



# mobiEMR: A DHIS2-conformant mobile app for community workflows



UNIVERSITY  
OF OSLO

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[www.hispzw.org](http://www.hispzw.org)



# Overview



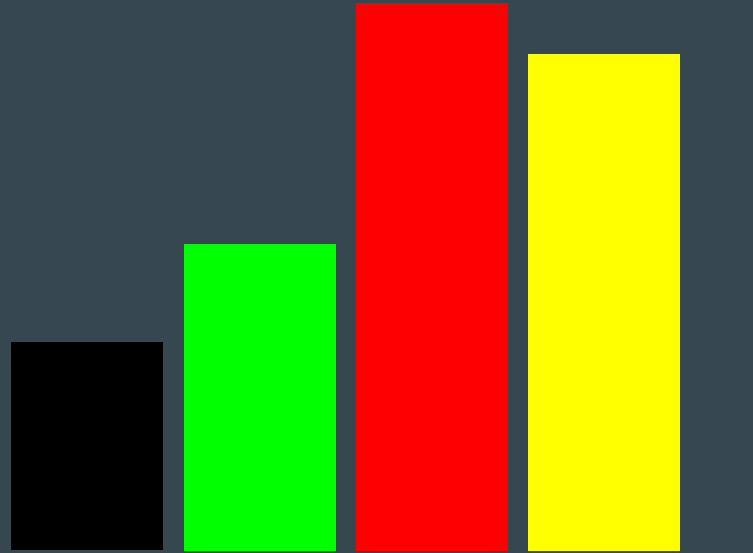
1. Problem statement
2. Context - AGYW/KP Initiative
3. Use Cases
4. Introducing mobiEMR
  - Security
  - Interoperability
  - Offline functionality
5. Architecture
6. Implemented Workflows
7. Demo
8. Appendix - Sample Forms
9. Technical Design
10. Roadmap

# The problem

The prevailing logic in CHIS implementations is of reporting data upwards from the community through generic interfaces which are sometimes difficult to navigate at the point of care.

This encourages the use of parallel systems thereby increasing workload with a negative impact on data quality

We aim to reduce complexity of user interfaces and give actionable information via simple navigation to community workers



# Context

- Involved in a project to implement community Android-based tools for 6000 cadres
- Multiple programs with complex workflows
- Need for complex reports - layering analytics
- Interoperability requirements across organisational boundaries
  - Referrals
  - Case-based to Aggregate
  - *Unique identification*
- *All tools implemented in DHIS2 across program areas*
- *Difficulties navigating among users and no possibility to use system at the point of care*

# Key User Stories for AGYW/KP use case

- Referrals
  - Possibility to capture and complete referrals in a user friendly manner - and across organisational boundaries
- Cohort Management
  - Numerous programs at community level track and deliver content to groups at the same time
- Caseload Management
  - Managing caseloads is at the heart of community work
- Program Management
  - Household
  - Individual

# The solution



mobiEMR

# mobiEMR

- mobiEMR stands for Mobile Electronic Medical Record
  - Android-centric
- Generic system where forms, business rules and workflows are created in a simple format and placed on the server
- Developed in conformance with DHIS2 data model
- Can interoperate with other third party systems
  - FHIR interoperability (DHIS2 FHIR Adapter)
- Not limited in terms of use cases due to advanced customisation framework
- Depends on DHIS2 for data warehousing, sharing and visualisation
- Has a mobile-based platform for supporting online and offline capabilities

# Security

- Implements and advanced identity and access management solution
  - Keycloak
- Has single sign on capabilities
  - Users can log in to multiple services in the background
    - DHIS2
    - FHIR
    - Other third party solutions implementing OpenID Connect and OAuth2
- Can leverage existing Android capabilities
  - Biometrics
  - Patterns / Pin
- Secure communication with servers - SSL
- Additional measures can be developed according to use case



# Interoperability

- Application has own internal representation suitable for user app development.
- Data can be stored on the server and later pushed to multiple backend services DHIS2, FHIR, etc.
- Interoperability is achieved by using Apache Camel routes.
- Translation code is required to convert the internal representation to appropriate format.
- Architecture allows the customization of:
  - Data synchronized
  - Frequency of synchronisation
  - Filter data (Privacy and Security)

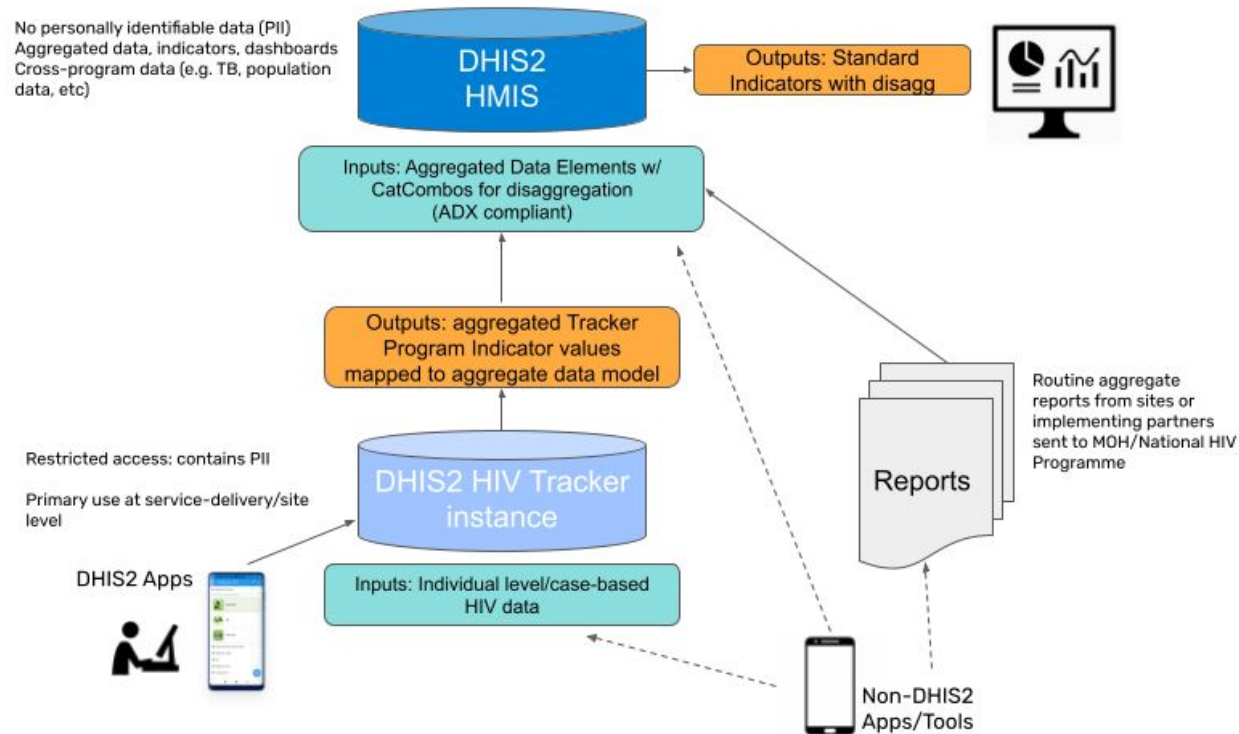
# Offline

- Keeps offline records on the client as events with dependencies.
- Replays events when reconnected.
- Allows user to make corrections if there is a conflict.
  - Recalculates derive values for dependant events.
  - Allows use to correct the values on the dependant events.
- Continues with replay.
- Why replay? Replay allow the easy reuse of UI asserts (UI design take the most effort in client side app development)
- Option to push update to supervisor or administrator if user cannot resolve.

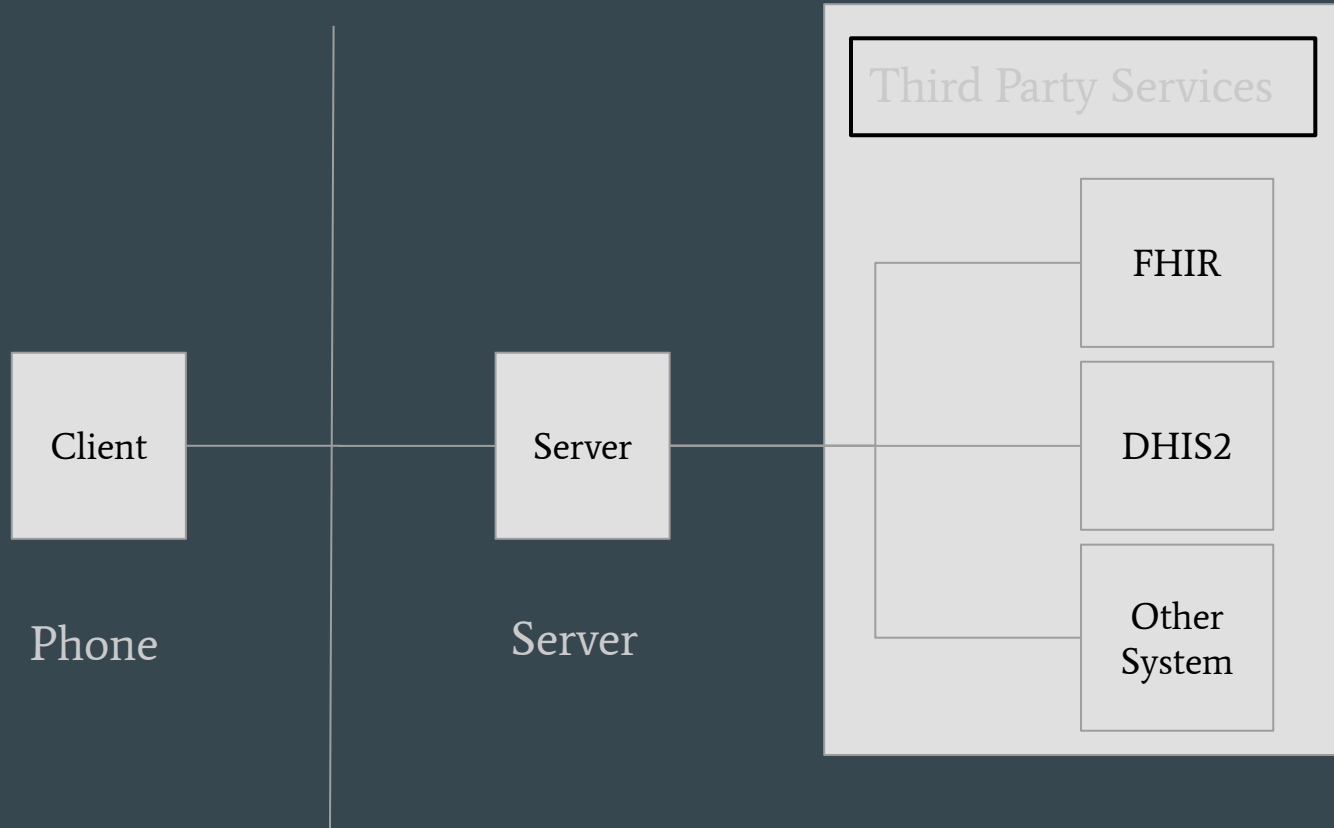
# Architecture




# DHIS2 HIV Prevention Package Architecture



# Architecture - network



A photograph of two healthcare professionals, a man and a woman, standing outdoors. They are both wearing white lab coats and have stethoscopes around their necks. The man is on the left, wearing a blue shirt under his lab coat, and the woman is on the right, wearing a red top. They are both smiling and have their arms crossed. The background is a blurred outdoor setting with some structures and a blue vehicle.

# Key Implemented Workflows



# Referrals

- *Customisable to available referral services and workflows*
- *Allows for 'outward' and 'back' referral processing*
- *Captured data seamlessly Integrated between Mobile, DHIS2 and FHIR standard*
- *Enables capturing of supporting information*
- *Allows for feedback to be shared from receiving facility to referring facility*



# Cohort Management

- *Customisable to cohort program requirements*
- *Easy enrolment and management of cohorts*
- *Allows for batch processing of cohorts at the point of care*
- *Data seamlessly integrated to DHIS2 backend*
- *Data can also be sent to other backends eg FHIR or other custom solutions*





# Household Programs

- *Customisable to program requirements (forms and workflows)*
- *Allows for registering multiple AGYW/KP and caregivers in household*
- *Allows for provision of differentiated services across individual household members*
- *Captured data integrated with DHIS2*



## Groups

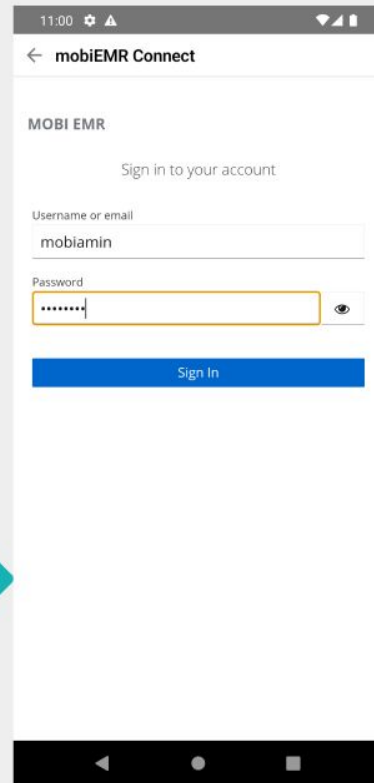
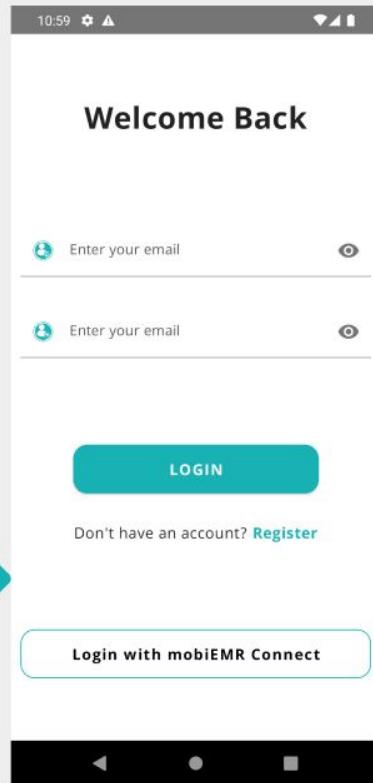
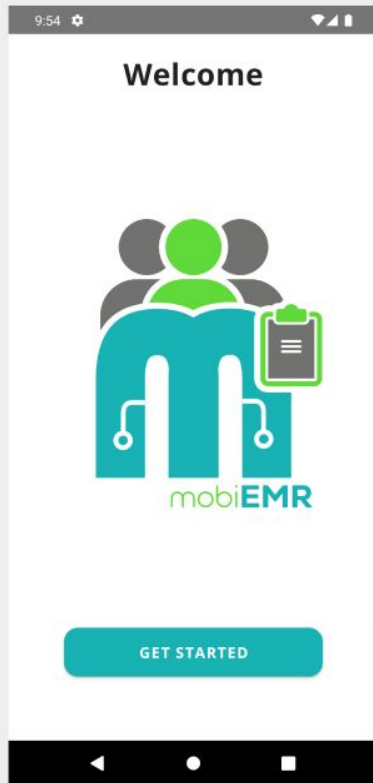
- *Allows for creating groups of households*
- *Allows for provision of differentiated services across groups of individual household members*
- *Captured data integrated with DHIS2*

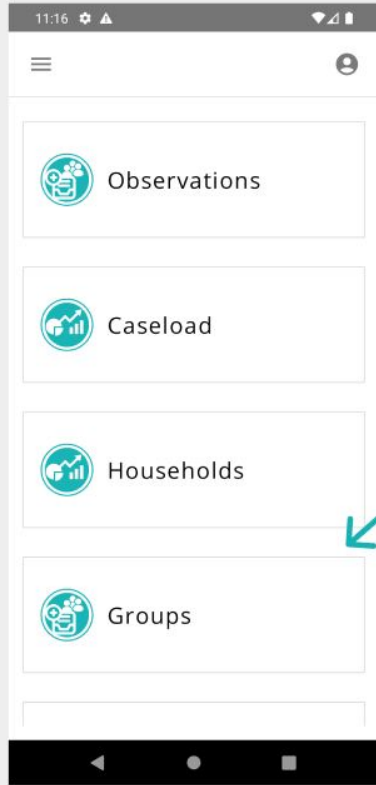
Demo



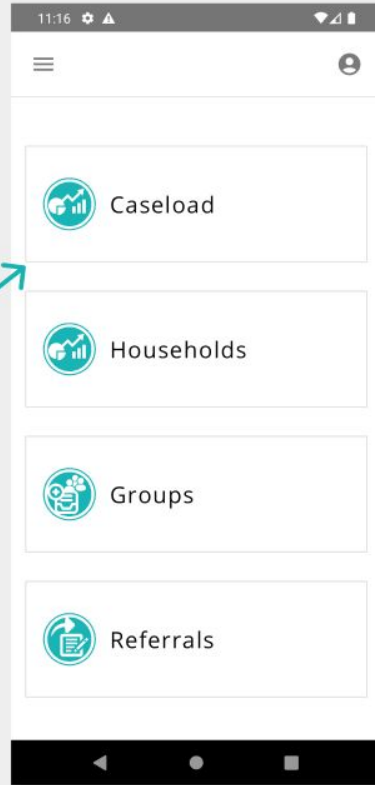


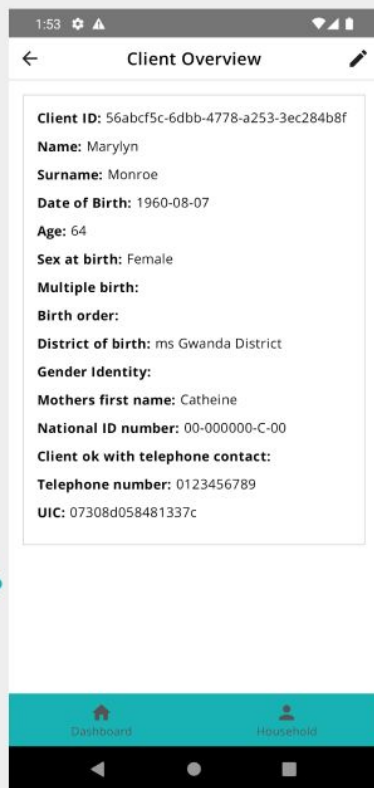
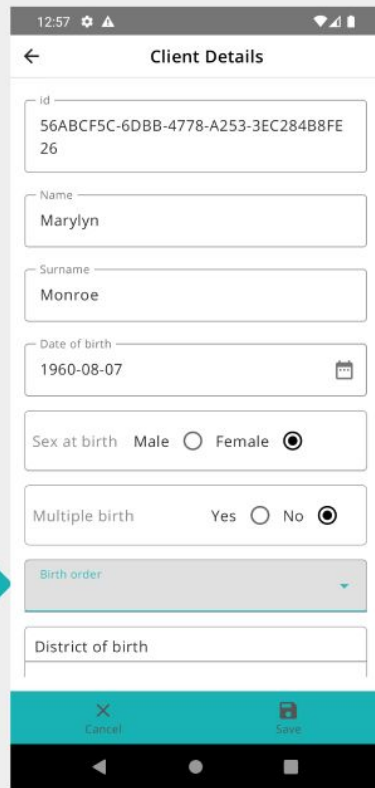
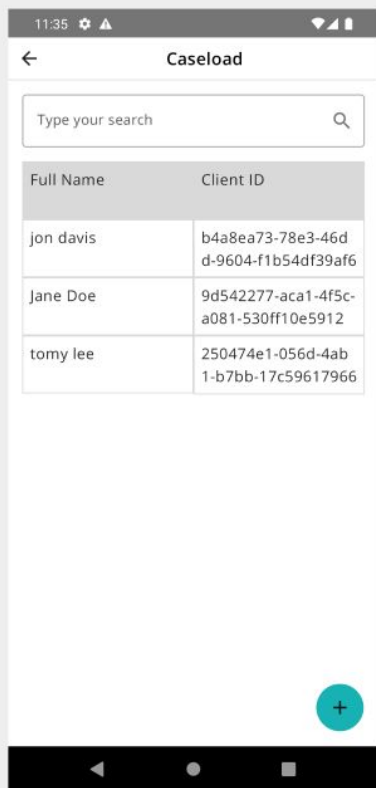
# Appendix 1 - Customised mobiEMR forms

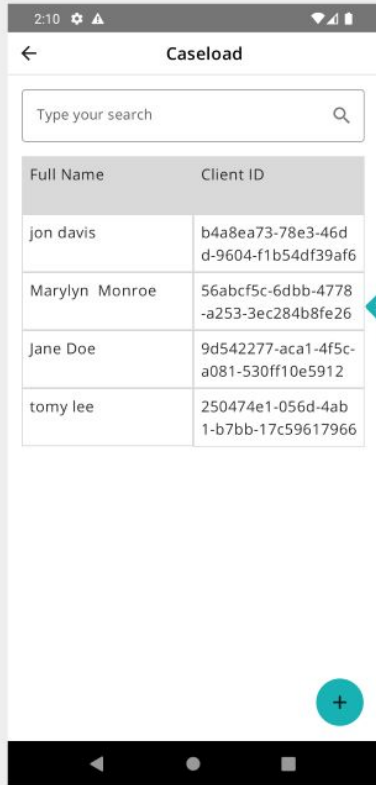




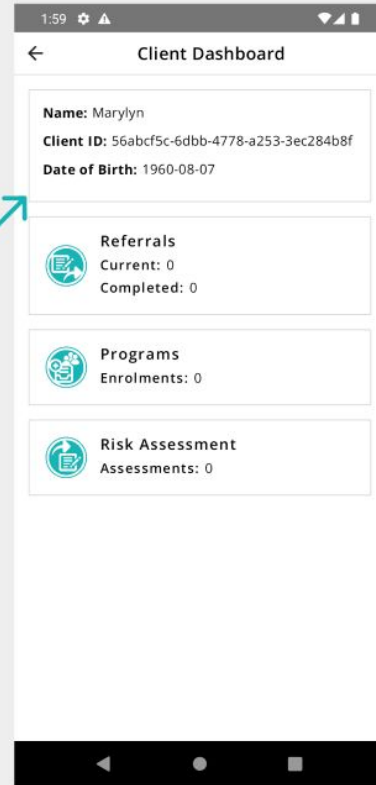
Scrollable list







Click on row to open a client





# Client Referrals

...

3:54

### Client Referrals

UIC: 4c46c731a41f3c94

#### Current referrals

- Ref #: 08947393**  
Initiating facility: mv gu Majada ...  
Date Referred: 2024-07-16  
Receiving facility: bu nku 25 s2s 03
- Ref #: 00896865**  
Initiating facility: mv gu Gutu Mi...  
Date Referred: 2024-07-16  
Receiving facility: mv Gaths Mine...

#### Completed referrals

- Ref #: 637377297263**  
Initiating facility: mv gu Matizha ...  
Date Referred: 2024-07-16  
Receiving facility: mv Dewure I R...

+



4:00

### Add Referral

UIC: 07308d058481337c

id  
C0485CFE-FE59-4BE9-8FE4-CF8A07DF9EC9

Client ID  
56ABCF5C-6DBB-4778-A253-3EC284B8FE26

Serial number  
SHI223892

Date of Referral  
2024-08-07

Referred from Facility  
mv gu Gutu Mission Hospital cts 02

Referred to Facility  
ms bu 13 s2s 01

Cancel Save



4:02

### Supporting Information

id  
AADBBB0F-F4B4-45EC-A050-2172E75DB2D1

Date of last HIV Test

Result of last test

Date of last SRH check

Any current treatment Yes  No

Specify

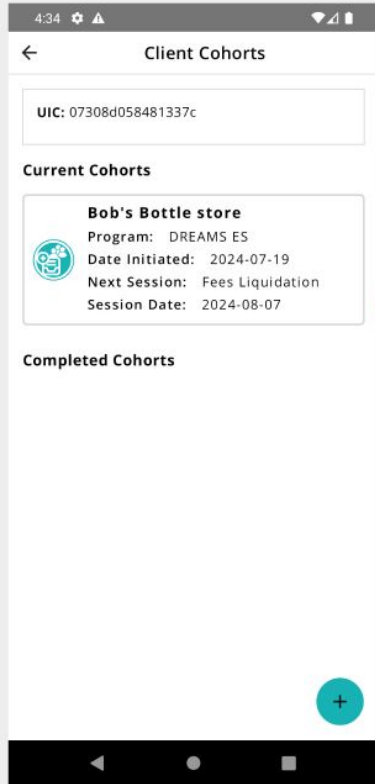
Date supplied

Most recent VL result

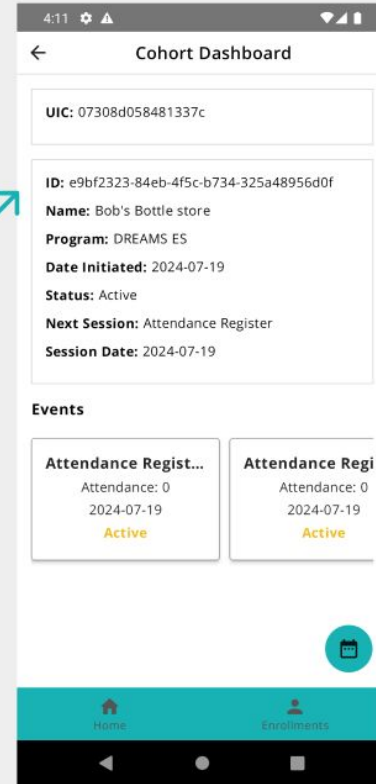
Skip Add

# Client Cohorts

...



Click on card to  
open the  
dashboard



4:11

### Cohort Dashboard

UIC: 07308d058481337c

ID: e9bf2323-84eb-4f5c-b734-325a48956d0f

**Name:** Bob's Bottle store

**Program:** DREAMS ES

**Date Initiated:** 2024-07-19

**Status:** Active

**Next Session:** Attendance Register

**Session Date:** 2024-07-19

#### Events

Attendance Regist...	Attendance Regi
Attendance: 0 2024-07-19 Active	Attendance: 0 2024-07-19 Active

Home Enrollments

4:13

### Add Event

**Cohort Name:** Bob's Bottle store

**Program:** DREAMS ES

id  
055D9D70-99CD-44FD-A392-9F7106CFC8  
DE

Cohort id  
E9BF2323-84EB-4F5C-B734-325A48956D0  
F

Event Type  
Fees Liquidation

Session date  
2024-08-07

Cancel Save

4:14

### Cohort Event

**Cohort:** Bob's Bottle store

**Event:** Fees Liquidation

**Attendance:** 1

Session date  
2024-08-07

Status  
Active

#### Questionnaire

DREAMS ES Liquidation Amount Paid

DREAMS ES Liquidation Term

DREAMS ES Liquidation Receipt Number

DREAMS ES Liquidation Currency

Questionnaire Participants

# Risk Assessment



5:00

← Risk Assessments

UIC: 07308d058481337c

**B2B**  
Score: 0.0  
Assessments: 1

+

5:02

← New Risk Assessment

UIC: 07308d058481337c

id  
EE287530-E46B-4F2D-A639-6DD9F7F300C  
2

Client ID  
56ABCF5C-6DBB-4778-A253-3EC28488FE  
26

Date of Assessment  
2024-08-07

Stage  
Peer Led

Location  
WARD 19

Cancel Next

5:02

← Risk Assessment Details

UIC: 07308d058481337c

**Event Details:** Peer Led  
**Date of Assessment:** 2024-08-07  
**Location:** WARD 19

**Questionnaire**

PL Are You Sexually Active Yes  No

PL Are You Aware of Your Partner's Status Yes  No

PL Have You Ever Been Diagnosed With A Sexually Transmitted Infection (treated or untreated) Yes  No

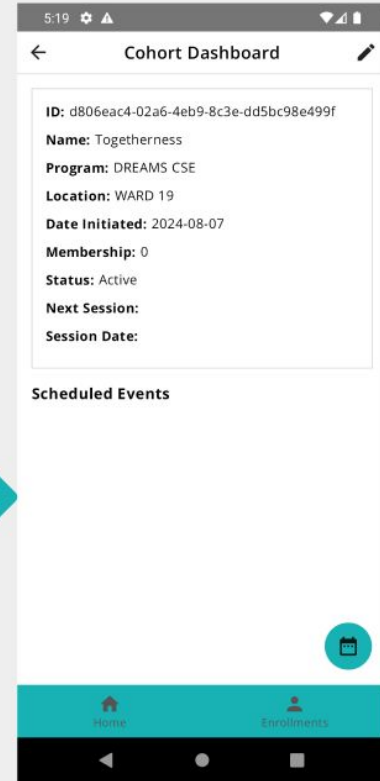
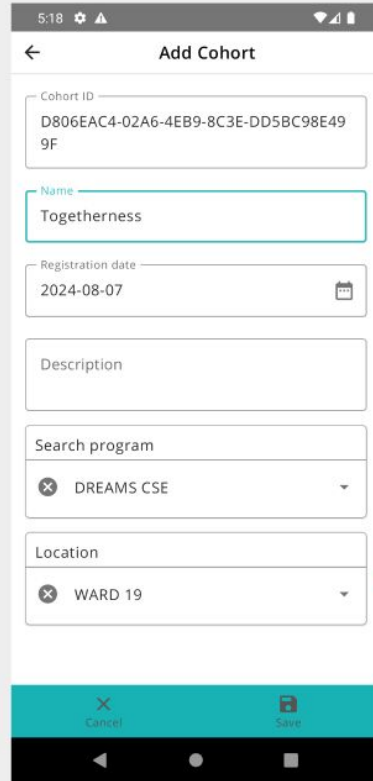
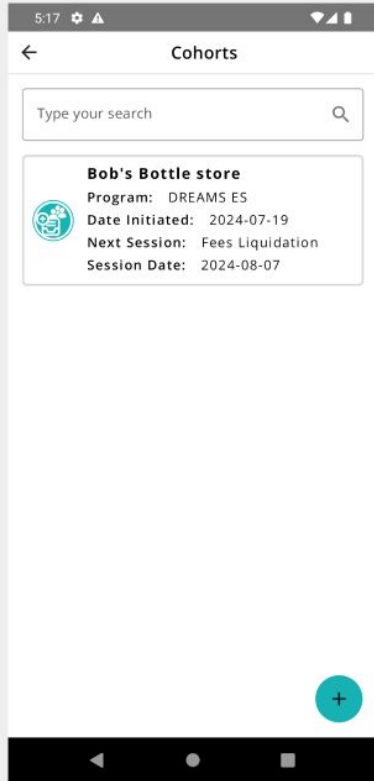
PL Do You Know Your HIV Status Yes  No

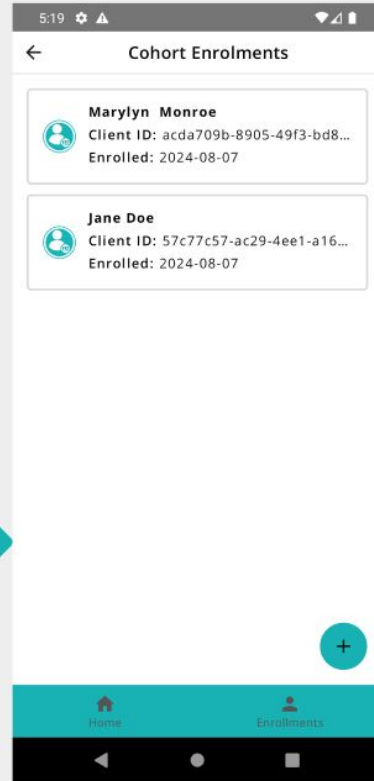
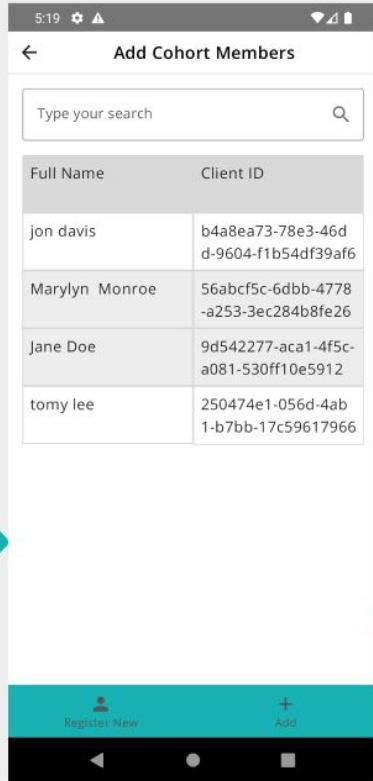
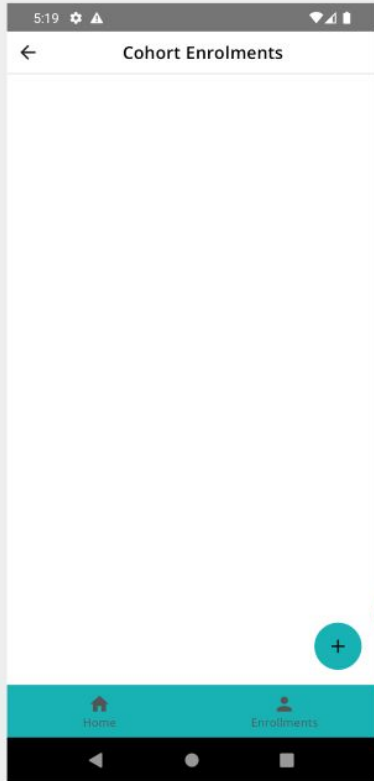
Cancel Save

# Cohorts

...







5:20

Cohort Dashboard

ID: d806eac4-02a6-4eb9-8c3e-dd5bc98e499f

Name: Togetherness

Program: DREAMS CSE

Location: WARD 19

Date Initiated: 2024-08-07

Membership: 2

Status: Active

Next Session: Dropout List

Session Date: 2024-08-07

Scheduled Events

Dropout List

Attendance: 0

2024-08-07

Active

Home Enrollments

5:20

Add Event

Cohort Name: Togetherness

Program: DREAMS CSE

id

D072FD8E-B2FE-4477-9A1B-A0E101DF0A58

Cohort Id

D806EAC4-02A6-4EB9-8C3E-DD5BC98E499F

Event Type

Dropout List

Session date

2024-08-07

Cancel Save

5:20

Cohort Event

Cohort: Togetherness

Event: Dropout List

Attendance: 0

Session date

2024-08-07

Status

Active

Questionnaire

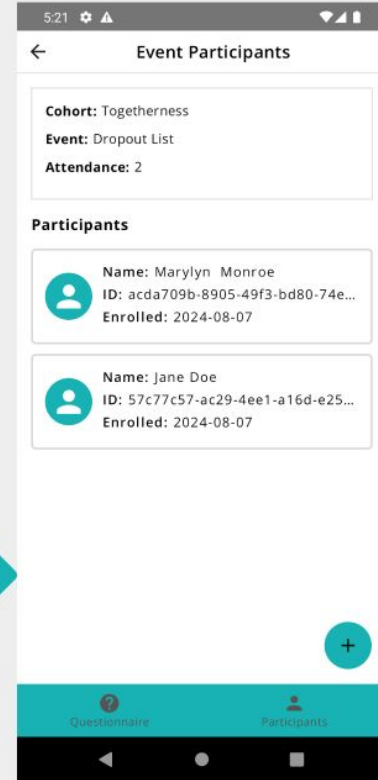
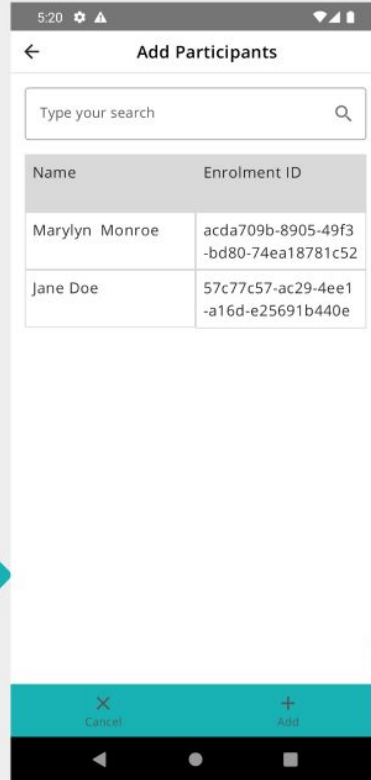
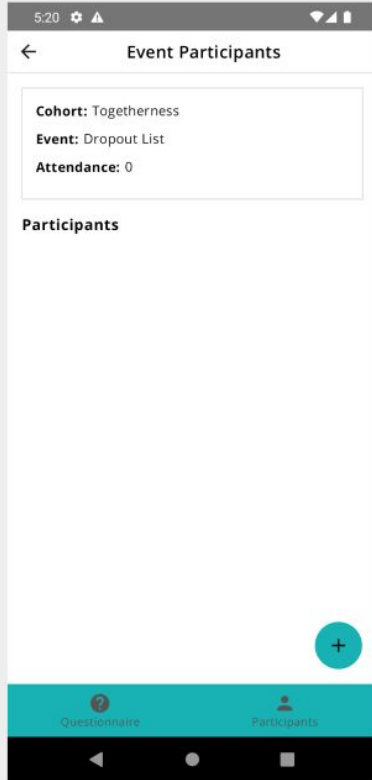
DREAMS Dropout Follow Up Done Yes No

DREAMS Dropout Date Recorded as Beneficiary

DREAMS Dropout Reason For Dropping Out

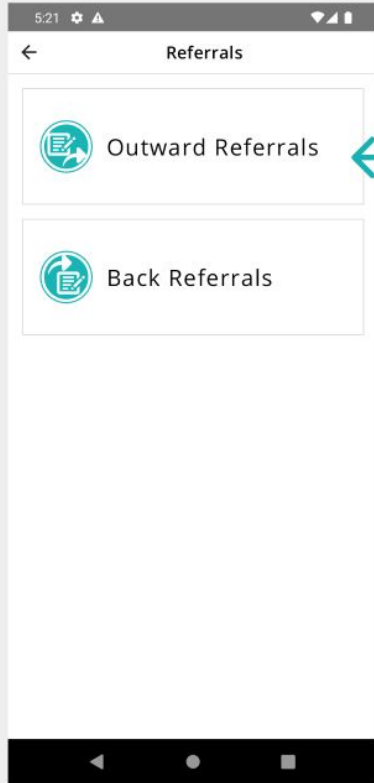
DREAMS Dropout

Questionnaire Participants

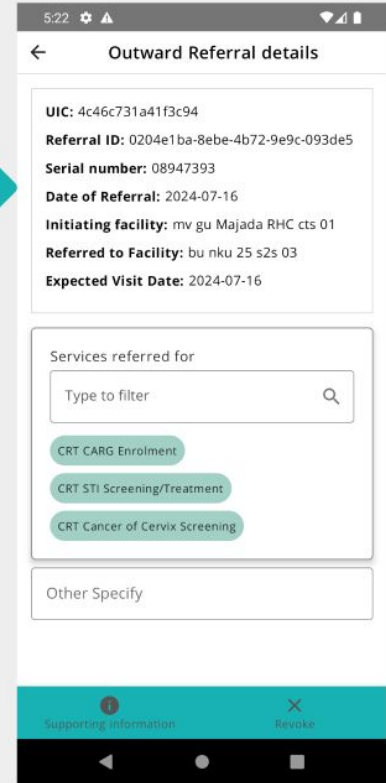
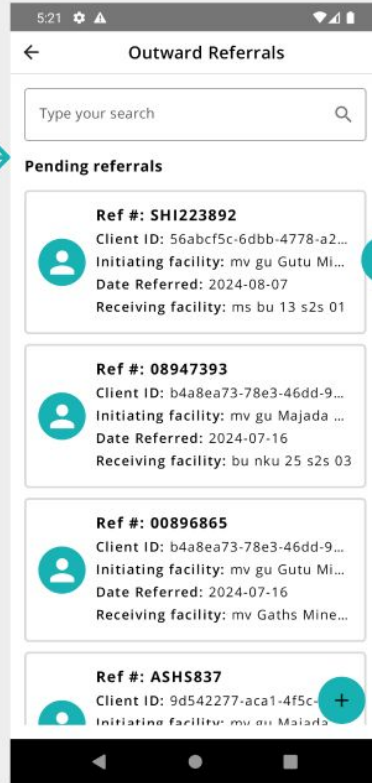


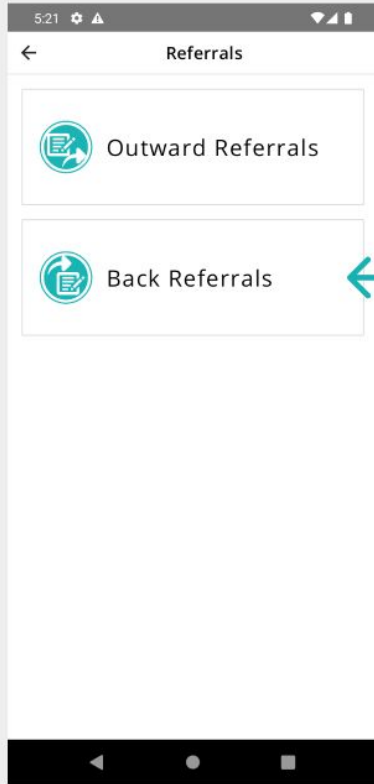
# Referrals

...

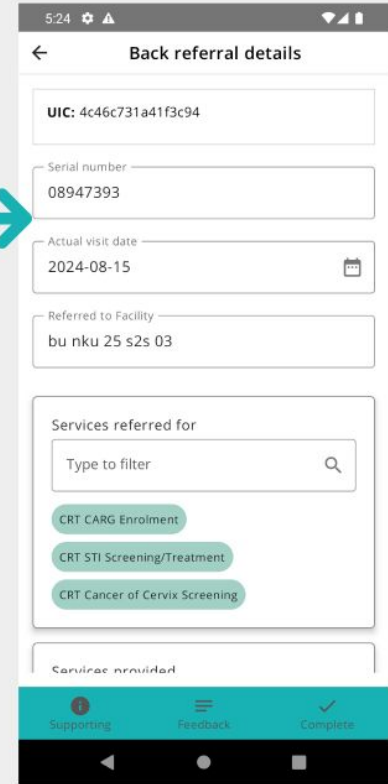
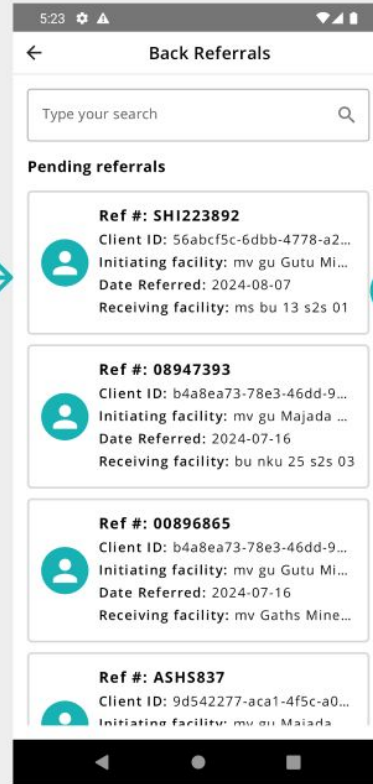


Click on button to open Back Referrals





Click on button to  
open Back  
Referrals



# TECHNICAL ANNEXES



# Technical Design

# How it works - overview

## Step 1

User stories are collected and UI designs and workflows specified

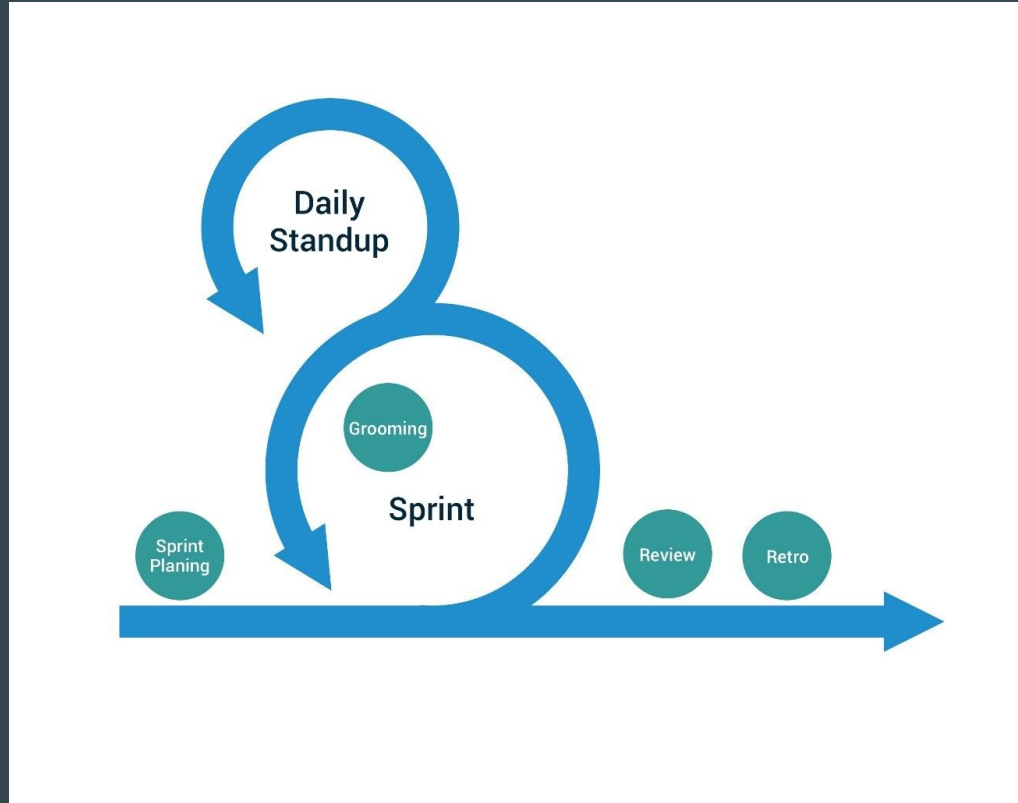
## Step 2

UI is customised with workflows.  
Interoperability specified and implemented

## Step 3


System piloted and maintained

# Design and Implementation Approach - Scrum



# Implementation - Step 1 - User stories

## ▼ Backlog (35 issues)

- MEMR-36 As a nurse I want to see scheduled referrals so that provide request service.  TESTING ▼
- MEMR-26 I want to Implement an oauth2 so that users can use reuse accounts from other appli... TESTING ▼
- MEMR-21 As a nurse I would like to see an overview of the referred clients pending referrals so I... TO DO ▼
- MEMR-15 As a nurse I want to capture data on the back referral form so I can complete the refer... TO DO ▼
- MEMR-20 As the initiating facility I want to be able to add supporting information to a client's re... TESTING ▼
- MEMR-52 I want to store oAuth key in account manager so that the oAuth keys are secured TESTING ▼
- MEMR-18 As a nurse I want to search for client details for a patient who has a scheduled referra... TO DO ▼

# Implementation - Step 2 - BPMN

## ← Outward Referral details

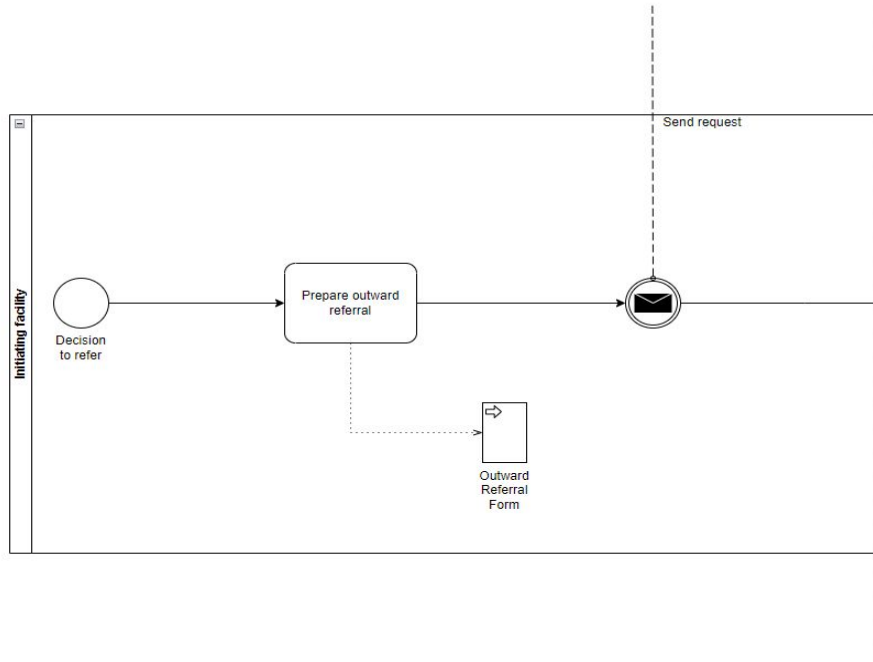
Serial number	Serial number	🔍
Date of referral	Date referred	📅
Initiating facility	Initiating facility	☰
Referred to facility	Referred to facility	☰
Expected visit date	Expected visit date	📅

Select services that the client is being referred for

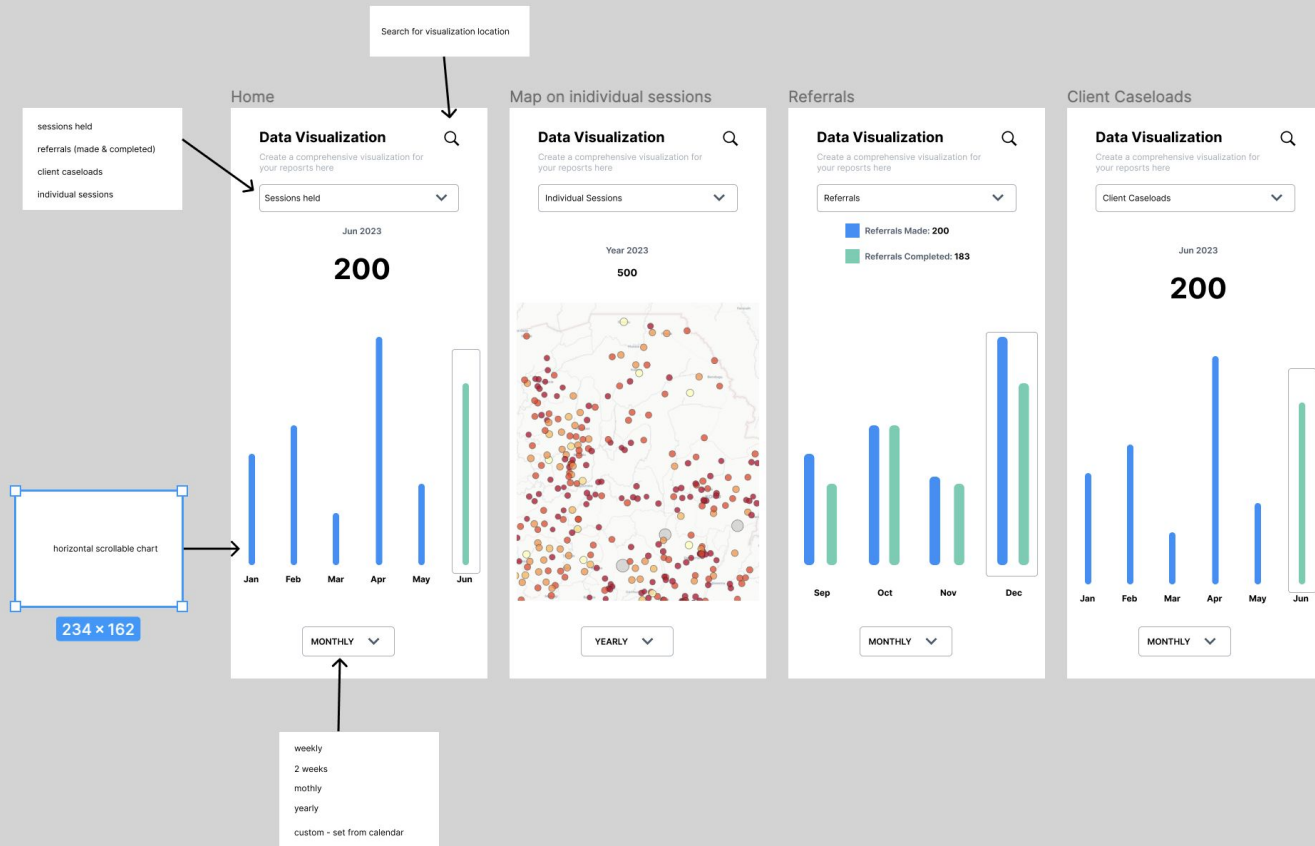
- Pre-ART registration
- ART initiation
- ART refill (defaulters)
- ART Decentralisation
- PMTCT/Option B+
- CTX/OI Management
- Economic Strengthening
- Emergency contraception
- Pre-ART counseling
- Enhanced Adherence Counseling
- HIV Rapid Test / HTS
- ART reinitiating (LFTU) or Stopped
- ART official transfer
- CD4 Count
- FBC Test
- LFT Test
- U&Es Test
- Viral Load Test/HTS
- DBS-PCR HIV Testing
- Post-Exposure Prophylaxis
- PrEP
- Psycho-social support
- Support Groups e.g CATS
- TB screening/management
- Family planning
- VMMC
- STI screening/treatment
- CARG enrolment
- Cancer of the Cervix Screening
- Victim friendly services (Police, courts)
- Legal Counsel
- Educational
- Emergency shelter
- Other

Other specify	Other specify	🔍
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Supporting information Complete

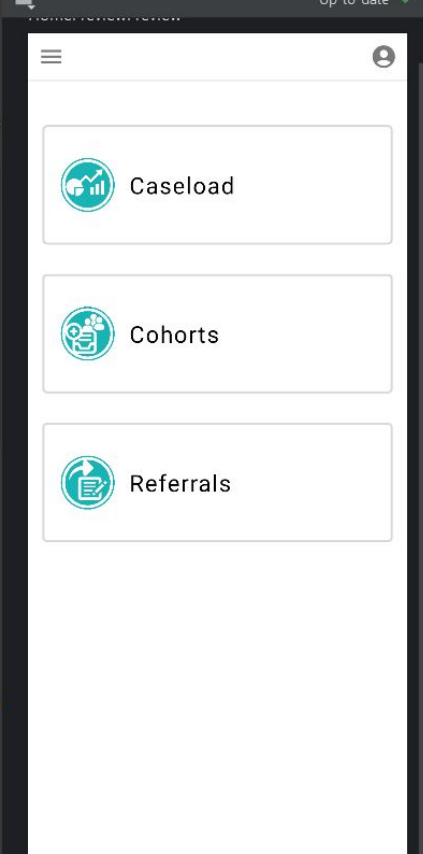


# Implementation Step 3 Design wireframes



# Step 4 - Customisation

```
{
  "class": "homeScreen",
  "root": {
    "label": "Home Screen",
    "placeholder": "Home Screen",
    "events": {},
    "widgetType": "MenuScreenWidget",
    "ui": {
      "main": [
        {
          "name": "caseload",
          "label": "Caseload",
          "placeholder": "Caseload",
          "widgetType": "CustomButtonWidget",
          "events": {
            "onClick": "nav: caseload searchResult=#call(client.findAll)"
          },
          "icon": "drawable.dashboard"
        },
        {
          "name": "cohorts",
          "label": "Cohorts",
          "placeholder": "Cohorts",
          "widgetType": "CustomButtonWidget",
          "events": {
            "onClick": "nav: cohorts cohortsList=#call(cohort.findAll)"
          },
          "icon": "drawable.cohorts"
        },
        {
          "name": "referrals",
          "label": "Referrals"
        }
      ]
    }
  }
}
```



The image displays a mobile application interface on the right and its corresponding JSON configuration on the left. The app's home screen features three large, white, rounded rectangular buttons stacked vertically. Each button contains a teal circular icon on the left and a text label on the right. The top button has a bar chart icon and the label 'Caseload'. The middle button has an icon of a group of people and the label 'Cohorts'. The bottom button has an icon of a document with an arrow and the label 'Referrals'. The app has a white background and a dark header bar with a hamburger menu icon on the left and a user profile icon on the right. The JSON configuration on the left defines the structure of these buttons, including their names, labels, placeholders, widget types, and click events. The 'Caseload' button's event is 'nav: caseload searchResult=#call(client.findAll)', and the 'Cohorts' button's event is 'nav: cohorts cohortsList=#call(cohort.findAll)'. The 'Referrals' button is partially visible and does not have an event defined in the snippet.

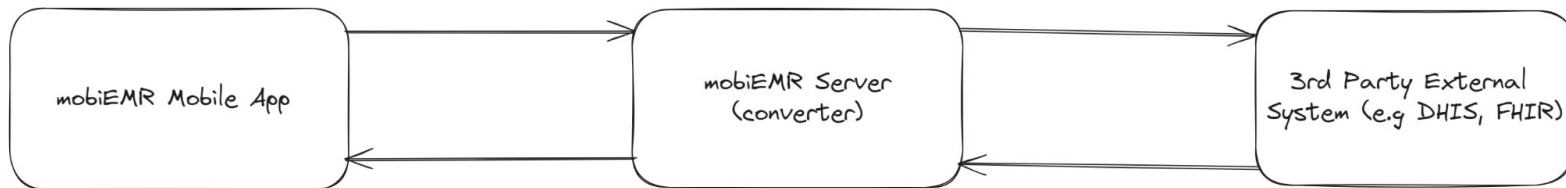
# mobiEMR Architectural Overview

User actions (e.g form submissions and data requests) are sent to server as raw data for conversion

mobiEMR Server acts as a middleman between 3rd parties by converting data from mobile into specific standards

Raw data sent from App to server for conversion

Standardized Data to 3rd party service.



Converted data to mobiemr standards inform of json files

Data from 3rd party source (e.g patients, referrals, etc)

UI widgets are created from Jsos to match specific data types as per mobiEMR Standards

Connections are made with outside sources to fetch data, then convert it into our mobiEMR standardised json files



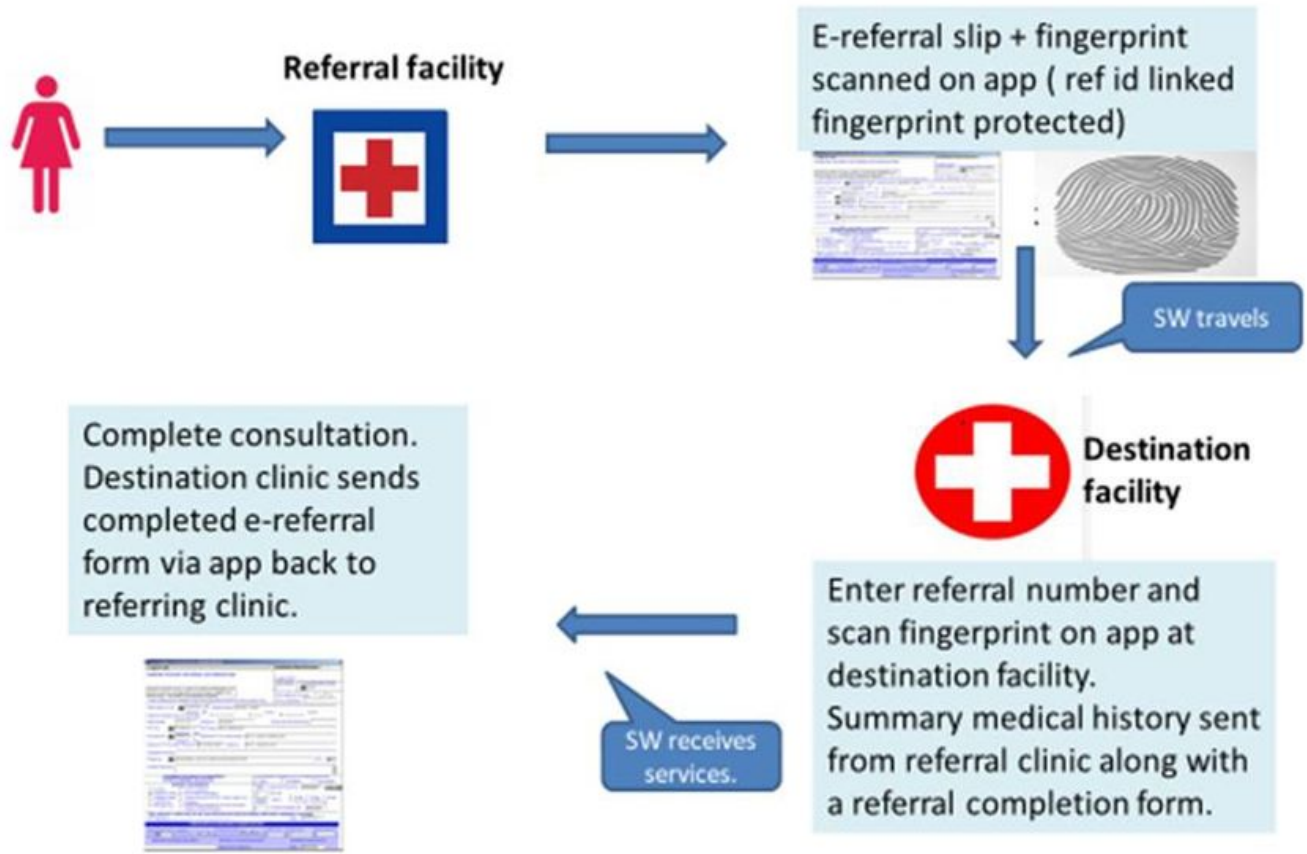
A photograph of two healthcare professionals, a man and a woman, standing outdoors. They are both wearing white lab coats and have stethoscopes around their necks. The man is on the left, wearing blue scrubs under his coat, and the woman is on the right, wearing red scrubs. They are both smiling and have their arms crossed. The background is a blurred outdoor setting with some buildings and a blue vehicle.

# Other developed modules



# Biometrics

## Proposed mobile app-based referral system for ensuring continued engagement in care – eg ART, PrEP and VL when SW travels cross border



# Biometrics Implications

- Phone can only store owners biometrics
  - Need external scanner
    - HID Global
    - Simprints
- Need a phone that can power biometric readers
- Biometric storage (security)
- Decide whether to search by biometric ID vs validate by biometric ID

# Roadmap

- Supporting additional use cases
- Supporting more advanced business rules and workflows
  - BPMN
  - AI/Machine Learning
- Developing android-side interoperability
- Implementation of standardised guidelines e.g WHO SMART guidelines, DHIS2 packages
- Android Visualisations

# Discussion

