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Artificial Intelligence: The Next Frontier in Pharmacy Automation and Drug Dispensing

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ABSTRACT

The integration of artificial intelligence (AI) into various healthcare domains has revolutionised traditional practices, such as medication work. This section looks on the use of AI in trade activities for medicine dispensing, with an eye towards how it might improve performance and safety in medical settings. Through the analysis of patient data, including medical history, allergies, and medication interactions, artificial intelligence (AI) technologies like machine learning and natural language processing are being used to enhance drug dispensing procedures. By guaranteeing proper medication administration, AI systems can assist chemists in making well-informed judgements regarding drug delivery dosage adjustments and medication reconciliation, which not only reduces the possibility of mistakes but also enhances patient outcomes. However, AI-powered automation tools enhance pharmacy inventory management and prescription fulfilment operations. These systems can estimate medicine request reminder stock levels and automate refills, minimising waste and stock outs while also ensuring that patients have easy access to critical prescriptions. AI dramatically increases patient safety when delivering medications. This proactive approach lowers the likelihood of prescription errors, which results in fewer hospital readmissions and antagonistic drug events. However, concerns like data privacy, algorithmic program bias, and regulatory conformance must be addressed in order to fully realise the benefits of AI in medicine dispensation. Lastly, the use of AI in medication dispensing procedures has great potential to luxuriate productivity and security in the medical environment. AI systems can detect potential adverse drug reactions, drug interactions, and dosage errors in real time, notifying healthcare providers and enabling them to substitute promptly.

Keywords: *pharmacy automation; artificial intelligence; dispensing robotic technologies*

1. INTRODUCTION

Over the last 25 years, pharmacies have performed a tremendous job meeting the Affordable Care Act's prescription demand. Additionally, it has performed a fantastic job of boosting work flow efficiency and lowering operating costs. Enhancing productivity, accuracy, and safety in every pharmaceutical setting.[1] Artificial intelligence (AI) is a technology that is being introduced into patient care to allow healthcare providers to spend more time with multiple patients.[2] In general, artificial intelligence (AI) in healthcare is described as technology that makes use of algorithms and software to assess human cognition in the examination of intricately medicated data.[3] Artificial intelligence's primary goal is to decipher the

connections between patient outcomes and diagnosis methods.[4] The application of algorithms and software to approximate human attention or awareness in the assessment of complex medical data is known as artificial intelligence (AI) the context of health. There is enormous degree of individual healthcare. Another name for artificial intelligence is "machine intelligence," which helps process massive volumes ofboth organized and unstructured data to provide intelligent and precise judgments. Specifically, the abilityof algorithms to draw judgments without clearcut human input is known as artificial intelligence (A I).[5] There are three main categories of artificial intelligence (AI).

They are:

a) Algorithms made by humans

b) AI

c) In-depth analysis

Artificial intelligence (AI) has the potential to improve decisionmaking by analyzing data and presenting the findings in a way that saves time, money, and human labor while potentially saving.it.Artificial intelligence (AI) has the potential to imp rove decisionmaking by analyzing data and presenting the findings in a way that saves time, money, and human labor whil e potentially saving lives.[6] Artificial intelligence (AI) is in opposition to humans, who lack the capacity to handle vast amounts of data quickly. Using natural language processing techniques (NLP) and algorithms, they function by deeply culturing large data sets.[7] NLP enables computers to analyze and use human language to carry out activities that would otherwise require human intervention.[8] Artificial intelligence, which was tamed by strict laws and regulations, has a radical impact on industry.[9] The regulatory environment has a significant impact on the financial and health care sectors, which significantly impact the lives of the general public. Rules are designed to protect more financial matters in the financial industry, whereas in the healthcare industry, these restrictions are meant to protect every part of patient cases.

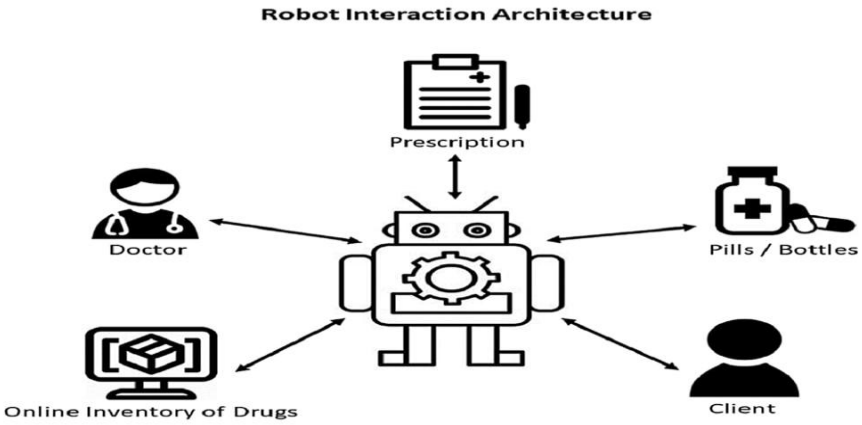

Fig 1: Architecture for Robotic Interaction

2. IMPORTANCE OF DRUG DISPENSING

A major global health concern, medication errors including dispensing errors have a profound impact on morbidity, mortality, and financial expenses. For dispensing verification, pharmacists employ techniques like barcode scanning and double-checking, however these approaches have drawbacks.[10] Pharmacy automation, which uses digital technologies and artificial intelligence (AI) like robotics and automated dispensing systems to improve medication distribution, reduce errors, manage inventory, and improve patient safety, is becoming a game-changer in healthcare and improving patient outcomes.[11] Pharmacists may make precise, evidence-based healthcare judgments with the use of tools and systems made possible by the integration of AI technologies. Pharmacists can analyse a lot of patient data, such as lab results, medication profiles, and medical records, by using AI algorithms and machine learning. This helps them determine whether a drug may interact with another drug, evaluate the safety and effectiveness of medications, and provide well-informed recommendations based on the needs of each patient.[12]

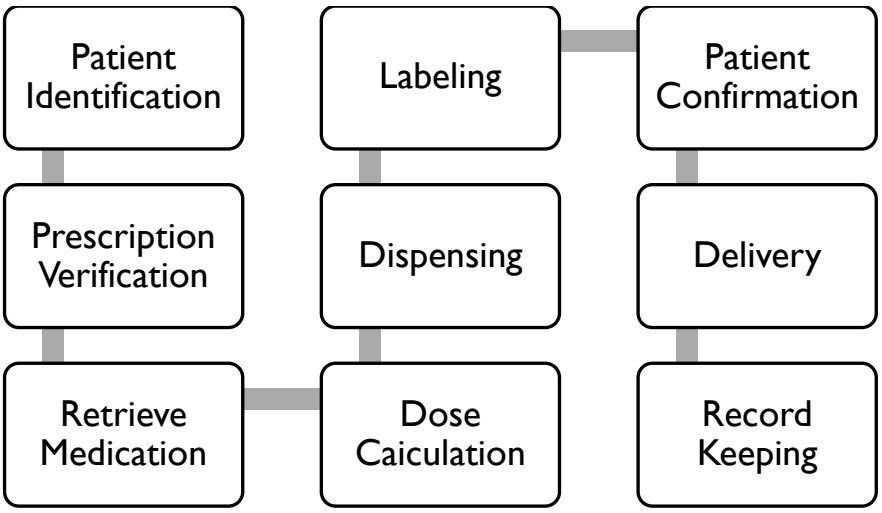

Fig 2: Importance of AI in Drug Dispensing

The Significance of Correct Medication Dispensing:

Patient safety and treatment effectiveness greatly depend on accurate medication dispensing. Mistakes in the administration of medications may result in unfavorable drug reactions, unsuccessful therapy, or even death. Research has indicated that mistakes with medications happen often when they are being dispensed, which highlights the importance of strict quality control procedures. By paying close attention to details, utilizing technology like barcode scanning and automated dispensing systems, and conducting verification procedures, chemists and pharmacy technicians play a critical role in guaranteeing accurate distribution.[9]

Efficiency and Timeliness in Drug Dispensing:

Efficient drug dispensing is essential for meeting the healthcare needs of patients in a timely manner. Delays in medication dispensing can result in patient dissatisfaction, exacerbations of symptoms, and prolonged hospital stays. Streamlining dispensing workflows, optimizing inventory management, and leveraging digital solutions can enhance the efficiency of the dispensing process. Additionally, collaboration between healthcare providers and pharmacists facilitates seamless communication and coordination, minimizing delays in medication access.[13]

Patient Education and Counseling:

Beyond dispensing medications, pharmacists play a crucial role in educating patients about their prescribed drugs, including proper usage, potential side effects, and adherence strategies. Patient counseling sessions empower individuals to make informed decisions about their treatment regimens, fostering medication adherence and therapeutic outcomes. Furthermore, pharmacists serve as valuable resources for addressing patient concerns, clarifying medication instructions, and promoting health literacy within the community.

Integration of Technology in Drug Dispensing:

Technology has completely changed how drugs are dispensed, improving precision, effectiveness, and patient involvement. Prescription processing and inventory control are made easier by automated dispensing systems, electronic prescribing platforms, and pharmaceutical management software. Remote drug dispensing is made possible by telepharmacy services, which increase access for rural and underprivileged people. Additionally, real-time contact between pharmacists and healthcare providers is made possible by electronic health records, guaranteeing thorough drug management and continuity of care.

Regulatory Considerations and Quality Assurance:

The World Health Organization (WHO) and the Food and Drug Administration (FDA) are two regulatory bodies that set criteria and recommendations to guarantee the quality, safety, and effectiveness of drugs given to patients. To maintain adherence to legal mandates and Good Manufacturing Practices (GMP), pharmacies are subject to stringent inspections and audits. Risk reduction and upholding high standards of pharmaceutical treatment depend on quality assurance procedures, such as routine medication reconciliation, error reporting systems, and staff training initiatives.

The Role of Drug Dispensing in Public Health:

Effective drug dispensing promotes broader public health initiatives by promoting medication adherence, reducing prescription errors, and reducing medical costs related to medication-related problems. By facilitating access to essential

pharmaceuticals and expediting medication management processes, drug distribution supports disease management programs and population health outcomes. Additionally, chemists play a crucial role in public health programs like vaccination drives and pharmaceutical therapy management programs that try to improve health outcomes and lessen the burden of chronic diseases.

Last but not least, medicine dispensing is a fundamental aspect of healthcare delivery that has a significant impact on public health, therapeutic effectiveness, and patient safety. Optimizing pharmaceutical therapy outcomes and guaranteeing the best possible patient care requires precise and effective dispensing procedures, patient education, and technological integration. Regulatory supervision and quality control procedures are essential to maintaining pharmaceutical safety and quality requirements. To advance the area of drug distribution and enhance health outcomes for people and communities globally, it will be crucial to maintain an emphasis on innovation, teamwork, and patient-centred care going forward.[14]

3. CONVENTIONAL METHODS

1. BCMA System:

Hospital prescription drug delivery is made less likely by human error with the use of the Barcoded Medication Administration (BCMA) inventory control system, which employs barcodes. By electronically authenticating and documenting drugs, BCMA aims to ensure that patients are receiving the right prescriptions at the right time. Barcodes provide information that makes it possible to compare the medication being given to the patient's order.[15]

A mobile computer (with Wi-Fi), a computer server, software, a barcode printer, and a barcode reader make up a BCMA system. All hospital medications have individual barcodes on their labels. The hospital's pharmacy receives prescriptions from patients, which are then input into a computer and faxed, electronically sent, or delivered by hand. The drug's barcoded dosage is given by the pharmacist to the patient on their floor. The clinician uses a handheld device to scan the barcodes on the drug, the patient's wristband, and his identification badge when it's time to give the patient their medication.[16] The barcode point-of-care (BPOC) system notifies the physician with a visual warning if it cannot match the drug to be administered with the order in the system. All of the essential details about a patient, including his prescription, are stored in his barcode.[17]

Objective: To ascertain how barcode medication administration (BCMA) affects the frequency of medication administration errors among patients in a day hospital specializing in onco-hematology and to pinpoint the traits of medication errors in that context.

METHODS AND VARIABLES: A pre-/postintervention, between-groups investigation was carried out. Prior to and following the introduction of BCMA, administration mistakes seen in patients with solid tumors (intervention group) were contrasted with those in patients with hematologic malignancy (control group). Along with the length of stay for therapy, the occurrence, kind, and severity of errors were evaluated. RESULTS: In the onco-hematology day hospital, the use of a BCMA system decreased the frequency and seriousness of medicine administration errors.[18] To ensure that the right medication is administered to the right patient in the right dosage at the right time via the right route, the BPOC system is designed to provide this assurance. We call this knowledge the "Five Rights.".

The Five Right of Barcode Medication Administration:

a. The right patient

b. The right medication

c. At the right time

d. At the right dose

e. By the right route

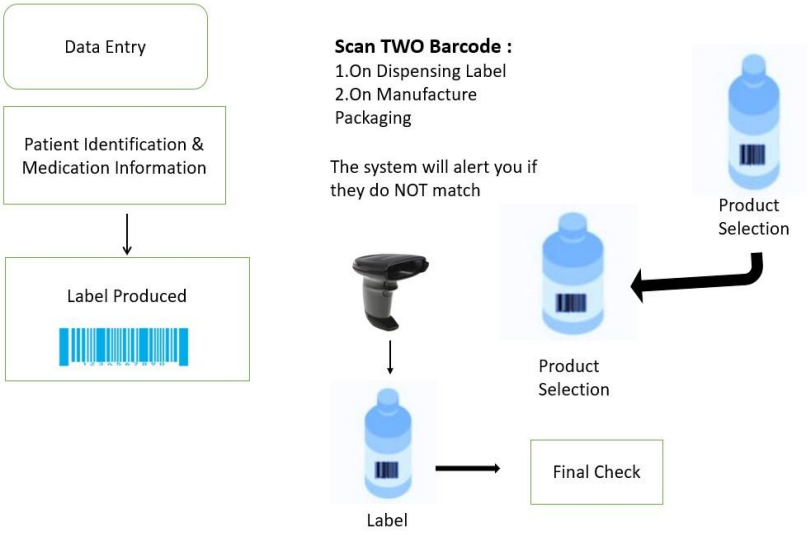

Fig 3: The Dispensing Workflow

2. Robotic Dispensing Systems:

Within the scope of a hospital pharmacy, a wide range of technologies are available that reduce prescription errors and missing medications, improving patient safety.[19] One of the most important technologies that significantly contributes to the development of hospital pharmacy systems is the pharmacy robot. According to a study, the pharmacy robot is nearly perfect at administering medications, and the right algorithm enables the use of the five rights.[20]

Objective: To determine how frequently medicine distribution errors occurred in an outpatient hospital pharmacy before and after a robotic original pack dispensing system was installed, and to assess how this system affected staff satisfaction and stock management quality.

Method: A disguised observation strategy was used to conduct a prospective before-and-after study on medication errors. A number of personnel satisfaction and stock management metrics were tracked. Technicians manually administered drugs using either the ROWA Vmax (ARX) dispensing robot (postimplementation phase) or a barcode-controlled system (preimplementation phase). Remaining manual dispensing was also employed because not all medications could be handled by the robot.

Result: The dispensing error rate decreased from 1.31% of prescriptions (43/3284) to 0.63% (19/3004) (945% CI: 17.3% to 71.8%; relative risk reduction [RRR], 51.7%). Excluding errors during residual manual dispensing reduced the error rate to 0.12% (3/2496) (RRR, 90.8%; 95% CI, 70.4% to 97.1%) or less. From 0.85% to 0.17% (RRR, 80.5%; 95% CI, 49.5% to 92.5%), the stock-out ratio was decreased. The median daily staff time in stock management decreased from 1 hour 36 minutes to 39 minutes, a 59.3% decrease. Staff satisfaction with this technique was good, however it was somewhat higher among pharmacists than technicians (8.63 ± 0.7 vs. 7.78 ± 0.7, P =.046).[21]

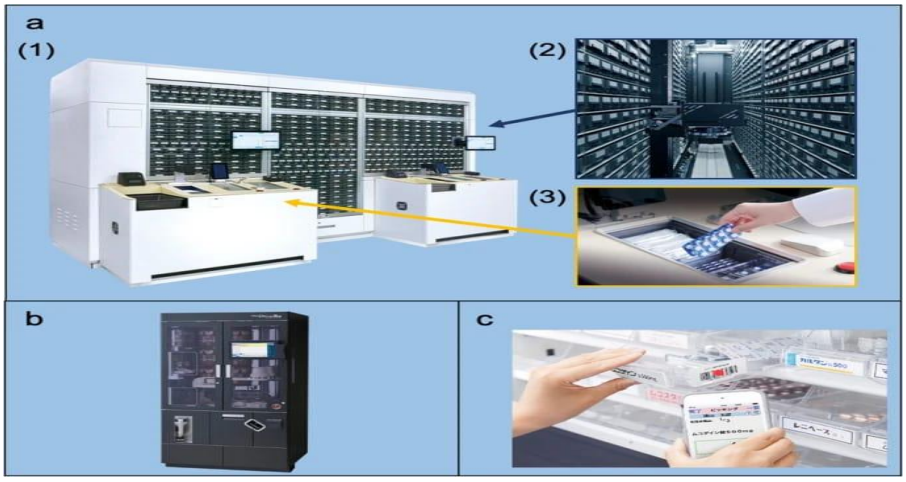

Fig4: Newly implemented dispensing devices

a) Automated dispensing robot, 1) outside view,2) storage bins and robotic arms ,3) slot

b) Automated dispensing robot for powdered medicine (Mini DimeRo)

c) Bar-coded medication dispensing support system with using PDA (Hp- PORIMS)

3. Natural Language Processing (NLP):

Objective: to assess the relationship between potentially unsuitable medications (PIMs) and possible prescribing omissions (PPOs) and insufficient pharmacological treatment, as well as to look into the clinical implications of these conditions.

Techniques: PIMs/PPOs were evaluated for clinical relevance for each patient after being concordantly identified by two physicians using the EU (7)-PIM list, the STOPP/START criteria, and a Swedish set in 302 consecutive older primary care patients. Before the next routine meeting, the doctors agreed on whether a medication-related measure was medically appropriate. If this was the case, the medication treatment was classified as inadequate; otherwise, it was deemed adequate.

Result:

Overall, there were 1010 PIMs/PPOs in 259 (86%) patients, of which 150 (15%) were deemed clinically significant in 81 (27%) patients (kappa: 0.26). Prior to the next routine visit, 75 (50%) clinically significant PIMs and PPOs were given priority for medical intervention. Acetylsalicylic acid (ASA) for primary prevention was the most frequently mentioned action-requiring clinically significant PIM (four out of 68 patients on ASA). Four out of 61 individuals with ischemic heart disease had matching PPOs using beta-blockers. Out of 259 individuals with PIMs/PPOs, 164 (63%) were deemed to have sufficient treatment when seen from a medical standpoint. Inadequate drug treatment was linked to the number of PIMs and/or PPOs as well as the number of medications in adjusted logistic regression.[22]

4. Machine Learning for Personalized Medicine: Patient Data Integration Machine learning models look at patient-specific data, including demographics, lifestyle factors, medical histories, and genetic information. Based on the analysis of patient data, machine learning algorithms for medication selection, dosage optimization, and therapy monitoring can generate tailored recommendations. Precision medicine aims to improve patient happiness, minimize adverse effects, and optimize therapeutic results by tailoring treatment regimens to each individual.[23].

5. Drug Interaction and Adverse Event Detection:

Data Monitoring: Artificial intelligence algorithms are designed to continuously scan real-world data sources, including pharmacovigilance databases, adverse event reporting systems, and electronic health records, for indications of possible drug interactions and unfavorable events.

Signal detection: By using sophisticated analytics techniques to find patterns, trends, and correlations in sizable data sets, it is possible to identify drug therapy-related safety issues early on.

Risk Mitigation: Healthcare providers can intervene quickly, modify treatment plans, and reduce risks to patient safety when drug interactions and adverse events are discovered early.

6. Decision Support Systems:

Clinical Guidelines Integration: To give physicians practical advice and alerts about medication prescription, dosage, and monitoring, decision support systems incorporate patient-specific data, medication databases, and evidence-based clinical guidelines.

Real-time Support: At the point of care, these systems provide real-time decision support to healthcare professionals, assisting them in making well-informed decisions regarding treatment planning and medication management.

Quality Improvement: By encouraging adherence to best practices, lowering medication errors, and improving clinical outcomes, decision support systems support efforts aimed at improving quality of care.

7. Telepharmacy and Remote Dispensing:

Remote Consultation: Through the use of video conferencing and other communication tools, telepharmacy services allow pharmacists to remotely review prescriptions, counsel patients, and impart medication-related knowledge.AI-enabled remote dispensing systems make it easier for patients in rural or underserved areas to receive medication and track their adherence.

Access to Care: By removing obstacles to in-person access and enhancing medication management and adherence, telepharmacy and remote dispensing increase access to healthcare services, especially in rural or remote communities.

4. APPLICATIONS OF AI IN DRUG DISPENSING

1. Drug Interaction and Adverse Effects: AI algorithms are able to identify possible drug-drug interactions, drug-food interactions, or allergies by analyzing Electronic Health Records (EHRs) and patient data. AI systems assist in reducing adverse drug events and preventing harmful drug interactions by giving pharmacists and healthcare providers real-time

alerts.[24]

2. Pharmacovigilance: The extensive dataset, identification of adverse drug reactions, possible safety issues, and improvement of patient safety. It improves the effectiveness and precision of processes for risk assessment and adverse event monitoring**.**

3. Medication Management: In the administration of medication and drug dispensing by maximizing dosage, determining the strength of drug interactions, and improving medication distinction through alerts and reminders. The pharmacies ensure patient safety by accurately dispensing medication and minimizing errors.[25]

4. Drug Discovery and Development: Artificial intelligence (AI) is used in drug discovery to evaluate molecular data, identify drug potencie, and analyze interactions between predicted drugs and targets. This is used to lower costs and enhance the quality of drugs. It makes the affinity higher.

5. Personalized Medicine: Genomic data can be analyzed using artificial intelligence (AI) techniques like machine learning and genetic algorithms to identify genetic variation linked to drug response and metabolism.AI models that have been trained on patient-specific data and treatment records are able to predict how a patient will react to various drugs and maximize the effectiveness of therapy**.[**26]

5. ADVANTAGES OF AI IN DRUG DISPENSING

1. Accuracy Enhancement:

To accurately dispense medications, artificial intelligence (AI) algorithms can analyze large amounts of patient data, including genetic makeup, medical history, and drug interactions. Artificial intelligence (AI) reduces human error to improve prescription accuracy and lower the risk of medication errors and adverse drug reactions (ADRs).[27]

2. Efficiency Improvement:

AI-powered solutions automate tedious processes like dosage calculations, inventory management, and prescription verification to expedite drug dispensing workflows. Because of this efficiency, medical staff can devote more of their attention to patient care, improving the quality of healthcare as a whole.[28]

3. Personalized Medicine: Machine learning algorithms can be used by artificial intelligence (AI) to analyze patient-specific data and tailor prescriptions for medications based on individual characteristics such as lifestyle, demographics, and genetics. Long-term patient results are enhanced by this customized strategy, which maximizes therapeutic efficacy and minimizes side effects.[29]

4. Drug Interaction Prediction:

Using extensive databases of medication profiles and patient data, artificial intelligence (AI) models are able to predict possible drug-drug interactions (DDIs). Informed decision-making and the prevention of adverse drug events are made possible by AI, which improves patient safety by identifying possible DDIs.

5. Real-time Monitoring and Feedback:

AI-enabled systems have the ability to continuously monitor how patients are responding to their medications, changing or adjusting dosages as needed. By ensuring prompt interventions and lowering hospital readmission rates, this ongoing monitoring guarantees optimal therapeutic outcomes.

6. Economic efficiency:

Artificial intelligence (AI) in drug dispensing lowers medication errors, prevents adverse events, and improves treatment plans, all of which result in significant cost savings for healthcare systems. Predictive analytics powered by AI can also assist healthcare providers in finding affordable treatment options and managing resource allocation more effectively.

7. Regulatory Compliance:

AI-powered medication dispensing devices can help ensure compliance with laws and regulations, including Good Manufacturing Practices (GMP) and the Health Insurance Portability and Accountability Act (HIPAA). AI assists healthcare facilities in maintaining compliance and reducing legal risks by automating documentation and guaranteeing adherence to protocol.

8. Robotics Use:

Robots in pharmaceutical manufacturing improve production efficiency and reduce contamination risk, allowing patients to obtain their prescriptions faster. In the pharmaceutical industry, robotics can increase productivity and reduce costs, which will ultimately lead to more widely available drugs. Even while wearing protective gear, robots outperform people in this field. Another way to cut down on patient wait times is to speed up the dispensing process.[30]

Fig5: Robotic dispensing machine

9. Robotic dispense machines:

Robotic dispensing machines can hold a variety of medications, precisely count pills and bottles, label prescription vials, and retrieve patient data. They also serve as medication dispensers for patients, following prescriptions, much like vending machines. This might result in closer observation, help with drug withdrawal, and stop prescription abuse.[31]

10. Continuous Learning and Improvement:

The ability of AI to learn and improve over time is one of its most compelling benefits when it comes to medication dispensing. Through the analysis of data from previous medication dispensing procedures, machine learning algorithms spot trends and gradually improve their decision-making algorithms. AI systems are able to improve their performance in medication management, integrate new evidence-based guidelines, and adjust to evolving healthcare environments thanks to this iterative learning.

11. Telepharmacy and Remote Dispensing:

Telepharmacy services which enable patients to get medications without physically visiting a pharmacy, particularly in underserved or distant areas are made possible by AI-powered drug dispensing systems. Through telepharmacy systems, patients can receive drug counselling, computerized prescription fulfilment, and virtual consultations with pharmacists. While maintaining the same level of quality and safety as traditional pharmacy services, this remote dispensing model makes medications more accessible, particularly for people with limited mobility or those who reside in rural locations.[32]

6. DISADVANTAGES OF AI IN DRUG DISPENSING

Artificial intelligence (AI) has advanced significantly in a number of industries, including healthcare, where it could completely transform the way that medications are dispensed. Like any technology, artificial intelligence has drawbacks when it comes to medication dispensing. The following are some major drawbacks:

1. Data Security and Privacy Issues:

AI systems used in medication dispensing significantly depend on patient data, including private medical records. There are serious privacy and security issues with the gathering, storing, and processing of this data. Security lapses may reveal private patient data, which could have moral and legal implications for AI developers and healthcare professionals.

2. Bias and Fairness Issues:

AI systems are trained using potentially biased historical data. Certain demographic groups may be unfairly treated as a result of these biases if they are not sufficiently addressed. Biased algorithms in drug dispensing could exacerbate already-existing healthcare disparities by causing differences in treatment outcomes.

3. Limited Generalizability:

It is possible that AI models developed for particular datasets will not generalize to different patient populations. Genetic variations, cultural disparities, and regional healthcare practices are a few examples of factors that can affect how effective AI-driven drug dispensing systems are. In the absence of meticulous verification and modification, these systems might not function at their best in various situations.

4. Complexity and Dependence on Technological Infrastructure:

Sophisticated technology infrastructure, including reliable data storage, processing power, and integration with current healthcare systems, is necessary for the implementation of AI systems for medication dispensing. Healthcare facilities may face difficulties as a result of this complexity, especially those with outdated infrastructure or scarce resources.

5. Regulatory Hurdles:

The implementation of AI-driven drug dispensing systems globally is made more difficult by the disparities in healthcare standards and regulations among various jurisdictions. These systems' adoption and deployment in clinical settings may be delayed by the time-consuming and expensive process of obtaining regulatory approval.

7. FUTURE SCOPE OF AI IN DRUG DISPENSING

1. Advanced Systems for Supporting Decisions:

AI-powered decision support systems will advance in sophistication and be able to give healthcare professionals recommendations in real time based on extensive patient data.

2. Integration of Block chain:

Block chain technology allows for immutable records of transactions and patient data, which can improve the security and transparency of drug dispensing procedures.

3. Robotics driven by AI:

AI-capable robotics systems will be used more often in drug dispensing to automate processes like labeling and packaging medications.

4. Integration of Genomic Medicine:

Precision medicine will advance as AI algorithms increasingly use genomic data to customize drug prescriptions based on individual genetic profiles.

5. Teamwork in Research:

Innovation in medication dispensing technologies will be fueled by collaboration between pharmaceutical companies, healthcare providers, and AI developers, resulting in more effective and efficient healthcare delivery.

6. Customized Medical Care:

Large-scale patient data is analyzed by AI to customize treatment plans. Optimizes treatments according to lifestyle, health, and genetic factors. Minimizes adverse effects and improves patient outcomes.

7. Medication Management:

AI reduces medication errors and adverse drug reactions. Real-time drug interactions and contraindications are found through monitoring. Uses predictive analytic, which to improve drug adherence.

8. Drug Development and Discovery:

Drug discovery is expedited by AI through modeling and data analytics finds innovative treatments and enhances treatment regimens. It simplifies the study of complicated illnesses like Alzheimer's and cancer.

9. Advantages for Operations:

Automated supply chain optimization and inventory control. Medication availability is guaranteed by predictive maintenance, decreases waste and increases workflow efficiency in healthcare facilities.

10. Technologies of Automation:

Accuracy is increased by automated pill counters and clever packaging techniques. Automated dispensing systems improve patient satisfaction, cut wait times, gives pharmacists more time to devote to patient care than manual labor.

11. Difficulties and Points to Remember:

Security, privacy, and compliance with regulations have consequences for the ethics of AI-driven decision-making. Healthcare organizations should prioritize training, collaboration, and cultural adaptation.

12. Ongoing Innovation:

Developments in machine learning and predictive analytics powered by AI give medical professionals more accurate and effective care. Encourage creativity and information exchange within the pharmaceutical sector.

13. Worldwide Effect:

The democratization of cooperative platforms and AI technologies propels innovative discoveries and quickens the

development of new drugs, focusing on unmet medical needs worldwide.

8. CONCLUSION

In conclusion, a revolutionary age in healthcare is being ushered in by the incorporation of artificial intelligence (AI) into medication dispensing procedures. AI-powered solutions for medication management provide unmatched precision, effectiveness, and safety while drastically lowering errors and enhancing patient outcomes. AI can evaluate enormous volumes of data to predict patient reactions to pharmaceuticals, discover possible drug interactions, and customise treatment plans by utilising sophisticated algorithms and machine learning techniques. Additionally, using AI in drug delivery has the potential to improve patient medication adherence. AI systems can assist patients in following their recommended medication schedules by sending them personalised reminders and customised interventions, which lowers the risk of treatment failures and readmissions to the hospital. But there are also moral and legal questions raised by the use of AI in medication delivery. Realising the full potential of AI in healthcare requires addressing several critical issues, including protecting patient privacy, guaranteeing data security, and preserving transparency in algorithmic decision-making. In conclusion, AI-powered medication dispensing systems constitute a paradigm change in pharmaceutical care, providing previously unheard-of chances to optimise healthcare delivery, increase treatment efficacy, and improve patient safety. To fully utilise AI's potential to transform drug dispensing procedures, cooperation between engineers, legislators, regulators, and healthcare practitioners will be crucial as technology develops.

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