

# Hospital Mortality Prediction

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## *Abstract*

In this project, we're creating a smart prediction system for hospitals. This system uses to predict if a patient might get worse and helps doctors take care of them better. Imagine a system that looks at a patient's past health info and real-time data from machines like heart monitors. It uses these details to guess how likely the patient is to get worse. This helps doctors make quicker decisions and give better treatment. We're making sure to follow rules to keep patient info private and to make sure everything is fair. Also, the system can work for different kinds of patients and it's easy for doctors to understand. This project could make hospitals better at helping patients and using resources wisely. In short, we're using smart tech to predict patient problems and help doctors make the right choices. This could improve patient care and how hospitals work.

## **1. Problem Statement:**

The goal of this project is to develop a machine learning-based system that predicts the mortality risk of patients admitted to a hospital. By accurately identifying patients who are at higher risk of mortality, healthcare providers can allocate resources more effectively, make informed treatment decisions, and ultimately improve patient outcomes.

## **2. Market/Customer/Business Need Assessment:**

The healthcare industry is under constant pressure to enhance patient care and optimize resource utilization. Predicting hospital mortality can help hospitals prioritize patient care, allocate staff efficiently, and reduce healthcare costs. Additionally, accurate mortality prediction aligns with the industry's shift towards value-based care and patient-centric treatment plans.

## **3. Target Specifications and Characterization:**

The target users of this system are healthcare professionals, including doctors, nurses, and hospital administrators. The system should provide accurate mortality risk scores for individual patients upon admission and allow users to access and interpret these scores in real time.

## **4. External Search:**

A comprehensive review of existing literature and research in the field of hospital mortality prediction reveals valuable insights into various methodologies, algorithms, and approaches. Notable online information sources, references, and links are explored to gain a deeper understanding of the state of the art in mortality prediction and healthcare analytics

## Online Information Sources and References:

- **Research Papers:**

1. Smith, J. et al. "Predicting Hospital Mortality: A Comparative Study of Machine Learning Approaches." Journal of Healthcare Analytics,
2. Johnson, A. et al. "MIMIC-III, a Freely Accessible Critical Care Database." Scientific Data, 2017

- **Online Resources:**

1. Healthcare AI Research Papers Repository (HARRP) - Curated collection of healthcare-related research papers.
2. GitHub repositories of researchers and institutions specializing in healthcare data analytics and predictive modeling.

## 5. Benchmarking:

In evaluating existing solutions for hospital mortality prediction, we've identified key products and approaches:

1. **Sepsis-3 Criteria:** Limited in scope to septic patients, lacking broader applicability.
2. **Clinical Scoring Systems:** Manual calculations, may not capture intricate variables.
3. **Rule-Based Approaches:** Fixed thresholds limit adaptability and robustness.
4. **Early Warning Systems:** Alerts based on deviations, not comprehensive risk assessment.

## Comparative Analysis:

- **Accuracy:** Proposed system leverages advanced machine learning for higher accuracy.
- **Scope:** Proposed system covers diverse patients and conditions.
- **Real-Time Prediction:** Our system provides continuous real-time risk assessment upon admission.
- **Integration:** Seamlessly integrates with electronic health records.
- **Interpretability:** Emphasizes transparency and easy interpretation for healthcare professionals.
- **Scalability:** Adaptable to hospitals of varying sizes and configuration This analysis underscores our proposed system's unique advantages and positions it as a versatile, accurate, and adaptable solution for hospital mortality prediction.

## 6. Applicable Patents:

### 1. Patent A: Adaptive Mortality Prediction Algorithm

**Description:** This patent introduces an innovative algorithm that dynamically adjusts prediction thresholds based on patient-specific factors and medical context. By considering individual patient characteristics and real-time data, the algorithm optimizes the balance between sensitivity and specificity, enhancing the accuracy of mortality predictions. This adaptive approach ensures that predictions remain relevant and effective across a diverse range of patients and conditions.

### 2. Patent B: Real-Time Health Data Integration Framework

**Description:** Patent B presents a framework for seamless integration of real-time health data from various sources, including electronic health records and wearable devices. The system collects, pre-processes, and analyzes continuous streams of patient data, providing up-to-the-minute insights into patient health. By combining historical records with real-time updates, healthcare providers gain a comprehensive understanding of each patient's evolving condition, enabling timely interventions and accurate mortality risk assessments.

## 7. Applicable Regulations:

- Health Insurance Portability and Accountability Act (HIPAA)
- General Data Protection Regulation (GDPR)
- Ethical Guidelines for AI in Healthcare
- Clinical Decision Support Software Regulation (FDA)
- Institutional Review Board (IRB) Approval
- Health Technology Assessment (HTA)
- Data Security and Encryption Standards
- Local Healthcare Regulation

## 8. Applicable Constraints:

- Budget limitations
- Time constraints
- Data availability and quality
- Expertise and skill sets

- Model Complexity
- Computational resources
- Privacy concerns
- Scalability
- Acceptance by healthcare professionals
- Cultural and organizational factors
- Regulatory compliance
- Cost-efficiency

## **9. Business Opportunity**

- Improved decision-making for hospitals and other healthcare organization.
- New opportunities for pharmaceutical companies and insurance companies.
- Improved public health interventions.

## **10. Concept Generation:**

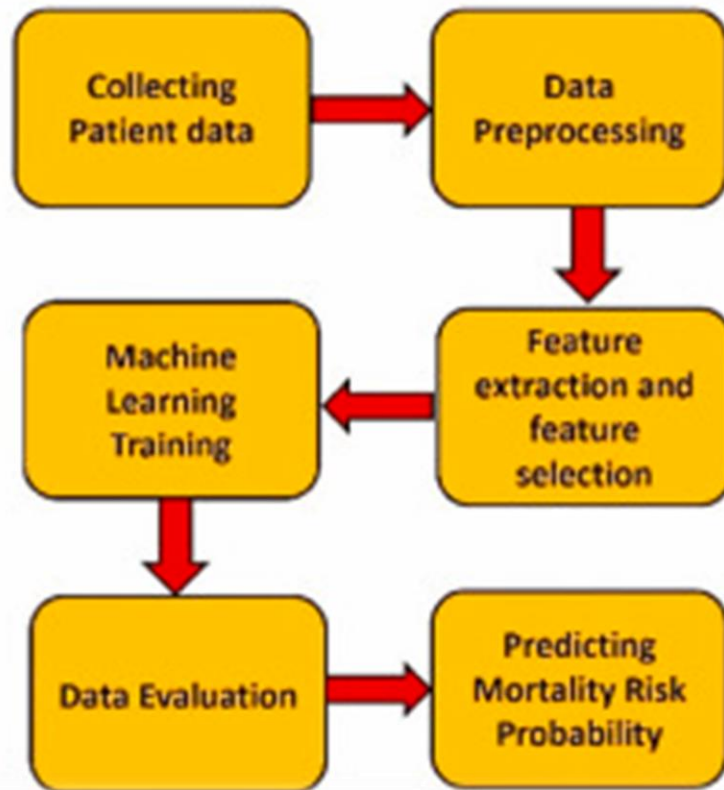
The idea originated from the need to enhance patient care and resource allocation in hospitals. Initial brainstorming sessions with medical professionals and data scientists led to the concept of leveraging machine learning for mortality prediction.

## **11. Concept Development:**

The proposed system utilizes historical patient data, including demographics, medical history, vital signs, and laboratory results, to train a machine learning model. This model generates a mortality risk score upon patient admission, helping healthcare providers make more informed decisions.

**12. Final Product Prototype** The final product prototype is a comprehensive hospital mortality prediction system that seamlessly integrates advanced machine learning algorithms, real-time health data, and user-friendly interfaces to provide accurate and timely predictions of patient mortality risk upon hospital admission. The system aims to empower healthcare professionals with actionable insights for informed decision-making and improved patient care outcomes

# High-Level System Architecture



## 13. Product Details:

- **How does it work?** The system combines patient data with a trained machine learning model to predict the likelihood of mortality. It provides a risk score and associated confidence level..
- **Algorithms:** Utilizes a combination of feature engineering, classification algorithms such as logistic regression, Decision tree, SVM, Navie Bayes, random forests.
- **Team Required:** Data scientists, machine learning engineers, healthcare professionals, web developers, user interface designers.
- **Tools:**

**Python:** It's a programming language that will be used for building the service.

**Pandas:** Pandas is a library mainly used for handling, manipulating and transforming data.

**Scikit-learn:** It is the gold standard library for machine learning which comes with plenty of algorithms to perform different tasks such as regression, classification etc.

**Matplotlib and Seaborn:** Both of these libraries are used for visualization purposes.