CHAPTER 4

APPLICATIONS OF COMPUTERS IN PHARMACY

The use of computers in pharmacy is becoming important day by day as it can provide critical information on drug interactions, usage, storage, mode of action, side effects etc. It is also used for patient counseling. Computers are used to keep a track of patient's record and provide them appropriate medication as per symptoms, diagnosis and allergies to any particular medication. Thus, computers help in improving overall patient care and drug management.

The major uses of **computers in pharmacy** are described below –

1. Manage patient's record.
2. Enter drug orders.
3. Monitor drug interactions or allergies, if any.
4. Automated dispensing.
5. Inventory control.
6. Medical research and analysis

Computers in Pharmacy

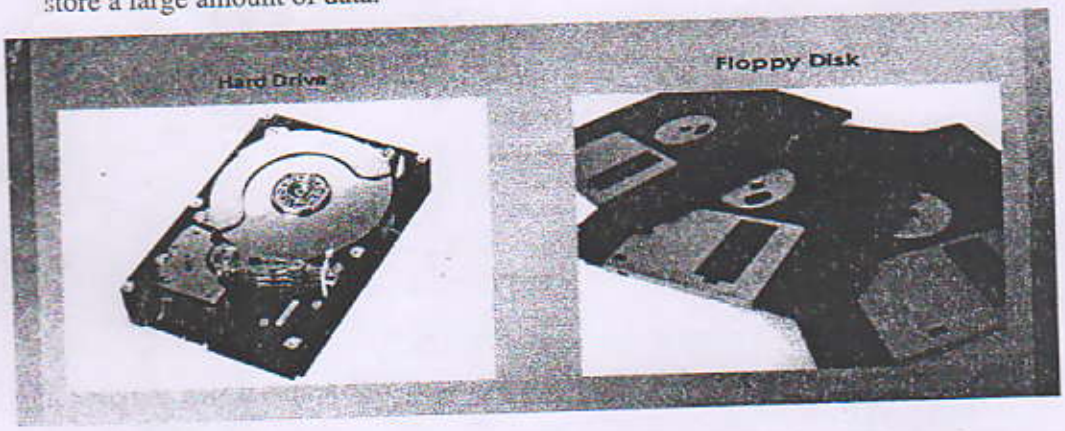
- **Patient Profile**
  - Allows complete information about patients, including prescribers, insurer, and medication history, and allergies; identifies drug interactions for patients taking multiple medications.
- **Billing**
  - Checks policies of third parties such as HMOs and insurers; authorizes third party transactions and credit cards electronically.
- **Prescriber Profile**
  - Includes state identification numbers and affiliations with facilities and insurers.
- **Labeling**
  - Creates label, receipt, customer information, and usage instructions.

DRUG INFORMATION STORAGE & RETRIEVAL

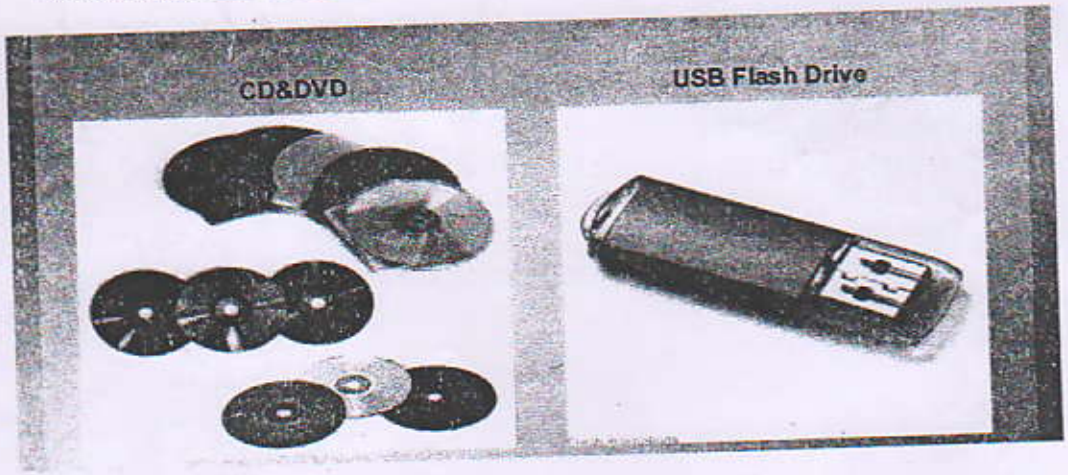
Drug information storage and retrieval refers to the process of compiling data and available information on a particular drug that can be assessed as and when required.
Computers have made it possible to compile, assess and display the relevant data on a given drug.

Types of Storage Media – Hard Drive, Floppy Disk, CD/DVD, USB Flash Drive

1. Hard Drive – It is found inside the computer and is used to store all programs used by computer.
2. Floppy Disk – It is a portable storage medium that can be used as per requirement. It can store a large amount of data.



3. CD/DVD – It is also an external device which can be used to store information.
4. USB Flash Drive – It is comparatively smaller than other storage devices and can be used to store more amount of data.



COMPONENTS OF INFORMATION RETRIEVAL

1. Database - It refers to the system of recording and storing data in the storage medium. It is a type of electronic filing of information.
2. Search Mechanism – It refers to the mechanism of retrieval of recorded data. It shows how relevant data needs to be searched and retrieved by any user.
3. Interface – It refers to the exchange of information between two or more components of a computer system. It determines whether the given system is user friendly or not.

TYPES OF INFORMATION RETRIEVAL

1. Online Information Retrieval – It refers to searching and analyzing data through various systems which are connected to each other. Eg List of doctors in any hospital.

2. CD Rom Information Retrieval – It refers to retrieval of that information which has already been stored on CD Rom. It works when other computers are not connected to user's system. The data is available as read only information which can be used as per requirement.

3. OPAC (Online Public Assess Catalogs) – It refers to that information which can be widely used by various users at a time and is readily available free of cost to any number of users. Eg. University Library

4. Web Information Retrieval – It refers to world-wide-web search which is most commonly used all over the world. Such information can be used by anyone anywhere and anytime. Only internet connectivity is required. It is not related to a particular topic or category. Eg. Google search

Drug Information Storage & Retrieval – Unlike other information systems, drug information storage refers to storage and retrieval of information related to any drug and its uses. Such systems are required by all medical personnel to access relevant information about various drugs whether it is their dosage, usage, mode of action, side effects, drug interactions, shelf life or any such detail. Such systems have helped a lot to improve the quality and quantity of drug usages at appropriate time and place. Life expectancy has increased and people have started living quality life free from various diseases.

Need of drug information

- The no of drugs in the international market has increased very much
- The newer drugs are generally more potent & selective, and formulations becoming increasingly complex
- The literature on drugs has also expanded and covers a wide range of information
- To introduce a new drug into the practice, the professionals need to evaluate the given information.
- A simple,quick reference to a pharmacopoeia or formulary is no longer sufficient.

PHARMACOKINETICS

It is a study of science which determines how a living organism affects any drug administered to him. This term should not be confused with Pharmacodynamics which determines the effect of any drug on a living organism.

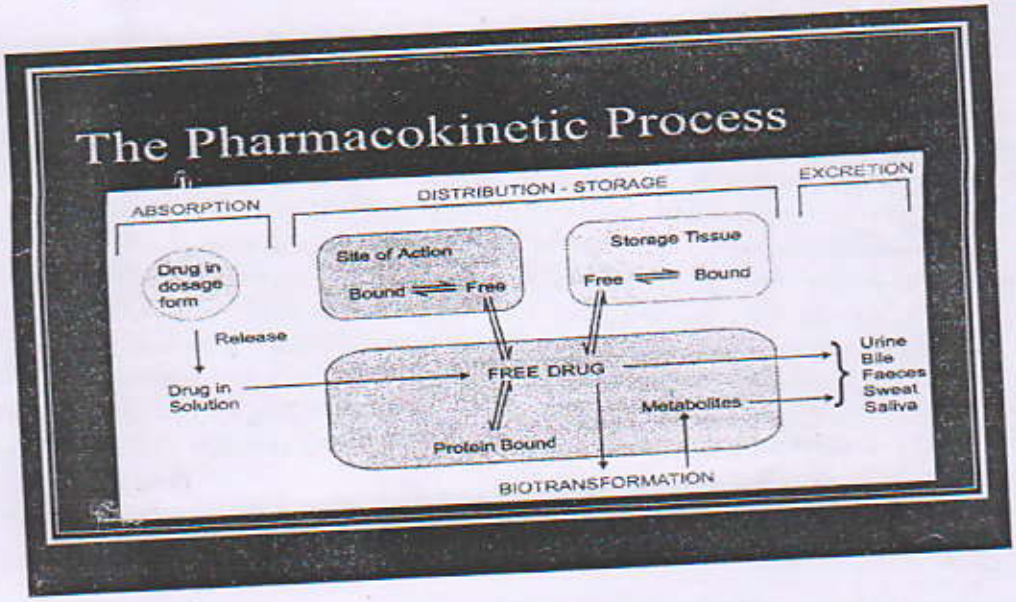
Pharmacokinetics studies the pathway of drug administered to a living organism from when it enters the body till its excretion. It can be studied under four categories as ADME namely –

1. **Absorption** – Refers to movement of medicine from the site of administration into the bloodstream. Rate of absorption varies from one drug to another depending upon the mode of administration of drug. Some drugs are administered as injections and some are taken orally. Hence, their rate of absorption is different.
2. **Distribution** – Refers to transport of administered medication from blood stream to its site of action. It is determined rate of blood flow to that particular area.
3. **Metabolism** - Refers to breakdown of administered drug into its active form to produce the desired action. It is determined by amount and consistency of administered drug.
4. **Excretion** – Refers to elimination of administered drug from the body. It is usually done by kidneys and liver but it can also be excreted through sweat, saliva, tears etc.

Review of the ADME Process

Absorption	• The process by which a drug proceeds from the site of administration to the site of measurement
Distribution	• the process of reversible transfer of drug to and from the site of measurement
[illegible]	• the process of a conversion of one chemical species to another chemical species
Elimination	• The irreversible loss of drug from the site of measurement. It may occur by metabolism or excretion.

Pharmacokinetics refers to behavior of drug inside the human body. It is due to study of pharmacokinetics that medical personnel can evaluate the amount of dose as well as schedule of dosage for any drug i.e. how much medicine needs to be administered and how many times a day.



MATHEMATICAL MODEL IN DRUG DESIGN

Mathematical models in drug design refer to study of mathematical calculations that have been implemented to estimate compositions, dimensions and preparation procedures of various drug delivery systems. Such systems are necessary to evaluate an effective method of drug delivery in order to get desired results in shortest possible time and with best available techniques. In this way, number of experiments conducted during product development can be reduced in order to save time and cost.

Mathematical models are used to analyse pharmacological data and its response during a particular investigation. Such kind of research is termed as Model Based Drug-Development (MBDD). Its main objective is to provide quantitative assessment of effectiveness and safety of any drug. If efficacy and safety can be estimated during drug development, it can save a lot of time and reduce cost of actual development process.

USE OF MATHEMATICAL MODEL

- Solves the real world problems and has become wide spread due to increasing computation power and computing methods.
- Facilitated to handle large scale and complicated problems.

HOSPITAL AND CLINICAL PHARMACY

This branch of science deals with study of treatment of patients with various drugs that can be used in a hospital or clinical setup.

Hospital Pharmacy – refers to a place within the hospital where all the drugs and medications are stored in order to provide in-house treatment to patients that have been admitted in that hospital. Such pharmacies usually do not provide medicines to out patients and hence, they are not considered as retail pharmacies. The drugs stored in hospital pharmacy are provided to the patients under medical supervision of trained and qualified pharmacists. Complete record is maintained on computer related to a particular patient and his treatment, drugs administered, course of action, time of delivery, dose given etc. Not only this, computerized records are also maintained regarding stock availability, expiry date of various medicines, adverse drug reactions, ledger account for payments and annual stock audit. Such records are maintained in all the hospital pharmacies to keep a track of all inventory received in the hospital and how and where it has been utilized. A hospital pharmacy is responsible for supplying safe and accurate medicine to its patients.

FUNCTIONS OF HOSPITAL PHARMACY –

1. Ensure purchase and proper storage of drugs.
2. Label all drug containers properly.
3. Ensure proper storage conditions as cold storage and refrigeration.
4. Dispense drugs as per prescription.
5. Discard expired medicines and order fresh stock.
6. Ensure timely stock audit and its provision.
7. Maintain proper records related to drugs, their manufacturing, expiry etc.
8. Provide support in research and training programs organized within the hospital.

9. Ensure availability of right medication at the right time and at minimal cost to the patient.
10. Act as counselors between doctors, nurses and attendants of patients.

Clinical Pharmacy – refers to study of science dealing with best utilization of pharmacist's experience and knowledge to provide safest medication during the course of effective patient care. The clinical pharmacy came into existence in order to minimize practice of self medication which can further lead to various complications.

Functions of Clinical Pharmacy –

1. Ensure maintenance of complete patient record like drug reactions, medications, allergies, hypersensitivity etc.
2. Save physician's time and efforts to decide best treatment for any patient.
3. Train and assist medical supervisor or physician about various drug complications, interactions, dosages, efficacies etc.
4. Assist physician in selecting best drug therapy for a particular patient.
5. Keep a close track of any drug reactions or contraindications among the patients.
6. Handle medical emergency in case of overdose or poisoning by providing best available antidote.
7. Assist in discharge counseling related to OTC drug medications as per patients' response to undergoing drug therapy.

Thus, we can say that clinical pharmacists are experts in handling and recommending best therapeutic use of medications.

APPLICATIONS OF COMPUTERS IN HOSPITAL AND CLINICAL PHARMACY

1. Maintain and assess patient records.
2. Maintain and assess drug records.
3. Evaluate stock and its timely updation.
4. Discard expiry and near expiry medications.
5. Ensure proper and timely supply of medications.
6. Review contraindications, overdose or any other adverse reactions among the patients.
7. Detailed study on various medications available in pharmacy.
8. Attend online research and training programs.

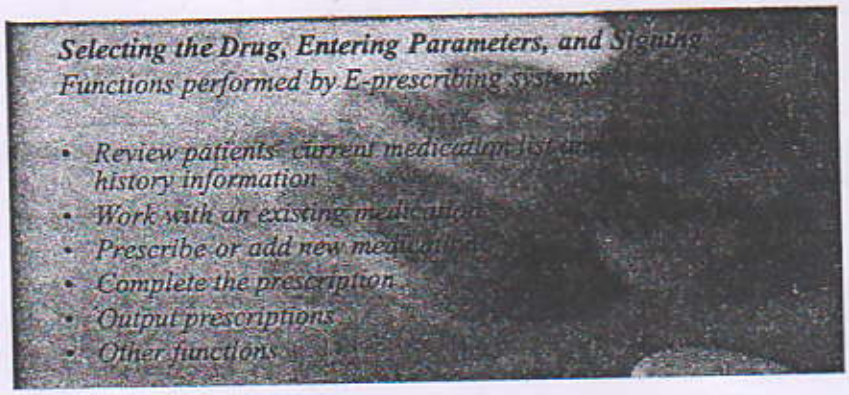
ELECTRONIC PRESCRIBING AND DISCHARGE SYSTEMS (EP SYSTEMS)

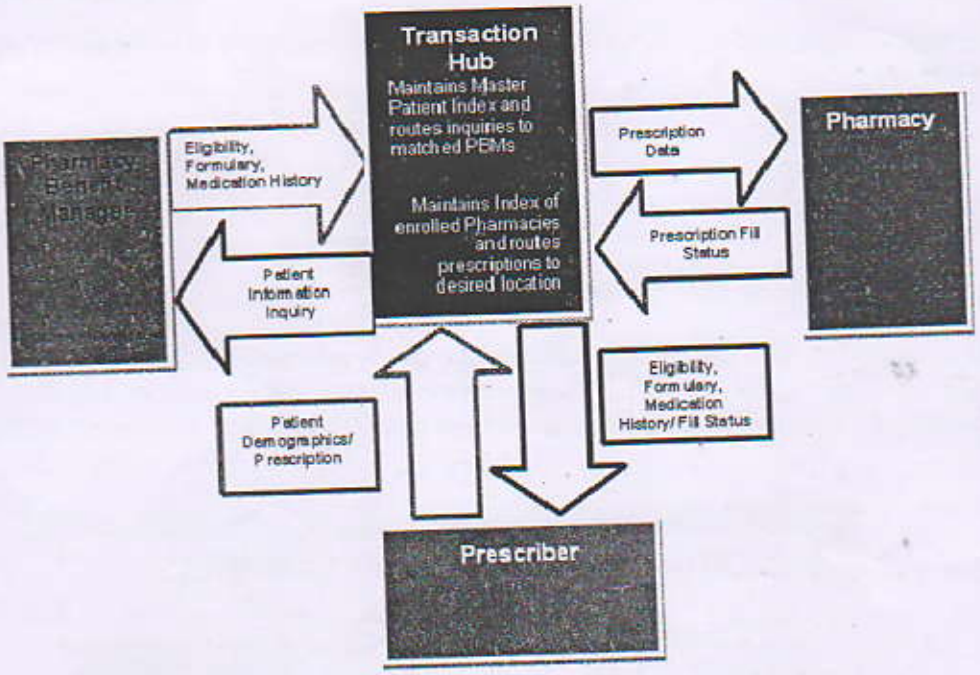
Electronic Prescription refers to computer based medical prescription which is generated online. It has replaced use of pen and paper. It allows nurse, doctor, pharmacist and patient's attendant to clearly look into the prescription. Pharmacist can dispense the medications at a faster rate and without any errors. It ensures accurate and error-free dispensing. The major drawback of hand-written prescription is illegible or bad handwriting which may sometimes lead to major complications.

Electronic prescription method is more reliable as it is based on patient's historical data as well as current use of medications. Before prescribing, a doctor can review all the possible side effects or drug interactions as complete record is available with him on the computer. A doctor can also select the pharmacy from where medication should be dispensed and in what quantity. Hence, it reduces the chances of self medication and overdose of medications.

BENEFITS OF ELECTRONIC PRESCRIPTION

1. Error-free dispensing.
2. Auton ated and faster refill of ongoing treatment.
3. Track any overdose, drug interactions or allergies.
4. Track whether a prescription has been refilled or not.
5. Provide better record maintenance services as detailed information about the patient is available right from the start of treatment.
6. Reduce chances of self medication and overdoses.
7. Keep a track of prescription related to controlled substances or narcotic drugs.





Electronic Discharge System – It refers to documenting a discharge order online instead of paper based filing process. Such a system of discharge is faster and more accurate as it reduces chances of any miscommunication between doctor, attendant and patient. It also allows a doctor to order discharge medications online which are further reviewed by clinical pharmacist to ensure best patient care. Not only this, this system of discharge allows hospital management to review real-time bed occupancy status. Electronic Discharge system has enabled speedy clearance of all discharge formalities. Thus, both the patient and attendants are relieved from lengthy process of getting no-due clearance from all the departments one by one.

BARCODE MEDICINE IDENTIFICATION AND AUTOMATED DISPENSING OF DRUGS

Barcode Medication Identification and Automated Dispensing refer to system of dispensing medications that uses barcodes for identification in order to prevent human errors. This system of dispensing ensures accurate dispensing to the right patient, at the right time, in the right amount and through the right method of administration.

This technology ensures patient safety and care in a healthcare practice. In this system, each and every drug is labeled with a unique barcode. When an electronic prescription is sent to the pharmacy, the barcoded medicine is dispensed in the right amount which is then checked by nurse and administered as per coded mode of administration.

BENEFITS OF BARCODE MEDICINE IDENTIFICATION DISPENSING

The barcode medicine identification dispensing has been formulated to ensure "Five Rights" of the patient.

- Right Medicine
- Right Patient
- Right Dose
- Right time
- Right mode of administration

This system of dispensing has also reduced time gap between actual prescription and dispensing. Further, it is useful for managing inventory as well as billing. Thus, we can say that barcode dispensing is faster, easier, more manageable and error-free mode of dispensing medications.

Automated Dispensing Cabinets (ADC)

- The ADC is a computerized point of use medication- management system that is designed to replace or support the traditional unit-dose drug delivery system.
- The devices require staff to enter a unique logon and password to access the system using a touch screen monitor or by using fingerprint identification.
- Once logged [illegible] the nurse can obtain patient-specific [illegible] drawers or bins that open [illegible] from a pick list.

MOBILE TECHNOLOGY AND ADHERENCE MONITORING

Mobile Technology and adherence monitoring refers to the process of monitoring medical practices that have been inculcated in improving patient care in medical practices. With advancements in technology, it has been made possible to keep a track of one's own health and wellness through various portable devices that assess medical information. Every body can monitor his/her vital signs on daily basis.

As the term suggests, adherence monitoring is related to evaluation of patient's commitment level to the doctor related to a particular medical service. A doctor can evaluate important events for any patient like whether the patient is following diet instructions or not, taking medications or not, has refilled his medications or not, is taking care of his vital signs or not, has got his lab tests done or not. All such information is available on the click of a button because of technology. By analyzing this information, doctor can actually check whether a patient is adhering to advised treatment or not. Accordingly possible outcomes can be evaluated and changes in treatment can be suggested.

Increased medication adherence leads to improved patient health. With the help of technology advancements, a patient can directly interact with his service provider without even visiting the hospital. He can discuss his problems or side effects if any. Changes in drug therapy can be implemented through electronic prescription. Thus, we can say that computer and technology plays a major role in bringing the whole world to a new platform called advanced healthcare management.

ADHERENCE MONITORING

Patients should have adherence counseling and assessment at each clinical encounter.

Measurement of adherence is imperfect and currently lacks established standards. However, some tools that a can be used include; patient self-reporting, diary cards, medication checks (pill counts), and other improvised measures.

HIV viral suppression, reduced rates of resistance and improved survival have been correlated with high rates of adherence to antiretroviral therapy.

Greater than 95% adherence is needed to achieve good virological response and to prevent the emergence of viral resistance. For a patient taking medication twice a day, missing more than 1 dose implies <95 adherences.

MEDICATION MONITORING

Computers are also used for effective medication monitoring in hospitals. To meet the optimum results of ongoing treatment, monitoring and adherence is essential. Each and every patient's complete information regarding prescribed drugs is entered into the computer and this data is maintained in chronological order. Computers provide two types of medication monitoring –

- Pharmacokinetic Information – These parameters include volume of distribution, bioavailability and excretion from the body. It helps analyze drug dosage schedule for the patient.

- Non-Pharmacokinetic Information – It includes drug interaction, adverse reactions etc. It helps to analyze possibilities of various drug combinations that can be administered to the patient.

DIAGNOSTIC SYSTEM

A diagnostic system is a program which is used to evaluate and analyze a particular problem based on its symptoms, functioning and issues being faced by the person. In healthcare, such a system is used to provide appropriate diagnosis to any patient. It starts with the arrival of patient having a chief complaint in the form of discomfort or other symptoms. Patient's history is considered well and many a times, lab tests or radio-diagnosis is recommended. A possible diagnosis called prognosis is given along with the tests but these tests are considered important in order to establish appropriate diagnosis. In today's world, diagnostic systems are widely accepted as they provide faster solution to a problem because one can consult and discuss that problem with other experts in the same field. Hence, vast knowledge, experience and skills of many experts can be put into practice at one instance to provide accurate diagnosis and best available treatment.

LAB DIAGNOSTIC SYSTEM

Lab Diagnostic System is a system that records, manages and stores data related to clinical lab test results of various patients. Such a system of diagnosis is being used to assess clinical diagnosis related to condition of the patient. A wide range of lab tests are available to diagnose a single problem and such tests are conducted under specified conditions in which clinical values are compared to standard values and results are provided. Lab diagnostics help clinical pathologists and lab technicians to add value to the care taking physician and hence, they ensure establishment of accurate and most appropriate diagnosis as per condition of the patient. Lab diagnostics are considered very important these days because they help in early detection of a medical condition which if not diagnosed and treated properly can become a deadly disease. People are advised to keep a track of their lab diagnostics after 35-40 years of age. This assures them of keeping healthy eating habits and good health.

PATIENT MONITORING SYSTEM

Computers are used as patient monitoring systems that refer to system of keeping a close track on patient's physiological functions, vital signs, functioning of life support equipment if any, day-to-day activities, medication adherence, requirement of any changes in ongoing treatment and assessment of all the related factors to ensure best healthcare services. The patient's physiological processes such as blood pressure, pulse rate, temperature etc play a major role in detection

treatment and prevention of critical conditions. Patient monitoring systems provide warning alert for immediate nurse's attention required by the patient.

Patients which are at high-risk stage of their life require close monitoring as far as their health is concerned. Eg Cancer patients and stroke patients. Similarly patients with unstable condition also require constant monitoring in order to avoid any unavoidable condition or circumstances. Eg. Overdose of anesthesia needs to be monitored in all patients who require surgical treatment OR supply of oxygen needs to be monitored for patients in ICU.

Some of the important parameters considered in patient monitoring are ECG monitoring, temperature, blood pressure, respirations, blood sugar etc. These are taken care with the help of ECG monitors, pulse oximeters, stethoscopes, Holter monitor etc.

Thus, we can say that patient monitoring systems refer to all those devices which are used to supervise the condition of the patient. Some of these devices are used as bed-side devices in the hospital and some of them can be owned by the patient for regular monitoring like BP check or blood sugar checking device.

PHARMA INFORMATION SYSTEM

Pharma Information System refers to use of information technology in the field of pharmaceutical industry. The science of technology that deals with storage, retrieval and use of information related to medical industry and pharmaceutical drugs is known as Pharma information system. This data is stored effectively for optimal use of drug information in safe pharmaceutical practice and patient care. Such information system is necessary to ensure faster and accurate decision making regarding pharmaceutical practices.

It helps in utilizing best available medicines under a particular condition. The application of technology in medical field has ensured better medical practices and safer patient care. Not only this, use of technology in this field has increased efficacy, reduced costing and enhanced safety of the patient. Medical personnel in today's world are dual specialists because they are experts in medical industry as well as tech savvy in order to keep themselves updated about latest advancements in technology.

BENEFITS OF PHARMA INFORMATION SYSTEM

- Faster
- Easier
- Error-free
- High reach to the people
- Expert advice
- Safer practice
- Increased efficacy
- Reduced cost
- Increased knowledge
- Qualitative assessment

Thus, pharma information system serves as a bridge between IT professionals and clinical experts that acts as a huge resource of information on pharmaceutical healthcare management and services.