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"A Review on an AI-Based Prescription Review System"

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ABSTRACT:
Artificial intelligence (AI) is becoming an effective approach to enhancing medication safety and the prescription review process. Traditionally, medication errors during prescribing, dispensing, or administration were mainly identified through manual review by healthcare professionals. Manual checking can be time-consuming, especially when a large number of prescriptions need to be reviewed.
Artificial intelligence can support prescription assessment by processing medication orders, patient-specific details, and relevant drug information efficiently. AI-based systems may detect potential risks problems such as incorrect doses, drug–drug interactions, contraindications, and allergies.Artificial intelligence (AI) can facilitate the identification of high-risk prescriptions that warrant comprehensive review by pharmacists or physicians. Artificial intelligence–based approaches can facilitate the systematic evaluation of prescriptions and the detection of potential medication errors, thereby contributing to improved medication safety and the quality of pharmaceutical care.These platforms can generate notifications and assist healthcare practitioners focus on prescriptions that may require immediate attention.
However, artificial intelligence serves acts as an aid to healthcare practitioners and is not intended to replace their clinical expertise or decision-making. Issues including data quality, unnecessary alerts, alert fatigue, patient privacy, and compatibility with current healthcare infrastructure need to be considered. Pharmacists and physicians remain essential for applying clinical judgement and making the final decision regarding patient care.
This review discusses the applications of AI in prescription review, the components and technologies used in AI-based systems, medication-error detection, clinical decision support systems, and the role of pharmacists. The advantages, limitations, challenges, and future scope of AI-based prescription review systems in improving medication safety and patient care are also discussed.

Keywords: Artificial Intelligence; Prescription Review; Medication Errors; Machine Learning; Deep Learning; Natural Language Processing; Clinical Decision Support System; Patient Safety; Pharmacist.

I. Introduction:

Maintaining the safe use of medications safely is a key priority in healthcare.Wrong or inappropriate use of medicines can cause problems for patients. Reviewing prescriptions before dispensing medications plays a vital role in identifying potential prescribing errors and supporting safer medication use **[1].**

Usually, pharmacists and doctors check prescriptions manually. They check the medicine, dose, route, frequency, and other patient-related information. However, checking numerous prescriptions can take considerable time. Because of this, computer-based systems are being developed to help healthcare professionals in prescription checking **[2].**

AI technology can assist with prescription assessment support the prescription review process. AI technology can examine analyse prescription records alongside patient-related data to detect potential medication-related concerns. ML and DL-basedtechniques can assist in detectingprescriptions that require closer evaluation by healthcare professionals.ML and DL techniques are AI approaches that can detect prescriptions that may need more attention.

AI-based systems can help detect possible problems such as wrong medicines, incorrect doses, drug interactions, and other prescription-related errors. They can also give alerts or help arrange prescriptions according to their level of risk **[3].**

The main purpose of using AI in prescription review is to support pharmacists and doctors, not to replace them. Healthcare professionals are still needed to check the patient's condition and make the final decision.

Therefore, AI-based prescription review can be a useful approach for improving prescription checking, reducing possible medication errors, and supporting patient safety.

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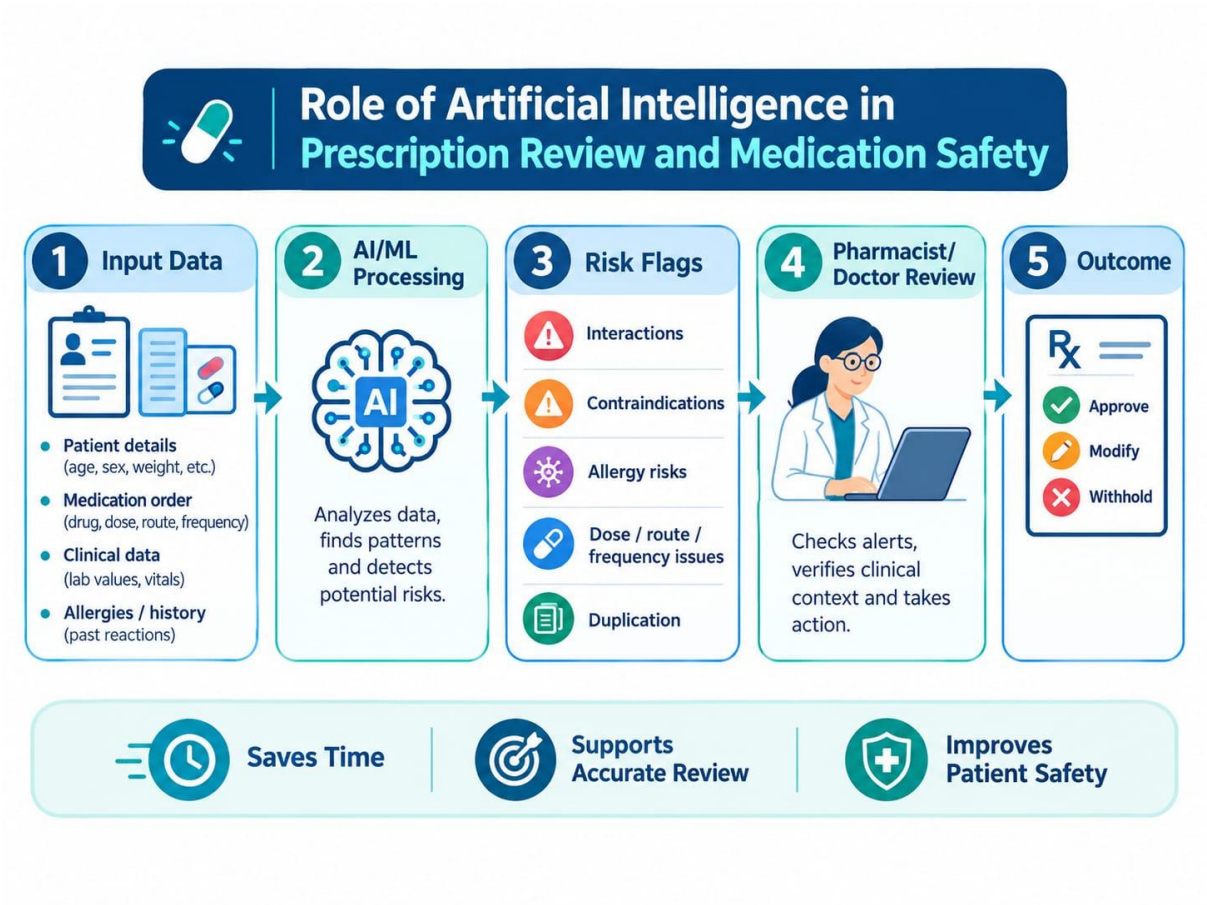


Fig.1: Role of AI in prescription review and medication safety.

II. Prescription and Medicine Error:

Medication errors are preventable events that can arise throughout the prescribing, dispensing, or use of medicines. They can occur at different stages, including prescribing, dispensing, administration, and monitoring. If such mistakes go undetected in time, they may affect the safety and quality of patient care.

Before a medicine is supplied to a patient, the prescription should be checked carefully. Important information such as the medicine name, dose, dosage form, route of administration, frequency, duration, patient details, allergies, as well as potential drug interactions should be reviewed.

- **Various categories of medication errors may include:**
  1. Wrong medicine: an inappropriate or unintended medicine is selected.
  2. Wrong dose: the prescribed amount of medicine is inappropriate.
  3. Wrong route: the medicine is prescribed through an unsuitable route.
  4. Wrong frequency: the medicine is scheduled at an incorrect frequency.
  5. Wrong dosage form: an unsuitable dosage form is selected.
  6. Drug interaction: two or more drugs may affect one another other.
  7. Allergy or contraindication: a medicine may be unsuitable because of the patient's condition or allergy.
  8. Duplicate therapy: similar medicines are prescribed unnecessarily.
  9. Incomplete dose information: important dosing information is missing.
  10. Wrong patient: the medicine is ordered for the incorrect patient.
- Machine-learning methods can analyse medication-order information and identify patterns associated with possible ordering errors.
- Text-mining methods can be employed to examine medication safety reports and categorize the identified information

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according to different types of medication errors**[4].**

- Therefore, early identification of medication errors is an important part of medication safety and patient care. AI and machine-learning methods can offer further assistance to healthcare professionals during prescription review**[5].**

III. AI in Prescription Review:

Artificial Intelligence (AI) can help healthcare professionals in the review of medication prescriptions. It can process prescriptions and patient information and identify medication orders that may need additional attention.

During prescription review, different factors including the medication name, dosage, formulation, administration route, and dosing frequency, allergies, laboratory values, drug interactions and contraindications can be checked. AI-based systems can use these factors to identify potentially inappropriate medication orders.

AI can also help in screening and prioritising prescriptions. Prescriptions that appear suitable according to predefined criteria may require less attention, while prescriptions with possible problems can be directed to a pharmacist or doctor for detailed review.

The basic process of AI-supported prescription review can be described as:

1. Collect data – Prescription and patient information are collected.
2. Process data – The information is organised for analysis.
3. Analyse prescription – AI or computer-based algorithms examine the prescription.
4. Identify possible problems – Potential medication-related risks are detected.
5. Generate alert – An alert is provided when further checking is required.
6. Professional review – A pharmacist or doctor reviews the identified problem.
7. Final decision – The healthcare professional decides the appropriate action.

Thus, AI can make prescription review more systematic and efficient, while the pharmacist or doctor remains responsible for the final clinical decision **[6].**

IV. Components of an AI-Based Prescription Review System:

An AI-based prescription review system consists comprises several interconnected elements to collect prescription and patient information, analyse the data, identify possible medication-related problems, and support healthcare professionals during prescription review. machine-learning techniques have been investigated for identifying medication orders that may require pharmacist intervention **[7].**

1. **Prescription and Patient Information Collection**
   The system begins by collecting essential information about the prescription and the patient. This includes the medicine name, dose, dosage form, route of administration, frequency, patient's age and weight, hospital department, kidney function, and other relevant clinical details. Machine-learning models can analyse this information to identify and predict potential medication-related problems.
2. **Processing and Organisation of Prescription Data**
   The collected data are processed and organised before being analysed by the AI model. Data processing helps convert prescription and patient information into a suitable form for machine-learning analysis. In research studies, prescription information and individual patient attributes have served as input features for prediction models.
3. **Drug-Related and Clinical Information Assessment**
   The system evaluates medication orders by considering relevant drug-related details and patient-specific clinical information. Factors such as the medicine prescribed, dosage, administration frequency, patient characteristics, and kidney function help the system identify orders that may require additional clinical assessment. This supports the early identification of potential medication-related problems**[8].**
4. **Machine-Learning-Based Prediction of Medication-Related Risks**
   The AI module processes prescription details and patient information to detect trends that could signal medication-related risks. Machine-learning techniques can help predict which prescriptions may require further assessment by healthcare professionals. Research has explored the use of these models to predict pharmacist interventions and support the identification

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of prescriptions that need additional review**[9].**

5. **Identification of Potential Medication-Related Problems**
   After analysing the data, the system can identify prescriptions that may have dose-related problems, inappropriate medication use, or other drug-related problems. Deep-learning-based approaches have additionally been investigated for classifying recommendations and drug-related problems identified during pharmacist-led prescription review.
6. **Alert Generation for Prescriptions Requiring Further Assessment**
   When the system identifies a potentially problematic prescription, it can generate an alert or recommendation for further assessment. This can help direct the pharmacist's attention towards medication orders that might need pharmacist action instead of reviewing every order with the same priority.
7. **Clinical Review by Pharmacists or Doctors**
   After the AI system generates an alert, a pharmacist or doctor evaluates the prescription and the information provided by the system. The healthcare professional considers the patient's condition, medical history, and other relevant clinical factors to determine whether corrective action is necessary. Thus, AI assists in prescription assessment, while the final clinical decision is made by the healthcare professional.
8. **Clinical Decision and Documentation**
   Once the AI-generated alert has been assessed, the pharmacist or doctor decides on the appropriate course of action. This may involve approving the prescription, making necessary changes, or providing recommendations to improve medication safety. Deep-learning techniques can additionally support categorise recommendations made by hospital pharmacists during prescription review, helping organise and document medication-review activities **[10].**

V. AI Technologies Used in Prescription Review:

AI-based prescription review systems use various technologies to examine prescription and patient-related information. These technologies help identify possible medication-related problems and provide useful information to healthcare professionals. Major technologies include Machine Learning (ML), Deep Learning (DL), Natural Language Processing (NLP), Large Language Models (LLMs), and image-based AI**[11].**

1. **Machine Learning (ML)**
   Machine learning allows computers to identify patterns from previously available data. In prescription review, ML models can analyse prescription information and recognise patterns that may indicate a possible medication problem.
2. **Deep Learning (DL)**
   Deep learning is a machine-learning approach based on neural network architectures to process complex patterns in large datasets. In medication-related applications, deep-learning models can help identify relationships between medicines and predict possible drug–drug and drug–food interactions**[12].**
3. **Natural Language Processing (NLP)**
   NLP enables computer systems to understand and analyse information written in human language. In prescription review, NLP can support the extraction of useful information from free-text clinical records, including information about patient allergies. This may assist in detecting potential medication-related risks **[13].**
4. **Large Language Models (LLMs)**
   Large Language Models are AI models that can understand and process large amounts of text. In medication-related applications, LLMs can be combined with pharmaceutical knowledge and safety rules to identify problems in medication instructions, such as incorrect dose or frequency.
5. **Image-Based AI**
   AI can also be applied to the identification of medicines from images. Deep-learning models can analyse features such as the shape, appearance, and markings of pills to identify a particular medicine. This technology can further assist with correct medicine identification **[14].**

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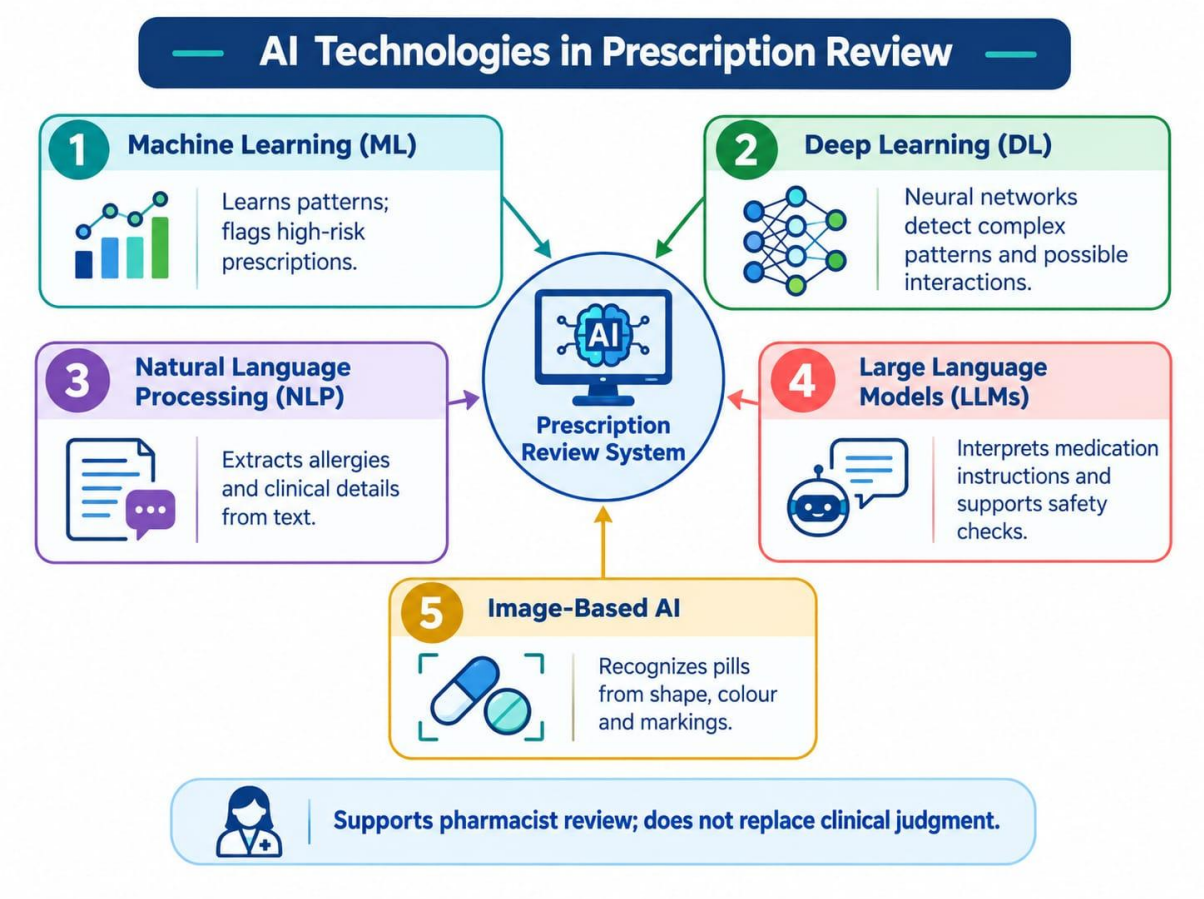


Fig.2: Prescription Review System.

VI. Detection of Medication Errors:

AI can support the prescription-review process by checking prescription details together with relevant patient information. By analysing these data, AI systems can recognise patterns that may indicate a possible medication-related error.

1. **Dose-Related Errors**
   Machine-learning models can help identify prescriptions where the selected dose may require changed. These models can use previous prescribing information and patient-related factors to predict situations where dose correction may be required.
2. **Drug–Drug Interactions**
   AI can assist in checking whether medicines prescribed together could produce interactions when used together. Deep-learning techniques can analyse drug-related information and identify possible drug–drug interactions, allowing healthcare professionals to assess the potential risk.
3. **Screening of Prescriptions**
   AI systems can examine a large number of prescriptions and highlight those that may need closer attention. This can help pharmacists and doctors concentrate on medication orders that have a higher possibility of requiring intervention **[15].**
4. **Generation of Alerts**
   When the system identifies a possible medication problem, it can generate an alert for the healthcare professional. The alert indicates that the prescription should be checked before further action is taken.
5. **Review by HealthCare Professionals**
   The final assessment of an AI-generated alert is carried out by a pharmacist or doctor. They consider the patient's clinical condition and other relevant information to determine whether the identified problem is clinically important and what action should be taken.

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Common Medication Problems:

✓AI-based prescription review may help identify
✓Incorrect dose
✓Possible drug–drug interaction
✓Inappropriate medicine use
✓Dose requiring adjustment
✓Other prescription-related problems **[16].**

VII. Clinical Decision Support System (CDSS):

A Clinical Decision Support System (CDSS) is a computer-based system designed to assist healthcare professionals by providing useful clinical information, alerts, and recommendations. In medication management, it can support prescription checking and help identify possible problems related to medicines.

The system can use information such as patient details, prescribed medicines, and relevant clinical data for analysis. By processing these data, CDSS can help detect medication-related problems and provide additional support during the prescription-review process **[17].**

When a potential problem is identified, the CDSS can provide an alert or recommendation to the healthcare professional. Such medication-safety systems have been examined investigated for their ability to provide alerts which healthcare professionals canassessed by healthcare professionals during medication review **[18].**

The alert generated by the system is not considered the final decision. A pharmacist or doctor reviews the alert together with the patient's condition and other clinical information before deciding what action is appropriate. Studies of medication prescription errors have also evaluated the clinical importance of such alerts for improving decision-support systems**[19].**

VIII. Role of Pharmacist in AI-Based Prescription Review:

Pharmacists are essential for checking prescriptions and helping patients use medicines safely. AI-driven tools can assist pharmacists in them find unusual medication orders that may need more attention. This can help pharmacists to identify prescriptions that should be checked carefully.

AI can examine several medication orders and highlight those that differ from common prescribing patterns. Pharmacists can review these orders and decide whether a potential possible problem. However, an unusual prescription does not necessarily indicate that an error has occurred.

AI can assist with prescription review, but the pharmacist's role remains important. Pharmacists need to check the available information, use their knowledge, and determine whether additional action is required. In this way, AI supports the pharmacist's work rather than replacing professional judgement.

Major Roles of Pharmacist:

Checking unusual medication orders identified by AI
Reviewing prescriptions requiring closer examination
Assessing the predictions made by AI.
Identifying possible medication-related problems
Using professional knowledge to evaluate prescriptions.
Deciding whether further review is needed.
Using AI support to help improve medication safety **[20].**

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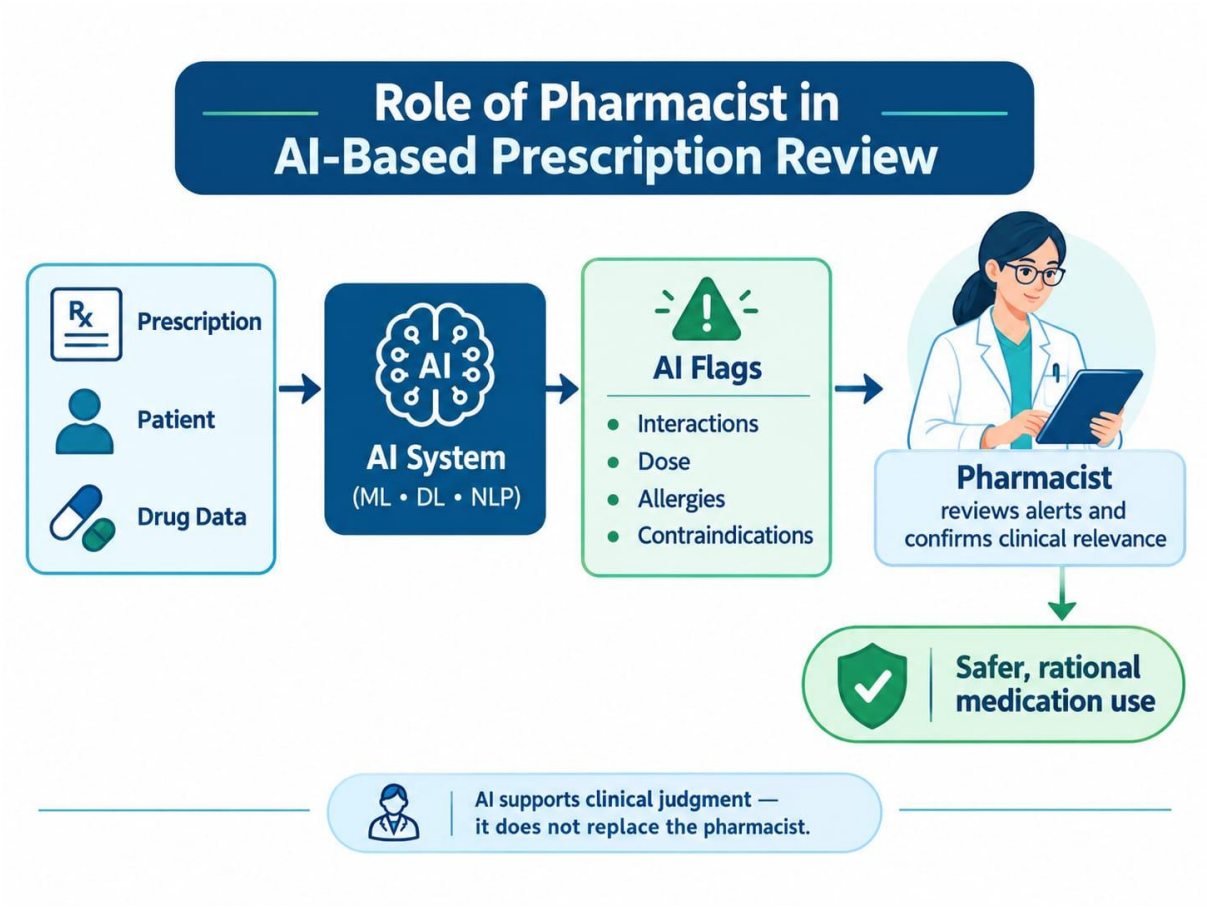


Fig.3: Role of Pharmacist in AI-Based Prescription Review

IX. Advantages of AI-Based Prescription Review:

AI-based prescription review can improve the speed, efficiency, and organisation of medication review. It can support pharmacists and doctors by screening prescriptions and identifying medication orders that may require further attention.

Faster Prescription Screening

AI can analyse a large number of prescriptions and help identify orders that may require further medication review. This can allow pharmacists to focus more attention on prescriptions with potential problems**[21].**

1. Early Detection of Medication Errors
   Machine-learning-based CDSS tools can assist in help identify medication-related problems, including wrong-drug errors, during prescription review. This may support earlier assessment and intervention by healthcare professionals**[22]**.
2. Reduction of Alert Fatigue
   AI and machine-learning models can help predict which medication alerts are more likely to require attention. This approach can support the reduction of unnecessary alerts and help make clinical decision-support systems more manageable**[23].**
3. Better Prioritisation of Prescriptions
   AI can help distinguish prescriptions that may need detailed medication review from those that may be safely excluded from intensive review. This allows pharmacists to concentrate on prescriptions requiring greater attention.
4. Reduced Review Workload
   By supporting the initial screening of medication orders, AI can reduce the amount of routine review required and help healthcare staff manage their time more efficiently.
5. Support for Clinical Decision-Making
   AI-based clinical decision-support systems can provide relevant alerts and medication-related information to healthcare professionals. This information can support pharmacists and doctors while reviewing

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prescriptions and assessing potential medication problems.

X. Limitations/Challenges of AI-Based Prescription Review:

AI can make prescription review easier, but it also has some limitations and challenges that need to be considered.

1. **Alert Fatigue**
   AI may generate many alerts. If healthcare professionals receive too many unnecessary alerts, they may start ignoring them. Therefore, alerts should be clear, relevant, and clinically useful **[24].**
2. **Wrong or Unnecessary Alerts**
   Some alerts may not be suitable for the patient's actual condition. Healthcare professionals may therefore override or ignore them. This may result in an important medication problem being missed **[25].**
3. **Data Quality**
   AI requires correct and complete patient and prescription information. Missing or incorrect data can affect the accuracy of AI-based results.
4. **Different Hospital Systems**
   AI performance can vary between hospitals because of differences in patients, clinical practices, software, and available data. Therefore, the system should be properly evaluated before implementation **[26].**
5. **System Integration**
   AI should work together with existing EHR, electronic prescribing, pharmacy, and hospital information systems. Problems with integration can make the system difficult to use in routine practice **[27].**
6. **Need for Human Supervision**
   AI cannot replace pharmacists or doctors. AI-generated alerts and recommendations should be checked by healthcare professionals before any clinical action is taken.

XI. Future Scope of AI-Based Prescription Review:

AI-based prescription review has a good future in healthcare. In the coming years, AI systems may become more accurate, faster, and easier to use.

1. **Better Detection of Medication Errors**
   Future AI systems may identify different types of medication-related problems more accurately. Deep-learning models can help classify drug-related problems from large prescription-review data**[28].**
2. **Real-Time Prescription Checking**
   AI can be connected with electronic prescription systems to check medicines while the prescription is being prepared. This may allow the detection of potential problems at an early stage **[29]**.
3. **Personalised Prescription Review**
   Future AI systems may use patient-specific information including a patient's age, body mass, clinical background, and test findings, allergies, and current medicines to provide more personalised prescription review **[30] .**
4. **Use of Advanced AI and LLMs**
   New technologies such as Large Language Models (LLMs) may help analyse complex medication information and support medication-safety decisions **[31].**
5. **Better Connection with Healthcare Systems**
   AI systems can be connected with EHR, electronic prescribing, pharmacy, and hospital information systems. Better integration can make AI-based prescription review easier to use in routine clinical practice**[32].**
6. **AI + Pharmacist Collaboration**
   In the future, AI can perform the initial prescription checking, while the pharmacist reviews the AI findings and makes the final clinical decision. This can combine the speed of AI with the professional knowledge of pharmacists.

XII. Conclusion:

AI-based prescription review is a useful method of enhancing the safe use of medicines and patient care. AI can quickly check prescription and patient information and assist in detecting potential issues, including wrong doses, drug interactions, allergies, and other medication errors.

AI can make prescription review faster and easier, but it cannot completely replace pharmacists and doctors. Healthcare professionals are needed to check AI alerts and make the final decision.

In the future, better AI technologies may provide faster, more accurate, and personalised prescription review. Therefore, combining AI technology with pharmacist and doctor expertise can help in reducing medication errors and improving patient safety.

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