Public Health and Informatics
J. Mantas et al. (Eds.)

doi:10.3233/SHTI210199

DITAS: An Integrated Gateway to E-health Communications

Ehsan BITARAF[a], Fatemeh SARANI RAD[b,1] , Maryam JAFARPOUR[b,c], Vajiheh JAMI[b], Ebrahim KESHAVARZ SAFARI[b] and Pourya NASIMI[b]
[a] *Center for Statistics and Information Technology, Iran University of Medical Sciences*
[b] *Center for Statistics & Information Technology, Ministry of Health and Medical Education, Tehran, Iran*
[c] *Department of Algorithms and Computation, College of Engineering, University of Tehran, Tehran, 1417613131, Iran*

Abstract. Today, the demand for health-oriented systems to facilitate and improve treatment processes is growing. For different information systems with different structures and technologies to be able to communicate with each other, a single gateway is required. The gateway acts as an interface between information systems and unifies protocols, rules, and standards related to communication processes. Health-related systems need a unique regulator that explains data models, coding, and data exchange structures. Moreover, the gateway has control over information systems and the data transmitted between them. In this paper, we explain an integrated gateway of health information exchange named DITAS which is a bridging point between health-related systems.

Keywords. DITAS, Point of care units, Point of care systems, Interoperability

1. Introduction

Most countries and organizations are forcing health care providers and Electronic Health Record (EHR) users to use special platforms for entering EHR data. This creates costs for health centers and providers and also eliminates competition for health software developers [1]. A robust health data exchange infrastructure enables all stakeholders to access data and services through any software system [2]. In [3] García-Sánchez et al presented a mobile gateway based on Service-Oriented Architecture (SOA) which deploys an e-health support system. The gateway works as an inference and rule base engine for mobile systems. Eun-Young Jung et al proposed a home health gateway based on healthcare services that provide health monitoring based on the u-Health platform. The proposed system has a healthcare decision support system in a ubiquitous environment[4]. Mu-Hsing Kuo et al suggests a Resource Description Framework (RDF)-based mediator that is implemented based on three basic elements a) Synonym Dictionary(SD), b) CXTR module and c) CRTX module whose goal is to solve interoperability problem in heterogeneous information system and also efficient health information exchange [5]. Similarly, in [6], A common-gateway-oriented mediator

[1] Corresponding Author: Fatemeh Sarani Rad, Center for Statistics & Information Technology, Ministry of Health and Medical Education, Tehran, Iran; E-mail:f.sarani.rad@gmail.com.

provided by Mu-Hsing Kuo et al that is based on three basic components included a) Synonym Dictionary, b) Semantic Mapping Engine and c) DB-to-XML module. The goal of the mediator is to implement a system that solves the interoperability issues between heterogeneous health information systems. Wilkinson et al presented some resource-oriented Web design patterns based on FAIR (Findable, Accessible, Interoperable, and Reusable) data principles for data discovery and integration of heterogeneous bioinformatics data sources whit different technologies[9]. In [10] a review of the published paper on commonly used technologies to integrate health data is collected by Cong Peng et al, based on their results, different technologies are being used to integrate data from different systems. Application Programming Interface (API) and Software Development Kit (SDK) are two of the frequently used infrastructures used to transfer and integrate data distributed in different systems. Iranian ICEHR (locally called SEPAS), due to its decentralization and structure, allows health service providers to use different information systems for implementing SEPAS services [7]. SEPAS services as well as other value-added services that are used in healthcare providing processes are offered on an integrated gateway for Iranian health information exchange called DITAS which is an API gateway. In this paper, we propose a novel architecture to address the basic needs of E-bridge and also provide extended features for health-related systems such as functional interoperability, semantic interoperability, privacy, security, trust, unified regulation, and equitable data access.

2. Methods

According to the rapid growth of health care centers/point of care units (POCU) as well as health care providers, there is a fundamental need to transfer vital information between the information systems/point of care system (POCS) of those centers, patients, insurers, research centers, and other stakeholders. The communication between various POCSs requires that different terms be mapped to the standard terms or semantics [8]. DITAS creates a new way for healthcare-related systems to engage and connect through an integrated gateway. DITAS specifies a standard policy for exchanging healthcare information. For communication through DITAS, POCSs need DITAS certification which certifies that they are passed DITAS standards. In the process of certifying POCSs, an ID is assigned to each system called SystemID. To identify which POCUs communicate with DITAS each unit has a unique ID called LocationID. User identification is a major concern when registering health information across a wide network. For this purpose, each user has a unique ID called UserID. DITAS's role in the aforementioned processes is to receive requests from various stakeholders, enforce policies, and respond to requests. It can also perform other functions such as authentication and authorization, collecting transaction log data, implementation security, and privacy rules, and also applying regulations. DITAS customers are divided into two basic categories. The first one includes micro-clients such as health care centers and the second category involves major-clients such as insurance companies.

2.1. Components of DITAS

This section provided an overview of DITAS components which can be divided into two basic categories. The first one is DITAS Services which shows an overview of the type

of services and classes to which each service belongs to. The second one describes DITAS Layers, which include three main categories.

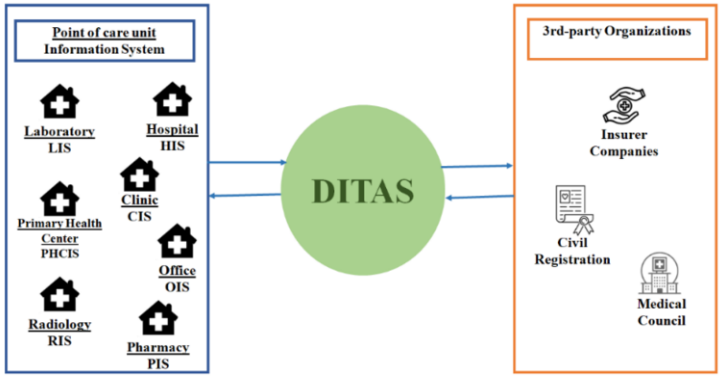

Figure 1. DITAS Architecture

2.1.1. DITAS Services

DITAS acts as the entry point in which health-related systems can communicate and transfer data through it. DITAS is an API gateway that exposes many health-related APIs. The DITAS services are categorized as different software development kits (SDKs). SDK types are based on POCSs which means a hospital information system can use services that encapsulate within Hospital Information System (HIS) SDK. The services provided by DITAS SDKs fall into three general categories, which are as follows.

- **SEPAS Services**: Iranian EHR locally called SEPAS has many services that integrated patients' EHR. The SEPAS architecture is based on ISO 13606 and HL7 standards. Each POCS based on its POCU process can call specific SEPAS services that are embedded in DITAS SDKs. services encapsulated in the SEPAS category are patient-centric which means they are related to the patient's EHR.
- **Internal Services**: In addition to SEPAS services, this category is also provided by the Ministry of Health, but their difference with SEPAS services is that these services are not patient-centric. One of the most important services in this category is the hospital bed management service, which shows the status of the beds in each hospital. Although this service is provided by the Ministry of Health, it is not related to patients' electronic health records.
- **External Services**: This category involves services that are provided by an external organization and somehow meet one of the data needs of POCUs. External organizations providing these services include the civil registry office, insurance organizations, and other organizations related to the POCUs process.

2.1.2. DITAS Layers

DITAS is a platform that is implemented based on different layers. DITAS layers can be divided into three major categories as follows, the authentication and authorization layer, the log management layer, and the monitoring and alarming layer. In this section, the three layers of DITAS are illustrated in detail.

2.1.2.1. Authentication and Authorization Layer

The most important concerns in health data exchange processes are security and trust. The Public Key Infrastructure/Encryption (PKI) is one of the most popular and significant technologies used for data security. Registration Authority is responsible for PKI certificate enrollments. The encryption and decryption of data are implemented based on public and private keys are stored in PKI certificates to be sure that the security of data in communication is preserved. Moreover, PKI used the digital signature to prevent forgery and implement the undeniable in health processes [2]. The basic elements that are used in the DITAS registration authority are SystemID, LocationID, and UserID. The custodian of each element is different.

- **Point of Care Systems Registration Authority (POCSRA):** Health-related systems to be able to exchange information with DITAS must comply with the standards and rules defined by the IT department of the Ministry of Health and Medical Education. To identify different systems, a unique identifier is assigned to each system during the evaluation process. This identifier is known as the SystemID. This ID is assigned to each system by POCSRA. If the relevant system succeeds in obtaining a DITAS exchanging certification, it will be recognized as approved in POCSRA and will be able to exchange data with DITAS.
- **Point of Care Units Registration Authority (SIAM):** Health care provider centers need a unique identifier to exchange with DITAS. These identifiers are generated by the Point of Care Units Registration Authority (locally called SIAM) and named LocationID. The structure of centers in SIAM is defined hierarchically. Thus, the Ministry of Health is known as the father in the mentioned structure and the sub-centers are subdivided according to the organizational division under the medical universities.
- **DITAS Registration Authority (DITASRA):** DITASRA is responsible for connecting the authentication elements and defining service call counts or call limitations. services' call limitations are defined in the regulatory center of DITAS based on POCU processes and the average number of patients who refer to each health center. Authentication and authorization elements in DITAS communications extract from security tokens. In each security token, an X.509 certificate compatible with the PKCS12 standard is registered. The certificate contains LocationID, SystemID, and UserID. Due to the multiplicity and dispersion of POCUs, DITAS security tokens are issued by government services offices that are scattered throughout the cities through the DITASRA system.

2.1.2.2. Log Management Layer

Each transaction through DITAS has some attributes which are stored based on the DITAS log management layer. This layer records the list of events that occur for a transaction from its birth time (The time when the transaction enters DITAS) to its dead time (The time when the transaction leaves the DITAS). During this cycle, the response time for each request as well as the description of the error that occurred is recorded. Besides, the basic elements of authentication and authorization are recorded for each

transaction to enable information retrieval and monitoring of POCUs, POCSs, and Users using the DITAS services.

2.1.2.3. Monitoring and Alarming Layer

DITAS's monitoring layer can monitor APIs functionalities based on some predefined metrics in which every failure in APIs or increasing in response times or generally every unusual behavior in APIs functions or resources can lead to alarms. Moreover, POCSs may encounter various errors in the process of calling DITAS's services. DITAS has services for translating the errors, in addition to providing complete error descriptions, they also offer error handling to fix solutions.

3. Results

The Ministry of health and medical education (MOHME) of Iran is responsible for designing and implementing the integrated gateway for health data communications. DITAS is implemented in Iran's health system to accomplish MOHME responsibilities. Today, about 70 million transactions are performed monthly on the DITAS platform. These transactions are made by 184 information systems and from about 29,960 POCUs. Despite all efforts, much remains to be done to expand the DITAS infrastructure, the number of POCUs connected to DITAS, and the utilization of data collected through this platform. Moreover, due to the fact, DITAS is the gateway to the SEPAS services and also value-added services through the EHR data collections process, we are trying to develop the DITAS infrastructure in terms of distributivity in the country to be able to handle disaster recovery for services implemented on the DITAS platform.

References

[1] Mandl KD, Mandel JC, Kohane IS. Driving Innovation in Health Systems through an Apps-Based Information Economy. Cell Syst. 2015 Jul;1(1):8-13.
[2] Braunstein ML. Health Informatics on FHIR: How HL7's New API is Transforming Healthcare. Springer International Publishing; 2018 Jul 26.
[3] Garcia-Sanchez P, Gonzalez J, Mora AM, Prieto A. Deploying intelligent e-health services in a mobile gateway. Expert Systems with Applications. 2013 Mar 1;40(4):1231-9.
[4] Jung EY, Kim JH, Chung KY, Park DK. Home health gateway based healthcare services through U-health platform. Wireless Personal Communications. 2013 Nov 1;73(2):207-18.
[5] Kuo MH, Kushniruk A, Borycki E. An RDF-based mediator for health data interoperability. Stud Health Technol Inform. 2009;150:399-403.
[6] Kuo MH, Kushniruk AW, Borycki EM. Design and implementation of a health data interoperability mediator. Stud Health Technol Inform. 2010;155:101-7.
[7] Riazi H, Jafarpour M, Bitaraf E. Towards National eHealth Implementation--a comparative study on WHO/ITU National eHealth Strategy Toolkit in Iran. Stud Health Technol Inform. 2014;205:246-50.
[8] Ashrafi N, Kuilboer JP, Stull T. Semantic Interoperability in Healthcare: Challenges and Roadblocks. InSTPIS@ CAiSE 2018; p. 119-122.
[9] Wilkinson MD, Verborgh R, da Silva Santos LO, Clark T, Swertz MA, Kelpin FD, Gray AJ, Schultes EA, van Mulligen EM, Ciccarese P, Kuzniar A. Interoperability and FAIRness through a novel combination of Web technologies. PeerJ Computer Science. 2017 Apr 24;3:e110.
[10] Peng C, Goswami P, Bai G. A literature review of current technologies on health data integration for patient-centered health management. Health informatics journal. 2020 Sep;26(3):1926-51.