



Australian e-Health
Research Centre

CBL on FHIR: A FHIR- based Platform for Health Professional Education

Australia's National Science Agency



Mark Braunstein, MD

Visiting Scientist
e-Health Research Centre

[linkedin.com/in/mbraunstein/](https://www.linkedin.com/in/mbraunstein/)



Ben Barry, PhD

Clinical Senior Lecturer
University of Queensland

[linkedin.com/in/ ben-barry-44001956](https://www.linkedin.com/in/ben-barry-44001956)



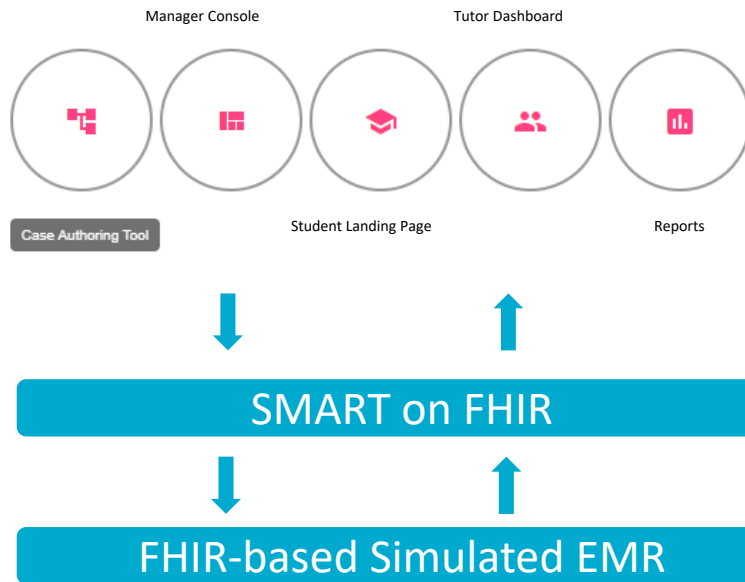
I would like to begin by acknowledging the Traditional Owners of the land that we're meeting on today, and pay my respect to their Elders past and present.





High level architecture

FHIR Platform





Case player

Videos

EHR
SMART Apps
Case

The screenshot shows the 'Case: Video Demo Test Case' interface. At the top, patient information for BRODSKY Vera is displayed, including date of birth (1955-06-12), age (68 years), sex (female), and MRN (225457). A navigation menu on the left lists 'History', 'Conditions', 'Physical Exam', 'Investigations', 'Medication', 'SMART App PROMs ver 1', 'SMART App ASCVD Risk Calculator (USA version)', 'Scan QR Code', and 'Case'. The main content area features a timeline with six triggers, with Trigger 3 selected. Below the timeline, the 'Investigations' section shows 'Section 1' containing 'ECG results'. A 'Custom Laboratory Report' table lists an 'Ambulatory ECG' performed on 2023-06-12 12:08:43. An ECG waveform image is displayed below the table, with a red arrow pointing to it from the 'Images' label.

Images



Case authoring tool

The screenshot shows the 'Full Vital Signs' configuration page. On the left is a navigation menu with a 'New' dropdown menu open, showing options like 'Trigger', 'Decision Point', 'Decision Choice', 'Information', and 'Result Set'. The main area is titled 'Full Vital Signs' and includes a 'Select the result set type' dropdown set to 'Vital signs Panel - Adult'. Below this is a 'Patient Age' field with a 'Time' dropdown and an 'Amount' field set to '2', with a 'unit' dropdown set to 'hours'. A 'Role' field is set to 'Professional nurse'. The 'Results' section has a table for configuring template values to display to the user.

Include	Name	Result	Normal Range
<input checked="" type="checkbox"/>	Respiratory rate	28 breaths/minute	12 - 18
<input checked="" type="checkbox"/>	Heart rate	124 beats/minute	60 - 100
<input checked="" type="checkbox"/>	Body temperature	37.2 degree Celsius	36.5 - 37.3
<input checked="" type="checkbox"/>	Systolic blood pressure	160	90 - 120
<input checked="" type="checkbox"/>	Diastolic blood pressure	95 mmHg	60 - 80
<input checked="" type="checkbox"/>	Oxygen saturation in Arterial blood	92 %	95 - 100
<input type="checkbox"/>	Body height	cm	? - ?
<input type="checkbox"/>	Body weight	kg	? - ?
<input type="checkbox"/>	Body mass index	kg/m ²	18.5 - 24.9

At the bottom, there is a 'Chart Notes' section with the text: 'CHF patient who appears to be in cardio-respiratory distress.'

Annotations on the image include:

- Age/Time Progression**: Points to the 'Amount' and 'unit' fields.
- SNOMED/LOINC Coding (8867-4)**: Points to the 'Results' table.
- Pre-defined Templates**: Points to the 'Normal Range' column in the results table.
- Hierarchy**: Points to the navigation menu.
- Chart Notes**: Points to the text entry area at the bottom.
- Templates**: Points to the 'New' dropdown menu.



Triggers

The screenshot shows a web-based interface for creating triggers. On the left is a navigation menu with categories like 'Presentation and history', 'Physical examination', 'Investigations', and 'Management'. The 'Management' item is selected. The main content area is titled 'Trigger: Management' and contains several sections:

- Trigger Roles:** A text input field containing 'Medical practitioner'.
- Trigger Text:** A rich text editor containing a paragraph of text: 'You discuss with Vera the management of her condition. You explain that in view of her heart failure, diltiazem is not the best treatment for her hypertension in this setting. You prescribe furosemide, a potassium supplement and atorvastatin. You arrange some follow-up investigations. You make a note in Vera's file to commence her on enalapril and carvedilol on her subsequent visit when she is euolaemic. You also wonder if you should start her on aspirin.'
- Discussion Starters:** A list of questions with edit and delete icons, such as 'What is the purpose of "stress" testing? What methods are available? What does stress testing with nuclear medicine or echocardiography tell you that simple ECG stress testing (without imaging) does not?'.

Annotations with arrows point to specific parts of the interface:

- Name:** Points to the 'Trigger: Management' title.
- Role:** Points to the 'Medical practitioner' text in the 'Trigger Roles' section.
- Case Player Text:** Points to the main text area of the 'Trigger Text' section.
- Timing:** Points to the 'Discussion Starters' section.
- Discussion Starters:** Points to the list of questions at the bottom of the interface.

Discussion Starters



EMR entries

Encounter



Conditions

Medications



Procedures

Adverse Reactions

Social Determinants



EMR Entries
Patient history that will display in the EMR once this Trigger is reached (subsequent Triggers can add to this history)

Reason for Encounter	Start Time	End Time	Diagnosis	Diagnosis Note	Finding	Finding Note	Procedure	Procedure Laterality	Role	Note	Action
CHF Relapse									Paramedic		Delete

Add Encounter

Condition	Recorded Time	Onset Age	Age Unit	Status	Role	Note	Action
Congestive heart failure		68	years	Relapse	Medical practitioner		Delete

Add Condition

Medication	Recorded Time	Dose	Route	Frequency	Period	Period Units	Instructions	Status	Clinical Indication	Role	Action
Ecdicin 25 mg tablet		25mg	1	1	day				Congestive heart failure		Delete

Add Medication

Procedure	Performed Time	Body Site	Age Performed	Age Unit	Status	Role	Action
-----------	----------------	-----------	---------------	----------	--------	------	--------

Add Procedure

Adverse Reaction	Recorded Time	Role	Action
------------------	---------------	------	--------

Add Adverse Reaction

Social Determinant	Recorded Time	Coded Value / Summary	Notes	Role	Action
Transport Access		Limited access, no nearby public transit			Delete

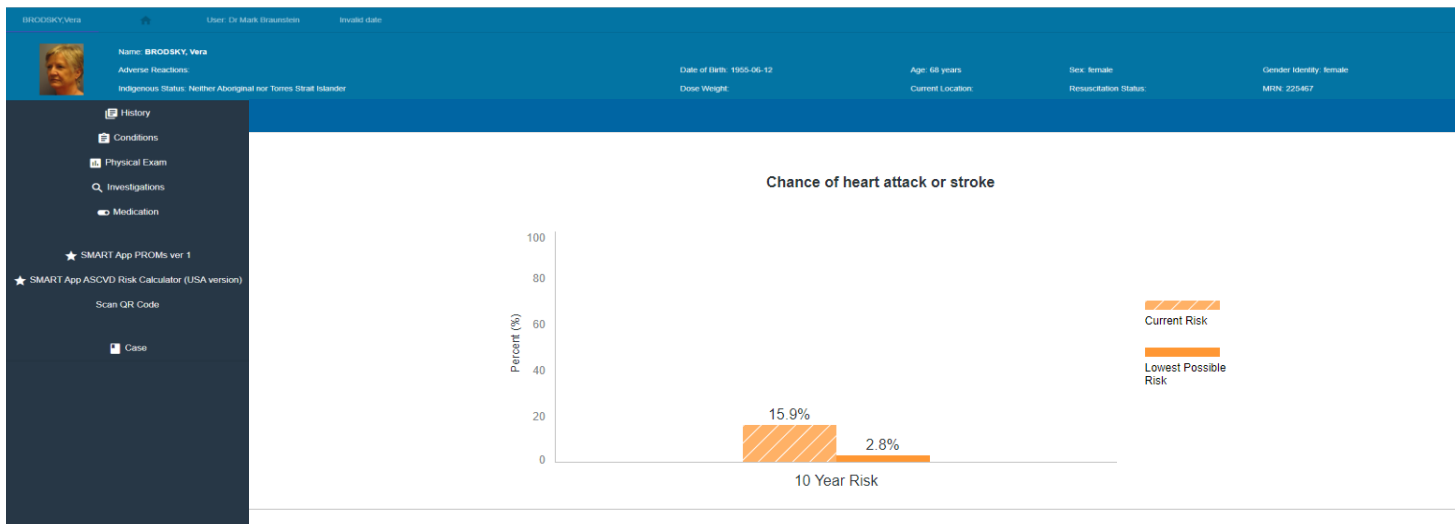
Add Social Determinant

Enter the text that will be displayed in the EMR History (appears in the Case Player under Encounters)

Patient has limited access to transportation.



SMART app integration





Future?

⚡ GenHealth.ai

Time Series of FHIR Data



```
History
[
  {
    "code": "64",
    "system": "age",
    "display": "64"
  },
  {
    "code": "E11",
    "system": "ICD10CM",
    "display": "Type 2 diabetes mellitus"
  },
  {
    "code": "E11.3551",
    "system": "ICD10CM",
    "display": "Type 2 diabetes mellitus with stable proliferative diabetic retinopathy, right eye"
  },
  {
    "code": "06-12-month",
    "system": "timegap",
    "display": "06-12-month"
  },
]
```



Future?

The screenshot shows a patient dashboard for BRODSKY, Vera. The top navigation bar includes the patient's name, a profile picture, and fields for Adverse Reactions, Indigenous Status, Date of Birth (1955-06-12), Age (68 years), Dose Weight, and Current Location. A left sidebar menu lists various medical history items, with 'SMART GenHealth' highlighted by a blue arrow. The main content area features a search bar for 'genhealth.ai' and a 'Simulate Patient Futures' section. This section includes a list of simulation categories: 'simulate', 'risk', 'cost', 'patients', 'network', and 'formulary'. Below this is a line graph showing multiple data series over 11 months. The y-axis ranges from 0 to 60. The x-axis is labeled 'months into future'. A legend at the bottom identifies 'All other events' (represented by blue and green lines) and 'Reoccurrence of Heart Failure' (represented by purple lines). A purple progress bar at the bottom indicates '25/30'.



Experience at UQ

2019: Large year 1 and 2 **medical student** cohorts

2021: **Nursing and midwifery** and **pharmacy** students and persists

2019 –on: **Information technology** students collaborate with health faculty or students to develop SMART FHIR apps for use on the platform

2022: Apps developed for **allied health** students and **interprofessional** learning