

Università degli Studi di Trieste

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Corso di Laurea Magistrale in  
INGEGNERIA CLINICA

**HEALTH INFORMATICS  
STANDARD: AN EXAMPLE OF  
APPLICATION**

**Corso di Informatica Medica**

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# THE LOMBARDY REGION HEALTHCARE SYSTEM



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- Large, heterogeneous territory (23863 Km<sup>2</sup>), spreading from the Po valley to the Alps
- Regional Healthcare System Numbers:
  - 10 millions citizens
  - 150,000 Health and Social Care Worker
  - 7,800 GPs
  - 2,600 pharmacies
  - 35 Public Hospitals
  - 15 Local Healthcare Units
  - 2,500 Private Healthcare Organizations.

# HEALTH IT ISSUES IN LOMBARDY



- Information Technologies (ITs) have now entered the everyday workflow in a variety of Healthcare Providers with a certain degree of independence → difficulty in interoperability between information systems
- Heterogeneous generations of IT systems were acquired through time, even over decades.
- The development and adoption of medical IT standards were evolving, and the evolution is still underway.
- The lack of clear and definite political guidelines favoured the emerging difficulties in obtaining interoperable systems able to exchange and share data



**the adoption and  
implementation of standards is a  
possible solution**

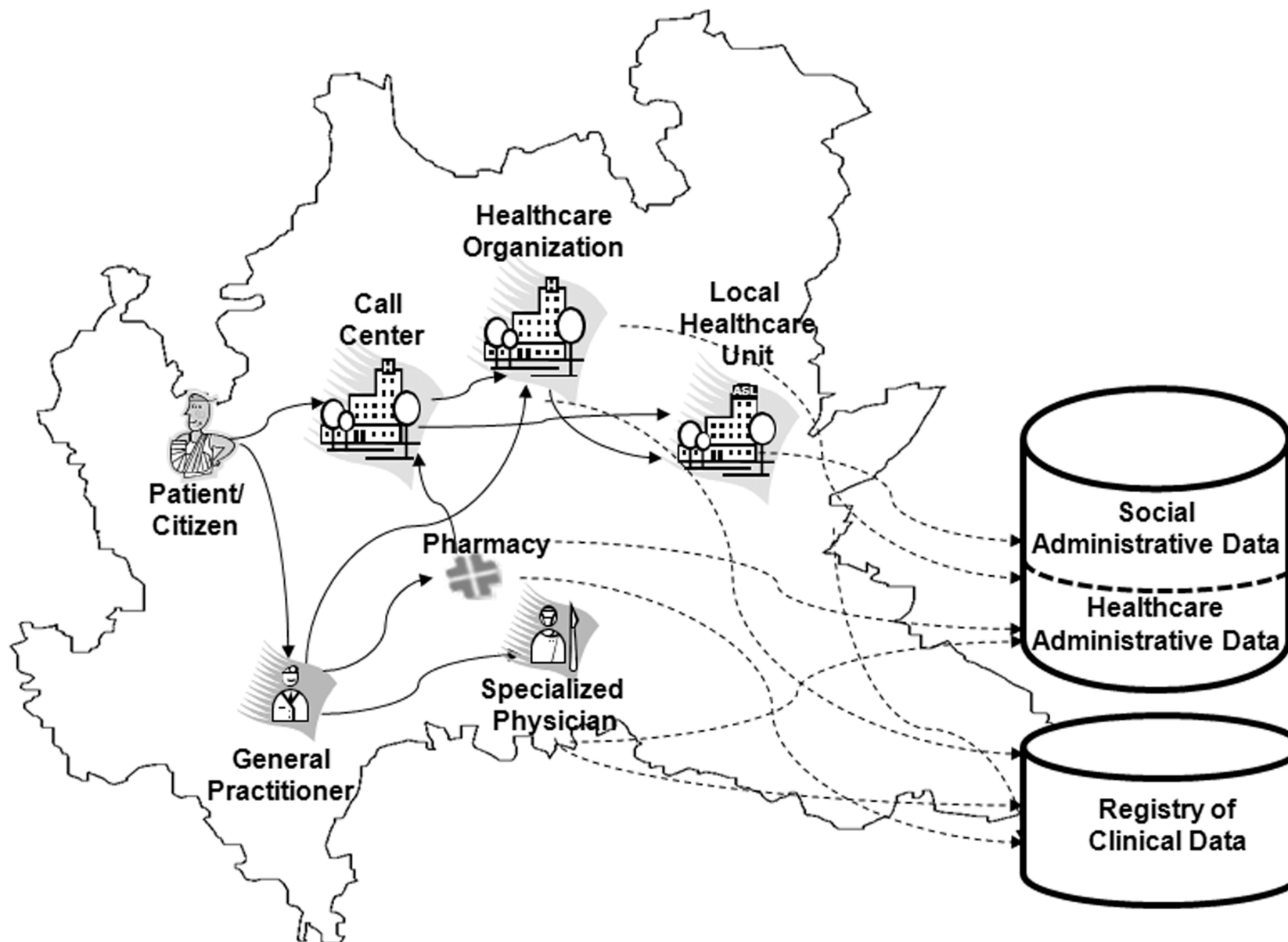
# MILESTONES



<b>Year</b>	<b>Milestone of the Lombardy information system development</b>
1978	Collection and filing of information relative to hospitalizations: All public hospitals send monthly files listing patient hospitalizations
1982	Establishment of Regional Personal Data Registry for Citizens and General Practitioners: A registry of personal data (tax-code, name, surname, date of birth, address, ...) of all Lombardy citizens; a registry of all Lombardy GPs; the association between citizens and GPs
1985	Collection and filing of information relative to pharmaceutical distribution: All pharmacies send monthly files listing drugs dispensed to citizens
1997	Collection and filing of outpatient visits data: All public hospitals send monthly files listing outpatient visits
1999	CRS – SISS Project requirements definition and feasibility analysis
2000	Start of the onsite pilot project in the Lecco District (300.000 citizens)
2002	Project Financing and beginning of the expansion to all Districts
2004	Two million citizens involved in the CRS – SISS System: The CRS (Carta Regionale dei Servizi – Regional Services Card) is distributed to two million citizens
2005	100% citizens involved in the CRS – SISS System: All Lombardy citizens receive their card
2008	Healthcare Private Sector interfacing: The Project involves the Private Sector as well as the Public Sector
2010	Lifelong personal health record started

**Table 1** - CRS-SISS project milestones.

# INTEGRATION CONCEPTUAL FRAMEWORK (1/2)



# INTEGRATION CONCEPTUAL FRAMEWORK (2/2)



- The system should **provide large-scale integration** among different healthcare organizations within the Region, to serve the patients.
- The system **should manage basic digital healthcare services** for citizens, particularly the centralized exam booking system, e-prescriptions, the life-long PHR, and the centralized citizen registry. Any clinical electronic document (CED) produced in any healthcare organization within the region is indexed in the Central Registry of Clinical Data, to populate the life-long PHR of each patient, together with e-prescriptions
- Even though health IT systems are already widespread, they are **fragmented** because local systems adopted differ **from healthcare organization to healthcare organization, and also within the same organization.**
- The integration scenario should be **implemented without disrupting the previous health-IT solutions** already present locally.
- **Interoperability guidelines should be defined** in order to provide a set of requirements to which these health-IT solutions should comply.
- **Documents** shared through the system should be in a **standard format**, to facilitate information exchange.
- The roadmap of system implementation should take into account the **heterogeneity of the geographic area**, and of the baseline situation of health-IT adoption. Hence, the project should be developed area by area, trying to decrease the execution time while proceeding in new areas.



# IMPLEMENTATION STRATEGY

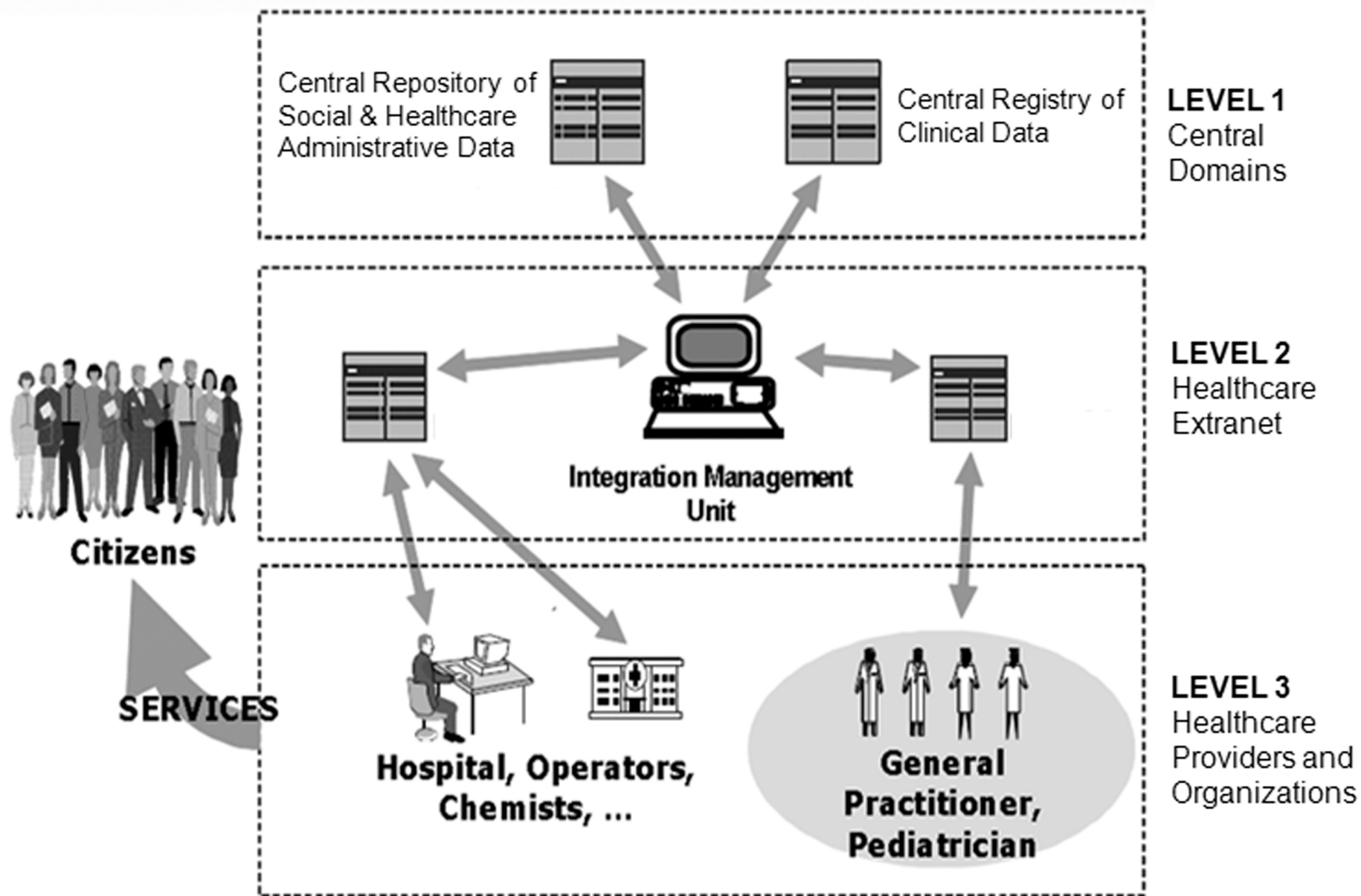
## HOSPITAL LEVEL: Standardization and integration of information flows within single healthcare organizations

- The integration architecture should ensure that administrative data, both at the hospital and at the departmental levels, are synchronized with a central citizen registry.
- The integration architecture should ensure that CEDs produced within single departments of the hospital are securely stored in a hospital repository, and, possibly, in a standard format.
- Within-hospital processes are well described in Integrating the Healthcare Enterprise (IHE) integration profiles which refer to HL7 standards.
- The integration architecture should maintain current information systems at the departmental or hospital level, and to provide an integration middleware able to satisfy standard requirements.

## REGIONAL LEVEL: Exchange data among different organizations.

- The regional healthcare system should ensure the existence of updated central repositories of administrative data, and also of clinical data and documents.
- Ad-hoc interoperability specifications: the architecture must be designed according to specific healthcare processes that depend on national and regional regulations and that are not usually mapped in international recognized standards.
- Top-down approach: any health-IT system developer have to adopt Regional Interoperability Specifications in order to implement systems whose messages are compatible with the central management of healthcare workflows.

# THE REGIONAL LEVEL INFRASTRUCTURE





# LEVEL 2 – LEVEL 3 COMMUNICATION: WEB SERVICES



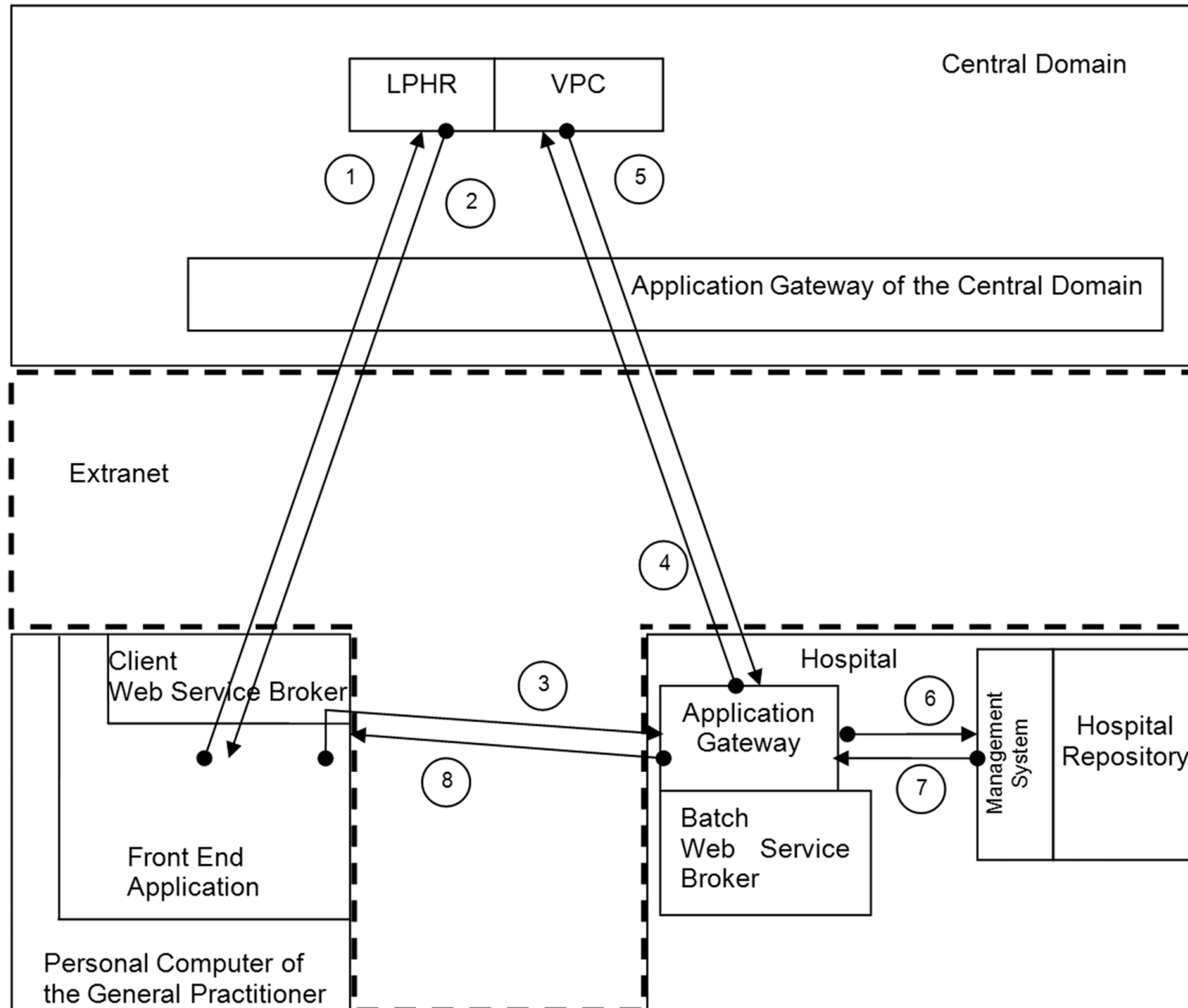
Actor	Web service		
	Action	Receiver	Object
Hospital, Regional Call Centre	Search Identify	Central Domain	e-prescription
Hospital	Notify	Central Domain	Ambulatorial event (laboratory exam, radiology, specialist visit)
Hospital	Notify	Central Domain	Hospitalization event (admission, transfer, discharge)
Hospital	Notify	Central Domain	Emergency event
Hospital General Practitioner Other worker	Identify	Central Domain	Citizen registry
Hospital	Insert Modify	Central Domain	Citizen administration data registry
Physician	Register	Central Domain	e-prescription
Physician	Delete	Central Domain	e-prescription
Physician	Sign	Workstation	Clinical Electronic Document
General Practitioner Hospital	Time stamp	Central Domain	Clinical Electronic Document
General Practitioner Hospital	Publish	Central Domain	Clinical Electronic Document
Physician	Read	Central Domain	Life-long personal health record
Physician	Read	Hospital	Clinical Electronic Document
Pharmacy	Read	Central Domain	Drug dispensation
Regional Call Centre Citizen Pharmacy	Dialogue	Hospital	Negotiation with hospital to book an exam
Regional Call Centre Citizen Pharmacy	Communicate	Hospital	Appointment confirmation
Hospital	Communicate	Central Domain	Service Catalogue
Hospital	Communicate	Central Domain	Directly booked appointments (without Regional Call Centre mediation)

Table 2 -Web services available for the communication between the single organization/healthcare

- The communication between the central domain and the local domain is implemented through XML-based messages
- independent of the IT company that has produced the specific hospital IT system.
- Interoperability specifications were developed by the Region according to the SOAP protocol (Simple Object Access Protocol) as recommended by the World Wide Web Consortium (W3C, www.w3.org) since 2003
- The content of different messages was chosen to represent specific regional healthcare processes.



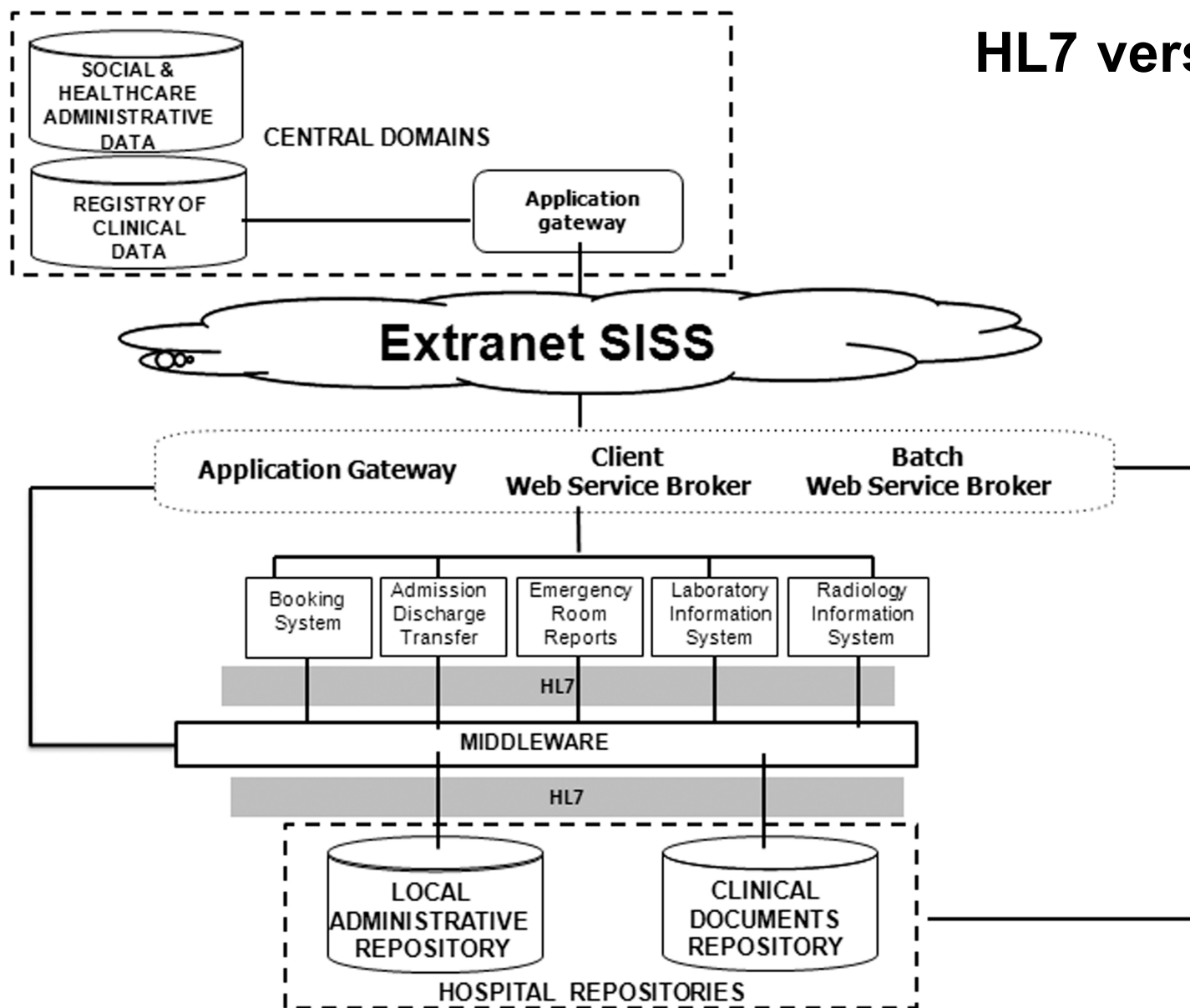
# CENTRAL DOMAIN ACCESS



# INTEROPERABILITY AT THE HOSPITAL LEVEL (1/2)



## HL7 version 2.5



# INTEROPERABILITY AT THE HOSPITAL LEVEL (2/2)



- All the processes and functions for system integration are based on the Java Composite Application Platform Suite (JCAPS) that was used to implement HL7 support.
- JCAPS is essentially a hub, managing and integrating all the HL7 messages exchanged among different hospital departments.
- JCAPS middleware provides the integration of different applications through HL7 messaging:
  - applications with a native HL7 interface: JCAPS does not intervene on the content of the message and only addresses it.
  - applications without a native HL7 interface: JCAPS creates HL7 messages from the native non-HL7 application.

## The Logical Host

- elementary software unit, developed and installed to manage a specific integration activity
- Manages the integration of all the departmental CED producers to the hospital clinical repository
- Manages the booking process from the regional call centre to the local booking system of a single hospital
- Supports HL7 integration of order entry procedures.

## The Enterprise Manager

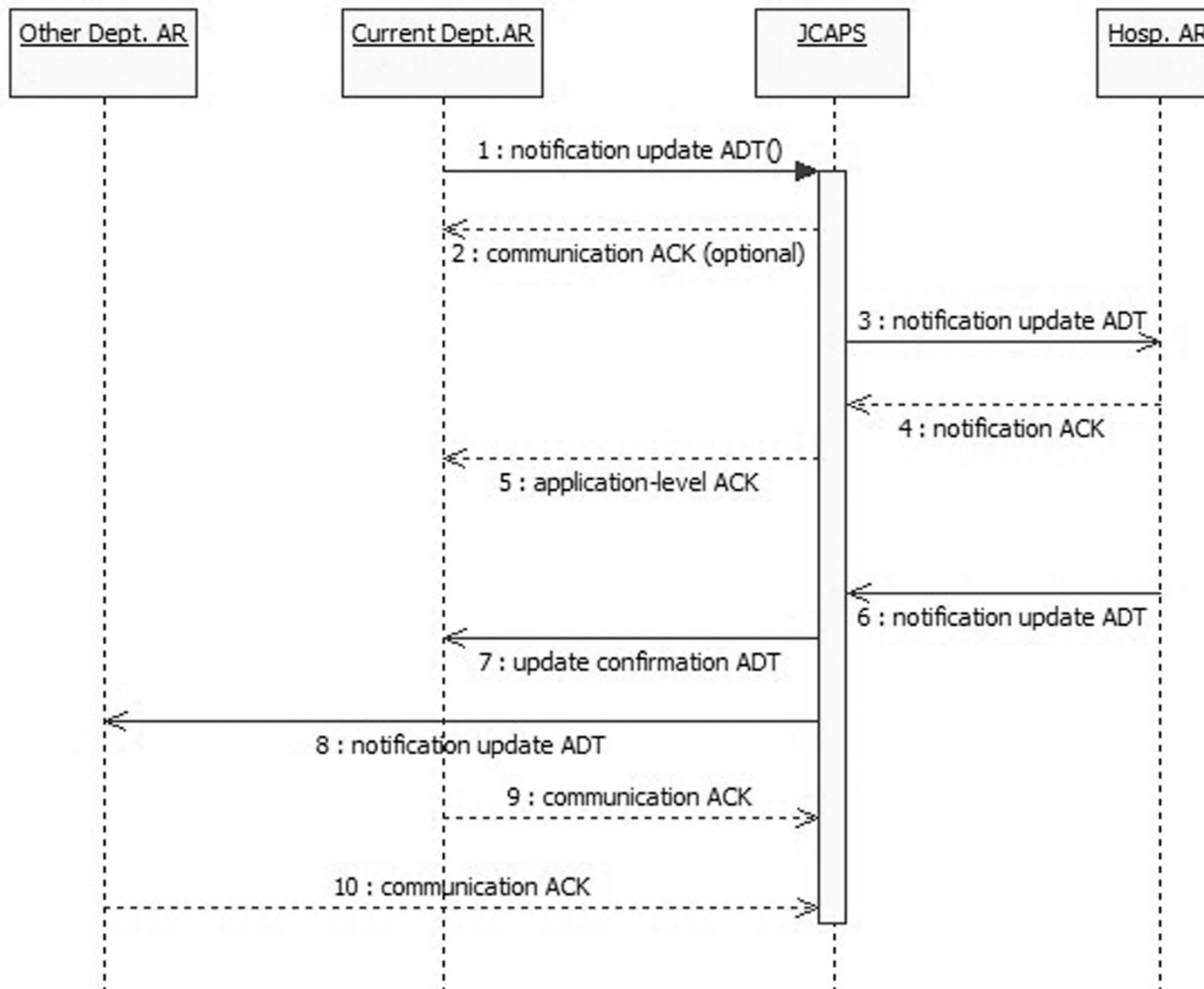
- web application that can be run from any local client
- It is used to monitor HL7 transactions on the middleware
- It controls the status of the configured logical hosts
- It monitors the queue of HL7 messages.



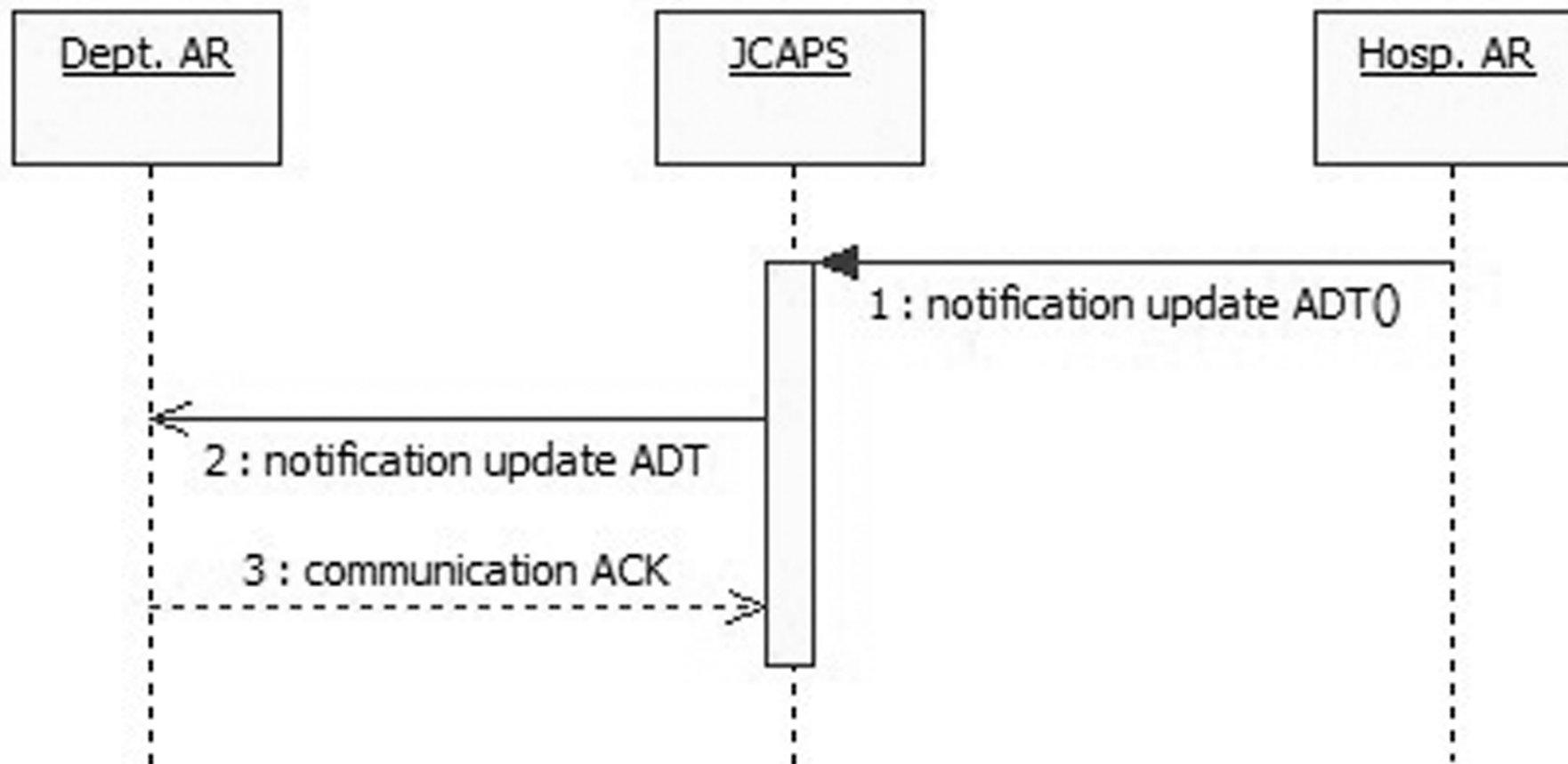
# HL7 ADOPTION

- **HL7 2.5 even though HL7 version 3 already existed**, because no hospital or other healthcare provider within the region had adopted it → and imposing such a change would have become a barrier against the implementation of the system.
- HL7 2.5 rarely defines fields as mandatory, and often leaves open possibilities in positioning single data within the message.
- To reduce such freedom (and further guarantee interoperability), the Lombardy Region defined **precise guidelines for the integration scenarios** and the messages to be used within single hospitals.
- Some **data** that the regional information system needed to be exchanged were **not foreseen by the HL7 standard**.
  - Strategy 1: information was included in fields of the message that had been conceived as containing other kinds of information
  - Strategy 2: information was carried in the “note” field. The specific solution adopted for different kinds of data was specified in the regional guidelines

# PATIENT ADMINISTRATION MANAGEMENT (1/2)



# PATIENT ADMINISTRATION MANAGEMENT (2/2)





# PATIENT MANAGEMENT



Message	Operation	Note
ADT^A02	Patient transfer notification	
ADT^A03	Patient discharge	
ADT^A04	Patient registration	
ADT^A05	Pre-admission phase	
ADT^A06	Notify hospitalization	
ADT^A07	Notify status of external patient	
ADT^A08	Update data regarding a clinical event	
ADT^A11	Patient hospitalization cancelled	Only if an error occurred in the decision to hospitalize the patient
ADT^A12	Rollback of transfer notification	Delete the effects of an erroneous ADT^A02
ADT^A13	Rollback of patient discharge	Delete the effects of an erroneous ADT^A03
ADT^A38	Rollback of pre-admission	Delete the effects of an erroneous ADT^A05

**Table 3** – Messages in use for the patient administration management.



# ORDER MANAGEMENT

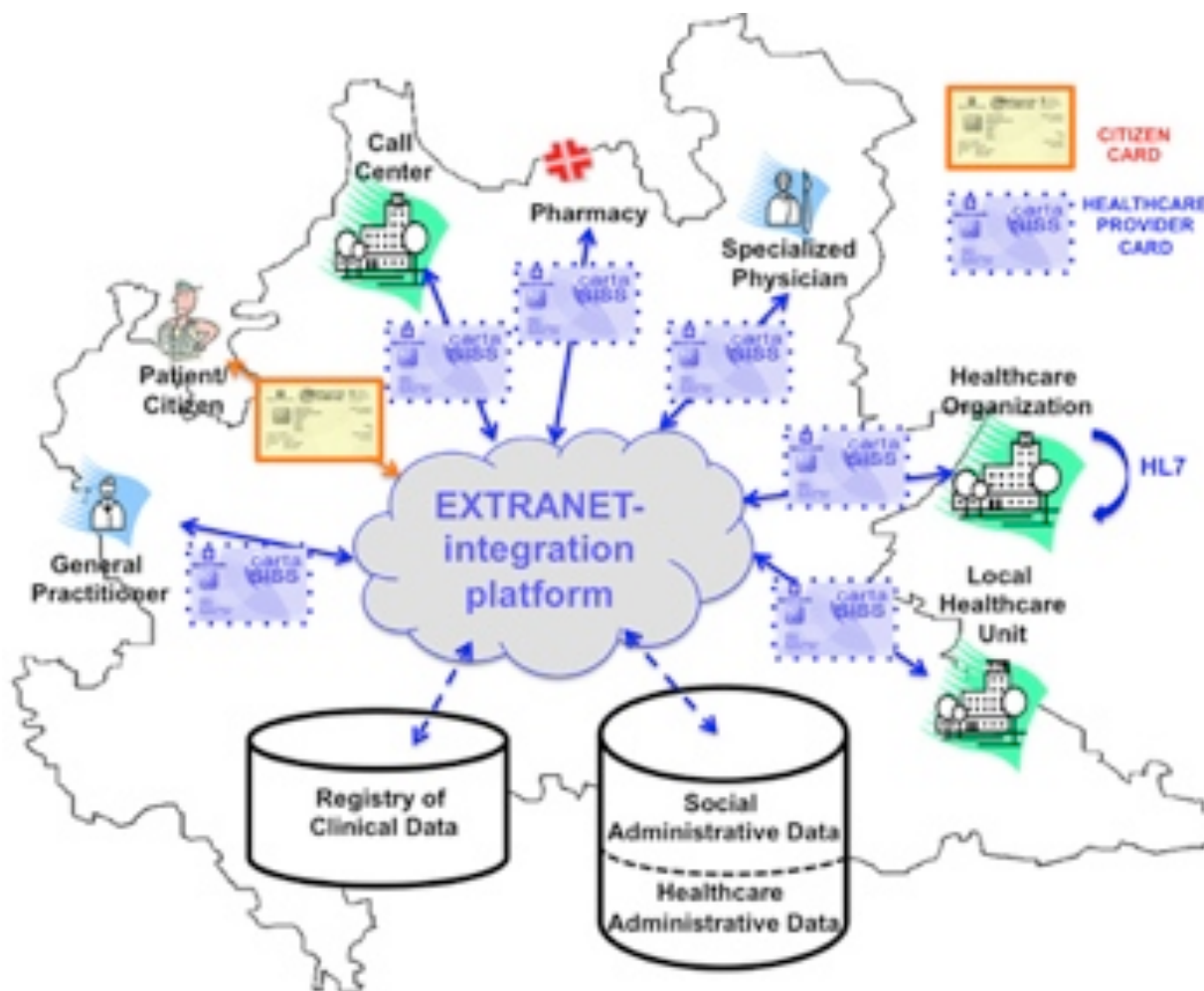
- Order management is characterized by the interaction between two IHE actors:
  - the Order Placer, representing the system that orders the service: the Central booking system, the departmental procedures, the Emergency Department.
  - the Order Filler, representing the system that provides the service after having received the order: Radiology, Laboratories, Ambulatory Units.
- There are two management profiles:
  - the Order Placer Management, managing the communication from the Order Placer to the Order Filler
  - the Order Filler Management, managing the communication from the Order Filler to the Order Placer.
- AMB, RAD, and LAB IHE transactions are implemented



# REPORT MANAGEMENT

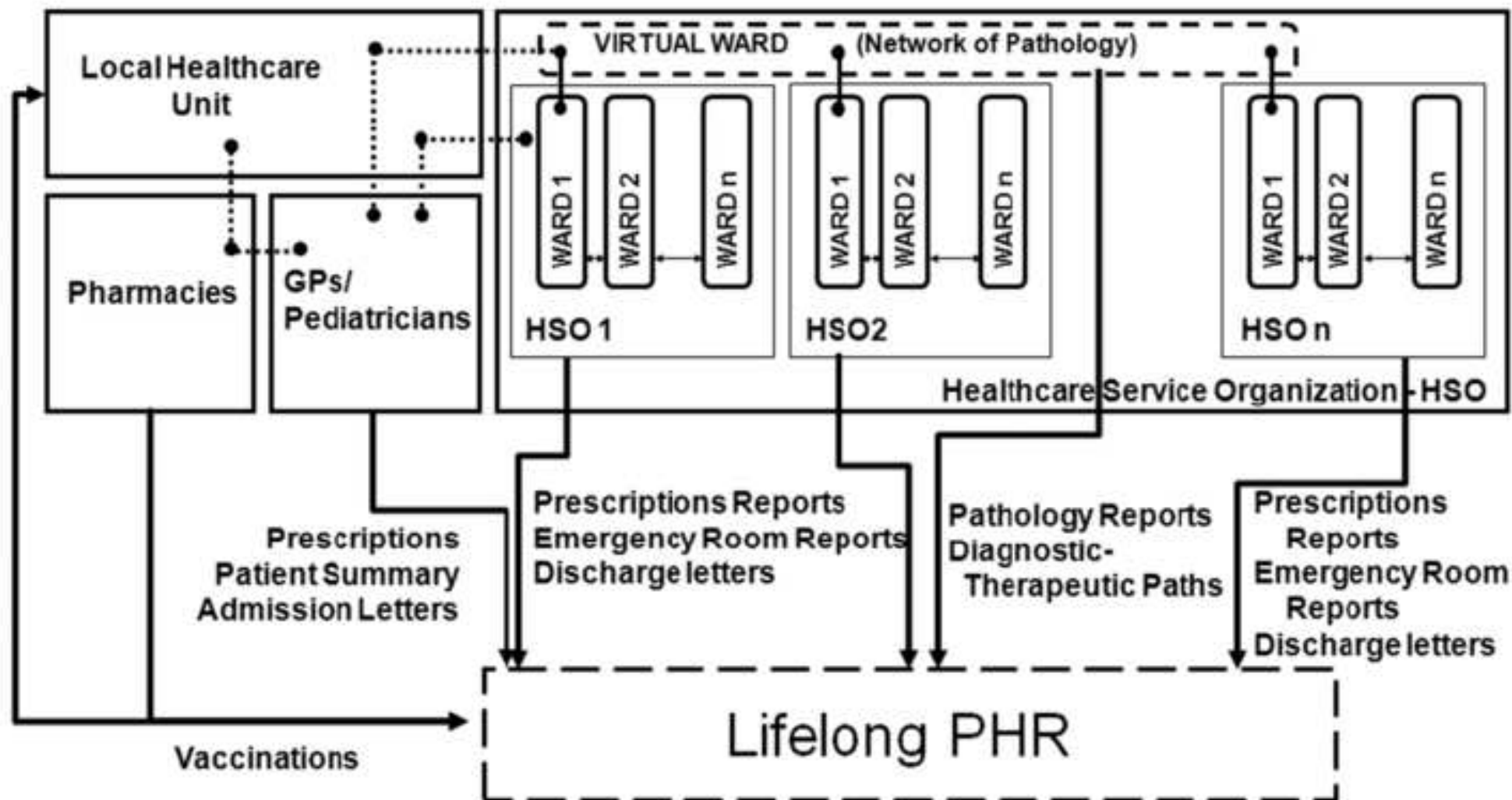
- HL7 messages are used to manage the **flow of messages and CEDs** (including exam reports, letters of discharge, prescriptions, ...) **to the hospital repository**, and to update CED metadata.
- HL7 messages are also used **to notify the logical link of the CED/image** in the repository to the structure that has requested the service, and to update the notification status.
- Messages:
  - MDM^T02 – to archive a standard CED or to update a CED draft. In response, the hospital repository will send a MDM^T01 message.
  - MDM^T06: to archive a CED with an addendum or to update a CED with an addendum draft. In response, the hospital repository will send a MDM^T05 message.
- **Enhanced Mode Acknowledgement (ACK)**: after receiving the MDM^T02 message, the hospital repository generates two ACKs. The first ACK is the commit, the second ACK is the application-level ACK, that conveys only the result of the operation and it is sent only if the MSA-1 field of the first ACK contains CA
- Once the report has been archived, the hospital repository sends the MDM^T01 response message, containing the logical link to the CED.

# PRESENT USE



9,900,000 citizen cards (100%)  
73,000 healthcare worker's card and  
26,100 workstations.  
97% of GPs and Paediatricians  
100% of pharmacies (2,593)  
100% of public hospitals (35)  
100% of local healthcare units (15)  
60% of private healthcare organizations  
(178)  
4,700,000 pharmacological e-  
prescriptions PER MONTH  
1,700,000 e-prescriptions for laboratory  
exams per month.  
490,000 laboratory medical reports per  
month  
180,000 radiology medical reports  
180,000 first aid medical reports  
58,000 discharge summaries.

# INTEROPERABILITY FOR THE LIFELONG PHR



# REFERENCES



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journal homepage: [www.elsevier.com/locate/yjbin](http://www.elsevier.com/locate/yjbin)



## Implementing standards for the interoperability among healthcare providers in the public regionalized Healthcare Information System of the Lombardy Region

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## ARTICLE IN PRESS

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## Implementing the lifelong personal health record in a regionalised health information system: The case of Lombardy, Italy

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