Advanced International Journal of Multidisciplinary Research

E-ISSN: 2584-0487
editor@aijmr.com

Volume 4, Issue 2, March-April 2026

CrossRef DOI: 10.62127/aijmr.2026.v04i02.1284

An Efficient Hybrid Machine Learning Methodology for Predicting Medicine Overdose

Dr. M. Vishnu Vardhana Rao[1], A. Sushma[2], A. Anjali[3], B. Satyavathi[4], G. Archana[5]

[1]Associate Professor, [2,3,4,5]B. Tech student
[1,2,3,4,5]Dept. of CSE(AI&ML), Vignan's Institute of Management and Technology for Women, Hyderabad, India.

Abstract:
Right now, the health sector is facing several difficulties when it comes to keeping medicine safe and properly managed. For example, medicine overdose is one of the issues that can lead to serious health risks or even death if the problem is not identified early. The Medicine Overdose Prediction (MOP) System uses data analysis and machine learning to look at a patient's information and figure out if there's a chance they might take more medicine than is safe. The authors have proposed using a combined method for predicting medicine overdoses. This paper utilizes the patient's data and medication dosage, applying various steps such as data preprocessing and training. The paper groups on the levels of medicine overdose into categories like safe, moderate, and high. This paper gives suitable suggestions based on the data that was predicted. The purpose of this study is to help patients and healthcare professionals manage medication dosages and prevent overdoses.

Keywords: Medicine Overdose Prediction (MOP), Machine Learning (ML), Single Patient Dataset (SPD), Drug Management (DM), Electronic Health Records (EHR), Risk Prediction, Healthcare Sector, Recommendation System (RS), Patient Data Analysis.

I. INTRODUCTION:

The lack of awareness about proper dosage guidelines and the increasing use of medications have made medicine overdose a serious health issue. A lot of patients may unintentionally take larger doses, which can lead to serious health problems or life-threatening conditions. Hand-to-hand monitoring is the primary means of traditional monitoring for patients by healthcare professionals. In spite of this, these techniques may not always detect overdose dangers in advance. Therefore, an intelligent system is necessary to forecast potential overdose scenarios. The paper suggests a machine learning-based system that can anticipate medication overdose by analysing patient data such as age, medical history, and medication dosage. Data cleaning, missing value handling, and normalization are among the preprocessing techniques used to improve accuracy. During the preprocessing phase, crucial features are extracted and utilized in training machine learning models.

Through data-driven learning patterns, these models can detect possible overdose hazards. Python is utilized to create a prediction model, along with machine learning libraries like NumPy, Pandas, and Scikit-learn, which are all useful for this task. It evaluates patient information and generates estimates about the likelihood of an overdose. Primarily to help healthcare professionals reduce

Advanced International Journal of Multidisciplinary Research
E-ISSN: 2584-0487
editor@aijmr.com
Volume 4, Issue 2, March-April 2026
CrossRef DOI: 10.62127/aijmr.2026.v04i02.1284

medication errors and improve patient safety. In addition, this paper presents the development process in its entirety: from design and implementation to eventual improvements.
Globally, Around 600,000 deaths per year are linked to drug use, and a large portion is due to overdose. United States, About 80,000 deaths in 2024 and over 100,000 deaths in 2023 due to drug overdose. Over a 5-year period (2019–2023), about 3,290 overdose deaths were recorded in India. Overall, Compared to global numbers, India reports fewer overdose deaths, but it is still a growing public health concern.

II. RELATED WORK:

Dong X et al. [1] Dong X developed a machine learning model using electronic health records to predict opioid overdose risk, demonstrating the effectiveness of clinical data in identifying high-risk patients. Li X et al. [4] Li, X., W. A. Chaovalitwongse applied machine learning techniques to analyze prescription opioid usage and detect individuals prone to overdose. Nguyen Khoa et al. [8] Nguyen designed a machine learning–based overdose risk prediction tool integrated into healthcare systems, enabling real-time decision-making in primary care. Furthermore, Ward Patrick J et al. [6] improved overdose mortality surveillance using machine learning to ensure timely public health responses. Additionally, Nagata Kenichiro et al. [5] proposed an unsupervised learning approach to detect overdose and underdose prescriptions, enhancing monitoring without relying on labeled datasets. These studies collectively highlight the significant role of machine learning in predicting and preventing opioid overdose.

Year	Authors	Titles of the Paper	Method Used	Limitation
2025	Smith et al.	Drug Overdose Prediction Using Machine Learning	Machine Learning & AI	Needs large data, not real-time
2024	Li & Wang	Predictive Analysis of Drug Overdose Using EHR Data	Predictive Analytics (EHR)	Depends on past data only
2023-24	Brown et al.	Statistical Methods for Overdose Risk Forecasting	Statistical Models	Not for individual prediction
2022	Kumar et al.	Mobile-Based Medicine Intake Monitoring System	Mobile Health App	Depends on user input
2021	Kim & Lee	Machine Learning Approach for Drug Safety Monitoring	Machine Learning	Limited to specific drugs
2020	Garcia et al.	Rule-Based Drug Dosage Monitoring System	Rule-based System	No early warning
2018	Johnson et al.	Threshold-Based Detection of Drug Overdose	Threshold Monitoring	Only detects high overdose

III. PROPOSED SYSTEM

The aim of the proposed system is to design an intelligent (MOP) Paper that leverages Machine Learning to help patients identify potential overdose dangers. Patient data, such as age, medical history, type of medicine, and dosage level, is gathered by the paper. A preprocessing stage is used to handle missing values, remove irrelevant data, and normalize the data to improve model performance. The training of machine learning models involves selecting crucial features that are selected after the preprocessing phase.

Advanced International Journal of Multidisciplinary Research
E-ISSN: 2584-0487
editor@aijmr.com
Volume 4, Issue 2, March-April 2026
CrossRef DOI: 10.62127/aijmr.2026.v04i02.1284

It uses a hybrid learning model that incorporates both supervised and unsupervised learning to analyze patterns in patient data and medication usage. Using supervised learning algorithms, the overdose risk level can be predicted using labeled data, while unsupervised learning allows for the detection of hidden patterns and unusual dosage behaviours. After analysing the input dosage, the trained model determines whether it is safe, moderate, or high risk. Furthermore, the system scrutinizes various dosage stages to determine the impact of increasing dosages on the patient's risk condition. Predictions made by the system help reduce patient overdose and improve safety. It enables healthcare professionals and patients to make more informed decisions about their medication usage. Generally speaking, the proposed system enhances the early identification of overdose dangers and facilitates safer medication control.

IV. ARCHITECTURE:

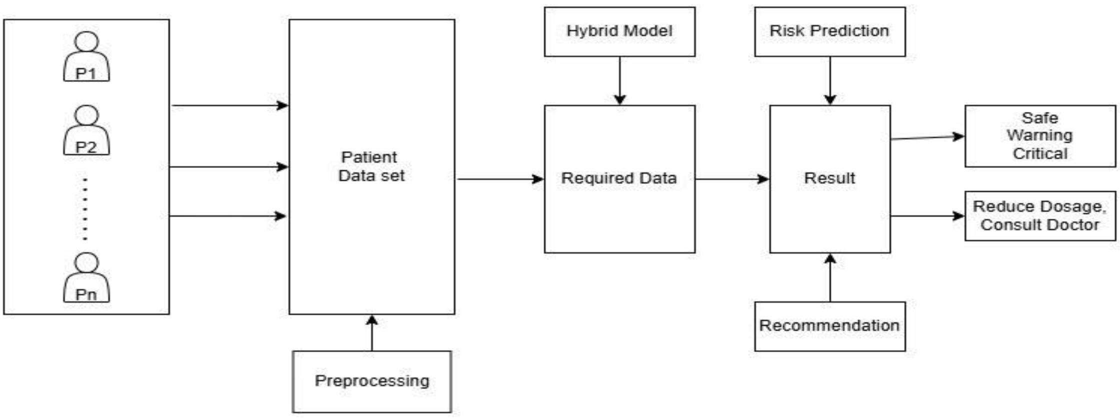


Figure-1: System Architecture

The Medicine Overdose Prediction figure-1 shows System's structure is depicted in the diagram, which combines patient data from various patients (P_1 to P_n) into a Single Patient Dataset (SPD). The required data is cleaned up and prepared for analysis using preprocessing of the dataset. A hybrid machine learning model analyses the necessary features to make risk prediction. The system divides the dosage condition into stages such as safe, warning, or critical based on the prediction results. Finally, the system makes appropriate recommendations such as reducing dose or seeking medical advice to ensure patient safety.

V. IMPLEMENTAION:

The Medicine Overdose Prediction paper is implemented in Python, augmented by machine learning libraries such as NumPy, Pandas and Scikit-learn. The data set consists of patient information such as their age, type of medicine, dosage level, and medical history. Preprocessing is performed on the data, which includes handling missing values and encoding. Boost early detection of potential overdose exposures and promote better medication management. The model's performance can be improved by including categorical data and numerical values for consistency purposes. Supervised learning algorithms such as Random Forest are trained to predict overdose risk levels from labelled data after the. Also, they use unsupervised learning methods like K-Means clustering to uncover hidden dosage patterns and identify

Advanced International Journal of Multidisciplinary Research

E-ISSN: 2584-0487
editor@aijmr.com

Volume 4, Issue 2, March-April 2026

CrossRef DOI: 10.62127/aijmr.2026.v04i02.1284

similar patient behaviours by grouping them. Using the trained hybrid model, the new input data is analysed and the risk stage is classified as either safe, moderate, or high. Ultimately, the system generates appropriate recommendations based on the expected risk, such as maintaining the same dosage, reducing medication usage, or consulting a doctor. Its prediction results and recommendations are presented in a user-friendly interface. The adoption facilitates early identification of overdose risks and supports better medication management**.**

ALGORITHM: Overdose Risk Prediction and Recommendation Algorithm

----

Input:
Set of patients and correspounding features such as Dosage Level (DL), Medical History, Medicine Type, etc..
Output: Dosage Levels – DL and RS
Step 1:
P = {p_1, p_2, p_3 … p_n} be the set of patients
F = {f_1, f_2, f_3 … f_m} be the set of input features (Age, Dosage Level (DL), Medical History, Medicine Type, etc.)
For Each patient i=0,i=1,i=2,……i=n FeatureVector: $X_i = (x_1, x_2, x_3 \dots x_m)$
where x_1= Age, x_2= Dosage Level (DL) x_3= Medical Condition x_m= Other health parameters
Step 2: The overdose risk prediction is defined as:

$$Y = f(X)$$

where
X → Input patient feature vector →dl-1
f → Trained Machine Learning Model→dl-2
Y → Predicted Risk Level→dl-3
Risk level belongs to:
Y∈ {Safe-dl-1, Moderate-dl-2, High-dl-3}
Step 3: Clustering Function (Unsupervised Learning)
Patients are grouped into clusters based on dosage behaviour

$$C = \{C_1, C_2, C_3 \dots C_k\}$$

Where ,
C_1 → Low Risk Cluster- dl-1, C_2→ Medium Risk Cluster-dl-2, C_3 → High Risk Cluster-dl-3
Distance between patients is calculated using:

$$D = \sqrt{\sum_{i=1}^{m} (x_i - y_i)^2}$$

(Euclidean Distance)
Step 4: Recommendation System RS Function
Based on predicted risk:

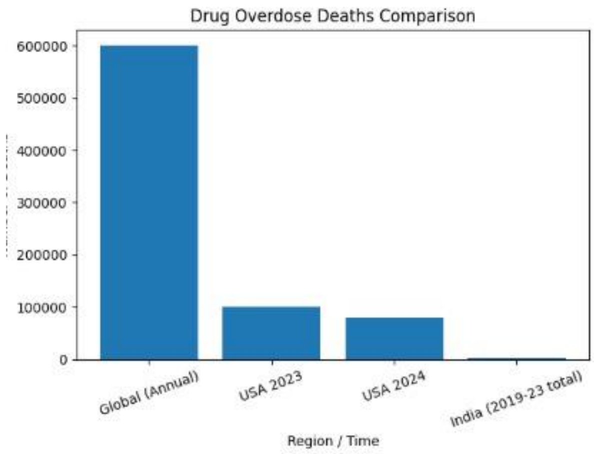
$$R = g(Y)$$

Where

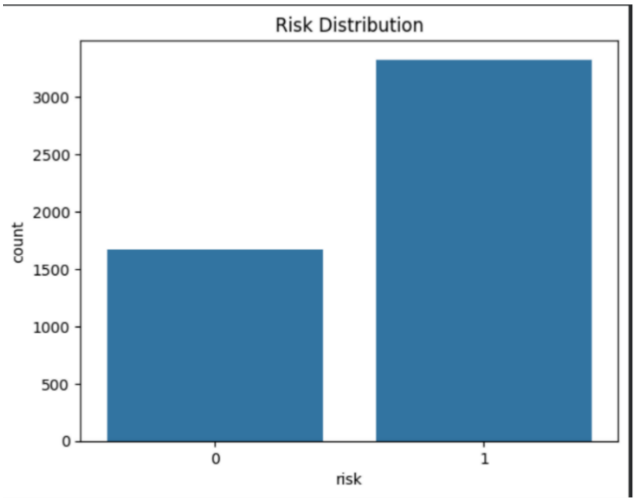
Advanced International Journal of Multidisciplinary Research
E-ISSN: 2584-0487
editor@aijmr.com
Volume 4, Issue 2, March-April 2026
CrossRef DOI: 10.62127/aijmr.2026.v04i02.1284

If Y = Safe → Continue dosage
If Y = Moderate → Reduce dosage
If Y = High → Consult doctor immediately

VI.RESULTS:

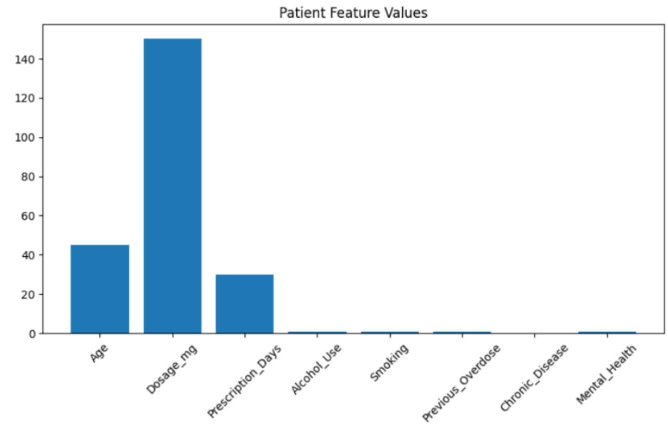


The bar chart illustrates a comparison of drug overdose deaths across different regions and time periods, highlighting that global annual deaths are the highest at around 600,000, followed by the USA with notable figures in 2023 and 2024, while India's total deaths from 2019 to 2023 are significantly lower in comparison.

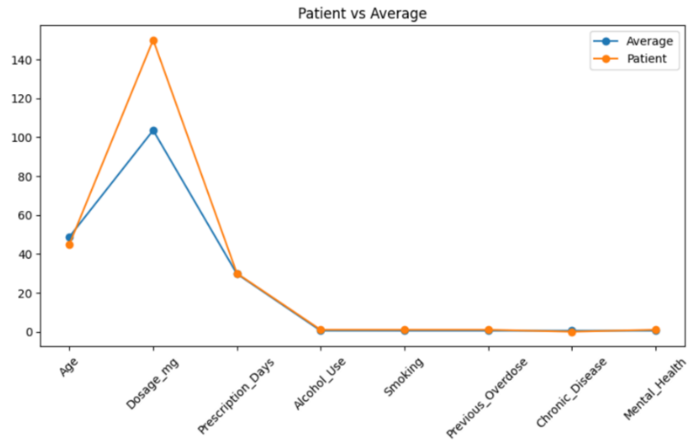


The chart shows the distribution of risk categories, where risk = 1 has a higher count than risk = 0. This indicates that the dataset contains more high-risk cases compared to low-risk cases. Overall, the data is imbalanced toward the high-risk category.

Advanced International Journal of Multidisciplinary Research
E-ISSN: 2584-0487
editor@aijmr.com
Volume 4, Issue 2, March-April 2026
CrossRef DOI: 10.62127/aijmr.2026.v04i02.1284

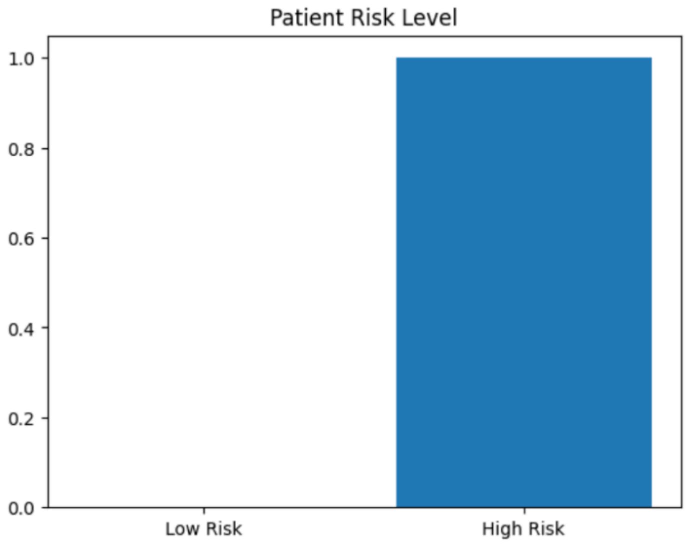


The bar chart represents different patient feature values, showing that dosage (150 mg) is the highest among all features, followed by age and prescription days, while factors like alcohol use, smoking, previous overdose, chronic disease, and mental health have comparatively very low values.

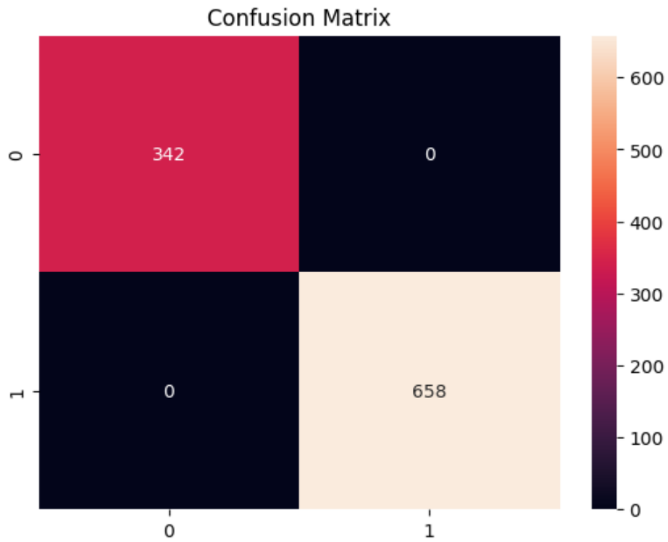


The line graph compares patient values with average values across different features, showing that the patient has a significantly higher dosage than average, while most other factors like prescription days and lifestyle-related features are similar or slightly lower.

Advanced International Journal of Multidisciplinary Research
E-ISSN: 2584-0487
editor@aijmr.com
Volume 4, Issue 2, March-April 2026
CrossRef DOI: 10.62127/aijmr.2026.v04i02.1284



The chart shows the patient's risk level classification, indicating that the patient falls entirely under the high-risk category with no presence in the low-risk group, suggesting a significant likelihood of overdose risk.



Confusion matrix shows model performance: True Positives (658) and True Negatives (342) are correct predictions, while False Positives (0) and False Negatives (0) indicate no errors → perfect classification.
Precision = TP / (TP + FP) = 658 / (658 + 0) = 1.0 (99%+), Recall = TP / (TP + FN) = 658 / (658 + 0) = 1.0 → model detects all positives correctly.
F1 Score = 2 × (Precision × Recall) / (Precision + Recall) = 1.0 → balanced and ideal performance (≈99–100%).

VII.CONCLUSION:

The MOP System was developed to provide an intelligent solution for identifying potential overdose risks using machine learning techniques. By analyzing patient data such as age, medical history, and dosage levels, the system is able to predict the risk stage and provide suitable recommendations. The hybrid approach using both supervised and unsupervised learning helps improve prediction accuracy and identify

E-ISSN: 2584-0487
editor@aijmr.com
Volume 4, Issue 2, March-April 2026
CrossRef DOI: 10.62127/aijmr.2026.v04i02.1284

hidden patterns related to medication usage. This system supports healthcare professionals and patients in making better decisions regarding medicine intake. Overall, the proposed system contributes to improving patient safety, reducing medication errors, and enabling early detection of overdose risks. Future enhancements can include real-time monitoring, integration with hospital databases, and advanced deep learning models for more accurate predictions.

VIII.FUTURE SCOPE:

The future scope of the MOP System includes integrating real-time patient monitoring devices and connecting with hospital or pharmacy databases for automatic data updates. The system can also be enhanced using advanced deep learning models and mobile application support to provide more accurate predictions and wider accessibility.

REFERENCES:

[1]. Dong X, Rashidian S, Wang Y, Hajagos J, Zhao X, Rosenthal RN, Kong J, Saltz M, Saltz J, Wang F. Machine Learning Based Opioid Overdose Prediction Using Electronic Health Records. AMIA Annu Symp Proc. 2020 Mar 4;2019:389-398. PMID: 32308832; PMCID: PMC7153049.

[2]. Vishnu Vardhana Rao, M., and Aparna Chaparala. "Structural Strength Monitoring System Practices Using Machine Learning." In *Proceedings of Integrated Intelligence Enable Networks and Computing: IIENC 2020*, pp. 255-267. Singapore: Springer Singapore, 2021.

[3]. Thejovathi, Murari, M. V. P. Chandra Sekhara Rao, and Rajeswara Rao. "Enhancing Healthcare Data Reliability Through Automated Cleaning Using Q-Learning Algorithm." In *International Conference on Information and Communication Technology for Intelligent Systems*, pp. 185-195. Singapore: Springer Nature Singapore, 2025.

[4]. Li, X., W. A. Chaovalitwongse, G. Curran, J. M. Tilford, H. Felix, and B. C. Martin. "Using machine learning to predict opioid overdoses among prescription opioid users." *Value in Health* 21 (2018): S245.

[5]. Nagata, Kenichiro, Toshikazu Tsuji, Kimitaka Suetsugu, Kayoko Muraoka, Hiroyuki Watanabe, Akiko Kanaya, Nobuaki Egashira, and Ichiro Ieiri. "Detection of overdose and underdose prescriptions—An unsupervised machine learning approach." *PloS one* 16, no. 11 (2021): e0260315.

[6]. Ward, Patrick J., Peter J. Rock, Svetla Slavova, April M. Young, Terry L. Bunn, and Ramakanth Kavuluru. "Enhancing timeliness of drug overdose mortality surveillance: a machine learning approach." *PloS one* 14, no. 10 (2019): e0223318.

[7]. Liu, Yang S., Derek V. Pierce, Dan Metes, Yipeng Song, Lawrence Kiyang, Mengzhe Wang, Kathryn Dong et al. "Population-level individualized prospective prediction of opioid overdose using machine learning." *Molecular Psychiatry* 30, no. 9 (2025): 4122-4127.

[8]. Nguyen, Khoa, Debbie L. Wilson, Julie Diiulio, Bradley Hall, Laura Militello, Walid F. Gellad, Christopher A. Harle et al. "Design and development of a machine-learning-driven opioid overdose risk prediction tool integrated in electronic health records in primary care settings." *Bioelectronic Medicine* 10, no. 1 (2024): 24.

[9]. Behnoush, B., E. Bazmi, S. H. Nazari, S. Khodakarim, M. A. Looha, and H. Soori. "Machine learning algorithms to predict seizure due to acute tramadol poisoning." *Human & Experimental Toxicology* 40, no. 8 (2021): 1225-1233.

[10]. Saloner, Brendan, Hsien-Yen Chang, Noa Krawczyk, Lindsey Ferris, Matthew Eisenberg, Thomas Richards, Klaus Lemke, Kristin E. Schneider, Michael Baier, and Jonathan P. Weiner. "Predictive

modeling of opioid overdose using linked statewide medical and criminal justice data." *JAMA psychiatry* 77, no. 11 (2020): 1155-1162.

[11]. Goodman-Meza, David, Chelsea L. Shover, Jesus A. Medina, Amber B. Tang, Steven Shoptaw, and Alex AT Bui. "Development and validation of machine models using natural language processing to classify substances involved in overdose deaths." *JAMA network open* 5, no. 8 (2022): e2225593.

[12]. Tai, Man Yeung Andy. "A machine learning approach to overdose risk assessment." PhD diss., University of British Columbia, 2024.

[13]. Ellis, R.J., Wang, Z., Genes, N. *et al.* Predicting opioid dependence from electronic health records with machine learning. *BioData Mining* **12**, 3 (2019). https://doi.org/10.1186/s13040-019-0193-0.