# Towards an Integrated HIE Approach to Patient-Level Indicator Reporting

## Two-Sentence Overview

To support with an integrated approach to patient level monitoring, we propose the use of a health information exchange that supports onboarding of multiple digital health systems through HL7 FHIR-based interfaces, providing a common way to connect and register data to a longitudinal client record, on which indicator calculations are performed.

This work will be achieved through a consortium of partners working together on a shared vision and architecture, leveraging each partner’s individual strengths while limiting overlap, and optimising investment through an integrated, extensible approach, enhancing existing global goods towards a solution that supports multiple Point of Service applications and Health Information Exchange components able to support patient-level indicator reporting.

## High-Level Budget Summary

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **WP1 - OCL Support** | **WP2 - OpenMRS Support for Patient Level Indicator Reporting** | **WP3 - openIMIS Support for Patient Level Indicator Reporting** | **WP4- Bahmni Support for Patient Level Indicator Reporting** | **WP5 - Integrated HIE Approach to Patient Level Indicator Reporting** | **WP6 - Instant OpenHIE CQL Component** | **Total Cost (USD)** |
| $138 946.15 | $66 000.00 | **$26 035.20** | **$39 983.92** | **$100 585.47** | **$38 752.00** | **$410 302.75** |

## Executive Summary

The Digital Square investment will be used to bring together a consortium of partners to collaborate on a solution to patient-level monitoring that is appropriate and scalable for low and middle income countries (LMICs). We propose the use of a standards-based architectural framework and integrated solutions to patient-level monitoring. Our vision of an integrated approach adopts the use of international architectural patterns (OpenHIE) to provide a mature solution that is both instantiable and reusable, through the use of an extensible framework able to support a multitude of Point of Service (PoS) applications in an integrated patient level monitoring system.

The consortium aims to use the Digital Square investment to support FHIR profiling activities to specify the data model, resource mappings, terminologies and indicator definitions relevant to the priority use case, supporting the development of HL7 FHIR interfaces in the selected PoS applications and IOL, and demonstrating the end-to-end feasibility of the paired and integrated approaches to extracting indicator data from a Minimum Data Set Message or a shared longitudinal data store.

## Consortium Team

Jembi Health Systems will lead and oversee a consortium that also includes OpenMRS Inc., BlueSquare, Open Concept Lab (OCL), and IntelliSOFT. In this role, Jembi will set up a central Health Information Exchange (HIE) sandbox for testing, and ensure the platform provides FHIR-based end points for Point of Service applications to submit demographic and clinical data, and enable extraction of indicators from a longitudinal FHIR server. OpenMRS Inc. will work to ensure OpenMRS supports integrated patient-level monitoring architecture, and similarly, BlueSquare will focus on openIMIS, Open Concept Lab on the OCL suite of tools, and IntelliSOFT on Bahmni.

Jembi is an African non-profit company specialising in digital health and open source software development and implementation. Jembi has a successful track record developing and implementing open source software in the health sector, including in a number of African countries. It has contributed to many open-source software development projects and communities of practice, including OpenMRS, Bahmni, OpenHIM, HEARTH and OpenHIE. Jembi is registered and headquartered in South Africa with country offices in Mozambique, Rwanda and Zambia.

OpenMRS Inc. provides oversight on the open source EMR, OpenMRS, and its associated community, which seeks to engage and motivate contributors and supporting organizations who actively engage in all aspects of the software development and implementation process.

Bluesquare is a Belgian data company founded in 2012, focused on digital health in emerging economies around the globe. Bluesquare, thanks to its proven experience in designing and leading IT products in use in UHC sector, will reinforce the development team and ensure that the high level architecture is translated without distortion into concrete software components. Thanks to its involvement in the openIMIS re-architecture, which includes the provision of a native HL7 FHIR interface, Bluesquare will also facilitate a good integration with the coming openIMIS platform.

Open Concept Lab (OCL) provides an open-source suite of tools to support terminology and metadata management, including the OCL Terminology Service, OCL Metadata Browser, and OCL for OpenMRS Authoring Interface. OCL is recognized as a digital global good and works in close partnership with the OpenHIE and OpenMRS communities. OCL is actively supporting PEPFAR’s demonstration project for TX\_PVLS to evaluate indicators directly from patient-level data.

IntelliSOFT Consulting Limited is a wholly owned Kenyan company with more than 8 years of experience. As a technology company, IntelliSOFT has deliberately focused on designing, developing, implementing, supporting and maintaining digital health solutions, particularly for Low to Medium-Income Countries. They have extensive experience in implementing appropriate digital health solutions running either on OpenMRS or Bahmni in resource constrained environments. IntellISOFT’s past and current projects are spread across Africa covering Kenya, Uganda, Tanzania, Zambia, Sierra Leone, Rwanda, Ethiopia, Mozambique & Zimbabwe.

## Background or Problem Statement

Significant effort and resources are expended in low and middle-income countries (LMICs) to collect and synthesize health, health system and social determinants of health related indicators using paper-based and digital data systems. Reporting on these indicators allows different stakeholder groups to perform a number of functions. The Integrating the Healthcare Enterprise (IHE) Quality, Research and Public Health (QRPH) Clinical Quality Language for Aggregate Data Exchange white paper outlines a staged framework that enables extraction and sharing of indicators from individual digital client records through the use of HL7 FHIR and related Integrating the Healthcare Enterprise (IHE) profiles.

The stages are described as a set of resources designed around three maturity scenarios:

Standalone - a standalone digital health system using a bespoke data model running on a low-powered and often disconnected device that wants to report an indicator directly and requires a precise definition of an indicator.

Paired - a standalone digital health system that can share data using the HL7 FHIR data model, is locally connected and that wants to offload indicator calculation to a locally available service.

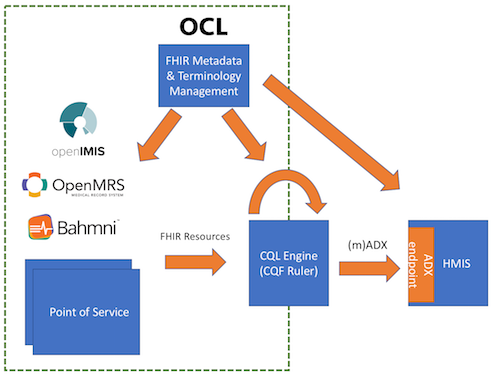
Integrated - a connected digital health system operating within a health information exchange that wants to contribute data to a longitudinal client record, using the HL7 FHIR data model, upon which indicator calculations are performed.

This proposal proposes an approach to patient level monitoring able to address both the paired scenario as well as an integrated scenario through the use of a health information exchange that supports onboarding of multiple digital health systems through HL7 FHIR-based interfaces and a FHIR-based terminology services layer, providing a common way to connect and register data to a longitudinal client record, share indicators across individual Point of Service (PoS) applications through the use of HL7 FHIR profiles, and extract indicator data from patient level indicator calculations performed on a longitudinal client record. Three point of service applications will be leveraged and extended to support and demonstrate the feasibility of this approach, namely:

* OpenMRS
* Bahmni
* openIMIS

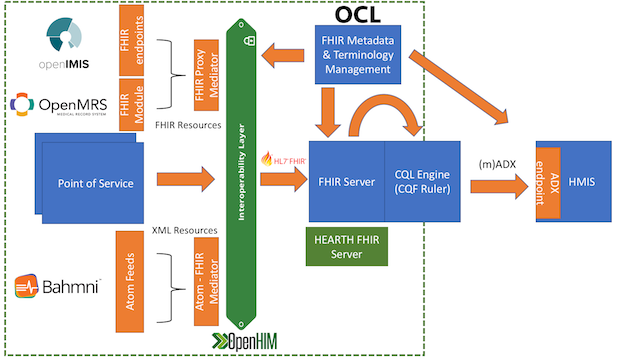
## Digital Health Technologies

This proposal proposes an integrated approach to patient level monitoring through the use of a health information exchange (HIE) that supports onboarding of multiple digital health systems through HL7 FHIR-based interfaces, providing a common way to connect and register data to a longitudinal client record, share indicators across individual Point of Service applications through the use of HL7 FHIR profiles, and extract indicator data from patient level indicator calculations performed against a Minimum Data Set Message (paired approach) or on a longitudinal client record (integrated approach). In addition, a simplified paired approach can be supported through the generation of FHIR-based Minimum Data Set Messages from the PoS applications, which are submitted and evaluated through a CQL execution engine, as shown in Figure 1.



*Figure 1 – Paired Patient Level Indicator Reporting Architecture*

The integrated approach extends this through the use of a Health Information Exchange (HIE) with an Interoperability Layer (IOL) and Shared Health Record (SHR), with endpoints for Point of Service (PoS) applications to submit demographic and clinical data through the OpenHIM IOL, which is then stored in a longitudinal FHIR-based SHR, HEARTH, against which indicator calculations can be performed using a CQL execution engine. The proposal proposes setting up a reference HL7 FHIR-based HIE using existing HIE component technologies, that will enable submission of HL7 FHIR-based patient-level data from multiple transactional PoS systems, and demonstrate the ability to define and extract indicator data from a FHIR-based longitudinal data store, as shown in Figure 2.



*Figure 2 – Integrated Patient Level Indicator Reporting HIE Architecture*

The consortium aims to demonstrate the feasibility of an integrated approach to extracting indicator data from a shared longitudinal data store, and the submission of data from OpenMRS, openIMIS and Bahmni PoS applications with this approach.

The OpenMRS platform provides a FHIR-based interface through the FHIR and Sync 2.0 modules. The FHIR module currently supports a number of FHIR resources (mapped to OpenMRS entities) and is being extended to support additional use cases, such as health financing. The OpenMRS data model is heavily influenced by the HL7 reference information model and uses a central concept dictionary to define the data it contains. As a result, the system is very flexible and can be adapted for any patient-centric health solution. The platform is also designed to be modular, making it extremely extensible by allowing customizations to be added or removed to meet local needs.

openIMIS is an open-source software application that manages social (health) protection schemes, linking beneficiary, provider and payer data. It can be used to strengthen strategic purchasing and digital processing of health system data. openIMIS has been working with the OpenHIE community to ensure that data exchange processes and requirements meet the needs of healthcare financing communities, and to develop and adapt OpenHIE workflows to incorporate health finance data sharing use cases and country needs. BlueSquare is currently supporting the modular transformation and re-architecting of openIMIS, which includes development of an HL7 FHIR based data model providing out-the-box support for standards-based data exchange and integration into an HIE.

Bahmni uses an atom feed framework for data synchronization and data interfacing, which uses an event driven system that publishes entries to an atom feed every time something happens in the system that may be of use to other systems or users, such as a new patient being added, or a new prescription issued for a patient. Systems find out about these events by polling the feed for new entries. With this approach, the feed provider does not need to be changed or updated when a new system wants to connect to the feed. To support the Bahmni to FHIR-based HIE interface, an atom to FHIR interface is proposed. Using the OpenHIM, one or more mediators could be used to support this through providing the following set of capabilities:

* Support for subscribing to an atom feed
* Polling the relevant atom feed(s) for new events
* Validating event data
* Transforming XML-based events into FHIR resources

OCL is an open-source suite of tools designed to help LMICs and their partners manage, publish, and use terminology and other metadata. The OCL Terminology Service is a REST-API service that provides all core functionality, including defining new codes, building subsets, mapping to reference vocabularies such as ICD-10, versioning, code validation, and code transformations. The OCL Metadata Browser is a lightweight tool for searching and visualizing metadata in OCL and across the OpenHIE stack (this is currently under development). The OCL for OpenMRS authoring interface allows implementers to build concept dictionaries in the cloud and subscribe to them from a local OpenMRS instance. For this project, we would enhance OCL to serve as an authoritative, platform-agnostic, FHIR-compliant source for codes, value sets, disaggregates, and other metadata required to support the FHIR/mADX approach to aggregate data exchange.

Through a set of discrete work packages, the consortium aims to use the Digital Square investment to a) support FHIR profiling activities to specify the data model, resource mappings, terminologies and indicator definitions relevant to the priority use case, and b) support further development of HL7 FHIR interfaces in the selected PoS applications, as well as c) OpenHIM mediator development that enables on-boarding of FHIR data from source PoS applications. The consortium aims to demonstrate end-to-end feasibility of an integrated approach to extracting indicator data from a shared longitudinal data store, leveraging OCL as a terminology service in the HIE, and the submission of data from OpenMRS, openIMIS and Bahmni PoS applications in this approach. The project deliverables and timeframe for each work package is outlined below.

## Use Cases and User Stories

The IHE QRPH white paper identifies several domains where patient-level indicator reporting can be applied. This proposal will focus on supporting a minimum data set and prioritised set of indicators able to support and demonstrate both the HIV 90-90-90 cascade and health financing use cases.

## Objectives and Activities

### Work package 1: OCL Support

This work package will be led by Open Concept Lab (OCL) and would enhance the OCL suite of tools to serve as an authoritative, platform-agnostic, FHIR-enabled source for codes, value sets, disaggregates, and other indicator metadata. A FHIR-enabled OCL would provide a level of support for all 3 data exchange scenarios (standalone, paired, integrated) and for all 3 levels of systems (PoS, HIE, and HMIS/DW). PoS applications would leverage OCL as a structured metadata reference (i.e .designing data models, interfaces, and CQL scripts against it), a subscription service (i.e. using the OCL subscription module to load required codes directly into OpenMRS), or a mapping and transformation service (i.e. to transform local data into the required MDSM format). The HIE would interface with OCL to look up and validate codes against relevant value sets or retrieve other structured indicator metadata (eg. disaggregates) required to support FHIR/mADX data exchange. OCL would use this award to support building a FHIR terminology services layer with basic support for the FHIR CodeSystem and ValueSet resources onto the existing OCL terminology server, publishing all codes, value sets, and other indicator metadata required by PoS and the HIE to demonstrate the mADX data exchange, and to enhance the OCL Metadata Browser to support intuitive browsing and downloading of the published indicator metadata. Because there is a cloud-hosted instance of OCL, any compatible product (PoS or HIE) would be able to leverage the metadata published to OCL for this effort, reducing the need to implement a local terminology service unless the implementation requires it.

#### **Objective 1.1:** Build a FHIR terminology services layer onto the existing OCL terminology server, specifically the FHIR CodeSystem and ValueSet resources.

##### *Activity 1.1.1:* Implement FHIR server within OCL environment and link with OCL authentication.

##### *Activity 1.1.2:* Implement (at minimum) required features of the FHIR CodeSystem and ValueSet resources.

#### **Objective 1.2:** Model and publish definitions for all codes, value sets, disaggregates, and other metadata required to support the aggregate data exchange process.

##### *Activity 1.2.1:* Curate terminology, indicators, mappings, and other supporting metadata used by PoS applications, HIE or business intelligence components and load into OCL. A point of service system like OpenMRS may manage an mADX-compatible subset (i.e. mapped to the data elements in the MDSM) in the cloud and subscribe to it, ensuring that it is capable of exporting data in the required format. To support the HIE, OCL will host the reference and operational indicator definitions, including disaggregates with the necessary business logic to define disaggregate inclusion/exclusion criteria. As determined, OCL may also host definitions from the MDSM and its mappings to the data elements in the FHIR profile. This model was successfully tested (without FHIR-TS support) with PEPFAR’s TX\_PVLS proof of concept.

#### Objective 1.3: Enhance the OCL Metadata Browser Prototype to support intuitive browsing, searching and downloading of all metadata published to OCL as part of this project and easy access to view or download the associated FHIR resources.

*Activity 1.3.1: Build reusable views for the OCL Metadata Browser to present metadata published as part of this project.*

*Activity 1.3.1: Engage existing communities of practice, such as the OpenHIE Data Exchange community, to provide feedback on the presentation, model, and content of the published metadata.*

### Work package 2: OpenMRS Support for Patient-Level Indicator Reporting

This work package will be led by OpenMRS Inc. and aims to provide a technical solution to support both paired and integrated system approaches. Where possible, OpenMRS will leverage existing work done for related modules, such as DHIS reporting module, FHIR module, and Sync 2.0 module.

**Objective 2.1:** Develop a module to support indicator reporting to a standalone system by preparing and submitting a CSV of person-level data directly to HMIS system using mADX messaging.

##### *Activity 2.1.1:* Use community forums to bring together a small team of subject matter experts and business analysts to define the initial scope, including target indicator, and identify existing work to leverage

##### *Activity 2.1.*2*:* Establish project page on OpenMRS Wiki with documented roles, responsibilities, and communication channels to be used during the project period

##### Activity 2.1.3: Iterate the architectural design to perform direct indicator calculations

##### Activity 2.1.4: Develop a module that prepares CSV of person-level data using mADX messaging according to specification and submit directly to the transactional system

#### **Objective 2.2:** Build a module that supports indicator reporting to a paired system by submitting a FHIR bundle to the OpenHIM mediator

##### *Activity 2.2.1:* Define the architectural design based on the TX\_PVLS specifications to support indicator reporting for the paired system scenario

##### Activity 2.2.2: Subscribe to OCL for standard concepts that can be used during data capture in order to support data collection

##### *Activity 2.2.*3*:* Build and submit a FHIR bundle to the OpenHIM mediator using final specifications and mappings defined in OCL for ETL into standard format

**Objective 2.3:** OpenMRS will contribute work to the integrated approach by contributing to the architectural design of an integrated solution (documented architecture), utilizing the module from the “paired” scenario to build a FHIR bundle and submit to OpenHIM mediator, FHIR profiling activities, where relevant, adapting FHIR interfaces in OpenMRS to support the overall workflow, and submitting OpenMRS data to the HIE via published interfaces.

##### Activity 2.3.1: Contribute to the architectural design of an integrated solution (documented architecture)

##### Activity 2.3.2: Leverage the module from the “paired” scenario to build a FHIR bundle and submit to OpenHIM mediator

##### Activity 2.3.3: Contribute to FHIR profiling activities, where relevant

*Activity 2.3.4:* Adapt FHIR interfaces in the OpenMRS to support the overall workflow

*Activity 2.3.5:* Submit OpenMRS data to the HIE via published interface

### Work package 3: openIMIS Support for Patient-Level Indicator Reporting

This work package will be led by Bluesquare and will support the development of a technical solution for reporting patient-level data collected from openIMIS in both paired and integrated system approaches. openIMIS will thus serve the role of Point of Service (PoS) for the proposed integrated solution and will contribute data on the patient-level indicators based on the claim (reimbursement). The data will include: demographic data, clinical (master) data and patient-level data (for indicators).

#### Objective 3.1: In order to create an instance of the CQL for ADX standard based on demographic and clinical data from distinct PoS (OpenMRS, Bahmni and openIMIS), openIMIS will need to make its data openly available in line with the FHIR standard.

##### Activity 3.1.1: Data Mapping

To leverage data from openIMIS, it will be essential to map the entities (IDs). In light of the limits for openIMIS to accomplish this task we have suggested that openIMIS provide IDs and that all the necessary ID mapping will be conducted outside of openIMIS using OCL. This will not be managed by Bluesquare however, additional support to ensure the tool runs smoothly will be provided as needed.

*Activity 3.1.2: Data Completeness - Analysis and Tool Extension*

The FHIR API under implementation in the openIMIS community already targets a very similar scope to the work needed for this solution. The key will be to ensure there is not any duplicate work and begin with an analysis of what is (will be) already available through openIMIS.

Currently openIMIS targets the FHIR 3.0.0 version (which may require rework/extension if other versions are needed). Generally speaking FHIR entities are very detailed, especially the Claim entity which includes diagnosis info, clinical procedures and openIMIS won't be able to deliver the fully detailed data.

Essentially, openIMIS FHIR API includes processing capabilities which can perform:

* data format transformations (date formats,...)
* basic calculations (transform fix dates into duration,...)

Depending on the needs we may need to rework or extend the tool to capture any data not currently covered in the current openIMIS FHIR API.

*Activity 3.1.3: Installation, configuration, testing*

For the final activity we will initiate the necessary configurations to ensure a smooth exchange. To do this we would install demo data, match the security levels determined by the team (basic auth, SSO, ...) and run integration tests.

The new openIMIS platform already includes an automatic 'remote authentication mechanism' in its roadmap, so with limited configuration and some testing we would be able to ensure the match.

### Work package 4: Bahmni Support for Patient-Level Indicator Reporting

This work package will be led by IntelliSOFT and will support the development of a technical solution for reporting patient-level data from Bahmni in such a way that complements the OpenMRS contribution in Work Package 2 and supports both paired and integrated system approaches. Where possible, IntelliSOFT will leverage existing work done to support the Bahmni data interface. This may include extending the OpenMRS FHIR module to support additional Bahmni-specific functionality, or using the existing Bahmni atom feed and developing one or more OpenHIM mediators to provide support for subscribing to an atom feed, polling the relevant atom feed(s) for new events, validating event data and transforming XML-based events into FHIR resources.

**Objective 4.1:** IntelliSOFT will contribute work to the integrated approach by contributing to the architectural design of an integrated solution (documented architecture), FHIR profiling activities, where relevant, adapting interfaces in Bahmni or developing OpenHIM mediators to support the overall workflow, and submitting data to the HIE via published interfaces.

##### Activity 4.1.1: Contribute to the architectural design of an integrated solution (documented architecture)

##### Activity 4.1.2: Contribute to FHIR profiling activities, where relevant

*Activity 4.1.3:* Adapt interfaces in Bahmni or develop OpenHIM mediators to support the overall workflow

*Activity 4.1.4:* Submit Bahmni data to the HIE via published interface

### Work package 5: Integrated HIE Approach to Patient-Level Indicator Reporting

This work package will be led by Jembi and will bring together outputs from the other work packages into a cohesive architecture, using a central HIE interoperability platform to support the integrated solution. The central HIE platform will provide functionality for the storage and management of enterprise unique client identification and associated demographics, longitudinal health data storage for patients / clients, and mediators to support submission of demographic and clinical data through the OpenHIM IOL. The central HIE Interoperability platform will expose master patient index endpoints of the HIE and their associated standards (FHIR) to identify patients and register new patients, and longitudinal health data endpoints and associated standards (FHIR resources) to submit encounter data about patients. Each partner supporting a Point of Service application will work towards contributing to the architectural design of the solution, FHIR profiling activities (where relevant), adapting FHIR interfaces in the PoS application to support the overall workflow, and submission of PoS data to the HIE via published interfaces.

#### Objective 5.1: HIE Architecture

##### Activity 5.1.1: Determine set of prioritised indicators based on priority use case(s).

##### Activity 5.1.2: FHIR profiling to define the data model, resource mappings, terminologies, indicator definitions and CQL queries.

##### Activity 5.1.3: Define messaging specifications and workflows for submission of data to the HIE and interfacing between system components.

#### Objective 5.2: HIE Configuration & Instantiation

##### Activity 5.2.1: Development of mediators to support submission and processing of data from PoS applications.

##### Activity 5.2.2: Baseline HIE infrastructure setup using the OpenHIM and HEARTH with endpoints exposed.

#### Objective 5.3: CQL Engine

##### Activity 5.3.1: Configure and instantiate CQL engine deployed in the HIE.

#### Objective 5.4: Final Testing and Documentation

##### Activity 5.4.1: HIE installation and configuration documentation published and publicly available.

##### Activity 5.4.2: Demo system to OpenHIE and other relevant communities, with input from consortium members.

### Work package 6: Instant OpenHIE CQL Component

This work package will be led by Jembi and will focus on extending the Instant OpenHIE offering to include a CQL service pod. This will be achieved through the containerisation of the CQL engine and development of component scripts to cover core CQL-related workflows.

#### Objective 6.1: CQL Service

##### Activity 6.1.1: CQL Containerisation and Deployment Strategy

##### Activity 6.1.2: Component scripts to cover core CQL workflows

##### Activity 6.1.3: CQL component instantiation & integration scripts

## Community Feedback

Jembi will lead on the coordination of consortium efforts, chairing & minuting check-in calls and community engagement efforts.

The consortium will engage with relevant PoS application communities/committees for input and feedback on the architecture and approach to patient-level indicator reporting, including:

* The OpenMRS design and leadership communities
* The Bahmni coalition community
* The openIMIS developers and implementers committee

The consortium will engage with the OpenHIE community (namely the architecture, interoperability layer & shared health record, and devops communities) for input, feedback and review of the architecture and HIE instantiation, and to ensure alignment with the Instant OpenHIE project. This will include relevant updates on the monthly community calls and a final presentation and demo of the solution towards the end of the project.

The consortium will also engage with the emerging What (CCG) working groups within the Digital Health & Interoperability Working Group, to align on synergies in standards-based data workflows in computable care and the use of FHIR and CQL.

## Schedule

The following is a high-level work plan.

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| --- | --- | --- | --- | --- | --- |
| **Activity** | **Team**  **Location**  **Month/ Quarter** | **Quarter** | | | |
| Q | Q | Q | Q |
| 1 | 2 | 3 | 4 |
| ***OCL Support*** | |  | | | |
| Develop FHIR terminology services layer | OCL, USA | x | x |  |  |
| Model and publish terminology and metadata definitions to support aggregate data exchange | OCL, USA |  | x | x |  |
| Enhance the OCL Metadata Browser Prototype | OCL, USA |  |  | x | x |
| ***OpenMRS Support*** | |  | | | |
| Project pages for standalone, paired, and integrated objectives describe purpose, scope, team, roles, and communication channels | OpenMRS Inc., USA | x |  |  |  |
| Documented architectural design to perform direct indicator calculations | OpenMRS Inc., USA | x |  |  |  |
| Module developed that prepares CSV of person-level data using mADX messaging according to specification and submit directly to the transactional system | OpenMRS Inc., USA |  | x | x |  |
| Documented Architectural design based on the TX\_PVLS specifications to support indicator reporting for the paired system scenario | OpenMRS Inc., USA | x |  |  |  |
| Module developed to submit FHIR bundle to the OpenHIM mediator using mappings defined in OCL for ETL into standard format | OpenMRS Inc., USA |  | x | x |  |
| Draft OpenMRS contribution to Integrated Patient Level Indicator Reporting Technical Architecture document | OpenMRS Inc., USA | x |  |  |  |
| Contributions to FHIR profiling activities, where relevant |  | x |  |  |  |
| FHIR interfaces adapted in the OpenMRS to support the overall workflow | OpenMRS Inc., USA |  | x | x |  |
| Module developed that submits OpenMRS data to the HIE via published interface |  |  | x | x |  |
| Project coordination calls and documentation | OpenMRS Inc., USA | x | x | x | x |
| ***openIMIS Support*** | |  | | | |
| Data Mapping |  | x |  |  |  |
| Data Completeness - Analysis and Tool Extension | BlueSquare, Belgium |  | x |  |  |
| Installation, configuration, testing | BlueSquare, Belgium |  | x |  |  |
| ***Bahmni Support*** | |  | | | |
| Draft Bahmni contribution to Integrated Patient Level Indicator Reporting Technical Architecture document | IntelliSOFT, Kenya | x |  |  |  |
| Contributions to FHIR profiling activities, where relevant | IntelliSOFT, Kenya | x |  |  |  |
| Interfaces adapted in Bahmni or OpenHIM to support the overall workflow | IntelliSOFT, Kenya |  | x | x |  |
| ***Integrated HIE*** | |  | | | |
| Determine set of prioritised indicators based on priority use case(s). | Jembi, South Africa | x |  |  |  |
| FHIR profiling | Jembi, South Africa | x |  |  |  |
| Define messaging specifications and workflows | Jembi, South Africa | x |  |  |  |
| Development of mediators | Jembi, South Africa | x | x |  |  |
| Baseline HIE infrastructure setup | Jembi, South Africa |  | x | x |  |
| Configure and instantiate CQL engine | Jembi, South Africa |  |  | x | x |
| HIE installation and configuration documentation published | Jembi, South Africa |  |  |  | x |
| Demo system to OpenHIE and other relevant communities | Jembi, South Africa |  |  |  | x |
| Consortium coordination, chairing & minuting check-in calls and community engagements | Jembi, South Africa | x | x | x | x |
| ***Instant OpenHIE CQL Component*** | |  | | | |
| CQL Containerisation and Deployment Strategy | Jembi, South Africa |  |  |  | x |
| Component scripts to cover core CQL workflows | Jembi, South Africa |  |  |  | x |
| CQL component instantiation & integration scripts | Jembi, South Africa |  |  |  | x |

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## Deliverables

|  |  |
| --- | --- |
| **Deliverable** | **Month/Quarter Due** |
| Project teams establish project page with documented roles, responsibilities, and communication channels to be used during the project period. | M1 |
| Integrated Patient Level Monitoring Technical Architecture document: Documented architecture, indicator definitions, data model & FHIR mappings/profile, messaging specifications. | M2 |
| openIMIS configuration and extension to properly link to the solution (using sample data) | M6 |
| PoS application development to support for submission of patient and clinical data, and submission of calculated indicators. | M8 |
| OpenHIM mediator development to support FHIR-based data interfaces. | M8 |
| HIE and FHIR implementation instantiated and configured with CQL queries implemented. | M10 |
| Integrated Patient Level Monitoring HIE configured end-to-end to support use case. | M12 |
| Instant OpenHIE CQL Component | M12 |

## Global Good Maturity Model Assessment

[OpenHIM](https://drive.google.com/open?id=1a6CWWltdGI0GXIKUl1rN_laUUxcW9zLS001noOSUY-4)

[Hearth](https://drive.google.com/open?id=1p8khsZStBqQFvVb7oBIWL3slm3jFnBQJdINb07bFZzI)

[Bahmni](https://drive.google.com/open?id=1vfJKH8UtmKHmLruQapd1xouAvGzWipzGj4KsGxZafZ0)

[openIMIS](https://drive.google.com/open?id=1nV5bRJTEnhkX4HLPm5Ut1i4sh19Uh1ITUQp1pkaygQs)

[OpenMRS](https://docs.google.com/spreadsheets/d/1SU1Ngn7nxLRurNTxmzm_Oiv6vTM81OQITbxHawaIT7k/edit#gid=0)

[Open Concept Lab](https://drive.google.com/open?id=1CSDpwOEMwunHDM578SMi5M-97O36SH_RpdBC3moDhVo)