

A SOA-Based Solution to Monitor Vaccination Coverage Among HIV-Infected Patients in Liguria

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Abstract. Vaccination in HIV-infected patients constitutes an essential tool in the prevention of the most common infectious diseases. The Ligurian Vaccination in HIV Program is a proposed vaccination schedule specifically dedicated to this risk group. Selective strategies are proposed within this program, employing ICT (Information and Communication) tools to identify this susceptible target group, to monitor immunization coverage over time and to manage failures and defaulting. The proposal is to connect an immunization registry system to an existing regional platform that allows clinical data re-use among several medical structures, to completely manage the vaccination process. This architecture will adopt a Service Oriented Architecture (SOA) approach and standard HSSP (Health Services Specification Program) interfaces to support interoperability. According to the presented solution, vaccination administration information retrieved from the immunization registry will be structured according to the specifications within the immunization section of the HL7 (Health Level 7) CCD (Continuity of Care Document) document. Immunization coverage will be evaluated through the continuous monitoring of serology and antibody titers gathered from the hospital LIS (Laboratory Information System) structured into a HL7 Version 3 (v3) Clinical Document Architecture Release 2 (CDA R2).

Keywords. Vaccination, immunization, HIV, SOA, HSSP, HL7, CDA, CCD.

1. Introduction

Vaccination in HIV-infected patients constitutes an essential tool in the prevention of the most common infectious diseases, which can be particularly severe in these kind of patients and could predispose them to complications [1]. The current national and international guidelines strongly recommend that these patients should receive all routine vaccinations [2] [3] [4].

Despite these patients representing an appropriate target group for immunization, the available data indicates suboptimal coverage rates, partially due to the difficulty in identifying those susceptible to preventable infections. In Italy, the Ministry of Health annually provides vaccination calendars which, are customized for different groups of people. In order to recruit these subjects, the Ligurian Vaccination in HIV Program

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(LIV in HIV) is based on a network of primary care and public health providers integrated with specialists working together to ensure the timely administration of recommended vaccinations. Selective strategies are proposed in this paper within this program, employing ICT tools, to identify this susceptible target group, to monitor immunization coverage over time and to manage failures and defaulting.

2. Background

A computerized immunization registry should be implemented to share clinical information about vaccination, to manage reminders and to monitor coverage and adverse events [5]. In Italy, a national immunization registry does not exist, only sparse situations at regional or civic levels are currently working. Gritti et al. performed a survey on this topic in 2010 [6], where a complete heterogeneous situation emerged. Very few regions had a fully implemented computerized immunization registry and in most regions it was completely absent. The majority of regions adopted mixed solutions, employing different systems based on software that could not guarantee interoperability even at the intra-regional level. In some of these regions, the data collected were sent directly to the Regional information system, but in most cases, data transmission was performed through paper reports. The latter scenario exists in Liguria.

3. Materials and methods

3.1. Materials

A solution that can help to reach a unique regional immunization registry (for HIV patients), without impacting too much on existing intra-regional architectures, could be to link the administration systems of all health care facilities, orchestrating all data anonymously in a single repository.

To monitor vaccination administration, it is essential to collect data in a unique regional immunization registry. However, as mentioned above, in the Italian region of Liguria there is no such system. Each of the five local health units ASLs (*Azienda Sanitaria Locale*) rely on different private companies to manage immunization information. One problem, faced within this project, was the harmonization of identification from the separate systems. Specifically, each hospital had a separate administration system, where the patient was identified by a tax code, a hospital ID and a regional ID. The hospital ID is used for intra-hospital data exchange, for example to identify patients' laboratory exam results. The regional ID is used when data needs to be exported outside the hospital, for instance to make periodical regional reports. Even if using both IDs, it is not possible to infer patient identity, without a direct link to the hospitals' anagraphic system.

An existing regional system linking the LIS of some hospitals had already been set up, by a few of the authors, to manage CTs (Clinical Trials) in HIV+ patients [7]. In order to exploit the existing architecture, a system was attached which connected the immunization registries of all ASLs involved, allowing the vaccination process to be completely managed. The platform proposed in this article aims to cover all steps, from selection of the target to supervision of immunization coverage, which can be evaluated through antibody titers and serological data stored in the LIS.

Vaccine administration data such as injection date, typology and dose will be recorded in the system. The most common vaccination types are considered in this study, but the system is also applicable for other vaccinations: hepatitis B, hepatitis A, measles, mumps, rubella, varicella, tetanus, diphtheria, whooping cough, poliomyelitis, pneumococcal, meningococcal (ACWY, B, C), papillomavirus, influenza, haemophilus influenza type B. Most of the related antibody titers will be obtained from the LIS.

3.2. Methods

The mentioned existing platform that allows clinical data re-use among different medical structures is called the Ligurian HIV Network, and it was developed in 2013 by some of the authors [8]. A web service-oriented architecture (SOA) supports the direct extraction of clinical data from the LIS of several hospitals to a central storage. This central repository enables management of a great number of CTs upon the collected data. Interoperability among different health care facilities is granted by the use of particular international standards, as HL7-v3 CDA-R2 [9].

Hospital client applications communicate with a central web service through HSSP RLUS (Retrieve Locate Update Service) standard interface. Technically different client applications are implemented, because of different LIS access policies: some hospitals provide direct access to the database, hosting a client application inside the HIS (Hospital Information System), while others only authorize data extraction through their own web services. The idea is to link together the immunization registries of all ASLs, by developing a system able to query all of them through a RLUS standard interface, and retrieve vaccination data for a single patient using his regional ID and eventually the starting date of interest. Data will be structured according to indications present in the immunization section of the HL7 CCD document.

4. Results

The proposed architecture drives the information flow as shown in Figures 1 and 2.

In Figure 1, the active enrollment of a new patient in the Ligurian HIV Network is shown through a UML diagram. In particular, using a client application hosted into the Local Area Network (LAN) of the hospital, the physician can select one or more patients for enrollment in the Ligurian HIV Network. The client application sends the patient's tax code to an identity management service through a standard HSSP IXS (Identity Cross-Reference Service) interface, asking for the assignment of a local ID. Some personal patient data, such as sex and year of birth, are then saved in the Ligurian HIV Network by association to the patient's local ID. Once registered in the database, the history of clinical and vaccination data has to be retrieved from the LIS and the immunization registries, respectively. In both cases, mapping of the local ID with the respective hospital and regional IDs is performed through a query to the IXS service.

In Figure 2, the routine update of clinical and vaccination data is explained. In this case, the start searching date must also be specified in the queries, in addition to patient IDs. At present, the existing platform allows automatic data extraction from the LIS of two hospitals: the IRCCS AOU San Martino Hospital – IST and the Galliera hospital in Genova. The serology and antibody titers for 2684 patients treated in both of these hospitals are therefore continuously monitored. LISs of other Ligurian hospitals can easily join this architecture, after HIS manager agreement.

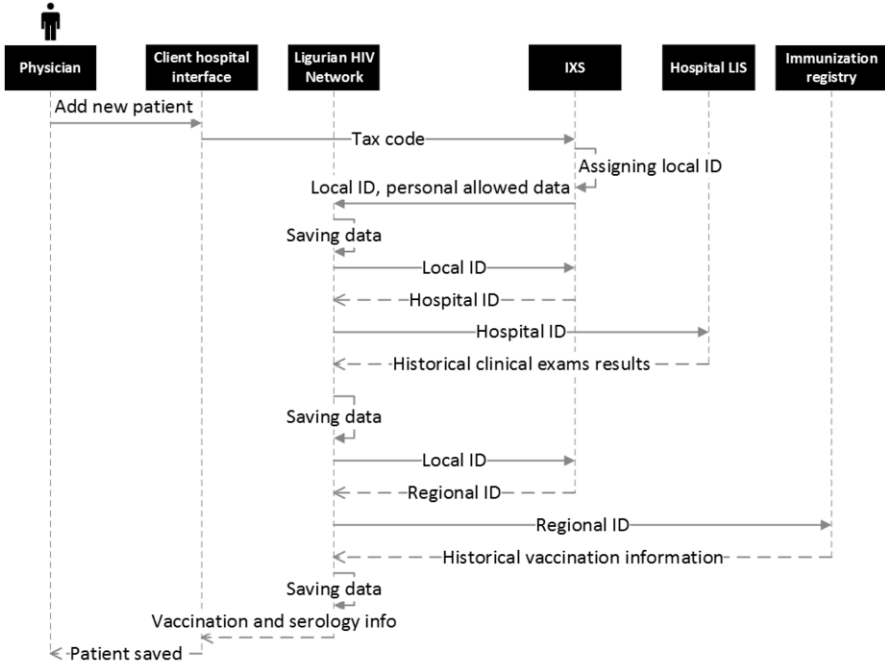


Figure 1. UML diagram showing on-line update of LIS data and vaccination information

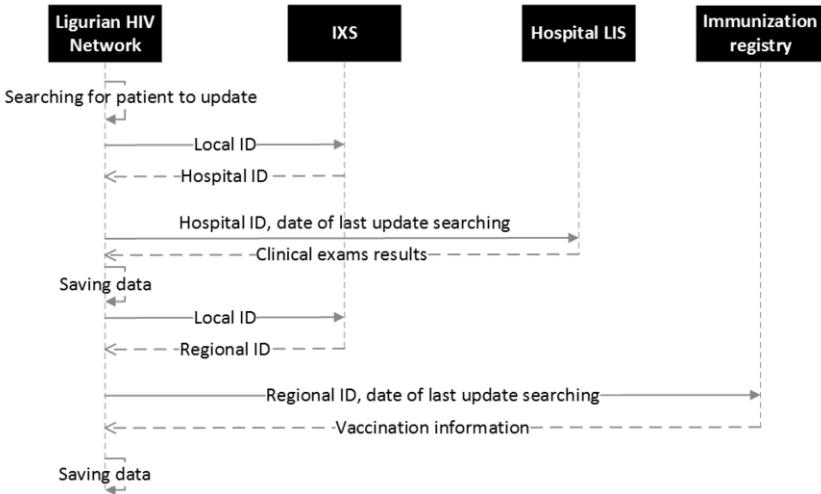


Figure 2. UML diagram showing off-line update of LIS data and vaccination information

Regarding vaccine administration information, while awaiting implementation of the immunization registry query system, at present an interface allowing manual data entry has been set up. The CCD-based interface between a private company supporting the vaccination registry of the two Ligurian ASLs and the planned system is at the design stage. The architecture developed previously to support LIS data extraction and the proposed architecture for complete monitoring of immunization has recently been approved by the regional Ethical Committee.

5. Conclusion and discussion

The proposed solution consists in the development of an infrastructure based on standardized services, as a prototype for full interoperability at the intra-regional level. It will allow effective supervision of the vaccination process in HIV+ patients, thanks to the integration of data from immunological registries with the existing regional network (Ligurian HIV Network). In particular, data retrieved from immunization registries, structured into the immunization section of CCD documents, will be recorded and associated with the corresponding serology and antibody titer values gathered from the hospitals' LIS. The existing architecture updates clinical data daily of patients enrolled in the Ligurian HIV Network. Other Ligurian hospitals will soon join this architecture, connecting their LIS. Preliminary agreements are under development with one of the main companies providing immunization registries.

Future developments could consist in the programming of alerts that inform physicians about patients who have not undergone vaccine administration or who do not have a correct immunization response time.

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