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Adapting Information Technology (IT) in healthcare for Quality patient care- Study conducted in a Hospital in South India

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Abstract: The earliest use of computers in health care was in administration. In recent years, the cost of providing high quality services and patient satisfaction in hospitals has increased tremendously. Using information system in healthcare has become one of the best solutions for hospital management to decrease cost, increase patient satisfaction, to improve hospital processes and to provide high quality patient care. The role of digital technology in medical care and its delivery has expanded at an ever-increasing pace. Information technology has brought about a big revolution in the health care industry. This paper shares our experience in implementing upgraded Hospital Information System (HIS) software into an already existing computerized system. The implications of having adopted multiple software modules specific to different clinical and special purpose applications has been highlighted. In an era of rapid advances in science and technology, dependability on biomedical equipments and the software that they support has become inevitable for taking decisions in healthcare delivery. There is a need to consider information technology (IT) compatibility at the very beginning, which is at the time of buying these high-end equipments, else the implementation and functioning of IT in hospitals will be in piece meal. In conclusion the benefits of implementing IT in healthcare in terms of productivity, cost, effectiveness etc may never be realized if we are not open to the future needs. That is adapting an 'open system architecture' which can be sensitized to the ever changing information technology.

Keywords: Information technology (IT); Healthcare; open system architecture; Hospital Information System (HIS)

Introduction

The earliest use of computers in health care was in administration. Hospitals instituted computerized budgeting and financial planning; medical offices used programs specifically designed to their needs. However, standardization of record keeping and integration of computer systems via complete electronic medical patient records lagged. Something as simple as introducing a standardized computerized sign-out system that lists patient problems, treatments and medications, so that incoming staff are fully informed, was found to improve patient care.[1]

In recent years, the cost of providing high quality services and patient satisfaction in hospitals has increased tremendously. Using information system in healthcare has become one of the best solutions for hospital management to decrease cost, increase

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patient satisfaction, to improve hospital processes and to provide high quality patient care.[2]

The study was conducted with the aim of assessing the implementation process of upgraded software into an already functional computerized system in a tertiary level hospital. The objective was also to study the extent of IT usage in tertiary level teaching hospitals. This study was conducted in a large tertiary level multi-specialty teaching hospital in Manipal, which forms a part of Udupi district. The study was conducted over a period of ten months from January – October 2009. The design is retrospective and prospective. The retrospective part involves perusal of records and registers & informal interviews with the staff of the IT department at Kasturba Hospital Manipal. The prospective nature of the study involves the study of implementation process.

Definition: Hospital Information System (HIS) is defined as a computer system designed to ease the management of all the hospital's medical and administrative information and to improve the quality of healthcare according to Degoulet and Fieschi (1997).[3] On the other hand, according to Sneider (1987), HIS is a hospital wide system or network designed to support the flow of information between departments.[4]

***1. Background of IT in healthcare*:**

Beginning with the computerization of hospital administrative tasks in the 1960s, the role of digital technology in medical care and its delivery has expanded at an ever-increasing pace.[1] The second generation of HISs, which started in the middle of 1970s and ended at the end of 1970s, mainly served financial systems and their main purpose was to transmit information from end users to financial systems. The third generation of HISs, which started in the late 1970s, was influenced by data based technology, which was introduced in early 1980's and focused on patient care planning and department solutions such as laboratory and pharmacy. The main features of the fourth and current generation HIS which started in 1980s is known as the integration facility of HIS with other third party systems including financial or other departmental services.[2]

There are many programs that automate and computerize functions in health care environment. Administrative applications include office management tasks, scheduling and accounting functions. Some of these activities are slightly different in a healthcare environment, so programs are needed that take into account the special needs of a healthcare environment. Some are for doctors' offices; others for hospitals, emergency rooms, pharmacies or chiropractors. Some are off-the shelf commercial software; others are written specifically for a particular office or hospital. These programs make it possible to keep track of a patients billing and health status electronically. The needs of each type of health care setting differ.[1]

Traditionally the application of computer technology in healthcare is divided into three categories. C*linical applications* of computers include anything that has to do with direct patient care, such as diagnosis, monitoring and treatment. *Special purpose applications* include the use of computers in education and some aspects of pharmacy.

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Administrative applications include office management, scheduling and accounting tasks.[1]

The use of IT is evidently a major component of work in businesses. Most responding companies prefer in-house training by their own staff for IT Training above other methods. The most important use of the IT by respondents is in office applications, followed by accounting software and sector-specific applications. The sector-specific and project-management applications were expected to show the greatest growth in demand over the coming years.[5]

1.1 Software used in healthcare:

The use of computers in hospitals has reached nearly 5 decades, with evolving changes in hardware & software. Software used previously includes COBOL and Fox pro. The main disadvantage in the use of these software programs is that they are file data base, and hence interfacing with evolving software technology is not possible. (i.e. they are not HL-7 compliant). The software programming platform at present are JAVA; JSP; .Net; Database; MSSQL; MYSQL etc which are Relational Data Base Management System (RDBMS) and HL-7 compliant.

1.2 Health Level Seven (HL7):

Founded in 1987, Health Level Seven International (HL7) is a not-for-profit, ANSI-accredited standards developing organization dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services.

"Level Seven" refers to the seventh level of the International Organization for Standardization (ISO) seven-layer communications model for Open Systems Interconnection (OSI) - the application level. The application level interfaces directly to and performs common application services for the application processes. Although other protocols have largely superseded it, the OSI model remains valuable as a place to begin the study of network architecture.[6]

1.3 Open System Vs Closed System[7]

Adhering to a standard protocol is called "open system architecture". Anybody can interface with an open system using appropriate protocols, independent of its vendor. When using HL7, the interface allows for numerous systems to be added to a single HL7 feed. New systems can be added without having to modify the original source system as demonstrated in the diagram below:

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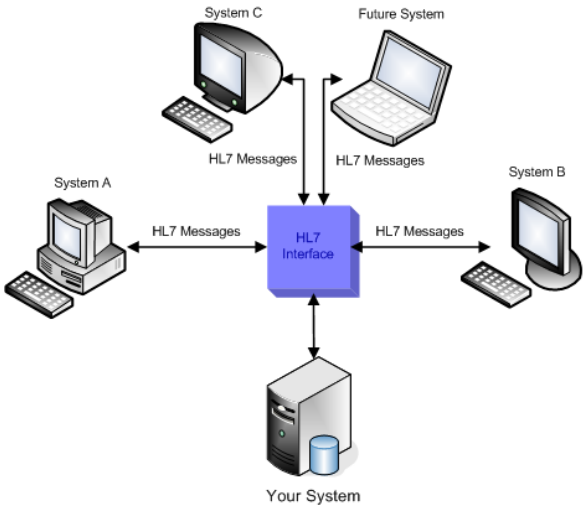

Figure-1: HL7 Interface Model

Closed system model also known as Proprietary interface model is as represented below:

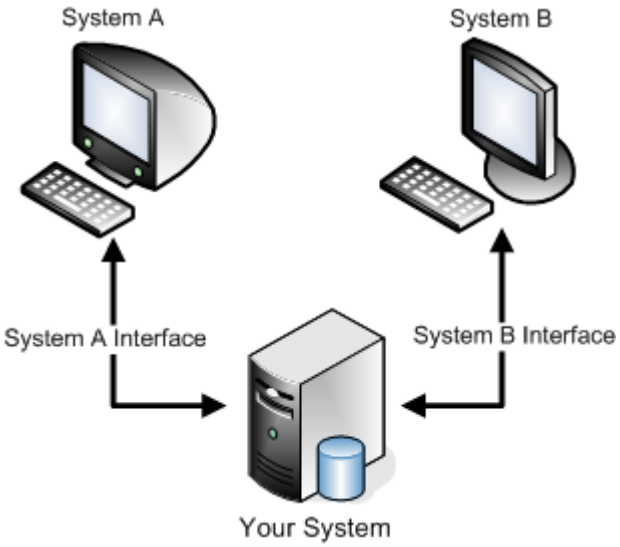

Figure-2: Proprietary Interface Model

The closed-system model is easier to design and initially costs less to implement, closed systems have greater reliability on single vendors and more reliance on specific applications and technologies. Although the worldwide trend is to follow open-system architecture, there are still tradeoffs in following a standard protocol when developing interfaces. For instance, a greater initial investment is required. Time and money must be spent to understand the standard and create the infrastructure required to support the

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standard, such as a parsing framework and networking code. The benefits are abundant. For example, it will be easier to answer user requirements because HL7 is considered the standard for exchanging data between healthcare systems. In addition, because HL7 is the standard, it will be easier to create a system that can interface with an open system now and in the future.[7]

1.4 Benefits of information technology in Health Care industry[5]

Information technology in the field of heath care allows complete management of the medical information and the safe exchange of information between the health care consumers and the providers. Information technology has brought about a big revolution in the health care industry. Some of the benefits of information technology in health care industry include:

- Improved quality of health care
- Prevention of medical errors
- Reduction in the health care costs
- Increase in the administrative efficiencies
- Decrease in the amount of paperwork
- Increased access to affordable health care options.

The other benefits of information technology would not only improve the individual patient care but would also bring about many benefits to the general public health like:

- Early detection of infectious disease outbreaks in the country
- Improved tracking of severe disease management
- Evaluation of health care based on value enabled by the collection of de-identified price and quality information that can be compared.

The introduction of information technology in health care system has helped people in better management of the health information and also patient management. The documents need not be filed in the form of papers and can be complied on the computer and given to patients. There are less chances of loss of documents and patient information.[5]

2. Implementation of HIS at a tertiary care teaching hospital

Kasturba Hospital, Manipal is a tertiary level medical college teaching hospital that has already been sensitized to the use of computer applications in its administrative functions over the last 2-3 decades. However due to the rapid changes in the healthcare technology and functioning over the years it was found necessary to adopt new software technology or upgrade the existing. In view of this the computer professionals who had previous implemented the software in the hospital was contacted. The software used earlier was COBOL based which our in-house IT professionals were very well versed with. However there were few major changes required in the existing software which prompted the hospital management to contact the software company officials. This was done during the financial year 2007-08.

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The company offered to implement their new software which was a window based program and also user friendly. After an initial negotiation the company offered to stage a demo of their new window based software. During the demo it was found that they had few basic modules which covered administrative functions like registration, admissions, billing and a general inventory module. However it was agreed to develop modules for other departments as well customized to the functioning of this hospital. After undertaking a 'gap analysis', the modules was developed for the remaining departments over a six month period.

While many people start computerization efforts in all earnest and with full enthusiasm, their efforts sometimes come to a naught. There are many reasons and knowing about them prepares us better for dealing with them. Sometimes, the first step of task definition will make it clear that a computer really is not necessary for that application. The correct formula is: Task definition then software than hardware. Reversing this order, although commonly done, will surely lead to disappointment and needless expense.[8]

2.1 Steps in Implementation of HIS:

The first meeting on HIS project implementation took place around in April 2008, to chalk out an action plan for implementation. The existing software/hardware support was assessed by a team of professionals from the company and the requirements were enlisted.

1. Procurement of software/hardware components for HIS implementation
    a. Procurement of 'Server', its installation and configuration
    b. Procurement of RM COBOL runtime
    c. Procurement of ILink software & client machine configurations
2. Implementation of the new software developed for user acceptance and testing: It was initially decided to go about implementing the new software in a phased manner. A total of 13 modules were shortlisted. See Table-1

    a. First Phase- To implement Access (Admin) module; OP registration& billing modules; IP registration & billing modules
    b. Second Phase- To implement Pharmacy module (Bulk/retail); MRD ; General Stores modules
    c. Third Phase- Implementation of the remaining modules which included purchase; finance; linen; dietary modules etc.

Table-1: List of Shortlisted Modules offered

Sl. No	Module Name	Sl. No.	Module Name
1.	Access Module	7.	Pharmacy Module- Bulk
2.	OPD Module-Registration	8.	Pharmacy Module- Retail
3.	OPD Module- Billing	9.	Medical Records Module
4.	In Patient Module- Admission	10.	General Stores Module
5.	In Patient Module- Registration	11.	Purchase Module

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6.	HAPS- Module	12.	Linen Module
		13.	Diet & Food Services Module

It was decided to deliver the programs for UAT and start parallel run before going live in the respective departments. This phased manner of implementation did not work as the functioning of the hospital was interlinked with various sections and hence there was a need for implementing all modules in one phase.

Feedback from the end-user was received during the UAT. The user requirements were adhered to in most situations but in few instances it was kept pending for want of clarity and clarifications. Once the pending work was cleared, which took nearly 8-10 weeks, it was decided to test the new soft ware. Data migration into the new soft ware was undertaken for this purpose implement the new software.

3. Developing Training Schedule for the end-user/s

Training schedules for the end user were formulated. Training was undertaken for nearly 4-6 hours in a day (mostly afternoons) for nearly a week. During the training sessions, two staff (instructors/trainers) from the company was deputed fulltime to provide training to the end users. The training schedule is as given in the table below:

Table-2: Training Schedule for HIS module

Date	Departments
11.05.2009	OP Registration
	OP Billing
12.05.2009	IP Admission
	IP Billing
13.05.2009	Wards
14.05.2009	Pharmacy-Bulk section
	Pharmacy- Retail Section
15.05.2009	General Stores- Bulk
	General Stores- Retail
16.05.2009	MRD

a. During each training episode three staff from each department was deputed to undergo training. One of them would necessarily be the in-charges of the concerned departments.
b. Once the training was completed, it was decided to go live only after having an 8-day error free running of all the modules. During this period it was decide to run the old system also in parallel. Show stoppers were incorporated which helped to detect errors more easily in the new system.

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It was decide to go live in the month of July; however the show stoppers continued to show up and added to the delay in going fully live. Simulation testing was done for nearly a week to ten days before being fully complacent in going live. Finally the new software was planned for implementation in the month of October 2009.

4. Going Live Process (Pre-preparation)

    a. Before going live, the in-charges were taken into confidence by the implementing team in clearing all the show stoppers that may have surfaced while running the respective modules during trial mode. All department in-charges had consented for 'ready to go live' (Sign-off), two days prior to going live.
    b. Master Checklists for verifying the modules to be implemented, pre and post going live was prepared.
    c. Discharges had been kept at the minimum on the proposed day for going live.
    d. Manual billing option was given to Billing and Pharmacy(provision for preparing IP billing in case of expired patients was given)
    e. Checklists of any other reports to be checked after migration before going live prepared for each module

5. Post-live
    a. Advance payment serials did not continue from the last serial

2.2 Interfacing of Modules:

During the time of upgrading the HIS software, they were many other modules already in existence which had been incorporated over time. Some of the special purpose applications were Picture Archival and Communication System (PACS) for Radiology and Imaging purposes; Lab Information System (LIS)for Clinical lab etc. Few modules like Radiology Information System (RIS); Electronic Medical Records (EMR) were being considered at the time of this study. After implementing the HIS software, it was decided to have interfaced all the modules for functional ease, however this was not possible as the new HIS system which covered all the administrative applications and special purpose applications could not be interfaced with the diagnostic modules due to software compatibility problems. The only possible interface was with Clinical Lab (i.e. LIS).

2.3 Challenges faced during the Implementation Process:

Although the hospital was sensitized to the use of computers, the implementation of the new HIS posed several challenges. Some of them are listed below:

1. Resistance to change: Accepting the change over from the existing system to new upgraded system for the end-users was difficult, especially when both systems had to run parallel.
2. Stock report checking of nearly 70 wards had to be done Pre-live and post-live with limited staff

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3. IT staff posting in the departments during the night on the day of going live
4. Last minute hitch: There was a delay in 'going live', (10:30am instead of 7:00am) on the proposed day due to some technical problems, this made it difficult to manage the patient crowd early in the morning

The lessons learnt during our experience in upgrading the existing software and implementation of a new HIS at the tertiary level teaching hospital has brought about in making the following suggestions:

1. It is always best to go for Window based HIS package.
2. Before planning for HIS it is worth while in conducting an in-depth study of the existing system, identifying its drawbacks and the proposed system.
3. Gap analysis has to be prepared taking into consideration the future requirements as well. (at least 10-15 years ahead)
4. Proper impact analysis has to be done for changes suggested by the users so that the defects are not reflected in other processes as the hospital works as a system
5. Active involvement of the process owners (end users) is the key to fruitful implementation of any new project.

Discussion:

The implementation of HIS at Kasturba hospital has been initiated quite early during the mid 1980's. With advancement in technology and growth in information technology, delivery of healthcare has become easier however only with the adoption of Information technology. Implementation of this ever changing information technology into the healthcare industry definitely poses a huge challenge. A stepwise approach to its implementation; taking users into confidence; initiating a change process; and commitment from the top management has made implementation a smooth process although there were few challenges to be overcome. Our study findings well correlate with studies conducted by Mary L. Houser et al.[9] who shares similar experiences. Another study conducted at a hospital in Indonesia by Achmad Nizar et al[10] concludes that the change management process is vital for implementation of an information technology (IT) system. A study conducted by Lewis in 1951 has stated, Any hospital that implements an automated information system must successfully work through the change process to attain positive results. Three critical steps are associated with change theory-the unfreezing process, the institution of change, and the refreezing process. In our institution we have been successful in unfreezing the process and instituting change, we are now into the refreezing process.

Conclusion:

It may not be possible to implement the entire HIS all at once, primarily due to the huge investment that may be necessary in acquiring IT products as against its depreciation rate and obsolescence. Other contributing factors include constant changes in the design & functioning of hospitals adapting to the needs of customers and keeping pace with advances in science & technology. However this can be overcome by implementing the administrative applications; clinical applications and special purpose

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applications etc as and when required in a phased manner, however it should be borne in mind that the software selected should be need based; user friendly and adhering to a standard protocol "open system architecture" to incorporate future requirements. It is advisable to adhere to HL-7 standard compliance.

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