The Ligurian HIV Network: How Medical Informatics Standards Can Help Clinical Research

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Abstract

Integrating evidence from systematic research in daily clinical practice is one of the pillars of evidence-based medicine. Electronic data capture tools simplify data collection from different centers and supports the management of multicenter clinical trials. The Ligurian HIV Network (LHN) is one such tool, originating from a regional effort to integrate clinical trial capabilities for HIV and other chronic infectious diseases. In order to manually collect a complete report of all clinical tests on patients enrolled in a trial, a strenuous human effort and the allocation of great resources would be necessary. Moreover, the risk of error in a manual system is very high. The proposed system automatically extracts clinical data from the EHR of three hospitals of the LHN in a standardized way, and enhance their re-use in clinical trials. Through dedicated questionnaires, physicians reported a strongly positive feedback about the efficacy of the platform in supporting clinical research.

Keywords:
Electronic Health Records, Health Level Seven, Clinical Trial

Introduction

Clinical Trials are indispensable tools for Evidence-Based Medicine [1]. To collect the large amounts of data needed for clinical research, the implementation of a system, which coordinates the conduction of scattered clinical trials, is required. The interchange of data coming from different and heterogenic medical structures has to be managed. The ARCA (Antiretroviral Resistance Cohort Analysis), ICONA (Italian COhort Naïve Antiretroviral) and CISAI (Italian Coordination Study for Allergies and Infections from HIV) databases constitute the most important Italian clinical cohorts for HIV studies.

In 2013, a regional research network called the Ligurian HIV Network (LHN) was implemented by some of the authors [2]. The LHN was originally conceived as a mere web platform to enable the collection of data from HIV patients using a web interface, in order to perform multi-centric clinical trials at a regional level [3]. For the first year, the platform was consistently used for its initial scope, supporting about half a dozen local studies. Routine use of the platform, together with the intention to address the well-known problem of errors due to manual data input into web interfaces, led to a consecutive gradual evolution of the system. The leading idea was that clinical data, already available in digital format in the LIS (Laboratory Information

System) and other components of the Hospital Information System (HIS), could be extracted and automatically exported to the LHN database. In this way, patients' laboratory data could be updated daily without human intervention. Clinical data was chosen since laboratory data is the largest data set used in clinical research concerning infectious diseases. Once this first process was completed, having reached a fully updated database, the authors decided to automatically connect the repository to the national HIV clinical studied mentioned above.

Methods

The LHN technical implementation choices are guided by the Electronic Source Data Interchange (eSDI) group recommendations. The scenario adopted and the architectural approach of the developed solution are thoroughly described in [4], while the technical approach is similar to those described in [5][6]. In order to protect patients' privacy, only indispensable personal information is managed such as year of birth, sex and nationality. The patient hospital code, that cannot be directly connected to the identity of the patient, makes it possible to track each patient through various hospital departments. If a patient moves to another hospital, explicit medical coordination is required.

A tool for the direct extraction of laboratory information was implemented, so that the data can be conveyed from the Laboratory Information System (LIS) towards the LHN. Depending on the hospital's level of IT support, two different scenarios arise: 1) the hospital does not have a LIS in which digital data are stored or it has LIS but does not allow external agents to access data; 2) the hospital has a LIS and allows external agents to access data. Hospitals belonging to the first scenario could participate in the LHN by inserting data manually from the web interface, while those belonging to the second scenario could exploit the paradigm of data reuse. Automatic clinical data flow from a hospital LIS towards the LHN is allowed by a Windows Console Application that encapsulates clinical data in standard Health Level 7 Clinical Document Architecture (HL7 v3 CDA r2) documents and sends them through a web service that is responsible for document validation and data recording. During this process, the web service also involves a terminology service, in conformity with the standard CTS2 (Common Terminology Service Release2), which allows the translation of local hospital terms to LOINC (Logical Observation Identifiers Names and Codes)[7]. This ensures a

correct understanding of the data exchanged between different laboratories that use their own terminology. A trigger launches the console application program once upon a night, searching for registered patients who have done laboratory exams during the day. When the program encounters for the first time a patient just registered on the platform, all historical data are retrieved.

Results

The LHN currently involves the Infectious Diseases Departments of eight hospitals in Liguria and Piedmont. Three hospitals (IRCCS AOU San Martino IST, Galliera and Sanremo) use the second scenario while the others use the first.

The three hospitals in the second scenario have two different informative systems, so two different methods for sharing clinical data were developed. The Galliera Hospital offers several services to access patients' clinical data, including a data management service to access laboratory test results. After authentication, data are available on demand in XML or JSON proprietary format. On the other hand, IRCCS AOU San Martino IST and Sanremo hospitals do not share data through services, thus the only way to access data is to extract them directly from the LIS, installing the console application inside the hospital firewall. Currently 4338 patients from eight different hospitals are involved in the LHN. Among them, data from 1851 patients from San Martino hospital, 1241 from Galliera hospital and 267 from Sanremo hospital are automatically updated using the described tool. The EHRs of the Galliera and San Martino hospitals started working at operating speed in 2008. There is a consistent difference among hospitals belonging to the first and the second scenarios in terms of quantities registered. In the data for Sanremo hospital, this trend is not yet appreciable, since the automatic connection with the LIS was only set up recently. Automatized centers insert 10 times lab test per year more than non-automatized ones (10679 vs 1910) and also a greater number of parameters per test is considered (41 vs 31). Using this tool, anonymized data were automatically transferred from the Electronic Health Records (EHR) towards the Clinical Data Management System (CDMS). This enhanced clinical trials conduction on chronic viral infections, the project has recently been expanded to include HBV and HCV diseases. Presently nine regional studies are supported by the platform as they are listed in the left menu of the web site (https://reteligurehiv.it/Default.aspx), pressing each button a short description is available.

This fully updated database is a reliable source of information that could be reused to fill national databases, like ARCA, CISAI and ICONA. At present, 1243 LHN patients are registered in the ARCA database, 590 in CISAI and 458 in ICONA. A program has been developed to continuously update the ARCA database with CD4+, HIVRNA and genetic sequence data for all patients included in the LHN. The CISAI study also involves HCV infected subjects and collects a greater amount of data. A collaboration with the ICONA data manager has not yet been arranged. Temporarily, a tool for data extraction in Excel format, which is available on the platform, helps in collecting data to be sent to the ICONA database.

Statistical reports and charts are prepared from the data collected using tools available on the web interface, in order to show continuously updated information. An extraction tool has been set up on the web interface to enable physicians to export selected information from the database to spreadsheet files. The extraction engine is flexible and optimized in timing. Patients, time range and the parameters of interest are customizable by the user.

Discussion and Conclusion

The LHN was initially set up to provide physicians with a web-tool to administrate data from HIV-positive patients in primary-care and to re-use the collected clinical information to perform CTs in Northern Italy. In this paper, an extension of the former architecture is presented, which provides the development of a system that automatically transfers clinical information from the hospitals' EHR towards the LHN database. A further extension enables direct communication between the developed system and the main HIV national databases.

The proposed system works properly for the two illustrated scenarios. In particular, for the second scenario, data can be automatically extracted in a standardized way, and conveyed towards the central repository for their re-use in clinical trials.

In order to manually collect a complete report of the laboratory activity for all the patients involved, a strenuous human effort and the allocation of great resources would be necessary. Moreover, the risk of error in a manual system is very high. Instead, a tool able to automatically transfer all data, such as the one described in this paper, is essential to rapidly collect all laboratory information in a reliable manner. The use of medical standards ensures possible future integrations with additional health care structures, enhancing the expansion of the project. Currently this system manages and elaborates data coming from regional hospitals, but in the near future, it would be possible to expand it, involving extra-regional facilities, thanks to interoperability efforts.

Statement on ethics vote

The research was approved by the Liguria Ethics Committee (directed by prof. Manlio Ferradini) on August 28th 2013,

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