



## THE HOSPITAL MANAGEMENT INFORMATION SYSTEMS (HMIS): A JOURNEY TO PAPERLESS HOSPITALS

**Vijay Kumar Tadia\***

Senior Resident Administrator Department of Hospital Administration AIIMS, New Delhi \*Corresponding Author

**Shubhang Gupta**

Senior Healthcare Consultant HOSMAC Middle East DMCC

### ABSTRACT

**BACKGROUND:** In recent years, there has been growing global emphasis on the need for Hospital Management Information Systems (HMIS)(1). A lot of studies have shown the benefits of implementing HMIS(2)(3)(4)(5)(6). The evolving paradigm shift resulting from IT, social and technological changes has created a need for developing an innovative knowledge-based healthcare system and the Hospital Information Management System (HIMS) is developed with this sole aim in mind. (7) Although information gathering, processing, communication, and management are essential to health care delivery, the health care sector as a whole has historically trailed far behind most other industries in investments in information/communications technologies.(8)(9)

**METHODOLOGY:** A descriptive observational study at two tertiary Care Hospitals in a metropolitan city of India from April 2012 to December 2012. Both the hospitals were located at two different places in the same city and were managed by single administrative set up, the Main hospital & Associated hospital. These hospitals were selected as these were among the few hospitals in India that had implemented an organisation-wide Hospital Management Information Systems. Purposive sampling was used to select Key Informants (KI). The KIs included the Hospital Administrators (Main hospital and Associated hospital), HOD/Incharge Radio-diagnosis; PACS engineer(s) and technician(s). Unstructured Interviews were conducted with Key Informants to understand HMIS. Documentation Review was also performed to gather data. The analysis of data was done with the help of Microsoft Suite.

**RESULTS :** The journey towards paperless hospitals started with formation of a Project Team, Collection of the User Specific Requirements (URS), detailed description of Software Requirement Specification (SRS) and Preparation of a System Design Document (SDD). With the blueprint of URS and the SDD in hand, the management decided to go ahead with the actual process of computerization. Hospital Information System (HIS) which was gradually adopted at Main hospital & Associated hospital included various Modules.

**CONCLUSIONS:** The journey to paperless hospitals is a gradual process. Different hospitals undertake this journey based on their need assessment and availability of the resources. Few hospitals go in for prefabricated solutions and few opt for indigenous development of hospital management information systems. This is one of the major decisions that can make or mar the success of the hospital management information systems in a hospital

### KEYWORDS :

#### INTRODUCTION

In recent years, there has been growing global emphasis on the need for Hospital Management Information Systems (HMIS)(1). A lot of studies have shown the benefits of implementing HMIS(2)(3)(4)(5)(6). The evolving paradigm shift resulting from IT, social and technological changes has created a need for developing an innovative knowledge-based healthcare system and the Hospital Information Management System (HIMS) is developed with this aim in mind. (7) Hospital Management Information Systems (HMIS) interfaces technology with the existing combination of people and procedures that make up the management of a hospital care system. Regular information systems do not provide intelligent data but HMIS does.

NITI Aayog had come up with the idea of a National Health Stack (NHS)—a digital infrastructure built with a deep understanding of the incentive structures prevalent in the Indian healthcare ecosystem. The NHS, a set of building blocks which are essential in implementing digital health initiatives, would be “built as a Common Public Good” to avoid duplication of efforts and successfully achieve convergence.(10) A robust HMIS is, thus, the need of hour.

#### METHODOLOGY

A descriptive observational study at two tertiary Care Hospitals in a metropolitan city of India from April 2012 to December 2012. Both the hospitals were located at two different places in the same city and were managed by single administrative set up, the Main hospital & Associated hospital. These hospitals were selected as these were among the few hospitals in India that had implemented an organization-wide Hospital Management Information Systems. Purposive sampling was used to select Key Informants (KI). The KIs included the Hospital Administrators (Main hospital and Associated hospital), HOD/Incharge Radio-diagnosis; PACS engineer(s) and technician(s). Semi-structured & Unstructured Interviews were conducted with Key Informants to understand HMIS. Documentation Review was also performed to gather data. The analysis of data was done with the help Microsoft Suite.

#### RESULTS

##### HOSPITAL STATISTICS (Cumulative for both the hospitals)

Year	Registrations
------	---------------

2006	41,156
2007	43,519
2008	45786
2009	47980
2010	54206
2011	57103

**TABLE 1**

Both the hospitals were pioneers in the introduction of Information Technology (IT) systems for the facilitation of healthcare delivery and were one of the few digital hospitals in India with their IT story going back to the year 1985 when a Norsk Data 500 Super minicomputer connected to 40 dumb terminals was installed in the main hospital. In 1997, the management decided to review the systems, processes and administration to make use of Information Technology for effective day-to-day decision making. Consequently, the IT Infrastructure was upgraded with the commissioning of an AS/400 BM server on Ethernet backbone with Client Server architecture and PCs acting as intelligent terminals across the Main hospital to meet future needs. The hospital information system was provided a major fillip with the incorporation of various specific modules such as Patient Administration, Materials Management, In-Patient Billing, Radiology Information System and the Laboratory Information System during the period 1999-2003.

#### HISTORY OF THE IMPLEMENTATION OF HMIS

To study the history of Computerization at these hospitals, we had to begin with the history of Computerization at Main hospital per se as the Main hospital was established earlier than Associated hospital. Main hospital initiated the process of computerization in the year 1985. A Consultancy Service was hired to do a feasibility study and project design for computerization. As an outcome of this study, computerization took off with the installation of the Norsk-Dats (ND) 550 Super-minicomputer in 1986. An application software related to patient Admission/Discharge/Transfer was developed to deliver better services in healthcare. Over the years, the Computer Department in these hospitals had developed other applications based on the ND System as well as PC based Networking Systems.

The Management later realized that ND 550 was not adequately serving the purpose so updation of the system was sought. At that point in time, the parent company had closed down so updation of the system had to be abandoned. There was an attempt to create a Modular System of Computers. Servers (Mini-computers) were installed in four areas: General OPD, Private OPD, Library and Central Research Section (CRS). Out of these, the two OPDs were linked to the ND 550 machine, while the other two were independent systems. The functions performed were the same but there was enhanced capability as a result of the addition of the minicomputers.

By the middle of 1990s, management felt the need to phase out the Machine as it had become increasingly difficult for the hardware vendors to support the ND System. The services of another consultancy agency were sought to conduct a diagnostic review of the systems, procedures, policies and controls. The objectives of the review were:

- a) To suggest improvements in the internal controls, procedures, policies, forms currently in use which would ultimately have an impact on control over costs, revenue augmentation and better information management.
- b) To identify control weaknesses and suggest measures of strengthening them.
- c) To suggest measures to reduce time delays and eliminate bottlenecks in various activities.

The agency carried out a diagnostic review of the systems, procedures, policies, existing documentation at various departments, and held detailed discussions with respective functional heads. It studied the following systems in the hospital:

- Patient Registration, Admission and Billing.
- Purchase and Stores (for consumables and dispensary items).
- Financial Accounting.
- Personnel & Payroll.
- Budgeting Systems.
- General Administration and Maintenance.

The agency submitted its report in early 1998. Its key recommendation on review of the underlying systems and procedures were that the computerization of the commercial systems at the hospital was inadequate, with few systems being computerized on a stand-alone basis.

Based on this report, a Memorandum of Understanding (MOU) with Communication & Networking partner was signed to provide services for Networking, Replacement of the existing ND-550 System with "Client-Server" architecture & Design and Development of the application Software.

A review of the technical requirements was carried out jointly by the Hospital Management, Consultancy agency and Communication & Networking partner to indicate the Hardware, System Software and Networking requirements for implementation of the various application systems. A report was submitted in mid 1998, detailing the requirements. The hospital purchased a new machine (AS/400) which would slowly replace the working of the ND 550. After that, gradual computerization of various systems at Main hospital & Associated hospital was carried out.

## REWINDING THE CLOCK: THE PROCESS OF COMPUTERIZATION

If we go back in time & see what happened during the process of computerization of Main hospital & Associated hospital, we will come across following milestones:

### FORMATION OF A PROJECT TEAM:

The project envisaged a project team that would look after the goal of networking. The team included:

- Project Coordinator
- Project Leader
- Project Team

### PROJECT COORDINATOR:

A senior member from the hospital administrative hierarchy was entrusted with this task. His functions included:

- Drawing a clearly laid plan for the computerization with deadlines.
- Supervising and reviewing the progress made by the team.
- Making sure that resources were available for the project at all the times.

### PROJECT LEADER:

He was the member of the computer department. The functions of the leader were the same as the coordinator, but he remained closer in proximity to the team than the latter. He provided constant guidance in terms of scheduled targets & internal review of the work done.

### PROJECT TEAM: This included the following people.

- Programmers
- The maintenance engineers
- Data entry people
- Representatives from each department in the hospital.

Their role was to plan the activities within the overall plans of the project. They served as the link between the users and the Communication & Networking partner

### COLLECTION OF THE USER SPECIFIC REQUIREMENTS (URS):

This was the first step in the process of computerization. The URS were converted to the System Specific Requirements (SRS). Each department involved in the computerization process was given a URS questionnaire for the inputs. The contents of URS included;

- Data Flow Diagrams with brief description covering activities, sub-activities, linkages, input, and output in a schematic form giving interfaces and inter linkages with other systems.
- Coding Structure and Logics giving the structure of each element that needed to be coded in the system.
- Input/Screen Formats covering: Functional description, Screen level information giving description of each & every field, Field level checks & controls, Authorization and security checks for each of the forms, Modification/Hold/Updating routine.
- Reports, the reporting frequency, contents of the reports, compilation logic, users of the report, input-output linkages.
- This URS report formed the blueprint of the final hardware and software configurations that were later purchased. The software was developed by the Communication & Networking partner.

### PREPARATION OF A SYSTEM DESIGN DOCUMENT (SDD):

The step after URS preparation was to make a detailed and technical SDD.

Data that was collected from the URS was analyzed and then used. The following were the issues tackled in the SDD.

- Screens with edit checks, attribute sheets, method of accepting data and its storage.
- Report formats with process sheets for their mode of retrieval.
- Database file structures.
- Data flow diagrams.
- Processes and their logic.
- Inter-relationship between various processes.
- Security features.
- Recovery procedures of backups.

With the blueprint of URS and the SDD in hand, the management decided to go ahead with the actual process of computerization. Hospital Management Information System (HMIS) which was gradually adopted at Main hospital & Associated hospital included various Modules. Computerization process at Associated hospital was the replica of the computerization done at Main hospital earlier as both the institutes were under same management & employed similar hardware & software & the Computer Departments at both the hospitals were integrated with each other.

### HOSPITAL MANAGEMENT INFORMATION SYSTEM:

Main hospital acquired in 1998 a database server (IBM AS400) for the purpose of creating an integrated Hospital Information System. The system worked in a client server environment with a Visual Basic front end on client PCs while the data resided on the central database server. Associated hospital had an integrated Hospital Management Information System. Diagnostic Information System (DIS) formed an integral part of the comprehensive HMIS. There existed an Electronic Medical Record (EMR) for all patients registered in the hospital. The HMIS had an inbuilt security system which defined the rights of access to information for all the users in the hospital based on the hierarchical responsibilities. The security also addressed the patient confidentiality issues adequately preventing unauthorised access. There was a dedicated department that looked after the needs of the HMIS. The following systems under the HMIS were operational on the system:

**A) PATIENT ADMINISTRATION:**

Patient Registration; Admissions, Transfers and Discharges; Appointments and Travel Concessions; Billing and Receipt.

**B) MATERIALS MANAGEMENT SYSTEM:**

- i) Inventory Management System for Stores, Dispensary and Purchase: Indents; Stock tracking; Requisitions; Purchase orders and Goods receiving and storage; Consumption tracking & Sales of drugs to different categories of Patients
- ii) Purchasing systems including Rate contracting; Enquiries; Comparative Statements and Order processing

**C) DIAGNOSTIC INFORMATION SYSTEM:**

Radiology Information System and Laboratory Information System The HIS at Associated hospital was made secure by Passwords for Authorisation, data was saved on magnetic drives, electronic trail system helped to pinpoint where a particular transaction took place. Main server room was well protected against fire hazard & unauthorized access was not possible to that area.

**DIAGNOSTIC INFORMATION SYSTEM (DIS) (FIGURE 1):**

The Diagnostic Information System was the central stage where crucial investigations were carried out on patients and was a vital component. The logistic requirements in terms of equipment and manpower were demanding. The need of timely information regarding diagnostic results, availability of equipment and consumables cannot be over emphasized. All the labs were connected to the Hospital Wide Network, which enabled the sharing of data and images with the rest of the hospital. Facilities were being provided to record and project investigations for live display in the hospital auditoria. Research was an integral part of the culture at both the hospitals. It was imperative that clinicians should be able to retrieve patient care details swiftly and accurately.

**AIMS AND OBJECTIVES OF DIS:**

- Raising the requisition from any terminal in the hospital.
- Documentation for the requisition.
- Generation of Memos for Billing.
- Collection of Samples.
- Receiving of the samples in the Departments.
- Testing the Samples in the respective departments.
- Recording the preliminary and finalized reports.
- Integration with the Electronic Medical Record and Discharge Summary.

**MODULES OF THE DIS:**

The following modules were covered in the DIS:

- Requisition
- Generating a memo
- Appointments
- Sample collection
- Department Receiving center
- Examination Signal
- Reporting
- Requisition status
- MIS Queries

**OVERVIEW OF THE MODULES OF THE DIS:**

- Requisition
- Generating a memo
- Appointments
- Sample Collection
- Department Receiving Centre
- Reporting
- Requisition status
- MIS Queries

**REQUISITION:**

Requisition for a particular test for a patient was raised on the advice of the concerned doctor. Each requisition was attached to a unique Requisition number. The requisition number indicated the Department and Modality in which the test would be conducted, the year in which the requisition was being generated and the serial number of the test in that year. Also, a Pathology number (Path number) was generated for all the pathology tests that were requested.

One requisition number could be used for conducting more than one examination in a department for Microbiology and Biochemistry.

**MEMO GENERATION:**

Memos were generated for all the raised requisitions. The memos indicated the amount to be paid to the hospital for each service requested. The outpatient memos were generated for outpatients and could be paid individually. The inpatient memos were generated for admitted patients and were included in final or interim bill.

**APPOINTMENTS:**

Appointments were issued for each requisition raised for the patient. The date, time, location and the instructions were specified for each service specified in the requisition.

**SAMPLE COLLECTIONS:**

In sample collection centre, technicians collected the samples and sent them to the respective departments. The collection centre in which the sample was collected, the department and modality to which the sample would be sent, and the case number of the patient whose sample was collected were noted down.

In sample collection centre, all the requisitions whose memos were paid were displayed. As and when the sample was collected, the corresponding requisition was ticked by the technician.

**SAMPLE RECEIVING CENTRE:**

The Sample Receiving Centre received the samples and an internal number was generated. The requisition number was ticked in the receiving department. If a Pathology sample was collected, Path number had to be entered.

**Examination completion** signal was generated by ticking the corresponding requisition number.

**Reporting** was done by the concerned doctor/pathologist. All the observations were marked and Preliminary report for each examination done was written by the doctors after seeing the examination details. The examination details were available, and the preliminary report was entered which was immediately available for the authorized person to finalize. The finalized reports were printed and attached to the case file.

**REQUISITION STATUS:**

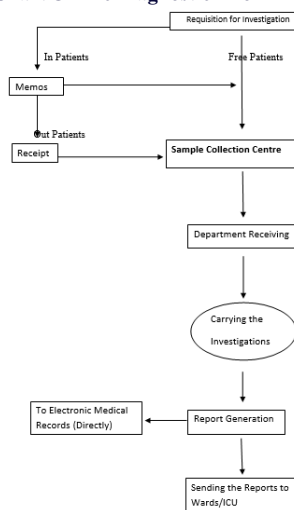
The status of any requisition could be found out from anywhere in the Hospital through the on-line system.

The status of all the requisitions between two given dates or the requisitions of a specific case number could be found. The status indicated the stage of the requisition, which could be Appointment, Memo generated, Payment paid, Sample Collected, Sample Received, Report Written and also Path Number if allotted.

**MIS QUERIES:**

The MIS queries were generated to list the details of all the patients for whom requisitions were raised between given dates, Surgical Pathology Reports generated between given dates, Referral cases and Doctor Wise details of the requisitions.

**Figure 1. Flow Chart Of The Diagnostic Information System**



**FUNCTIONAL REQUIREMENTS:**

All the screens were designed as per a Standard Architecture.

**HARDWARE AND SOFTWARE REQUIREMENTS:**

In order to have a meaningful system, it was proposed to have the following Hardware & Software environment.

**CLIENT/SERVER ENVIRONMENT:**

A Centralized Database Server (AS/400) to cater to the various requirements of both the hospitals. Clients at all the sections to get connected to the Centralized Server over Ethernet and co-axial lines to gain the advantage of distributing an application.

**HARDWARE REQUIREMENTS:**

- AS/400 Machine
- 12 Nos. Of Pentium nodes in a network.

**SOFTWARE REQUIREMENTS:**

- DB2/400
- OS/400
- Windows Xp/ Win7
- MSOffice 2007/2010
- VB 6.0
- VB.Net

**PERFORMANCE OF THE DIS:**

Hospital-DIS module had been designed under client/server environment. To determine the number of users, for a reasonable response, the Hardware and Software configuration at server and node should be considered. Server could handle around 400 terminals initially. The volume of transactions was expected to be less initially, but on usage the volume could be high. The recommended hardware and system software could handle a minimum TPC rating of 1200 per minute. The system indicated a uniform method of reporting error messages. The Performance of the product depended on the number of factors like: Number of users, Number of records that could be handled, Volume of transactions, Response time, Background and batch processing time and Error handling procedures

**SECURITY FEATURES:**

Appropriate security and control: The Systems would provide adequate security and control features such as Password and Security for operational, middle and top management level; Control of user access to applications (read only, write only, read and write); Data Integrity; Disaster recovery and Audit trail features

**DATA PROTECTION AND SECURITY:**

The system had level of data protection to guard against loss of data. These features were provided:

- Easy backup and retrieval
- Data maintenance in the file say for a period of 24 months, normally
- Data carry forward while creating the file or period end process for the next year or for a new period
- Transfer of annual data into separate file for preservation of the data on a long-term basis.

**USER CHARACTERISTICS:**

The systems were user friendly, menu driven, since they would be used directly by users, some of whom might not possess specialized information technology skills. The user-friendly features viz. list of values, structured querying etc., were provided.

**THE INTENDED USERS WERE CLASSIFIED AS:**

- Operational level users
- Middle level management users
- Top level management users
- Security level users

The users were expected to have computer awareness and were trained to use the application.

System Administrators should possess the Knowledge of OS/400, RDBMS concepts, Application Administration and also thorough knowledge of the application and the requirements of their departments.

**OTHERS:****GENERAL FEATURES**

- The system should be on-line and integrated.
- Highly user-friendly and menu-driven
- Data was captured at source and would be complete and accurate.
- Every screen contains title and standard buttons for operations such as insertion, viewing, modification, saving, cancelling, exiting etc. wherever applicable.
- A uniform graphical user interface should be provided for all the screens which facilitates easy learning and user friendliness.

**OTHER FEATURES:**

Database backup/Recovery procedures and utilities should be made available to the System Administrator. To back up HIS database hospitals were using BRMS (Backup, Recovery and Media Services) System.

**DISCUSSION****“THE INFORMATION IS POWER”**

The above motto holds true for both the hospitals under consideration. These were few of the first 'digital' hospitals in India as their story goes back to 1985 when India was not even aware of the distant world of the computers. These hospitals started on a pioneering path to Information Management with the ND550 Super minicomputer and 40 dumb terminals across the hospital-wide LAN and thus journey to indigenous HMIS started. The reason to create HMIS in the year 1985 was to computerize normal transactions in the hospital and retrieve them at a later stage efficiently for better healthcare delivery. It all started with abstracting information like registration, patient demographic and clinical data from the patient files and entering them on the system. Thus the information collection was not on the real-time basis and thus outlived its utility by the year 1996. The need to get an integrated enterprise system was felt later so as to integrate all the systems in hospital. The focus of HMIS was to develop various modules compatible with hospital system requirements and suitable for future developments.(7)

The Patient Admission System was implemented in the year 1999 and it was an important addition to EMR. The implementation of this system catered to various patient care activities such as registrations, appointments and travel concessions, wait listing, admissions, transfers and discharges of the patients. This system provided key demographic and patient status information to other modules that were installed later. The management related information such as trends in registration, waitlists, bed occupancy, lead-time analysis for treatment and re-admission rates were important outputs of this system and helped in analysis of hospital operations.

The Diagnostic Information System was implemented during 2001-02. It enabled the hospital to put in place various diagnostic services e.g., radio-diagnosis consisting of conventional radiography, CT, MR, mammography and ultrasound, bio-imaging unit consisting of PET-CT, pathology including surgical pathology, cytology, haematology, transfusion medicine including blood banking, diagnostic endoscopy and cardiology including ECG, etc. With the implementation of this system, the diagnostic reports were made available on the clinician's desktop as soon as the investigations were reported. Thus, the turnaround time had been considerably reduced. The problem of misplaced reports had almost been eliminated due to this. The MIS reports, both operational and executive, were a positive outcome of the system. In addition, the interfacing of analytical equipment like biomedical analyzers and cell counters with the diagnostic information system had reduced the lead-time of reporting and had eliminated transcription errors tremendously.

The Operation Theatre Module was developed in the year 2003 incorporating the essential features like scheduling of procedures, pre-anesthesia evaluation, pre-operative check lists, surgical procedure details, anesthesia details and post-operative check list. The OT module was one of the first modules to be implemented in the hospital. Traditionally, the surgery team had been a difficult team to convince in hospital, as it was the busiest team. Therefore, compliance from them was sought first.

The implementation of this module streamlined the Operation Theatre procedures in the hospital with real-time data capture of the information and its availability across the hospital. In fact, the refinement in the OT module got lot of inputs from the clinicians themselves as they wanted more information in a structured manner. A

case study on developing an effective information based healthcare services had revealed that the scope of their usage is limited to administrative functions in India and the IT uptake is limited to custom developed software for areas like billing and patient scheduling(11).

The HMIS that was developed was an integrated system and not a collection of stand-alone systems. One system complements the other system and does not work at cross purposes. If the stand-alone systems were not properly integrated, they would under-perform. Across the world there were very good stand-alone systems, but there was a need for a totally integrated enterprise system which could address every aspect of hospital function. At that time, the most digital sources of evidence were stand-alone systems that were not integrated into clinical information systems. The challenge for practitioners was to use these sources of evidence in combination with their experience and expertise to make clinical decisions.(8)(12)

The hospitals under consideration avoided this dilemma. The back-end server in the hospitals was a single database. It was also a completely customized system whereby every stakeholder in hospital knew his role and what he had to do. On the other hand, in prefabricated systems, users had to learn about the systems and how to use them. It was a conscious decision taken by the management in 1998-99 as no system available if the market suited the requirements of the hospital. The software was customized in every aspect such that the existing work practices got incorporated into this software easily. It is almost always easier and faster to design and build a stand-alone system than it is to add a functionality to existing, large scale system. (13) In addition, the hospital had guarded them from system failures with back-to-back servers and data replicators.

The HMIS was developed by the Communication & Networking Partner which also provided the software programs and upgraded them as per the changing requirements. The end users from hospital communicated with the Communication & Networking Partner as to what was required and how it had to be structured. The Communication & Networking Partner professionals did the coding and programming and domain logic was sourced from the hospitals.

The hospital management was staunchly opposed to vendors who proposed a ready-made product which was a collage of different requirements. As they start off with a generic product and then try to fit in the requirements. The hospital management wanted a software vendor who could develop the software and maintain it as per their changing needs from time to time. The partnership with Communication & Networking Partner had been successful in hospitals journey towards filmless milieu. The Ministry of Health & Family Welfare has made significant contribution to public health care by pioneering e-Hospital – an integrated Hospital Management Information System (HMIS) which now runs in almost 30 major public hospitals across the Country including premier institutions such as All India Institute of Medical Sciences (AIIMS) and Dr Ram Manohar Lohia (RML) in Delhi and National Institute of Mental Health and Neuro Sciences (NIMHANS) in Bangalore(14).

A study on the HMIS at the Tata main Hospital Jamshedpur(15) concluded that deploying the Information Technology in the healthcare helps to improve the quality of service, controlling costs and ensuring optimal use of the available resources.

Another study on the utilization of the HMIS (16) titled, “A study of the management information system used in the outpatient department” concluded that the HMIS in the OPD provided different categories of information to different categories of users. There was a deficiency in the information supplied. The administration department had a lot of information which was not processed and made available to the top management.

#### CHALLENGES IN THE PATH

The route to implementation of different modules had not been easy for the hospital. It was very difficult when the process started in the year 1999 because people were new to the concept of real-time data entry and departments were very reluctant to share the data with each other citing privacy issues.

The other major challenge was to get acceptance among the end users. The department of pathology was most concerned that the reports would get lost in the process. It took a long time for them to get

convinced and they kept maintaining a duplicate copy in the department for a long time.

#### FUTURE PLAN

Both the hospitals had started the process of implementing web-enabled systems. This would include services like patient registration, appointments, admission wait list follow-up, cyber consultation, e-health initiative, investigations/ product requisitioning, access to EMR and tendering for materials management. Web enabling would enable access to patient records online and ease downloading and archiving, which would not only be more convenient but also save time and money. Patient would be the ultimate winner finally.

The hospitals were also mulling over the concept of e-health which combines aspects of medical informatics, public health and business with reference to health services and information delivered usually through the internet. There was a long way to go and still the utilization of the information technology was increasing day by day in both the hospitals paving way for filmless and paperless milieu.

#### CONCLUSION

The Software Requirement Specification (SRS) described in detail the computerization requirements of laboratories at these hospitals. All functional and other requirements were discussed. The SRSs were prepared based on mutual discussions and continuous interaction between hospital officials & Communication & Networking Partner and it formed the basis for design.

Systems had to be developed in such a way that they had the acceptability for a broad spectrum of employees of the hospital at all levels. The concept of why different systems were being implemented and what were the benefits to each of the stakeholders had to be etched in the minds of the end users. Further, the end users had to be motivated to use this system to bring in some sort of acceptability of paperless culture. It was a painstaking process that required lot of patience.

#### REFERENCES:

- Mukherjee K, Babu PA. Economic evaluation of hospital management information systems in Tamil Nadu, India. *Int J Med Public Heal*. 2014;4(3):269.
- Hillestad R, Bigelow J, Bower A, Girosi F, Meili R, Scoville R, et al. Can electronic medical record systems transform health care? Potential health benefits, savings, and costs. The adoption of interoperable EMR systems could produce efficiency and safety savings of \$142-\$371 billion. *Health Aff*. 2005;24(5):1103-17.
- Wang SJ, Middleton B, Prosser LA, Bardou CG, Spurr CD, Archardi PJ, et al. A cost-benefit analysis of electronic medical records in primary care. *Am J Med*. 2003 Apr 1;114(5):397-403.
- Frissie ME, Holmes RL. Estimated financial savings associated with health information exchange and ambulatory care referral. *J Biomed Inform*. 2007 Dec;40(6 SUPPL.).
- Shekelle PG, Morton SC, Keeler EB. Costs and benefits of health information technology. Evidence report/technology assessment. 2006. p. 1-71.
- Kian LA, Stewart MW, Bagby C, Robertson J. Justifying the cost of a computer-based patient record. *Healthc Financ Manage [Internet]*. 1995 Jul [cited 2020 Jan 26];49(7):58-60, 62, 64-7. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/10143674>
- Wadhwa S, Saxena A, Wadhwa B. Hospital information management system: An evolutionary knowledge management perspective. *Int J Electron Healthc*. 2007;3(2):232-60.
- System NA of E (US) and I of M (US) C on E and the HC, Reid PP, Compton WD, Grossman JH, Fanjiang G. Information and Communications Systems: The Backbone of the Health Care Delivery System. 2005;
- Henry D, Cooke S, Buckley P, Dumagan J, Gill G, Pastore D, et al. THE EMERGING DIGITAL ECONOMY II ECONOMICS AND STATISTICS ADMINISTRATION Office of Policy Development AUTHORS [Internet]. [cited 2020 Feb 8]. Available from: <http://www.ecommerce.gov>
- NITI Aayog. National Health Stack Strategy and approach [Internet]. 2018 [cited 2020 Jan 19]. Available from: [https://niti.gov.in/writerreaddata/file\\_s/document\\_publication/NHS-Strategy-and-Approach-Documents-for-consultation.pdf](https://niti.gov.in/writerreaddata/file_s/document_publication/NHS-Strategy-and-Approach-Documents-for-consultation.pdf)
- Sastri AP, Misra AS, Rao GR, Prasad BDCN. A case study on developing an effective information based healthcare services-India's scenario.
- Bakken S. An informatics infrastructure is essential for evidence-based practice. Vol. 8, *Journal of the American Medical Informatics Association*. Hanley and Belfus Inc.; 2001. p. 199-201.
- Boland P. Making Managed Healthcare Work: A Practical Guide to Strategies and Solutions. Aspen Publication. Maryland; 1993. 494-95 p.
- Garg R, Garg A. Hospital Management Information System(HMIS) in India. *Adv Comput Sci Inf Technol [Internet]*. [cited 2020 Jan 26];2(10):42-6. Available from: <http://www.krishisanskriti.org/acsit.html>
- Rajesh M, Sarosh R, Saroj K. Hospital Information system in Medicare, an experience at the Tata Main Hospital, Jamshedpur.
- Sweta D'Cunha BSR. A Study of The Management Information System Used in the Outpatient Department. *J Acad Hosp Adm [Internet]*. [cited 2020 Jan 19];16(2). Available from: <https://www.indmedica.com/journal.nals.php?journalid=6&issueid=30&articl eid=343&action=article>