FHIR® Webinar

Introduction to Android FHIR® SDK

February 2, 2022

Agenda

1. Recap FHIR Questionnaire and SDC

2. Android FHIR SDK Intro

- What is Android FHIR SDK
- Design principles
- Libraries
    - FHIR Engine Library
    - SDC Library
    - Workflow Library

3. Walkthrough: build an Android app using the SDK to display FHIR Questionnaire

- Create an application
- Add dependency on the Android FHIR SDK libraries
- Use the SDC library to display a questionnaire

4. Q&A

- Your context / Challenges / Ideas

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Goals

1. **Understand the Android FHIR SDK work**
   - what the Android FHIR SDK is and the design principles behind it
   - the main libraries in the SDK
   - how to use the Android FHIR SDK libraries

2. **Learn to build an Android app using the SDK to display a FHIR Questionnaire**
   - Walkthrough of an skeleton Android application that displays a questionnaire from previous sessions of this series

Preparation for the walkthrough

Clone repository:

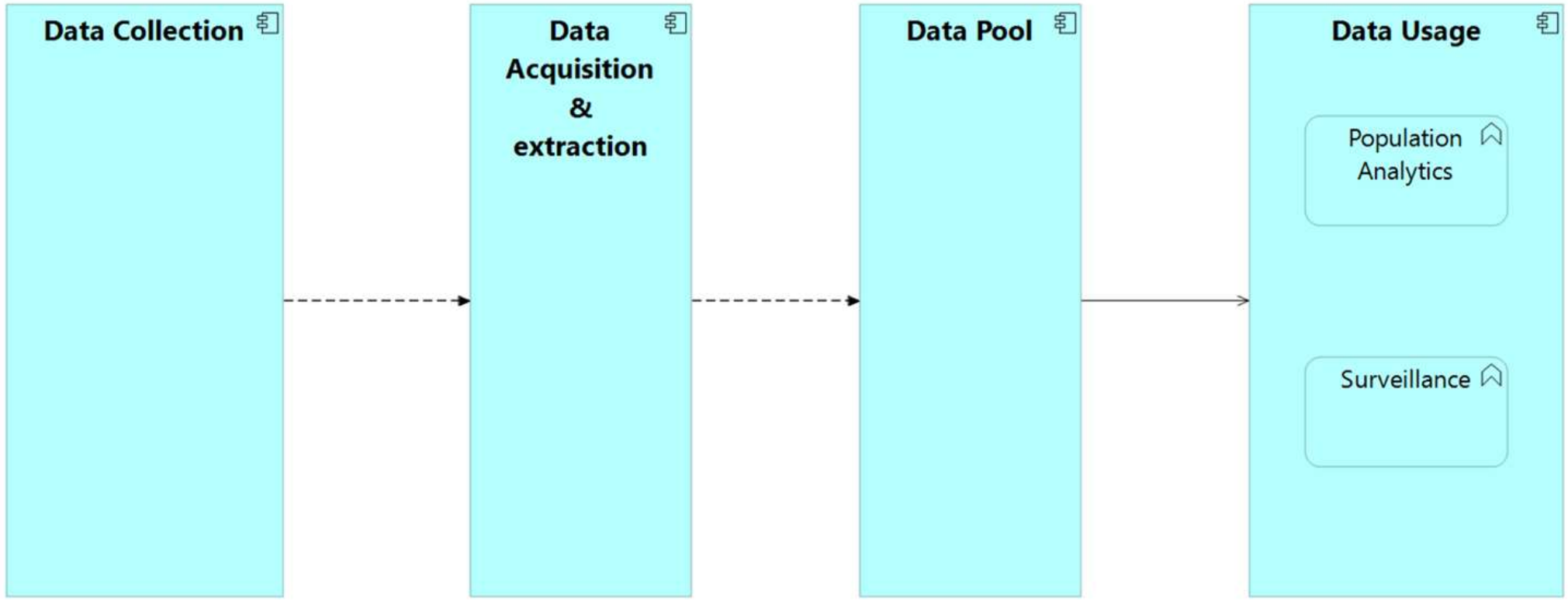
- https://github.com/openhie/FoodAllergy-webinar

IDE:

- Download Android Studio 2021.1.1 from https://developer.android.com/studio

Part 1
Recap

Examples of using form - Case Reporting



Food Allergies ImplementationGuide
0.1.0-test - CI Build

OpenHIE

IG Home | Table of Contents | Specifications

Table of Contents / **Artifacts Summary**

Food Allergies ImplementationGuide - Local Development build (v0.1.0-test). See the Directory of published versions

4 Artifacts Summary

This page provides a list of the FHIR artifacts defined as part of this implementation guide.

Contents:

4.0.1 Structures: Logical Models

These define data models that represent the domain covered by this implementation guide in more business-friendly terms than the underlying FHIR resources.

Food Allergy Logical Model	Food Allergy information model

4.0.2 Structures: Questionnaires

These define forms used by systems conforming to this implementation guide to capture or expose data to end users

Food Allergy self-report	A form for self-reported food allergies, including the basic information and contained valuesets

4.0.3 Structures: Resource Profiles

These define constraints on FHIR resources for systems conforming to this implementation guide

(link)

From Logical Model to Form

4.1.1 Logical Model: Food Allergy Logical Model

Defining URL:	http://ohie.org/fhir/food-allergy/StructureDefinition/FoodAllergyModel
Version:	0.1.0-test
Name:	FoodAllergyModel
Title:	Food Allergy Logical Model
Status:	Active as of 1/28/22, 4:31 PM
Definition:	Food Allergy information model
Publisher:	OpenHIE
Source Resource:	XML / JSON / Turtle

The official URL for this profile is:

```
http://ohie.org/fhir/food-allergy/StructureDefinition/FoodAllergyModel
```

4.1.1.1 Formal Views of Profile Content

Description of Profiles, Differentials, Snapshots and how the different presentations work.

Text Summary | Differential Table | Snapshot Table | Snapshot Table (Must Support) | All

This structure is derived from Base

Name	Flags	Card.	Type	Description & Constraints
FoodAllergyModel		0..*		Food Allergy Logical Model
patient		1..1	Reference()	The person that has the allergy
allergen		1..1	CodeableConcept	The substance that the person is allergic to
clinicalStatus		1..1	CodeableConcept	The status of the allergy - if it is active or resolved
verificationStatus		1..1	CodeableConcept	The verification status of the allergy - if it is confirmed or suspected or refuted
recordedDate		0..1	dateTime	When the allergy was reported
recorder		0..1	Reference()	Who recorded the allergy
asserter		0..1	Reference()	Who asserted the allergy
reactions		0..1	BackboneElement	known past reactions to the allergen
manifestation		0..1	CodeableConcept	How the reaction manifested itself
certitude		0..1	CodeableConcept	How certain we are that the cause of the reaction was the allergen indicated
exposure		0..1	CodeableConcept	The exposure route to the substance
note		0..1	string	Additional text note about the allergic reaction

Food Allergies ImplementationGuide - Local Development build (v0.1.0-test). See the Directory of published versions

Tree View | Form | XML | JSON | TTL

4.2.1 Questionnaire: Food Allergy self-report

Branch:

LinkId	Text	Cardinality	Type	Description & Constraints
FoodAllergyQuestionnaire			Questionnaire	A form for self-reported food allergies, including the basic information and contained valuesets
title	Food Allergy report	0..1	display	
instructions	Reporting instructions: Please report any allergy or allergic reaction	0..1	display	
patient	Patient ID	0..1	string	
allergen	Substance that the person is allergic to	0..1	choice	Value Set: FoodAllergyVS
clinicalStatus	Status of the allergy - active or resolved	0..1	choice	Value Set: FoodAllergyVS
verificationStatus	Verification status of the allergy - confirmed or suspected or refuted	0..1	choice	Value Set: FoodAllergyVerificationStatusVS
recordedDate	When was it reported	0..1	date	
recorder	Who recorded the allergy	0..1	string	
asserter	Who asserted the allergy	0..1	string	
reactions	Reactions	0..1	group	
substance	Substance that is thought to have triggered the reaction	0..1	string	
manifestation	Manifestation	0..1	string	
note	Note	0..1	string	

4.2.1 Form: Food Allergy self-report - Form

Food Allergy self report

Name	Value
Food Allergy report	
Reporting instructions: Please report any allergy or allergic reaction	
Patient ID	Type a value
Substance that the person is allergic to	Select one
Status of the allergy - active or resolved	Select one
Verification status of the allergy - confirmed or suspected or refuted	Select one
When was it reported	MM/DD/YYYY
Who recorded the allergy	Type a value
Who asserted the allergy	Type a value
Reactions	
Substance that is thought to have triggered the reaction	Type a value
Manifestation	Type a value
Note	Type a value

Making of a Questionnaire

https://github.com/openhie/FoodAllergy-webinar/blob/master/input/fsh/form.fsh

- Please let us know:
  - More sessions/workshops on SDC questionnaires?
  - More sessions on sushi?
  - …?

Part 2
Android FHIR SDK

Main topics

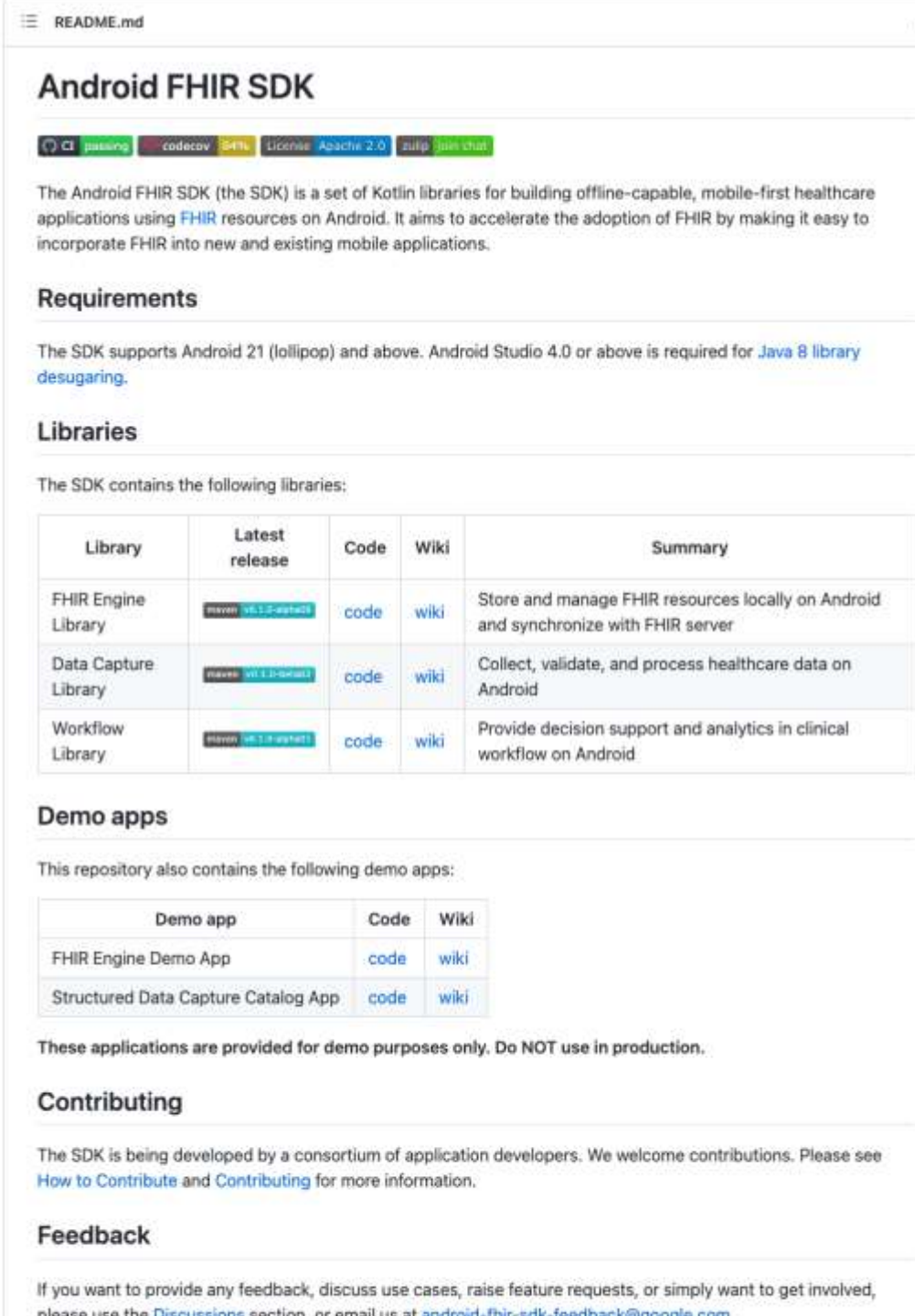
- Overview
- Design principles
- Libraries
  - ❑ FHIR Engine Library
  - ❑ Structured Data Capture Library
  - ❑ Workflow Library
- Demo apps
- Resources

Overview

The Android FHIR® SDK is a set of Kotlin libraries for building offline-capable, mobile-first healthcare applications using FHIR resources on Android.

https://github.com/google/android-fhir

NOTE: The libraries are in active development and we are constantly looking for community feedback and community contributions are welcome.



README.md

Android FHIR SDK

CI passing codecov 84% License Apache 2.0 zulip Join chat

The Android FHIR SDK (the SDK) is a set of Kotlin libraries for building offline-capable, mobile-first healthcare applications using FHIR resources on Android. It aims to accelerate the adoption of FHIR by making it easy to incorporate FHIR into new and existing mobile applications.

Requirements

The SDK supports Android 21 (lollipop) and above. Android Studio 4.0 or above is required for Java 8 library desugaring.

Libraries

The SDK contains the following libraries:

Library	Latest release	Code	Wiki	Summary
FHIR Engine Library	maven v0.1.0-alpha03	code	wiki	Store and manage FHIR resources locally on Android and synchronize with FHIR server
Data Capture Library	maven v1.1.0-beta01	code	wiki	Collect, validate, and process healthcare data on Android
Workflow Library	maven v0.1.0-alpha01	code	wiki	Provide decision support and analytics in clinical workflow on Android

Demo apps

This repository also contains the following demo apps:

Demo app	Code	Wiki
FHIR Engine Demo App	code	wiki
Structured Data Capture Catalog App	code	wiki

These applications are provided for demo purposes only. Do NOT use in production.

Contributing

The SDK is being developed by a consortium of application developers. We welcome contributions. Please see How to Contribute and Contributing for more information.

Feedback

If you want to provide any feedback, discuss use cases, raise feature requests, or simply want to get involved, please use the Discussions section, or email us at android-fhir-sdk-feedback@google.com

Design Principles

- **Open source.** Part of the ecosystem of global health digital infrastructure. Apache 2.0 license.
    - repo forking and contrib folder

- **FHIR native.** FHIR as its native data model (HAPI structures) with support for terminologies to drive interoperability.

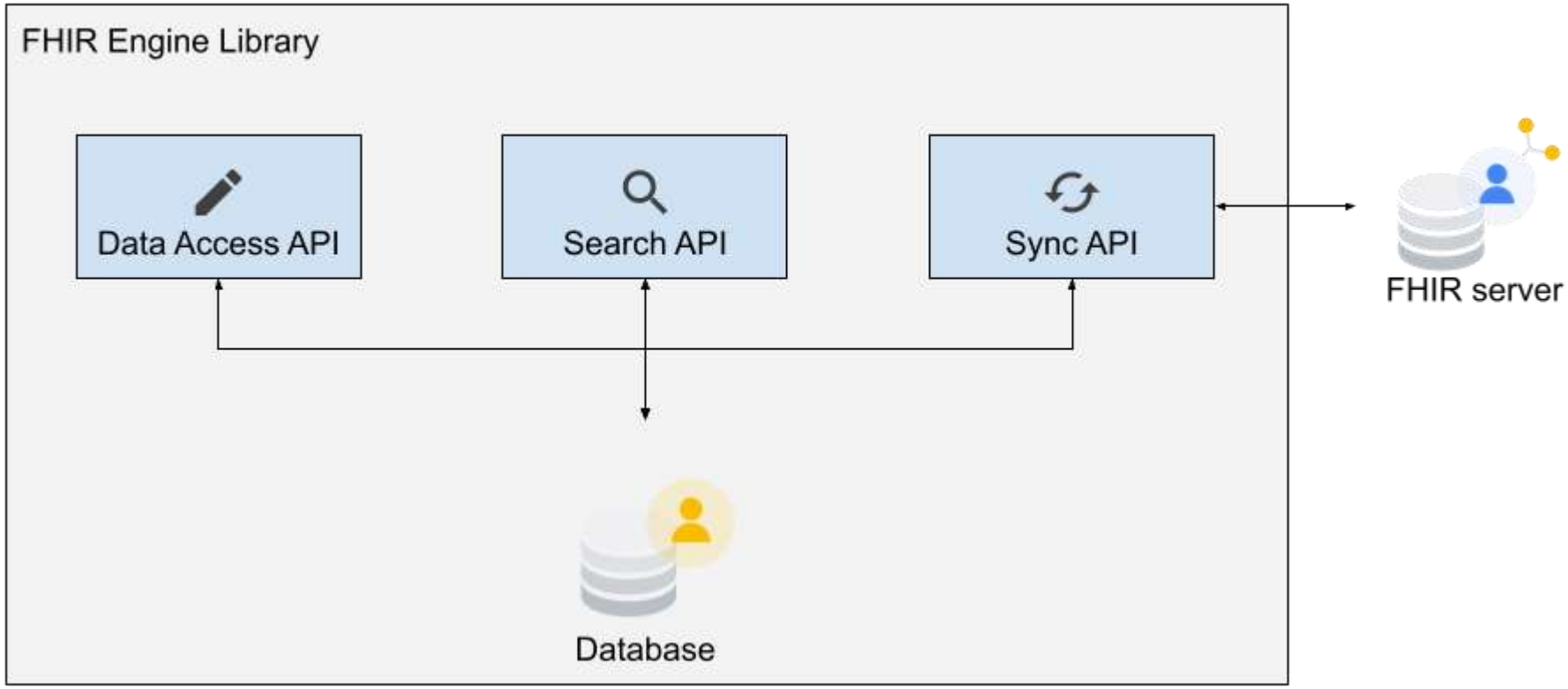
- **Support online/offline use.** Designed for mobile first settings with online and offline usage in mind.

- **Support clinical workflows.** Provide building blocks for clinical workflows (e.g. SDC library and workflow library).

SDK Libraries

- **FHIR Engine Library.** Store and manage FHIR resources locally on Android and synchronize with FHIR server.
- **Structured Data Capture Library.** Collect, validate, and process healthcare data on Android.
- **Workflow Library (WIP).** Provide decision support and analytics in clinical workflow on Android.

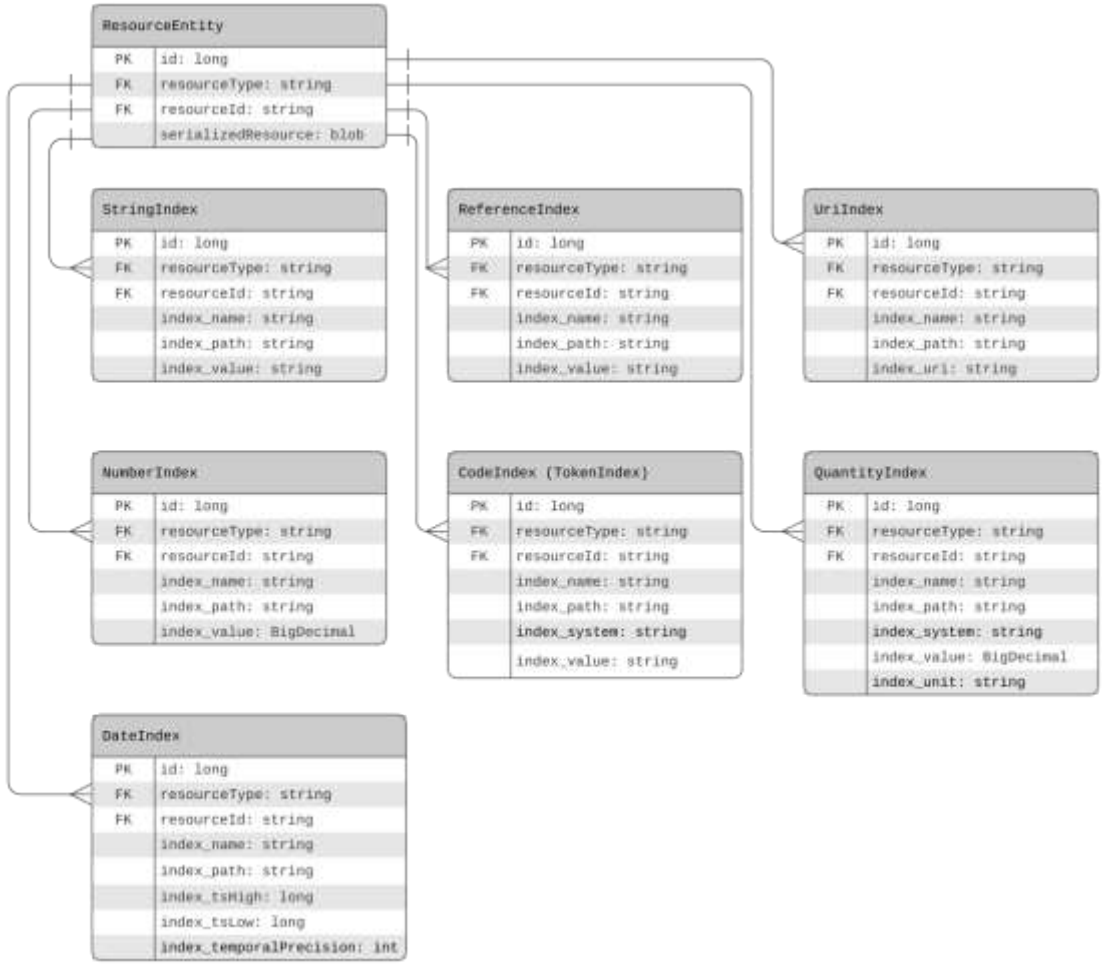
FHIR Engine Library



FHIR Engine Library: database

Designed for all FHIR resources

- **Resource table.** Serialized FHIR resources as JSON documents
- **Index tables**. Structured index tables per data type. Using FHIR search parameters as hints to build index.
- **Local change table.** Store local changes in order to sync with FHIR server.
- Encryption using SQL cipher



FHIR Engine Library: APIs

- **Data Access API:** basic access to local FHIR resources, namely, the CRUD operations: create, read, update, and delete
- **Search API:** a Kotlin DSL (domain-specific language) for searching local FHIR resources
- **Sync API:** synchronizes local FHIR resources with FHIR backends

FHIR Engine Library: Data Access API

- CRUD (create, read, update, delete) operations
- Example: FhirEngineImplTest.kt

```
fhirEngine.save(patient)
fhirEngine.saveAll(listOf(patient1, patient2))
```

FHIR Engine Library: Search API

- Kotlin DSL (domain specific language) to search local resources
- Example: PatientListViewModel.kt in demo

```
val patients: List<Patient> = fhirEngine.search()
    .of(Patient::class.java)
    .filter(string(Patient.ADDRESS_CITY, ParamPrefixEnum.EQUAL,  value: "KIGALI"))
    .run()
```

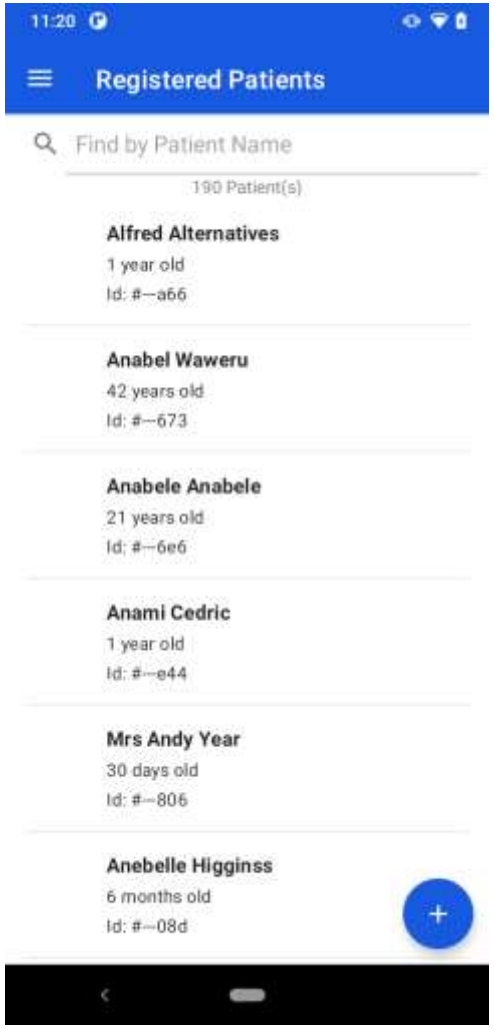
FHIR Engine Library: Sync API (WIP)

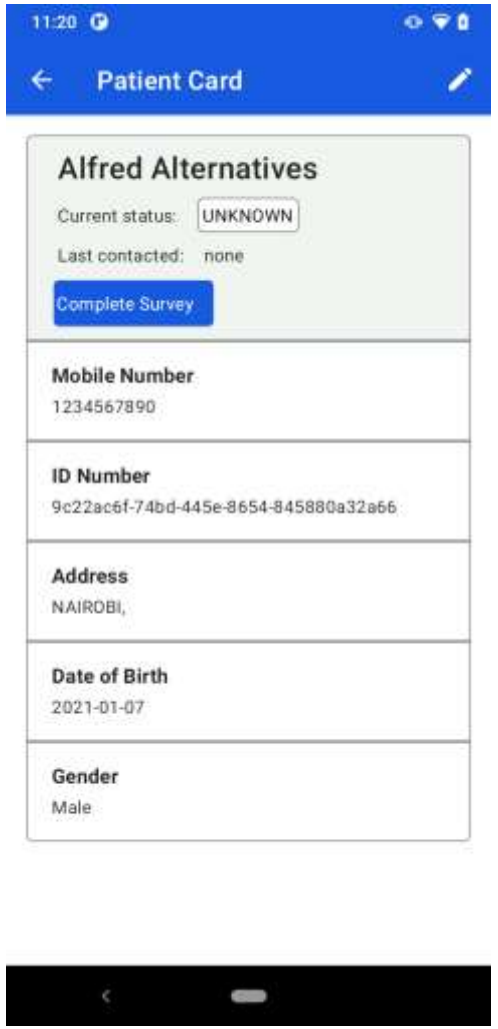
- Synchronize with FHIR server by defining a Sync worker

```
class FhirPeriodicSyncWorker(appContext: Context, workerParams: WorkerParameters) :
  FhirSyncWorker(appContext, workerParams) {

  override fun getSyncData() = mapOf(ResourceType.Patient to mapOf("address-city" to "NAIROBI"))

  override fun getDataSource() =
    HapiFhirResourceDataSource(HapiFhirService.create(FhirContext.forR4().newJsonParser()))

  override fun getFhirEngine() = FhirApplication.fhirEngine(applicationContext)
}
```

```
Sync.oneTimeSync<FhirPeriodicSyncWorker>( context: this)
```

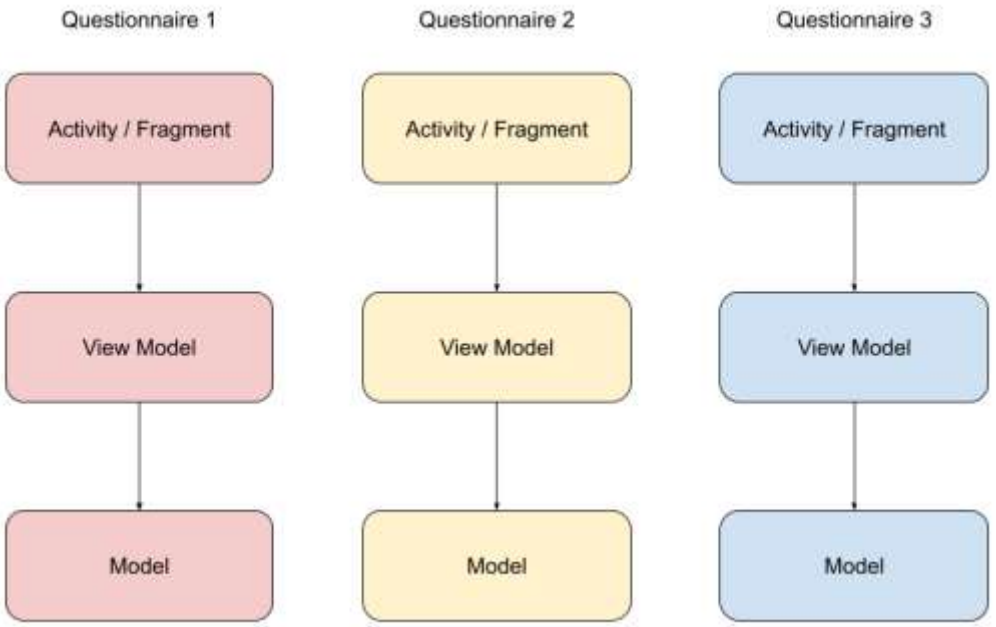
FHIR Engine demo app



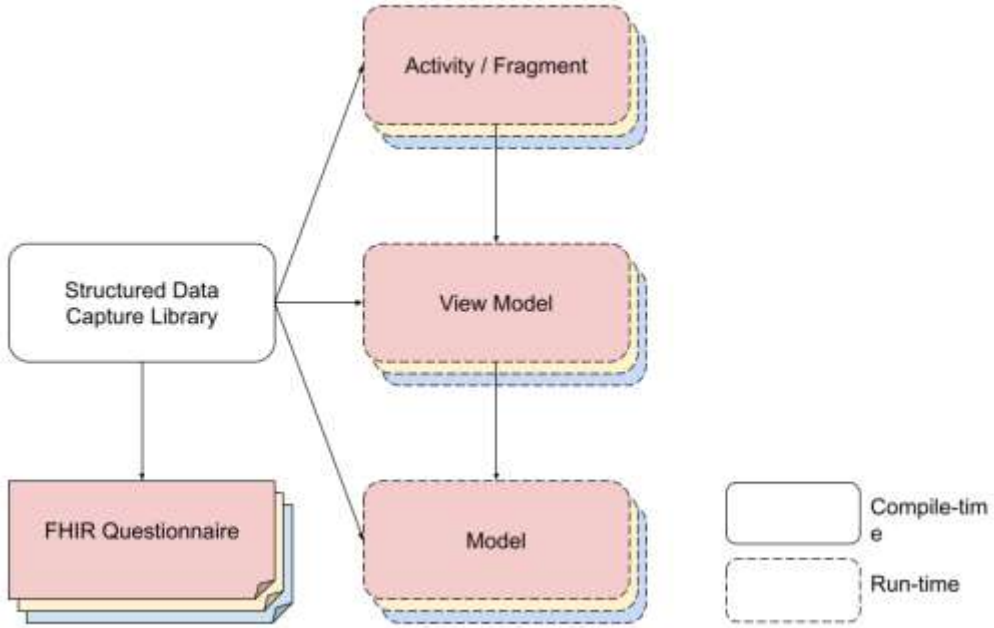


Structured Data Capture Library

Before



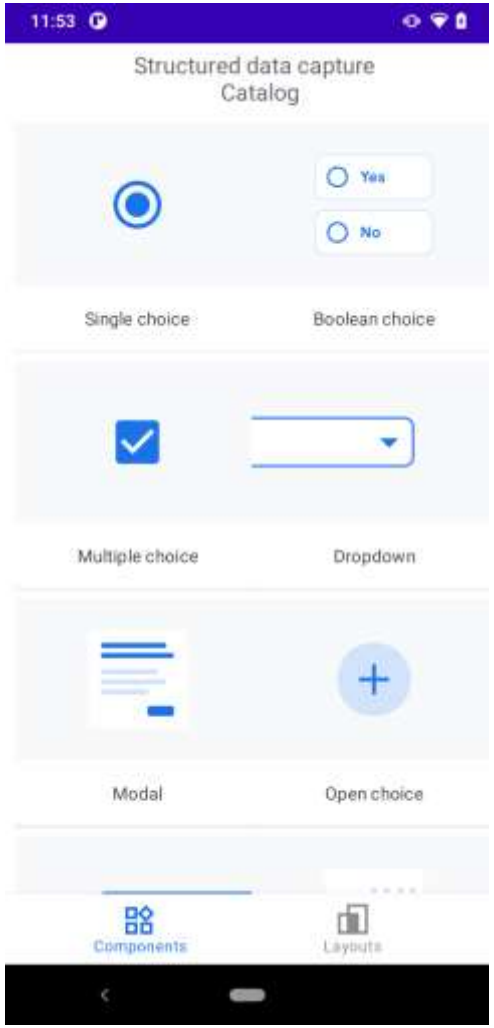
After



Structured Data Capture Library: APIs

- **QuestionnaireFragment:** the main class for rendering questionnaires
- **ResourceMapper:** handles data extraction and questionnaire population
- **QuestionnaireResponseValidator:** validates questionnaire responses against questionnaires

Structured Data Capture Catalog App



Workflow Library

- WIP
- Depends on CQL evaluator https://github.com/DBCG/cql-evaluator
- Support operations such as $apply and $evaluate-measure to generate CarePlan or MeasureReport

Resources

- **GitHub:** https://github.com/google/android-fhir
- **Zulip chat for Android:** https://chat.fhir.org/#narrow/stream/276344-android
- **Feedback:** android-fhir-sdk-feedback@google.com
- **Support clinical workflows.** Provide building blocks for clinical workflows (e.g. SDC library and workflow library).

Part 3
Walkthrough:
Build an app using the SDK

Walkthrough

Clone repository:

- https://github.com/openhie/FoodAllergy-webinar

IDE:

- Download Android Studio 2021.1.1 from https://developer.android.com/studio

Open the android subdirectory in the repo as an Android project

Android Resources

Build your first app:

- https://developer.android.com/training/basics/firstapp

Run apps on emulator:

- https://developer.android.com/studio/run/emulator

Run apps on device:

- https://developer.android.com/studio/run/device

Q&A, Ideas

Get in touch, be active

- Check with others (at chat.fhir.org or community.fhir.org)
- Create (or ask someone to create) a change request
- Join a FHIR® event like DevDays (devdays.com), discuss
- Join a FHIR® connectathon, test and provide feedback

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Demo and hands-on

- https://lhcforms.nlm.nih.gov
- http://ui.hl7.beda.software
- http://smartqedit4.azurewebsites.net