Global Good Final Activity/Progress Report

Name of Submitting Organization: OpenMRS, Inc
Date of Report: 20 August 2023
Dates of Implementation: 27 July 2022 - 31 August 2023
Name of Global Good: OpenMRS
Country(ies) of Work: Global

Project Journey and Future Directions

August 2023

Summary

With support from Digital Square, the OpenMRS Community collaborated with partner organizations Mekom Solutions, Partners In Health, Sonder Collective, WHO, and CDC to achieve the shared goal of adapt the Antenatal Care Digital Acceleration Kit for OpenMRS users by creating and packaging digital solutions that work in tandem with existing OpenMRS technologies.

This report includes information on:
Background. This section describes what motivated the community to integrate ANC SMART Guidelines into OpenMRS and the challenge this project is designed to address.

Project Journey. This section describes the major actions we took to organize and facilitate the OpenMRS UX Design Conference & Mini-Meeting, from a deep dive into the ANC DAK and SMART Guidelines and defining a technical approach to user research and design to engineering technical tools & extending features. Specific highlights are also discussed.

Lessons Learned & Future Directions. This section reflects on key lessons learned from our efforts to implement the ANC DAK and SMART Guidelines for OpenMRS. This includes decisions about the technical approach, what we discovered about SMART Guidelines and emerging tooling, and how we overcame some of the challenges we encountered.

Artifacts. This section provides links to key artifacts created over the course of this project.

Background

The OpenMRS Community is committed to collaboratively building technology that is user-driven and based on standards.

What might success look like? If the OpenMRS community and implementing organizations successfully implement the ANC DAK into the right OpenMRS technical products, then health care providers will be able to use standard antenatal care content, clinical decision support, and program indicators through OpenMRS forms, familiar or newly delightful UI patterns, and existing reporting tools. For years, the community has sought a solution for Decision Support rule authorship and calculation engine: We hoped this work would also help us answer if the recommended SMART Guidelines tooling pipeline could help us achieve a community standard Decision Support tooling chain that could also be leveraged by any other SMART Guidelines or implementer needs.

The challenge? In order to implement SMART Guidelines for OpenMRS and other global goods, five essential ingredients are needed: terms/concepts, forms, a way to write rules in software, a brain or engine that the software uses to calculate those rules, and a way to inform end-users of the result.

Solution: The OpenMRS SMART Squad defined an approach that brings together existing and/or agnostic tooling from OpenMRS and other Global Goods into a technical workflow that implements ANC DAK requirements along with the recommended SMART Guideline technical tooling:

1. **Open Concept Lab (Global Good)** to map concepts aligned with WHO codes;
2. OpenMRS' **Form Builder (existing OMRS resource)** to create a prototype form that triggers the workflow;
3. **CQL Engine (OSS)** and **FHIR IGs with planDefinitions (Standard)** to write the rules in software; and,
4. Improved **Patient Flag Module, FHIR Module, and Reporting Module (existing OMRS resources)** to inform end-users of the result through flags, tasks, and program indicator reports.

Project Journey

The Team

The OpenMRS Community brought together UX designers, business analysts, product managers, and developers from multiple organizations. We used the pre-eclampsia use case to improve the various modules and tooling used in the overall technical workflow for implementing ANC SMART guidelines in OpenMRS. This particular use case was chosen because it had a nicely broad array of different types of possible guidance outputs, from urgent to informative.

The team included: Partners in Health (Ellen Ball), Open Concept Lab (Jonathon Payne, Joe Amlung), Sonder Collective (Paul Adams, Ciaran Duffy), SmileCDR (Brynn Rhodes), and Mekom Solutions (Dimitri Renault, Brandon Istenes). OpenMRS (Grace Potma, Suruchi Dhungana, Daniel Kayiwa, Jennifer Antilla) provided coordination, product management, engineering support, and grant administration.

Deep Dives & User Research

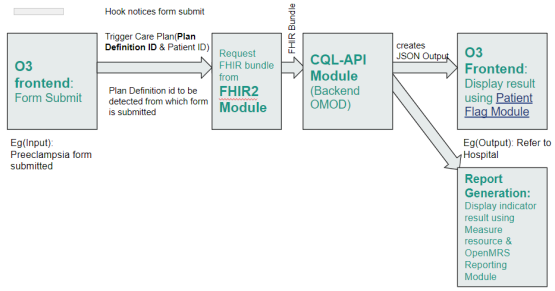
ANC DAK & SMART Guidelines. The OpenMRS SMART Guidelines squad immersed themselves in the ANC DAK in order to fully understand the requirements, identify gaps between current OpenMRS functionality, concepts, and features, and inform both the squad's technical approach and designs. We then also had multiple sessions with industry experts to understand the FHIR-IG-based approach recommended to date, which convinced us to try using that recommended tooling chain, including the CQL Engine OSS project.

Design with the User. UX Designers from Sonder Collective conducted user research to interview different clinical personas from different countries and contexts.

Highlights & Achievements

SMART Technical Workflow featuring emerging open source tooling.

Basic Technical Workflow Diagram:



- Adaptation of OpenMRS:
    - **The OCL Module:** This is necessary for the OpenMRS data model to receive and successfully interpret concept/terminology-related information from OCL.
    - **The Form Builder:** A growing GUI / WYSIWYG tool where community members without comfort writing HTML, SQL, or even JSON can use a UI to rapidly build forms. However, one must first have all the required concepts already set up in your system first. By adding required ANC concepts into our Open Concept Lab account, the SMART Squad was able to quickly use existing OpenMRS form tooling to create a pre-eclampsia screening form based on the ANC DAK.
    - **The Patient Flags Module:** Had an admin UI and community-known pattern of showing "flags" in the patient chart, but was not usable in the current generation of OpenMRS products yet due to API gaps.
    - **The FHIR2 Module:** As shown in the diagram above, the FHIR2 Module was integral to the project. It enabled us to handle standardized information exchange and leverage the existing SMART Guideline technical tooling work already in the ecosystem.
    - **The "OMOD" Standard:** OMODs, aka "OpenMRS Modules", are an OpenMRS-standardized way of packaging software such that it can be added (or

removed) as a component into an OpenMRS system without impacting unrelated modules. OMODs extend the functionality of the basic OpenMRS system without forcing all implementers to have to use that new component, but still allowing existing implementers to quickly adopt new components where desired.
    - **The Reporting Module:** The reporting process and UI in OpenMRS is well known by existing implementers, and they are often quick to ask us how any work might impact or leverage this mission-critical module which they rely on to generate reports for their funders. For this reason, changes to or departures from this module are generally viewed with great concern, as implementers want to avoid process changes that could cause report-generation downtime.
- Adaptation of Other Complimentary Global Goods:
    - **Open Concept Lab:** Open Concept Lab was a key tool that made the creation, management, and mapping of the required concepts and affiliated yvalue sets far simpler than in previous project experiences. For instance, when we needed to map our preferred concept IDs (CIEL codes) to the equivalent WHO-SMART codes, this was quite a fast exercise and helped us both learn more about and share feedback with the OCL team on their Terminology Mapping features.
- Adaptation of Other Projects the SMART WHO Team has Invested in:
    - **The CQL Engine:** Early on, the SMART squad looked into different approaches and tools to handle clinical decision support, ultimately deciding to use the open source CQL Engine / cqfevaluator project. OpenMRS Community Lead Daniel Kayiwa then bundled the CQL Engine into an OpenMRS-consumable “OMOD” (OMRS Module) called the CQL-API Module, which enables OpenMRS platform users to leverage the CQL Engine OSS project and update the module as that project grows.
    - **The ANC FHIR IG:** Also early in the project, the SMART squad reviewed the L3/FHIR IG already set up through WHO SMART Team investment. This existing resource combined with the CQL Engine appeared to be a very compelling way to consume the DAK content without needing to entirely re-write or exhaustively copy-paste, and the planDefinition model the FHIR IG approach applies matched some of our strategic hopes for using FHIR in OpenMRS.

Lessons Learned & Future Directions

Lesson Learned:

- **The WHO SMART Guideline Technical Pipeline we anticipated and attempted to utilize in our project is generally not yet Production Ready:** Unfortunately throughout our work, we continually ran into challenges with the complexity of the SMART Guideline Implementation Modeling that still today prevent us from recommending this tooling approach to implementers for purposes of CDS in general, or in-EMR reporting in particular. We anticipate continuing to provide feedback to WHO, and iterating in our attempts to incorporate the work into OpenMRS. More detail on that below.

- One very helpful finding has been that **The DAK Spreadsheet Pattern Instantly Resonates:** Many clinical/patient-care level users whom we showed the DAK to immediately expressed delight, commenting that the layout was much simpler and clearer to interpret than any guidelines publication they had seen before. However: **The DAK Contained Incorrect Mappings (produced by WHO):** Another reason we are tentative about recommending direct software-automated uptake of the DAK as-is is that we found over 90 places in the ANC DAK where SNOMED mappings were semantically incorrect. The risk this poses for implementations cannot be overstated. Incorrect mappings can result in false positives or false negatives in either Decision Support alerts or existing reporting. For example, the majority of OpenMRS Implementations leverage concept IDs considerably in the formulas driving various cells of their reports. Incorrect mapping of one concept to another can immediately impact the results of those reports, which often directly impact Implementations' financing. It is also very rare that field-level implementations have terminology experts in their team, so we have seen numerous instances where developers have copy-pasted code IDs trusting that the ID is correct without a cross-check. The need for mapping rigor is especially true if SMART Guidelines hope to usher in a world where terminology codes help drive CDS rules and Reporting (which makes sense), because in that world, mappings will create even more semantic connections across systems and reports than they do today.
- **OCL can be used for rapid terminology assembly and mapping:** Our positive experience with this contributed to training materials assembled in onboarding new countries to OCL tooling in another workstream, including NigeriaEMR, KenyaEMR, and ICAP-Ethiopia.
- **Beyond HIV:** This award has also been helpful in giving an obvious example that OpenMRS can go "beyond HIV" - as it is a common myth that OpenMRS is "only for HIV", and one which we are actively trying to demystify. In fact this is a tremendous risk for our whole Global Good industry: As National Ministries take over operational responsibility for Global Good systems previously funded by HIV-centric mechanisms, those systems are at high risk of being deprecated if they cannot rapidly demonstrate that they are capable of more than HIV disease surveillance. We are hearing this feedback repeatedly in particular from both implementation leaders and Ministry of Health officials from multiple countries throughout Africa.

<u>Future Direction</u>:

- Gaps blocking production-readiness need to be addressed (covered more below).
- Mappings in DAKs should be checked carefully in the future, vetted and validated broadly, and corrected in current DAKs.
- Continue leveraging the spreadsheet pattern as a way to communicate content and rules to stakeholders. Consider a technical implementation approach that could directly leverage a UI like this.
- **Thanks to this award, we now have the Patient Flags module available and working for production implementers to use in the newest version of OpenMRS**,

and we know that a hook-workflow can be used to trigger rules to run - next we will follow up on disseminating this with more implementers!

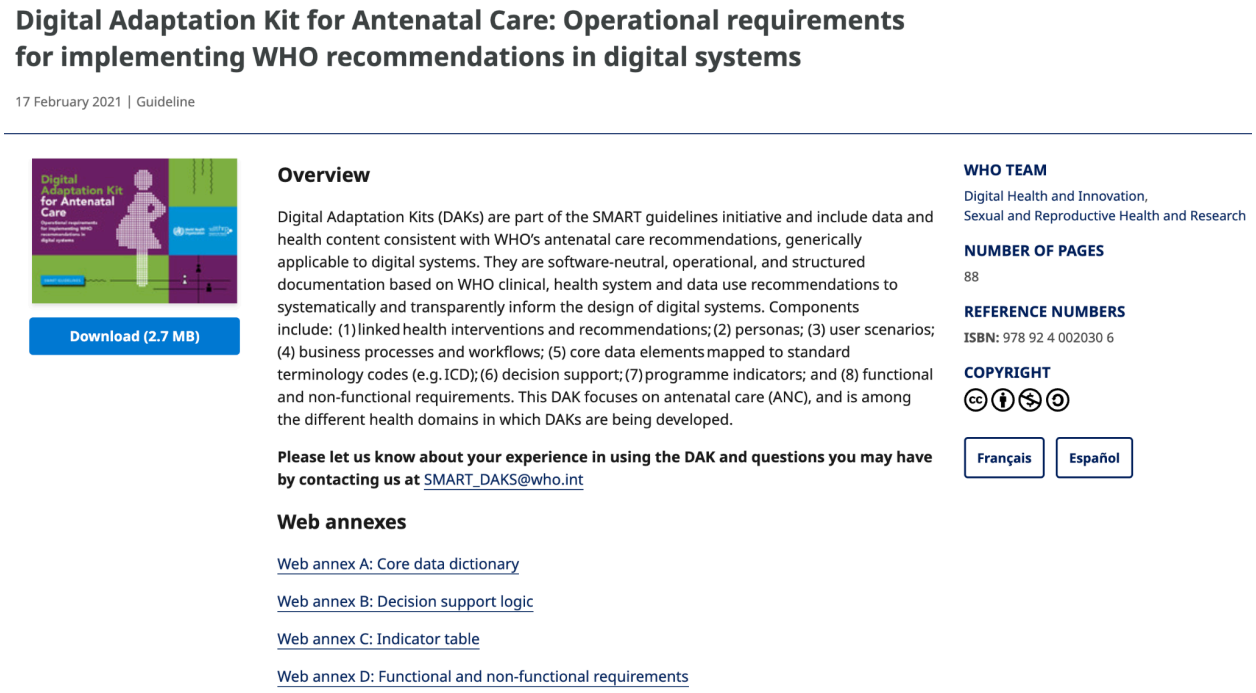
Gaps:

1. **Time to Familiarize with FHIR Modelling:** Training folks on FHIR IG layout and ingestion is not yet intuitive to the vast majority of in-country Global Good implementers. For instance, exceptionally few folks are aware of planDefinitions, which is foundational to this project. That learning curve takes time - it took our multi-organizational team numerous deep-dive meetings to get all stakeholders aligned - and will delay L2 update if L3-via-FHIR is defined as the only acceptable route of digital uptake.
2. **Burden of Learning and Maintaining CQL Syntax:** Learning to write or simply edit CQL code takes significant time even from experienced developers. We heard from several stakeholders during this award that it is extremely unlikely that many implementation staff will have the protected focus time to learn both the FHIR IG approach as well as CQL syntax enough to tweak the rules as required by their production sites and national or regional guidelines. To adjust a rule like "when to recommend referral", one needs to change the CQL file, then also the FHIR planDefinition file, and ensure affiliated value sets are in place. While the current approach appears elegant and simple when looking at steps like this one, such a change management structure is quite complex even for the simplest rule management in the field.
3. **CDS Rule Performance with CQL Engine is Too Slow for Point of Care:** The CQL Engine's performance is currently still too far away from being production ready - e.g. clinicians will have difficulty waiting for 10-30 seconds or more for every individual rule calculation to generate. Until this and other modeling issues with the CQL Engine are addressed, the community will not readily adopt this approach to production systems.
4. **Using the CQL Engine for Reporting is More Ideal for Separate FHIR Databases - not within the transactional EMR.** Currently, production implementations are unlikely to have a good experience running reports or indicators using measure reports directly in their production database, because of how the CQL Engine drives these to run. Specifically:
    a. Runs against the entire patient dataset, then stores this temporarily in memory
    b. While SQL is optimized at our DB level and sent to different database processes, CQL is running strictly at the memory level in JVM, and also dealing with very verbose FHIR resources.
    c. The combined impact: would cause your production system to slow down dramatically, unless your database has only a very small double-digit number of patients.
    d. *Instead*: Ensure you have a separate analytics database, ideally a separate FHIR database, and start very small to test. (Preliminary results from a different project for HIV Indicator Reporting via the CQL Engine is showing that this alternative approach works better.)

5. **Key User Request needs more TLC to Implement:** One of the main findings from user research was that users want to receive relevant alerts and support *during the context* where that information was gathered - not as a big list of advice at the end of their workflow. For example, while I am asking someone about their tetanus vaccination history, show me suggestions quickly based on what I enter right now - not much later on in my workflow. The current CQL Engine bundling approach we used depends on a point-in-time where a whole form is submitted before running and executing rules, in part because it lives in the backend of the software. There are ways around this that could be leveraged especially to generate “Tasks” in OpenMRS as a user enters relevant information.

Future Direction:

- **The SMART Guidelines community urgently needs to become more aware of the large barriers created by the current advised technical complexity.** For SMART Guideline adoption to thrive in production environments, where implementers need to perform many tweaks or additions to indicator formulas or CDS rules, there must be a lighter weight adoption and maintenance technical pipeline.
- **Intentional ideation on approaches to L2 consumption.** We hope we can liaise with the WHO SMART Team and perhaps Digital Square to coordinate a session on exploring the many approaches that could be taken to L2 consumption, including alternatives to the current approach, as it is clear from our user interviews that the user-facing feedback and guidance was exciting to end users, and we would like to see such content leveraged by production systems.



Digital Adaptation Kit for Antenatal Care: Operational requirements for implementing WHO recommendations in digital systems

17 February 2021 | Guideline

Download (2.7 MB)

Overview

Digital Adaptation Kits (DAKs) are part of the SMART guidelines initiative and include data and health content consistent with WHO’s antenatal care recommendations, generically applicable to digital systems. They are software-neutral, operational, and structured documentation based on WHO clinical, health system and data use recommendations to systematically and transparently inform the design of digital systems. Components include: (1) linked health interventions and recommendations; (2) personas; (3) user scenarios; (4) business processes and workflows; (5) core data elements mapped to standard terminology codes (e.g. ICD); (6) decision support; (7) programme indicators; and (8) functional and non-functional requirements. This DAK focuses on antenatal care (ANC), and is among the different health domains in which DAKs are being developed.

Please let us know about your experience in using the DAK and questions you may have by contacting us at SMART_DAKS@who.int

Web annexes

Web annex A: Core data dictionary

Web annex B: Decision support logic

Web annex C: Indicator table

Web annex D: Functional and non-functional requirements

WHO TEAM

Digital Health and Innovation,
Sexual and Reproductive Health and Research

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Français Español

Artifacts

Project Management
O3 ANC DAK Wiki page
SMART Guidelines: ANC DAK Roadmap
ANC DAK Jira tickets - PDF Summary Version here, or, Detailed PDF Version Here
Updated OpenMRS Global Goods Maturity Model
Design
Gap Analysis: ANC DAK requirements
Analysis of ANC DAK Indicator-Data Requirements
Technical Approach, including workflow
Presentation of user research and results
Preliminary mockups
Final UI designs and patterns
Development & Quality Assurance
ANC DAK Prototype Test Cases
Prototype for Usability Testing
Tests written for CQL Engine
CQL Engine Project tests and fixes
Pre-eclampsia concepts in OCL
Pre-eclampsia form: View or Config Setup Guide
FHIR2 Module
Patient Flag Module
OpenMRS CQL Module
Community Capacity & Engagement

ANC DAK Fellowship Journey Blog
WHO SMART Authoring Community Forum call
Digital Square Webinar with Ona on Implementing SMART Guidelines
Lightning Talk at March 2023 OpenMRS Meeting