

Predicting Postoperative Complications Using Machine Learning on Anesthesia CareNet Data

Ms. Anusha P M, Sampath H M

Assistant Professor, Department of MCA, BIET, Davangere, India anupm1808@gmail.com, Davangere, India

Student, Department of MCA, BIET, Davangere, India sampathhm682@gmail.com, Davangere, India

ABSTRACT

An intelligent machine learning-based healthcare system called the Anesthesia Complication Predictor evaluates surgical and patient data to forecast the likelihood of complications during or following anesthesia. To determine whether anesthesia results are successful or complex the system uses crucial input criteria like age gender BMI type and duration of surgery anesthesia type pain level and clinical notes. Advanced data preparation techniques like textual TF-IDF vectorization standardization and one-hot encoding are used to guarantee reliable and accurate predictions. A variety of machine learning methods, such as Random Forest XGBoost and Logistic Regression are used and evaluated to determine the most efficient model. The system provides both users and administrators with a safe and engaging platform in addition to prediction capabilities. While users can register log in enter their medical information and get quick predictions as well as useful advice for lowering anesthesia Administrators are able to update and manage user accounts health-related recommendations. The system enhances clinical decision making boosts patient safety and assists medical professionals in organizing more effective anesthetic procedures by fusing predictive analytics with user management and awareness features.

Keywords: *Anesthesia Complication Prediction, Machine Learning, Logistic Regression, Random Forest, XGBoost.*

I. INTRODUCTION

The Anesthesia Complication Predictor is an AI-powered machine learning system that makes predictions the likelihood of complications during or after anesthesia using patient and surgery related information. In order to categorize results as successful or complication-free the program analyzes patterns in a dataset that includes age gender BMI type and duration of surgery anesthesia type pain levels complications and textual notes.

In order to determine the most accurate model it employs sophisticated preprocessing methods like one-hot encoding scaling and TF-IDF for text data. It then compares a variety of algorithms including Logistic Regression Random Forest and XGBoost. By offering data-driven insights for safer anesthetic management this application assists medical professionals in evaluating risks and making decisions.

Using patient and surgery-related data the machine learning-based Anesthetic Complication Predictor forecasts the likely outcome of anesthetic procedures. In order to determine whether a patient is likely to have complications (Outcome = 1) or have a smooth anesthesia experience this predictive tool examines a number of input

features such as age gender BMI length of surgery type of anesthesia standardization one-hot encoding and TF-IDF vectorization respectively to handle different types of data.

To assess the model's effectiveness objectively the dataset is split into testing and training sets.

The model that performs the best is saved for use in future predictions. With the help of this projects interactive command-line interface healthcare providers can enter new patient data and get a predicted outcome right away.

By offering data-driven insights such a Prediction models have a lot of potential for improving anesthetic planning and lowering postoperative complications in medical data analysis and risk

assessment. An effective tool for managing and forecasting anesthesia-related outcomes the Anesthesia Success Prediction System is a smart healthcare application.

Algorithm Used

The proposed Anesthesia Complication Predictor system utilizes a machine learning-based classification approach to predict the likelihood of anesthesia-related complications.

In the data preprocessing is performed to ensure data quality and consistency. Missing values in numerical and categorical attributes are handled using imputation techniques, while numerical features are standardized using scaling methods. Categorical variables such as gender and surgery type are transformed using one-hot encoding, enabling machine learning algorithms to interpret them effectively. Additionally, textual data such as clinical notes is converted into numerical form using TF-IDF (Term Frequency–Inverse Document Frequency) vectorization, which extracts meaningful patterns from text data.

Following preprocessing, the dataset is divided into training and testing sets to evaluate model performance objectively. The system then applies multiple supervised machine learning algorithms, including Logistic Regression, Random Forest, and XGBoost, to train predictive models. Each algorithm is integrated with the preprocessing pipeline using a structured workflow, ensuring that raw input data is transformed consistently before model training.

II. RELATED WORK

[1].The existing literature emphasizes that traditional anesthesia risk assessment methods primarily rely on the clinical experience and subjective judgment of anesthesiologists. These approaches involve manual evaluation of patient records, including factors such as age, Body Mass Index (BMI), type of surgery, and medical history. However, such methods lack a comprehensive and systematic mechanism to simultaneously analyze multiple risk factors, often leading to inaccuracies and increased chances of postoperative complications. The absence of automated and data-driven systems in conventional practices highlights a critical gap in ensuring precise and reliable prediction of anesthesia-related risks.

[2].Recent advancements in healthcare analytics have introduced machine learning techniques as a promising solution for predictive modeling in clinical decision- making. The reviewed work presents an intelligent system that utilizes structured and unstructured patient data to forecast anesthesia complications.

[3].By incorporating features such as age, gender, BMI, surgery duration, anesthesia

type, pain levels, and clinical notes, the system ensures a holistic analysis of patient conditions. The integration of preprocessing techniques like one-hot encoding, standardization, and TF-IDF vectorization enables effective handling of diverse data types, thereby improving prediction accuracy and robustness.

[4].Furthermore, multiple machine learning algorithms have been explored in the literature to enhance predictive performance. Techniques such as Logistic Regression, Random Forest, and XGBoost are employed and comparatively evaluated to identify the most efficient model.

[5].In addition to predictive capabilities, modern systems emphasize the importance of user interaction and system usability. The reviewed solution integrates both user and administrative modules, enabling secure registration, login, and data management. Users can input their medical details and receive real-time predictions.

[6].Overall, the literature demonstrates a clear transition from traditional manual assessment methods to intelligent, automated systems powered by machine learning. The integration of advanced data processing techniques, multiple predictive models, and user-friendly platforms significantly improves the accuracy, efficiency, and reliability of anesthesia complication prediction. This evolution highlights the growing importance of data-driven approaches in enhancing patient safety and optimizing clinical outcomes in modern healthcare systems.

III. METHODOLOGY

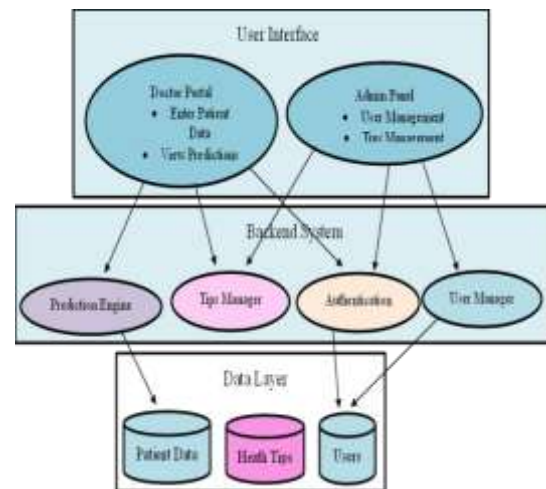


Fig 3.1: System Architecture

MODULES DESCRIPTION:

The proposed system architecture of the Anesthesia Complication Predictor is composed of three key modules—Admin Module, User Module, and Predictive Module—each designed to perform specific functional roles to ensure accuracy, usability, and secure data handling.

1) Administration Module - The Admin Module lets the administrator administer and monitor the entire system. The administrator can log in safely with proper credentials. Once logged in, the administrator can see a list of all registered users and delete any that are inactive or have incorrect information. Furthermore, the administrator can manage the health recommendations section by adding new suggestions about anesthesia and general health care or removing outdated or irrelevant ones.

2) User Module - The User Module is intended for end users such as patients or individuals who want to comprehend the risk of anesthetic problems. Users can register by entering legitimate information such as

their name, email address, and medical information. After successfully registering, users can log in with their credentials. Once logged in, users can utilize the prediction feature to see if an anesthetic issue is likely to arise based on their medical information. The system processes their data using a machine learning model and displays the predicted result as "Complication Present" or "No Complication."

3) Predictive Module - The system's core is the Prediction Module, which handles the machine learning-based prediction process. Users enter their medical information, include age, prior medical history, allergies, and anesthetic reactions. The system then uses a trained machine learning algorithm, such as Logistic Regression or Random Forest, to examine the data and make the forecast. The output is displayed to the user, indicating the possibility of an anesthetic problem. This module generates realistic and data-driven results that help consumers understand their possible dangers.

Overall, the integration of these modules establishes a seamless workflow from data input to prediction output. The methodology emphasizes not only the precision of machine learning algorithms but also the usability and operational efficiency of the system.

IV. RESULT

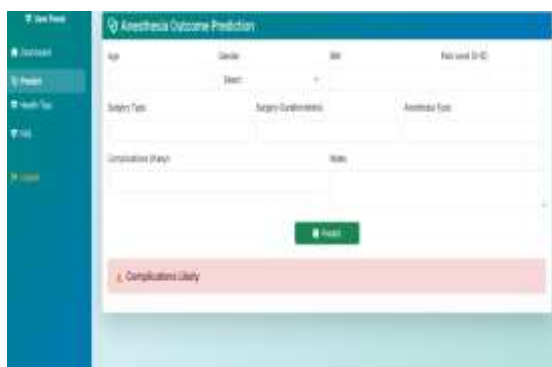


Figure 4.1: Predicting Page Displaying Complication Risk Result

As shown in the image, the output message "Complications Likely" is displayed within a highlighted alert box, indicating a higher probability of postoperative risks. This visualization not only enhances interpretability for end-users but also assists medical professionals in making informed preoperative decisions.

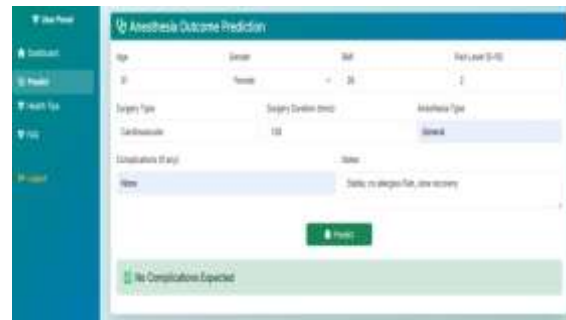


Figure 4.2: Predicting Output Indicating No Complications

It allows users to input patient details such as age, gender, BMI, pain level, surgery type, duration, and anesthesia type. Additional fields capture complications and clinical notes for more accurate analysis. After submitting the data, the system processes the inputs using a machine learning model. The displayed result indicates "No Complications Expected," providing a quick and user-friendly clinical decision support output.

V. CONCLUSION

The Anesthesia Complication Predictor project demonstrates how AI and ML can enhance clinical judgment and patient safety in the medical field. The system successfully predicts the likelihood of complications during or after surgery by evaluating patient and operation-related data such as age BMI type of surgery anesthesia type pain level and medical notes.

Precision and dependability in prediction results are ensured by combining a variety of machine learning algorithms such as

Random Forest XGBoost and Logistic Regression with sophisticated preprocessing techniques like standardization one-hot encoding and TF-IDF vectorization. In addition to prediction the system offers an intuitive platform that helps end users and administrators alike.

While the user module enables patients and medical staff to easily register log in and receive real time predictions the admin module enables safe user administration and health advice. The system becomes a thorough and useful anesthetic risk assessment solution when predictive analytics and digital health management are combined.

All things considered the project achieves its objective of offering data-driven insights to assist anesthesiologists and other medical professionals with patient monitoring and preoperative planning.

It serves as an example of how machine learning could help lower medical risks enhance evidence-based decision-making and encourage safer surgical outcomes. The Anesthesia Complication Predictor possesses the capacity to be a vital tool in modern healthcare practice with additional improvement and integration into hospital systems.

REFERENCES

[1] Title: Interpretable multi-label classification model for predicting post-anesthesia care unit complications: a prospective cohort study.

Authors: Guoting Ma, Wenjun Yan, Zunqiang Zhao, Yanjia Li & Lingkai Wang.

Link: Not provided in the reference

[2] Title: Machine learning-based prediction of post-induction hypotension: identifying risk factors and enhancing anesthesia management

Authors: Ming Chen, Dingyu Zhang, Link:

<https://doi.org/10.1186/s12911-025-02930-y>)

[3] Title: Predicting postoperative nausea and vomiting using machine learning: a model development and validation study. Authors: Maxim Glebov, Teddy Lazebnik, Maksim Katsin, Boris Orkin, Haim Berkenstadt, Svetlana Bunimovich-Mendrazitsky, Publication: BMC Anesthesiology, Volume 25, Article 135 (2025),

Link: (<https://doi.org/10.1186/s12871-025-02987-2>)

[4] Title: Machine learning in perioperative medicine: a systematic review

Authors: Valentina Bellini, Marina Valente, Giorgia Bertorelli, Barbara Pifferi, Michelangelo Craca, Monica Mordonini, Gianfranco Lombardo, Eleonora Bottani, Paolo Del Rio, Elena Bignami, Publication: Journal of Anesthesia, Analgesia and Critical Care, Volume 2, Article 2 (2022), Link: (<https://doi.org/10.1186/s44158-022-00033-y>)

[5] Title: Development and multicenter validation of machine learning models for predicting postoperative pulmonary complications after neurosurgery.

Authors: Ming Xu, Wenhao Zhu, Siyu Hou, Hongzhi Xu, Jingwen Xia, Liyu Lin