



Suggested architecture for integration of diabetes POGD to FHIR-IL

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IMNA Solutions

Overview

This document details the architecture IMNA will put in place to connect its platform containing the Patient Generated Outcome from Rambam Medical Center with FHIR-IL systems using the FHIR standard for exchanging the information.

Audience

This document include technical information within the scope of the integration of FHIR-IL phase 2 project

Motivation

IMNA is participating in the introduction of the FHIR standard in Israel to facilitate the exchange of information between systems by adapting the FHIR common language. For the specific scenario of Diabetes data collection, IMNA is storing the gathered information using its platform and will expose FHIR compliant interfaces to Prometheus system.

Resources Specifications

- Patient
- Address
- Practitioner
- Practitioner-role
- Location
- Organization
- Observation
- Condition
- DiagnosticReport
- ValueSet
- MedicationRequest
- MedicationStatement
- MedicationAdministration
- Questionnaire
- QuestionnaireResponse
- ServiceRequest

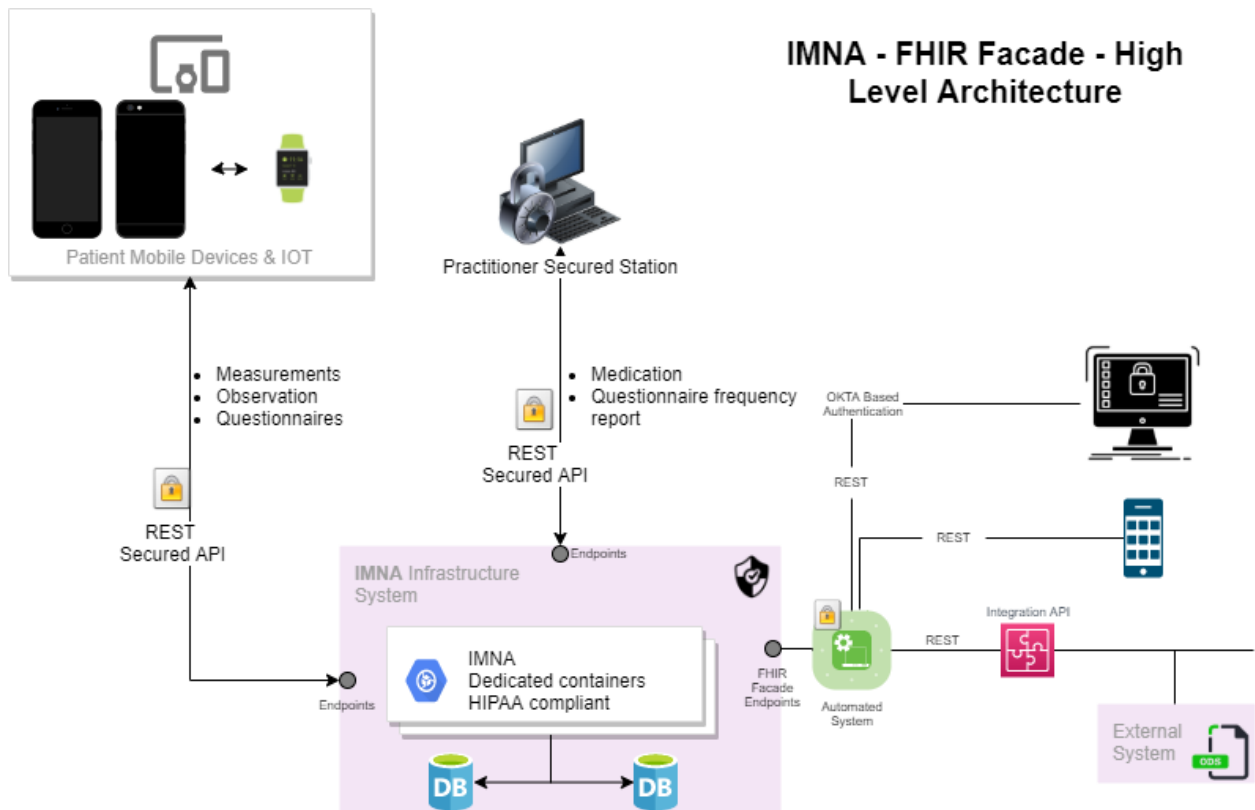
Architecture

I. Architecture design considerations

- A. What is your architectural approach (FHIR server, Façade, Asynchronous messaging, Hybrid)?

Facade : This approach will allow us to immediately use the capabilities of the IMNA platform and mobile applications. The microservice layer of the platform will be extended to expose the functionality to servicing FHIR.

1. Provide architecture diagrams including source, target and intermediary systems, application and storage components, security components. Indicate cloud/on-prem separation, if applicable. Indicate vendors and platform names. If custom development is required, indicate runtime platform/programming language.



Data query from internal systems is exposed via Secured WEB Services endpoints. The endpoints are working with certificate exchange between the system to allow SSO (oAuth, OKTA...) The Facade endpoints are accessing the relevant documents in the IMNA platform and manipulate the information to JSON format compatible with FHIR.

2. Provide data flow diagrams for common scenarios.(attach a number beside each call in the sequence)

Refer to paragraph 2 for more information

- B. What is the total dataset size that you will be exposing via FHIR? Is this data originating from/should be copied to other organizational systems?
FHIR Facade built on IMNA will be exposing relatively small information in JSON format, related to patient condition. IMNA will be providing screen access to embed the visualization of the information to the practitioners/providers without the need to duplicate the information with other organizations systems. However, if the need of other organizational systems is to retrieve the information, the endpoints will return JSON FHIR compliant values.
- C. If the data must be synchronized with other organizational systems - what is the acceptable synchronization delay?
In case synchronization of the data is required, specific API will be set to allow near real time notifications between the system and inform the external system of data availability for subscribed patients/condition
Refer to paragraph 2 for more information
- D. What is the size of a single record (in a business sense - might include several FHIR resources) that will be transferred? What's the number of records to be transferred per day/during peak load?
Estimated Size Record would be less than 50KB, the information exchanged is text only - Some efficient methods of compression might be used to improve latency and data size.
The amount of records to be transferred is dependent on the amount of patients engaged by the clinic - Assuming one report per day/patient, the calculation is derived directly.

- E. Will the FHIR interface be exposed to multiple consumers? What is the expected number of consumers? What is the expected amount of concurrent requests during peak load?

The FHIR interface is only exposed to the Prometheus system for the purpose of gathering extra-clinic data to the providers/clinic of Rambam hospital.

- F. What infrastructure/platform will be used for FHIR server/façade/messaging? Provide vendor and system names. Is it already present in your organization or will be acquired/installed for the project? Does it natively support FHIR in client and/or server modes (i.e. FHIR client and/or FHIR server/facade is built into the platform) or it will require additional extensions/modules/custom development?

Custom Development is required for the implementation of the facade; IMNA will run it over custom containers in usage today for the platform. The current nodes are not supporting FHIR repository format however the information and knowledge in the platform are stored according to HL7/SNOMED/Loinc/ICDx/etc and can easily be manipulated to answer FHIR.

- G. Where applicable - how scalability/availability/redundancy will be addressed?

IMNA Platform is built for security, scalability, high availability and redundancy (including auto scaling and geographical replication of information); it is also certified for HIPAA usage. The facade will run over the existing infrastructure and benefit all.

- H. If FHIR façade/Server will be used - where and how data will be stored?

Un-Personified Data will be stored as part of the IMNA Databases (Document DB).

- I. Where will the components of the solution be located (on-prem/cloud/hybrid)? If on a cloud, please describe which provider,

All the information is stored over cloud infrastructures hosted in AWS.

- J. How will the FHIR interface be monitored for quality & availability?

Cloud monitor functions and metrics that are already in place for while IMNA will apply to the FHIR interface. Availability is checked with

microservice healthcheck, query round trip time is measured to ensure service grade.

- K. How the interface will be secured (VPN, static IPs, TLS & certificates, etc.)? Will specialized security platforms/gateways be used for online/asynchronous schema validation? If yes, do they natively support FHIR?

Several mechanisms can be used for securing the interface; IMNA is making usage of the following technologies on its existing platform:

- **oAuth**
- **OKTA IDP/Certificate**
- **RSA/AES exchange**
- **Secure Certificates on each end point**
- **Site to Site VPN for specific organizations**

The preferred approach will be finalized at the integration phase.

- L. For message based asynchronous communication - how data will be packaged (e.g. resources as individual files, FHIR bundle, custom envelope format - e.g. JSON array, bulk FHIR, etc.). Will space optimization (e.g. compression, BSON) be used? Is the selected infrastructure/platform compatible with the chosen format out of the box or additional customizations will be required?

N/A

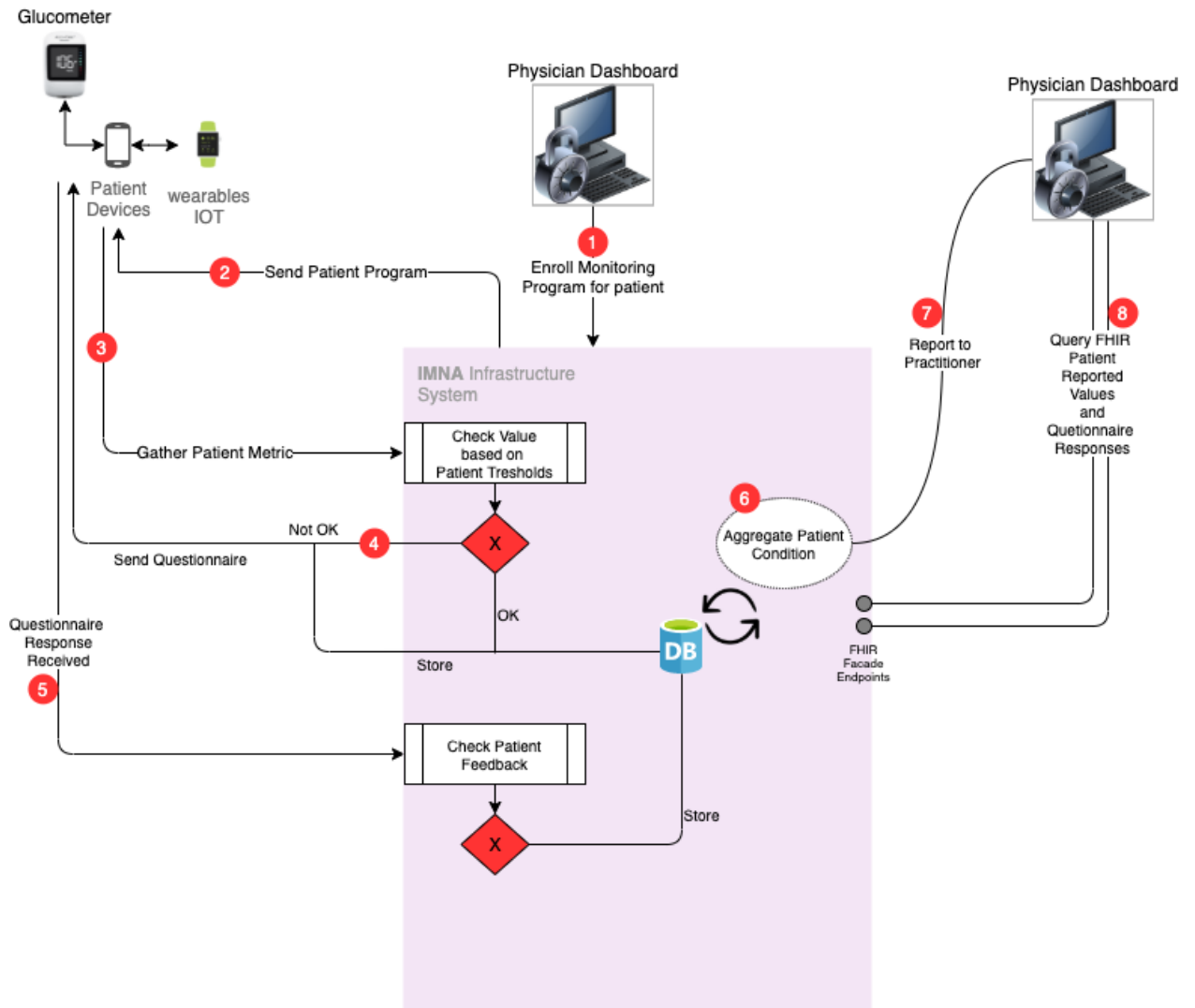
- M. Will FHIR resources conformance validation be performed and if yes - how it'll be done (online/ batch, what tools/infrastructure will be used)?

FHIR resource conformance would be performed to ensure data validation and integrity. IMNA has not yet chosen the final tool and is also considering the development of specific scripts to achieve the above.

- N. Will codesystems validation be performed and if yes - how it'll be done (online/ batch, what tools/infrastructure will be used)?

The codesystems in place are HL7/SNOMED/ICD/LOINC/HM.... The mapping between the various codesystems is done via IMNA mapping tables.

II. Architecture



1. **Starting point: Physician enrolls a monitoring program for a patient using the IMNA dashboard.**
 All inputs of patient data from the physician, including observations, medications, diagnoses and other medical interventions are sent through the IMNA physician dashboard, then gathered and stored using the IMNA infrastructure system.

2. **All inputs of patient data from the patient himself including programs (goals, self-administered medication reported, etc) are sent through the IMNA ListenCare patient-centric health tracker app, gathered, and their validity is evaluated based**

on patient threshold.

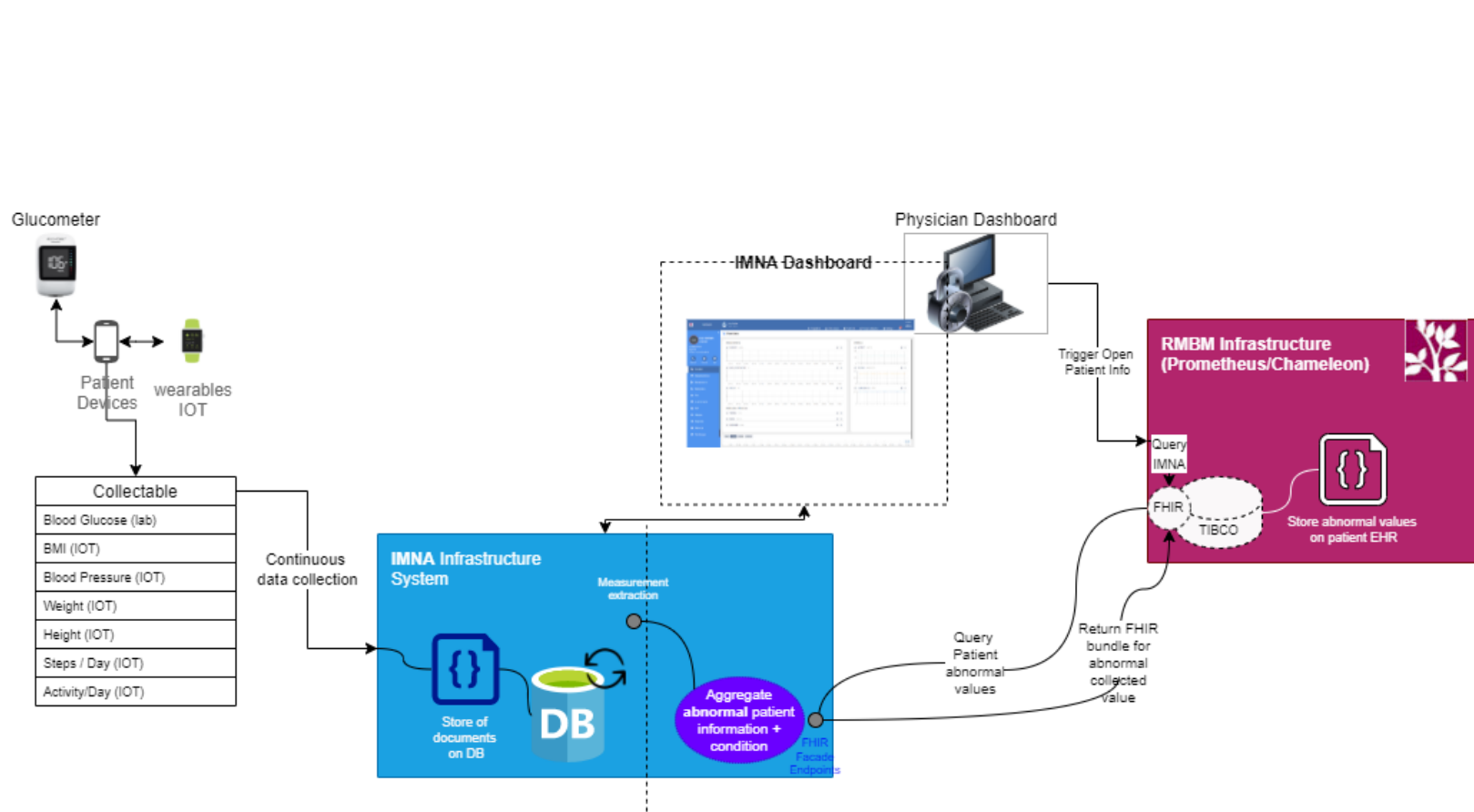
3. All inputs of patient data containing various metrics (self reported measurements, vital signs, etc) are sent through the IMNA ListenCare patient-centric health tracker app, gathered, and their validity is evaluated based on patient threshold. Valid data is then gathered and stored using the IMNA infrastructure system. Invalid data is re-evaluated by sending additional questionnaires back to the patient app.
4. The re-evaluation questionnaires mentioned in step 2, are filled and reported to IMNA by the patient using the IMNA ListenCare app. The metrics gathered in step 3 are then re-evaluated along with the questionnaires. Steps 3 and 4 are an iterative process. The end of this process is finished when data is valid.
5. After receiving specific questionnaires as part of the patient monitoring program, the patient responses are then sent back to IMNA, and then being evaluated prior to storing in IMNA's databases.
6. The patient data is gathered and stored in IMNA databases.
7. The aggregated patient data is then reported back to the physician or the medical practitioner.
8. Using the Façade architectural approach, the patient data stored in the IMNA platform is then accessed using the Façade endpoints, manipulated to a JSON format for FHIR compatibility, and then queried.

III. Implementation over Rambam

IMNA is implementing together with Rambam a flow for exchanging extra clinical information gathered by different IoT for patients; The purpose would be to amend the abnormal information gathered integrally into the prometheus patient record system for the provider's awareness.

IMNA is already present in the diabetes clinic and already has integration points with Prometheus, however the usage of information exchanged via FHIR is now done via dedicated endpoints and API agreed with Rambam.

Below is the high level architecture and flow diagram for the implementation



Explanation of the system architecture

1- Collection process for observables

Via IoT connected to the patient (through IMNA application), the IMNA platform is gathering information on the below observations:

Blood Glucose (lab)
BMI (IOT)
Blood Pressure (IOT)
Weight (IOT)
Height (IOT)
Steps / Day (IOT)
Activity/Day (IOT)

These information are gathered at periodic intervals and stocked into the IMNA databases, each gathered information having specific treatment according to the normal threshold defined for each observable. For example an abnormal Blood Pressure might be triggering the requirement for further collection of Blood Glucose.

2- Exposure of Endpoint for querying FHIR abnormal observations

Further to the process of gathering the information above and treating the abnormal values, IMNA has created an endpoint for querying the information per patient and per period. The endpoint is allowing the retrieval of abnormal observables for specific patients in FHIR bundle format; this information is treated on Prometheus and amended to the patient EHR. As HIPAA compliance is requested the storage of the information is not personified into the IMNA system, the FHIR facade exposing the endpoint is gathering information for several sub-system to comply with the regulatory requirements and produce FHIR compliant documents.

Security considerations:

- In order to avoid bureaucracy of IT in order to open the access for constant pushing of the information to Prometheus, it was agreed to have an endpoint in IMNA triggered when the patient EHR would be accessed by the physician/provider.
- IMNA API is secured with tokens generated periodically
- IMNA API is compliant to the highest standard of security and implements https encryption for exchanging of the information on top of WPA and edge security.

The endpoint is only having Rambam as consumer.

3- Triggering the information exchange

Prometheus is monitoring the Physician access to the platform and the accessing of the patient record; it was agreed that when the physician shall be accessing the patient record, a call will be made to the IMNA FHIR endpoint to retrieve the abnormal values.

Note: the abnormal values are stored in the patient EHR, however a complete vision of all the collected observations is made available through the patient dashboard on the IMNA platform for deeper analysis and information crossing.

4- FHIR documents

The following documents are showing the produced final FHIR documents per observable and bundle.



Bundle document for anomalies is being produced and will be shared soon