Building on FHIR: OpenHIM COVID-19 Data Exchange

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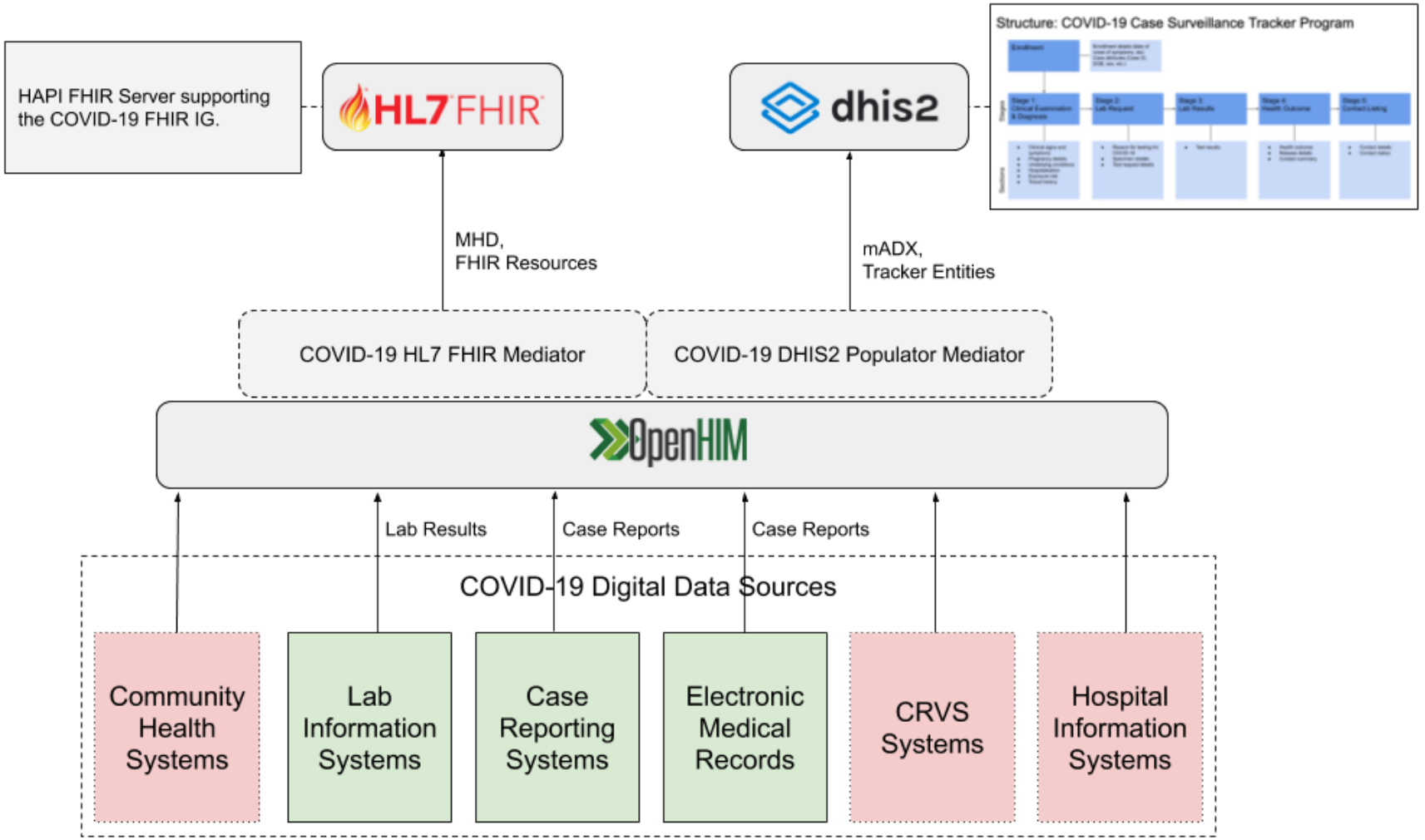
Jembi Health Systems - Introduction

- Specialist African-based digital health company, with expertise in:
  - Health information systems and health information exchange
  - Implementation of interoperability standards and profiles.
- Experience with FHIR
  - Curators of the OpenHIM and Instant OpenHIE, that includes FHIR-based data exchange mediators and interfacing with HAPI-FHIR server.
  - Contributors to FHIR Clinical Guidelines implementation guide (WHO)
  - Participants in FHIR Africa working group
  - Participants in OpenHIE communities focused on FHIR-based data exchange development (e.g. COVID-19, case-based surveillance, health financing).

OpenHIM COVID-19 Data Exchange

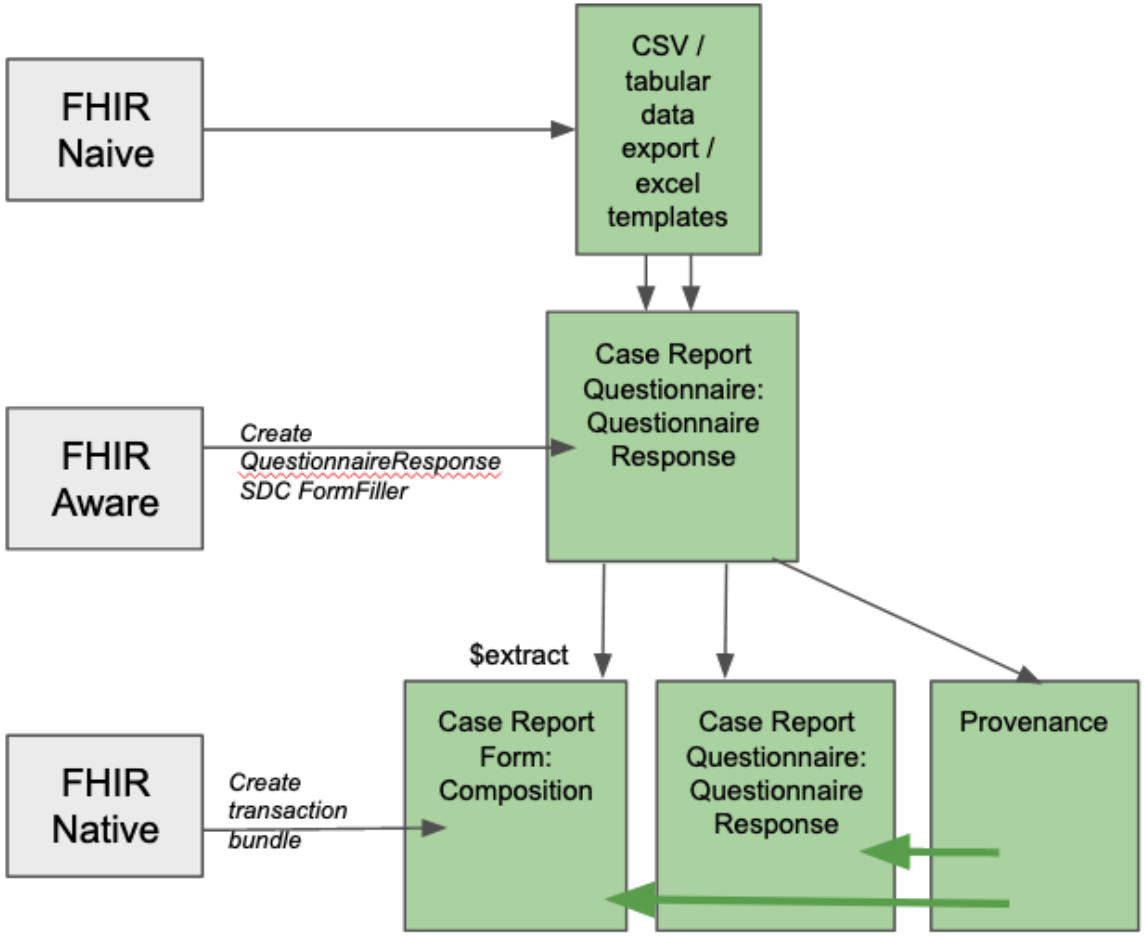
- OpenHIE COVID-19 Task Force established in April 2020 in response to the interoperability and data sharing needs of the global community.
- OpenHIM COVID-19 project focused on:
  - Develop a COVID-19 FHIR Implementation Guide
  - Support ingestion of COVID-19 case reporting and lab data to:
    - a central HAPI FHIR server, and
    - DHIS2 (supporting the COVID-19 metadata packages)
  - Enable support for a simple ingestion format to ease the burden on existing, or difficult to modify, systems.
  - Ensure a generic solution that is adaptable based on country needs.

Data Exchange Use Case



Levels of FHIR Support

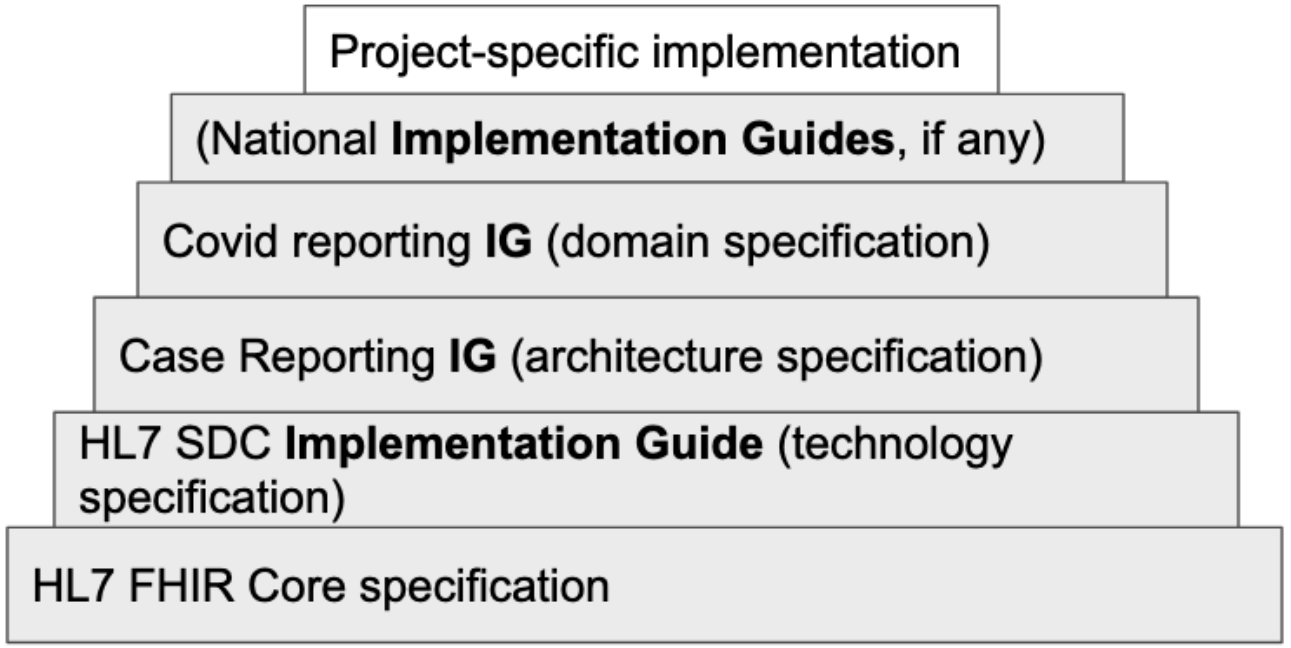
- Aim is to support data exchange from Point of Service (POS) systems with varying levels of FHIR compatibility:
- FHIR Naive
  - Existing tools with limited resources or potential to upgrade to include FHIR support. Have back-end access to database or way to generate tabular reports.
- FHIR Aware
  - Basic FHIR Questionnaire support available for simple data exports from template reports. Can initiate FHIR API calls.
- FHIR Native
  - Full FHIR stack, data model and supporting tools are within the system. Can generate robust FHIR resources and data models



FHIR Implementation Guides (IGs)

Used to describe how FHIR is used in a particular context, with a layered approach.

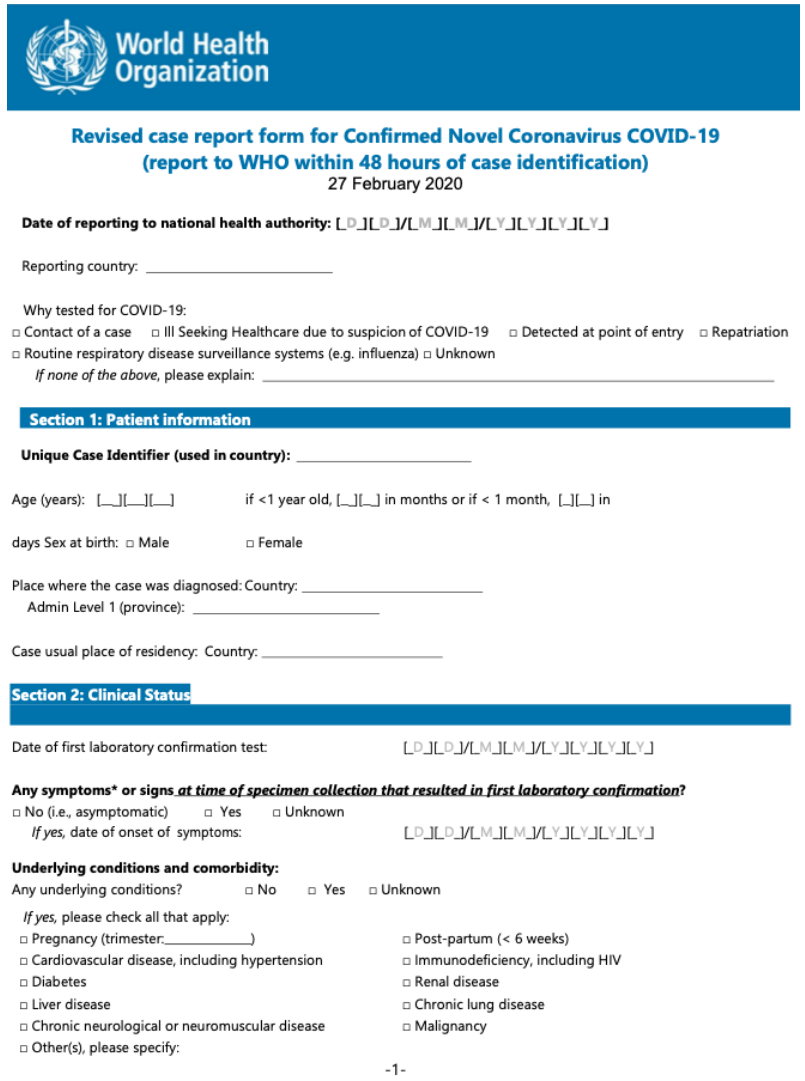
- Jurisdiction Base
  - Usually a country specific set of rules.
- Domain Guide
  - Describes the proper way to represent specialized content in FHIR.
- Application Solution
  - Describes how FHIR is used to solve a particular problem in an application.



FHIR Structured Data Capture (SDC)

- FHIR SDC uses a form-driven workflow to capture and encode data by creating FHIR Observations from the captured data.
- Provides standard workflow models and roles for managing, discovering and completing forms
- Useful for areas where questionnaires/forms are a standard mechanism for data collection
- Used here to provide a simpler way for Point of Service systems to offer limited support for FHIR data exchange
  - Doesn’t require a fully-fledged FHIR API
  - Only needs to support the population and submission of FHIR Questionnaire/QuestionnaireResponse resources.

FHIR Profiling – From Form to FHIR IG



World Health Organization

Revised case report form for Confirmed Novel Coronavirus COVID-19
(report to WHO within 48 hours of case identification)
27 February 2020

Date of reporting to national health authority: [_D_][_D_]/[_M_][_M_]/[_Y_][_Y_][_Y_][_Y_]

Reporting country: _____

Why tested for COVID-19:
□ Contact of a case □ Ill Seeking Healthcare due to suspicion of COVID-19 □ Detected at point of entry □ Repatriation
□ Routine respiratory disease surveillance systems (e.g. influenza) □ Unknown
If none of the above, please explain: _____

Section 1: Patient information

Unique Case Identifier (used in country): _____

Age (years): [__][__][__] if <1 year old, [__][__] in months or if < 1 month, [_][_] in

days Sex at birth: □ Male □ Female

Place where the case was diagnosed: Country: _____
Admin Level 1 (province): _____

Case usual place of residency: Country: _____

Section 2: Clinical Status

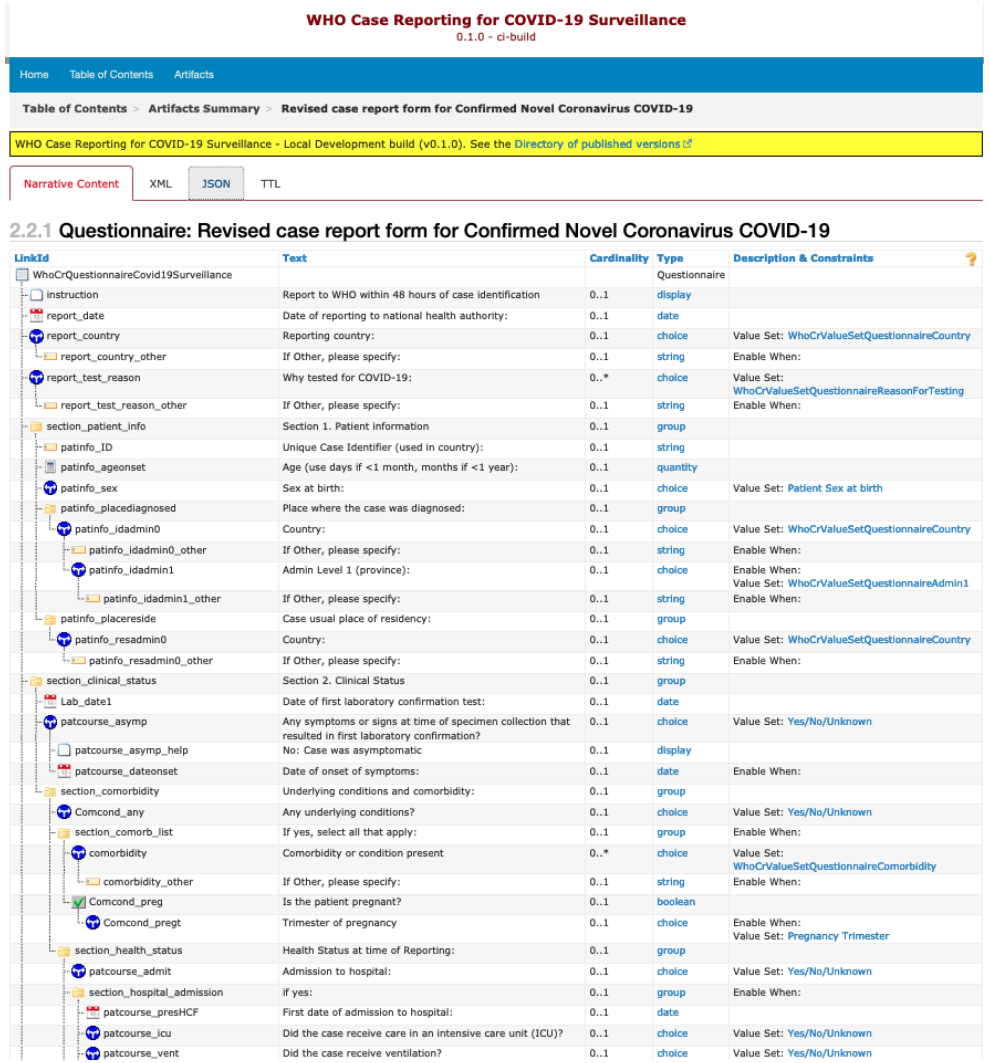
Date of first laboratory confirmation test: [_D_][_D_]/[_M_][_M_]/[_Y_][_Y_][_Y_][_Y_]

Any symptoms* or signs *at time of specimen collection that resulted in first laboratory confirmation*?
□ No (i.e., asymptomatic) □ Yes □ Unknown
If yes, date of onset of symptoms: [_D_][_D_]/[_M_][_M_]/[_Y_][_Y_][_Y_][_Y_]

Underlying conditions and comorbidity:
Any underlying conditions? □ No □ Yes □ Unknown

If yes, please check all that apply:
□ Pregnancy (trimester:_____) □ Post-partum (< 6 weeks)
□ Cardiovascular disease, including hypertension □ Immunodeficiency, including HIV
□ Diabetes □ Renal disease
□ Liver disease □ Chronic lung disease
□ Chronic neurological or neuromuscular disease □ Malignancy
□ Other(s), please specify:

-1-



WHO Case Reporting for COVID-19 Surveillance
0.1.0 - ci-build

Home | Table of Contents | Artifacts

Table of Contents > Artifacts Summary > Revised case report form for Confirmed Novel Coronavirus COVID-19

WHO Case Reporting for COVID-19 Surveillance - Local Development build (v0.1.0). See the Directory of published versions

Narrative Content | XML | JSON | TTL

2.2.1 Questionnaire: Revised case report form for Confirmed Novel Coronavirus COVID-19

LinkId	Text	Cardinality	Type	Description & Constraints
WhoCrQuestionnaireCovid19Surveillance			Questionnaire	
instruction	Report to WHO within 48 hours of case identification	0..1	display	
report_date	Date of reporting to national health authority:	0..1	date	
report_country	Reporting country:	0..1	choice	Value Set: WhoCrValueSetQuestionnaireCountry
report_country_other	If Other, please specify:	0..1	string	Enable When:
report_test_reason	Why tested for COVID-19:	0..*	choice	Value Set: WhoCrValueSetQuestionnaireReasonForTesting
report_test_reason_other	If Other, please specify:	0..1	string	Enable When:
section_patient_info	Section 1. Patient information	0..1	group	
patinfo_ID	Unique Case Identifier (used in country):	0..1	string	
patinfo_ageonset	Age (use days if <1 month, months if <1 year):	0..1	quantity	
patinfo_sex	Sex at birth:	0..1	choice	Value Set: Patient Sex at birth
patinfo_placediagnosed	Place where the case was diagnosed:	0..1	group	
patinfo_idadmin0	Country:	0..1	choice	Value Set: WhoCrValueSetQuestionnaireCountry
patinfo_idadmin0_other	If Other, please specify:	0..1	string	Enable When:
patinfo_idadmin1	Admin Level 1 (province):	0..1	choice	Enable When: Value Set: WhoCrValueSetQuestionnaireAdmin1
patinfo_idadmin1_other	If Other, please specify:	0..1	string	Enable When:
patinfo_placereside	Case usual place of residency:	0..1	group	
patinfo_resadmin0	Country:	0..1	choice	Value Set: WhoCrValueSetQuestionnaireCountry
patinfo_resadmin0_other	If Other, please specify:	0..1	string	Enable When:
section_clinical_status	Section 2. Clinical Status	0..1	group	
Lab_date1	Date of first laboratory confirmation test:	0..1	date	
patcourse_asymp	Any symptoms or signs at time of specimen collection that resulted in first laboratory confirmation?	0..1	choice	Value Set: Yes/No/Unknown
patcourse_asymp_help	No: Case was asymptomatic	0..1	display	
patcourse_dateonset	Date of onset of symptoms:	0..1	date	Enable When:
section_comorbidity	Underlying conditions and comorbidity:	0..1	group	
Comcond_any	Any underlying conditions?	0..1	choice	Value Set: Yes/No/Unknown
section_comorb_list	If yes, select all that apply:	0..1	group	Enable When:
comorbidity	Comorbidity or condition present	0..*	choice	Value Set: WhoCrValueSetQuestionnaireComorbidity
comorbidity_other	If Other, please specify:	0..1	string	Enable When:
Comcond_preg	Is the patient pregnant?	0..1	boolean	
Comcond_pregt	Trimester of pregnancy	0..1	choice	Enable When: Value Set: Pregnancy Trimester
section_health_status	Health Status at time of Reporting:	0..1	group	
patcourse_admit	Admission to hospital:	0..1	choice	Value Set: Yes/No/Unknown
section_hospital_admission	if yes:	0..1	group	Enable When:
patcourse_presHCF	First date of admission to hospital:	0..1	date	
patcourse_icu	Did the case receive care in an intensive care unit (ICU)?	0..1	choice	Value Set: Yes/No/Unknown
patcourse_vent	Did the case receive ventilation?	0..1	choice	Value Set: Yes/No/Unknown

Steps involved:

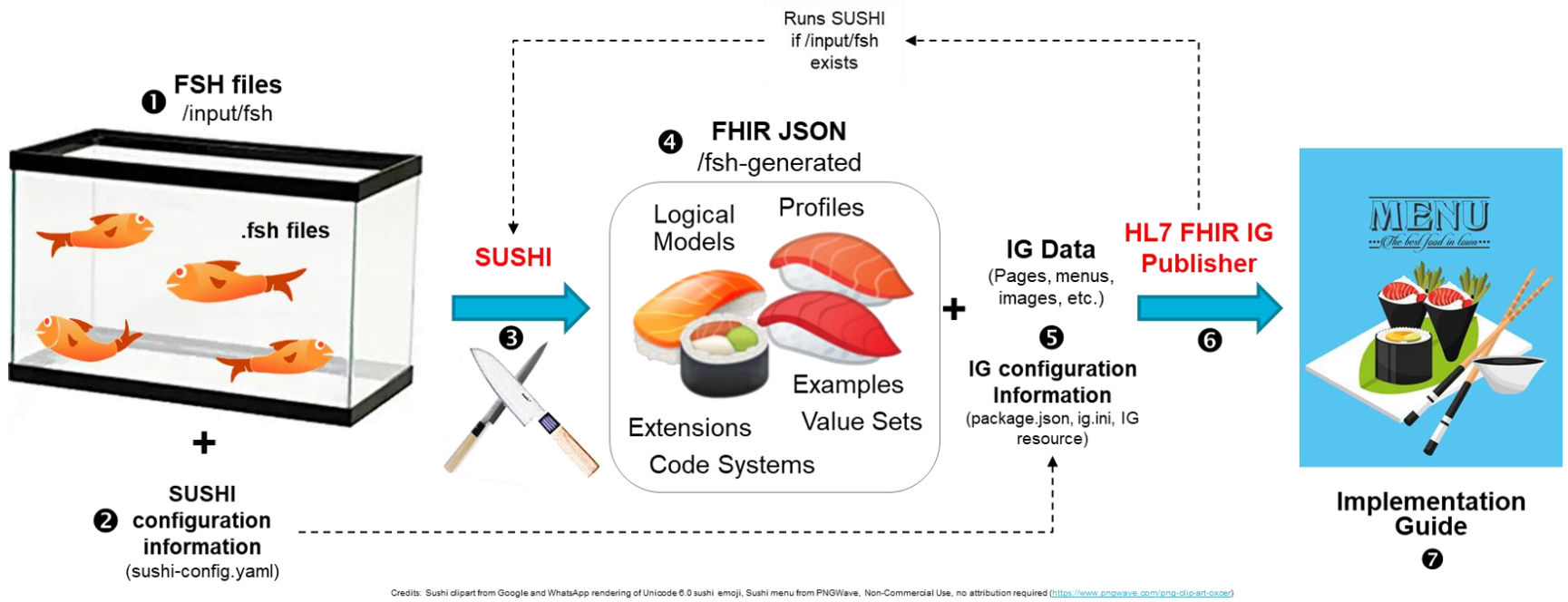
- Identify data and constraints
- Define Logical Models
- Define a Questionnaire
- Map to FHIR resources
- Add examples

FHIR Profiling – Data Mapping & Logical Model

	Case Report Input: QuestionnaireResponse						Hapi-FHIR Resource Mapping (FHIR Bundle)			
2	**Form Section**	**Field name**	**Description**	**Sample data**	**Data type**	**Format**	**Resource Type**	**Field Name**	**Data Type**	**ValueSet Mapping**
3	Reporting	report_test_reason	Test Reason	"CASE_CONTACT"	coded	-Contact of a case -Seeking Healthcare -Detected at point of entry -Repatriation -Surveillance -Unknown	Observation	code: - system - value valueString	coding	https://loinc.org/67098-4/ using the valueset that's in the FHIR IG for this: https://openhie.github.io/covid-ig/CodeSystem-WhoCrCodeSystemReasonForT
4	Reporting	report_country	Country where case was reported	ZA	string	two letter code	Observation	code: - system - value valueCodeableConcept.coding[].code: - value - system	coding	https://loinc.org/77967-8/ value: country code system: http://hl7.org/fhir/ValueSet/iso3166-1-2
5	Reporting	report_date	Date of reporting	"2021-01-20"	date		Encounter [Case Encounter]	status = 'in-progress' period.start class = ACUTE		https://loinc.org/77970-2/
6	Patient Information	patinfo_ID	Unique Case Identifier	123e4567-e89b-12d3-a456-4	UUID		Composition	identifier.value	string	
7	Patient Information	patinfo_idadmin0	Place where the case was diagnosed: Country:	ZA	string	two letter code	Encounter	location[0].location.reference		
8	Patient Information	patinfo_idadmin1	Province where case was reported	KZN	string				UUID	
9	Patient Information	patinfo_ageonset	Age years	30	integer	0-30 days 1-11 months 1-120 years	Observation	valueQuantity.value		
10		author.reference	Reference ID of responsible Practitioner	Practitioner/123456789	FHIR reference	Practitioner/<ID>	Composition	author.reference	FHIR reference	
11	Patient Information	patinfo_sex	Sex at birth	"male"	string	female male	Observation	valueCodeableConcept.coding[]	coding	http://hl7.org/fhir/R4/codesystem-administrative-gender.html
12	Clinical Status	Lab_date1	Lab Confirmation Test Date	"2021-01-20"	date	yyyy-mm-dd	Observation	valueDateTime	date	https://www.hl7.org/fhir/datatypes.html#dateTime
13	Clinical Status	patcourse_asymp	Symptoms at time of specimen	"UNK"	string		Observation	valueCodeableConcept.coding[]	coding	
14	Clinical Status	Comcond_any	Comorbidity Conditions indicator	"N"	string	Y N	Observation	valueCodeableConcept.coding[]	coding	
15	Clinical Status	patcourse_dateonset	Symptoms Date	"2021-01-20"	date	yyyy-mm-dd	Observation	valueDateTime	date	https://www.hl7.org/fhir/datatypes.html#dateTime
16	Exposure Risk	expo_travel	Travelled Last 14 Days	"Y"	string	Y N	Observation	valueCodeableConcept.coding[]	coding	
						PREGNANCY POSTPARTUM				

FHIR Implementation Guides (IGs)

- FHIR Shorthand (FSH) is a specially-designed language for defining the content of FHIR Implementation Guides (IGs). It is simple and compact, with tools to produce FHIR profiles, extensions and implementation guides (IGs).
- SUSHI is a set of tools that supports the use of FSH to create and publish FHIR IGs.



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Challenges, Opportunities and Lessons Learnt

FHIR Implementation and Deployment

- FHIR profiling can be time consuming and requires specialized skills.
- FHIR profiling process repeatable
  - I.e. There is an initial learning curve, but going through this once provides a standard procedure/set of steps for future projects.
- FHIR Structured Data Capture (SDC) approach can provide a quicker and easier way for Point of Service systems to support a FHIR-based data exchange.

FHIR Customization

- Various approaches and processes available to customize FHIR and Implementation Guides.
- Different jurisdictions (e.g. country-specific customizations, data fields and extensions)
- Multi-language support
- Use of value sets, international and custom terminologies and health data standards (e.g. LOINC, SNOMED CT)

FHIR Tooling and Versioning

- Tooling for creation and publishing of FHIR Implementation Guides is always improving and easy to use (e.g. FSH, SUSHI)
- Tooling for displaying and rendering Questionnaires available (e.g. Questionnaire App, Form Builder, FHIRPath)
- FHIR Documentation well maintained, includes clear examples.
- HL7 FHIR Dev Days events provide great opportunities for upskilling and gaining practical experience.
- FHIR specification release cycle
  - New versions published on 18-24 month release cycle.
  - Maturity of FHIR resources changes, can include breaking or substantive changes.

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