

# Health Level Seven (HL7): Short Overview

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## SUMMARY

Health care systems today require some important changes. Many patients, doctors and other health professionals with right have suspicions that the health care system are managing available resources and information of interest in an optimal way, and as a result of that, health care that we receive isn't of best possible quality. Considering the large investment in health systems, and the population with an increasing life expectancy, the mobility of patients and the emergence of new high-risk infectious diseases (HIV, SARS, etc.), modern systems of treatment must be proactive, efficient, economical and safe. To provide a basis for improving the quality of health care the system needs to meet several key preconditions and requirements. Professional groups from the world's most advanced countries (USA, Japan, EU countries) have recognized the introduction of specialized computer and business solutions to national integrated information system in the field of health as a key component to improve the efficiency of the system, all in order to better manage the information of interest, and optimize the consumption and quality of resource management. Information systems must however meet very important common criteria that are based on openness, integration, security of data management, reliability and modularity. In this way it would ensure the vertical (within single health care institutions) and horizontal (between different separate institutions) interoperability of different solutions, and connectivity of different levels of health care within and outside the borders of individual states. Bearing in mind the requirements mentioned, this paper provides a short overview of Health Level 7 (HL7) as open information and communication technology (ICT) standard that should be adopted at the global level by professionals and users. Without quality standards that meet the needs of the business health systems, and ensure the applicability of existing and new solutions the above vision of integrated health care system is certainly not achievable.

**Keywords:** health information systems, HL7

## 1. HL7 AND ITS MAIN FEATURES

In the past few decades we have witnessed very significant achievement in knowledge and technology in medicine, as well as the implementation of various information and communication technology (ICT) solutions into everyday medical practice. However, most health information systems or applications in the world today operate on the level of clinic or hospital department, and although fully meet local needs, in a system in which

the patient is extremely agile it cannot meet the requirements of modern medicine (1, 2). Information about the patients should be managed at a high-quality mode, and the required information must be accessible regardless of location and time (3).

Nineties of the 20th century, which can be marked as the beginning of the era of "information society", are marked by the appearance of microprocessor technology with multimedia features and the introduction of new information and communication technologies (mobile phones, television teletext, fax, email, etc.), and the beginning of the era of the Internet. In many places in the world are developed health information systems, but they are generally limited in scope and generally cannot communicate with each other (4).

Reasons for the problems in the mutual communication of health information systems can be found on the one hand in the diversity of health care institutions and medical facilities where they are involved in and different levels at which they operate (institution, regional, national, international), on the other hand there are diversities of the computers and other information and communication technologies, and medical equipment-based computers. In order that all of these systems and their networked equipment connect and to be able to communicate with each other, it is necessary to define the communication norms. Work on this issue has become one of the important topics of medical informatics (5).

The idea of an integrated health system in transition to modern medicine of the 21st century is based on use of advanced ICT technologies and business solutions in information management. Feasibility of this idea, along with other factors largely depend on open ICT standards that will ensure the possibility of connecting different solutions in a wide variety of application domains. Health Level Seven (HL7) in this sense is a key component of the quality of modern health care solutions. HL7 is a communication standard that enables electronic exchange of data and information within the health care system. It was created as an expression of the need for communication between different segments of health care, especially between laboratories, departments, diagnostic and

treatment units within the hospital. HL7 Standard today develops and promotes international organization group HL7 (HL7 Group) together with its subsidiaries, which exist in many countries around the world (6). It is an ANSI (ANSI–American National Standard Institute) supported non-profit association whose scope of work covers the standardization of clinical and administrative changes of data in the field of health. Although fundamental to the American organization, the influence of the association spread all over the world, so that today there are over 30 branches on 5 continents, whose mission is to promote the importance of HL7 standards in the field in which it operates. Mission of HL7 Inc. is to provide standards for change of management and data integration which include clinical patient care and case management, definition and evaluation of health services. Goal based on this mission is the creation of flexible and effective approaches, standards, rules, methodologies and associated services as a basis for interoperability of health information systems, and in this context, it is the leading global normative initiative in the field of medical informatics (7).

Objectives set before the HL7:

- definition of message formats and protocols for exchanging data between information systems in health care,
- Standardization of formats,
- to minimize the number of formats,
- to reduce the implementation time for the format (60 to 80%)
- increase efficiency in communication,
- to define guidelines for the specification of the format of data exchange between the parties concerned,
- to set an international standard.

HL7 standardizes protocols and structure for exchange of critical sets of health data on the application level—the seventh level of ISO (International Organization for Standardization) reference model of open communication systems. Provided the correct application of HL7, the necessary information can be exchanged between the differently informatically organized departments in the same health institution, as well as various health institutions in the same city or country—even globally. HL7 standardizes:

- abstract message definition,
- encoding,
- triggering events.

Domains of the HL7 organization are clinical and administrative data. Their task is to: provide standards for the exchange, management and data integration that enable clinical and patient care management, conduct and evaluation of health services. In particular, to create a flexible, cost-effective approaches, standards, guidelines, methodologies and related services for interoperability between information systems in health care.

The particularity of this organization to others who are also involved in creating standards for data exchange in healthcare is that HL7 oriented to fulfill the needs of the entire health care organizations while other initiatives are involved in separate sections or departments of

health. HL7 is trying to create a set of protocols that meet the needs of hospital systems already installed, some of which use some of the older technology.

HL7 is trying to achieve international competitiveness and standardization also outside the United States. Thus, Argentina, Australia, Canada, China, Czech Republic, Finland, Germany, India, Japan, Korea and many other countries participating in the work on HL7.

What is the highest quality of HL7 standards is the fact that the recommendations are related highest applicable level of communication (seventh level of the referent OSI communication, (8) and hence the number 7 in the name of the association), and that standard uses unified process and object-oriented approach to the design recommendations (9, 10). This means that the recommendations follow the business model and identified medical processes, and that they are independent of the particular communication technologies and implementations, which makes the norm applicable in all health systems in a unique way. HL7 association operates through its Technical Committees–TC, and Special Interest Groups–SIG, approved by the Board of Directors. Participation in the domain of technical committees and special interest groups is open to all interested persons, regardless of the HL7 membership. The Association organizes regular working meetings three times a year, while TC and SIG organizes regular telephone conferences, or continuing work through the electronic mail, where they work on certain specialized parts of the standards.

## 2. HL7 NORMS AND RECOMMENDATIONS

HL7 association within their work published a series of recommendations for the different domains of information management and changes in the health care system, the Clinical Documents Architecture–CDA), through the Clinical Context Management Specification–CCOW and the Arden Syntax, the message format specification for the exchange of information between health care entities (HL7 Messaging Standards). However, when talking about computer applications and HL7 standards, it usually works on the implementation of different versions of HL7 Messaging Standards set of recommendations, with the remark that the CDA, which is probably the most common implementation of HL7 standards, using the rules and recommendations HL7 Messaging Standards. The last official version of HL7 Messaging Standards is HL7v2.5, which was approved by ANSI Association in June 2003.

HL7v2.x family of recommendations, which success marked the of the quality of HL7 standards, showed all the complexity of tasks that is part of this Association's mission. HL7v2.x does not explicitly define the methodology of the message development, and leaves too much freedom in making them, and the implementation of the standard version of the work in controlled with conditions which are very dependent on the manufacturer and the application environment and are therefore not able to provide a horizontal interoperability and easy integration of all entities involved in patients health care. Seeing these insurmountable problems in the specification of HL7v2.x

standards, the association in 1996 started to create new versions—HL7v3—which takes a fundamentally different approach to making recommendations. Standardized Reference Information Model—RIM), and the modeling methodology and the process message creation are much more limited in options during implementation. RIM is a key component of quality standards, which define the class of information, their attributes and connections, including a table of codes used for specific attributes, and their meanings (also called Vocabulary Domains). RIM is further recognized by the European Standardization Organizations CEN and which started the process of acceptance by ISO association, by which this model becomes an unavoidable component of all future health care system (11).

RIM is a large picturesque representation of clinical data (domains) and identifies the life cycle of events that message or group of related messages carried. RIM is critical for increasing accuracy and reducing cost of implementation. Based on RIM there are HL7 templates that represent data content needed in a specific clinical or administrative context. These templates can range from simple to describe blood pressure (systolic, diastolic, the position of the patient...), to very complex diagnostic procedures, which include hundreds of information, including anatomy, orientation, order of measurements, etc.

HL7v3 norm, unlike its predecessor precisely defines the methodology of the message creation, using advanced methods of design information models such as the unified process and object-oriented analysis and design. All information models are based on the RIM, which is a static model of health information covered with HL7 standardization activities, and which last version 2.01 is accepted as ANSI standards. Based on RIM are implemented DMIM—Domain Message Information Model, or dynamic models that include a set of information for a particular application domain, such as patient administration and laboratory. DMIM models in its set of information includes one or more RMIM—Refined Message Information Model, which is usually related to individual cases of the use of the domain of interest (e.g., billing or patient enrollment in the registry). With further restrictions one RMIM can define one or more HMD—Hierarchical Message Description, which gives a detailed description of a hierarchical format and content of HL7 messages. All of the above models are part of the normative standards, which significantly limits the options in messages and ensures interoperability at semantic level of information.

HL7 standard does not make conditions or any details about the local architecture of information systems and application solutions such as storage technology in your area, or a graphical representation of them, which is very important when connecting to existing solutions and the so-called Legacy. Also, the norm is does not prescribe the specific conditions of transport mechanisms at lower levels of communication, unless defined requirements for reliable transmission of information, character conversion, and support for unlimited length of messages. However, the methodologies that are used to create technical com-

mittees HL7 model must be fully monitored during localization process and application of standards for specific areas of interest. Only in this way can be achieved support of the standards, which actually ensures the interoperability of different application solutions used in the system.

### 3. LOCALIZATION AND IMPLEMENTATION OF HL7 NORM

Application of HL7 standards is considerably different to the version of the recommendations that are used as a reference and starting point.

*Version 2.3 (HL7v2.3)* includes standards for data exchange related to:

- administration jobs with the patient (admission, discharge, transfer and registration of out patients),
  - calculation of the cost of health services,
  - ordering service
  - clinical data on the patient,
  - management of medical services,
  - scheduling of patients and resources,
  - referral,
  - messages about the care of patients in connection with the problem,
  - reports of adverse events,
  - reports on immunization and clinical experiments.
- (6)

*Version 2.5 (HL7v2.5)* consists of 15 chapters, where the first two are common (introduction and control mechanisms for message transfer), while the following 13 refers to a particular domain of standard application (e.g., patient administration, clinical laboratory data, etc.). It is in the second part, which is about the control parameters, the mechanisms of information transfer and the rules of the message creation where options cause the problem of not defined methodology. As a result of the application of HL7v2.x standard does not require long hours of design and implementation in the context of communication mechanisms, transactions, and the focus is soon shifted to the implementation of business logic and information models, which again includes a broad foundation for the use of locally defined models. So today there are a number of commercially available tools that further simplify the implementation process of communication by HL7v2.x standards. However, although the fact is that using HL7v2.x standards and tools for modeling implementation time required is significantly reduced, these solutions show to be very short lasting, and do not meet the needs and requirements for the integration of health systems. So it is almost the rule that the implementation of the same version of HL7v2.x norms by two different manufacturers do not have the possibility to change information, which we come to a situation such as that one laboratory cannot communicate to pharmacy in the same institution if they have different suppliers of computer equipment, and that the horizontal integration outside institutions is like utopia (12, 16).

Implementation of *version 3 (HL7v3)* on the other hand requires more time and effort, and knowledge of

the mechanisms for modeling of business information systems using advanced methods such as the unified process, object analysis, and UML (Unified Modeling Language.) (13), which today constitute the foundation of advanced business application solutions regardless of application domain. Methodology for information model and messaging, and transaction mechanisms are strictly defined, which significantly reduces variability of format and content of messages, and achieves interoperability platform for individual solutions. With the methodology described HL7v3 recommendations in a separate document, the standard includes a separate chapter "Refinement, Constraint and Localization", which describes the permitted methods of modeling used during the localization standards. In the context of ensuring the interoperability of the system in this document is forbidden to add new options without the RIM harmonization process with the original application which requires making a profile that describes the supporting HL7v3 standards, but also many other rules which must obey all the technical committees and development teams.

It is one of the key documents of the norms that is in the second round vote, but actually after the first deployment is expected feedback that will give the necessary results and directions for further steps. HL7v3 norm in this manner should provide sufficient wide and originality, and on the other hand locally define a unified method that can satisfy local needs, and where are the requirements for interoperability, and supporting the previous version and the other represented health standards common to all implementation.

Many countries around the world have launched major projects inspired by the demands of modern medicine, which include standardizing HL7v3 as a key component in solutions for health. So projects like the Central Registry of patients medications (Netherlands), the National Health System (United Kingdom), National Health Cards (Canada), and Sciphox Project (Germany) presents some of the most advanced project in terms of implementation of HL7 standards at the national level, and certainly does not diminishes the importance of quality and a wide range of HL7 projects in other countries (USA, Australia, Japan, etc.). These projects related to work with HL7v3 standard, are a key factor in quality standards and the future of modern health care system (12).

#### 4. EXPERIENCES IN IMPLEMENTATION OF HL7 NORM IN REPUBLIC OF CROATIA

In the context of projects of computerization of primary health care (ISPHC) and integrated hospital information system (IHIS) work on HL7 standards represented an essential component in both projects. Lead by the experiences and results from other projects or existing state of equipment used in the field of health in the Republic of Croatia, the general consensus of experts involved in the project directed implementation of HL7 version 3 standard, despite the fact that the standard has not yet been officially released, in order to avoid any short-term prob-

lems and depending on the vendor solution that brings with it implementation HL7v2.x. ISPHC project was officially launched in autumn 2002 (Figure 1), and included the design solution that satisfies all business processes of primary care follow HL7v3 norm. Using the methodology and processes of ISPHC localization system is used and implemented in more than 60 localized HL7v3 information model and 30 registered code systems, which on the one hand completely follow the original, and the other covering business processes domain in primary health care in the Republic of Croatia (14).

Sample design and implementation of e-account from a primary health care centers to Croatia Institute for public health was created within the Project of informatization of Health Care System in Croatia developed by Ericsson Nikola Tesla Ltd. in Zagreb and team led by Miroslav Koncar. Their experience about application HL7 standards Koncar described in several published articles (15, 16), especially about used HL7 methodology in copmputerization of Primary Health Care System in Croatia. and Hospital Information System, based on HL7 standards.

Information system of Primary Health Care (ISPHC) was tested within experimental phases in 30 offices and simulators of Croatian Institute of Health Insurance and Croatian Institute for Public Health. This system (ISPHC) is in the center of the system and associated entities in a system of Primary Health Care. General practice and Family practice teams sent information to the central system and Health Insurance Fond and Public Health Institute by using HL7v3 norm, that is digitally signed message that are formatted according to the localized HL7v3 models (16).

The process of creating localized HL7v3 model includes a detailed study of bussines processes in the System of Health Care, and their information into the information models and message specifications of HL7v3 standards. All accounts from Primary Health Care and Family Practice units Public Health Institute received electronically very easy.

The construction of these models was a key co-operation of IT and medical professionals (doctors, nurses, people involved in the work Croatian Institute for Public Health and the Health Insurance Institute, etc.) for the qualitative description of the business process of the Croatian health. As the standard is still under construction, problems in the process of localization standards were expected. All these experiences, especially where we found the incomplete models, and identify inconsistent communication mechanisms, we reported to HL7 community, and these are suggestions and the results of today proposals to improve the original HL7v3 standards. Also, a special quality ISPPH solutions should be pointed out very thoroughly designed system security and data protection, which in the context of standards means HL7v3 implementation of digital signature in each message, which manages the system, using advanced technology, XML digital signatures.

In less than two years of work ISPHC project its results have attracted attention throughout the HL7 community,

where they share thoughts and experiences with other experts around the world working on similar problems. Based on these results the Republic of Croatia, and HL7 Croatia today has its representatives in the HL7 International Affiliate Committee (IAC) technical committee, and the position of Technical Co-Chair (elected in April 2004, with a term of two years). In addition to promoting the standards, the role of IAC is to represent the needs and requirements of the HL7 branch toward HL7 Board of Directors. Furthermore, the project of ISPHC is registered in HL7 Early Adopters projects database, which brings together initiatives related to the implementation of the first HL7v3 standards in health systems (15, 16, 17).

Standardization of medical informatics using HL7 form was initiated in Croatia from 2002 by professor Gjuro Dezelic, who was the first chairman of HL7 Croatia International Affiliate until the year 2008. Unfortunately Bosnia and Herzegovina till now not yet included in this project

## 5. CONCLUSION

Characteristic of most health systems today is the large amount of information of interest which are not managed in the best possible way, poor levels of communication and multidisciplinary access to treatment, and the high price and consumption of resources that the system possesses. One of the important guidelines in order to improve the quality of health care system is the continuous rationalization of the costs of resources, both financial as well as the amount of time that the patient spent in the system. With this in mind the key step that leads to the optimization of business processes, and thus the basis for a number of new improvements in terms of security, the application of the latest medical achievements, etc., involving the introduction of effective methods of communication and access to all necessary information as soon as possible. All modern business information systems, health applications and solutions today must have a common goal, and that is the possibility of integration and quality control of information outside the institution or the domain in which they operate, of course, respecting all security measures and protection of information. HL7 standards with its quality and references occupied the attention of the general public and different groups of people, from the manufacturer through the scientists and experts to the user—the medical staff, which has become an inevitable component of modern health systems, whose common goal is optimization of consumption, quality of information management and patient safety in the system.

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