Review Article

Can AI replace the Role of Clinical Pharmacist in Healthcare?

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ABSTRACT

The integration of Artificial Intelligence (AI) in healthcare has transformed many aspects of patient care, raising a critical question: Can AI replace the role of clinical pharmacists? This review examines the current and potential contributions of AI in improving patient safety and the indispensable role of clinical pharmacists in the Indian healthcare system. AI demonstrates significant capabilities in supporting clinical decision-making, monitoring medications, remote patient surveillance, diagnostic assistance, and post-discharge follow-up. It enhances medication adherence, reduces human error, and streamlines clinical documentation. However, its applications remain limited in areas requiring empathy, human judgement, and contextual understanding—domains where clinical pharmacists excel. In India, clinical pharmacy is still evolving, with the Pharm.D program introduced only in 2008. Despite advanced training, pharmacists often remain underutilized due to limited awareness, infrastructural gaps, and unclear role definitions. Moreover, policy and educational shortcomings hinder full integration into multidisciplinary teams. AI tools, while powerful, cannot replace the human interactions essential for medication counselling, error identification in real-time clinical settings, and personalized patient education. Issues such as data privacy, algorithmic bias, high implementation costs, and limited accountability further challenge AI's standalone reliability. Therefore, while AI can augment pharmacy services, it cannot fully replicate the nuanced, patient-centered care provided by clinical pharmacists. Rather than replacement, a collaborative model that leverages AI's strengths while preserving the clinical pharmacist's expertise offers the most promising approach to optimized patient care. This review concludes that AI is a tool — not a substitute—in clinical pharmacy practice.

Keywords: Artificial Intelligence (AI), Clinical Pharmacist, Patient Safety, Medication Management, Healthcare Technology, Pharmacy Practice in India.

INTRODUCTION

Policymakers continually seek strategies to support healthcare providers in managing the increasing number of patients with drug use disorders and the associated medical costs of prescription drug misuse. In recent years, clinical pharmacy has significantly expanded its scope and professional responsibilities, becoming a critical component of interdisciplinary healthcare teams[1].

Clinical pharmacists now play a pivotal role in patient care, actively collaborating with physicians and interacting with patients to optimize therapeutic outcomes[2]. Their deep understanding of pharmacology and frequent communication with prescribers positions them as effective intermediaries between patients and doctors. This collaboration ensures high- quality, evidence-based patient care.

The integration of clinical pharmacists into healthcare teams represents a major advancement in the pharmacy profession, especially in areas such as expert medication management, pharmacovigilance, safety monitoring, and treatment optimization (fig 1) [3]. Often, clinical pharmacists accompany physicians during ward rounds, offering real-time recommendations and interventions as needed[4]. They critically evaluate prescriptions for appropriateness in terms of indication, dosage, duration, timing, and drug selection—taking corrective action when standards are not met.

Despite the absence of a definitive count of clinical pharmacists in India from the Pharmacy Council of India (PCI), it is estimated that around 1 million (10 lakh) registered pharmacists are currently serving in various capacities, including clinical roles.

With a growing number of Indian hospitals pursuing accreditation from the National Accreditation Board for Hospitals and Healthcare Providers (NABH)—whose standards are endorsed by the International Society for Quality in Healthcare (ISQua)—the demand for clinical pharmacists is increasing. These professionals are now recognized as vital contributors to evidence-based medicine and rational drug therapy[5,6].

Furthermore, clinical pharmacists are essential to the pharmacy practice departments of hospitals, where they not only contribute to improved health outcomes but also generate revenue through efficient pharmaceutical care. In the near future, clinical pharmacists are expected to play an even greater role in shaping and transforming the Indian healthcare system by strengthening its infrastructure, safety, and treatment standards[7].

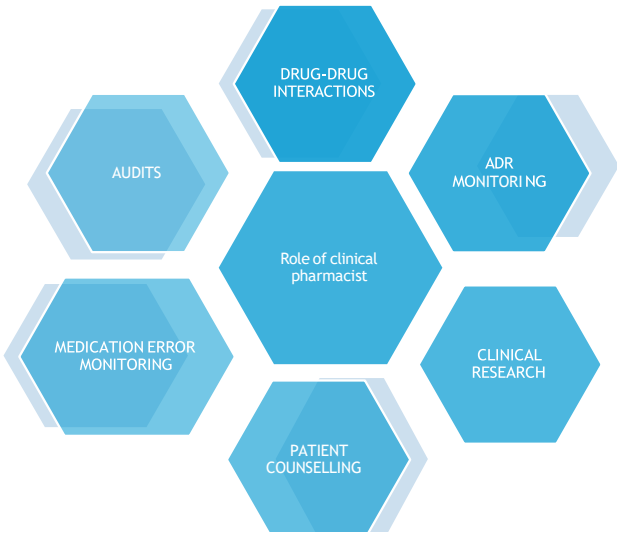

Figure 1: Roles of clinical pharmacist

Audit

Medical audit is in charge of making sure these requirements are followed in caregiving process. Establishing guidelines and using performance reviews to evaluate the calibre of care has to be a regular aspect of clinical practice. The study of prescribing patterns is the area of medical audit that aims to track, assess, and, if required, recommend changes to physicians' prescribing procedures in order to make medical care more economical and logical. Prescription auditing is a component of "drug utilisation" studies[8]. The World Health Organisation and the International Network for Rational usage of Drugs have collaborated to create standard drug usage indicators and data gathering methods. After realising the enormous potential of drug utilisation studies in promoting rational drug therapy. audits conducted by other professional groups, either independently or in collaboration, are becoming more and more important[9]. Since they usually keep track of their contributions to appropriate prescribing practices, pharmacist might play a significant role in the audit process. Including medication specialists in an audit of a medical procedure that involves drug use offers clear advantages as well, like aiding in process improvement[10].

Drug drug interactions:

According to the findings, hospital medical errors cause between 44,000 and 98,000 deaths each year. Medication errors are a significant subset of all medical errors, according to the IOM[11]. Moreover, pharmacological dis adventuring has a significant financial cost. In 1995, Johnson and Bootman calculated the direct costs of drug-related morbidity and mortality to be $76.6 billion using a decision analysis model and an expert panel[12]. According to an updated examination of this model, the direct costs of pharmacological mis adventuring increased to $177.4 billion in 2000. With $145 billion spent on prescription drugs overall, for every dollar spent on the drugs themselves, more than $1 is spent on direct medical expenses associated with drug mishaps[13].

Medication errors, a type of medical error, are responsible for nearly 7,000 deaths in the US yearly. However, the exact number of these errors resulting specifically from drug-drug interactions (DDIs) remains unknown[14]. DDIs can lead to severe health complications, often requiring extensive medical intervention. For example, one documented case involving a combination of fluoxetine and selegiline highlights the potential severity of such interactions. The patient experienced serious adverse effects that necessitated a 15-day hospitalization, multiple emergency room visits, *MEDICATION ERROR: A SYSTEMATIC REVIEW AND COMPARIOSON OF REPORTING SYSTEM IN USA, UK AND INDIA, n.d.)* ambulance services,

magnetic resonance imaging (MRI), an electrocardiogram (ECG), laboratory testing, and specialist consultations. The total cost of managing the complications from this single interaction-induced illness amounted to $17,213.60. This case underscores the significant clinical and economic burden that DDIs can impose on both patients and healthcare systems[16]. While medication errors are recognized as a leading cause of preventable harm, the lack of precise data on the role of DDIs in these incidents presents a major challenge in improving drug safety and optimizing therapeutic strategies in clinical practice.

A fragmented healthcare system, multiple prescribers per patient, an ageing population, and complex medication regimens in outpatient care all contribute to a higher risk of serious drug- drug interactions (DDIs)[17]. Clinical pharmacists depend on their understanding of interactions and distributing software to find possible DDIs. Furthermore, clinical pharmacists have led the way in using technology intended to lower medication-related errors, such as DDIs. To detect possible drug therapy issues and avoid adverse events, including DDI, the majority of pharmacies employ in-store prospective drug utilisation review (PDUR) software, which offers a real-time[18], concurrent review of medication regimens. Furthermore, a large number of claims processors and pharmacy benefit managers (PBMs) use online concurrent PDUR software that offers medication regimen reviews[19]. The ability to analyse all patient pharmaceutical claims—not just those submitted by a specific pharmacy or chain—is one benefit of PBM-initiated PDUR.

The role of clinical pharmacists in hospitalised patient care has changed, placing more of a focus on collaborative treatment and patient contact. ADRs, adverse drug events, health- related quality of life, economics, medication appropriateness, and patient satisfaction are all included in clinical pharmacists interventions.

Table 1: Adverse drug reactions

Based on Mechanism (ABCDEF Classification)

Type	Name	Description	Example
A	Augmented	Dose-dependent, predictable from known pharmacology	Hypoglycemia from insulin
B	Bizarre	Not dose-dependent, unpredictable (idiosyncratic/allergic)	Anaphylaxis from penicillin
C	Chronic	Related to long-term use	Adrenal suppression from steroids
D	Delayed	Occurs after some time, even after stopping drug	Carcinogenesis from chemotherapy
E	End-of-use	Withdrawal reactions	Opiate withdrawal symptoms
F	Failure	Unexpected failure of therapy (often due to interactions)	Resistance to antibiotics

Based on Severity

Type	Description	Example
Mild	Requires no or minimal treatment	Mild rash
Moderate	Requires change in therapy, may need treatment	Persistent vomiting
Severe	Life-threatening, causes disability or hospitalization	Steven-Johnson Syndrome
Lethal	Directly or indirectly causes death	Fatal anaphylactic shock

Based on Immunological Mechanism (Gell and Coombs Classification)

Type	Mechanism	Example
Type I	IgE-mediated (Immediate)	Anaphylaxis from penicillin
Type II	Cytotoxic (IgG or IgM mediated)	Hemolytic anemia
Type III	Immune complex mediated	Serum sickness
Type IV	Delayed-type (T-cell mediated)	Contact dermatitis

Patient counselling

One definition of patient medication counselling (PMC) is "giving patients or their representatives written or verbal medication information or advice on side effects, storage, diet, and lifestyle changes[20], as well as appropriate usage instructions." Providing suitable and sufficient PMC could assist chemists in recognising and resolving drug therapy issues[21], including patients in disease self-management, preventing treatment failure, and minimizing resource waste. Pharmacists' delivery of these patient-centered services is still emerging in developing nations like Nigeria in contrast to developed ones[22].

Some countries require prescription medication coverage (PMC) under enabling laws (fig 2). Failure to submit PMC might lead to financial fines. Despite rising interest in the quality and acceptability of patient counselling in clinical pharmacists frequently fail to provide accurate and complete medication information to patients[23]. Although tough pharmaceutical care is becoming the norm in Nigeria, many chemists still offer insufficient patient-centered services, such as PMC. According to Abdu-Aguye et al., this could be attributed to professional complacency, institutional shortcomings, and insufficient health-related human resources[24]. There are no PMC policies, rules, incentives, or standards in the country. To increase PC, rate The Pharmacy Council of India (PCI) and the National Universities Commission require undergraduate students to learn communication skills and patient counselling through externships and clerkships in hospitals. This is also featured in a session for community and hospital pharmacists in the PCI's Mandatory Continuing Professional Development program. Various professional organisations in the US and Australia have produced counselling guidelines, with variable substance. Several studies have studied chemists' use of counselling guidelines, the frequency of verbal counselling with author-defined content, and the content of verbal counselling[25].

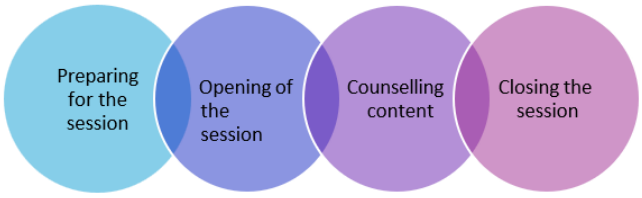

Figure 2: Steps of patient counselling

Anti-Microbial Stewardship programme:

Multidrug-resistant infections can cause significant morbidity and mortality among hospitalised patients. In

2019, MDR pathogens caused approximately 4.95 million deaths worldwide, with Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Streptococcus pneumoniae, Acinetobacter baumannii, and Pseudomonas aeruginosa being the most common culprits[26].

Carbapenem-resistant gram-negative bacteria, including A. baumannii and Enterobacterales, are a major concern in the United States, Europe, and Asia-Pacific. During the age of MDR pathogens, Active antibacterial drugs are becoming increasingly scarce. To tackle MDR pathogens, multiple measures must be implemented, including enhanced infection prevention and control, antimicrobial stewardship, active surveillance, and the discovery of novel antimicrobial drugs[27]. In developed countries like the US[28], the ASP team should include multidisciplinary healthcare professionals such as infectious diseases physicians, clinical pharmacists, infection control nurses, and clinical microbiologists to influence appropriate antimicrobial prescriptions. Including a pharmacist in the ASP team improves antibacterial efficacy, prescriptions and reduction in antimicrobial consumption, hospital antimicrobial cost, and length of stay. Several research from throughout the world have shown that clinical pharmacist-led therapies are effective[29].

Interventions included conducting a prospective audit and feedback, educating healthcare professionals, developing treatment guidelines for specific infections (e.g., Staphylococcus aureus and Clostridium difficile), encouraging penicillin allergy delabeling, and facilitating real-time pathogen identification and feedback to physicians[30]. The infectious diseases (ID) pharmacist is an excellent role model for pharmacist-led ASP interventions. Several studies have shown that ID pharmacist-led ASP therapies are successful. Clinical-pharmacist-led therapies have been most effective in high-income countries including the US, Canada, Australia, and Japan, as well as Europe[31].

Medication error:

medication errors (ME) are preventable events that can result in incorrect pharmaceutical usage or patient damage while under the control of healthcare professionals, patients, or consumers. ME refers to any medication-related error, regardless of whether it resulted in injury or the risk for injury. Some MEs don't cause injury, while others are detected before harm happens ("near-misses")[32]. MEs can occur at any stage of the drug-use process, including prescribing, dispensing, administering, monitoring, and recording[33]. Medication- related problems (MRP) are unfavourable outcomes of drugs that might harm people. Including pharmacists as part of the healthcare team enhances patient care by reducing medication mistakes (MEs) (fig 3). DW Bates (2007) found that chemists can accurately monitor error frequencies and near misses. Pharmacy interventions involve chemists making recommendations to healthcare providers to improve patient management or therapy. While pharmacists understand the meaning of intervention, other healthcare experts and hospital managers may have varying interpretations.

Documenting and measuring pharmacy interventions to avoid prescription errors may lead to increased appreciation for chemists among hospital administrators and risk management[34].

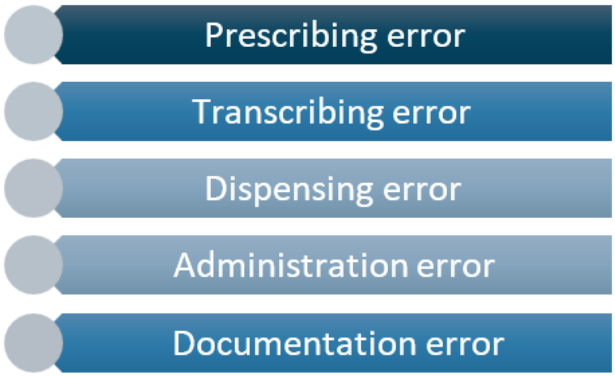

Figure 3: Types of medication error

Clinical pharmacists' function in research:

Even though India is the second most populous country in the world and has many hospitals, its contribution to clinical and epidemiological research is not particularly noteworthy worldwide. Indian doctors, nurses, and other healthcare professionals are mostly responsible for the current contribution.

The contribution of CPs to the research is now little because the idea of clinical pharmacy is still in its infancy. On the other hand, doctors are unable to fully participate to research due to their hectic schedules and heavy patient loads. Because of this situation, the nation lags behind other developed nations in producing high-quality data and research, less hospital data is published, and a significant amount of hospital data—such as rare case reports/case studies, retrospective studies, etc.—remains unpublished in journals. The presence of thesis work as part of the curriculum, sufficient hospital exposure, and familiarity with topics like pharmacotherapeutics, clinical pharmacy, hospital pharmacy, clinical toxicology, biostatistics, research methodology, clinical pharmacokinetics, pharmacoeconomics, etc. are characteristics of CPs with regard to research. The presence of CP will create new research opportunities in India for Pharmacoeconomics, clinical research, patient reported outcomes, quality of life, clinical pharmacokinetics and other areas. Physician nurses and other health care providors may help India to produce enormous amount of data.

Medical writing

"Medical communication" or "scientific writing" are other terms for this. Medical writing entails creating healthcare materials for various audiences and purposes[35]. Medical writers are needed in various industries, including pharmaceutical and healthcare companies, contract research organisations, BPOs/KPOs, healthcare communication companies, media and publishing

companies, medical journals, and medical societies[36]. Competent medical writers possess domain expertise, strong language and grammatical abilities, and the ability to quickly analyse medical facts. Many Indian CROs, BPOs, KPOs, and pharmaceutical corporations are increasingly hiring medical writers[37].

Medical coding:

Medical coding, often known as medical classification, is the process of turning medical diagnoses and procedures into globally recognised codes. These codes are used in various sectors, including medicine, public health, and medical informatics, for statistical analysis and reimbursement. India currently has multiple medical coding firms[38].

Medical transcription:

Medical transcription involves typing doctor's reports from audio recordings that have been dictated. In afluent countries, health practitioners dictate their operations to medical transcriptionists, who then transcribe and edit the reports. Patient-specific health information is documented in textual form and stored in print, electronic, or patient record files. Speech recognition software is increasingly employed in medical transcribing to improve accuracy. Hospitals may engage medical transcriptionists or outsource the task[39]. Currently, India has numerous medical transcribing companies. Currently, limited hospitals in India are recruiting MTs. MTs require strong understanding of medical terminology, illness conditions, anatomy, physiology, and pharmacology, as well as proficiency in medical language and grammar, typing, and excellent communication skills[40].

Clinical research and drug development:

Both of these are relevant to clinical trials. There are many clinical research organisations in the country. CPs can work in clinical research organisations as clinical research coordinators, clinical research associates (CRAs), research statisticians, or higher-level jobs with relevant experience. CPs can serve as main investigators and patient educators in clinical trials[41]. Pharmacists can help patients take part in clinical trial research. Working in a clinical research organisation necessitates knowledge of statistical, medical, and pharmacologic terminology, pharmacovigilance, meticulous documentation, and the ability to travel regularly (especially for CRAs) [42].

Prescription audits using artificial intelligence:

With its rapidly growing uses in a variety of industries, including clinical pharmacy, artificial intelligence (AI) has emerged as a disruptive force in the healthcare industry. AI systems in clinical pharmacy are intended to help pharmacists and medical professionals to provide effective, efficient, and individualised patient care[43]. Machine learning, natural language processing, and predictive analytics are used in AI systems to optimise workflows, improve patient outcomes, and reinforce decision-making processes.

With the help of these tools, chemists may analyse enormous volumes of patient data to reduce risks, make better judgements, and create individualised treatment plans. Clinical pharmacy AI applications fall into a number of important categories[44]. Medication safety is among the most important. Another important area that AI has identified is drug adherence, which is being improved by AI-driven systems[45] that monitor medication use patterns and offer tailored interventions to increase patient compliance. Incorporating AI into these clinical pharmacy domains not only enhances drug safety and effectiveness but also facilitates pharmacy operations, lessening the workload for medical personnel[46].

The quick development and application of AI technologies in clinical pharmacy is indicative of the healthcare system's continuous transition to a more precision-based, data-driven approach. AI's potential uses in clinical pharmacy are expected to grow as it develops further, offering chances to raise the standard of patient care and safety even more[47].

Prescription Review & Analysis

Task	Description
Error Detection	Identify incomplete or incorrect prescriptions (e.g., missing dosage, frequency, route).
Drug-Drug Interaction Check	Detect potentially harmful drug interactions.
Drug-Allergy Check	Compare prescribed drugs with known patient allergies.
Duplicate Therapy Detection	Flag multiple drugs from the same class unnecessarily prescribed.

Clinical Decision Support

Task	Description
Dose Optimization	Suggest appropriate doses based on patient factors (age, weight, renal function).
Therapeutic Alternatives	Recommend safer or more cost-effective alternatives.
Guideline Adherence Check	Ensure prescriptions align with standard treatment guidelines.

Data Mining & Pattern Recognition

Task	Description
Prescribing Trends Analysis	Identify overused or underused medications.
Polypharmacy Detection	Analyze for excessive simultaneous drug use, especially in elderly patients.
Outlier Detection	Spot unusual prescribing patterns that may indicate errors or malpractice.

Documentation & Compliance

Task	Description
Legibility/ Transcription Audit	Use OCR and NLP to digitize and interpret handwritten or scanned prescriptions.
Regulatory Compliance Check	Validate that prescriptions comply with legal standards (e.g., Schedule H drugs).
Audit Trail Generation	Automatically generate logs and reports for review.

Cost & Resource Optimization

Task	Description
Cost Comparison	Suggest lower-cost therapeutic equivalents.
Inventory Forecasting	Use prescription data to predict future drug demand.

Quality Improvement & Reporting

Task	Description
ADR Reporting Automation	Flag patterns suggestive of adverse drug reactions.
KPI Tracking	Monitor key indicators (e.g., % of guideline-compliant prescriptions).
Dashboard Creation	Visualize audit results for continuous quality improvement (CQI).

Commercial & Clinical AI Tools Used in Prescription Audits

AI Tool / System	Developer / Provider	Key Features
Watson for Health	IBM	AI-powered clinical decision support, drug interaction checks, and treatment optimization.
Medi-Span Clinical APIs	Wolters Kluwer	Drug-drug interaction checks, dose checking, allergy screening.
First Databank (FDB)	FDB (part of Hearst Health)	Clinical decision support including medication safety alerts.
Cerner Millennium	Cerner (Oracle Health)	EHR system with embedded AI for prescription safety checks.
Epic Systems	Epic	Includes AI modules for alerts on drug interactions, dosing, allergies, and clinical guidelines.
PharmaLex	PharmaLex Group	Offers pharmacovigilance and audit tools with AI features.

In 2008, India introduced the Doctor of Pharmacy (PharmD) degree, which sparked intense debates over the program and the function of clinical pharmacists (CPs) in the nation. Prior to the start of the study program (PharmD), the majority of people in the country believed that a pharmacist's job was to "dispense, manufacture, and market the drugs." The majority of the instruction was provided as part of the Master of Pharmacy (M. Pharm) program (Pharmacy Practice/Clinical Pharmacy). Additionally, the nation has "almost no" professional clinical pharmacy services (CPS) available. The ideas of CP and PharmD are therefore relatively new in India.

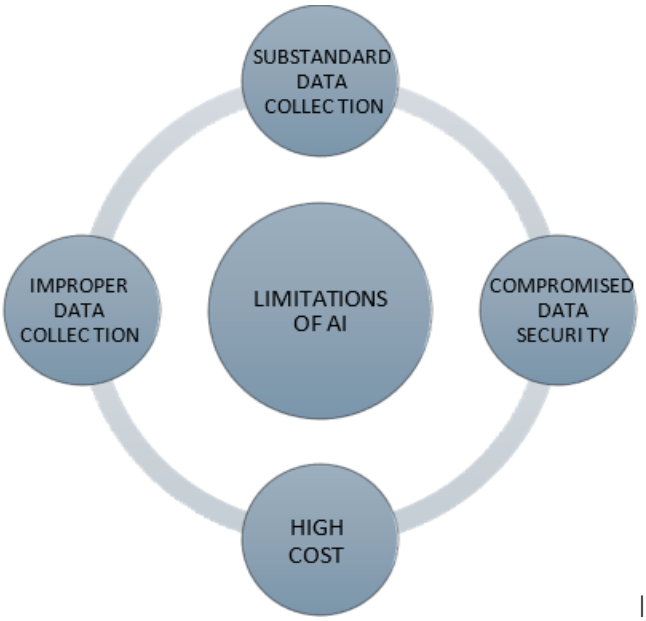

Figure 4: Limitations of Artificial Intelligence in clinical pharmacy

Robotic data collection of clinical information may be compromised and utilised maliciously, reducing security and privacy. Some social networks collect and retain a lot of user data—such as mental health information—without the users' consent, which can be useful for these businesses' marketing, sales, and advertising. Additionally, some unlicensed and poorly regulated genetics testing and bioinformatics businesses sell client information to biotechnology and pharmaceutical firms. Implementing AI can be very costly which may increase the healthcare cost. Audits generated by AI cannot be completely relied on[48].

Why Clinical Pharmacists are Required

Clinical pharmacy focuses on identifying, addressing, and preventing drug-related issues. A drug-related difficulty is described as "an event or circumstance involving drug therapy which actually or potentially interferes with desired health outcomes."

A clinical pharmacist can evaluate drug-related issues in primary care, nursing homes, and hospital interdisciplinary teams, among other contexts. The number of drug-related issues resolved or avoided, or the clinical results for the patients, can be used to gauge the contribution to drug therapy optimisation. These measurements are direct and indirect, respectively, with the latter offering the strongest proof.

Research indicates that most drug-related issues (between 50 and 80 percent) can be avoided. Clinical chemists' interventions to solve or avoid drug-related problems are widely accepted and followed by prescribers. An acceptance rate of 41–96% has been reported. Direct

measurement of the influence of clinical pharmacists is based on observations of the patient's clinical outcomes. Preferably, hard endpoints such as mortality, disease occurrences, and disease prevention should be assessed. These end-points are for practical reasons difficult to assess in clinical practice and research.

Interventions and Adherence

Clinical pharmacists will counsel the patient before discharge and will make sure that the patient is well aware about the drug, frequency, dose and timing. Pharmacist will also talk about the importance of the drug which will motivate the patient to take drug without missing any dose. The whole counselling process will be done in a simple and understandable language.

The counselling needs understanding and empathy towards the patient, which will lack in AI.

Medication Error Monitoring

Clinical pharmacist can identify the error that is happening in real life scenario. Example: 12 o'clock drug is getting administered at 3 o'clock, which can be manipulated and entered in the system at the time of auditing.

The Foundation and Operational Ethics of Pharmacy Practice for Indian Outpatients

In India, the Clinical Establishment Act of 2010 defined a clinical facility, maternity home, nursing home, dispensary, hospital, sanatorium, or any other type of facility that offered services. Pharmacy practice includes dispensaries, which are defined as the analysis (interpretation, evaluation, and implementation) of medical orders, prescription dispensing, and drug orders.

Clinical pharmacists must take part in the selection of medical devices and medications, administer medications, review patient dosage regimens, conduct medication-related research, counsel patients, and intervene where pharmaceutical care is needed in all facets of patient care, including primary care.

Applying Pharmacy Practice Principles Was:

Clinical pharmacists were responsible for ensuring patient prescriptions were safety, effective, and economical. It was determined by interpreting, assessing, and carrying out the prescription in accordance with the patient's condition and the results of the lab investigation. A clinical pharmacist's primary duty is to provide patients with medication and disease education.

The DIPh (Drug Information Pharmacist) is responsible for providing the public and healthcare providers with necessary drug and poison information. Provide affordable prescription drugs. Drug Administration and Health Promotion. The clinical pharmacist's professional duty was to conduct medication-related research.

Clinical Pharmacists' Needs in Society for Outpatients

The clinical pharmacy service provided by pharma doctors is a vital component of society for our patients. Patients with chronic diseases, such as diabetes mellitus (DM), hypertension (HTN), coronary heart disease, chronic renal failure (CRF), thyroid disease, cancer, HIV, etc., may also require multiple treatments and medications. These medications may interact with one another, which could result in drug-drug, drug-lab, drug-disease, drug-food, and drug- alcohol interactions losing their therapeutic activity.

Additionally, patients may become confused about the administration of medications for multiple treatments; to overcome these obstacles, patients must be knowledgeable about drug administration. Clinical pharmacists are knowledgeable about medications and will help patients overcome pharmacotherapeutic obstacles by creating the safest, most effective, and most economical prescriptions. Giving patients information about medication adherence might enhance their quality of life and enable improved medication administration.

The public now uses allopathic medications on a daily basis. Our nation has a large number of pharmaceutical businesses, brands, and a mix of drugs. Drug and Poison Information Centres are necessary in outpatient clinical pharmacy practice to address the risk of drug confusion caused by the public's ignorance about novel combination medication administration for outpatients.

Creating a Clinical Pharmacy for Outpatients

Pharmacy practice refers to the interpretation, assessment, and application of medication administration and medical instructions.

- **Interpretation**: Drug relevant problems (DRP) such as drug relevant interactions, dosage and frequency adjustments, polypharmacy, cost-efficacy, and pharmacotherapy efficacy based on medication usage period are analysed in medication orders or prescriptions. These parameters are identified in the prescription, which then assesses the severity of DRP and gives the authorised prescription writer the appropriate advice on DRP severity.
- **Evaluation**: Prescription safety is enhanced and patient life expectancy is increased through evaluation of prescription orders, which has a positive economic impact on both IPD and OPD.

By establishing a clinical pharmacy with the support of appropriate documentation, using medication-related medical software with knowledge of pharmacotherapy, therapeutic drug monitoring and pharmacokinetics, pharmacology, clinical pharmacy, etc. (as on Pharm.D syllabus), it is possible to implement medical orders by identifying DRP and advising the safest prescription to authorised practitioners.

The provision of improved clinical pharmacy practice is the crucial element. Clinical pharmacy practice also includes patient counselling, drug administration, and drug and poison information.

According to the 2015 Pharmacy Practice Regulation (PPR 2015), the opening of a clinical pharmacy for outpatients required certain equipment, document registers and forms, medical software and a different setup at the community pharmacy site.

Applying Pharmacy Practice Principles for Outpatients Was:

- Analysis of prescriptions in accordance with PPR 2015
- Medication, illness, and lifestyle modification counselling for patients
- Information on drugs and poisoning
- Research on medications
- Managing the programs for disease awareness and medication safety

Figure 5: AI Can Be Used for Better Patient Safety

Support for Clinical Decision Making

By evaluating patient data and medical literature, AI helps doctors make recommendations for tests, provide diagnostic advice, and guarantee that clinical guidelines are followed[49]. This assistance lowers the possibility of mistakes by assisting in the making of well-informed judgements. For example, when making decisions, (fig 5) it can remind medical professionals of pertinent clinical guidelines and best practices[50].

Management of Medication

AI tools assist in reminding patients, monitoring prescriptions, dosages, and schedules, and warning medical professionals about possible drug interactions or adverse effects.

This proactive strategy reduces the hazards associated with improper pharmaceutical usage and improves medication adherence[51].

Remote Patient Monitoring (RPM)

Early identification of possible health problems is made possible by AI-powered devices that remotely monitor patients' vital signs and health indicators. AI can detect irregularities and notify medical professionals, enabling prompt actions, by evaluating data from wearable technology and sensors[52].

Documentation in Clinical Practice

By creating draft notes and transcribing patient-clinician exchanges, AI expedites the clinical recording process. This lessens the administrative load on medical staff, freeing them up to concentrate more on patient care and improving safety in general[53].

Health Education and Assistance

Patients may easily access information about their medical issues, available treatments, and preventative actions thanks to AI tools. AI helps patients make educated decisions by providing individualised education and assistance, which improves health outcomes.

Follow-Up After Discharge

AI helps with post-discharge patient monitoring by offering advice on recuperation, spotting any issues, and determining when to seek additional medical care. This ongoing assistance keeps patients safe during their recuperation and helps to avoid readmissions.

Help with Diagnosis

AI analyses patient data and medical records to help discover difficult or uncommon illnesses. As seen by instances when AI assisted in identifying ailments that medical professionals had previously missed, this support can result in earlier and more precise diagnoses[54].

Limitations

Underutilisation and Restricted Practice Area

Many clinical pharmacists are limited to traditional responsibilities like administering drugs, even with advanced training. Underutilisation of their abilities and experience occurs in the public health sector due to the lack of standardised frameworks and clearly defined positions. Their capacity to successfully contribute to patient care and public health activities is hampered by this constraint.

Absence of Awareness and Recognition

The public and medical professionals generally don't know enough about the role of clinical pharmacists. This false belief frequently minimises pharmacists' potential contributions to patient care by reducing them to the role of merely dispensing drugs. Their recognition is further

hampered by the prevalence of clinicians in the healthcare industry and the lack of efforts by regulatory bodies to require clinical chemists to work in the public sector.

Gaps in Education and Training

Due to a lack of clinical training and clear goals, the current Pharm.D. program produces subpar results. Many graduates have not participated in any training programs designed to enhance their professional abilities after graduating from college. One of the reasons for these shortcomings is that pharmacy schools do not have clinical preceptors with clinical expertise.

Insufficient Knowledge and Acceptance

The function of clinical pharmacists is not well understood by medical experts. As a result, there is a lack of collaboration and acceptance, some physicians view chemists as encroaching on their space rather than as collaborators in patient care.

Limitations on Resources

The infrastructure and resources necessary to support clinical pharmacy services are lacking in many hospitals, particularly those located in rural locations. Inadequate room for patient counselling and a lack of trained pharmacists to efficiently handle the patient load are two examples of this.

Policy and Economic Barriers

Patients' financial burden is increased by the Indian healthcare system's reliance on private health insurance and self-financing, which may result in inappropriate pharmaceutical use. Clinical chemists' ability to optimise drug therapy is limited by government policies that frequently place greater emphasis on laws pertaining to the pharmaceutical sector than on safe medication use.

CONCLUSION

A subset of pharmacy practice is clinical pharmacy. A clinical pharmacist is a practitioner of clinical pharmacy. Clinical pharmacy services were required for both inpatient and outpatient settings. Although it is well managed by the pharmacists, AI has come up with many new technologies to make the work easier—but AI cannot be totally reliable. A human volunteer is always needed to monitor the results. Based on the above studies, AI cannot replace the role of clinical pharmacists.

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