Interoperability across Public EHR Systems

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Thinking Beyond

ABSTRACT: With the advent of public PHR systems like Microsoft Healthvault and Google Health there is an increasing pressure for the hospitals to access these systems to populate data and extract data. These public PHR systems enable easy portability of patient health data when patients relocate or choose a different provider. These systems also enable the movement of ownership of patient medical data from the provider to the patient. Hence with increasing adoption of these public PHRs by patients to store their medical data, it would be incumbent upon applications, which generate and consume medical data, to be able to access these public PHR systems. But the number of public PHR systems providers is increasing on a daily basis starting with big players like Microsoft, Google Health and IBM to even smaller players. As these systems do not follow any generic standards every application which plans to access these PHR systems need to invest separately for connecting to each public PHR system. In this paper we delve into this problem and provide conceptual pointers on possible solutions to this problem.

KEYWORDS: Electronic Health Record, Healthvault, Google Health

TABLE OF CONTENTS

1. Introduction

1.1 PHR Version 1 – Hospital Based PHR

Patient's medical records were typically maintained by clinics and hospitals in their premises. Previously all the medical records were present in paper form, but slowly the storage of medical records moved from paper based to electronic form. Normally these records were present in a database in the hospital and can be accessed electronically by the provider through an onsite EMR (Electronic Medical Record) system installed in hospitals and clinics. But with the rise of the internet, the need for the patient to access their medical information through the web without making a trip to the hospital gained significance. Reacting to this growing need, many of the EMR/PM (Practice Management) providers also started providing web-based PHR (Personal Health Record) systems for the patients to view their health information stored in hospital EMR.

1.2 Problems with PHR Version 1

All relevant patient medical information is present in the hospital EMR database and can be accessed through a hospital provided web based PHR system which can connect directly to the hospital EMR database and retrieve the data. In other words medical data is captured and input by the providers during the patient's hospital/clinic visit in their EMR systems which can be accessed by the patient through the associated PHR system. The EMR/PHR system of the hospital is a self-sufficient system with respect to medical data flow. But then the problem with such a system is that it restricts health data portability across hospitals.

Suppose a patient has been using a hospital provided PHR to aggregate his medical information and say he is relocating from his state to another state due to work or plans to shift to a different provider. After relocating he will be visiting another clinic or hospital in the other city – which means he has to start using another PHR provided by that clinic. Now what happens to his medical history which is extremely crucial in treating the patient? His medical records are present in the EMR database of the previous hospital. One traditional way is for him to get his medical history and reports in paper form and submit it to the new hospital for manual reentry into the current system. This process is very cumbersome and error prone.

1.3 PHR Version 2 – Webbased Public PHRs

Recognizing this inherent problem in health data portability software players like Microsoft and Google released free web-based repositories to be used by general public to store their personal health information. The initial problem these PHRs faced was with adoption. Unlike the hospital based PHR systems these public PHR systems didn't have a default source of medical records data. The medical records were present mostly with the providers. Hence to provide initial impetus, Microsoft and Google partnered with hospitals like Cleveland Clinic and Mayo Clinic to export the patient records of these hospitals to these public PHRs subject to the assent of the patient. The public PHR players partnered with more such hospitals to increase the adoption rate and started accumulating considerable number of patient records.

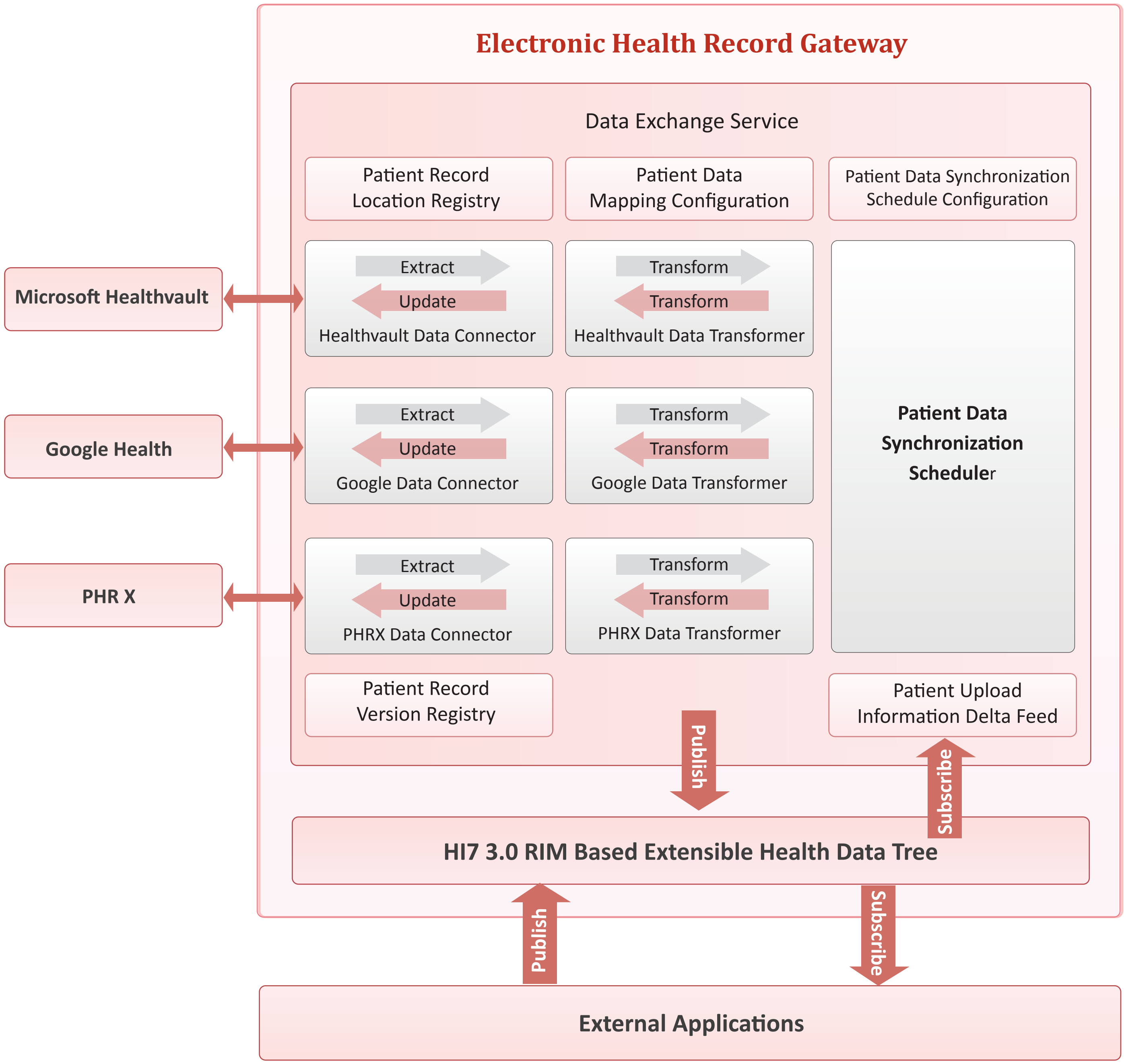
This solves to an extent the problem faced by patients using PHR Version 1 – Hospital Based PHRs. Suppose a patient has been using a hospital provided PHR to aggregate his medical information and say he is relocating from his state to another state due to work or choosing a different provider. After relocating he will be visiting another clinic or hospital in the other city – which means he has to start using another PHR provided by that clinic and migrate all data from the previous clinic to his present clinic. If he had been storing or synchronizing his data in a public PHR like Healthvault he doesn't need to worry about data migration as long as the EMR system of hospital in the other city can connect to Healthvault and retrieve the data.

1.4 Problems with PHR Version 2

But the question now is what happens when a patient moves from Cleveland Clinic to Mayo Clinic. We see we are stuck with the same problem but at one level higher in the abstraction stack. This is one of the interoperability problems which healthcare industry will face as more and more clinics adopt EMRs and connects itself to public PHRs. This problem will not only be faced by the patients but also third party service providers who work on the patient data (with patient's consent) residing in these public PHRs and then provide value added services like Diet Management, Preventive Disease Management and other such health related services based on that data. These third party provides would now need to connect to multiple public PHRs, authenticate itself on behalf of patient, extract patient data from these PHRs, analyze it and update the PHR data with some value added information. This would mean tackling multiple communication protocols, multiple authentication mechanisms, multiple data extraction methods and multiple data formats. This problem faced by these third party value added service providers can be solved in two ways as explained below.

2. Short Term Solution – Abstraction through Middleware

With the presence of an intermediate middleware, that encapsulates within it the several complications involved in interacting with multiple public PHRs and exposes and standard and uniform interface to the data consumers, the third party value added service provider can concentrate on providing value than bothering about interacting with multiple data repositories.



A high level conceptual diagram of such an electronic health record gateway is detailed above. In this conceptual diagram the two main components are common data model and storage which is represented as the HL7 3.0 RIM based Health Data Tree and the Data Exchange Service which transfers data between the common data storage and public PHR systems. These are explained in subsequent sections.

2.1 HL7 3.0 RIM based Health Data Tree

As described in the diagram the external third party applications would only need to interact with the HL7 3.0 RIM based Health Data Tree which abstracts all the data elements and data in the public PHRs. This Data Tree would among different data access methods provide a standards compliant webservice to publish data to it which in turn would publish it to the public PHR. Data Tree also provides a mechanism to register or subscribe for changes (granularly) in data in the Health Data Tree. An outgoing web-service (implemented by third party data consumers as per the spec provided) endpoint needs to be provided during subscription. This end point would be accessed and the outgoing service will be invoked by Health Data Tree to intimate the subscriber of any changes. The subscription granularity details both desired data elements and frequency of change notification. Apart from webservice based data transfer (between health data tree and external third party apps) other native mechanisms like file-transfer and database transfer could be looked at based on performance needs.

2.2 Data Exchange Service (DES)

The Data exchange Service is the middleman between the Public PHR and the Health Data Tree and facilitates the bidirectional data transfer.

Data Transfer from Health Data Tree to external Public PHR Systems

The patient delta feed component subscribes for changes in the health data tree and keeps the feed upto date with all changes. DES truncates this feed once all changes have been updated to the relevant PHR. Based on the synchronization schedule DES picks up the information from the Patient Delta Feed and passed it to the Data Transformer. DES looks up the patient record location registry to decide which transformer to pass the data through. The respective data transformer looks up the mapping configuration (created using a schema mapper) for the data element and appropriately converts it to the desired format and passes it to the desired connector. The desired connector looks up patient record location registry to retrieve the endpoint identifier credentials and relevant certificate and uses this information to interact with the respective public PHR and uploads the data.

Data Transfer from external Public PHR Systems to HealthData Tree

The DES on a periodic basis as mentioned in Patient Data Synchronization Schedule Configuration would activate all PHR data connectors to connect to the respective PHR systems and verify if any data has changed after the last pickup time. This information is gained through patient record version registry which stores for each record last download time. This is matched with the last modified time in the public PHR records so that only records changed after last download are extracted. After extraction it is passed to the transformer which transforms data as per the mapping configuration and publishes to the Health Data Tree. Health Data Tree keeps tracks of these changes and on a periodic basis based on the subscription parameters sends it to the subscribers.

3. Long Term Solution – Standardized Protocol and Data Formats

Though the above solution removes the hassle of connecting to multiple systems from the third party applications, the problem still remains and is specifically solved by the EHR gateway. When a new public PHR system like Healthvault comes up, a new set of connectors and transformers need to be written. This is because the communication protocol and the medical data formats are not standardized. With growing adoption of these public PHRs the need for a common standard for protocols and data formats to interact with these PHRs will gain significance. Looking at the standards available in the healthcare industry HL7 3.0 being adopted as the standard seems very likely and hence the choice of HL7 3.0 RIM for modeling the Health Data Tree.

In such an environment the need for a centralized repository like Healthvault loses meaning if all the PHR systems of all hospitals

implement the standard. In that scenario data migration would be standard based and would be similar to the situation which currently exists between email clients and mail servers. Any email client can connect to an email server as long as both support IMAP (Internet Message Access Protocol). In the same way in future any medical system can access data present in any other medical system as long as each supports a unique medical data messaging standard. It is only reasonable to assume this standard would be based on the preexisting HL7 standard. But inspite of such standards in the email space, one does find the prevalence in usage of public email systems like gmail and hotmail for personal emails. Similarly Google Health and Healthvault might still be relevant for different reasons even after widespread adoption of internet data messaging standards.