



**Review**

## **A mini review on the role of computer applications in hospitals pharmacy practice**

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### **Abstract**

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The pharmacy practice in hospitals has undergone a great change with the introduction of computer technology to enhance medication safety, workflow, and clinical decision-making. The purpose of the mini review is to summarize and critically review the role of computer applications in the pharmacy practice of hospitals with emphasis on medication management, clinical services, research support, and patient care. This literature review mini narrative was carried out because of a search of the literature in PubMed, Scopus, Web of Science, and Google Search. After a review of the relevant studies published within the last two years (2018-2025), studies relating to hospital information systems, electronic health records, clinical decision support systems, automation, and pharmacy informatics were considered. The use of computer programs such as electronic health records, computerized physician order entry, clinical decision support systems, automated inventory management, and computer-enhanced diagnostic tools has improved medication accuracy, reduced errors, and efficiency of operational systems. The development of such sophisticated applications as pharmacy informatics, artificial intelligence, and automation underlays clinical trials, research, and patient-centered care. Hospital pharmacy today cannot be practiced without computer applications. Although these technologies help to enhance patient safety and efficiency, there are challenges like data security, interoperability, and training of the systems. The research and development of artificial intelligence and digital health are likely to improve pharmacy services in hospitals in the future.

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**Introduction:** Computer technology and advancement provide the ideal environment for researching the universe of limitless possible results and creating one's unique example of overcoming hardship in a variety of pharmacy-related contexts<sup>1</sup>. Nowadays, computer systems are well known both locally and internationally for their outstanding teaching methods and inventive advancements. It provides the ideal assistance with connected education, excellent working programming, straightforward time management, and many more knowledge open offices to the Pharmacy home<sup>2</sup>.

The Pharmacy Department now offers both theoretical and practical computer education, facilitated by sophisticated technology access to the web and various workplaces. Developments are assured both within and beyond the pharmacy profession and health sciences professions with a competent academic attitude and a satisfyingly functional modern approach and its capabilities. Throughout all branches of science and technology, the computer has emerged as a relatively common instrument. The proportion of a computer's budget to functionality is continuing to decline as a result of the expansion of the Internet and advancements in computer production and technology<sup>3</sup>.

Consequently, numerous computer programs have been created. Since 1980, computers have been used effectively in the pharmacy profession. Since then, the pharmacy sector is in the growing market for computers. The usage of computers in the pharmacy industry has significantly improved the industry and will grow to do so as pharmacists become more accustomed to using computers. Computers are helpful in several crucial sectors, including the development of new pharmaceuticals, drug structural analysis, pharmaceutical production, and healthcare pharmacies. Information systems enable pharmacists to cooperate with other experts, which is extremely important in today's research, in addition to these benefits<sup>1,4</sup>.

It also offers different ways for laborious manual tasks. Without the many technologies that have been established, finding, creating, producing, and studying drugs would be extremely difficult. More advancements are continually being made, which will simplify the work of pharmacists. The ever more significant reality is that they will make it possible for us to find new treatments for deadly illnesses such as cancer and HIV/AIDS, as well as reduce the expense of making medications for conditions that are simply treatable. Computer systems are utilized in pharmacies for company information, pharmaceutical entries, databases, and folders, medication governance (making, changing, inserting, and removing data in patient data to analyze data), and medication lists. The sole role of computers is to access updates, store them, analyze them, and disseminate them. This constant flow of information demonstrates how well any system is performing.

A hospital pharmacy is a department that oversees the receipt and distribution of medications, professional consumables, and outpatient and in-patient prescriptions<sup>5</sup>. It may also have a production extension to produce pharmaceuticals and injectables in large quantities. The area of pharmacy known as the clinical pharmacy is when pharmacists and pharmacologists offer patient care that encourages health, well-being, and illness prevention while optimizing the utilization of medications<sup>6</sup>. In hospitals, maintaining patient records is a crucial task, but with the use of computers, information can be simply preserved and routinely updated. Stock management entails that the computerization of managing inventory is extremely effective<sup>7</sup>. Monthly or perpetual inventory control systems can be modified for this aim. Computers might be doing various jobs,

- To create a list of the things that need to be bought and how much of each.
- To eliminate duplication and to produce purchase orders for vendors.
- To identify the seldom-bought products to potentially return or remove from medication supplies at the drugstore.
- To create recurring summaries and data on buying and inventory management.
- Keeping a patient's medical record current.
- Drug education programs.
- Patient observation.
- The usage of programs like Microsoft Excel keeps all kinds of numerical data.

Computers may be used by clinical pharmacists to monitor therapeutic drugs, even those with a very limited therapeutic window and high potencies, such as antiepileptic drugs and cardiac glycosides<sup>8</sup>. Programs are created to determine medicine doses to meet each patient's needs. Software like MEDIPHOR (Monitoring and Evaluating Medication Interactions by Pharmacy Oriented Reporting) and PAD Pharmacy Automated Drug Interaction Screening can also be used to check for drug side effects.

**Methodology:** This paper is written in the form of a narrative mini review. A systematic literature review was done in PubMed, Scopus, Web of Science, and Google Scholar. The search terms were hospital pharmacy, computer applications, pharmacy informatics, electronic health records, clinical decision support systems, automation, and digital health. The preference was given to the studies that were published in the past 57 years (2018-2025). The older references were added only in case of the need for the foundational concepts. Only articles that had the practice of hospital pharmacy, medication safety, informatics systems, and digital healthcare tools were considered, whereas non-English articles and studies that did not involve the pharmacy practice were eliminated.

**Basic Computer Uses in Hospitals:**

**Hospital Information Systems (HIS) and Electronic Health Records (EHRs):** Digital hospital pharmacy is

based on HIS and EHRs. The systems provide pharmacists with access to patient demographics, lab data, medication history, and clinical notes in real-time. Pharmacy module integration into EHRs facilitates medication reconciliation and allergy screening as well as continuity of care<sup>9</sup>.

**Payments, claims management, and inventory control:** Maintaining a data file makes stock management easier over time. Additionally, payment may be done digitally; in our electronic era, this suggests distinctiveness and scope. Online payment is possible for medical or pharmaceutical costs. Medical claims that the business supplies for its workers are paid directly to the billed institution. Clinical preliminaries are a crucial component of modern drug development since they provide information on the risks and benefits of any drug. A section of the pharmacy and healing facility, a medical center that monitors patients' receiving and identification of remedies and medications, expert supplies, manages their storage, and provides in-and-out patients<sup>10</sup>.

**Computer use in online medical stores:** The unexpected development in PC Innovation in technology and programming has had a massive impact on clinical preliminary exams, administration, and the collection of information. In healthcare facilities, patient records maintenance is a necessary job, although with Computers' help, data may be easily updated and periodically renewed. Therefore, periodic or ongoing stock control systems could be modified. Microsoft Office and other related programs are useful for maintaining all types of statistical information<sup>11</sup>. Therapeutic drug specialists may use Computers for examining restorative medications as they are quite powerful and have incredibly restricting usefulness. Computer programs are designed to compute medication quantities to meet the needs of specific patients. Information management and collection are extremely crucial in clinical antecedents. Virtual objects are used for the initial database, the portion that gathers data, enrollment, randomization, and analysis administrative tools that are quantifiable investigation<sup>12</sup>.

**Prescription process or medications filling or refilling:** Prescription processing includes printing the label, computing the price and reduction, and more. It involves entering the patient's name, the doctor's name, the medicine identifier, the amount, and the code of the prescription. To prevent any alert notification from appearing if the information is missing from the prescriptions, the pharmacists insert incomplete data. E-prescriptions are written by a doctor or other medical specialist using computers and transmitted right to the pharmacy. E-prescriptions are digitally sent via a secure, secure network. Every time a fresh medication is filled, the pharmacist may update the patient's profile. Furthermore, the patient's profile should be updated if any potential problems, including allergies, occur<sup>13</sup>.

**Clinical Decision Support Systems (CDSS):** CDSS support pharmacists by giving warnings on drug-drug interaction, dose mistakes, contraindication, and duplication of treatment. Such systems have been demonstrated to significantly decrease medication errors and improve clinical outcomes with outcomes being especially poor in high-risk groups of patients<sup>14</sup>.

**Hospital Pharmacy Advanced Applications:**

**Pharmacy Informatics and Pharmacy Automation:** Pharmacy informatics is the combination of data, technology, and clinical knowledge to maximize the use of medication therapy. The automation technologies like robotic dispensing and barcode medication administration enhance the efficiency of the workflow and decrease the rate of human error<sup>15</sup>.

**Tele pharmacy and other Outpatient Services:** Tele pharmacy and other Outpatient Services. Online services allow the management of prescriptions remotely, patient counseling, and medication follow-up. Tele pharmacy enhances the provision of pharmaceutical care, more so in underserved population. Numerous components of patient care are handled by doctors using laptops and mobile computers. The three most frequent uses of computers in healthcare are practice management, online access to health knowledge, and emailing patients and other parties<sup>16</sup>. EMRs are used by 58% of primary care physicians in the UK and 90% in Sweden<sup>17</sup>. Within ten years, interoperable electronic health information and computerized patient records should be used, according to the IOM and HHS in 2002, just 17% of primary care doctors in the US did so<sup>18</sup>.

**Clinical Services:** Type 2 diabetes, which shows the excessive synthesis of glucose and insufficient use of sugar, is a long-term metabolic condition. Type I diabetes mellitus is treated with subcutaneous injections of insulin. 27 For diabetes patients, the injection administration method is highly unsettling since it might hurt and create discomfort. Consequently, pharmaceutical researchers are still working on another delivery technique, which involves the oral administration of insulin in tablet form, utilizing a pharmacoinformatic approach. The use of virtual screening, quantum chemical research, and pharmacoinformatic in molecular modeling and bioinformatics studies on medications linked to Type II diabetes was also made. For the comparative investigation of several DNA-binding medicines for leishmaniasis treatment, pharmacy informatics approaches are employed<sup>19</sup>.

Additionally, pharmacy informatics use informatics, the internet, and other technologies innovative technology to address the drug's use issue which emphasizes offering the best pharmacological care attention and increasing patient security. Aside from that Pharmacoinformatic might boost effectiveness and enhance the medicinal treatment of terminally ill patients. By using pharmacy informatics, the significance of informatics and technology in medication therapy may change for the better. The

ability to incorporate pharmacoinformatic into the practice of clinical oncology has been employed as a result of the informatics transformation in health care to address drug-related issues<sup>20</sup>.

A unified informatics strategy is described in some research as a means of identifying medication adherence issues and facilitating the methods used by the patient and the provider to communicate about the drug being taken. It is interesting to notice that the position of pharmacy informatics expert has developed in acute care hospitals. When a pharmacy informatics specialist is present in the pharmacy, the utilization of clinical pharmacy informatics in patient care in acute care hospitals is substantially more likely. For usage in a regional hospital, there is also an incremental pharmacy informatics approach to the detection of drug-related issues that is improved by the next generation of hospital rules-based medical informatics for patient safety<sup>21</sup>.

**Use of computers in clinical trial management:**

Clinical studies are quite a crucial component of today's medication development that offers knowledge concerning the advantages and risks of any drug. Data administration and acquisition of data are essential to clinical trials that have been conducted. The incredible progress in the development of both computer hardware and software had a huge influence on the findings from clinical trials. selection and administration. before the explosion, clinical studies and technological innovations were dependent upon depending on human processes or to a certain extent computer. The computer can be used for research management solutions, statistical methods, randomized, entering data, identification, as well as research databases. Volunteers and doctors must communicate. For communication purposes, a variety of computer-assisted techniques can be used, including e-mail websites, and video teleconferences. E-clinical programming consists of integrated suites of apps that serve the medical research process. These apps provide several methods for information collecting, data input, online documentation, and batch data loading. One example of an e-clinical application is

1. Oracle clinical V4i® from Oracle Corporation, which allows for rapid and simple study design and clinical information gathering.
2. Data LabsXC®, a product of Data Labs, Inc.
3. Omnicomm Systems' Trial Master®.
4. Data management using Cliniplus® from DZC software solution, Inc.
5. Akaza research's Openclinica, Cambridge, Massachusetts<sup>22</sup>.

**Computer-aided drug design:** The method of announcing new pharmaceuticals is known as CADD. Based on sophisticated graphics software that is already in use or input information, medicinal chemists have the opportunity to create new molecules and enhance their activity effectiveness<sup>23</sup>.

**Information storage and retrieval:** As there will be ongoing modifications, hospital administration

computers aid in data storage and recovery (retrieval). The clinical and nursing personnel, beds, operating rooms, critical care units, pharmacies, radiological facilities, etc. are regularly seen throughout the patient admission procedure. As soon as a patient is hospitalized, a computer keeps track of and stores data on their diagnoses, medications, demographics, clinical findings, etc<sup>24</sup>.

**Patient web consultation:** A few businesses serve as a modem to link patients and physicians while controlling commission. Online live physician consultations are offered. For further inquiry, the physician may call the patient in for an examination and might speak with someone with further knowledge. In addition to therapists, counseling is also available. The connection method includes emails, audio messages, teleconferencing, sites, social media sites, and clinical knowledge<sup>25</sup>.

**Digital laboratory for diagnostic purposes:** Manual processes required a huge amount of time, while automated computerized tools can do many jobs providing precise outcomes in assessment. A lab management platform is utilized to manage large amounts of information. Tools serve as preprocessors, converting the raw information to a digital format and presenting the numerical values in the reports as a result. The development of persuading computers offers the diagnostic imaging department a greater and increased picture and awareness. Numerous digital radiographic methods, including both magnetic resonance imaging (MRI) and computerized tomography (CT), are fundamentally electronic. Through complex computations on observable values, this computer creates a "usable picture"<sup>26</sup>.

**Drug Distribution and Drug Information:** Particularly in the area of medicine, medical knowledge is expanding at an exponential rate. Pharmacologic developments have produced a wide range of drugs that clinicians can use to treat patients. Drug-drug interactions, fluctuating purposes, specific precautions, and intricate dose memory has its limitations. Physicians find it more challenging to stay current on the prescription guidelines for medications, particularly those that have obtained approval. One of the most frequent queries that practitioners receive is about medications. In light of this, point-of-care technology, which may offer to prescribe information at the bedside, in the hospital ward, and in the office examination hall, is particularly appealing<sup>27</sup>.

**Assessment of Information & Drug Research:** Pharmaceutical development involves researchers from a wide range of fields. Even though their study focuses may be rather dissimilar, all of them produce scientific data (and written papers), which are byproducts of innovation laboratories. To accompany experimental and commercial authorization files, government regulators receive actual truckloads of data and documentation. For instance, an Investigational New Drug (IND) registration typically includes 50,000 pages of supporting documentation.

Every single piece of information must in some manner follow a set of particular standards and norms when it comes to collecting, analyzing, storing, transmitting, monitoring, and preserving information. The increasing use of computers has greatly boosted the effectiveness and productivity in the production of pharmaceuticals. In addition, side, it has also brought forth particular issues and difficulties for the sector. By concentrating on the preclinical development field (also known as the area of Chemical Manufacturing and Control, or CMC), this review briefly examines these subjects. Given how commonplace computer applications are in every scientist's day-to-day tasks<sup>28</sup>.

#### **Advantages, limitations, challenges, or risks of computer applications in hospital pharmacy:**

Although computer applications have enormous advantages in the pharmacy practice of the hospital, there are some challenges and ethical issues that restrict their maximum use. Among the most significant problems, there is the question of data safety and patient confidentiality. The system used in hospital pharmacies hosts very sensitive patient data, which is susceptible to cyber threats, including data breaches, ransomware attacks, and unauthorized access. The lack of proper cybersecurity can jeopardize the confidentiality of patients and reduce their confidence in digital health systems, which can be improved through a strong encryption system, access control, and compliance with regulations.

Interoperability issues also limit the use of computerized systems in pharmacy. There are numerous cases in which healthcare facilities adopt numerous software systems, which consist of non-standardized data exchange protocols that produce divided patient records and repetitive documentation, in addition to delayed access to critical medication-related information. Such restrictions may impair the efficiency of the working process and lead to the possibility of drug errors. The other issue of concern is alert fatigue related to clinical decision support systems. Automated alerts are considered to improve the safety of pharmacists and prescribers, but in large quantities and not specific to issues, they can be overwhelming and cause clinically significant alerts to be disregarded. Also, system bugs, erroneous databases, and bad customization may lead to irrelevant recommendations, and that is why it is important to evaluate the system continuously and control it by human means. The excessive use of automation and artificial intelligence is a possible threat to clinical judgment. In as much as automation will enhance efficiency, over-reliance on computerized processes can limit critical thinking and professional accountability. Expert knowledge of pharmacists is also crucial to confirm system outputs and the safe usage of medications. Also, the obstacle of implementation, like high cost, poor infrastructure, and staff training, can be a hindering factor to adoption, especially where resources are limited. Issues of ownership of data, transparency of

algorithms, and responsibility of errors generated by the system are also ethical issues that should be taken into consideration. The resolution of these issues using policy formulation, training initiatives, and ethical governance models is critical in the responsible use of computer applications in the pharmacy practice in hospitals.

**Hospital pharmacy informatics trends in the future:** Hospital Pharmacy Informatics Trends in the Future. The use of new technologies like artificial intelligence, machine learning, predictive analytics, and sophisticated automation is set to improve medication safety and individually tailored therapy. Clinical pharmacy services and patient outcomes will be enhanced due to the integration of interoperable systems and real-time analytics.

**Conclusion:** Computer applications have turned out to be essential in a hospital pharmacy practice due to the enhancement of medication safety, operational efficiency, and clinical outcomes. Evidence-based decision-making and patient-centered care are facilitated by systems like EHRs, CDSS, automated inventory management, and pharmacy informatics platforms. These issues will play a central role in ensuring that the benefits of these technologies are maximized by addressing issues of data security, interoperability, and training of the users. Further innovations in the field of digital health and artificial intelligence will also change the hospital pharmacy practice in the future.

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