

Functional Requirements of the National Health Infrastructure in Haiti

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This document defines the functional requirements for the national health infrastructure in Haiti in support of the migration from iSanté to iSantéPlus and is intended for a technical audience in preparation for software development. The iSanté application is a custom electronic medical record system. In coordination with the Technical Working Group, we are actively working to upgrade the custom iSanté EMR to the OpenMRS platform in the clinic and work toward a national deployment beginning in October 2017. iSanté has been used at more than 130 clinics across Haiti and each clinic pushes to a national consolidated server that acts as a single repository for national patient records, continuity of care, reporting and unique patient identification. The decision was made to upgrade the consolidated server to a national health infrastructure to support open health standards across the country. This national health infrastructure includes a master client index and fingerprinting system that supports unique patient identification, a shared health record that collects clinical encounters and laboratory orders for all patients in the country and a health management information system that supports national data aggregation, information management and reporting.

The national health infrastructure will replace the current iSanté consolidated server and will implement reference technologies based on the work done by the Open Health Information Exchange (OpenHIE) community. Specifically, we aim to follow the structure outlined by OpenHIE and implement health standards-based workflows for the Client Registry, Facility Registry, Health Management Information System, Shared Health Record, and Interoperability Layer. We have identified supplemental requirements and workflows to ensure patient identification through fingerprinting, simplify the burden of national reporting and working in environments with intermittent internet connectivity. We anticipate that this infrastructure investment will provide a robust environment for the national deployment of iSantéPlus and reduce the barriers to adopting standardized health workflows in the future.

Acronyms

AWS - Amazon Web Services
CCD - Continuity of Care Document
CR - Client Registry
EMR - Electronic Medical Record
ETL - Extract Transform Load
FR - Facility Registry
HIE - Health Information Exchange
HMIS - Health Management Information System
IL - Interoperability Layer
ILR - Interlinked Registry
NFPS - National Fingerprint Server
NHI - National Health Infrastructure
OpenHIE - Open Health Information Exchange
OpenMRS - Open Medical Record System
SHR - Shared Health Record

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High Level Functional Requirements

This section defines the functional requirements of the national health infrastructure.

Patient Continuity of Care Across Clinic Sites

The NHI will require that clinic sites utilizing iSantéPlus are able to exchange continuity of care documents (CCDs) that ensure a patient's information is available if they choose to visit another clinic that's using iSantéPlus. This CCD will be made available in a centralized OpenSHR shared health record and all clinics will be required to push information into the Shared Health Record (SHR).

National Reporting

The NHI will maintain a data warehouse that extracts information from different services in the NHI and aggregates reports. This data warehouse is responsible for all national level reporting and must make data available upstream to MESI/DHIS2 and the national surveillance systems HASS and NSSS.

Unique Patient Identification across sites with National Fingerprint Server Integration

Unique patient identification across all clinic sites is critical for serving clients with updated health information and national level reporting. We must maintain a client registry (CR) that allows us to uniquely identify patients across the HIE and connect to the Ministry of Health's (MSPP) national fingerprint server that collects and stores fingerprints from clinic sites across the country.

Integration of Lab Orders and Results at the Clinic and National Levels

Specific critical diagnostic tests can only be obtained from the national laboratory or from regional laboratories in Cap Haitien and Les Cayes. The NHI will ensure the movement of laboratory orders from the clinic to the national laboratory using standard information exchange methods. Once processed, the national laboratory will deliver digital results to the clinic where the order originated.

Working with intermittent internet connectivity

The operational environment in Haiti includes intermittent internet connectivity. We need to ensure that the architecture is able to function when the internet goes out by building in the components to queue messages and retry sending them when the internet connection is down and when the transfer is incomplete.

Offsite Backup

The clinic sites perform local backups to USB sticks, but this system has not proven robust. The national architecture must make a system available to receive backups of each site so they can be restored in case of natural disaster or data corruption. Additionally, the offsite backup must support backup of components in the health information exchange.

Ensuring Availability of Services

The National Health Infrastructure must utilize best practices to ensure uptime including, system redundancy, load balancing, and monitoring of all systems and services at the national level. These systems all aim to ensure the system is operational nearly 99+% of the time to reduce the occurrence of failures.

Security

The NHI must conform to security best practices in all IT systems including the storage, transportation and utilization of the systems. Security certificates, encryption and backup must be managed with the highest protection of patient information in mind.

Assumptions

This document makes the following assumptions:

- We aim to utilize existing systems and workflows to the greatest extent possible in an effort to reduce the burden of development and implementation.
- We must deliver systems that account for both intermittent and continuous internet connectivity. This assumption has an impact on the design decisions to create queueing mechanisms at multiple levels of the architecture.
- We will not be using a terminology service at this time. A terminology service is a centralized repository that stores and hosts up to date terminologies so that all consumers can use standard terminologies across all clinics. At this time, we have complete control of the terminologies within the NHI and clinics and do not require a terminology service because we will manually maintain this at the national and clinic levels. iSantéPlus currently uses OpenConceptLab terminologies. At some point in the future, an OCL server to host terminologies within the NHI could be added.
- Individual patient records will not be available in the HMIS. The HMIS is responsible for aggregate reporting and integration with MESI/DHIS2.

Architecture Overview

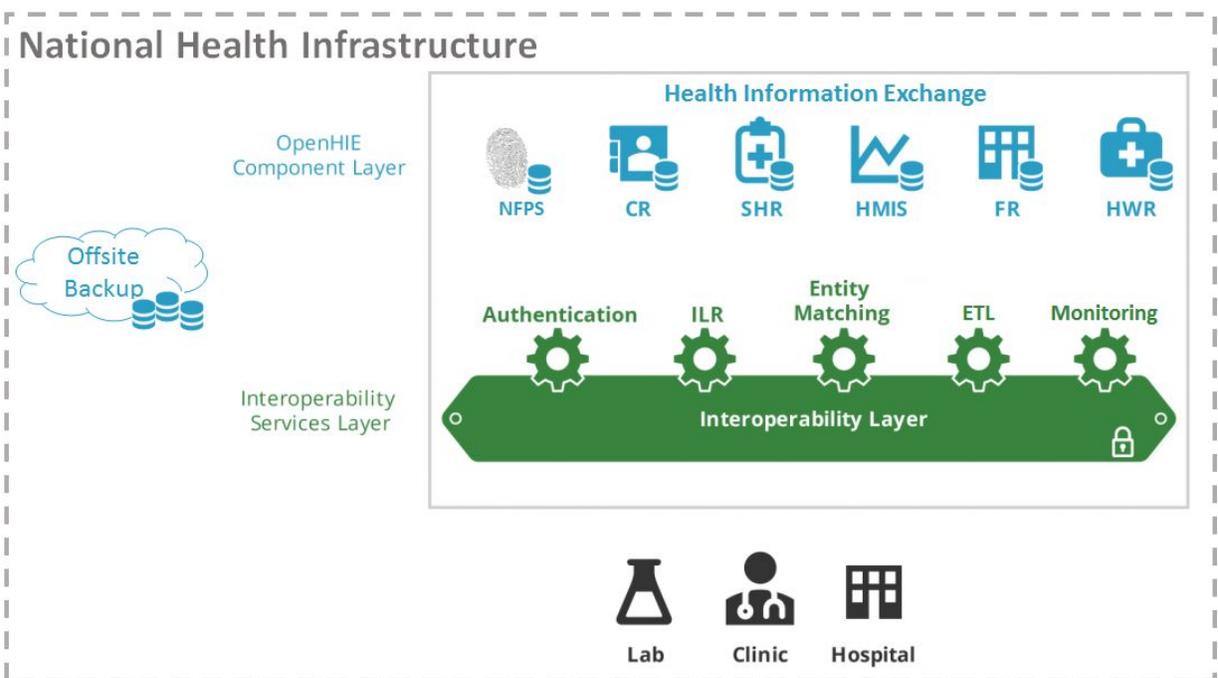
The National Health Infrastructure is a network of patients, providers, clinics, labs and information systems that help deliver care across Haiti. The NHI includes numerous technical components: the Clinic, Offsite Backup and the Health Information Exchange (HIE). The systems in the clinics support the point of service workflows for frontline patient care. Clinics are built to be independent, to be able to complete their functions regardless of internet connectivity. The clinics are enhanced when internet connectivity is available by providing a strong offsite backup that can enable full restoration in the event of a failure. Additionally, the clinics are able to interact with the HIE, which provides an environment for centralizing and exchanging information across all clinics and hospitals participating in the HIE.

This architectural overview aims to build on the work accomplished by the [OpenHIE community](#) by applying the workflows and information systems to the Haitian context. The core objective of this architecture is to establish the systems and services in an open source way that utilizes standardized health information exchange. This architecture represents the minimum viable product to replace the existing features of the consolidated server.

Core Components of the NHI (Clinic, Offsite Backup and HIE)

At this time, we have identified appropriate technology for a subset of the core components and will further refine the technologies involved with an appropriate vendor with HIE experience. There is a need for specialization across the NHI and we have architected the solution to provide robust registries and services to achieve the required functions. The core components of the National Health Infrastructure include the point of service clinics, hospitals and laboratories, the offsite backup system that stores information in case of failure and the Health Information Exchange which centralizes health information across Haiti.

The following graphic displays these concepts with detail in the Health Information Exchange. As you can see below, the point of service (lab, clinic and hospital) connects to the Health Information Exchange and the Offsite Backup. The Health Information Exchange contains a number of components that are defined in the Health Information Exchange Functional Architecture section below. The subsequent sections describe the functions and systems at the clinic, offsite backup and Health Information Exchange.



Clinic/Hospital Site

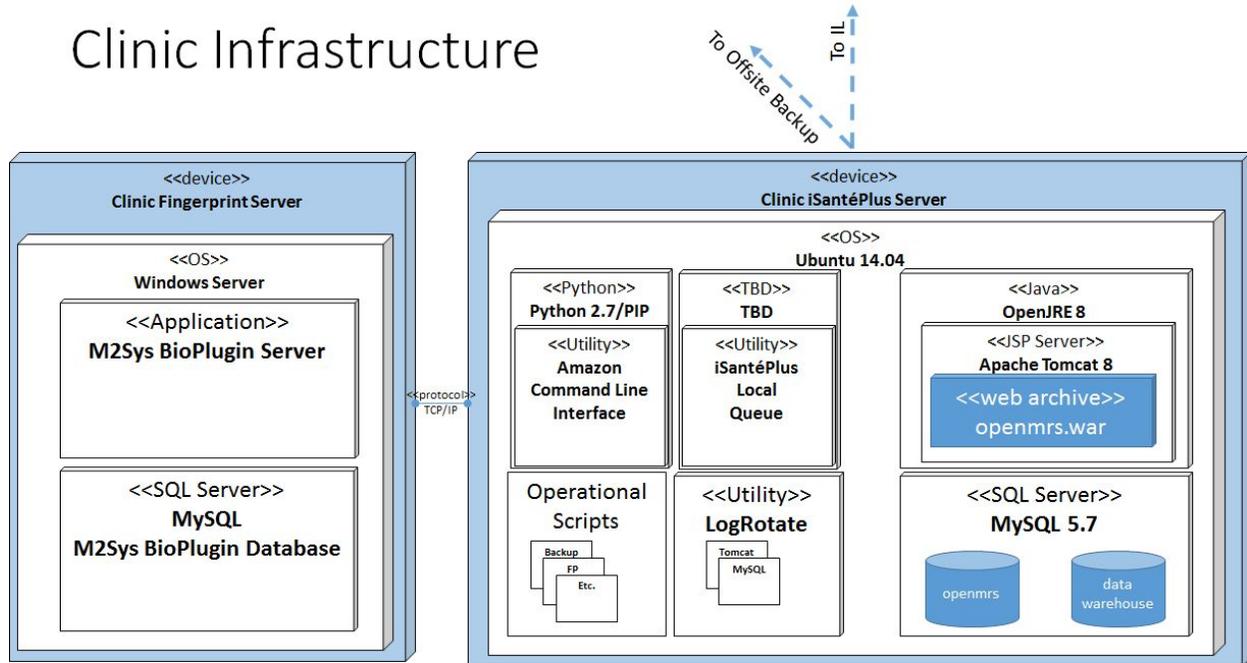
iSantéPlus is the core electronic medical record system deployed at clinics and hospitals across Haiti. The I-TECH team is actively developing the iSantéPlus application in the clinic, which is built using the latest version of the OpenMRS reference application v.2.5. The clinic also has a local fingerprint server. The development of the iSantéPlus is progressing with interoperability in mind. The NHI accounts for this clinic application, but also includes interoperability with the offsite backup and HIE.

iSantéPlus is built on top of the OpenMRS Reference Application v. 2.5 with a custom module that standardizes the user interface, forms and terminologies. This package is actively under development and will be deployed nationwide at over 85 active clinic sites. iSantéPlus integrates with the national fingerprint server provided by M2Sys. Below is a list of functions that are planned to be available for the iSantéPlus release:

- Custom registration app for the Haitian context
- Integration with the national fingerprint server and local fingerprint server where required
- Capture data in standard forms based on the iSanté system
- Local reporting using an ETL process
- Integration with the HIE
- Backups to a local USB thumb drive and offsite backup

Below is a detailed diagram of the clinic server infrastructure for clinics that work primarily offline. The standard offline clinic deployment includes two servers, one for the M2Sys fingerprint system running Windows and one for the iSantéPlus system running Ubuntu. Clinics who have near constant internet connectivity do not require a local fingerprint server. Standard technologies are installed to operate OpenMRS with local ETL, logrotate and other operational scripts. Additionally, the Amazon Command Line Utility is installed to provide a link to the offsite backup. The iSantéPlus Local Queue has been added to this diagram, but the technology has not been chosen. An evaluation needs to be performed to identify if the requirements for the local queue can be handled within iSantéPlus/OpenMRS or if it requires a third party service with integration.

Clinic Infrastructure



The workflows section describes a list of core workflows that support the offsite backup interaction with the interoperability layer. The core integration with the offsite backup utilizes the AWS command line interface to provide a full offsite backup for all clinics. The core integration for iSantéPlus and the iSantéPlus Local Queue is an exchange with the HIE's interoperability layer.

Description of the iSantéPlus Local Queue

The iSantéPlus local queue is the mechanism in the clinic that supports working with intermittent internet connectivity. The idea is to queue all interactions between the local clinic when the internet is down and process the queue when the internet is available. This allows the clinic to fully function when the clinic is offline for short and extended periods of time. This queue is responsible for transporting all data from the clinic to the interoperability layer. The queue supports the workflows defined in subsequent sections.

Core features of the iSantéPlus local queue:

- Support the workflows defined in the Workflows section
- Interact with the interoperability layer when the internet is available
- Support ordering of queued items by patient identifier
- Provide visibility into the status of queued items and failures so system administrators can respond

Offsite Backup

The offsite backup allows clinics to perform a full backup to the cloud to ensure the system is available in the event of total failure at the clinic. It also provides a backup mechanism for the Health Information Exchange. The backup process happens on a regular schedule with a minimal amount of interruption to the system that is being backed up. The offsite backup is kept an independent service with independent access controls to ensure it doesn't have dependence on any of the other services within the NHI. Each clinic, HIE registry and service interacts with the offsite backup on a regular schedule. The technical maintainers of the NHI will be responsible for managing the backup and restoration process.

Health Information Exchange Functional Architecture

The Health Information Exchange is the primary component at the national level. It contains numerous systems that allow clinics to store and exchange information. Each piece of the HIE infrastructure provides a specific set of data elements and workflows that, when combined, create a centralized national infrastructure that achieves the functional requirements. Below is a description of the systems planned for the HIE. A number of these descriptions were paraphrased from the [OpenHIE Planning and Implementation Guides](#).

HIE Component Layer

- **National Fingerprint Server (NFPS):** The national fingerprint server stores all fingerprints in a centralized location. Each fingerprint collected anywhere in the country is pushed to the national fingerprint server, it receives a unique identifier and is able to be linked to a client record.
- **Client Registry (CR):** The Client Registry maintains a central registry of all patients and their demographic information. The registry assigns a unique identifier to each patient, links multiple registrations to a single identifier and enables healthcare workers to identify the facilities where a patient has received care.
- **Shared Health Record (SHR):** The Shared Health Record facilitates the sharing of clinical information between clinics. It stores all encounters collected across the health system in a single normalized location. The SHR will be utilized as the foundation for national reports in a de-identified way. Additionally, the SHR is able to generate continuity of care documents on demand that provide a succinct patient summary of the most up to date information on a given patient from all clinics. The CCD is reviewed by a provider when a patient transfers from one clinic to another to inform their first clinic interaction.
- **Health Management Information System (HMIS):** The Health Management Information System is a centralized reporting repository of aggregate and de-identified data that supports the national reporting needs. Regular reports are generated in each of the registries and pushed to the HMIS. It can also receive aggregated data directly from clinics.

- **Facility Registry (FR):** The Facility Registry is a central authority to collect, store and distribute an up to date and standardized set of facility data.
- **Health Worker Registry (HWR):** The Health Worker registry is a central authority for all health workers in Haiti. Every doctor, nurse and provider will be saved in the HWR to verify that all encounters are linked to a provider in the registry.

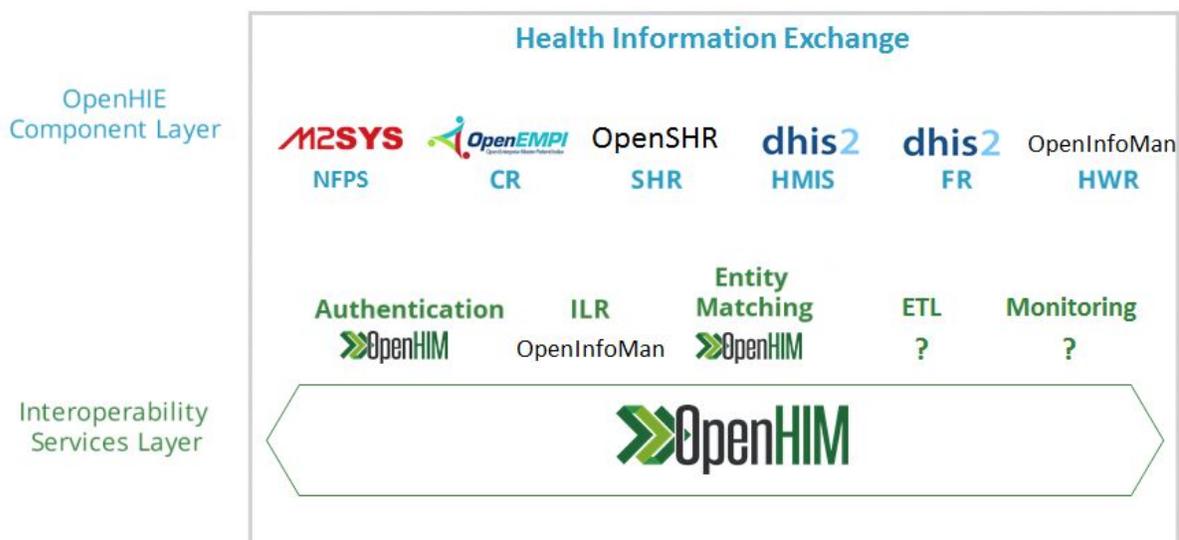
HIE Interoperability Services Layer

- **Interoperability Layer (IL):** The Interoperability Layer acts as a middleware layer that provides a single interface for the clinic systems. It also mediates the interactions between each registry system. For example, a single message will arrive from the iSantéPlus Local Queue that needs validation and enhancement by the CR, FR and HWR before it gets pushed to the SHR. All point of service access to the HIE is restricted by the IL.
- **Authentication:** The interoperability layer provides authentication and auditing as a service. It maintains a list of users/clinics who should have access to the HIE and tracks their interactions with the HIE. This authentication ensures that the HIE is a closed environment that's only accessible through the IL.
- **Interlinked Registry (ILR):** The Interlinked Registry interacts with infrastructure systems on a regular schedule, maps fields across registries and stores the information so it's available to the interoperability layer. The primary data points kept in the ILR are organizations, facilities and providers.
- **Entity Matching:** The entity matching service allows iSantéPlus clinics to send bulk requests to the HIE to be matched. This service receives a list from the clinic, matches or processes each row in the list and returns a result to the clinic. This is useful for tracking a specific set of patients, orders or encounters.
- **Extract Transform Load (ETL):** The ETL service interacts with numerous registries to support the movement of de-identified data for reporting purposes. ETL is a process where data is extracted from a registry, transformed into the appropriate data model and loaded into the reporting system (HMIS). We have chosen an ETL tool to perform this task to reduce the burden on the registries to generate reports natively.
- **Monitoring:** The monitoring service is used to monitor all activities within the HIE with alerts to a support team when there are failures in the system. Standard monitoring tools are used to ensure databases are active, web servers are serving pages appropriately and failures are immediately addressed.

HIE Software Systems

We have chosen to base this implementation on the reference applications developed by the OpenHIE community allowing us to adopt the existing field tested systems that are deployed globally instead of developing the HIE ourselves. We aim to utilize software systems that are available for each of the core components and workflows, with software development occurring only where needed. This section provides an overview of the systems planned for the NHI, defining their role within the HIE and a brief introduction to integrations.

The following graphic displays the chosen systems applied to the HIE graphic. Following the graphic is a table that matches the software systems with the function as outlined in the previous section.



List of Software Systems and their HIE function

Software System	HIE Function
OpenEMPI	Client Registry
OpenSHR	Shared Health Record
DHIS2	Facility Registry Health Management Information System
OpenInfoMan	Health Worker Registry Interlinked Registry
OpenHIM	Interoperability Layer Authentication Entity Matching
M2Sys	National Fingerprint System
TBD	ETL Monitoring

Note: We will retain the NFPS provided by M2Sys and recognize that software development will need to occur to interact with this system. We haven't chosen an ETL process or a monitoring system, but aim to make that decision in the coming months.

HIE Component Layer

National Fingerprint Server: Proprietary M2Sys system

The national fingerprint server has been deployed for a number of years and will remain the proprietary M2Sys system. The National Fingerprint Server retains a repository of fingerprints that have been collected throughout the country and assigns each fingerprint an identifier. Fingerprints will continue to push to the national fingerprint server from the clinics as they are collected. The server will also integrate with the client registry to be able to cross reference the national unique identifier with the fingerprint identifier to support the movement of client records to support the continuity of care.

Client Registry: OpenEMPI

OpenEMPI is an open source enterprise master patient index, which is the current reference application for the OpenHIE client registry. OpenEMPI retains a list of all patients and demographic information that's collected on them. OpenEMPI will assign a unique identifier for every patient in the NHI with integrations to the National Fingerprint Server, Shared Health Records and Interlinked Registry.

Shared Health Record: OpenSHR

OpenSHR will be utilized as the Shared Health Record. The Shared Health record will store all patient encounters in a document repository. The SHR will also contain the forms and terminologies that are deployed in the clinic with an ETL process to support national reporting on individual users and the export of that to the HMIS. The SHR will integrate with the clinic through the IL, the HMIS for aggregate data reporting, the CR for unique patient identification and the ILR for facility/provider mapping.

Health Management Information System and Facility Registry: DHIS2

DHIS2 will be utilized as the health management information and facility registry. DHIS2 is the core HMIS deployed globally numerous OpenHIE implementations, including the DATIM node that is currently available. The HMIS will contain aggregate and de-identified data for national level reporting. Additionally, the HMIS will be responsible for reporting up to MESI. The HMIS will integrate with the SHR, CR and ILR.

As a Facility Registry, DHIS2 will maintain an org structure and facility list, which has been proven as an FR in field deployments of OpenHIE. This curated list will interact with the ILR and will serve as the primary facility registry for all systems.

Health Worker Registry: OpenInfoMan

OpenInfoMan is the reference implementation of the Health Worker Registry. OpenInfoMan stores organization, facility and provider information in the CSD standard, which is accessible

for identifying providers within the clinics. The HWR is a set of modules loaded into OpenInfoMan that allow it to act as the registry. OpenInfoMan will also be utilized as the ILR service.

HIE Interoperability Services Layer

Interoperability Layer, Authentication and Entity Matching: OpenHIM

OpenHIM is the core interoperability layer for the OpenHIE platform which provides a single interface for accessing the HIE. OpenHIM is a modular system that manages the connection between iSantéPlus at the clinic and the registries, including authentication. OpenHIM provides an audit log of all transactions in the system as well as the ability to do entity matching. The interoperability layer integrates with all registries in the NHI and the ILR.

Interlinked Registry: OpenInfoMan

OpenInfoMan is the chosen interlinked registry for the OpenHIE platform. It acts as a broker for all providers, facilities, organizations and services provided across the nation. It regularly interacts with all infrastructure systems and integrates as a service with the interoperability layer to provide responsive information without burdening the registries.

ETL: TBD

The ETL tool is yet to be determined, but must be able to extract information from the CR and SHR to move de-identified data to the HMIS. There are a number of open source tools that can accomplish this task, but it's premature to identify the appropriate tool at this time.

Monitoring: TBD

The HIE monitoring service is yet to be determined. This service must connect to all registries with the appropriate credentials and automatically alert operational support personnel when there are failures within the HIE. There are a number of open source tools that can accomplish this task, but it's premature to identify the appropriate tool at this time.

Offsite Backup Software System

The offsite backup will utilize Amazon Web Services Simple Storage Service (S3). The offsite backup will run in the local clinic and push the backup to the cloud using a local tool called the AWS Command Line Interface (CLI). The offsite backup is an independent service that ensures data continuity in the event of a critical failure at any clinic. It is not mediated by the interoperability layer to keep it independent with access controls managed by the AWS platform.

Workflows Introduction

Workflows are complicated by the complexity involved in synchronising the local sites (Clinic, Hospital or Lab) with the HIE. Intermittent internet connectivity requires that our workflows

account for clinics that have no internet, clinics that have intermittent internet and clinics that have internet nearly completely. We must accommodate these three cases:

- Internet is available for interactive response
- Internet is available but unresponsive
- Internet is unavailable

Workflows need to be structured based upon the above assumptions, with emphasis on allowing local work to continue uninterrupted by internet availability. In our experience, intermittent internet connectivity can be managed by queuing messages between the clinic and HIE with automatic retry on a set schedule.

Clinic Site to HIE Workflows

This section defines the core functional workflows from a clinical perspective. Each workflow either sends information from the clinic to the HIE or returns information from the HIE to the clinic. Workflows that will be defined in detail as we move through the process of developing both the clinic and HIE systems are summarized below. It should be noted that clinic represents clinics, hospitals and other point of service locations that interact with the HIE.

Offsite Backup and Restore for the Clinic

The goal of the offsite backup and restore is to provide a second line of redundancy in the event the primary local backup fails. iSanté currently has the capability to restore a local server from the consolidated server. The National Health Infrastructure will retain this feature through offsite backup of daily transactions. The offsite backup will export the transactions from the OpenMRS database, the fingerprint database, log files and configuration files on a regular schedule (daily and weekly). These exports will be uploaded the cloud for long term storage, retrieval and restoration in the event of major failure at the clinic.

List of workflows for offsite backup and restore:

- Create the backup package on the local server
- Storing and validating the backup on the USB drive
- Transportation and verification from clinic to cloud backup platform
- Create/update user in cloud backup platform
- Create/update clinic in cloud backup platform
- Restore from USB/cloud backup platform using daily backup
- Restore from USB/cloud backup platform using weekly backup
- Monitoring the offsite backup system with alerts when thresholds are reached

Patient Check-in/Registration (NPFS and CR)

These workflows identify the processes for patient interaction at check-in at the clinic's registration desk. The diagrams display how a patient interacts with a registration clerk who interacts with the NHI. OpenHIE Workflow Source: [Create Patient Demographic Record Workflow 1.0](#) OpenHIE Workflow Source: [Update Patient Demographic Record Workflow 1.0](#)

List of workflows for patient check-in:

- Fetch patient ID from HIE via fingerprint swipe
- Fetch patient ID from HIE via demographic search
- Fetch patient registry information from HIE via patient ID
- Send patient fingerprint scans to HIE
- Update patient registration information in the HIE

Encounter in iSantéPlus to Shared Health Record (SHR)

Workflow

iSantéPlus is an encounter-based system. Each encounter is a distinct transaction within the system, which will be sent from each iSantéPlus clinic to the Shared Health Record. Encounters include intake and follow-up forms, adherence tracking, drug orders and diagnoses. Fortunately, each of these encounters use the same workflow - all encounters in all clinics will be sent to the SHR. OpenHIE Workflow Source: [Save Patient Level Clinical Data Workflow 2.0](#)

List of workflows for iSantéPlus encounters:

- Generic encounter workflow
- Send lab order to national lab/SHR
- Query lab results from national lab/SHR

Request Continuity of Care Document (via SHR)

When a patient signals that they have previously visited a different clinic, a continuity of care document (CCD) can be requested. The CCD follows the HL7 CDA R2 CCD template, and implements it using the FHIR standard. We choose to implement the FHIR standard because it is natively supported in OpenMRS and iSantéPlus. The CCD template contains a succinct patient summary that providers can use to inform the intake of new patients with prior history. The CCD will be generated on demand from the SHR, downloaded to the iSantéPlus system at the clinic and made available for review by the provider. The provider will use this document to learn about the patient and so they can populate fields in their local version of iSantéPlus. (Note: This document will not automatically import anything into the local patient record. It is meant to inform the provider so they can review the information with a patient and work through the forms in iSantéPlus as they would for a new patient.) OpenHIE Workflow Source: None, this is a new workflow.

Continuity of care document workflow: Request continuity of care document from Shared Health Record

Provider Registration in Health Worker Registry

New provider registrations in iSantéPlus need to be pushed to the Health Worker Registry in the HIE to ensure that all patient records are appropriately matched to a provider. This workflow focuses on adding providers to the HWR from the clinic. OpenHIE Workflow Source: None, this is a new workflow.

Provider Registration Workflow: Create/Update provider in HWR

National Lab Workflows

The national lab is responsible for handling lab orders for viral load samples and other tests that are done centrally. Clinics send lab orders marked for the national lab to the SHR and retrieve results from the SHR provided by the national lab as discussed in the SHR workflow section above. The national lab uses the SHR to discover orders and supply results.

List of workflows in the national lab:

- Retrieve lab orders from the SHR
- Get Patient information from the CR
- Send lab results to the SHR

Internal HIE Workflows

The Health Information Exchange requires regular management and maintenance to ensure data is appropriately moved between the components. This includes regularly syncing information between the registries and the ILR, running an ETL process from the registries to the HMIS and queries from MESI to the HMIS.

List of HIE workflows:

- Synchronize the Interlinked Registry (ILR) with the Facility Registry (FR).
(OpenHIE Workflow Source: [Query health worker and/or facility records workflow - V1.0](#))
- Run ETL scripts to populate the HMIS
The ETL process is a critical step for ensuring data quality and reporting within and across the HIE. The HMIS is the single location for reporting across the HIE that will contain de-identified patient data as well as reports that compare the quality of data across registries.
- Send HMIS data stream(s) to MESI
The iSanté consolidated server currently reports to MESI (Monitoring, Evaluation, and Surveillance Interface), which is a DHIS2 server managed by a third party. At this time, we recognize the need to push aggregate data from the HMIS to the MESI system, but are not able to identify the specific reporting requirements. This will have to be developed at a later time.
- National Reporting from the HMIS
The HMIS is the primary repository for reporting at the national level. All patient data from clinics is de-identified and represented in the HMIS. Additionally, the HMIS is responsible for internal reporting within the HIE. The majority of reports will be developed based on the national reports that are currently in the consolidated server. Additionally, the HMIS will need to create reports and push them to MESI. All of these items need to be scoped in detail as part of the software requirement specification as we develop the NHI.

- HIE System Monitoring Service

HIE system monitoring includes monitoring the status of all underlying technology: SQL servers, MongoDB, Tomcat, NodeJS, APIs, etc. Alerts for queued messages when they reach a predetermined threshold will be implemented. Tracking for most recent clinic sync, so IP addresses can be kept up to date.

- HIE to Offsite Backup

Each HIE system will be able to backup all data to the offsite backup to ensure continuity of information in the event of failures. This workflow defines the backup process of each component and how it interacts with the offsite backup system.