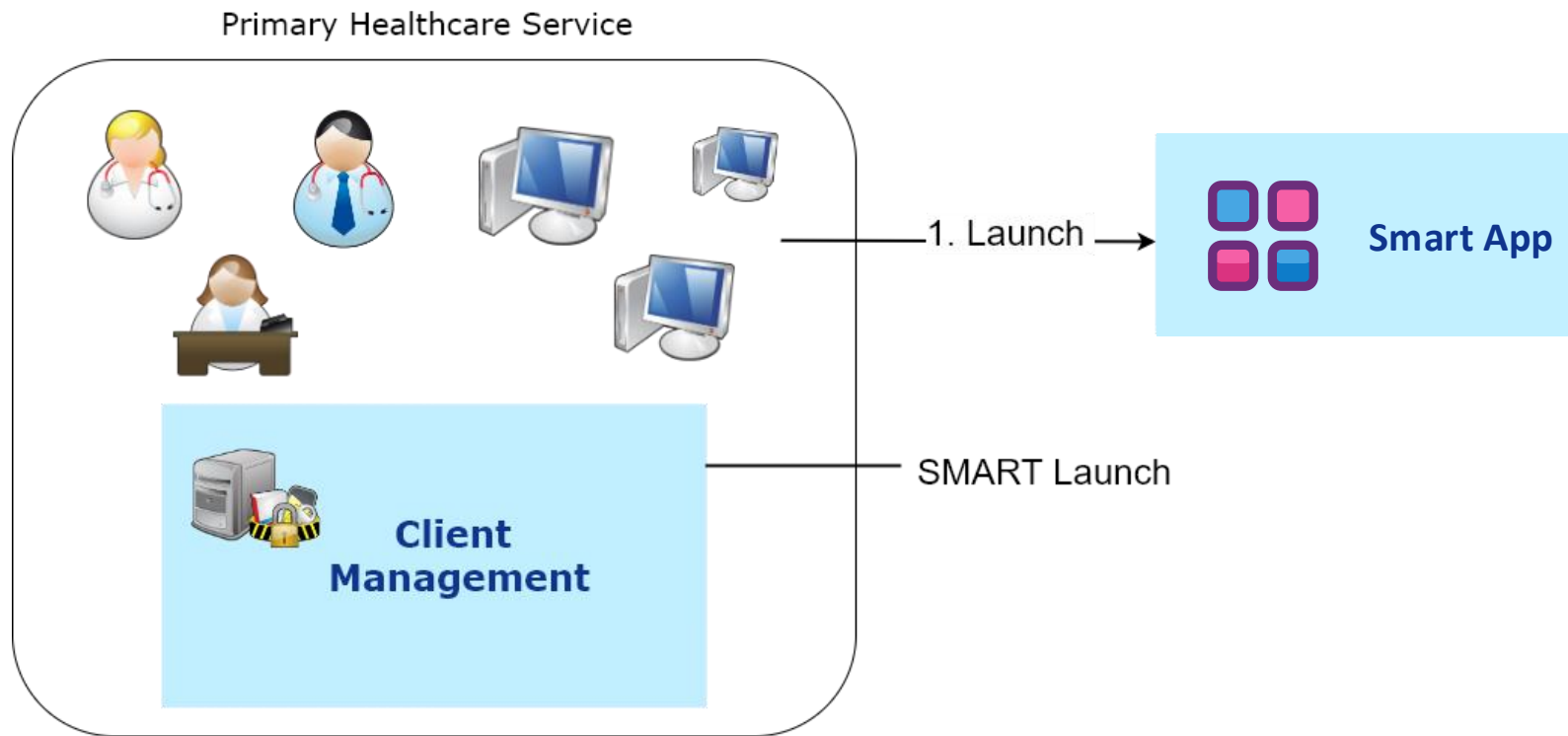


SMART Launch

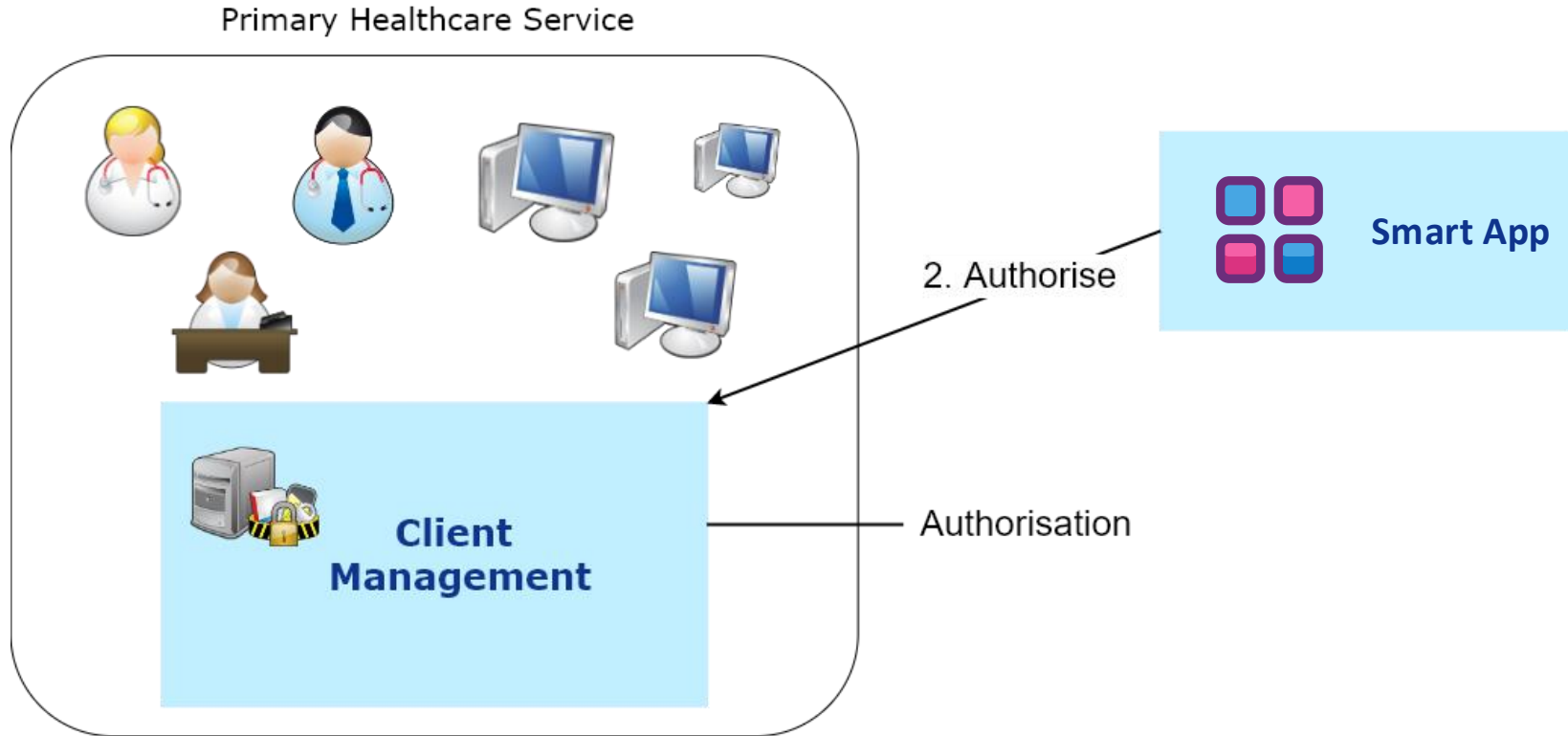
Authorisation

FHIR API  
Patient  
Practitioner

# App Launch

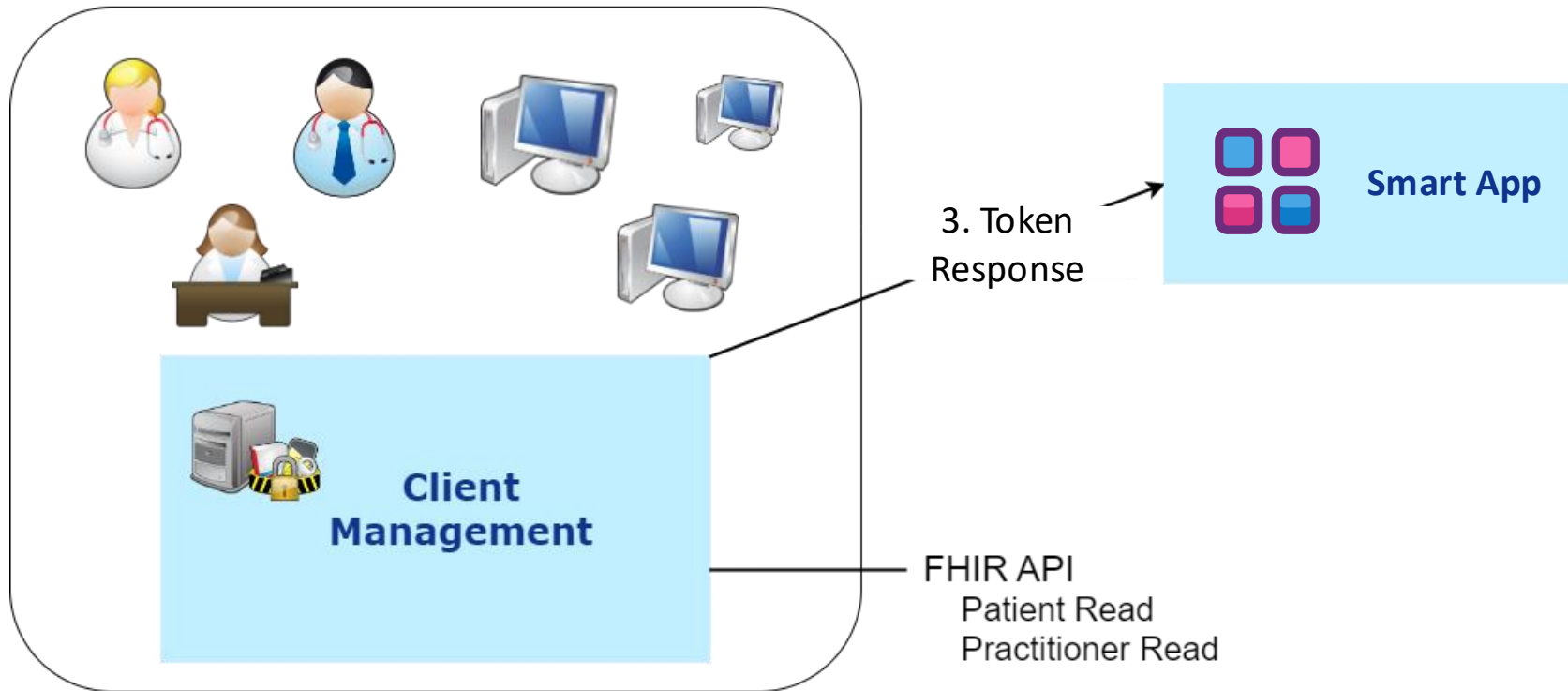


# Authorisation – OAuth2

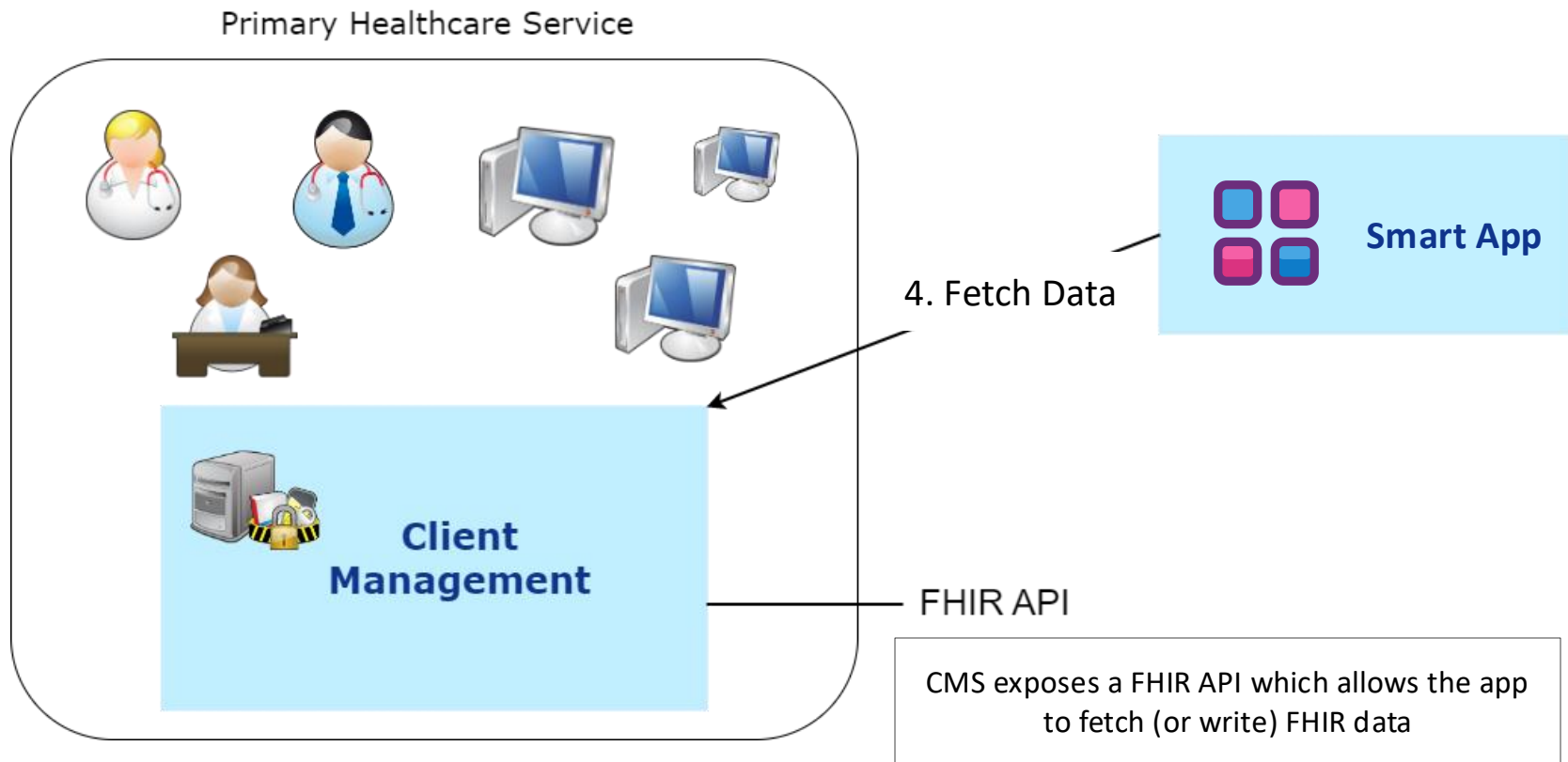


# Token Response

Primary Healthcare Service

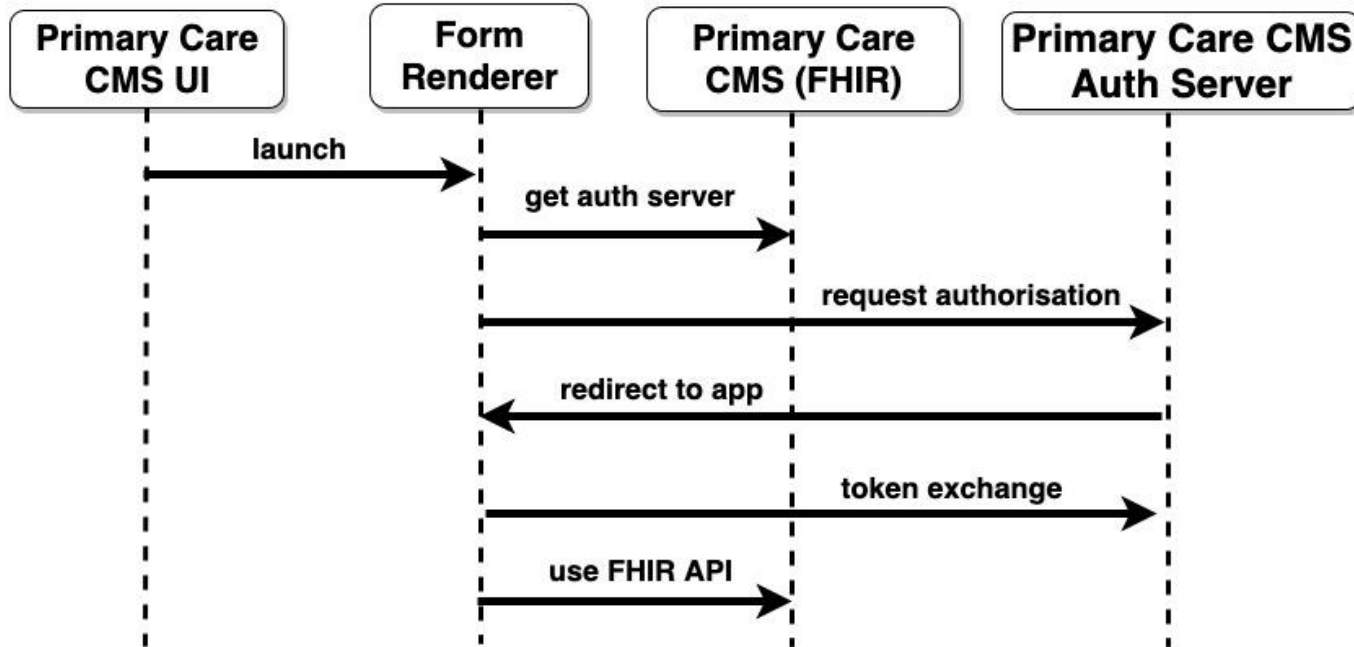


# Data exchange

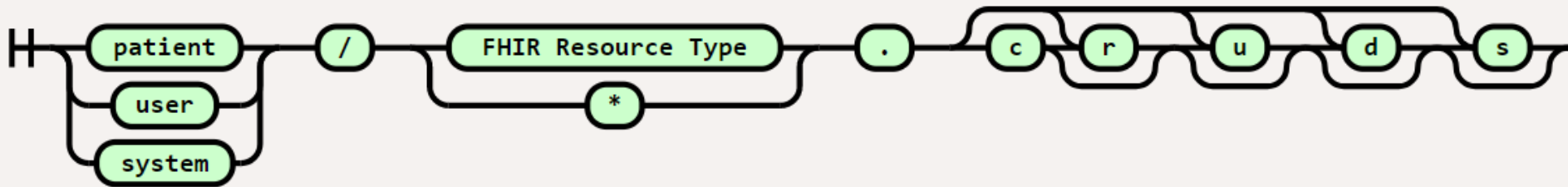




# App Launch Sequence



# 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

## SMART on FHIR JavaScript Library

JavaScript client for FHIR

[View on GitHub](#)

### SMART on FHIR JavaScript Library

This is a JavaScript library for connecting SMART apps to FHIR servers. It works both in browsers (IE 10+) and on the server (Node 18+).

This is the documentation for version 2+. If you want to migrate from older versions, please check out [what's new in v2](#) and [migration instructions](#).

NodeJS Tests passing Browser Tests passing coverage 96% npm package 2.5.4 types included node >=18  
downloads 619.3K

- 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.

The screenshot displays a digital form for the MBS715 Aboriginal and Torres Strait Islander Health Check. The 'Home address' section is pre-populated with the following information:

- Name: Form, Smart Mrs
- Preferred name: Clever Form
- Preferred pronouns: she/her/her/hers/herself
- Gender identity: Identifies as female gender
- Sex assigned at birth: Female
- Date of birth: 11/10/1968
- Age: 56
- Aboriginal and/or Torres Strait Islander status: ☒ Aboriginal

Below this, the 'No fixed address' checkbox is unchecked. The 'Street address' section is also pre-populated:

- Street address: 4 Brisbane Street
- City: Brisbane
- State: Queensland
- Postcode: 4112

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 clinical 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**.

Select items to write back to patient record



UNSELECT ALL



Type 2 diabetes mellitus  
Condition

new



Chronic kidney disease stage 3B (disorder)  
Condition

update

2 of 2 valid entries selected



Clinical status  
New value: Inactive

replace



Abatement date  
New value: 2025-09-09

replace

3 of 3 valid entries selected

CANCEL

WRITE BACK (3 ENTRIES)

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

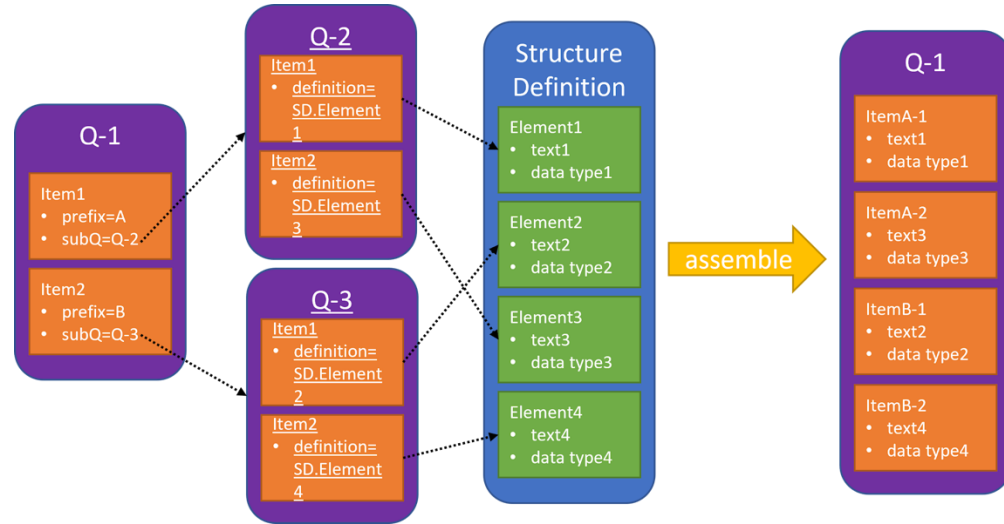
- Choice items draw possible answers from a list of possible options e.g. radio button, checkbox, dropdown, autocomplete
- Open-choice are like choice items, but also allows a free-text entry
- Base Questionnaire contains two ways to define option values in choice/open-choice items
  - AnswerOption –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

The image shows a user interface for a medical condition selection. At the top, a header bar is labeled "Condition". Below it, a search input field contains the text "t2dm" and has a close button (X) on the right. A dropdown menu is open, displaying a list of medical conditions related to type 2 diabetes mellitus. The list includes: "Type 2 diabetes mellitus", "Type 2 diabetes mellitus uncontrolled", "Unstable type 2 diabetes mellitus", "H/O: type 2 diabetes mellitus", "Ketoacidosis due to type 2 diabetes mellitus", "Pre-existing type 2 diabetes mellitus", "Transient neonatal type 2 diabetes mellitus", "Type 2 diabetes mellitus in obese", and "Type 2 diabetes mellitus with ulcer". A vertical scrollbar is visible on the right side of the dropdown list.

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

# 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? <b>code=8302-2&amp;_count=1&amp;_sort=-date&amp;patient={{%patient.id}}</b>
Example FHIR Query	<a href="https://gw.interop.community/QHConnectathon2025/open/Observation?code=8302-2&amp;_count=1&amp;_sort=-date&amp;patient=smart-1577780&amp;_format=json">https://gw.interop.community/QHConnectathon2025/open/Observation?code=8302-2&amp;_count=1&amp;_sort=-date&amp;patient=smart-1577780&amp;_format=json</a>
Result	Bundle containing a single weight Observation with <b>valueQuantity</b>

# 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](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?

