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The Rhône-Alpes Health Platform

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Summary

Objectives: The purpose of this work is to develop a health information platform connecting most health facilities in the Rhône-Alpes region. The health platform called SIS-RA is used through a Web interface. An iconic interface is dedicated to the platform and presents information in a unique way for all users.

Methods: New techniques have been used to develop this platform which will be used by a great number of Rhône-Alpes doctors in the future. We chose a user-centered design which takes into account doctors' requirements (hospital and GP). We also consider that no system has to be rebuilt, but a direct connection to the legacy systems should be provided.

Results: The platform permits fast and more appropriate medical decisions than those made without this information system. The iconic interface presents all medical documents in a uniform way. Currently, 11 healthcare facilities and 15 community health networks are connected to SIS-RA sharing more than 60,000 records with 1.2 million indexed items. 3200 doctors use the system.

Conclusion: The platform is approved by French supervision authorities (regional hospitals association (ARH)), regional practitioners union (URML) and Rhônes-Alpes region administration and is known as the official shared health record.

Keywords

Electronic medical record, medical interfaces, health platform

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1. Introduction

Health networks currently represent the most friendly and innovative concept in terms of coordination of patient care between health practitioners. As a consequence of recently passed governmental policies, medical information systems (IS) must now comply with new standards aiming at improving communication between as yet very different platforms. This heterogeneity can be defined at different levels such as data format (relational, XML, object, etc.), operating systems (MacOS, Linux, Windows), data exchange protocols (HL7, Dicom, EhrCom, etc.), data semantics and syntax. On a larger scale, differences between IS are observed within medical subspecialties (e.g. cardiology, nephrology, emergency care, ambulatory medicine, etc.) as well as medical IS structures (e.g. departmental IS, distributed IS, etc.). The concept of a health platform at the state level dates back more than ten years. During the 1996 Medical Informatics Europe congress, Johansen [1] proposed the "ten commandments for implementation of regional health care networks". Ten years ago, this innovative concept had no chance of implementation due to the limits of technology and the lack of understanding from healthcare professionals.

Rhône-Alpes (Fig. 1) is the second largest administrative region in France after Ile-de-France (which includes the capital, Paris). As large as Denmark in size and with 6 million inhabitants, it is comparable to a European country. Rhône-Alpes has 300 healthcare facilities, three academic medical centers (based in the cities of Lyon, Saint Etienne and Grenoble), one regional comprehensive cancer center, more than 20,000 physicians and over 10,000 caregivers. The concept of a universal electronic patient record (DPPR) was initiated in 2000 by health professionals from the regional comprehensive cancer center of Lyon (Centre Léon Bérard) and the ONCORA community cancer network (ONCOlogy Rhône-Alpes). We present here the Rhône-Alpes health platform currently in use by numerous physicians and caregivers.

The project was possible because:

- Rhône-Alpes doctors have been involved in the project and have understood what benefit they would derive from it (patient medical information available in a very short time).
- The system is exclusively based on medical documents, which facilitates its use by medical teams. The working process is the same, whether the doctors use the system or not.
- The universal interface which is proposed allows very simple retrieval of medical information.
- There has been a total consensus between the three university medical centers, Léon Bérard cancer center and the 53 hospitals from the ONCORA community network regarding the direction of the project.

2. The Rhône-Alpes Health Information System

2.1 Reference Knowledge and Former Experience

Several major issues are at stake: the type of regional health record system needed, the level of computerization in the health sector,

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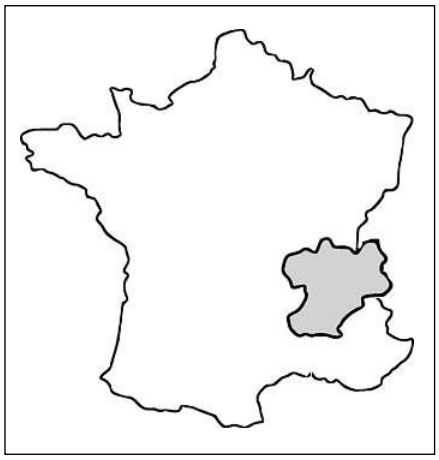

Fig. 1 Rhône-Alpes region in France

and the suitability of existing information systems as a basis for elaborating the new regional system. To answer those questions, we used a bottom-up model allowing us to involve key health actors in the implementation of the record. All ideas started from observations in the field by practitioners themselves. Involvement of end users was a key aspect of our project.

ONCORA was originally confronted with the incredible heterogeneity of existing IS. To judge by the interviews we conducted for selecting the five pilot facilities, the management and consultation of local patient records depended entirely on the type of institution. We decided to conduct a preliminary appraisal of the computerization level of hospitals and existing information systems. Our major goal was to identify organizational differences between facilities, which would help elaborate connections adapted to each type of structure. We built a scale of six different levels of computerization (Fig. 3) and asked the 300 facilities in Rhônes-Alpes to position themselves on this scale. The span of the survey and proportion of responses (more than 86%) ensured the credibility of the results and their relevance for determining our current development strategy.

Instead of a traditional Gauss curve, the computerization survey revealed two peaks (Fig. 3) identifying two groups of hospitals. The first group (58%) are little-computerized institutions that must resort to manual tools to structure and send their data to the regional IS. The second group (the other 42%) corresponds to hospitals which have enough infrastructure to directly and automatically store and share information with the regional IS. Consequently, we decided to work on two different connections taking into account the specificity of each hospital. New results of the same survey will probably be published in about 12 months to monitor changes, the long-term goal of the project being to bring all hospitals to a minimum of level 3.

We also draw inferences from a former experience of a centralized specialized cancer record that was stopped a few years ago because it was found unsuitable for use in the healthcare environment. We decided to go the opposite way to avoid repeating the same problems. The regional IS described in this paper is a fully distributed, multi-disease model (maximum record).

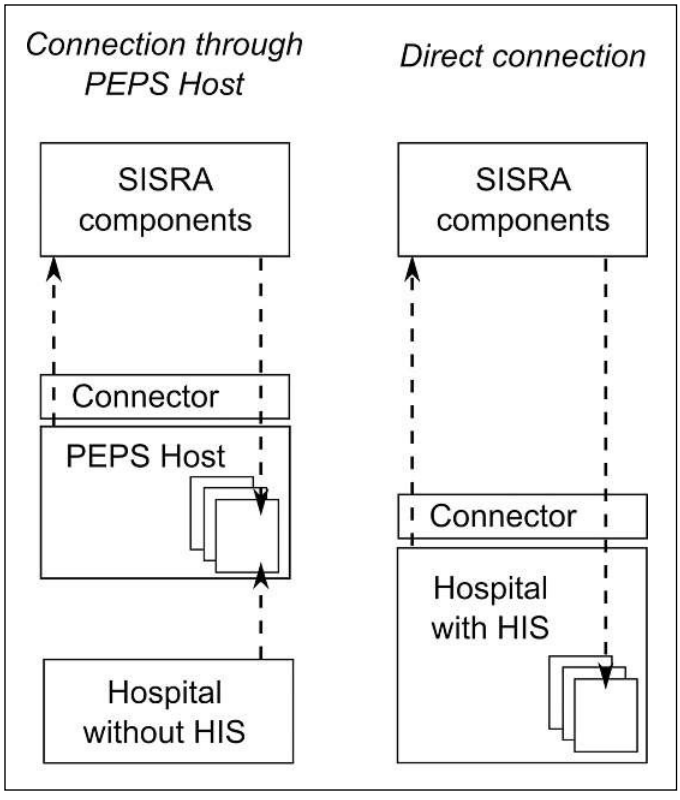

Fig. 2 Two different connections according to the computerization level of hospitals

2.2 Architecture of the Rhône-Alpes Platform (SIS-RA)

We took into account all specific features of the health information systems in current use in Rhônes-Alpes. SIS-RA was composed of different business components in order to meet the needs of every existing health IS. The basic principle underlying the project was that no interference with the local IS plan should be possible.

The first part of the project consisted of making hospital document repositories connectable. According to the survey, the second group of hospitals (levels 3 to 5) were able to connect directly to SIS-RA and share information. Connection was achieved through connectors (Fig. 2) developed in partnership with software editors in each hospital.

Hospitals of the first group needed to implement a new tool to organize, store and share their data. SIS-RA provided them with an external storage tool (PEPS Host) (Fig. 2) that could store and guarantee full-time access to information. For scattered members of the health community network, SIS-RA provided a communication tool (PEPS Network) that also ensured connections with the regional IS.

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Finally, all health facilities in Rhône-Alpes became able to share their data, whatever their computerization level. Today, the connected hospitals are totally available and no negative feedback has been received. In any case, a hospital with availability difficulties can adopt a PEPS host solution.

An essential requirement for SIS-RA is patient identification, which allows the organization of data. French law does not permit the use of national patient identifiers, so every legacy IS has developed its own local patient numbering system. The challenge was to match all the local records available for a given patient. A specialized dedicated component (STIC) was built to achieve patient identification on a regional basis. According to the principle that existing systems should not be modified, the local identification (ID) of a given patient in a given hospital remained the same. The STIC connection was designed as an add-on to existing processes.

We have set up a regional identification charter that was published by the Regional Hospital Agency in 2003 and has been put into practice since. Five immutable identity fields are used: birth name, first name, birthdate, postcode of birthplace, and sex. Using special algorithms, STIC matches identity fields and links every local ID with the patient's regional ID. Manual human check is required if automatic mapping looks suspicious or cannot be achieved.

Last but not least, the DPPR federates all regional health repositories and serves as a unique web-based portal to health information in Rhônes-Alpes. The system handles the authentication of users, authorizations for record queries and displaying of structured (XML) or unstructured data (pdf, doc, jpg ...). The DPPR contains no data but only meta-data indexes. On each record query, the system generates queries to all hospital repositories known to store data about the patient. In this decentralized system, hospitals are responsible for updating the information they produce. The DPPR is just a pointer system and authorization manager.

The regional authorization policy (Fig. 4) protects patients' rights. Health professionals must be directly authorized by the patients themselves to have access to their health record. They are strongly authenticated via their professional electronic card and its embedded certificate chip. All authorizations are detailed and manageable online, and can be specially configured for the health professional or information category.

PEPS Host and PEPS network provide storage and connectivity to little-computerized hospitals and scattered users. Patient identification integrity is secured by STIC whereas the DPPR is the unique consultation portal for health information in Rhônes-Alpes. With those three components, Rhônes-Alpes has been able to meet most of the needs in health information accessibility.

Today, the nomenclature of the types of information are based on which used in the French DMP. For the diseases, ICD-10 is implemented.

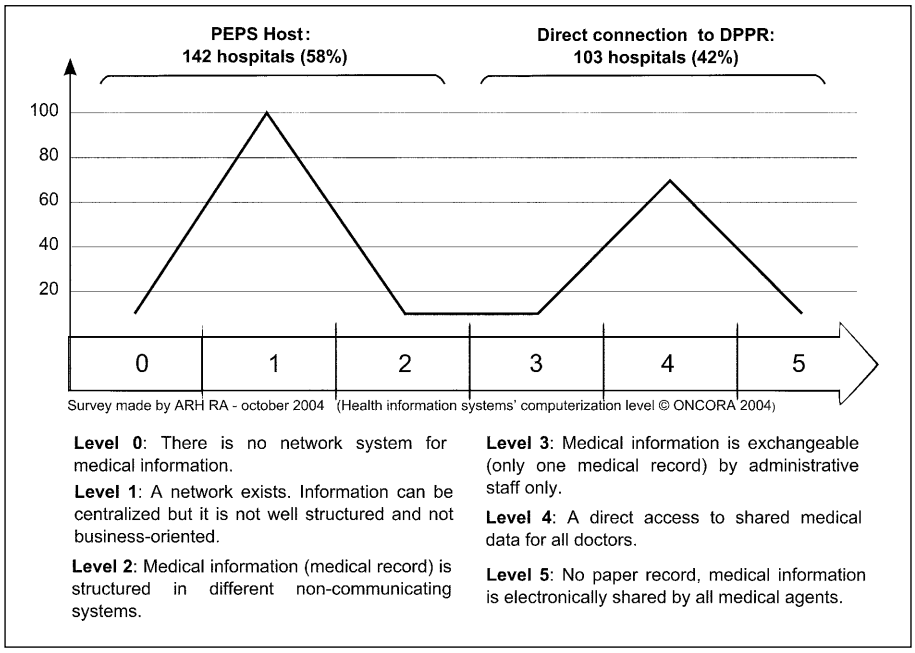

Fig. 3 Levels of computerization

2.3 Functional Scenario

The scenario (Fig. 5) involves two steps: creation of the patient record and consultation of the data. The creation of the virtual patient record is as follows:

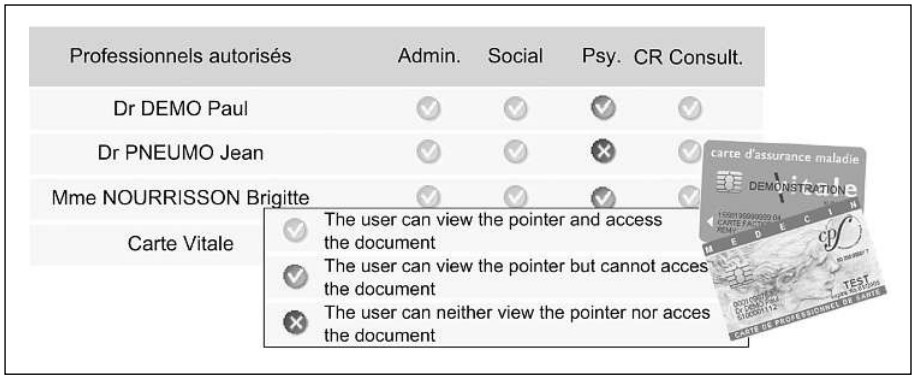

Fig. 4 Screens of access rights

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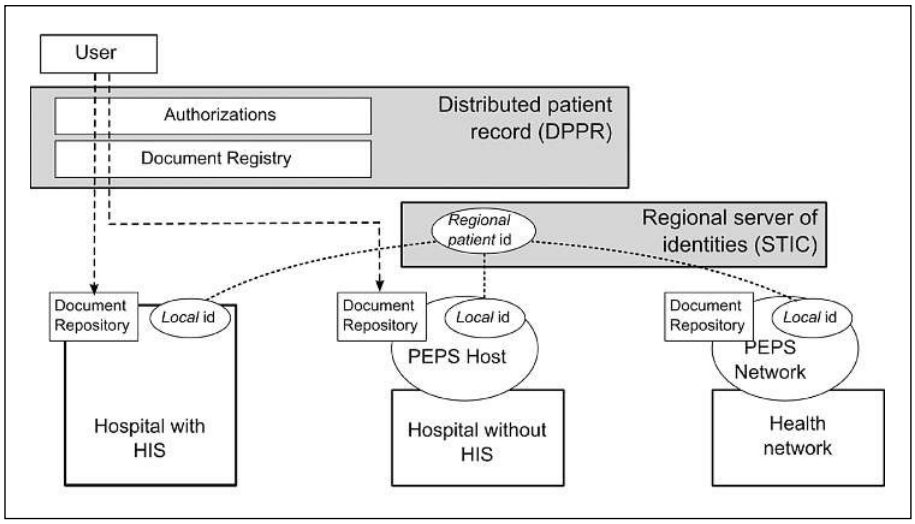

Fig. 5 SISRA general architecture

1) During their care trajectory, patients may be admitted to different hospitals, with different levels of computerization, but all clinical teams can access the patients' health records and complete them if the hospital is connected to SIS-RA. At each step of the patient trajectory a local ID is created.
2) STIC provides algorithms and tools, allowing to automatically match new identity data with those of known patients. If no match is found, a new patient record is created in the regional repository. Both SIS-RA and hospitals can then use the same regional ID to identify the patient.
3) New health record items are linked to the electronic DPPR record of each patient via this ID. Actually, the data remain in the document repository of the hospital and only meta-data are sent to and indexed by the DPPR.

After the record has been created, doctors can access data:

1) Consultation is available from any computer connected to the Internet. Users are identified via a certificate embedded in their health professional card.
2) The DPPR checks access authorizations, then health professionals can browse the files and ask for display.
3) The IS where the data are stored makes them suitable for display, whatever the format of the original document (doc, pdf, XML, html ...).

3. The Iconic Interface Management System (I²MS)

Currently, SIS-RA essentially connects hospitals and health facilities. To facilitate the integration of general practitioners into the system, we propose to weave an Ariadne's thread between their practices and hospitals. This system would be a semantic middleware between the two entities involved in the pulling and pushing of medical information.

3.1 Definition

Our system is based on the fundamental principle that rebuilding cannot be painless: legacy medical information systems are too different and specific to offer even a slight possibility of reasonable interoperability. The goal of the project was to develop a toolbox able to assign a data pattern to each type of data used in the medical domain: documents, structured or semi-structured data, anatomic data (numeric or text), etc.

These different patterns (referred to as "objects") must be visualized as simply as possible. We defined a chronological model with a temporal axis. The patterns are instantiated into values to be manipulated by the end user. Prescriptions, summary reports, or lab tests are converted into patterns and the instantiation of theses patterns is displayed on a chronological axis. Data storage and display are independent, and a remote access (if needed) is proposed. The legal aspects have not been really considered. The external documents are not (for the moment) downloaded in the local databases, they are displayed on the user's screen and will disappear after closing. In the French DMP, the problem is the same: all the documents must be shared and read by a local user.

3.2 Architecture

The architecture of the system is structured around three levels:

- The meta-meta level (not presented here) concerns the definition of the abstract structure of the iconic interface management system.
- The meta-level is the I²MS, an abstract structure adapted to the medical domain. All medical objects and documents are defined, based on a consensus which is a prerequisite for data sharing.
- The business level, where medical objects are derived for medical specialties.

A linear classification of objects used in a given domain (here medicine) was impossible as different levels of analysis were specified. We proposed a multi-classification based on three criteria:

- composition: simple objects and complex objects;
- communication: specialty objects, common objects and owner objects;
- abstraction: instantiation of abstract objects to produce concrete objects.

3.3. Object Representation

3.3.1 Composition Criterion

A simple object is an elementary unit corresponding to only one of the following

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types: text, numeric data, image, video, and signal. A simple object is described by an identifier, a name, and a list of attributes.

SO = {id, name, attribute*{value, type}}

A complex object is an item composed of one or several simple or complex objects. It contains its own data and the meta-data contained in other simple or complex objects.

CO ={id, name, attribute*{value, type}, SO*, CO*}

3.3.2 Communication Criterion

An owner object is only visible to its designer. It is used locally and never shared.

A common object is shared by all users in the network.

A specialty object is visible to its designer and to all professionals of the same specialty (cardiologists at different hospitals, for instance).

3.3.3 Abstraction Criterion

An abstract object is a meta-level object defining the nature, composition and interface of the object. It is represented by a tuple of three components: AO = {name, structure, interface}.

Business designers generally develop abstract objects from a consensus among the profession. Some individual users can create abstract objects for their own use.

A concrete object represents the instantiation of an abstract object.

3.4 Interface Building

Objects are displayed on a chronological axis representing the global medical history of a given patient. Two types of elements are displayed: disease episodes and objects consisting of medical documents or data.

3.4.1 Object Representation

Examples of simple or complex objects are given below.

Simple object: patient prescription (Fig. 6); a click on P displays the document; complex object composed of multiple simple objects.

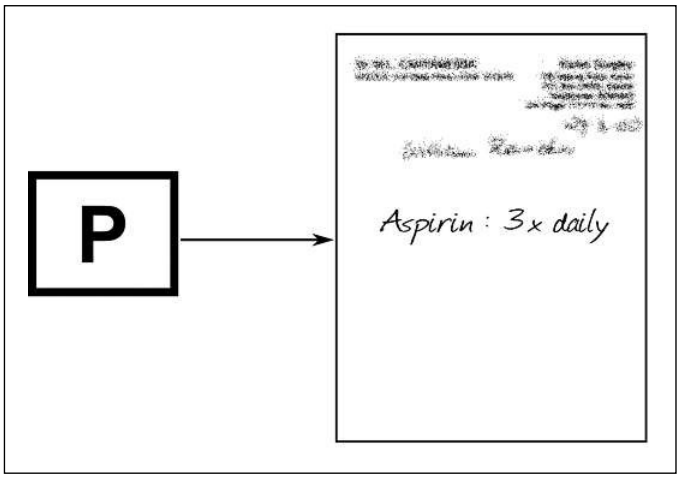

Fig. 6 Representation of a simple object (prescription)

In an oncology unit (Fig. 7), all objects are displayed on the user's screen and accessible to the entire medical team. In a consultation room, objects CH are removed and not accessible to physicians from other specialties.

The interface described in Figure 8 is divided into three parts. The first part, on the left of the screen, corresponds to the knowledge base. It contains abstract objects and a medical ontology.

Abstract objects are instantiated by the user into local or common objects. The upper zone corresponds to the iconic interface: concrete objects and episodes are placed on the chronological axis and their contents are stored in the local system where they have been created. The lower zone is optional and is only displayed when an ontology or a databank is needed to find the name of a given object.

4. Related Work and Discussion

Many groups are currently investigating medical platforms using different approaches: the first approach consists of

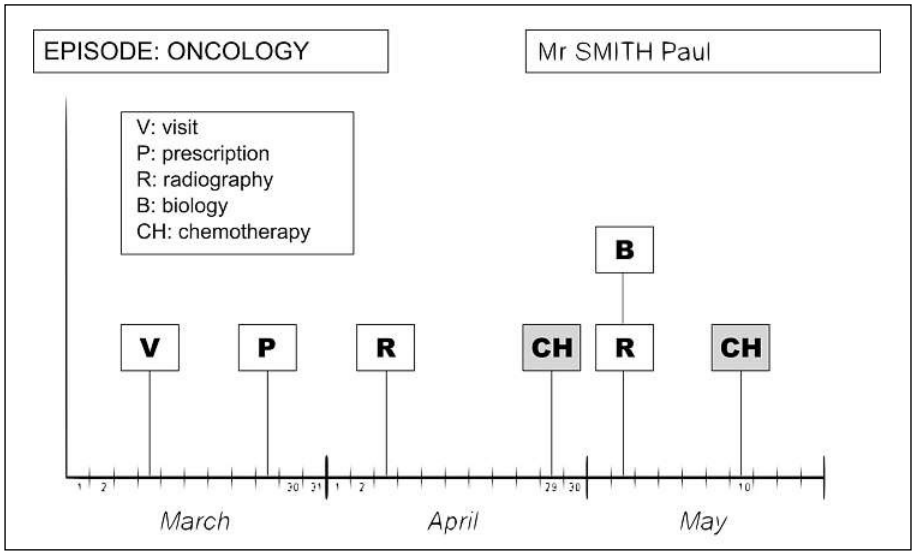

Fig. 7 Representation of a complex object (chemotherapy: CH)

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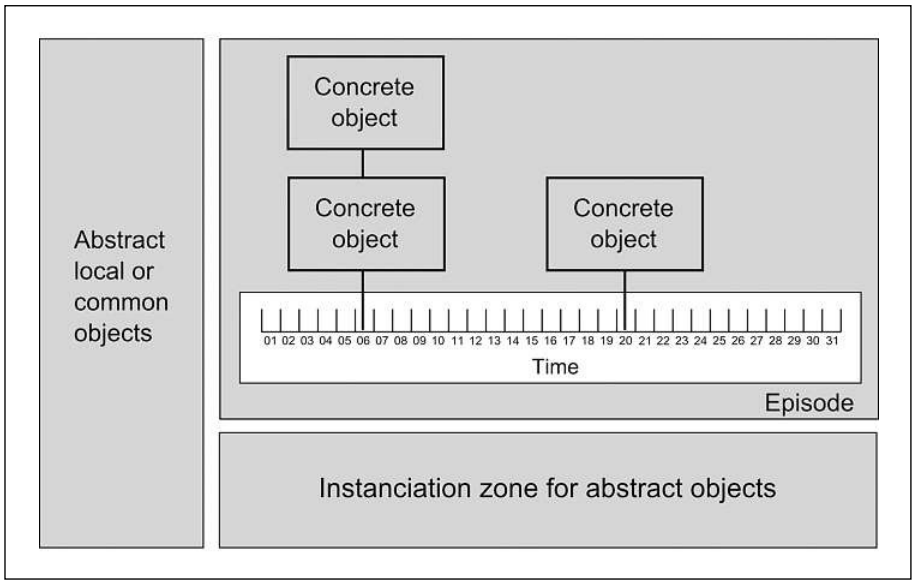

Fig. 8 I²MS structure

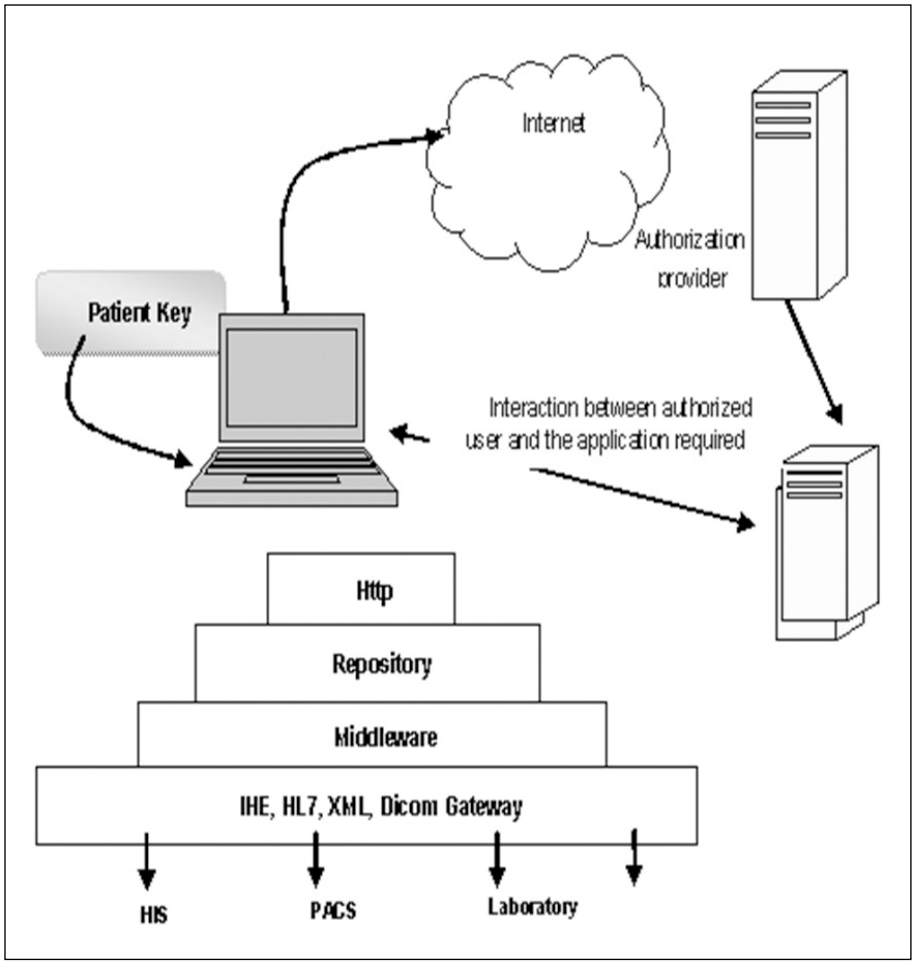

Fig. 9 Milan's health platform architecture

considering the web as a useful medium to link medical data and facilitate patient follow-up [2, 3].

Other work has addressed the issue of interoperability between heterogeneous medical information systems. Spahni et al. [4] and Xu et al. [5] have created Pilot, an application program interface that serves as a mediator between different information systems. Masuda et al. [6] proposed an upstream system which creates an exchange format at the conceptual level (use cases). Semantic integration is also a very important topic of research, with interesting studies published by [7-9].

Some approaches are more centered around the users and propose navigation tools [10] or the integration of interfaces [11].

Finally, some studies have been carried out to promote evaluation in health networks [12] and [13].

Two main projects concerning a health platform are ahead of Western Europe apart the Rhône-Alpes platform.

The Swiss project (http://www.geneve.ch/reforme/fiche.asp?noref=C4) called e-toile is a platform which aims to connect each medical partner through a patient card. This card gives access to all information systems: hospital, GP, specialists, pharmacies and other networks. Through e-toile, every health professional can have access (with authorization) to the patient medical record.

The Italian project of Lombardia called e-government (www.niguardaonline.it) develops a complete workflow system within the Niguarda hospital in Milan (e.g. Fig. 9). All the flows concerning a patient are defined and all processes identified in an Internet-based architecture shown in the following figure. The access rights are given from a small patient case. Some gateways are created to "understand" all types of medical data and some exchange formats.

The Rhône-Alpes health platform is in line with these projects but the main difference is the scope of the platform (in the other projects, the network is limited within an hospital). The Quebec region is building a prototype to validate the Rhône-Alpes platform in Quebec.

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5. Conclusion

The DPPR is currently considered as a consolidated shared health record and has received approval from French supervision authorities: Regional Hospitalisation Agency (ARH), regional federations of health insurance funds (URCAM), Regional Independent Doctor Association (URML), Rhône-Alpes region administration. Eleven healthcare facilities and 15 community health networks are now connected to SISRA, sharing more than 80,000 records with 1.2 million medical items indexed.

Some tests have been done. Response times are dependent on both the type of connection and the information format. Today, with high-speed networks, the browsing of the patient record is similar to the navigation in a Web site.

These tools have been developed with public funds and are being shared in an Open Source community. Many other French or foreign healthcare organizations are interested in the functionalities of the system, all the more so as many other projects should be incorporated shortly: development of information flows in emergency care, introduction of medical items by independent physicians, development of an ASP hospital information system, and the I^2MS project.

The third generation development plan for the organization of health foresees that, by 2010, all healthcare facilities of the region should be connected to the DPPR.

Evaluations concerning the appropriation of the platform by the doctors and the intuitive fact that it will permit a better quality of care and a more rapid decision making have not been yet carried out. The platform is quite new and no real feedback can be given.

Acknowledgments
The authors thank particularly all doctors for the vision to develop such an ambitious project, the four Rhône-Alpes institutions (Conseil Régional, Agence Régionale de l'Hospitalisation – ARH, Union Régionale des Caisses d'Assurance Maladie – URCAM, and Union Régionale de la Médecine Libérale – URML) for their important political and financial support, and the ASTHRA society for their support.

References

1. Johansen et al. Ten commandments for implementation of regional health care networks. MIE 1996, Copenhagen.
2. Poulymenopoulou M, Malamateniou F, Vassilacopoulos G. Emergency healthcare process automation using workflow technology and web services. Medical Informatics and the Internet in Medicine. Taylor and Francis Publishers 2003; 28 (3): 195-207.
3. Eichelberg M, Kronberg K, Heidkamp D, Gründler M, Nee O, Spekker H. Cross-departmental access to relevant clinical information for early rehabilitation using a web-based medical multimedia document server. IEEE Computers in Cardiology, September 25-28, 2005.
4. Spahni S, Scherrer JR, Adany J, Labussière S, Sauquet D. The Pilot: a tool for connecting existing HIS to an extranet quicky, easily and smoothly. Medinfo 2001. Patel V, et al. (eds). Amsterdam: IOS Press, IMIA, 2001. pp 53-57.
5. Xu Y, et al. Integrating medical applications in an open architecture through generic and reusable components. Medinfo 2001. Patel V, et al. (eds). Amsterdam: IOS Press, IMIA, 2001. pp 63-67.
6. Masuda G, Sakamoto N, Sakai R, Yamamoto R. An exchange format for use-cases of hospital information systems. Medinfo 2001. Patel V, et al. (eds). Amsterdam: IOS Press, IMIA, 2001. pp 109-113.
7. Ehrig M, Sure Y. Adaptive Semantic Integration. Proceedings of the 31st VLDB Conference, VLDB Workshop ODBIS 2005. Trondheim, Norway, 2005. pp 12-17.
8. Casanovas P, et al. SEKT legal use case components: ontology and architectural design. In: Proceedings of ICAIL 05, 2005.
9. Tempich C, et al. XAROP: a midterm report in introducing a decentralized semantics-based knowledge sharing application. In: Karagiannis D, Reimer U, editors, Proceedings of the 5th Int Conf on Practical Aspects of Knowledge Management (PAKM 2004). LNCS, Vienna, Austria: Springer; December 2004.
10. Ouziri M, Verdier C, Flory A. Data integration and user modelling: an approach based on Topic Maps and Description Logics. ICEIS 2005. 6th Int Conf on Enterprise Information Systems, supported by ACM. Miami, USA: May 2005.
11. Clayton PD, et al. Building a comprehensive clinical information system from components: the approach at Intermontain Health Care. Methods Inf Med 2003; 42 (1): 1-7.
12. Nykänen P, Karimaa E. Success and failure factors in the regional health information system design process – Results from a constructive evaluation study. Methods Inf Med 2006; 45 (1): 85-89.
13. Machan C, Ammenwerth E, Schabetsberger T. Evaluation of the electronic transmission of medical findings from hospitals to practitioners by triangulation. Methods Inf Med 2006; 45 (2): 225-233.

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