2.1 Technical Application

OpenMRS Quality Assurance for Interoperability

Two-Sentence Overview

OpenMRS aims to advance our shelf-readiness by producing high-quality interoperable software and increasing trust in our system through rigorous, comprehensive, systematic quality assurance. By bringing together experienced community members and collaborating with other global goods communities, this investment will be used to 1) extend OpenMRS automated test portfolio, 2) address QA for OpenMRS interoperability testing, and 3) strengthen the adoption of the improved QA for community-wide utilization and conduct dissemination of a QA model to the broader global goods community.

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

Founded in 2004, OpenMRS is a high quality, open source, integrated electronic medical records platform (EMR) aimed at resource-constrained settings where structured patient record keeping systems can support improved care delivery and help achieve health equity. As OpenMRS continues its growth in over 5,500 health facilities in 60 countries to date, it increasingly is recognized as a de-facto EMR standard, supported by the OpenMRS community.

At OpenMRS, we contend that a critical factor of shelf-readiness is a user being able to trust the product. This trust is earned through rigorous, comprehensive, and systematic quality assurance testing and protocols; thus, quality assurance is an integral part of building shelf-ready, standalone, and interoperable OpenMRS technical products. With funding from Digital Square Notice C, the OpenMRS Quality Assurance (QA) Team was established to improve community quality assurance processes and tools. As a first step, our QA Team identified an initial set of priority test cases to automate with the OpenHIE

testing framework. As a result, OpenMRS is the first global good trialing the adoption of the OpenHIE testing framework into a community QA process and tooling for OpenMRS products.

With additional funding, the OpenMRS QA team can a) expand the set of automated tests for full product release and system interoperability testing, b) participate in the generalizability of the OpenMRS test portfolio for standard EMR/EHR testing in the Instant OpenHIE ecosystem, and c) transition the QA process from emerging to established, community-owned and community-wide standard. Our consortium will achieve these objectives by fostering collaborative work between the OpenMRS QA Team and the larger OpenMRS community, including the FHIR Module Squad and OpenMRS implementers, OpenHIE subcommunities such as the LIS CoP and Client Registry CoP, and Instant OpenHIE representatives. The QA Team's current scope of work and relationships with these stakeholders serves as a foundation for future collaboration. The QA team recently explored an approach for integrating this process and tooling into the FHIR Squad project to support their work on EMR-LIS and EMR-SHR use cases. The OpenMRS QA team is well positioned to serve as an advocate and leader for how other global goods can adapt the model and tooling to their community and products, resulting in Shelf-Readiness improvements to the global goods domain as a whole.

Consortium Team

In 2019, UW CIRG and OpenMRS partnered to lead OpenMRS QA Team work as well as the OpenMRS FHIR Squad project. Our consortium team reflects our commitment to supporting the OpenMRS QA Team and FHIR Squad by continuing this partnership.

UW CIRG (University of Washington Clinical Informatics Research Group) is one of the premier global health informatics organizations, specifically working to advance digital health global goods and the communities supporting them. CIRG has contributed substantially to multiple digital health communities, and led numerous large-scale informatics grants and programs around the world in partnership with global health funders and Ministries of Health. CIRG faculty member Jan Flowers serves as Chair of the Board of Directors of OpenMRS, a member of the Board of Directors for OpenELIS, and is the co-founder and project co-lead of the OpenHIE Laboratory Information Systems Community of Practice. In addition, CIRG staff member Jennifer Antilla has served as the Director of Community for OpenMRS for nearly 2 years, successfully supporting the development of a new governance model that included the decentralization of decision making into small committees focused on specific aspects of the product, strategy, or operations of the community. Ms. Flowers and Ms. Antilla have over a decade of experience working on OpenMRS and other global goods and HIS architectures in real-world LMIC implementations. They have each led multiple national-level OpenMRS architecture, implementation, and interoperability projects, including in Kenya (KenyaEMR), Haiti (iSantePlus), Mozambique (eSaude), and Vietnam (eClinica). Ms. Flowers has been the lead interoperability architect for Haiti, Kenya, Cote d'Ivoire, Mozambique, and Vietnam health programs. Ms. Flowers and Ms. Antilla are the founders of the OpenMRS Quality Assurance team and is an ongoing required operational group and process within the community.

OpenMRS, Inc. OpenMRS is an open source EMR and community that functions as a consortium, with many organizations working in LMICs supporting the work of individual OpenMRS contributors. As such, the community seeks to engage and motivate both volunteers and supporting organizations to actively contribute to all aspects of the software development and implementation process. OpenMRS is the home for the OpenMRS Quality Assurance team, with the expectation that this emerging team, led by the UW currently, will transition to a core operational component of the OpenMRS community long-term and will be funded under the OpenMRS core operational budget after that transition in the next few years

once the QA process and adoption has been fully established. The OpenMRS Quality Assurance team has led the first global good community pilot of the OpenHIE test management platform. In addition, the QA Team has established a need for and disseminated lessons learned in how to manage the required culture change in a global good community to build and incorporate comprehensive proactive quality assurance program as part of a core aspect in software development. This ultimately leads to increased trust and value in the products.

Background or Problem Statement

OpenMRS is utilized globally as the de facto EMR for LMIC, implemented in more than 5,500 facilities across 64 countries, serving ~12.5 million patients. Although OpenMRS is a mature software, QA processes have been largely left to developers to manage; resulting in limited and non-systematic testing that didn't involve the acceptance by implementers, which leaves low levels of trust in the safe and effective use of the product. With the establishment of the QA Team from Notice C, there has been a community-wide initiative to move from reactive QA to proactive QA by including both developer and implementer participation in the software release lifecycle, and through the initial steps to adopt the OpenHIE testing framework and tooling. Although well-received by the community, this more robust and systematic QA is in its infancy in establishing a community-wide comprehensive testing portfolio, and implementer product acceptance. The QA team has begun to explore how this process and use of the OpenHIE tooling can be disseminated to the broader global goods community and utilized by the OpenHIE subcommunities to address interoperability test standards with OpenMRS and EMRs in general.

Digital Health Technologies

OpenMRS The OpenMRS platform is a generic platform for developing electronic medical record (EMR) system implementations. It is designed to collect and manage patient-centric longitudinal medical data. The platform consists of a database, an abstraction layer between code and the database (i.e., Hibernate, a tool to map between Java objects and a database), a Java-based service layer, and a web services (a bespoke REST interface and a standard FHIR interface). The 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 – not focused on a specific vertical use case – 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.
Multiple APIs are available, supporting interoperability. Proven interoperability already exists between multiple systems, and, in fact, OpenMRS has been proven to support case based reporting using the OpenHIE architecture. We also use OCL for terminology support, and actively support this work. We have been working closely with OpenHIE, building and evaluating the ability of OpenMRS to share data through the defined OpenHIE architectural stack. More information is available at https://wiki.openmrs.org/display/docs/Technical+Overview.

OpenHIE Test Management Platform OpenHIE utilizes the Cucumber Studio test platform for open source projects to be able to build the business test case and trigger automated test scripts for conducting comprehensive and systematic software testing. The test platform has solely been utilized by OpenMRS QA team thus far, and is early in understanding its full potential. The test management platform will require additional exploration and use by global goods community members to become a de facto standard for the global goods interoperability test management platform.

Use Cases and User Stories

As an OpenMRS user, I want to be able to use the system without bugs so that I am not interrupted or having to find workarounds to do my work.

As an OpenMRS implementer, I want to know that the products I am installing are rigorously tested and bug-free so that I do not experience system issues during installation or implementation that can slow or delay my workplans and deliverables, and affect future funding.

As an OpenMRS software tester, I want to be able to systematically test the OpenMRS products, even if I'm new to OpenMRS.

As a stakeholder in the public health system, I want to feel confident that I can make critical and timely decisions based on the data within the systems that are implemented.

As an OpenMRS software developer, I want to be able to have my code quickly systematically tested once it is integrated into the development branch so that I know if there are issues I need to fix before I can consider that work completed.

As an OpenMRS implementer, I'd like to make sure that features or changes that I requested work the way that I expected them and need them to work before I install the product at the site.

Objectives and Activities

Our consortium proposes two work packages. Work package 1 will expand the current portfolio of test cases managed in the OpenHIE test management platform, Cucumber Studio. Work package 2 will expand collaboration to include the FHIR Module Squad and OpenMRS implementers, OpenHIE subcommunities such as the LIS CoP and Client Registry CoP, and Instant OpenHIE representatives. Expanding this work will allow us to progress towards our goal of providing a quality, shelf-ready product and result in a significant gain in Shelf-Readiness for the OpenMRS products.

Work Package 1: Assuring a quality, shelf-ready and standalone OpenMRS Reference Application.

In work package 1, the team will focus on expanding the current portfolio of automated test cases for the OpenMRS reference application. The team will utilize several different methods to grow and strengthen the culture and the skillset within the OpenMRS community to develop automated test cases. The team will conduct OpenMRS University working sessions to work with community members on how to build out the business test case in Gherkin, to develop the automated test script for each test case, and to work with the Cucumber Studio test platform to manage the software testing cycle. The team will recruit and engage community members to develop the prioritized test cases on the existing QA test portfolio roadmap, and integrate those into the OpenMRS testing. Finally, the team will conduct additional webinars, and working sessions with the broader global goods community through OpenHIE, to disseminate knowledge and lessons learned in utilizing the OpenHIE test management platform.

Objective 1.1: Automate priority Reference Application test cases using OpenHIE test framework.

Activity 1.1.1: Develop Reference Application test cases in Cucumber Studio-Selenium integration through OpenMRS University sessions and sprints

Activity 1.1.2: Integrate set of shelf-ready OpenMRS automated test cases into the OpenMRS Release Cycle

Activity 1.1.3: Document automated testing on OpenMRS Wiki

Objective 1.2 Disseminate lessons learned and knowledge to support the improvement of global goods quality

Activity 1.2.1: Identify specific global goods communities or stewards/implementers that are ready to use the OpenHIE test management platform and conduct specific 1:1 outreach to engage them, share lessons and knowledge

Activity 1.2.2: Conduct webinars and working sessions for showcasing and sharing knowledge of automated testing using the OpenHIE platform by the OpenMRS community and global goods domain

Work Package 2: Develop shelf-ready interoperability test cases to support priority EMR interoperability workflows.

In work package 2, the team will focus on identifying a core set of interoperability test cases for OpenMRS to exchange data with other systems in the OpenHIE architecture. By addressing interoperability test cases, OpenMRS will be able to integrate with the Instant OpenHIE project, as well as, leverage its experience with the OpenHIE testing framework and process to serve as an advocate and leader for adapting this model and tooling for other global good communities and products, resulting in Shelf-Readiness improvements to the global goods domain as a whole. The team will engage several OpenHIE subcommunities that already have developed a standards-based exchange specification and at minimum, a working prototype with OpenMRS - including the Lab Information Systems subcommunity, and the Client Registry subcommunity - and the Instant OpenHIE project team to collaborate in designing a test strategy using the test management platform. The team will then identify criteria for selecting prioritized interoperability test cases, and develop a roadmap for addressing those. The team will work with the OpenMRS FHIR squad to develop test cases as an initial set.

Objective 2.1: Automate interoperability test cases for the OpenMRS FHIR module and Instant OpenHIE.

Activity 2.1.1: Identify and prioritize interoperability test cases in the OpenMRS QA roadmap with input from OpenMRS community squads, developers, and implementers; OpenHIE CoPs; and from Instant OpenHIE project members

Activity 2.1.2: Develop automated interoperability test cases in Cucumber Studio-Selenium (OpenHIE test framework)

Activity 2.1.3: Conduct OpenMRS automated interoperability testing with Instant OpenHIE project

Activity 2.1.4: Document recommendations for how to generalize OpenMRS interoperability test cases to other EMRs, and use within the Instant OpenHIE project.

Community Feedback

This consortium expects to collaborate closely with the OpenMRS and OpenHIE communities of practice, and will actively engage other global good partners that are interested in developing robust test management portfolios utilizing the OpenHIE test management platform. The team will continue to lead the OpenMRS community QA team, engaging additional members for that team and contributors to the QA portfolio. The team will work directly with the Director of Product, the Technical Advisory Committee (TAC), and the individual community project squads to identify and develop priority test cases. In work package 2, the team will also specifically work with the OpenHIE subcommunities and the Instant OpenHIE project team to identify priority interoperability test cases and to conduct testing within the OpenHIE architecture.

Schedule

The following is a high-level work plan.

Keys:

- OpenMRS QA Team (QA), University of Washington (UW), OpenMRS Community (OMRS), Global Goods (GG), OpenHIE Community (OHIE), Instant OpenHIE Project (IHIE)
- Responsible (R), Accountable (A), Support (S), Consult (C), Inform (I)

Activity	**Team Location Month/ Quarter**	**Quarter**			
		1	2	3	4

Activity 1.1.1: Develop reference Application test cases in Cucumber Studio-Selenium integration through OpenMRS University sessions and sprints	QA (R) UW (A) OMRS (S,C) GG, OHIE (I)	X	X	X	X
Activity 1.1.2: Integrate a set of shelf-ready OpenMRS automated test cases into the OpenMRS Release Cycle	QA (R) UW (A) OMRS (S,C) GG, OHIE (I)		X	X	X
Activity 1.1.3: Document automated testing on OpenMRS Wiki	QA (R) UW (A) OMRS (S,C,I)		X	X	X
Activity 1.2.1: Identify specific global goods communities or stewards/implementers that are ready to use the OpenHIE test management platform and conduct specific 1:1 outreach to engage them, share lessons and knowledge	QA (R) UW (A) OMRS (S), GG, OHIE (C, I)	X	X	X	X
Activity 1.2.2: Conduct webinars and working sessions for showcasing and sharing knowledge of automated testing using the OpenHIE platform by the OpenMRS community and global goods domain	QA (R) UW (A) OMRS (S), GG, OHIE (C, I)	X	X	X	X
Activity 2.1.1: Identify and prioritize interoperability test cases in the OpenMRS QA roadmap with input from OpenMRS community squads, developers, and implementers; OpenHIE CoPs; and from Instant OpenHIE project members	QA (R) UW (A) OMRS, OHIE, IHIE (S,C) OHIE, GG (I)	X			
Activity 2.2.2: Develop automated interoperability test cases in Cucumber Studio-Selenium (OpenHIE test framework)	QA (R) UW (A) OMRS, OHIE, IHIE (S,C) OHIE, GG (I)		X	X	X
Activity 2.2.3: Conduct OpenMRS automated interoperability testing with Instant OpenHIE project	QA (R) UW (A) OMRS, OHIE, IHIE (S,C) OHIE, GG (I)				X
Activity 2.2.4: Document recommendations for how to generalize OpenMRS interoperability test cases to other EMRs, and use within the Instant OpenHIE project.	QA (R) UW (A) OMRS, OHIE, IHIE (S,C) OHIE, GG (I)				X

Deliverables

Deliverable	Month/Quarter Due
Work Package 1	
Activity 1.1.1 Link to OpenMRS Reference Application test portfolio	M12
Activity 1.1.2 Reference Application Release Cycle QA Process Document	M12
Activity 1.1.3 Link to OpenMRS Wiki QA Test Development Documentation	M12
Activity 1.2.1 and 1.2.2 Link to Webinar and Working Session Minutes and Recordings	M3, M6, M9, M12
Work Package 2	
Activity 2.1.1 Link to OpenMRS Roadmap with Interoperability Test Cases	M3
Activity 2.1.2 Link to OpenMRS Interoperability test portfolio	M12
Activity 2.1.3 Link to Test Results Documentation	M12
Activity 2.1.4 EMR Interoperability Testing Recommendations Report	M12

Global Good Maturity Model Assessment

OpenMRS Maturity Model Assessment
https://docs.google.com/spreadsheets/d/11VUCKxI0k00NcFboT_HiJGnLhi5KcwXs1Y587CAkyZ0/edit#gid=249752520