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Patient-Generated Health Data Interoperability Through Master Patient Index: The DH-Convener Approach

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Abstract. Patient-Generated Health Data (PGHD), such as data provided by wearable devices, hold promise to improve health outcomes. However, to improve clinical decision-making, PGHD should be integrated or linked with Electronic Health Records (EHRs). Typically, PGHD data are collected and stored as Personal Health Records (PHRs), outside EHR systems. To address this challenge, we created a conceptual framework for PGHD/EHR interoperability through the Master Patient Index (MPI) and DH-Convener platform. Then, we identified the corresponding Minimum Clinical Data Set (MCDS) of PGHD to be exchanged with EHR. This generic approach can be used as a blueprint in different countries.

Keywords. Interoperability, PGHD, Master Patient Index

1. Introduction

Patient-Generated Health Data (PGHD) are clinically relevant data captured by patients outside of the traditional care setting [1-3]. PGHD transforms the healthcare landscape through patient-centric platforms which led to better patient outcomes [4,5]. However, data are typically collected and stored as Personal Health Records (PHRs) in different platforms outside the clinical domain [3]. To provide clinicians with access to the PGHD of their patients, PGHD should be integrated/linked to Electronic Health Records (EHR) using interoperability standards while ensuring data protection compliance [6-9]. Additionally, a Master Patient Index (MPI) is needed to accurately identify and match patients across PHRs and EHRs [10-11].

This work aims to create a conceptual framework for PGHD/EHR interoperability

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through MPI and our Digital Health Convener (DH-Convener) Platform [1]. The DH-Convener aims to provide PGHD interoperability and security as a service. We also identified the required Minimum Clinical Data Set (MCDS) for PGHD exchange with EHR. The MCDS is an essential component of the MPI that enables healthcare information exchange for better clinical decision-making [9-14].

2. Methods

As a part of our DH-Convener project, we first conducted an integrative literature review on interoperability architecture for PGHD integration with EHR. The DH-Convener platform data collector, securer, and connector modules will establish secured interoperable PGHD and EHR, as described in [1]. Then, the authors investigated the available functional MPI for integrating eHealth systems [10,11]. Accordingly, we created a conceptual framework to highlight the interoperability architecture (see Figure 1) based on Health Level Seven (HL7®) Fast Healthcare Interoperability Resources (FHIR®) standard. Finally, we identified the minimum clinical data set necessary for integrating PGHD, as listed in Table 1.

3. Results and discussions

3.1. PGHD Interoperability Architecture

Figure 1 depicts the data flow of PGHD, as follows:

- PGHD are collected and converted into HL7 FHIR formats by the DH-Convener and then stored into a PHR.
- The FHIR server enables rapid exchange of PGHD [15] between the DH-Convener and other information systems, e.g., PHR, EHR, etc.
- The PHR assigns a Unique Patient Identifier (UID) during patient registration.
- MPI creates MCDS, which contains all necessary data for the PHR and is linked to a National MPI (NMPI) through an Application Programming Interface (API).
- The NMPI is integrated with the federal electronic medical record system using a UID.
- In countries having district information systems, cluster MPI will be used to integrate that data using Essential Service Buses (ESB).

3.2. MCDS for PGHD interoperability

MCDS should include basic demographic information and information about the device, in addition to measurements of physiological parameters, such as heart rate, blood pressure, activity level, and sleep data. In addition, environmental data as well as user data about symptoms, medication adherence, etc. are being collected. Moreover, the specific data set requirements may vary [14], based on the intended use of the health and fitness app (monitoring, tracking, etc.) and the target clinical domain. For example, a device designed for monitoring chronic conditions such as diabetes may require more detailed data on glucose levels. A device intended for tracking fitness may emphasize activity levels and calories burned. Table 1 provides some examples. During the future

implementation phase, the limitation of the proposed MCDS and comparison with other conceptional frameworks will be addressed.

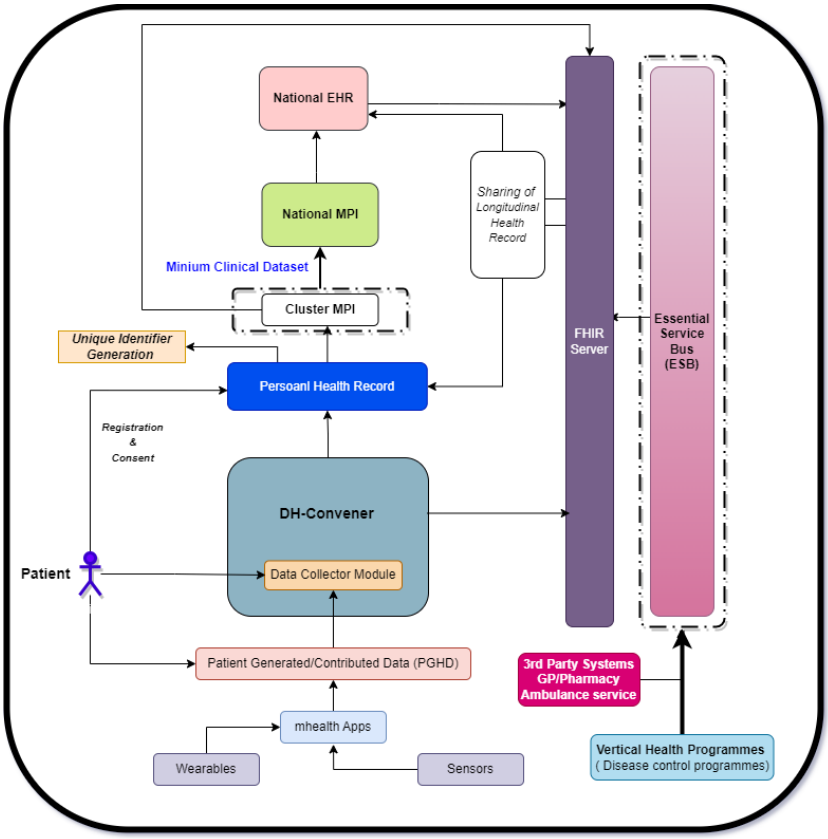

Figure 1. PGHD interoperability through MPI and the DH-Convener

Table 1. MCDS for PGHD interoperability

Category	Data Elements
Basic demographic information	Age, gender, and height/weight
Information about the device	Manufacturer, model, firmware version, etc.
Physiological parameters	Heart rate, blood pressure, respiratory rate, and oxygen saturation
Activity level	Steps count, distance travelled, and calories burned
Sleep-related data	Sleep time, sleep stages, and sleep quality
Environmental data	Temperature, humidity, and ambient light levels
Symptoms	Temperature, pain level, fatigue, and mood
Medication adherence	Taken the prescribed medication on schedule
Disease-specific measurements	Electrocardiogram (ECG) readings, blood glucose levels, cholesterol levels, etc.

4. Conclusions

The described conceptual architecture introduces a generic model for integrating/linking PGHD with EHR integration using HL7 FHIR standards via MPI for exchanging MCDS. The provided MCDS for PGHD interoperability and related examples in the cardiovascular domain can be followed in other domains. Thus, this approach can be used as a blueprint for a continued care model with a longitudinal health record at the district/national levels.

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