Theme 14. Types of information systems in healthcare. Hospital information systems and their development

The Importance of Information Systems

Since many of you may have had limited exposure to the way large organisations work, the following facts may be of interest:

• Globally, the annual capital (fixed) investment in information technology (computers, telecommunications) currently exceeds the investment in all other productive capital assets (buildings, equipment, machinery, tractors etc.) combined.

• In the developed countries, more than half of the labour force can be classified as *knowledge workers* i.e. it spends most of its time processing information.

• The amount of new knowledge is said to double every five years i.e. in the next five years we will create as much new knowledge as was created in mankind's entire previous history.

• Each month the equivalent processing power of one of the early personal computers (half a million microchip transistors) is being produced for each human on the entire planet.

• The information systems of many large organisations would be able to store and process the curriculum vitae of every single human being that lives and ever lived on the Earth, assuming that this information was available in electronic format.

Healthcare is a very important part of our society and it is imperative for healthcare providers to do their jobs in an efficient manner. The employees have to manage and integrate clinical, financial and operational information that grows with the practice. Previously, this data was organized manually, which was time consuming and failed to deliver the desired level of efficiency.

The global healthcare industry is growing at a fast rate and is one of the areas that have the most urgent need of automation.

In a broad scope, the term ***Information Systems (IS)*** *is a scientific field of study that addresses the range of strategic, managerial and operational activities involved in the gathering, processing, storing, distributing and use of information, and its associated technologies, in society and organizations*.

The 'classic' view of Information systems found in the textbooks of the 1980s was of a pyramid of systems that reflected the hierarchy of the organization, usually *transaction processing systems* at the bottom of the pyramid, followed by *management information systems*, *decision support systems* and ending with *executive information systems* at the top (Fig. 13.1). Although the pyramid model remains useful, since it was first formulated a number of new technologies have been developed and new categories of information systems have emerged, some of which no longer fit easily into the original pyramid model.

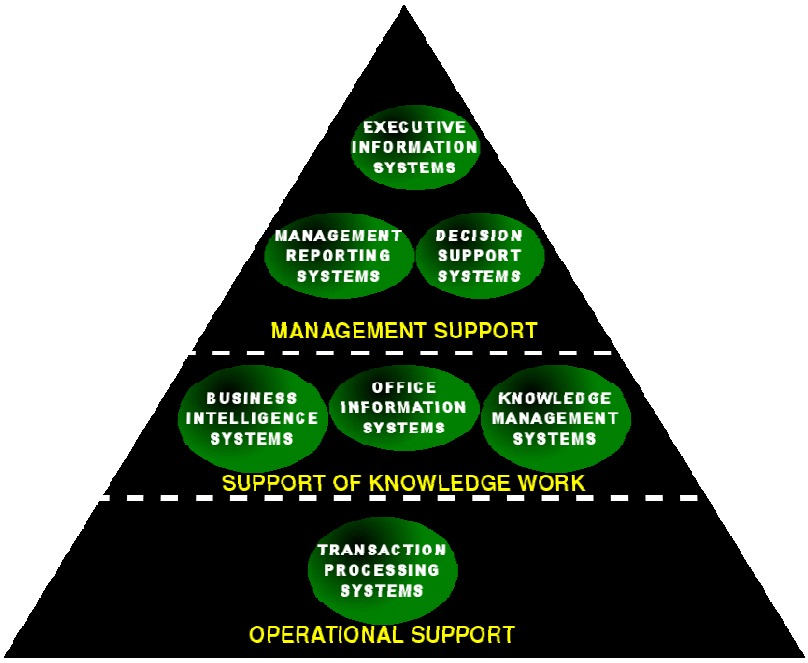

Fig. 13.1. Pyramid of systems reflecting the hierarchy of the organization

Some examples of such systems are:

- data warehouses
- enterprise resource planning
- enterprise systems
- expert systems
- geographic information systems
- global information systems
- office automation

Types of Information Systems according the levels of organisation management pyramid

As it was said above a common approach to examining the types of information systems used within organisations, is to categorise IS applications by the roles they play at various levels in the organisational structure (Fig. 13.1). The organisation is viewed as a management pyramid with the following levels:

• *At the lowest level*, *non-management staff* attends to routine daily organisation transactions.

• *Operational management* is responsible for monitoring the transactions that are occurring, and dealing with any problems that may arise.

• *Tactical management* decides on budgets, sets targets, identifies trends and develops short term plans for the organisation.

• *At the top of the pyramid*, *strategic management* is responsible for defining the long term goals of the company, and how it intends to position itself within its particular industry.

These levels of management correspond approximately to *four types of information systems*.

Transaction Processing Systems

At the lowest level of the organisational hierarchy we find the transaction processing systems (TPS) that support the day-to-day activities of the business. These applications are normally the first to be computerised and are characterised by large numbers of transactions updating the corporate database. The users of transaction processing systems tend to work at the lowest level of detail as they process or query one transaction at a time, using computer systems to capture the raw data which reflects the business processes of the organisation.

Management Information Systems

The next level in the organisational hierarchy is occupied by low level managers and supervisors. This level contains computer systems that are intended to assist operational management in monitoring and controlling the transaction processing activities that occur at clerical level. Management information systems (MIS) use the data collected by the TPS to provide supervisors with the necessary control reports. The main focus of MIS is to avoid wading through huge volumes of detailed data, instead using control totals and exceptions to identify problems.

Decision Support Systems

Tactical management occupies the next level in the organisational hierarchy. These managers are responsible for ensuring that plans and targets set by senior management are achieved. They tend to focus not on the progress of individual transactions but on the bigger picture. To achieve this they need to receive regular reports from the MIS with summary totals and comparison between prior months and years, or planned activity levels. Where summary figures are of concern, these managers may request more detailed reports from the operations personnel. Many organisations have recognised the importance of this type of information need, and have implemented sophisticated ***user driven decision support systems (DSS)*** which allow managers to generate their own reports and enquiries. When information is required to support management decision making, the user is able to interact directly with the computer via a graphical user interface to request the relevant data, select and apply the appropriate decision model and generate the output report in the format required.

Executive Information Systems

The highest level in the organisational structure is that of strategic management, and once again its information requirements are unique. These managers are charged with the task of setting the strategy for the organisation. They

require an information system that will enable them to identify problems, opportunities and trends that may enhance or threaten their organisation's competitive position. In order to reduce the time taken in finding and integrating a few critical numbers from many different reports, the concept of the executive information system (EIS) was developed.

The following table (Table 13.1) summarises the major differences between the four levels of organisational support systems based on their major inputs, processing characteristics and outputs:

Table 13.1.

Types of Information Systems

Management Level	Applications Support	Inputs	Processing	Outputs
Clerical	**Transaction Processing System**	Detailed transactions	Transaction updates	Detailed reports Operational documentation
Operational Control	**Management Information Systems**	Operational data	Selection Summarisation Reconciliation	Summary and Exception reports
Tactical	**Executive Support Systems**	Operational data & Decision models	Simulation Analysis	Ad hoc reports
Strategic	**Decision Support Systems**	Internal and External data	Summarisation Drill down	Critical Success Indices

Office Automation Systems (OAS)

Other types of information systems are not specific to any one level in the organisation but provide important support for a broad range of users. Many standard computer applications, such as word processing, spreadsheeting, data management, and presentation graphics are used across all management levels of the organisation. Apart from their individual capabilities, many of these programs are able to exchange information, so that for example a word processing document may include a graph developed using a spreadsheet program, which is dynamically updated when the data in the spreadsheet is changed.

Components of an information system

An information system is a system that gathers and transforms data in order to produce information for its end-users. Typical technologies that are incorporated in this process are *hardware, software, data* and *networks*. (The fifth important component of an information system, *people,* is not classified as a technology!) . Compatibility of the various system components is vital, since the outputs of one technology may well provide the inputs for another. And above all, the purpose of an information system is to provide useful information to *people* (the non-technical

component of the system), so the selection of technologies to be used should be based on the need to meet human requirements.

Hospital Information Systems (HIS).

Hospital information system (HIS) also known as *health information system* or *clinical information system* is a comprehensive and integrated information system designed to encompass all information of the hospital whether financial, administrative or clinical. It also includes paper based information processing and data processing machines.

These systems have been around since they were first introduced in the 1960s and have evolved with time and the modernization of healthcare facilities. The computers were not as fast in those days and they were not able to provide information in real time as they do today. The staff used them primarily for managing billing and the hospital inventory. All this has changed now, and today hospital information systems include many applications addressing the needs of various departments in a hospital. They manage the data related to the clinic, finance department, laboratory, nursing, pharmacy and also the radiology and pathology departments. The hospitals that have switched to HIS have access to quick and reliable information including patients' records illustrating details about their demographics, gender, age etc. By a simple click of the mouse they receive important data pertaining to hospital finance systems, the diet of patients, and even the distribution of medications. With this information they can monitor drug usage in the facility and improve its effectiveness. Many hospitals have as many as 200 disparate systems combined into their HIS.

The HIS modules have been designed according to three categories – *core modules, supporting modules and enterprise-enabling modules* (Table 13.2).

Table 13.2.

HIS modules

Core modules						
Patient Administration		**Doctors**		**Nursing**		**Ward**
Theatre Management		**Laboratory**		**Radiology & Imaging**		**User Management**
Supporting Modules						
Blood bank	**Physiotheraphy**	**Dieting**	**Dialysis**	**Bio-Medical**	**CSSD**	**Movements**
Housekeeping	**Complaints**	**Billing**	**Preventive Maintenance**	**Pharmacy**	**Purchase**	**General Stores**
Enterprise-enabling Modules						
Fixed Assets		**Finance**		**Human Resourses**		

Patient Registration and Appointment Scheduling Module

The Registration module is an integrated patient management system, which captures complete and relevant patient information. The system automates the patient

administration functions to have better and efficient patient care process. Appointment scheduling deals with scheduling of physician appointments for the patients. The user can view the schedule for a particular doctor; the appointments scheduled for the doctor, the free slots available, and blocked slots. Based on the slot availability, the appointment can be fixed. The appointment can be rescheduled and cancelled based on the scenario. The hospital can track and manage Scheduled Visits, Emergency Visits, and Visit cancellations. The user can view all patients' previous visitations to the hospital and also No- show patients list. Telephonic appointments for unregistered patients can also be scheduled.

Some of the features of this module are

- Patient Registration Details
- Inpatient and Outpatient Registration
- Medical Alerts Details
- Appointment Scheduling (Patient / Doctor wise)
- Doctor's Schedule Summary
- Doctors Daily Schedule List
- Patient Visit History
- Medical Record Movements
- Appointments for Radiology tests and Operation
- Patient Visit Slip
- Sponsorship Details

It provides for enquiries about the patient, the patient's location, admission, and appointment scheduling and discharge details. Furthermore, this system even takes care of package deals for a patient for a fixed cost. The Medical Record keeps an abstract of clinical data about patients. It allows easy retrieval of medical records on patients.

Outpatient Management Module

The Outpatient module serves as an entry point to schedule an appointment with the Hospital Resident Doctor or Consultant Doctor for Medical Consultations and diagnosis. This module supports doctors to take better and timely consultation decisions by providing instant access to comprehensive patient information. Patient visits are divided into New, Follow-up and Review. This module also handles requests and results of laboratory tests and other examinations. External Doctors visits to in patients can be defined as "Call on". Some patients may avail only the hospital facilities like Lab, Radiology, Nuclear Medicine, and Physiotherapy and so on.

This system calculates the cost for the services rendered to the patient and reflects in the billing module appropriately resulting in smooth billing process.

Nursing Module

The Nursing module is a tool provided in the hospital management system software to the nurses to manage their routine tasks with the objective of improving

patient care. It is tightly integrated with the Inpatient module and other clinical modules for the smooth flow of information.

Some of the features of this module are

- **Patient Charting:** A patient's vital signs, admission and nursing assessments and nursing notes can be entered into the system. These are the stored in a central repository and retrieved when needed.
- **Staff Schedules:** Nurse can self schedule their shifts using scheduling rules provided in shift modules. The shifts can later be confirmed or changed by a scheduling coordinator or manager.
- **Clinical Data Integration:** Here clinical information from all the disciplines can be retrieved, viewed and analyzed by nursing staff.
- **Improved workload functionality:** Staffing levels and appropriate skill mix per shift can be more easily determined by the shift modules.
- **Better care planning:** Time spent on care planning is reduced, while the quality of what is recorded is improved. This makes for more complete care plans and more complete assessments and evaluations.
- **Better drug administration:** Electronically prescribed drugs are more legible, thus making it less likely that drugs would be wrongly administered to patients.

Pharmacy Module

The Pharmacy module deals with the automation of general workflow and the administration management process of a pharmacy. The pharmacy module is equipped with bar coding facility, which makes the delivery of medical items to the patient more efficient. In addition the Online prescription facility assists and facilitates the physicians to track the patient's prescription details and as well reflects the medication billing details in the Billing module.

Laboratory Information System

The Laboratory module automates the investigation request and the process involved in delivering the results to the concerned department/doctor of the hospital. Laboratory module starts with receiving the online request from doctors and also allows laboratory personnel to generate requests. The Laboratory module supports the performance of various tests under the following disciplines: Biochemistry, Cytology, Hematology, Microbiology, Serology, Neurology and Radiology. Tests are grouped under various sections and sample type (specimen). Based on the request the user can input the sample and generate the sample number. Results can be entered based on the sample type either to one test or multiple tests. If the test result requires approval, the supervisor has to approve the result and it is made available to concerned doctors.

Test reports can be made confidentially. Tests can be performed only after the billing is done. This rule is exempted when the case is declared as Urgent. In addition, this module facilitates investigations for referral patients.

Benefits of HIS.

- Easy Access to Patient Data to generate varied records, including classification based on demographic, gender, age, and so on. It is especially beneficial at the ambulatory (out-patient) point, hence enhancing continuity of care. As well as, Internet-based access improves the ability to remotely access such data.
- It helps as a decision support system for the hospital authorities for developing comprehensive health care policies.
- Efficient and accurate administration of finance, diet of patients, engineering, and distribution of medical aid. It helps to view a broad picture of hospital growth
- Improved monitoring of drug usage, and study of effectiveness. This leads to the reduction of adverse drug interactions while promoting more appropriate pharmaceutical utilization.
- Enhances information integrity, reduces transcription errors, and reduces duplication of information entries.

Control questions

1. What is the importance of an information system?
2. What is information system?
3. Which types of information systems do you know?
4. What are the main components of an information system?
5. Why is important to use Hospital Information Systems (HIS)?
6. What are the main HIS modules?
7. What are the Benefits of HIS?

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