

National, regional and international interoperability of Croatian healthcare information system

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Abstract—Croatian national health ICT implementation strategy is determined by Croatian national health strategy and plan, Croatian ICT development strategy for 21st century, and requirements specifications for the health information system. National health ICT implementation strategy components are accented: purpose of the ICT implementation strategy, information principles, needs and ICT enablement in domains of patients, healthcare professionals, policy-makers and managers and public. Telemedicine and telecare positions and implementation steps are described. Based on the determinants, three organizational levels have been established – government, ministerial and project levels. General architecture of Croatian healthcare information system and respective pilot projects and results of pilot implementations as well as national ICT environmental accelerators for health ICT implementations are presented.

Keywords—health ICT implementation strategy, healthcare functional requirements, healthcare standards, electronic health record, integrated healthcare, agent based software technology, healthcare computer, communication network healthcare pilot implementation.

1. Introduction

Conceptual design of national healthcare information system has been based on:

- national strategic documents:
 - Croatian strategy for health and health insurance reform [1],
 - Strategy of Information and Communication Technology Development – Croatia in 21st Century [2],
 - National Health ICT Implementation Strategy [3];
- international documents:
 - eEurope Action Plans: 2000, 2002, 2005,
 - EU eHealth Strategy,
 - The eEurope Smart Card (eESC) initiative,
 - National eHealth Strategies (GB and US);

- health information system conferences and forums:
 - Conference on Health Information System and Telemedicine Developments (Zagreb, May 2001),
 - National Health Information System Implementation Conference (Zagreb, Nov. 2002),
 - Cooperation on Sustainable Healthcare Strategies, 1st Central East and South East Europe Symposium (Zagreb, Sept. 2003): Implementation and Interoperability of Health Information Systems in Central and South East Europe: Major Issue of the Reform; Sustainable Cardiovascular Healthcare and Technology Strategies for CE&SEEurope – Leading health and economy problem.

Knowing the complexity of national healthcare information system and having experienced inefficiency and incompatibility of isolated legacy systems, competitive national pilot project approach has been implemented.

2. Project organization and management

Three-level project organization and management has been established.

Government level – Government Steering Committee for Internet Infrastructure Development (GSCIID) – responsible for national ICT policies and corresponding infrastructure developments. GSCIID established the health information system expert group as the advisory group of experts in the fields of medicine/health and ICT, with the responsibilities for advising and monitoring high level implementation policies.

Ministerial level – advisory teams to minister of health were appointed with the representatives from hospitals, national institute for public health, national institute for health insurance, faculty of medicine, chambers of health, as well as the regulatory bodies for public procurement for the health related ICT projects.

Pilot project level – central primary healthcare information system (PHIS) implementation team with 60 pilot implementation site teams, and hospital information system (HIS) implementation team with 4 corresponding pilot implementation site teams were appointed.

3. The requirements and functional specifications

3.1. National requirements

The strategic national requirement for the national health information system (NHIS) is to enable implementation of national health system (NHS) reform.

The strategic information requirements are:

- to ensure patients can be confident that NHS professionals caring for them have reliable and rapid access, 24 hours a day, to the relevant personal, medical and health information necessary to support their care;
- to eliminate unnecessary travel and delay for patients by providing remote on-line access to services, specialists and care, wherever practicable;
- to provide access for NHS patients to accredited, independent, multimedia background information and advice about their condition and to provide every NHS professional with on-line access to the latest local guidance and national evidence on treatment, and the information they need to evaluate the effectiveness of their work and to support their professional development;
- to ensure the availability of accurate information for managers and planners to support local health improvement programmes and the national framework for assessing performance;
- to provide fast, convenient access for the public to accredited multimedia advice on lifestyle and health, and information to support public involvement in, and understanding of local and national health service policy development.

The specific targets are:

- reaching agreement with the professions on the security of electronic systems and networks carrying patient-identifiable clinical information;
- developing and implementing a first generation of person-based electronic health records, providing the basis of lifelong core clinical information with electronic transfer of patient records between general practitioners (GPs) and medical specialists;
- implementing comprehensive integrated clinical systems to support the joint needs of GPs and the extended primary care team, either in GP practices or in wider consortia (e.g., primary care groups);

- ensuring that all acute hospitals have the ability to undertake patient administration, including booking for planned admissions, with an integrated patient index linked to departmental systems, and capable of supporting clinical orders, results reporting, prescribing and multi-professional care pathways;
- connecting all computerized GP practices to NHS virtual private network (NHS VPN);
- providing 24 hour emergency care access to relevant information from patient records;
- using NHS VPN for appointment booking, referrals, discharge information, radiology and laboratory requests and results in all parts of the country;
- the development and implementation of a clear policy on standards in areas such as information management, data structures and contents, and telecommunications, with the backing and participation of all key stakeholders;
- community prescribing with electronic links to GPs and the prescription pricing authority;
- routinely considering telemedicine and telecare options in all health improvement programmes;
- offering NHS direct services to the whole population establishing local health informatics services and producing hosted local implementation strategies;
- completing essential national infrastructure projects including the networking infrastructure, national applications, etc.;
- opening a national electronic library for health with accredited clinical reference material on NHS VPN accessible by all authorized NHS organizations;
- planning and delivering education and training in informatics for clinicians and managers.

3.2. International requirements

National requirements were strengthened by the requirements for functional, technological, regional and international interoperability of NHS and NHIS, focused to meet EU e-health goals by the end of 2005, and functionally and technologically, smoothly and cooperatively, serve any requirement for healthcare of residents and non-resident during the stay in Croatia followed by the open international participation of health professionals for health related processes in Croatia by the usage of telemedicine and telecare.

International requirements are stressing the implementation of international medical/health and corresponding ICT standards.

3.3. Functional specifications

Development of functional specifications resulted by 3052 detailed specifications for the HIS and high number of detailed functional specifications for PHIS.

Two stage aggregation processes derived mid and high level aggregated function specifications. In this paper we present high aggregated functional specifications.

3.3.1. Primary healthcare information system – high level functional specifications – central system

The central system contains:

- **primary healthcare information system management:** health insurance management, patient management, electronic health documentation management, extended communications management, health information system reporting management;
- **clinical information system management:** service management, data access and protection management, clinical documentation management, health related registers management (state, local), HL/7 communication system, clinical data management, “virtual” electronic health and electronic medical record management;
- **administrative and business support:** global registration management, health insurance database management, personal ID-management, national MKB-10 classification system, ICPC-2 classification system, drug, pills, orthopedic supplement list management, list of services and procedures;
- **privacy and security management:** smart card technology driven privacy and security for patients and healthcare professionals, user authentication system, role based data access control;
- **additional functionalities:** external database access (medical and health libraries, e-professional education, registers), intranet and Internet communication;
- **technical and technological integration with:** hospital information systems, institute for public health information system, institute for health insurance information system, central state treasury system, ministry of health and social care information system.

3.3.2. Primary healthcare information system – high level functional specifications – client system

The client system contains:

- **health professional:** role based health profession identification, authentication and administration services, patient care service workflow, diagnostics, referrals, prescriptions, medical services, automatization of patient health and medical document generation, professional navigation services, visit manage-

ment, laboratory services, calendar and administrative management, comprehensive reporting system;

- **health and medical supporting services:** health documentation management, clinical documentation management, disease related drugs recommendations, drug retrieval;
- **patient oriented services:** visit registration and waiting room management, patient identification, authentication and administration services, patient related medical documentation (laboratory, images, other), task list, procedures and memos, patient relationship management;
- **patient management:** general patient data, health insurance related data, patient health data (anamnesis, risk factors, allergies, medical treatments, health problems, chronic diseases), patient medical data, vaccinations, administrative document issued, illnesses;
- **interoperability with core primary healthcare system:** XML/HL7 client agent communications services.

3.3.3. Hospital information system functional specifications

The general functional specification list contains:

- **management and control:** consolidated strategic, strategic, tactical and operational management, investment management, business intelligence, performance management, controlling;
- **general services:** accounting (managerial and financial) and general ledger, payroll, inventory management;
- **patient management:** patient administration, patient accounting and billing, patient scheduling, patient service management, marketing and health promotion;
- **diagnostics and therapy:** diagnostic support and ancillaries, clinical order management, medical and clinical documentation, treatment and operation, research and education;
- **care management:** care planning, clinical care, care documentation, after care management;
- **hospital and health system communication:** internal communication, communication with providers, communication with payers, communication with patients, communication with suppliers;
- **support services:** medical technology, environmental health and safety, transportation, facility services, health and medical document management, patient information center (help desk);

- **business support:** human resource management, procurement, treasury/corporate finance management, fixed asset management, real estate, equipment maintenance;
- **interoperability:** medical equipment data communication, external professional and administrative communications.

4. General architecture of Croatian healthcare information system

General architecture of NHIS consists of central components – the NHIS infrastructure, and contextual portals:

- **central components:** core networked healthcare repositories¹ (population, health insurance, public health, health financials) along with acting application service providers – ASPs (primary healthcare, secondary healthcare, public health, health insurance, health professional associations);
- **contextual portals:** ministry of health, public health, health insurance, primary healthcare, hospital, pharmacy, health professional associations, professional and public education, general health communications², other health related portals, as presented in Fig. 1.

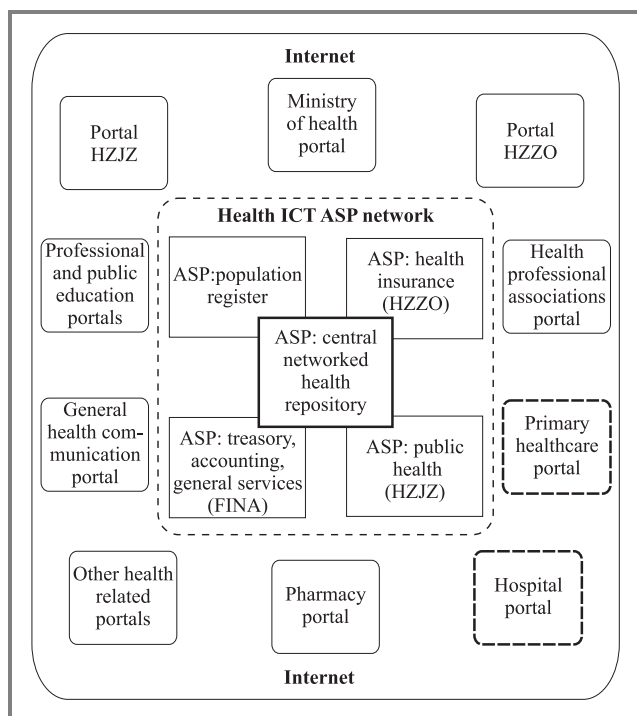


Fig. 1. General architecture of healthcare information system.

¹With respective data, process and knowledge interdependencies.

²General health oriented communications and professional communications. Telemedicine is an example of event driven temporal multipoint professional health communications.

Portal implementations provide autonomy of professional functionalities and contextually “glue” all stakeholders in their mutual interactions.

5. Implemented pilot projects

Based on the general architecture and priorities given, public tender for two-staged competition (short list competition, competition throughout pilot implementations), following results of pilot competition were obtained.

5.1. Primary healthcare information system

Primary healthcare information system (PHIS) is designed and implemented as central and client components of PHIS.

5.1.1. G1 – central component of PHIS

Central component of PHIS implements functional requirements in the form of integrated system. Integration is based on interoperability standards.

Central component of PHIS integrates: information systems of the ministry of health, health insurance organizations,

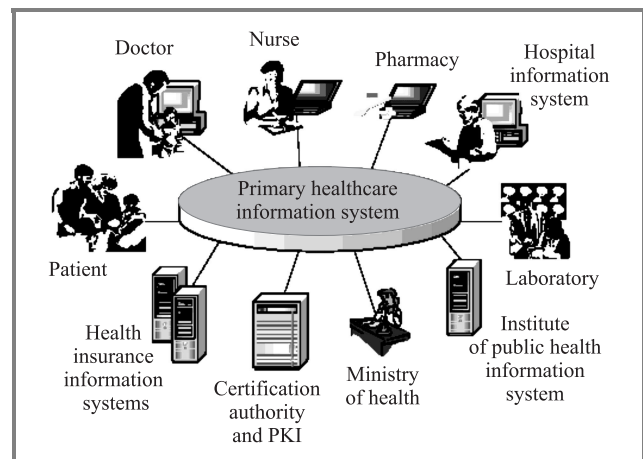


Fig. 2. Basic entities in primary healthcare information system.

hospitals, public health, national certification authority, pharmacies, laboratories, primary healthcare teams and patients (Fig. 2).

Central component of PHIS program architecture is implemented on three layers (Fig. 3):

- **open application layer:** applications related to PHC teams (doctors, nurses), laboratories, public health, other;
- **middle layer:** middle layer implements common health services (electronic health record management, patient record management, resource management, terminology services, authorization) and common general services (coding schemes, directory management, transaction tracing, message interchange, authentication);

- **communication layer:** standards driven authenticated communications.

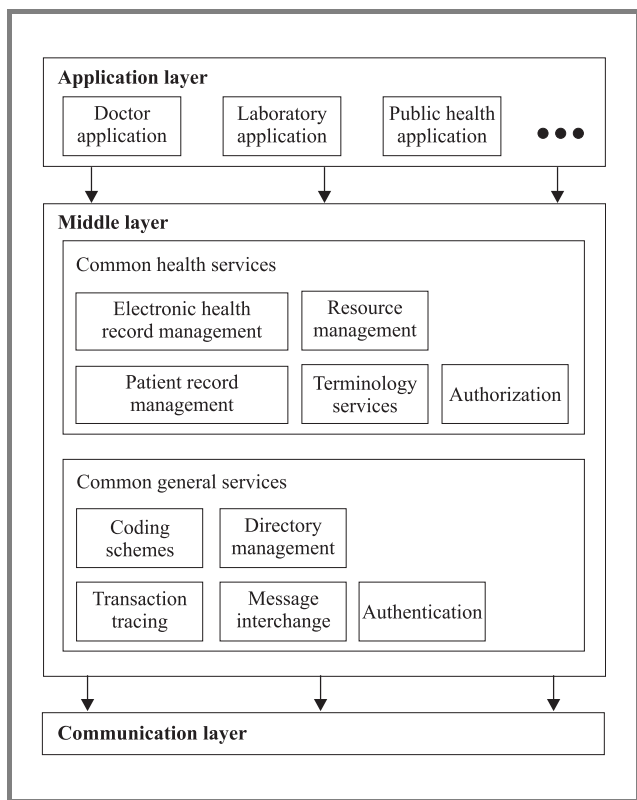


Fig. 3. Referent PHIS program architecture.

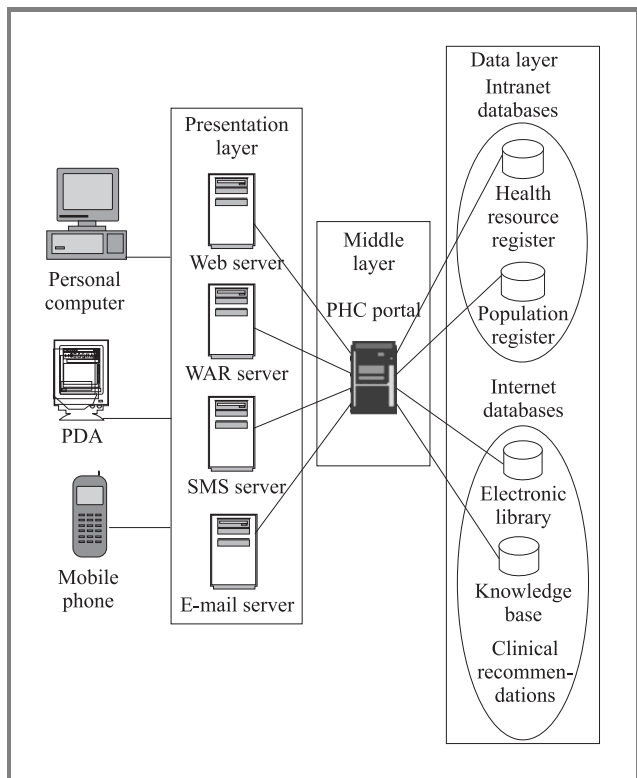


Fig. 4. PHIS portal architecture.

Portal technology implemented in middle layer integrates data layer (Intranet databases: health resource registers, population register; Internet databases: electronic libraries, knowledge bases, clinical recommendations) and presentation layer (web server, WAP server, SMS server, e-mail server). Figure 4 presents the implemented portal architecture.

5.1.2. Management potentials in central PHIS

Management and control in health system is implemented by strategic and operational patient relationship management, drug prescription, referrals, therapeutical processes performance and drug efficiency assessments.

Professional service management covers authorized access to distributed electronic patient records (EPRs) and related medical document resources (images, laboratory evidences, diagnostics, etc.), professional access for emergency and crisis management, professional and administrative messaging management, personal performance management, health and medical reporting system.

Public health management support facilitates healthcare intelligence, evidence based management in public health, public health dynamics management and management of many of public health dedicated segments.

Ministry of health and social care management support enables implementation of healthcare intelligence for ministerial purposes, NHS performance management, health resources management, NHS business and economic intelligence.

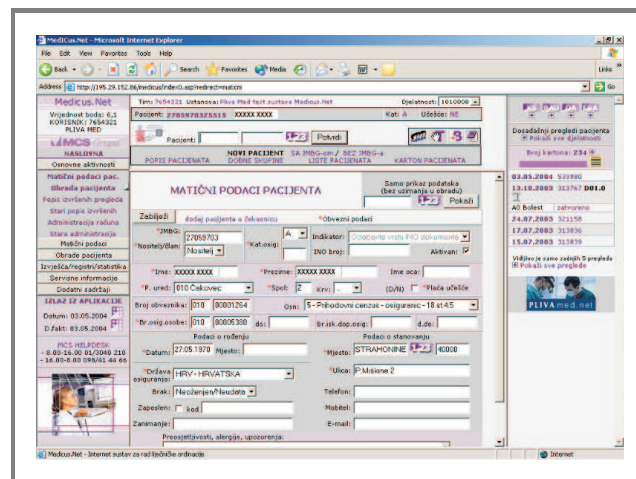


Fig. 5. Example of context sensitive navigation.

Health insurance institute management support – by implementation of direct HL7 communication on healthcare activities, ICPC-2 activity based costing on daily base is enabled as well as pharmacy management, drug consumption management, evidence based planning, budgeting and monitoring.

Patient management implementations allows direct control on electronic patient record, access and usage, quality

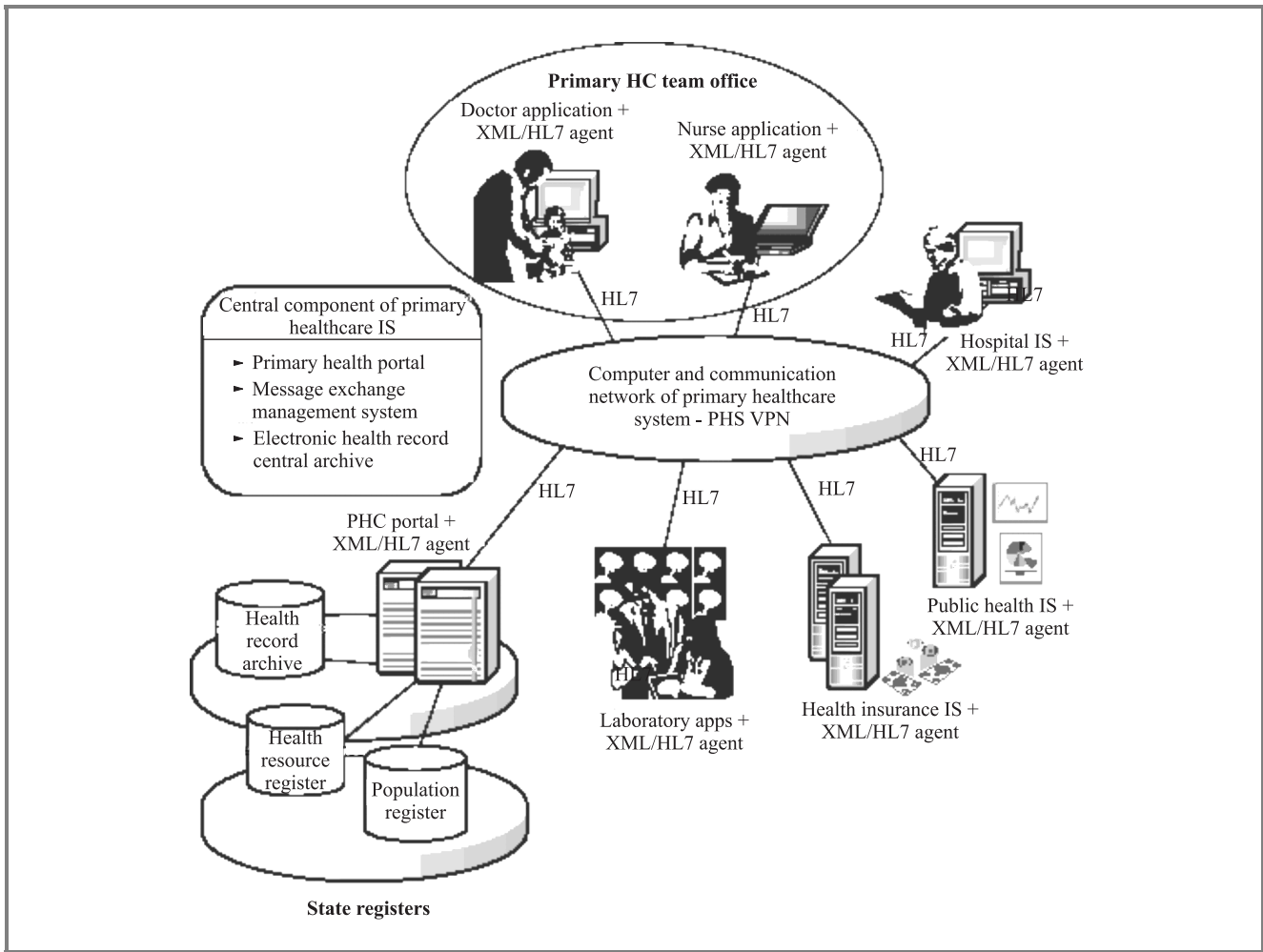


Fig. 6. Primary healthcare communication architecture.

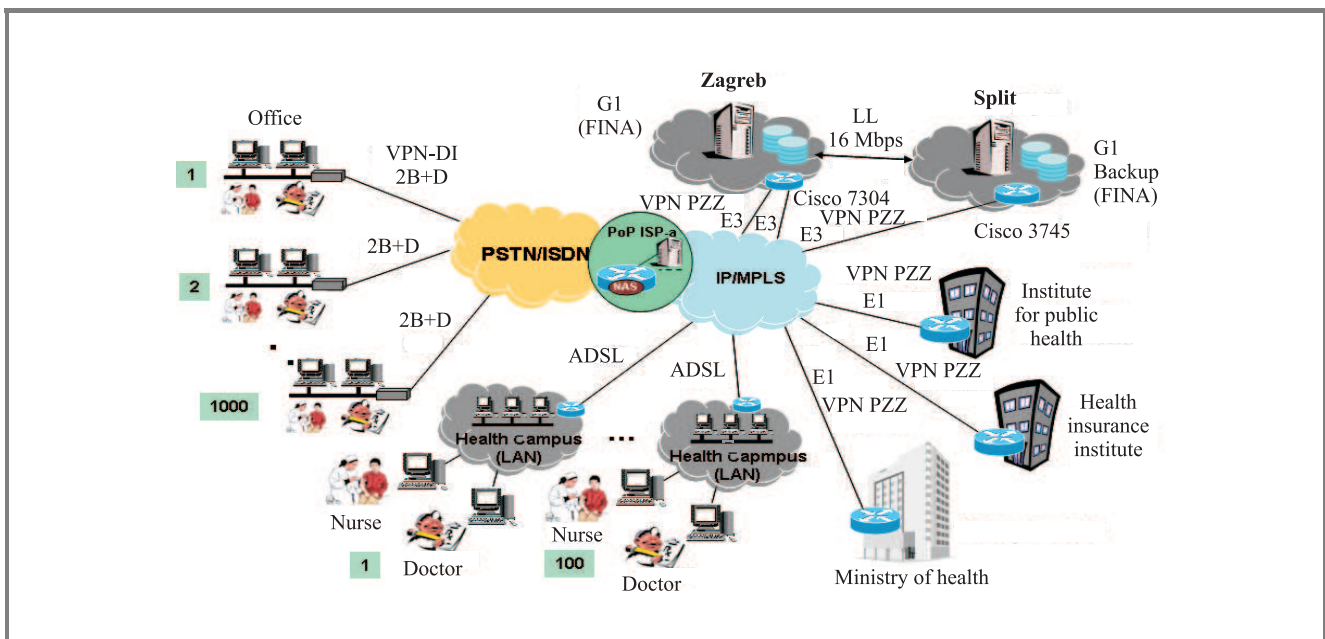


Fig. 7. System PHIS VPN.

of service (QoS) assessment and review, patient relationship management, privacy audit and reporting, healthcare service ordering system, public related health education, discrete selection/change of MDs.

Public is supported by the accurate information on health condition of the population, transparency and benchmarking of public health services.

5.1.3. G2 – client component of PHIS

Client component of PHIS implements client system functional requirements, customized for the dedicated application area.

Interoperability standards as the prerequisite for the integration in PHIS integrated system allow for open competition in application developments as well as implementations and maintenance.

Context sensitive navigation and correspondent workflow is applied for the patient, doctor, nurse. Illustrative example of patient context is presented in Fig. 5.

5.2. Communication system

Two components of communication system have been implemented for the pilot implementations.

Primary healthcare communication architecture (Fig. 6). Agent based software technology and implemented XML/HL7 standards are supporting networked asynchronous execution of all health related activities.

PHIS virtual private network (VPN) – see Fig. 7. Pilot implementation is based on elaboration of government computer and communication network as one instance of it, thus enabling wide connectivity and interoperability of health as well as government and public services.

Structure of **computer resources** has been formed by central and backup PHIS computer resources, health insurance computer resources, public health computer resources, scattered small/medium/large LAN resources and standalone PC configurations. PHIS VPN connects all aforementioned resources into primary healthcare computer and communication network.

Pilot implemented **VPN services** were based on estimated pilot requirements and tuned as leased line, IP/MPLS over ATMs, ADSL, PSTN/ISDN, and PoP ISP.

5.3. Hospital information system

Competition for the national license for hospital information system was the primary purpose of two staged public procurement process. First selection was based on the given evaluating results of bidding proposals. Final selection was planned on results of measurement and evaluations of implemented functions in the given timeframe for selected pilot implementers (eligibility of implementers).

Hospital information system pilot implementations started on June 2003 in the following hospitals (Fig. 8): Clinical Hospital Dubrava (Zagreb), Clinical Teaching Hospital Rijeka, Clinical Hospital Split, General Hospital Sveti Duh (Zagreb).



Fig. 8. Location of HIS pilot hospitals.

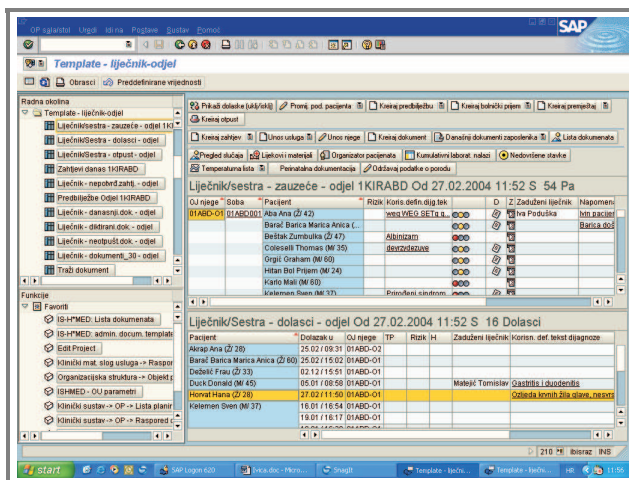


Fig. 9. Medical doctor's contextual working environment.

Requested functionality is implemented with dozens of related hospital and medical context screens. Figure 9, taken from Sveti Duh implementation project, illustrate such screens.

Implemented functionality covers following medical areas: internal medicine, pneumophthisiology, infectology, neurology, psychiatry, neuropsychiatry, dermatology and venereology, pediatrics, general surgery, neurosurgery, child surgery, maxillofacial surgery, plastic surgery, urology, orthopedics, otorhinolaryngology, ophthalmology, obstetrics and gynecology, anesthesiology and resuscitation, transfusiology, radiology, radiotherapy, nuclear medicine, physical medicine and rehabilitation, cardiology, traumatology, sports medicine, emergency medicine, medical microbiology with parasitology, medical cytology, pathology, clinical pharmacology.

5.4. National health card

Smart cards can add mechanisms to the Internet to implement security and protection (data protection and anonymity-confidentiality) which are easy to use. Any

IT system in healthcare, combining Internet and smart cards could claim to be more “human-centric” than the old typical models for two main reasons:

- citizen’s and patient’s own awareness of their health related data and information, because smart cards offer ubiquitous access to information;
- citizen’s and patient’s empowerment, because secured information can be circulated without prohibition.

National health card in pilot projects, based on smart card functionality, implemented two basic functionalities:

- for professional usage – health practitioner card for secure access to patient data stored either in a patient card or on a remote server, with security components (PKI, crypto-processor, data encryption keys, encryption algorithms, digital signature, authentication certificates) is implemented; by using smart cards, medical professionals are able to access the patient data they need much more quickly and reliably than conventional paper file and document methods, saving invaluable time and expense – and time may be at a premium;
- for citizen’s/patient’s usage – insured patient’s card which include the following data addressed by remote data access pointers: **administrative data** (i.e., insured ID, name and address, health coverage “coordinates”, period of entitlement, availability period, relevant regulation, etc.); **medical data** (emergency clinical data, protected private file); **security components** for reliable identification of the person covered and secure access to personal health data of the patient.

5.5. Pilot implementation metrics

5.5.1. Primary healthcare teams

Sixty primary healthcare teams, consisting of the physician and the nurse, were selected and trained to implement G2 component of PHIS. In order to reduce pilot costs, pilot locations were clustered in Zagreb, Čakovec, Požega, Split, Koprivnica.

Standardized hardware and communication equipment has been installed at the PHC team’s premises.

Short list G2 competitors were the implementers (local companies ABA Informatika, MCS Group, IPT, ISD, In-2).

5.5.2. Health insured individuals

More than 100 000 health insured individuals were included in respective PHC team files.

5.5.3. G1 – central component of PHIS

Selected central component of PHIS has been designed and implemented by Ericsson Nikola Tesla d.d. with following

subcontractors: ABA Informatika d.o.o., Helix d.o.o., Computech d.o.o.

5.5.4. Hospitals

Characteristics of selected testbeds and competitive pilot implementers for HIS:

- **hospital Dubrava** (Zagreb): 611 beds, 142 MD, with installed standardized database and application servers, desktop and communication equipment and Ericsson Nikola Tesla & Grad Pula as HIS implementers;
- **hospital Rijeka**: 1264 beds, 310 MD, with installed standardized database and application servers, desktop and communication equipment, and IBM Croatia (for cerner HIS application) as HIS implementers;
- **hospital Split**: 1455 beds, 367 MD, with installed standardized database and application servers, desktop and communication equipment, and AME Consortium (from Austria and Switzerland, with SYS d.o.o. as local partner) as HIS implementers;
- **hospital Sveti Duh** (Zagreb): 542 beds, 113 MD, with installed standardized database and application servers, desktop and communication equipment, and B4B – (SAP HIS solution) as HIS implementers.

5.5.5. National health cards

The 120 health professional cards were issued with implemented functionality: electronic ID, advanced electronic signature, attributes (roles).

5.5.6. Implemented security levels

For the pilot testing purposes following security levels were implemented:

- **smart health card**: identity card, advanced electronic signature, assigned attributes (roles);
- **application**: role based access control (HL/7, RBAC), certification of applications;
- **message and messaging agents**: digital signature of messages and message encryption;
- **equipment**: server security, desktop security, mobile desktop (authentication, integrity, encryption);
- **network security**: local area network access control (router/ firewall), virtual private network implementation of Internet protocol security with IPv4/IPv6 (IPSec – Internet engineering task force standard).

6. Embedded standards

International interoperability requires implementation and maintenance of a large set of international standards.

Two important subsets are presented as ICT related standards and health related standards.

6.1. ICT related standards

ICT related standards treated:

- **interoperability:** object management group OMG, W3C, XML, GIF (UK Government Interoperability Framework);
- **ICT and software engineering:** software engineering standards (IEEE SECS), International Organization for Standardization/International Electrotechnical Commission (ISO/IEC JTC1/SC7), data interchange standards association, CENELEC – The European Committee for Electrotechnical Standardization, CEN/ISSS (European Committee for Standardization – Information and Communications Technologies) activities., FIPS (Federal Information Processing Standard), National Institute of Standards and Technology (US NIST), American National Standards Institute (ANSI), The Foundation for Intelligent Physical Agents (FIPA);
- **smart card:** identification cards – physical and electronic characteristics, dimensions and location of the contacts, inter-industry commands for interchange, system and registration procedure for application identifiers, inter-industry data elements, machine readable cards for healthcare applications, security categorization and protection for healthcare information systems, other healthcare cards specification standards: ISO/IEC 7816-1-10, 8824-8825; CEN/EN 726-1-7, CEN/ENV 1257 1-3, 1284, 1387, 1867, 12018, 12388, 12924, 13729; smart card interoperability specifications and “Open Smart Card Infrastructure for Europe” (OSCIE) common specifications³;
- **telecommunications:** ITU (International Telecommunication Union), ETSI (European Telecommunications Standards Institute).

6.2. Health related standards

Health related standards⁴ were specified as a set of requirements, and consequently implemented as a prerequisite for prevention of health hazards (e.g., drug hypersensitivity), patients starting to demand that “their” data should be available on-line, improved efficiency by enabling professional co-operation in new ways, quality management requirements on aggregated data, integration of modular systems

³eEurope Smartcards – Open Smart Card Infrastructure for Europe, March 2003.

⁴Health on-line, eEurope, CEN/ISSS, 2002.

from different suppliers, lowered costs and facilitated procurement, and primarily the national, regional, European and global interoperability and action.

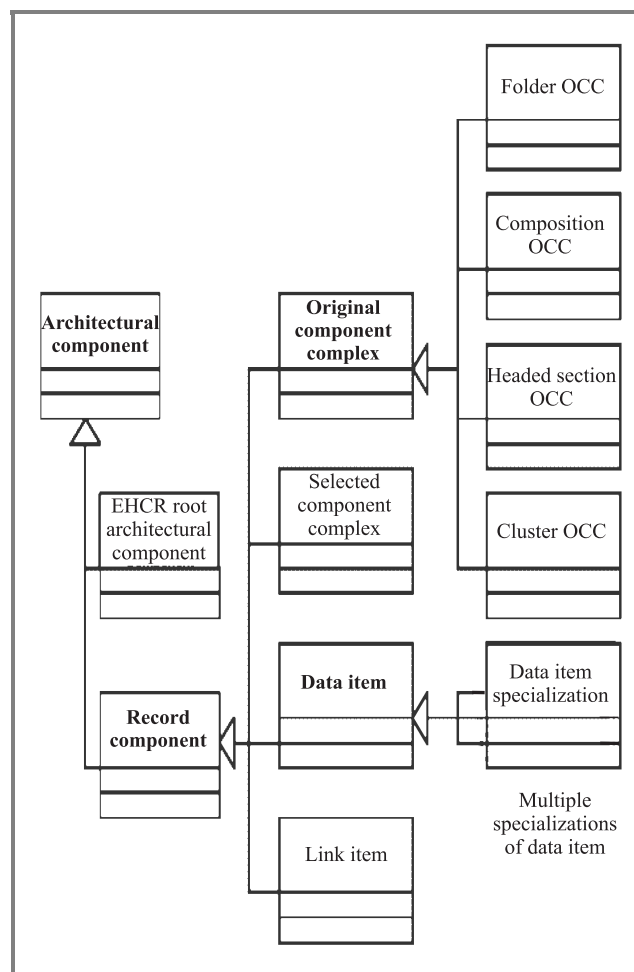


Fig. 10. Architecture of electronic health record ENV 13606.

Health standardization institutions treated:

- **CEN/TC 251** (Commitee European de Normalization): European Standardization of Health Informatics Technical Committee 251 – Healthcare information interchange within Europe; **CEN/TC 224**: machine-readable cards, related device interfaces and operations;
- **ISO TC 215**: “Health Informatics” (Messaging standards for information exchange between healthcare information systems; WG 5 – Health Cards);
- **ASTM** (American Society for Testing and Materials – interchange of data between medical information systems);
- **ACR/NEMA** (American College of Radiology/National Electronical Manufacturers’ Association: Digital Imaging and Communication in Medicine – DICOM; Program of Assertive Community Treatment – PACT).

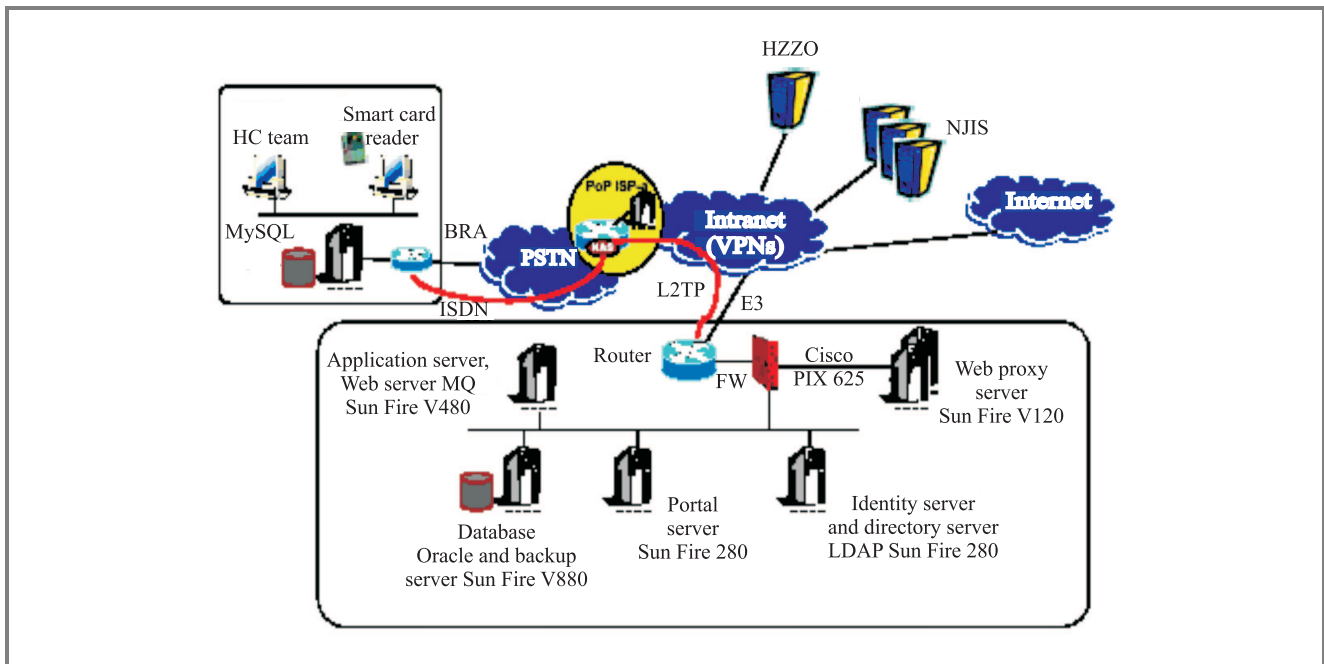


Fig. 11. Computer and communication architecture.

Here is the example of implemented standards and classifications during the pilot implementation:

- **GEHR** (Good Electronic Health Record): openEHR;
- **ICD-10**– classification of diseases for the collation of medical statistics;
- **ICPC-2** – International Classification for Primary Care;
- **LOINC** – Logical Observation Identifier Names and Codes;
- **DRG** – Diagnoses Related Groups;
- **ATC** – Anatomic Therapeutic Chemical Code;
- **IEEE/P1157** – standard for healthcare data interchange (standards for moving data from medical devices to computers and vice versa along standardized hardware buses and interfaces);
- **ANSI HL7** – standard for electronic data exchange in healthcare environments;
- **HER ENV 13606** (Fig. 10).

7. Technical and institutional interoperability

7.1. Technical interoperability

Technical interoperability is provided by implementation of technical standards and standardized hardware instances as well as standardized middleware software components enabling networked interoperability. Figure 11 illustrates one instance of implemented technical interoperability.

Software agent technology – asynchronous cooperative message processing is enabled by implementations message exchange management system on central site and XML/HL/7 agent as client site implementations.

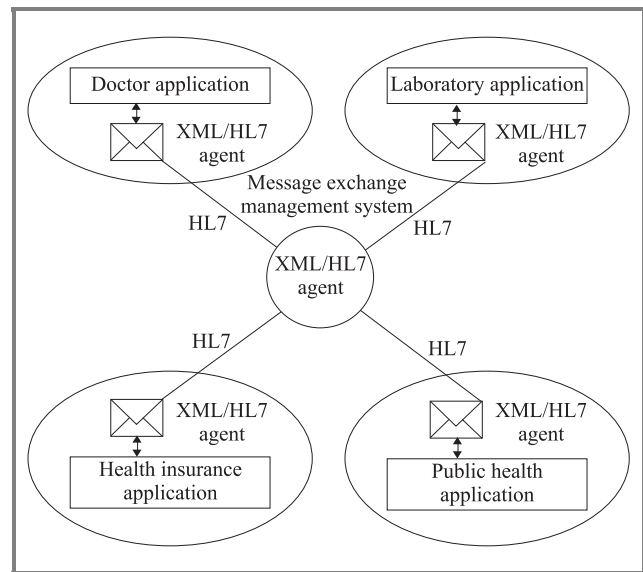


Fig. 12. Agent based message exchange system.

Figure 12 illustrates implementation of such interoperable and cooperative messaging system.

7.2. Institutional interoperability

Institutional interoperability, due to requirements of inter-related national public development projects (health and welfare system reform, reform of the government and public services), requirements for common ICT infrastructure

(government computer and communication network, national smart card infrastructure), related cooperative IT projects (healthcare, healthy food, healthy environment – water, land, air, new personal identity card and personal identity management, national emergency system, to mention some of them), is implemented by the coordination committee for institutional interoperability appointed by the government.

Main institutional stakeholders are: **the government** – office for e-Croatia; **ministries**: Ministry of Health, Ministry of Interior, Ministry of Finance; **institutes and associations**: Institute of Public Health, health insurance institutes, health professional associations; FINA – National Financial Agency in the role of **government ICT outsourcing institute**.

8. The results

8.1. Implementation of primary healthcare information system

As a result of proven implementation of functional requirements, G1 and G2's are contracted for implementation by the minister of health in November 2003. Implementation was planned for 2004 i 2005 fiscal years.

8.2. Implemented functionality of hospital information system pilot project

Interim pilot implementation status estimation provided at Sveti duh General Hospital:

- management and control 70%,
- general services 70%,
- patient management 100%,
- diagnostics and therapy 100%,
- care management 100%,
- hospital and health system communication 80%,
- support services 70%,
- business support 70%.

For the areas indicated with less than 100% implementation, all customizations have been implemented.

New appointed government expert group has been started validation process for all pilot implementations.

9. National implementation scenario

National implementation scenario is based on ICT strategy recommendations and action plans, and corresponding government program and financial priorities.

G1 as a central component of PHIS is contracted for the period of 3 years.

G2 licenses are given to first 6 solution providers for competitive implementations for more than 2700 PHC teams in

next 3 years. Competition for new set of G2 developments in areas of stomatology, pharmacy, laboratory and other areas are in preparations.

Development efforts on customizations in pilot projects for HIS will enable the implementation of national license for all hospitals in the Republic of Croatia.

Pilot project functionalities implemented and capacities built, will shift the focus of overall implementation to organizational, educational and financial resources rather than to ICT developments.

9.1. National ICT accelerators

Government computer and communications network, multifunctional national smart card project, and national license for HIS, are accelerators for fast deployment of projected and pilot-projects confirmed functionalities of NHIS.

9.1.1. Government computer and communications network

Standards and principles for government computer and communications network implementation (GCCNI) are elaborated in the study financed by the Ministry of Science in 2001, implemented in tender documentation, and proposed by Croatian Telecom to the government in 2003. GCCN is designed to serve as a backbone network and infrastructure for secure e-government services.

Implementation based on CCNI is applied for the PHIS pilot project. Final proposal of healthcare VPN complies with GCCN and forms the part of it.

9.1.2. Multifunctional national smart card

Multifunctional smart card, enabling the implementation of requirements from different government areas (national identity card, budget beneficiary card, social welfare card), health card (health insurance, patient identification, health professional), PKI requirements (advanced electronic signature) as well as group of ICT requirements (single user profile for role based access control) was selected.

Design to implement interoperability for national population register, national health card is starting instance for implementation of multifunctional national smart card.

9.2. National license for hospital information system

National license for hospital information system is planned to enable successive implementation for 37 hospitals in Croatia for the years 2005–2007.

10. Conclusion

Implementation of very complex national health information system is based on corresponding national and international strategic documents, precise definitions of functional

requirements for primary healthcare information system and integrated hospital information system and the results of started pilot project implementations.

Development and implementation concepts are based on common government ICT infrastructure and project developments.

Hierarchical and functional project management is implemented to synchronize pilot implementation activities and resources as well as to build capacities for accelerated implementations in the years to come.

Aligned with international standards and implementation policies for information societies, healthcare information system provides the drivers for national, regional and international interoperability.

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