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Applications of Computers in Pharmacy

Technology has revolutionized many aspects of business and society, and in pharmacy whether it is hospitals or pharmaceutical industries. Hospitals rely on computers to perform numerous tasks whether it is the cataloging of medical data in regards to storing medical records or basic tasks such as medical billing. Computers are utilized in scanning and imaging procedures as well. The procedures include the wide range of functions ranging from simple blood test to sophisticated CT scans. Computers are also used in the therapeutic monitoring of patients. With the help of computer, doctors are able to keep an eye on everything from blood glucose levels to heart rates. Perhaps the biggest advantages computers provide to hospitals are speed and accuracy.

Now-a-days computers are also used in pharmaceutical industries, and in various departments for drug information, education, evaluation, analysis, and for maintenance of financial records, etc. They have become indispensable in the development of clinical pharmacy, hospital pharmacy and in pharmaceutical research.

In this chapter, some of the hospital/hospital-related applications of computers are illustrated.

1. Role of Computers in Registration Process and Medical Record-keeping

Records may be termed as any information and documents kept in a systematic, scientific and convenient ways that help to receive the required data at the time of necessity. Similarly, medical record is also a systematized way of storing the required data, information and other relevant documents with the objective of making easy availability of necessary data at the time of its need. Medical record consists of name of patient, address, age, sex, occupation, disease, modes of diagnosis and recommendations made by the concerned doctor in course of undergoing treatment. It helps patients to acquire the right and

appropriate treatment. Moreover, it acts as a tool for the doctor who is looking into the patient.

Record-keeping is poor in most of the Government hospitals in India. The number of patients is so large that it becomes almost impossible to keep a track. There are long queues on the registration counters and files are traceable with great difficulty for follow-up consultation. There are heaps of files stacked in record rooms which are very hard to retrieve. Valuable data about patients and different diagnostic features stored inpatient files becomes untraceable because of huge number of files.

The condition becomes pitiable for patients seen in emergency condition where the knowledge of previous health and disease status is required and available time is short. In addition, there are problems of storage space, missing pages of records due to mishandling and also illegibility. The whole problem can be solved if the whole registration process and medical record-keeping are computerized. The initial effort and investment may be discouraging but it shall prove to be an asset in the long term. The system is quick and efficient, reduces waiting time and improves retrievability.

In most of the big sized private hospitals in India, for example, Max, Medanta, Apollo Hospitals, etc., there is a main centralized computer with terminals available at all registration counters and other workplace. Each patient, who comes for consultation is given a unique registration number. Even if a patient is seen in more than one departmental clinic, the same number shall suffice and multiplicity of clinic number may be avoided. Details of age, address, sex, marital status and other diagnostic data are recorded. The complete computerized patient registration record is available to each clinic dealing with the patient from a single data base.

In other hospitals, unique 'pass words' are provided to the users. Therefore, the user is identified by the computer and recorded. This avoids the unauthorized use to maintain secrecy.

To fulfill these requirements, one would need a sophisticated/ advanced computer, a large number of terminals, display units and printers, memory storage discs and tapes. Above all, there is need of expert or technically sound manpower to run the computerized system.

A master index of all patients is created in the central registration department (CRD). Whenever a patient reports to the outpatient department for follow-up, check-up or in emergency department, the master index is searched to check-up his previous medical records. Even if the previous registration number is not known, the search from the master index can be made easily using the patient's name, place of residence or disease state, etc.

It is important to add the recent/newer data in the patient file regarding revisits, admissions, discharges, transfers between wards, interspecialized department consultations and added problems and disease complications. This continuous monitoring is essential for up-to-date knowledge about the patient as well as for statutory on hospital statistics regarding total attendance, admissions, bed occupancy and mortality. Break-up patient statistics are done according to age, sex, occupation and consultancy obtained. For example, one can easily obtain history of rheumatic cases between a particular age group over particular period of time.

Medical records are legal documents and may provide significant evidence in regulatory, civil, criminal, or administrative matters when the patient care provided by a physician is questioned.

2. Role of Computers in Medical Research

In medical research, computers have two kinds of applications:
1. Computerized diagnostic equipment
2. Data collection

The first use is beyond the realms of this article except to say that most of the modem equipments, be it small or big, has built in computer system. Some common examples are: MRI, computerized spirometers, blood chemistry and gas analyzer, ultrasound scanners and CT scanners. All these pieces of equipment are used for diagnostic purposes and data/diagnostic features are automatically displayed on computer screen during examination. These data/images from CT scans, ultrasounds and X-rays can be viewed on the computer anywhere in the world.

The second application or major use relates to research planning, data collection, data analysis and statistics. The computer software may vary depending on individual needs. For example, the physiologist may require computer for creating mathematical models or for analysis of biological signal, records, graphs and images. The computer analysis of complex data is very fast, simple and reliable but also mandatory when manual calculations become impractical.

3. Role of Computers in Drug Information System

The Drug Information System (DIS) (discussed in Chapter 16) is a computer-based system where information on all prescription drugs dispensed are gathered and securely stored electronically linked to all health care sites, such as:
• Pharmacies
• Physicians' offices

- Health centers
- Addiction centers
- Hospital pharmacies
- Emergency departments

The informations regarding drugs are accessible to authorized health care professionals, including physicians and pharmacists intended to support the delivery of health care to patients.

The drug information system is helpful to:
- Reduce the potential for harmful drug interactions, prescription errors, and adverse drug reactions.
- Make it easier for pharmacists to report adverse drug reactions.
- Help pharmacists to counsel patients about their medications.
- Promote better patient care by enhancing the partnership between physicians and pharmacists.
- Eliminate the need to repeat your medication history at each visit to your physician or pharmacist.

4. Role of Computers in Drug Inventory Control

Drug control procedure is necessary to prevent the purchasing in excess and to avoid the out of stock situation which may be dangerous in emergency cases. Inventory control is still done manually in most of the general hospital as well as in retail pharmacy in India. It needs more staff and more time to check the stock situation at regular intervals by counting the number of items. The Pharmacist check manually the batch number and date of expiry. But some private hospitals and organized retail pharmacy have the computerized system for the inventory control. It is more accurate, time saving and economical. In the computerized system, each drug is allotted code number. Thus, the quantity of each drug is entered code wise received from the supplier and issued to various departments. The batch number, date of expiry and supplier name are also recorded. Minimum stock balance of every drug is marked. It is the drug quantity which must be present to avoid the out of stock situation. When minimum stock situation reaches, computer signals for placing the order of that particular drug.

The user pharmacist can collect the entire information about a drug via; stock position, shelf life, batch number, current consumption rate, buffer stock to be maintained, expiry date, mode of purchase, sources approved, indication for the submission of the fresh indent, issuing details and all other related information about the drug which shall be flashed on the screen.

5. Role of Computers in Monitoring Drug Utilization Trends

The computer is used to track drug utilization trends within the hospital. The Pharmacy department conducts studies to identify changes in medication usage that can improve the quality of patient care or provide more cost-effective treatment. Typically, pharmacists visit patients taking a particular medicine, review their charts, and gather all necessary information to assess whether utilization of the medicine is appropriate. The computer application captures information such as why a particular medication was prescribed, the dosage, the patient's age and physical condition, and how the patient responded to the therapy.

At the end of the day, the pharmacist synchronizes the medication data to the pharmacy department's central system at the same time as their consulting records. A medication usage database is aggregated over time, and provides the ability to generate reports by patient demographics and medical conditions.

6. Role of Computers in Adverse Drug Reaction Reporting

Because of a rapid increase in the list of newer drugs launched in the market in the last few decades, adverse drug reaction monitoring of these drugs has assumed prime importance. Since India is a high populated country, which caters to the maximum number of human population for the final assessment of drug safety as a part of post-marketing surveillance studies, it becomes necessary to report any untoward reaction of any pharmaceutical product. The drugs, which are marketed in India, are pretested on very small population groups of European countries in an optimal environment and the data about the drug safety collected from that population could not be applied straight in our population because of the climactic and corporal differences. The adverse drug reactions (ADRs, are the fourth-to-sixth leading cause of death among hospitalized patients and it occurs in 0.3–7% of all hospital admissions. The incidence of serious ADRs is 6.7% and 30–60% of these ADRs are preventable.

Adverse drug reaction may be due to drug-drug interaction, allergic reactions, etc. For reporting purposes, drug control department categorizes serious adverse event (event related to drug or devices) as one in which "the patient outcome is death, life-threatening (real risk of dying), hospitalization (initial or prolonged), disability (significant, persistent, or permanent), congenital anomaly, or required intervention to prevent permanent impairment or damage." For observing drug-drug reaction, the computer software program MEDIPHOR can be used which increases the efficiency of clinical services provided by the hospital pharmacist.

The computerized drug order entry as given under is screened here for events related to adverse drug reaction and a detailed investigation is done if any clue is found.

- Medication order screening.
- Abrupt medication discontinuation.
- Abrupt dosage reduction.
- Orders for tracer substances.
- Orders for special tests or serum drug concentrations.
- Orders for high risk drugs, which are likely to cause ADRs, are screened and their use is monitored.

Examples of high risk drugs are aminoglycosides, amphotericin, anti-neoplastics, corticosteroids, digoxin, heparin, lidocaine, phenytoin, theophylline, thrombolytic agents, warfarin, etc.

7. Role of Computers in Pharmacokinetics

'NONLIN' is a program which can predict the pharmacokinetic parameters like absorption, distribution, bioavailability, rate of excretion. From this program, further dose can be adjusted to maintain the effective drug concentration in blood.

8. Role of Computers in Emergency Situation

Computerized system has decreased errors inpatient care by giving relevant information in emergency conditions and other practitioners to quickly access the patient's complete records from anywhere in the world. In emergency, the complete diagnostic features can be sent to other advanced country for expert comments.

9. Role of Computers in Finance Control in Hospitals

The basic ledger system deals with the day-to-day purchases that the hospital needs for proper functioning on a day-to-day basis. It covers everything that is bought by the hospital and accounts for their purchase and their use by a particular department. All departments have budgets and these are then managed by the computer system. The finance system also manages the payroll needs of the hospital. This is the basis by which health authority pays the salary of each individual. Computers are used for billing process of patient.

10. Role of Computers for Monitoring Patients with Chronic Disease

The hospital pharmacist and new clinical activities have been partially filled by the introduction of computers. In addition, hospital systems are designed specially with functions which allow pharmacists to easily

check the work completed by technical staff. Computers are useful to hospital pharmacists for monitoring patients with chronic disease such as diabetes, hypertension and other chronic ailments to observe the outcome of therapy.

11. Role of Computers for Patient Counseling

Patient medication counseling is considered as the most important function of a pharmacist. How much and what information about their medications should be disclosed to the patients varies from pharmacist-to-pharmacist. The availability of sophisticated medication databases further simplified these issues with available information on every medication they dispense at their fingerprints, it is understandable that differences could arise about what to include. Giving too much information may be potentially harmful to a patient as giving too little. The use of computer-generated counseling sheet has the potential of adversely affecting the one-to-one interplay between pharmacist and patient. Pharmacist who has grown to rely on these databases might be unable to function effectively in which patient counseling support during periods of computer downtime. Computerization also creates the possibility in which patient counseling is actually performed by an intelligent computer program. Computer system provides patient counseling support in the form of patient education leaflets. Each leaflet contains the informational sections about a medication such as name, uses, how to take this medications, drug interactions, missed dose, storage.

12. Role of Computers in Medical Imaging

The role of computer technology is actually unquestionable in the field of medical imaging. The technology and the instruments have helped to save lives of millions of people. Various types of techniques help create images of the human body, or body parts, for medical purposes. The modern methods of scanning and imaging like magnetic resonance imaging (MRI), ultrasonography, mammography, 3-D images are based on advanced computer technology. Storing of these images has become easy due to computer technology for future reference to be helpful in diagnosis of particular disease. Computerized machines and infrared cameras help get sharp, fine and perfect images. Computers can inform about the changes taking place inside the human body without a cut in the skin. For example, bone scan, prenatal ultrasound imaging, blood glucose monitors, endoscopy, blood pressure monitors, etc. Computers have brought more precision in medical examinations and diagnosis.

Use of computers in the health sector promotes faster detection of cause of the disease, and early but correct diagnosis. Medical alerts help prevent diseases and disorders. All this has resulted in increased life expectancy of patients.

13. Role of Computers for Labelling

Computer system is capable of producing labels of required size, with pictograms for dispensed drugs. Specially designed software is helpful in producing labels of required shape with pictograms. Label making software is very easy to use and can be enjoyed by all including people with very basic computer knowledge.

14. Role of Computerized Internal Diagnosis

There are various diseases which are treated with the help of computer technology. For example, earlier, few years back for eye check-up, the traditional method of eye-checking was used. However, now-a-days computerized eyesight checking is done. Similarly, there are various surgeries which use the computer technological equipment in operations.

There are often scenarios where the doctor needs to perform the internal diagnosis of the patient to get the clear picture and state of the disease. Certain tumors and cancer may seem neutralized from outside but from inside the situation can be completely opposite and this cannot be found out until and unless a proper internal diagnosis of the infected body part is performed. Even performing CT scans, X-rays and other scans cannot give a proper state of the disease and can delay the treatment at the same time.

The introduction of computerized internal diagnosis has made the job so much easier, faster and effective. While employing the computerized internal diagnosis, most of the times a computerized tiny robot with a camera head are inserted in the body of the patient. The tiny robot makes its way through the infected part of the body providing real-time images of the internal parts at the same time. The doctors can literally see each and every area of the infected part and then can make justified decision about the criticality of the disease and can perform the treatment accordingly.

15. Role of Computers in e-Laboratory Management

The various diagnostic tests are performed in the pathological laboratory and results are immediately transferred to patient identification number, doctor's identification number and hospital record. The patient can

take the attractive print out and at the same time doctor can have the diagnostic or therapeutic outcome of their patient through the e-laboratory management.

16. Role of Computers in Drug Design

Drug design, also sometimes referred to as rational drug design, is the inventive process of finding new medications based on the knowledge of the biological target. This is referred as computer-aided drug design. This type of drug design can be assisted by computer software. Software will generate number of lead molecules depending upon the feed data and among these; compound of interest can be developed and tested. If such process is carried out manually then it will be time consuming and tedious. But use of computer reduces time hugely.

Molecular modelling and molecular graphics have shown dramatic growth and are becoming integral part of drug discovery process. Molecular modelling is the generation, manipulation and representation of three-dimensional form of molecule. Molecular graphics refers to the use of computer graphics to represent the molecular structure. In the past synthetic chemists have used molecular models, but computer modelling has enhanced the detailed display of molecular structures.

17. Role of Computers in Pharmaceutical Analysis

Computers in pharmaceutical analysis are mainly utilized for data storage, processing of data, searching of various files. Also, various instruments like UV visible spectrophotometer, infrared instrument, HPLC, microscopes, mass spectrometer come along with particular software. These software do all necessary process required for analysis purpose. Also, these programs contain in built libraries which prove useful for searching of data related to different chemical entities. For example, if a mass spectrum of any unknown chemical is obtained then instructions can be given to the program to find out similar mass spectrum among the library which is present in it, which will help to find out unknown chemical entity. For interpretation of IR spectra commercial software packages are available. Sadtler Standard infrared collection and Sadtler commercial infrared collection contain over 1,20,000 spectra.

USE OF INTERNET IN PHARMACY

Internet is collection of huge data which is available for us in just a one click. Internet is useful tool in literature survey. Books are also available on the internet. Various research journals can be easily accessed via

internet. There are number of web-sites which are related to pharmacy field. Some of these websites are as follows:

- www.pharma.org

  Organization representing America's pharmaceutical research companies provides details of drug development, industry news, and health guides.

- www.health careforums.com

  Created to facilitate interaction among health care professionals on specific topics which include discussion of cases, research and other relevant issues.

- www.astra.com

  This is official website of ASTRA pharmaceuticals which produces medications for respiratory tract, cardiovascular and gastrointestinal diseases, and for pain relief.

- www.biogen.com

  This is official website of Biogen company principally engaged in developing genetically-engineered human pharmaceuticals along with career advice, and drug information.

- www.gene.com

  This is about Genentech company, who develops pharmaceuticals mostly for the treatment of genetic disorders, including a listing of the major drugs and their uses.

- www.genzyme.com

  This is about Genzyme, American Biotechnology company (fully owned subsidary of Sanofi). This company specializes in biotechnology and health care products, with career, product, and services information.

- www.pfizer.com/main.html

  Find out about research projects and career opportunities at this Pfizer pharmaceuticals. Includes health education and pharmaceutical advice section.

- www.roche.com

  Roche produces pharmaceuticals and products for treatment of HIV, obesity and cardiac conditions. Offers news and company information.

- www.pharmweb.net/pwmirror/pwk/pharmwebk.html

  Listing of international pharmaceutical regulatory bodies including the US Food and Drug Administration.

- https://www.pharmatutor.org/

  It provides unprecedented support to novice pharmacy students and researchers in their day-to-day doubts and also to increase the

awareness among the students about this field and introduce the various upcoming areas of research and job opportunities.

ELECTRONIC HEALTH RECORD

An electronic health record (EHR) is the systematized collection of patient electronically stored health information in a digital format. These records can be shared across different health care settings. Records are shared through network-connected, enterprise-wide information systems or other information networks and exchanges.

The purpose of EHR, or electronic health record, is to consolidate a patient's medical chart into digital documents. They are updated patient records that can be accessed in real time by authorized users in a digital format.

Among other types of data, an EHR typically includes:
- Contact information
- Information about visits to health care professionals
- Allergies
- Insurance information
- Family history
- Immunization status
- Information about any conditions or diseases
- A list of medications
- Records of hospitalization
- Information about any surgeries or procedures performed

Benefits of Electronic Medical Records

Examples of the numerous benefits of electronic medical records in hospitals and other health care facilities include:
- *Improved quality of care:* Computerized notes are often easier to read than a physician's handwriting. This reduces the risk of errors and misinterpretations that can negatively impact the quality of patient care.
- *Convenience and efficiency:* Medical and office staff no longer have to waste time sorting through cumbersome paper records. Users can access electronic health records quickly and efficiently with just a few strokes on a keyboard.
- *Efficient storage and retrieval saving space:* Electronic health records eliminate the need to store documents in bulky file cabinets, which frees up more space in the office for medical supplies and equipment and other essentials.

- *Patient access:* Many EHR systems include a patient portal that allows patients to view their medical history and information whenever they wish.

Disadvantages of Electronic Medical Records

These include as:

- *Potential privacy and security issues:* EHR systems are vulnerable to hacking, which means sensitive patient data could fall into the wrong hands.
- *Inaccurate information:* Because of the instantaneous nature of electronic health records, they must be updated immediately after each patient visit—or whenever there is a change to the information. The failure to do so could mean other health care providers will rely on inaccurate data when determining appropriate treatment protocols.
- *Frightening patients needlessly:* Because an electronic health record system enables patients to access their medical data, it can create a situation where they misinterpret a file entry. This can cause undue alarm, or even panic.

SOFTWARE USED IN HOSPITAL PHARMACY

 i. *Rx30:* It provides complete solutions for hospital outpatient pharmacy, including integration with admission discharge transfer (ADT) system.
 ii. *Halemind:* This cloud-based software streamlines the multiple reports and records related to lab and pharmacy. Its automated billing and management system is of immense help to the entire medical fraternity.
iii. *GOFRUGAL pharmacy:* It covers all major operations like sales, purchase, inventory, re-order, financial accounting, claims and returns.
iv. *Medicin ERP:* This pharmacy software gives an online presence to your chemist shop. One can easily customise it to manage and offer the best care to its customers.
 v. *Liberty pharmacy management software:* This software solution offers better safety, profitability and patient care. It can easily be used across many android and iPhone devices.