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Analysis of the EHR Systems in Spanish Primary Public Health System: The Lack of Interoperability

**Isabel de la Torre · Sandra González ·
Miguel López-Coronado**

Abstract This paper presents the impact of the Electronic Health Records (EHRs) systems jointly in the Spanish Primary Public Health System. Different EHRs that exist in each of the Spanish regions are discussed. Moreover, other purpose of this analysis is to identify the current state of knowledge about health information systems adoption in primary care in Spain. For the analysis and study of EHRs systems in Spain we have relied on the use of different sources, mostly items related to the study of EHRs systems in different areas. We will analyze some technical aspects of these and some of their major implications, both positive and negative. Moreover, we have resorted to make direct contact with the organizations that have implemented the EHRs systems. The result of this study leads to a main idea, the need for interoperability between different systems. We will delve into how we have reached this conclusion and that is the key to EHRs systems homogenization of Spanish territory. EHR systems used in different regions of Spain offer the access to medical information as well as provide a clinical analysis of each patient more quickly. The adoption of health information systems is seen world wide as one method to mitigate the widening health care demand and supply gap.

I. de la Torre (✉) · S. González · M. López-Coronado
Department of Signal Theory and Communications,
University of Valladolid,
Paseo de Belén, 15,
47011 Valladolid, Spain
e-mail: isator@tel.uva.es

S. González
e-mail: sgonmar@ribera.tel.uva.es

M. López-Coronado
e-mail: miglop@tel.uva.es

Introduction

Nowadays, Electronic Health Records (EHRs) systems play an important key role since they account for a breakthrough in the area of technology applied to medicine. Acting as an electronic version of paper medical record and they are considered as an essential part of medicine in the information system era.

In many countries, the health care sector is entering into a time of unprecedented change [1]. EHR systems implementation is included within the scope of e-Health, health care practice supported by Information and Communications Technology (ICT). This is complemented by the end of telemedicine creating a variety of services, including these histories are located between medicine and technology-assisted healthcare. If we start from the time when the need arises we may note that the number of aged people is growing and their care needs will progressively become more intense.

EHRs architecture can be highly variable to meet the needs of different health sectors and health disciplines [2]. But soaring health care demand is not just driven by age [3]. Some papers show that systems' graphical user interface design quality, feature functionality, project management, procurement and users' previous experience affect implementation outcomes. Implementers had concerned about factors such as: privacy, patient safety, provider/patient relations, staff anxiety, time's factors, care of quality, finances, efficiency, and liability [4].

The framework in which we locate this paper is mainly in the area of primary care of the various existing health

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centers in the Spanish territory. The goal is to understand factors and influencers affecting implementation outcomes from previous health information systems implementations experience [4].

The objective of this research is to undertake a systematic review of the literature from several systems to identify the current state of knowledge about EHRs systems adoption in Spain. The main priority is to provision of all information generated by a patient over a lifetime regardless of the number of hospitals in which he has been treated. Access to services should be facilitated for improving medical diagnostics. All of them have advantages and disadvantages. The main upside of the EHR's is we could digitalized all patient information and stored together but instead, these systems need to be modified because they present problems that often slow down the work of professionals.

These EHRs systems are made possible because Spanish health service is public, so that through them you can gather information, a situation that would be more difficult in countries where health is private, for example United States of America, United Kingdom, etc. Health maintenance is crucial for preventing premature mortality, but many patients do not receive preventive services at recommended intervals. One reason is the lack of up-to-date information accurately reflecting patients' history. EHRs can be useful, but they are often incomplete [5].

The process of computerization of health records in primary care has been a decisive shift in performing their work and health professionals on how to integrate the different areas. The incorporation of information technology in health centers enables faster communication and accurate patient clinical information. This avoids duplication of diagnostic tests, treatment errors and data loss in the exchange of levels of care, benefiting both, the patient and healthcare professional.

On the other hand, the fact that these aspects should be noted that the computerization also improves the bureaucratic process which slow the clinical evaluation. The integration of the making appointment of the patients in the EHR allows health professionals to better manage their business but most important of all is that all projects must respect the privacy rights of patients [5]. We can say also, the EHR was frequently incomplete when compared to a patient report.

In the next section the background is described and we will conduct a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of EHRs in Spain, then the methodology used is shown. Next, we will show a comparison of different EHRs in each of the regions of Spain, describing each of their main features and we will propose different solutions to get the interoperability of the different systems. Finally, we will make a discussion and final conclusions will be shown during the analysis of full review.

Background

In Spain, we have 17 autonomous communities or regions. Public health is not only accessible to all those who contribute to your quote but to all citizens, we mean, it is your responsibility to set health policy, resource allocation to its share of National Health System (NHS), and ensure the rights of citizens to health care. Moreover, there is a health management of the Autonomous Territory which is established for a reference map for the System of Primary Care Information. This map is governed by a set of policies, establishing a series of health system structures, which are responsible for managing their own health service centers in the region. Each of these territorial boundaries involved in the health services and health programs to develop them. This raises the problem of lack of homogeneity in the EHR from Spanish health system, because each autonomous community is governed by its own independent policies. The different ways of organizing health care developed by the regions along the time has been one of the main problems, the decentralization, as they have followed different organizational criteria for planning and management.

This organization is decentralized since it is governed by rules dictated by each autonomous region and which does not work the same way. This is due to a series of political and economic factors that make the health sector do not work together and each of them has created a different EHR. This is an important problem. The storage of medical records of citizens are not 100% compatible, it is impossible to share this information among the medical sector between different regions, so they have invested large amounts of money without getting a common goal for all Spanish territory.

EHRs require a level of functional interoperability within and among EHRs and different support systems. There are a number of standards developed to ensure the required interoperability for EHRs like Health Level 7 (HL7), ISO 18308, etc.

Below it is a SWOT analysis of the different EHRs in the Spanish Public Health System (see Table 1).

Methods

We have resorted to the analysis of several papers published as well as consultation the URLs about the systems, for the analysis and study about the view of EHR systems in the Spanish Primary Public Health System. Bibliographic material has been obtained mainly from MEDLINE source. Due to the lack of information and privacy that are subjects to the above systems, we have resorted to making direct contact with the organizations that have implemented these systems and several technological providers.

Table 1 SWOT analysis about EHRs systems in Public Health System in Spain

Strengths	Weaknesses
- There are many international, European and national projects aimed at implementing the EHR. - There is consensus among European Health Ministers that it is a matter of high priority. - Health professionals understand the benefits: an interchangeable patients' EHR can facilitate cooperation among professionals, while avoiding repetitive tasks and costs.	- Cooperation between different care institutions remains difficult. - Implementation of the necessary systems is often seen as an activity that falls outside the normal budget of a general institution. - The willingness and ability of health personnel to accept and manage change is considered a major obstacle to implementing the EHR.
Opportunities	**Threats**
- As "managers" of personal information, citizens will be able to manage their own healthcare. - No duplicate data when a patient is transferred to a medical center to another reduces the risk of errors in the data and allows institutions to focus on its primary task of assistance. - Information intermediaries and the intermediate solutions will become an important area of development. - The diversity of solutions already available provides a rich learning opportunity. - There is an opportunity for close cooperation in the definition of standards. The continuing proliferation of e-health applications will likely cause a move towards shared access structures.	- Healthcare professionals need a change of attitude. This requires people to cooperate beyond the limits of their institutions, to describe the medical records of patients so that appropriate for all users of information. If not addressed the issue of protection and certification of data, implementation of services could found resistance

With this research we wanted to cover two main objectives: having a generalized view of the problems posed by the non-interoperability of different EHR systems in the Spanish Primary Public Health System, and undertaking the implementation thereof.

Results

EHRs systems incorporate many elements of information. The aim is to provide a global and an integrated clinical information system distributed across multiple heterogeneous and autonomous information [5]. In this section we will show the EHRs systems in the different regions in Spain and several solutions to get the required interoperability.

EHRs solutions in the different regions

Firstly, and as most important idea is that these systems contribute to improving patient care. We may say that the main objective is to integrate all the information for each user. This will improve the sanitary quality of the Spanish system and to be digitized, and will replace paper medical records.

Then we will analyze individually each of the pointing system in which standards are based, as well the characteristics:

Medora system Its development began in 2004. It has been developed by global technology company Indra and EHR system. It is divided into different modules and each of them has a different characterization [6].The first module was made up of basic health data, second data module on diagnostic measures and the third one includes contact information assistance.

Diraya system 'Diraya" comes from the Arabic word *knowledge*. It has been developed by company Indra and it is an EHR system is the pioneer in Spain. It is characterized by offering electronic prescription service as well as the centralized appointment system. It provides service to 94% of the population of Andalucia. It provides dispensing prescriptions electronically and it is the first which works in Europe. This is recorded in database so that simply presenting a health card to obtain medications.

Turriano system Health System Castilla la Mancha for excellence based on a group of applications [8]:

– Tajeta Turriano-health: updated online form administrative data of patients using the card information.
– Turriano - SITRAP: Allows you to request and seek medical transport.
– Turriano - Martindale: Indicates drug interactions based on Stockley.

- Turriano - Lab: allows sending and requests as a result of both analytical results. As for this service have used a variety of applications, this integration was done using the standard HL7, XML-based integration platform and BIE.
- Turriano - Ykonos: It promotes the mobility of digital radiology images from hospitals to health centers. You can see both the image and the corresponding radiological report.

A special feature to mention is the funding of the health system of e-learning courses for professionals who will make use of EHR.

SGP system In 2007 started developing its first phase being in 2009 when it began the introduction. In the beginning was implanted in one of the major hospitals in the community, continuing its implementation in other health centers [9]. Its features are the 'clinical station', 'Report Manager' and 'manager requests. First of all gives the possibility to access to medical records at a glance. The second contains the data objects connected with the patient and to retrieve data from other systems, making this an important feature. The latter allows the management of appointments between the different hospitals.

JARA system It was launched in 2004 but its development process began earlier. As noted in previous descriptions of the systems, it is based on a modular design [10]. The system has been awarded to IBM. Their main feature is that it is shared in primary care and specialty care.

HC³ system In 2006, the project was developed, having set the standards a year later. It should be noted that with accreditation, a user can access your HCCC through internet, who can make decisions about what data is visible or not the medical professional [11]. HCCC is based on a mixed model, featured because the assistance information is stored in different information systems, both hospitals, as primary care centers and, simultaneously, establishing a central contact point through a common system indexing, which makes information accessible to other healthcare organizations.

IANUS system Its first contact in a hospital occurred in 2004, and its full implementation by the end of 2007 produced a development of the same throughout this time [12]. It was a project carried out by the company Indra, this project is aimed at both primary care as the hospital ensures patient confidentiality. It was a project that includes the idea of compatibility with mobile handsets.

ABUCASIS system Project launched in 2005. It allows access to patient medical information, either primary care or

specialty hospital. It is a modular system consisting of three modules: MOS (Counter manager), GIP (Manager Comprehensive patient) and IND (Indicators Datamart). The first one is based on management diaries, both professionals and patients. The second module is responsible for the various different levels of access to the patient's EHR depending on the user profile. This project covers the entire network of the Valencian Community [13].

SELENE system As you can highlight features that is a healthcare information system that provides support and represents all that information. It meets the needs of professionals and all services associated with applications. It presents a global interoperability through the same because there are interactions between health care facilities in the Principality [14]. Also noteworthy is a history in summary form containing all the information generated at all levels of health and for all sites.

EDESIS system One of its main features is the use of the enterprise Service Bus: standards-based software platform that combines messaging, web services, data transformation and routing intelligent connect and coordinate the interaction of different applications [15]. It is also important to emphasize its service-oriented architecture.

HCI de SNS-O system There are two types of EHR in Navarre, one for Primary (commercial tool IMO) and one for Specialized (the tool itself HCI). The ultimate goal is the union of two sources of information to unify all information from the patient [16].

AP – MADRID system It is introduced in 11 health districts. In July of 2009, its implementation is around 97% of health facilities and replaces the previous system OMI-AP [17]. One current project is the implementation of electronic prescriptions. It has remained a developing system since it produces a variety of problems to solve.

Drago-AP system This management system is a tool well-established and accepted within the health field of Primary Care, for administrative and clinical management. System integrates the so-called "Program Counter" for managing agendas, quotes, service portfolio, completion of care, waiting list, reuptake, management consults and request additional evidence to the field of Specialized Care [18]. Of note is the functionality built into the application so that emergency services have access to a summary of the patient's medical history.

OSABIDE system It is based on the design of a general medical clinic station, which is mandatory viewing complete timeline of events and activities, a full planning work

for various care areas, a group of patients for each user of the system episode summaries, issue of diagnostic or drug prescriptions [19].

HCEC system During 2007 we have carried out the process of completing the different information systems that comprise the first phase of HCEC, the second phase includes the main improvements of this first phase and it is also based projects such as the corporate hospital information system corporate and clinical station. The first one is a system that manages the clinical care and administrative information necessary for the daily operation of a hospital. The second project will allow the user to have unified access to different applications of the system [20].

SELENE-AP system The need arises to address the adoption of technical standards, functional and semantic as a strategic element for the planning, design, implementation and maintenance of health information systems [21].

e-SIAP system. The main features are the next [22]:

– Multilayer. 3-layer technology allows you to easily change the user interface, so almost immediately the development of new interfaces to other devices such as phones, PDAs (Pocket-SIAP) or a web browser.
– Multilanguage. You can translate or configure the entire system without modifying the source code or compile. You can create as many concurrent languages as desired.
– Adapted to the rules of confidentiality and data protection of the Spanish Data Protection Act. (before LORTAD).
– GUI very carefully. Functionality and aesthetic quality. Developed using all the graphical power of Java Swing platform properties.
– Independent Data Base Management. Native access to the main managers of Oracle databases, Informix, Sybase.
– Distribution of Software over the Internet with integrated remote upgrade versions. This ensures that each user always has the latest version.

The cause of non interoperability is a fact, because each EHR system is based on a different standard (some of them don't apply an official standard) and that has some characteristics that differ from each other. The key is not based on the use of a common database on a server for the whole Spanish geography.

Table 2 shows a review with the most important techniques features about EHRs systems in primary care.

The awareness of the need that all professionals have hands all the information on a patient regardless of the point Spanish geography in which it is located, this is very important; for this, we must develop a common architecture for

Table 2 EHRs in primary health system in different regions of Spain

Region	EHR system	EHR Standard / used technologies
Castilla y León	MEDORA[6]	HL7/CDA. Java
Andalucía	DIRAYA[7]	Java
Castilla-La Mancha	TURRIANO [8]	Java
Aragón	SGP [9]	DICOM, HL7, HTTP/FTP or INE
Extremadura	JARA[10]	Java
Cataluña	HC³ [11]	Java
Galicia	IANUS [12]	Java
Comunidad Valenciana	ABUCASIS [13]	Java
Región de Murcia	SELENE [14]	CIE-9-CM
Principado de Asturias	EDESIS [15]	HL7
		It incorporates other standards like (CDA, CCOW, Geller)
Comunidad Foral de Navarra	HCI de SNS-O [16]	Java
Comunidad de Madrid	AP-Madrid [17]	HL7, IHE, DICOM, XML
Canarias	Drago-AP [18]	Java
País Vasco	OSABIDE [19]	Java
Cantabria	HCEC [20]	Java
		Information integration with HL7 y DICOM
La Rioja	SELENE AP [21]	Java
Islas Baleares, Ceuta and Melilla	e-SIAP [22]	Java

all systems that allow compatibility between each of the systems of each region.

Solutions for interoperability

Analyzing different possibilities, we concluded that we can mention, at least, two feasible solutions, without taking into account the huge economic investment would be for the state as well as the enormous work that would develop these projects. It could be feasible because it wouldn't be a solution for each autonomous community whose problem has been mentioned before, the independent health polity, but would be a joint solution to the whole state.

One solution is: why not create a unique EHR that store data of all patients who are part of the health system? The idea is to develop a uniform system for each and every one of the regions that make up the country. Create a single and centralized database, keeping each of the communities their own electronic health records without having to design a common project, nowadays, and the amount of money invested in each of these electronic systems by the autonomous communities, would not be viable. This idea is showed

by Fig. 1. Like any project, it has problems, being the most notable, the large financial investment that this would be for the state, because it would have to dump millions of records of millions of people who use Spanish health system. This idea involves the creation of a backup, a security copy of the database, due to it would be a catastrophe to lose all these clinical data. We may also throw over this idea, but storing new records without the need to dump data from the millions of existing users. It presents a problem, not to be a total homogeneous solution but these would be a long term solution therefore this is not a solution for the population currently are using these systems.

A second solution would be to develop a link through the Internet that allow to access to each of the databases for EHRs systems from anywhere in the country. Why not create a Web platform from which health personnel, with certain permits's own primary care physician of the patient,

could access to database which is stored the patient record in question?

We agree that should meet certain conditions, such as clinical data that could only be modified by the primary care itself, being only permissible consultation and writing of new data by medical personnel who accesses it through web platform. It would be a project of a lower economic impact because of it would be necessary to move data from one database to another, but that would be accessed the patient's own history by a web link. On this occasion, to make use of the Internet, enter into discussions to ensure the privacy of patient data, but you can assume that the company would develop the web platform into account all security protocols such as HTTPS. There is a pilot solution aimed at resolving the problem when a patient is temporarily in other region, but not when the patient changes the residence. This is because it is based on a partial interoperability. You can
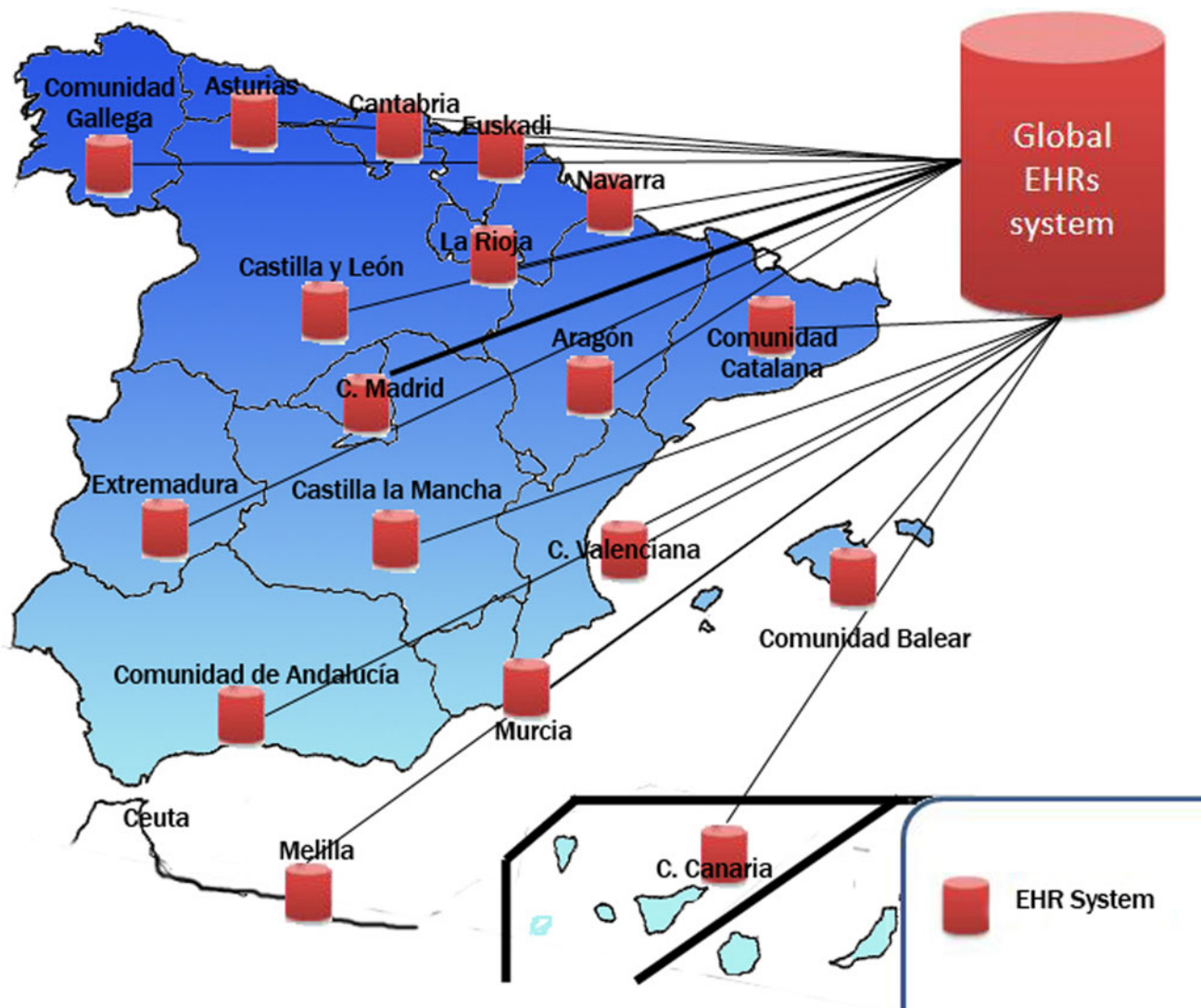

Fig. 1 Unique EHR system

access a summary of the most important antecedents of the patient but not the full medical history. Many of these excerpts from medical history are in patient's hands. Its development began in late 2007 and early 2008 to develop proposals to take forward the project to get called HCDSNS, which aims EHRs interoperability of all the NHS. The standard policy to follow is: The format of the documents to be exchanged must be in PDF format, DICOM images and formatting XML data exchange. It must meet the same way about security certificates. The exchange of clinical information is based on HL7. The technical architecture is based on the Central Node Exchange of the Ministry of Health and Social Policy, and technology standards defined in the framework of the project. This node is the hardware and software infrastructure that facilitates the exchange of information. We can also see this idea in Fig. 2.

This pilot project is divided into two phases being in the first 8 Communities that opted to join the Phase I: Andalucia,

Baleares Islands, Cantabria, Castilla and Leon, Catalonia, La Rioja, Murcia and Valencia. Phase II includes Castilla la Mancha and Extremadura. In March 2009 has begun the exchange phase of the pilot study, with the participation of professionals and citizens delimited territorial actual scenarios of two regions: Baleares Islands and Valencia.

Discussion

The use of EHRs systems in primary care is supported by patients and health professionals alike. However, to sustain adoption of EHR services, systematic educational and awareness raising activities are necessary. In this way, the next generation of empowered Internet-aware patients will ripe the full benefits of e-Health not only in urban highly-developed areas, but also in less-developed remote and isolated rural communities [23]. They all have one main
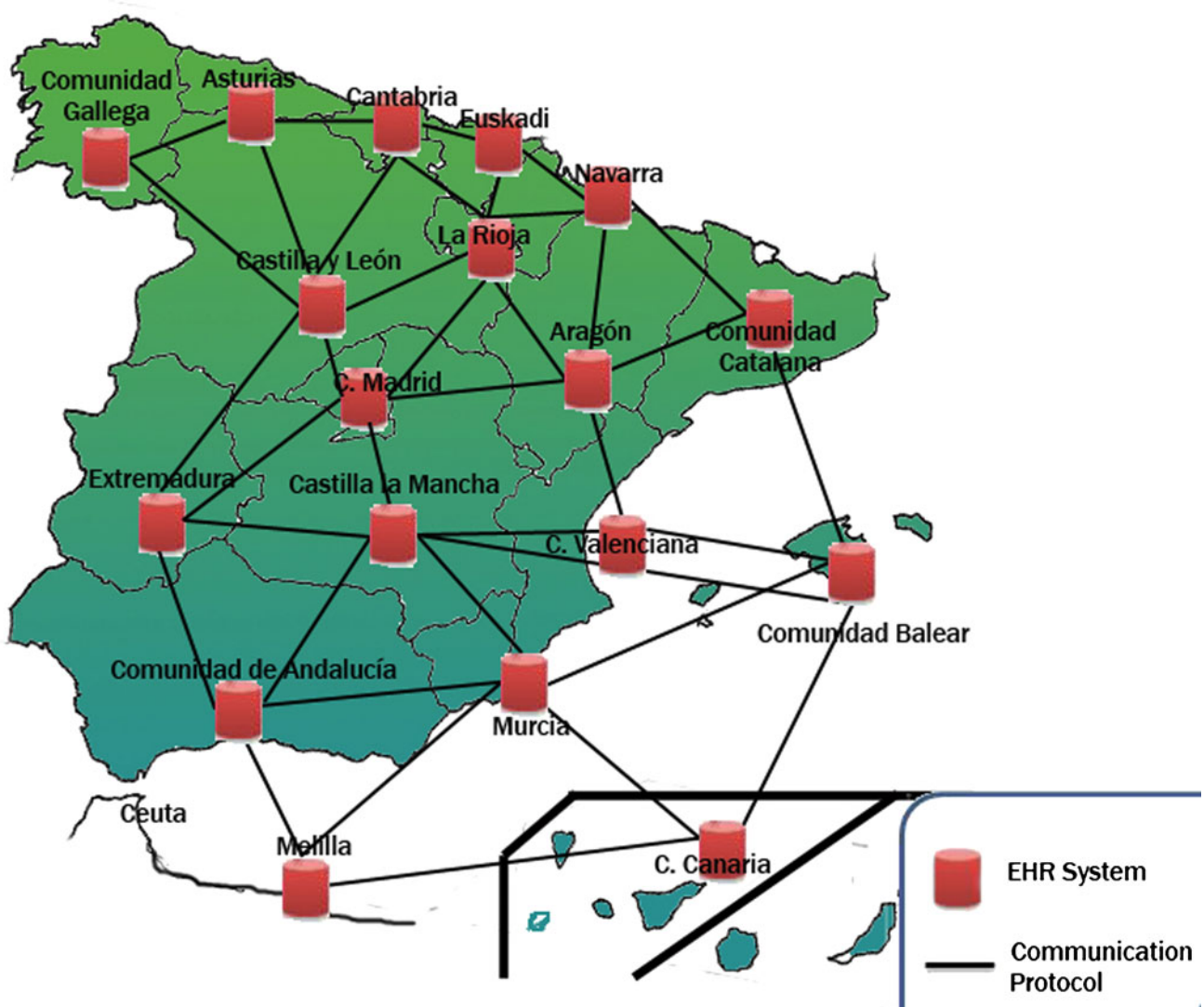

Fig. 2 Link through Internet

objective that we have mentioned before, but each one works differently. They all rely on a database that stores all scanned patient information, but each one has some strengths and weaknesses that must be improved to a good health system performance. The most important thing is that no information is lost and that access to it can be performed quickly and efficiently because otherwise it will slow down the primary care and waiting by patients for treatment is one of the weaknesses the public health system. It consists to define minimum variables that should include the corn of a common EHR without wondering about problem solving. The patient lies on the axis of the system and they are increasingly effective criteria of quality and excellence in the services offered to citizens, becomes more important the need to manage resources appropriately. One of the many problems that have occurred in some of these systems is the fall of the servers that cause problems in the program, as well as blocked. One of the worst systems and major controversy has been generated is AP-Madrid. This forces professionals to return to pencil and paper.

About feedback is not good for all of them. They present many mistakes which should be solve earlier. Sometimes health maintenance data in EHRs were often incomplete. Patients were often able to provide useful information, demonstrating the value of patient contributions in keeping records up-to-date by the way engaging patients in the review and electronic submission of health maintenance information can contribute to a more complete EHR [24].

It is very important that there is no breakdown in these systems because they depend on transit daily health. One of the most important aspects which it has been developed this project is a result of a consensus of medical professionals. But is important to say as a major moral discussion that this entails is: Are these programs safe and maintain the privacy of medical records of patients? Based on experience of privacy research, we may classify the privacy issues in following seven categories: consent, transparency, control over the record, collection limitation, data security and accuracy and identifiers [25].

Talking about moral point of view, one of the largest surveys of the health information privacy views of patients and their physicians in EHRs practices says that generally embraced the potential benefits that computers can bring in terms of sharing, integrating and evaluating information when used for their direct care. But however many patients were concerned that access to this electronic database might not have adequate restrictions. Particularly they are worried about the information can be to make public through internet [26].

Little information was available about privacy and liability. Soaring health care demand is driven by age. In other hand increased primary health care demand is more permanent than originally thought due to the complicating factors. Such

solutions can assist physicians in tracking patient medical history, interventions, encounters, lab test results as well as managing allergies and drug contraindication. Physicians and their staff may have concerns over efficiency, financial, quality, liability, safety and other factors which must be addressed before they consider investing significant resources in the project [27, 28].

Conclusions

In Spain, all regions have a EHRs system in primary health care. It is a big step but we should develop a unique system for all the different regions of Spain. This system would allow for all Spanish citizens the information was stored in only one database. It would be the best way for professionals could consult all patient information regardless of the Spanish region in which the patient was although this was not his original region.

The last aim is the interoperability of different systems in the network of EHR's in the different regions, but this is not easy. Autonomy has invested large amount of money to develop these systems with their corresponding standards, it would be possible to establish a single program but it wouldn't be viable since all the amounts spent and the efforts and support that have persisted for each of the projects is too much.

How could the interoperability? The need arises to develop a common protocol for all storage systems of electronic patient records but this is not a simple task since it would have to develop a protocol that was able to translate and make interoperable the different systems in each community and not all of them are based on a common standard.

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