Fast Healthcare Interoperability Resources (FHIR)®

Essentials & Implementation Guide Training - Hackathon Concept Note

March, 2023

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Introduction

The purpose of this hackathon is to simulate a data exchange between an EMR and laboratory system through a planned practical demonstration. The overall intent of this planned practical is to allow participants to demonstrate what they have learnt through the creation of FHIR® Implementation Guides (IG) where the use cases and FHIR® data elements are provided by the lecturer. Participants are required to deploy their FHIR® IG to a lecturer provided centrally hosted platform per country and then demonstrate that their FHIR® IG is able to support the lecturer provided use cases through a data exchange.

Prerequisites

The following prerequisites are essential to the training:

- A minimum dataset (MDS) complete with mapped FHIR® data elements, will be provided by the lecturer.
- The FHIR® profiles, FHIR® profile examples, code systems, value sets and FHIR® profile identifiers to support a data exchange with a laboratory system, will be provided by the lecturer.
- An amazon web services (AWS) hosted Jembi-on-platform solution that can be spun up per participating country.
    - A locally employed Jembi-on-platform solution needs to be set up as a backup should there be little to no internet connectivity.
- A FHIR® IG that describes the lecturer identified use cases and supports the MDS data elements.
    - **Note**: This FHIR® IG is the proposed solution to the hackathon.
- The User Interface (UI) for the EMR and Lab systems must be hosted by each country's Jembi-on-platform AWS instance.

- Both UIs must be able to point to each country's implementation guide that will be found on each country's Jembi-on-platform instance. See the section for Lecturer Provided UIs for more details.

Objectives

The following objectives have been identified for participants in this hackathon:

1. To build a FHIR® IG based on the lecturer provided MDS data elements.
2. To demonstrate their FHIR® IG's capability to support the lecturer provided use cases and MDS through a data exchange.
3. To produce a FHIR® IG quality assurance report that is free of implementation errors.

Assumptions

The following assumptions are noted for this hackathon:

1. The data exchange will take place by **only** using a lecturer provided web UI, one for EMR and another for laboratory.
2. All lab resources (FHIR® message bundle complete with laboratory profiles) will be provided by the lecturer. This is to ensure that the hackathon is not too overwhelming with too many requirements.
    a. **Note**: The lecturer is responsible for adding all of the laboratory profiles, profile examples and value sets to each country's FHIR® IG during pre-training configuration.
3. The hackathon will not support direct access to HAPI FHIR® for message requests.
4. All message requests must be submitted to the OpenHIM coming with each country's Jembi-on-platform AWS instance.

5. From a laboratory perspective, this hackathon will only support lab orders and results for Viral Load (VL) specimens.
6. Each country can only have one AWS instance but each country can have multiple participants.

Exclusions

- This hackathon will not explore any use cases other than the ones identified by the scope of this hackathon.
- The hackathon will not explore any aspect of system configuration and/or implementation associated with HAPI FHIR® or any other component of the jembi-on-platform AWS technology stack.
- Retrospective documenting of lab results will not be included in this hackathon. All lab results must come from the lab system via a data exchange.
- The UIs for EMR and Laboratory will be limited to the lecturer provided requirements and will not be extended to support additional requirements as identified by participants.
- Probabilistic patient searches will not be included in this hackathon.
- It will not be required that the participant first has to execute a patient search request before being permitted to register a new patient.
- The UIs for EMR and Laboratory will not include any form-level data validation.
- The forms in the UIs for EMR and Laboratory will not indicate or enforce any mandatory data elements.
- Ensuring that participants specify the correct FHIR®.Resource.element cardinalities in their FHIR® IG profiles as per the lecturer provided MDS, will only be possible by manually checking their profile configuration.

Scope

The scope of this hackathon will be limited to the use cases as defined by the lecturer and the accompanying MDS to support each of the use cases. The use cases for this hackathon are limited to that of a HIV patient.

The use cases are defined as follows.

EMR Use Cases

1. As a Nurse, I want to be able to search for a patient using a National Identity (NID) and/or Medical Record Number (MR).
2. As a Nurse, I want to be able to register a new patient.
    a. Document the patient identifier for NID and MR.
    b. Document a patient's contact information by phone and email.
    c. Document the first name, middle name and last name for a patient.
    d. Document the gender and date of birth.
    e. Document the address for the patient.
    f. Document the patient's marital status.
    g. Document the next of kin contact information for the patient.
    h. Document the key population status for the patient.
    i. Document the name of the organization that is registering the patient.
    j. Document the name of the transferring facility (if the patient is a transfer-in).
    k. Document the date and time of the encounter.
3. As a Nurse, I want to be able to document the episode associated with enrollment into HIV care,
    a. Document the patient's unique enrollment identifier.

   b. Document the date when the patient was enrolled into care.
   c. Reference the patient's documented condition as a diagnosis.
   d. Reference the registered patient
   e. Reference the organization who documented the HIV diagnosis.
4. As a Nurse, I want to be able to document the patient's HIV diagnosis.
   a. Document the code used for HIV diagnosis.
   b. Reference the registered patient.
   c. Reference the patient's encounter.
   d. Document the date of diagnosis.
   e. Document additional supporting notes regarding the diagnosis.
5. As a Nurse, I want to be able to document the date when I requested for the HIV test to be performed.
   a. Document the code that will be used by the observation to uniquely identify that observation indicates that an HIV test was done.
   b. Reference the registered patient.
   c. Reference the patient's encounter.
   d. Document the date when the HIV test was done.
   e. Document additional supporting notes regarding the HIV test.
6. As a Nurse, I want to be able to submit a new VL lab order:
   a. Document the Order ID.
   b. Reference the service request associated with the lab order.
   c. Document the the date when the lab order was submitted
   d. Reference the organization who submitted the lab order request
   e. Reference the organization who owns is responsible for the lab order request.
   f. Document additional supporting notes regarding the lab order.
7. As a Nurse, I want to be able to document the service request details for the new VL lab order:

a. Document the code for the lab order to represent the test type.
b. Reference the registered patient.
c. Reference the patient's encounter.
d. Document the requesting practitioner's details
e. Document the organization who is responsible for carrying out the lab order examination.
f. Document the supporting reason(s) for the lab order.
g. Reference the specimen that is associated with the service request
h. Document additional supporting notes regarding the service request.

8. As a Nurse, I want to be able to cancel an existing lab order:
    a. Document the date when the service request was canceled.
    b. Document additional supporting notes.
    c. Document the reason for canceling the service request.
9. As a Nurse, I want to be able to view all finalized lab orders:
    a. Display the order number
    b. Display the date when the test was requested
    c. Display the test type:
        i. Code
        ii. Display
    d. Display the date when the specimen was collected
    e. Display the date when the service request was concluded
    f. Display the outcome:
        i. **Completed**: An examination result was documented for the lab order.
        ii. **Rejected**: The lab order was rejected by the lab assistant.
        iii. **Canceled**: The nurse canceled the lab order.
    g. Display the test result (if outcome = completed)

10. As a Nurse I want to be able to see a list of all lab orders that are currently in progress.
    a. Display the order number
    b. Display the order date
    c. Display the test type and description
    d. Display requesting practitioner details
    e. Display responsible facility
    f. Display reason for lab order
    g. Display specimen type
    h. Display collection date
    i. Display notes/comments regarding the lab order
11. As a nurse I want to be able to prescribe an ARV regimen.
    a. Reference the registered patient.
    b. Reference the patient's encounter.
    c. Document the ARV regimen code.
    d. Document the therapeutic line code
    e. Document the date when the ARV regimen was prescribed
    f. Document the next appointment date
    g. Document if there was an ARV regimen change and whether the regimen was switched or substituted
    h. Document additional supporting notes regarding the ARV regimen prescription.
12. As a Nurse I want to be able to document the date when a patient refused ARV treatment.
    a. Reference the registered patient.
    b. Reference the patient's encounter.
    c. Document the code representing refusal of treatment
    d. Document the date

e. Document additional supporting notes regarding the patient's refusal for ARV treatment.

13. As a Nurse I want to be able to document the date when a patient was contacted for ARV treatment.
    a. Reference the registered patient.
    b. Reference the patient's encounter.
    c. Document the code representing patient contact
    d. Document the date
    e. Document additional supporting notes regarding the nurse's contact made with the patient.

Laboratory Use Cases

1. As a lab assistant, I want to be able to request new lab orders.
2. As a lab assistant, I want to be able to see the history of all lab orders that I have processed (Rejected or Completed).
3. As a lab assistant, I want to be able to document the specimen details for the VL lab order:
    a. Document the specimen ID for the test type associated with the service request.
    b. Document the type of specimen that was submitted for examination.
    c. Reference the registered patient.
    d. Document the sample collection date.
    e. Document additional supporting notes regarding the specimen.
4. As a lab assistant, I want to be able to finalize the service request:
    a. Document the date when the service request has ended.
    b. Document additional supporting notes.

   c. Document the code that will uniquely identify what the documented findings are for.
   d. Reference a diagnostic report that is associated with the examination result.
5. As a lab assistant, I want to be able to document the diagnostic report details for a VL examination result:
   a. Reference the service request associated with the lab order.
   b. Reference the registered patient.
   c. Reference the patient's encounter.
   d. Reference the performing practitioner.
   e. Reference the observation where the examination result details are documented.
   f. Document any conclusion notes.
6. As a lab assistant, I want to be able to document the examination result for the VL:
   a. Document the code that will be used by the observation to uniquely identify that the observation indicates that a VL exam was performed.
   b. Reference the registered patient.
   c. Reference the patient's encounter.
   d. Document the date when the VL result was made available.
   e. Document the VL result
   f. Document the code that will be used to represent the VL suppression status.
   g. Document additional supporting notes regarding the VL test result.
   h. Document the performer who conducted the examination and submitted the result.
7. As a lab assistant, I want to be able to reject a lab order:
   a. Document the date when the service request has ended.

b. Document additional supporting notes.
c. Document the reason for rejecting the service request.

Requirements

Loading of Participant Developed Bundles

Participants will be able to select their custom developed FHIR® bundle which will be submitted as metadata in the API requests, for the purpose of applying the Validation Process. The relevant participant developed bundle, will be included with the message request as metadata and included in the mediator profile validations. It is each participant's responsibility to select the correct bundle that must be included when submitting data.

Participant Developed Bundles as metadata: The files selected must be streamed with each relevant POST request, for the purpose of using the profiles inside the file (the participant developed bundles) during the Validation Process. The information carried inside these bundles are therefore not part of the actual payload to save to HAPI-FHIR, but part of the process to train participants, therefore these files (process memory) can be discarded after processing.

Lecturer Provided UIs

The UIs must be able to support the following:

- Allow participants to see response data (Success and failed messages)
- Allow participants to browse to the location of their locally published FHIR® IG using command ***./genonce.sh*** and select the appropriate bundle to be JSON.stringify().

- For example: JSON.stringify(/Users/userName/Documents/***fhirIgName***/output/Bundle-EMR.json)
- Use: <input type="file" />
- **Note**: Each UI must be able to allow participants to upload all applicable bundles. (Uploading of Bundles not mandatory)
  - EMR UI:
    - EMR Bundle
    - Lab Order Bundle
    - Lab Cancellation Bundle
  - Lab UI:
    - Lab Result Bundle
    - Lab Cancellation Bundle

- Allow participants to enter a patient's NID and/or MR (deterministic matching) to search for a patient record.
  - **Note**: If there is an identifier specified in both search boxes (NID and MR), then the system must first try to find the patient using the NID and if the NID cannot be found, only then try to find the patient using the specified MR.
- Allow participants to save and update patient records.

UI Validations

The notion is to limit additional development work related to validating user input/actions in the MVP. The lecturers will be responsible for guiding participants to use the applications appropriately.

- EMR & LAB UI:
  - Bundles selected/uploaded:

- Basic validation to be applied on the UI to check for participant developed bundles selected/Uploaded.

Operation	**Participant Developed Bundle Required**
Save Patient Demographic and HIV Information	EMR Bundle
Submit New Lab Orders	Lab Order Bundle
Cancel Lab Order	Lab Cancellation Bundle
Finalize Service Request	Lab Result Bundle
Reject Lab Order	Lab Rejection Bundle

- If the required bundle is not selected per above table, then:
  - Display error message: “Please select/upload the required bundle”
  - Exit

- Field validations: No validations to be implemented on the UI for data to be captured. All validation feedback will be provided back from the OpenHIM, as validation feedback from:
  - Custom Mediator feedback.
  - Base FHIR Spec validation feedback.
  - Participant’s deployed FHIR IG feedback.

Admin UI

The User Interface (UI) for administrator/lecturer configuration must be hosted by each country's fhir-training-on-platform AWS instance.

- Only for use by a lecturer.
- Functionality:
    - Option to enable/disable the custom mediator. This option should be enabled by default but should bypass the custom mediator validation process if not enabled.

Wireframe

The wireframe for this can be found here.

FHIR® IGs

Each country's AWS instance must be able to support the deployed country specific IG. This is the IG that will be created by participants.

The solution FHIR® IG is the proposed solution in which to address the use cases identified by the lecturer. The solution FHIR® IG message bundles will be used by both UIs when submitting transactions to OpenHIM.
The bundles in the solution FHIR® IG must be used as a first pass validation check when messages are submitted to the OpenHIM. See Data Exchange.

Data Exchange

Support

Using the lecturer provided UIs, the participant must be able to:

- Search for a patient using the NID or MR.
- Create new patient records
- Update existing patient records
- Submit lab orders
- Request new lab results
- Request new lab orders
- Result lab orders
- Cancel lab orders
- Reject lab orders

Validation Process

The workflow process can be identified as follows.

Assumptions:

- Participants have deployed their FHIR® IG to their assigned AWS instance.
- The lecturer is responsible for ensuring that the exact same profile IDs are used as defined in the MDS.

Note: The validation process can be bypassed depending on a config setting (Refer to Admin UI).
Note*:* The solution FHIR® IG message bundles must always be used to submit data to the OpenHIM.

1. Participants submit a message bundle to the OpenHIM.
2. When the message bundle arrives at the OpenHIM, it must first be determined if the Validation Process must be applied, by checking the custom mediator config setting:
   If Enabled, then follow **Process Using Validation**

Else

Follow **Process *Not* Using Validation**

Process Using Validation: (Mediator FHIR profile validation enabled)

1. Deliver the message to a custom mediator that is responsible for comparing the solution FHIR® message bundle with the custom FHIR® message IG bundle. The participant FHIR® bundle must be included as metadata in the submitted message, which can be extracted and used in this validation process.
    i. Check for the presence of at least one participant FHIR® bundle.
        1. If zero custom bundles are found then Exit with a response submitted back to the initiating UI.
    ii. The mediator enumerates through the solution FHIR® message bundle(s), one profile (FHIR® resource) at a time.
    iii. The mediator picks the resource.meta.profile ID.
        1. For example, the profile ID is in bold text: http://localhost/fhir/SolutionIgName/StructureDefinition/**profileIdentifier**
    iv. The mediator enumerates through the custom FHIR® IG bundle and searches for http://localhost/fhir/customFhirIG/StructureDefinition/**profileIdentifier**
        1. If the resource.meta.profile ID is found, then the mediator will enumerate through each of the data elements found in http://localhost/fhir/SolutionIgName/StructureDefinition/**profileIdentifier** and see if they exist in http://localhost/fhir/customFhirIG/StructureDefinition/**profileIdentifier**.
        2. If all of the data elements are found in http://localhost/fhir/customFhirIG/StructureDefinition/**profileIdentif**

ier, then the mediator searches for the next resource.meta.profile ID and repeats the above process.

3. The mediator must successfully verify the existence of all solution FHIR® IG profiles as well as their data elements before allowing the message bundle to be submitted to HAPI FHIR®.
4. The message bundle that must be submitted to the HAPI FHIR® server must be the exact same bundle that was submitted from the UI. However, it is essential that the mediator updates the structure definitions for each of the profiles so that it references their custom developed FHIR® IG.
5. For example: http://localhost/fhir/**customFhirIG**/StructureDefinition/profileIdentifier. **customFhirIG** will be the name that was specified during the spin up of the country specific AWS instance.
6. This is very important to ensure that HAPI FHIR® validation takes place against participant developed FHIR IGs.

Note: See Addendum 1 for the list of elements that do not need to be validated.

Process Not Using validation: (Mediator FHIR profile validation *not* enabled)

1. The customer Mediator Validation Process must be *bypassed* and messages forwarded directly to HAPI FHIR via the openHIM.
2. This means that the Solution FHIR IG bundle containing the UI captured data will be validated only against the:
    a. Base FHIR Specification.
    b. Participants developed a custom FHIR IG.

Rationale:

The lecturer needs a way to ensure that false positives are not possible when participants conduct their demonstrations. For example, the lecturer has defined the following as needed (not mandatory) in the MDS for patient registration:

- Contact First Name (Patient.contact.name.given)
- Contact Last Name (Patient.contact.name.family)
- Contact Email (Patient.contact.telecom)
- Contact Phone Number (Patient.contact.telecom)
- Patient Relationship with the Contact (Patient.contact.relationship)

However, these data elements are not mandatory in the HL7 FHIR® specification. If participants created their FHIR® IG with one or more of the above missing, HAPI FHIR® would be perfectly fine with this. This poses a problem for training because the lecturer needs to ensure that participants understand how to create a FHIR® IG profile of data elements as required by the MDS.

The mediator will be vital in this regard by comparing the message bundles between the solution and custom FHIR® IGs before allowing HAPI FHIR® to perform its own data validation.

Response Data

The following responses are essential to the training.

Successful Requests

When participants submit a message bundle to their AWS instance, and the file checker mediator has successfully compared their custom message bundle against the solution message bundle and that HAPI FHIR® has successfully validated and processed the

data, then simply return the following message to the UI that initiated the request: "**Success**".

Failed Requests: Rejected by File Checker Mediator

When participants submit a message bundle to their AWS instance, and the custom file checker mediator has detected the absence of at least one profile ID in the custom FHIR® IG or there is at least one data element missing, then simply return the following message to the UI that initiated the request: "**Your FHIR® IG does not meet the requirements as defined by your lecturer**". The UI must not point out what exactly is missing because the lecturer needs participants to ask questions amongst themselves and learn.

Failed Requests: Rejected by HAPI FHIR®

When participants submit a message bundle to their AWS instance, and the file checker mediator has verified the custom message bundle against the solution message bundle but HAPI FHIR® rejected the bundle, then simply return the HAPI FHIR® error message.

Failed Requests: Network, Processing and Communication Errors

From the point of participants submitting a message request to the OpenHIM, it is possible that there could be some sort of application, system or CDR network issues that can prevent the request from being successfully processed. Should one or more of such issues arise, simply return the error message(s) as they are generated.

Addendums

Addendum 1: Custom Mediator Validator - Excluded Data Elements

The following data elements can be excluded from the aforementioned custom mediator validation process:

1. resourceType
2. id
3. type
4. entry
5. entry.fullUrl
6. entry.resource
7. entry.resource.resourceType
8. entry.resource.id
9. entry.resource.meta
10. Entry.resource.meta.profile (except for the actual ID part after the last “/”, this is needed for validation)
11. entry.resource.text
12. resource.request
13. resource.request.method
14. resource.request.url