World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(REVIEW ARTICLE)

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Software data objects application integrity modeling in medication dispensing errors predictions using machine learning algorithms in workflow-based pharmacy software systems

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World Journal of Biology Pharmacy and Health Sciences, 2024, 19(03), 571–574

Publication history: Received on 14 August 2024; revised on 25 September 2024; accepted on 27 September 2024

Article DOI: https://doi.org/10.30574/wjbphs.2024.19.3.0687

Abstract

The study focuses on using the software objects created at each stage of the workflow-based systems (and in our article we can focus on the pharmacy-based medication dispensing software systems) to predict the anomalies or potential issues in that software object constructed at each stage of the workflow using the historical issues recorded in that specific workflow stage using linear regression, decision trees, and neural network algorithms. By utilizing historical data and integrity metrics, the research aims to forecast potential failures and maintain the reliability of software applications. The focus is on employing algorithms such as linear regression, decision trees, and neural networks to enhance predictive accuracy and facilitate informed decisions or recommendations to the workflow users (pharmacists) about the potential medication dispensing error the software objects constructed at that state or workflow could cause and advise to take necessary corrections.

Keywords: Pharmacy; Medication; Dispensing; Software; Intelligence

1. Introduction

In workflow-based software systems, the integrity of the software data objects constructed at the end of each workflow stage is crucial for the end outcome of the expected process. Undetected anomalies at each stage causing the end-state behavior to change or causing unexpected outcomes. We are evaluating the constructed software data objects at each stage using the historical problems that occurred due to the nature of the objects at that stage using the AI model built and trained using the historical objects to cause issues and provide business recommendations to the workflow user to take appropriate action at that workflow stage, ensuring the successful outcome at the end of all the workflows.

1.1. Objective

This study aims to apply the concept of software data objects and AI-modeled validations at every workflow of the pharmacy systems and to provide recommendations and assist pharmacists in different stages of the prescription processing by using a machine learning-based prescription model built and trained using historical prescriptions and generative AI-driven recommendations on potential dispensing/medication error alerts to the pharmacist. The AI model will use the historical prescription data to forecast future outcomes.

As pharmacists are highly concerned about patient safety, integration of this AI-modeled validation at each workflow can help detect and prevent medication errors, such as incorrect dosages or potential drug interactions, thereby minimizing adverse effects and hospital readmissions.

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2. Problem statement

Medication dispensing errors can pose significant challenges in healthcare settings, impacting patient safety and treatment efficacy. Here are some common types of errors and the challenges associated with them:

2.1. Types of Medication Dispensing Errors

- Wrong Drug Dispensed: Providing the patient with the incorrect medication, often due to look-alike or sound-alike drug names.
- Incorrect Dosage: Dispensing the wrong dose, either too high or too low, which can lead to adverse effects or therapeutic failure.
- Incorrect Formulation: Giving a medication in the wrong form (e.g., liquid instead of tablet), which can affect absorption and efficacy.
- Labeling Errors: Incorrect or unclear labeling on medication packages can lead to confusion and improper usage.
- Omitted Medications: Failing to dispense a prescribed medication, which can impact patient treatment plans.
- Drug Interactions: Not recognizing potential interactions between medications being dispensed.

2.2. Challenges Contributing to Dispensing Errors

- Complexity of Medication Regimens: Patients often take multiple medications, increasing the risk of errors due to complexity.
- High Workload and Staffing Issues: Busy pharmacy environments can lead to rushed work, increasing the likelihood of mistakes.
- Inadequate Training: Insufficient training for pharmacy staff can result in a lack of familiarity with medications and dispensing protocols.
- Technology Issues: While electronic health records (EHR) and automated dispensing systems can reduce errors, technical malfunctions or user errors can introduce new risks.
- Communication Breakdowns: Poor communication between healthcare providers, pharmacists, and patients can lead to misunderstandings about prescriptions and usage.
- Look-Alike/Sound-Alike Medications: Confusion arising from similar drug names or packaging can result in the wrong medication being dispensed.
- Environmental Factors: Distractions in the pharmacy environment, such as noise or interruptions, can contribute to errors.

2.3. Existing manual Strategies to Mitigate Errors

- Double-Checking Systems: Implementing checks and balances, such as requiring a second pharmacist to review prescriptions before dispensing.
- Enhanced Training Programs: Providing ongoing education and training for pharmacy staff on medication safety practices.
- Improved Communication: Establishing clear communication channels among healthcare providers, pharmacists, and patients.
- Technology Utilization: Utilizing barcoding systems and automated dispensing systems to enhance accuracy.
- Standardized Protocols: Developing and enforcing standardized procedures for medication dispensing.
- Patient Education: Engaging patients in their medication management by providing clear instructions and encouraging them to ask questions.

3. Impact [2]

The impact to the patient safety and health care economy of a nation is drastically higher due to the medication dispensing errors and few highlights below

- Medication error rates during patient administration range from 8% to 25%.
- Medical errors in private residences occur between 2% and 33% of the time.
- Poor dispensing practices lead to medical error rates ranging from 0.014% to 55%.
- In hospital settings, approximately 1.5% of prescriptions involve dispensing mistakes
- Nearly 20% of dosages provided in hospitals are associated with mistakes.
- Outpatient clinics witness 530,000 injuries annually due to medication errors.

- Elderly patients are four times more likely to be impacted by medication errors compared to children
- Preventable medication errors contribute significantly to this financial burden, accounting for over $21 billion in expenses each year. These errors are pervasive across the entire spectrum of the healthcare industry.
- The global cost attributed to medication errors represents nearly 1% of the entire worldwide expenditure on health.

4. How can we solve or reduce the problem using AI Machine Learning.

Forecasting Errors: By analyzing historical data on workflow errors and their potential predictors, linear regression can create a model that predicts future errors based on current conditions.

- ML model using linear regression to predict the potential anomalies in the software data object constructed at the stage of the workflow.
- The model to be trained with the historical prescriptions resulted in the medication errors. The software data objects for those prescriptions are used to train the model.
- The pharmacy workflow system processing the prescription at the end of every workflow completion will consult the AI model with the prescription details packed data objects for any anomalies of potential errors that could result in a medication dispensing error.
- The AI model in turn provides a list of feedback to that specific prescription using the historical trained issues encountered (prescription, patient, drug, dosage, frequency, prescriber, region, etc.).
- The outcome of the ML model can be sent to the GenAI (ChatGPT/LLM) model APIs to get the user brief content, and the alert is being displayed at the workflow or pharmacy user to take appropriate action to avoid the potential medication error to occur later, which will be costly to fix.

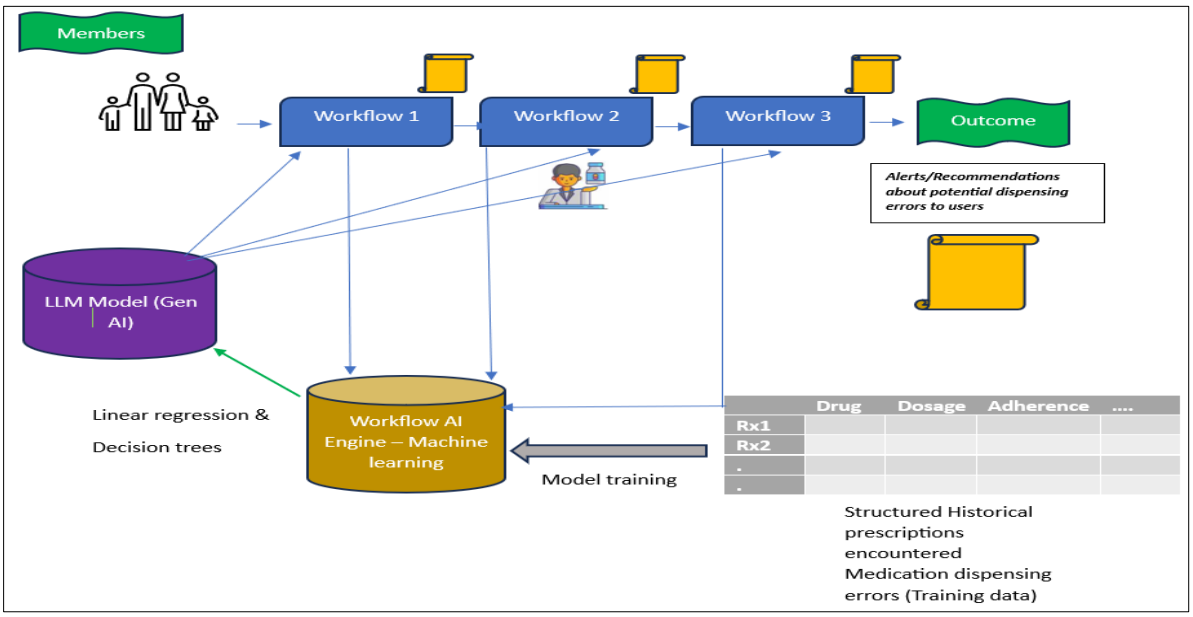

Figure 1 Medication dispensing workflow embedded with AI consultation

5. Prescription AI Model Outline

- Identify Key Medical dispensing parameters (Drug, Dosage, Adherence, Patient, formulation, drug-drug interaction)
- Building the Prescription model training data
- Data preprocessing - Normalize or standardize data
- Building the predictive model using the linear regressions

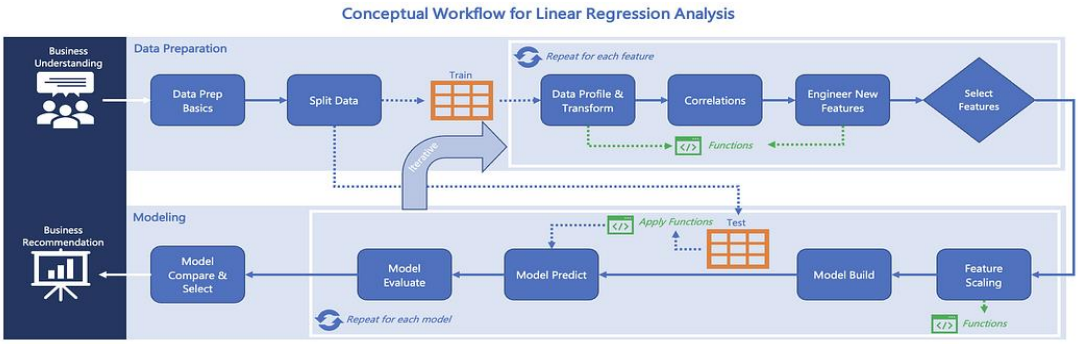

Figure 2 Linear Regression Workflow [1]

6. Conclusion and Benefits

By addressing these challenges and implementing strategies to reduce errors, healthcare providers can improve patient safety and enhance the overall quality of care. Analyzing the direct costs obtained through reviews of the literature, hospital charge data, and Medicare and Medicaid reimbursement in the base case, the mean expected cost of a medication error was $88.57 in the US, and the dispensing practices lead to medical error rates ranging from 0.014% to 55% .The preventable medication errors contribute significantly to the financial burden of every country , accounting for over **$21 billion in expenses each year[2]** in US. These errors are pervasive across the entire spectrum of the healthcare industry.

Successful adoption and deployment of the concept in pharmacy practice will substantially reduce the error, and the cost incurred in the pharmacy medication dispensing ecosystem and will improve the health care economy.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Data science: https://towardsdatascience.com/multiple-linear-regression-python-101-af459110a8af

[2] Medication-error-statistics: https://renewbariatrics.com/medication-error-statistics/