# **Overview and Instructions**

Using feedback received in the concept note phase, notified applicants will begin preliminary application development. Please build off your [concept note](https://wiki.digitalsquare.io/images/b/b0/Concept_Note_Template_FINAL.doc) to create your technical application in this document. *Please delete all “Instructions for the applicant” prior to submitting the application for review.* [Please delete highlighted text fields, update with supporting information for the given category.] You may expand upon these requirements to include diagrams and other elements that will further describe the project. Should you have questions about the guidance provided in this document, please reach out to your Digital Square point of contact or digitalsquare@path.org for additional guidance.

**The preliminary application should contain only this document.** During the application finalization step, following the application co-creation and comment period, the full application package must include the cost application, consisting of a [detailed budget](https://wiki.digitalsquare.io/images/0/0c/Sample_Detailed_Budget.xlsx) and [budget narrative](https://wiki.digitalsquare.io/images/1/11/Budget_Narrative_Template_FINAL.doc).

The technical application must be written clearly and define all work, deliverables, and timelines of performance to eliminate ambiguity. Any acronyms used must be spelled out and technical jargon should be minimized in favor of commonly understood terms.

During the preliminary application co-creation step applicants, and other stakeholders can continue to provide feedback, comments, and suggestions. Applicants may post iterations on the forum until the preliminary application comment period begins. Please indicate updates by saving the file with a version number at the end of the file name or date (e.g., “ApplicationTitle\_v1”). As necessary, please revise the two-sentence overview, executive summary, and consortium team on the [OAP platform](https://proposals.digitalsquare.io) application page.

In the application finalization phase, please bear in mind that the technical application and cost application are complementary documents. The programmatic relevance of elements of cost such as level of effort (LOE), equipment, travel, and subawards or consultants, which should include consortium members, must be demonstrated by the scope of work (SOW).

Following the investment decision by the [Governing Board](https://wiki.digitalsquare.io/index.php/Governing_Board) or funder, finalization of the SOW will be an iterative process between your organization and PATH prior to execution of a subaward. Once agreement on the SOW is reached, the SOW and other supporting documents will be incorporated into the agreement between your organization and PATH.

*For an introduction to vernacular, please review the* [*Grants and Contracts Basics.*](https://wiki.digitalsquare.io/index.php/Grants_and_Contracts_Basics) *Please navigate to* [*procurement processes*](https://wiki.digitalsquare.io/index.php/Procurement_Processes) *for more information on funder investment mechanisms. For more information on the overall process for selected applicants, please review the* [*investment process for global goods*](https://wiki.digitalsquare.io/index.php/Global_Good_Investment_Process)*.*

# mADX on FHIR on Android

## Two-Sentence Overview

Most mobile health reporting is generated server side or in a HMIS. Our goal is to provide a standardized way for health apps to make real-time reports accessible to health workers offline for better decision making. We will create a set of open source libraries, expanding [HAPI FHIR](http://hapifhir.io/) and CQL tools, to enable Android based apps to quickly generate health reports offline using a standards based approach defined in the mADX Profile.

## High-Level Budget Summary

*Instructions for the applicant:*

* ***Please leave blank during preliminary application step. This section should be completed in the application finalization step.***
* *Input the total requested value.*
* *If the technical application includes multiple work package, please include the value of each work package.*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Work Package 1 [Title]** | **Work Package 2 [Title]** | **Total Cost (USD)** |
| **Total Project Costs** | [Insert cost for this in USD] | [Insert cost for this in USD] | **[Insert total cost for this category in USD]** |

## Executive Summary

The digital health ecosystem is rapidly maturing with mobile solutions that support the capture of health services delivered by frontline health workers. While data collection in these apps is quite mature, in-app reporting is still very limited with most solutions limited to pushing reports into a Health Management Information System (HMIS) from the central system.

There are two major problems that we aim to address. First, the majority of mobile frontline health systems push report generation to a central system that requires internet connectivity instead of providing the capability to generate reports at the point of service. This results in frontline health workers not having access to up-to-date reports offline for decision making. Second, developing performant reporting on low powered mobile is technically challenging and, to date, a standards based approach to address this has not emerged.

Our goal is to develop an open source FHIR standards based reporting stack for offline generation of health reports on Android devices. We will use OpenSRP to implement a reference app using this approach. To achieve this we will adapt a reporting architecture we developed for OpenSRP in-app reporting.

## Consortium Team

Ona is a technical social enterprise focused on global health, based in the United States & Nairobi, Kenya. Ona was founded in 2013 and has been in operation for close to 6 years. The company has a 25-person development team which includes software developers, software architects and machine learning experts. Ona has extensive experience designing, developing and implementing health information systems that are used at national scale and integrate with existing government health information systems and open standards. Ona has developed numerous open source standard tools and libraries in the space that are used by mobile teams to add functionality to their existing technologies. Ona serves as the technical lead for the Open Smart Register Platform, having co-created the platform with the World Health Organization.

As an organization we have extensive experience developing digital health applications for mobile. We are the technical leads and main developers of OpenSRP - a digital health global good that provides service delivery support for frontline health workers. With OpenSRP we currently are supporting large implementations of OpenSRP in Tanzania with Jhpiego, with UNICEF in 5 countries in West Africa and with GAVI and Mastercard in Mauritania. Previously, we supported PATH to use OpenSRP to develop a national electronic immunization registry (EIR) in Zambia. For this we developed extensive in-app reporting, that was used to tally over 100 indicators which were then reported to DHIS2. This work forms the technical foundation for this proposal.

With Akros, Vital Wave and CHAI we are developing Reveal ([https://revealprecision.com](https://revealprecision.com/)) a next generation task based service delivery tool developed on top of OpenSRP. Reveal relies heavily on FHIR including supporting FHIR task, planDefinition and location resources. As part of the Reveal work, Ona is developing with Novel-T the geo-widget - an Android SDK that makes it possible to view locations and structures on map and link services to it by clicking on it. The Geo Widget a global good that is currently being adopted by DHIS2, CommCare and other popular digital health applications.

Lastly, for the past year we supported Village Reach to help develop a reporting stack using an open source enterprise analytics suite we developed called Canopy. In doing this we got hands on experience using the appropriate R4 FHIR reporting resources that are cited in this application including generating measures, measureReports and libraries. This work also included building organizational capacity in running HAPI FHIR as part of the Canopy stack.

### Proposed Project team

Craig Appl - Technical Lead and Project Manager

Craig has deep experience in developing health information systems used at multiple levels within the health system. He is responsible for running the OpenSRP technical communities, coordinating features across multiple vendors, organizations and implementations. Craig is active in multiple global communities including the Open Health Information Exchange, Open Logistics Management Information System, Open Smart Register Platform and Open Medical Record System. He led the collaboration with Village Reach and is proficient in the application of FHIR R4 reporting in real world contexts.

Samuel Githengi - Sr. Engineer

Samuel is a senior engineer and engineering team manager on the OpenSRP platform and has been actively developing the platform for multiple years. Samuel is responsible for architecting and delivering multiple new features on the OpenSRP platform, including the Reveal product, Mobile Stock Management and Peer-to-Peer sync. Sam is actively involved in the World Health Organization Computable Care Guidelines working group that’s focused on developing technologies that can deliver robust FHIR based reporting at scale.

Rodgers Andati - Sr. Engineer

Rodgers is the senior engineer who is responsible for the OpenSRP In-App Reporting product. Rodgers has over 5 years of experience developing mobile tools for multiple clients.

Peter Lubell-Doughtie - Technical Advisor

Peter is the Chief Technical Officer of Ona with decades of experience in developing cutting edge technologies and data science solutions.

We are not currently collaborating with any partner organizations. We are **seeking collaboration** with groups that have in-app reporting needs to help validate the proposed FHIR based reporting standard we wish to develop. We will not require support in developing the prototype. If we validate the approach, we would want to work with other partners to adopt this approach.

## Background or Problem Statement

Each health ecosystem contains disparate technologies and tools that are used everyday to deliver care to clients. The great unifying factor is the enforcement of national standardized reports into a common platform. Historically, this has allowed program officers to ignore what technologies are deployed at the point of service, as long as the monthly reports are submitted on a regular basis. As a result, any given district has multiple mobile tools, surveys and electronic medical record systems collecting information on clients with each system defining the process for generating their reports.

OpenSRP is part of an ecosystem of mature bespoke mobile data collection tools that are deployed around the world. Our community has consistently invested in building and improving these technical solutions, but there is no standardized approach to generating reports in Android systems. At this time, a ministry could approve deploying three mobile tools for maternal health in a district and have three different reporting systems setup to feed the monthly reports into the health management information system. Each of these mobile deployments have their own way of collecting information, defining indicators and reporting them to the national system with quality controlled only when the information hits the health management information system.

The majority of mobile frontline health systems push report generation to a central system that requires internet connectivity instead of providing the capability to generate reports at the point of service. This results in a situation where frontline users, who are responsible for the day-to-day information collection, do not have the power to generate, check and analyze reports on their mobile device. This causes inefficiencies in the system that lead to less information, reporting lag and suboptimal information across the health system’s distributed points of service.

Our opinion is that there needs to be a fundamental shift in how reporting is done in mobile tools. These bespoke mobile solutions are currently setup as either standalone or paired solutions as defined in the maturity model in section 2.3 of the IHE QRPH CQL for ADX whitepaper. The fully integrated level of maturity is not achievable in the mobile solutions of today unless we restructure our bespoke mobile applications to support FHIR natively on an Android client so real-time analysis and monthly report generation is available on mobile devices.

Our proposal is to better empower frontline health workers to ensure they have the ability to generate in-app reporting and analysis when offline on their Android device using standardized report definitions that are created once at the central level. Our goal is to develop an open source FHIR standards based reporting stack for offline generation of health reports on Android devices. We will use OpenSRP to implement a reference app using this approach. To achieve this we will adapt a robust existing reporting architecture we developed for OpenSRP in-app reporting.

The Ona teams are located in both the United States and Nairobi, Kenya with the majority of software development occurring by our Kenyan team. This idea is experimental, but it builds off of our proven mobile reporting strategy that has been actively in use and under development for more than two years.

## Digital Health Technologies

The Open Smart Register Platform (OpenSRP) is a mobile data collection system that specializes in supporting reproductive, maternal and child health programs in numerous implementations across the globe. OpenSRP utilizes Android mobile devices for primary data collection at health facilities and in the field supporting community health workers. We propose to convert OpenSRP’s existing in-app reporting functionality from a custom module into open source native Android libraries that build off of HAPI FHIR and the myriad of open source Clinical Query Language tools that are available. These libraries will be well documented and made available as a global good so any vendors are able to add these features to their existing mobile applications opening up the ability to convert custom android data architectures into standardized FHIR compliant reports. Furthermore, these libraries will be able to support centrally defined resources, allowing for the same business logic to be run on the Android client, central level and even in a fully integrated health information exchange.

### Existing Functionality

OpenSRP functions as a point of care health application that tracks the care provided to clients. We provide the core features of any electronic medical record system natively on an Android device including the ability to register clients, establish relationships between clients, track the care provided to them, track tests and report on the transactions that have taken place in the system. Technically, we implement a native SQLite transactional database and with helper tables that are generated following the Extract, Transform, Load (ETL) paradigm for computing resource intensive reports on lightweight hardware.

OpenSRP has a custom in app reporting module that utilizes custom libraries for calculating indicators from the transactional database and representing them in local reporting tables. We developed this module due to implementation demands for providing rich reports at the offline point of service. Additionally, we have built the capability for each facility to generate, check and post their mandatory monthly reports from their tablet to the DHIS2 Health Management Information System (HMIS). These reports are compiled on a regular schedule utilizing background processes, presented in the Android interface so a user can review them, make edits and submit from the tablet to the centralized server, which then forwards them to the centralized HMIS. In other words, all indicator reporting is done by frontline managers in the Android client.

Once a form is saved, it is processed using post save actions that are coded right now in Java. Those actions convert the form and store it into transactional SQLite tables. These tables are queried on a regular schedule, the information is extracted, transformed and loaded into standardized reporting tables that are used to drive dashboards. Below is an illustrative diagram of this functionality



Figure: Current OpenSRP Reporting Architecture

### Conversion from a Custom Solution to FHIR and CQL

We propose to convert this process from custom business logic to utilize open FHIR standards and tooling. We will utilize FHIR resources for defining the reporting tables so reports are stored in the standard FHIR resources that are appropriate for reporting including the Measure, MeasureReport, Library and ValueSet resources. We will also convert the business logic that’s defined in the custom ETL process to utilize the CQL rules engine so that the transformation from the transactional database and the Measure business logic can utilize a common CQL library.

We will build off of the existing open source [HAPI FHIR Java libraries](https://github.com/jamesagnew/hapi-fhir) to store information as FHIR resources and will use the Java CQL tools provided by the [Database Consulting Group](https://github.com/DBCG) including the cql-engine and cqf-ruler. Our target is to develop a minimum viable product that implements an open source Android implementation of mADX on FHIR on Android and make these open source libraries available to be implemented by any mobile solution.

When developed, this will allow point of service mobile applications to overcome the barriers to implementing a fully integrated FHIR indicator reporting solution. It will also serve as a gateway for mobile applications to transition their bespoke data collection solutions toward storing information as modeled in FHIR.

## User Stories

This section defines the needs of three distinct users who will benefit from this project.

### Frontline Health Worker Using a Tablet

I’m a frontline health worker using an Android app to track the care provided to clients and I am responsible for providing a monthly report of my activities to the government’s health management information system. I want to generate my monthly reports on my tablet, make modifications offline and submit my report to the health management information system when internet becomes available.

### Program Officer

As a program officer, I want to be able to define the indicators in a simple and standards based approach so they can be used across multiple technical tools. I want to define the indicators once and have them seamlessly link to the data dictionary in multiple systems regardless of whether it’s using Android devices or electronic medical record systems. It is important for me to be enabled to define these indicators to cut down on the time required to check for errors if I have to hand the process off to developers.

### Android Technology Provider

As a technology provider, I want to reduce ambiguity in indicator definitions that I receive from my customers and the amount of time it takes to transition from narrative indicator definitions to implementation in my product. I want to build a dynamic reporting solution in my Android application that uses standards so I can reduce development time, costs and deliver more quickly for multiple customers in multiple contexts.

## Objectives and Activities

### Work package 1: Develop a Minimum Viable Product

#### **Objective 1.1:** Verify that Open Source Java Libraries can run efficiently on Android

##### *Activity 1.1.1:* Identify the core FHIR resources that are required for implementing FHIR on ADX in the Android client.

##### *Activity 1.1.2:* Build FHIR resources in Android using the work from the HAPI FHIR community.

##### Activity 1.1.3: Build, test and run the CQL Engine on Android.

##### Activity 1.1.4: Integrate these libraries with the OpenSRP Android client.

#### **Objective 1.2:** Develop and test an end-to-end prototype for an HIV or RMNCH workflow

##### *Activity 1.2.1:* Develop a sync mechanism of FHIR measureReports from Android to the HMIS.

##### *Activity 1.2.2:* Develop an end-to-end test that supports a basic HIV or RMNCH workflow from generating the transactional information to the Android client, generating a MeasureReport on the Android and pushing that report to the HMIS.

### Work package 2: Develop a user interface that allows users to view the generated measureReports in Android

This work package is dependent on success from work package 1.

#### **Objective 2.1:** Define User Experience Needs

##### *Activity 2.1.1:* Scope the user experience needs for displaying measures and measureReports to an end user on an Android device.

##### *Activity 2.1.*2*:* Define an information schema for converting measures and measureReports to something that is easy to consume by an end user.

##### Activity 2.1.3: Develop a generic user interface using the Android Model View Presenter pattern so all implementations could have a baseline of displaying the generated information to a user.

## Community Feedback

Ona is actively engaged with the Open Health Information Exchange communities as well as the World Health Organization’s Computable Care Guidelines working groups. We will continue these engagements, which require regular attendance at monthly meetings. We expect to present architecture and use cases at WHO CCG and receive constructive project and technical feedback from these working groups. We will work with these communities to present our project progress on a regular basis. Ona is the technical lead for the OpenSRP community and we will share our progress at weekly technical calls.

## Schedule

The following is a high-level work plan.

|  |  |  |
| --- | --- | --- |
| **Activity** | **Team****Location****Month/Quarter** | **Quarter** |
| Q | Q | Q | Q | Q | Q |
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1.1.1  | Ona KE & US | x |   |   |   |   |   |
| 1.1.2 | Ona KE & US | x |  |  |  |  |  |
| 1.1.3 | Ona KE & US | x |  |  |  |  |  |
| Go/No-Go Decision on working on 1.1.4 | Ona KE & US | x |  |  |  |  |  |
| 1.1.4 | Ona KE & US |  | x |  |  |  |  |
| 1.2.1 | Ona KE & US |  | x |  |  |  |  |
| 1.2.2 | Ona KE & US |  | x | x |  |  |  |
| Go/No-Go Decision on Work Package 2 | Ona KE & US |  |  | x |  |  |  |
| 2.1.1 | Ona KE & US |  |  |  | x |  |  |
| 2.1.2 | Ona KE & US |  |  |  | x |  |  |
| 2.1.3 | Ona KE & US |  |  |  |  | x |  |
| Contract Wrap-up | Ona KE & US |  |  |  |  |  | x |
| OpenSRP Community Meetings | Ona KE & US | x | x | x | x | x | x |
| WHO CCG WG Meetings | Ona KE & US | x | x | x | x | x | x |
| Global Goods Monthly Meetings | Ona KE & US | x | x | x | x | x | x |
| Quarterly Reports | Ona KE & US | x | x | x | x | x | x |
| Maturity Matrix Eval | Ona KE & US |  |  |  |  |  | x |

##

## Deliverables

|  |  |
| --- | --- |
| **Deliverable**  | **Quarter Due** |
| Activity 1.1.1: OpenSRP wiki document defining resources used | Q1 |
| Activity 1.1.2: Source code available online on GitHub | Q1 |
| Activity 1.1.3: Source code available online on GitHub | Q1 |
| Go/No-go decision on working on 1.1.4 documented on the wiki | Q1 |
| Activity 1.1.4: Scoping Document | Q2 |
| Activity 1.1.4: Source code available on GitHub | Q2 |
| Activity 1.1.4: Sample app available and demonstration meeting | Q2 |
| Activity 1.2.1: Source code available on GitHub | Q2 |
| Activity 1.2.2: Workflow documented on wiki | Q2 |
| Activity 1.2.2: Source code available on GitHub | Q3 |
| Activity 1.2.2: Demonstration meeting | Q3 |
| Go/No-go decision on work package 2 documented on the wiki | Q3 |
| Activity 2.1.1: Scoping document available on the wiki with mock-ups | Q4 |
| Activity 2.1.2: Mapping document defined on the wiki | Q4 |
| Activity 2.1.3: Source code available on GitHub | Q5 |
| Activity 2.1.3: Demonstration meeting | Q5 |
| Matrix Evaluation | Q6 |

## Global Good Maturity Model Assessment

Please find our updated global good maturity model assessment on our wiki: [https://smartregister.atlassian.net/wiki/spaces/Documentation/pages/671580176/Global+Goods+Self+Assessment](https://smartregister.atlassian.net/wiki/spaces/Documentation/pages/671580176/Global%2BGoods%2BSelf%2BAssessment)

# Appendix 1 - Curriculum Vitae for Key Staff

To Be Completed for Final Proposal