

A Conceptual Framework for the Assessment of Health Management Information System

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Abstract

A Health Management Information System (HMIS) can be a powerful tool to make health care delivery more effective and far more efficient. Health Management Information System where the health data are recorded and stored from which the any patient and doctor can easily find the information. The lot of paper work is reduced during the health management information system. Health Metrics Network (HMN) is working to improve health and lives by strengthening and-aligning health information systems around the world. The Electronic Health Record (EHR) is an online record, which tracks and details a patient's care during the time spent in hospital. The EHR replace paper-based records by integrating patient information in a central system and allows authorized clinicians to access a patient's records from any location. HL7 is a standard. Data sharing among local hospitals is being increasingly realized with the proliferation of the healthcare information system interoperability Standard, Health Level Seven (HL7).

Key words: Health Management Information System (HMIS), Health Metrics Network (HMN), Electronic Health Record (EHR), Health Level Seven (HL7).

1. Introduction

A Health Management Information System is a computer system that is designed to manage all the hospitals medical and administrative information in order to enable health

professional perform their jobs effectively and efficiently.

Hospital Information System was first developed in the 1960 and has been an essential part in health information management and

administration. Early system consisted of large central computers connected to by dumb terminals, which are now being replaced by network microcomputers. The system was used to manage patient finance and hospital inventory.

Health Management Information System focuses on the integration of all clinical, financial and administrative applications and thus could also be called an Integrated Hospital Information Processing System.

An HMIS is basically a database system in which “raw data” are stored and transformed into information, raw data are numbers, characters, images or other outputs. Such data are typically further processed by a human or input into a computer, stored and processed there, and transmitted output to another human or computer. The information has meaning or can inform, while data do not. Computers work with data and not with information. The HMIS in first instance is a “system” and, it has an organized set of interrelating components which can be grouped under two entities. At a first level the data collection process is to ensure the collection of data from lower levels to the central level and to transform data into information. The conceptual level relates to the analysis plus feedback mechanisms assisting in transforming information into knowledge for informed decision making.¹²

It is a process where the health data are recorded, stored, retrieves and processed for decision making. HMIS is responsible for collecting information to be used in the effective planning, development, coordination and evaluation of the individual programme⁴.

1.1. *Benefits of HMIS :*

The benefits of the HMIS system are described as follows:

A. Increased Access to Care :

The use of HMIS and the Internet allows for faster evaluations, which directly relates to the number of diagnoses and evaluations per time. Also, in most illnesses, the impact of early diagnosis and treatment on survival rates and treatment costs cannot be denied. Early diagnosis and early treatment creates better health outcomes at reduced direct costs to the health care system.

B. Better Resource Utilization :

It allows for better utilization of physicians and related hospital staff; thereby expediting diagnoses. Potential effects include greater satisfaction of providers, patients and their families, and possible increased retention rates of staff.

C. Increased Diagnostic Accuracy :

Diagnosis accuracy is always a huge concern for the medical community; therefore, the teleradiologic phase of a HMIS project is considered a primary benefit. It is easier for PCP's to get expeditious diagnoses, for doctors to get second opinions and for educators to correctly train our next generation of physicians. This greater access to specialists helps ensure more patients will get the appropriate level of care and therefore be treated correctly, the first time.

D. Increased Productivity of the Health

System :

HMIS allow for the routing of consults to a specialty hospital rather than to a general network hospital or provider. At sites where specialists are not utilized to capacity, the health system can eventually shift the workload to improve utilization. This would allow for better utilization of physicians at remote sites, with the potential for primary care providers providing the needed care.

1.2. HMIS Components :

The main HMIS components are described below:

- A. Information Architecture* is the fundamental building block of all HMIS design and development.
- B. Technology Architecture* entails the effective deployment of computer hardware, software, interface and communication network to support HMIS integration and use.
- C. Domain Architecture* exemplifies the interdisciplinary nature of managing health care information services.
- D. Control Architecture* presupposes that the science and art at HMIS design and development can only be perfected through building, administering and managing an intelligent organizational technology interface.

1.3. HMIS Functions :

Health management information system is built on the foundation of three processing phases: data input, data management, data output. The *data input* phase includes data acquisition and data verification. The *data management* or processing phase includes data

storage, data classification, data update, and data computation. Finally, the *data output* includes data retrieval and data presentation. These eight elements and three phases together define a typical HMIS.

- A. Data Acquisition :* It involves both the generation and collection of accurate, timely and relevant data.
- B. Data Verification :* It includes involves the verification and validation of gathered data.
- C. Data Storage:* It involves the data preserving and archiving.
- D. Data Classification:* It is a critical function for increasing the efficiency of the system when the need arises to conduct a data search. It provides the greater understanding of how the data will be used after the data have been collected and storage.
- E. Data Computation :* It involves various forms of data manipulation and data transformation, such as the use of mathematical models and statistical applications, linear and non linear transformation. New and changing information is accounted for the element of data update.
- F. Data Retrieval :* It is concerned with the data transfer and data distribution. Final, data presentation has to do with how users will interpret the information produced by the system.

2. Health Metrics Network :

Health Metrics Network (HMN) is working to improve health and lives by strengthening and aligning health information systems around the world. It is founded on the premise that better health information leads to better public health decision making that will improve health for millions worldwide.⁷

2.1. Goal of HMN :

To increase the availability and use of timely and accurate health information by catalyzing the joint funding and development of core health information systems is the overarching strategic goal of HMN. To accomplish this goal, HMN is laying out a vision; identifying strategies for health information systems development and strengthening; supporting countries in strategies implementation; and generating new knowledge and global public good through research, technical innovation, and sharing lessons learned.⁷

2.2. HMN Framework :

The HMN Framework consists in the definition of health information system and the interaction of its components. A health information system can be described in terms of its inputs (resources), processes (selection of indicators and data sources; data collection and management) and outputs (information products and information dissemination and use).⁷ Hence, the six components of a Health Information System (HIS) are represented in fig. 1.

- A. *HIS Resources* : These include the legislative, regulatory and planning frameworks to ensure a fully functioning HIS and the resources available for health information, including human resources, logistic support, information and communications technology, and coordinating mechanisms within and between the six components.
- B. *Indicators* : A minimum set of indicators and related targets, covering the main domains of health information (determinants, health system inputs and outputs, health service

coverage and quality, and health status) is the basis for a health information system plan and strategy.

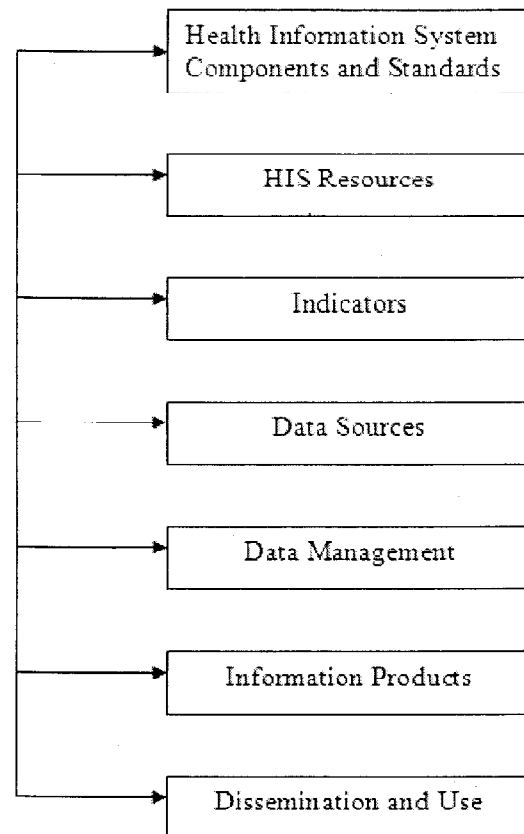


Fig.1. HMN Framework

- C. *Data Sources* : There are two main types of data sources, those generating population-based estimates (census, vital statistics and household/population-based surveys and surveillance) and those that depend on health service or administrative records (disease-surveillance, health-facility records, administrative records and health-facility surveys). For each data source a basic set of standards and key strategies to achieve the

standard are described.

- D. *Data Management*: This covers all aspects of data handling from the collection, management and flow of data to its processing and analysis.
- E. *Information Products* : Data must be transformed into information that is the basis for evidence, and that ideally becomes knowledge to shape health action.
- F. *Dissemination and use*: The value of health information can be enhanced by making it readily accessible to decision-makers and giving due attention to behavioral and organizational constraints and incentives to use.

3. Electronic Health Record :

The Electronic Health Record (EHR) is an online record, which tracks and details a patient's care during the time spent in hospital. The EHR replace paper-based records by integrating patient information in a central system and allows authorized clinicians to access a patient's records from any location within an Area Health Service, at any time, to make rapid assessments and coordinate care. Ultimately, the EHR will improve the quality, safety and efficiency of care by providing an integrated system of patient information. The use of EHR can effectively prevent and decrease the diagnostic mistakes, reduce the medical expense, and increase the efficiency of medical work.^{1,10}

3.1. The Function Modules of EHR System:

This system was designed according to the requirement of the CHC. It was divided into three function modules logically, which were Personal Information Record Module, "Six in One" Function Module and Transport

Module. However, both the personal information record module and transport module are not insulated modules. They are designed according to the "six in one" function when the system is implemented.⁸ The diagram of function modules of EHR system is shown as follow in Fig. 2.

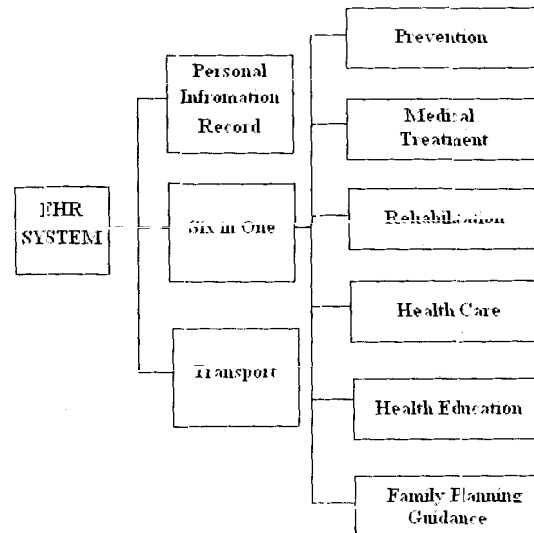


Fig. 2. The Function Modules of EHR System

A. Personal Information Record Module:

The personal information record module, containing database management, recorded the personal information and health information (such as the history of genetic disease, personal habits and past medical history etc.), and structures the text information. Because this module could be extensible, thus other functions were able to be added (take data mining function for example). The residents' health record could be shown on the interface, and the user could add, delete, query and modify the record by pressing the corresponding button. Because

and download information via the existing wireless network between the other wireless devices and database server. Thus the information can be exchanged immediately in the community.⁸

3.2. *OpenEHR :*

An electronic longitudinal collection of personal health information usually based on the individual, entered or accepted by health care providers, which can be distributed over a number of sites or aggregated at a particular source. The information is organized primarily to support continuing, efficient, and quality health care. The record is under the control of the consumer and is stored and transmitted securely.⁹

3.3. *Advantages of EHR :*

The main advantages of EHR System^{1,10} discussed as follows:

- A. *Improve Documentation:* Eliminates illegible handwriting, links related records electronically, reduces data entry errors, and helps eliminate missing/required patient information.
- B. *Improved Quality of Care:* With complete and immediate access to patient records, providers are able to provide better, faster, more personalized care, raising the level of both medical care and personal attention.
- C. *Improved Security :* Role-based security allows only authorized individuals access to medical records. Access logging and auditing provides a history of who accessed and who modified any record.
- D. *Reduced Documentation Expenses :* Eliminates need for most transcription activity and dramatically reduces the need for paper storage facilities.

4. *Health Level 7 (HL7) :*

HL7 is the standard in the health care communication. HL7 was founded in 1987 to produce a standard for hospital information systems. HL7 is a standards organization that was accredited in 1994 by the American National Standards Institute (ANSI). The name "Health Level-7" is a reference to the seventh "application" layer of the ISO/OSI Reference model. The name indicates that HL7 focuses on application layer protocols for the health care domain.^{5,3} for people or computers to be able to share clinical data with one another, they must both:

- A. Have functions to be able to physically communicate, e.g. speak & hear, send and receive documents and data files, share data and information. This is called "functional interoperability".
- B. Speak a common language (in terms of nouns, verbs, grammatical structure, etc.) and share the same vocabulary that allows them to understand complex medical conditions and processes. This is called "semantic interoperability".

A group of healthcare computer systems users develop the HL7 protocol to create a common "language" that allows healthcare applications to share clinical data with each another. Over time the HL7 interoperability protocol became a nationally, internationally and globally accepted and accredited standard.^{5,3}

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from patient records to billing information is recorded in computer systems. In order for these different types of systems to communicate with each other they use a standard like HL7.

4.1. HL7 Interface Engine :

An HL7 interface engine is an interface or integration engine built for the healthcare industry. It connects legacy systems by using a standard messaging protocol. Because hospitals and other healthcare providers usually have different systems for different aspects of services, they are often unable to communicate with each other. HL7 provide the framework for the exchange, integration, sharing and retrieval of electronic health information.⁹

The HL7 middleware can connect to medical devices through LAN interface. For interoperability of various medical data, middleware receives raw data from medical device, converts to HL7 data, and creates unsolicited observation message in order to send message to HIS based on HL7 interface engine. Because HIS consists of various clinical subsystems, integrating data is necessary in order to improve patient services, optimize resource management, and support decision-making. In Figure 3, middleware components collect raw data from medical devices, convert raw data according to HL7 standard. Then, middleware components send HL7 messages to HIS.⁹

4.2. HL7 Standards :

There are various standards of HL7. The main HL7 standards are described below:^{9,11}



Fig. 3. System Architecture based on HL7 Interface Engine

A. Version 2.x Messaging Standard :

V2 Messages, formally published as “Application Protocol for Electronic Data Exchange in Healthcare Environments” is an interoperability specification for transactions produced and received by computer systems. These specifications are published as a collection of chapters that describe the transaction interactions by domain.

B. Version 3 Messaging Standard :

V3 Messages is an interoperability specification for transactions that are derived from the HL7 V3 Foundation models and vocabulary and define communications produced and received by computer systems. V3 Messages include the concepts of message wrappers, sequential interactions, and model-based message payloads. These specifications are published as a collection of topics that describe the transaction interactions by domain.

4.3. Principle of data exchange based on HL7 standard :

HL7 standard, application data of different format is built into standard HL7 message format, which will be sent to a receiving system in terms of certain network transport protocols and communication rules.

And then HL7 messages will be parsed in the receiving system. At last, they will be converted into application data, thereby achieving data exchange between different systems. The basic principle is shown in fig. Among them message construction is to build application data into data structure and export message character string.⁶ While the process of parsing message is opposite to message construction in fig 4.



Fig. 4. Data exchange based on HL7 standard

In order to complete data exchange between medical systems, a variety of affairs are defined in HL7. Each affair contains a great many of events, each event consists of several messages, while messages are made up of a series of segment, field, component and subcomponent.⁶

A *trigger event* in the real world of health care creates the need for data to flow among systems. A *message* is the atomic unit of data transferred between systems. Each message has a message type that defines its purpose. For example: the ADT message type is used to transmit portions of a patient's Patient Administration (ADT) data from one system to another. A *segment* is a logical grouping of data fields. A *data field* is a string of characters. Some fields consist of many components or sub-components. For example, patient name is composed by family name, given name etc.¹¹

- Message
 - Segment
 - Fields
 - Components
 - Sub Components

5. Conclusion

The system Health Management Information System (HMIS) is for computerizing the working in a hospital. The software takes care of all the requirements of an average hospital and is capable to provide easy and effective storage of information related to patients that come up to the hospital. The system reduce the time spent by staff filling out forms, provide better quality of care, procedures and service to patients and increase productivity.

It generates test reports; provide prescription details including various tests and medicines prescribed to patient and doctor. It also provides labs details and billing facility on the basis of patient's status whether it is an indoor or outdoor patient. The system also provides the facility of backup as per the requirement.

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