

Maternal-Guard & Life-Link

AI-Driven Maternal Risk Monitoring & Emergency Donor Network

1. Introduction

Maternal mortality remains a major health concern, especially in rural and low-resource settings. Many maternal deaths occur due to delayed recognition of complications such as postpartum hemorrhage, hypertension, infection, and gestational diabetes. Quick risk identification and timely blood availability are critical during emergencies.

Maternal-Guard & Life-Link is an AI-based web application designed to:

- Predict maternal health risk using clinical vitals
- Provide explainable risk analysis
- Automatically activate an emergency donor matching system for high-risk cases

The system combines machine learning with donor compatibility filtering to improve emergency response in maternal healthcare.

2. Problem Statement

In many healthcare centers:

- Risk assessment is manual and subjective.
- Emergency donor networks are not well organized.
- Blood availability delays increase mortality risk.

The objective of this project is to create a system that:

1. Classifies maternal patients into Low, Moderate, or High risk.
2. Provides transparency through feature importance.
3. Activates compatible donor matching when High Risk is detected.

3. Dataset and Features

We used the Maternal Health Risk dataset from Kaggle.

Input Features:

- Age
- Systolic Blood Pressure

- Diastolic Blood Pressure
- Blood Sugar (mmol/L)
- Body Temperature (°F)
- Heart Rate

Target: Risk Level (Low / Mid / High)

Data Preprocessing:

- Removed unrealistic age values
- Filtered abnormal heart rate entries
- Ensured consistent blood sugar units
- Applied 80-20 stratified train-test split

Final cleaned dataset: 863 records.

4. Machine Learning Model

Model Used:

Random Forest Classifier

Why Random Forest?

- Handles nonlinear relationships between vitals
- Works well with medical tabular data
- Resistant to overfitting
- Provides feature importance (Explainable AI)

Model Performance:

- Accuracy: 75%
- F1-score (High Risk): 0.84
- Recall (High Risk): 0.86

The high recall ensures severe cases are not missed.

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... Confusion Matrix:
[[66  4  1]
 [25 26  7]
 [ 1  5 38]]

Classification Report:
              precision    recall   f1-score   support
             0       0.72      0.93      0.81      71
             1       0.74      0.45      0.56      58
             2       0.83      0.86      0.84      44

accuracy          0.75
macro avg       0.76      0.75      0.74      173
weighted avg    0.75      0.75      0.73      173
```

5. Risk Threshold Optimization

To reduce unnecessary emergency alerts, a stricter probability threshold (≥ 0.85) was applied for High Risk classification.

If confidence is lower than 0.85, the case is treated as Moderate Risk.

This improves reliability and prevents false emergency activation.

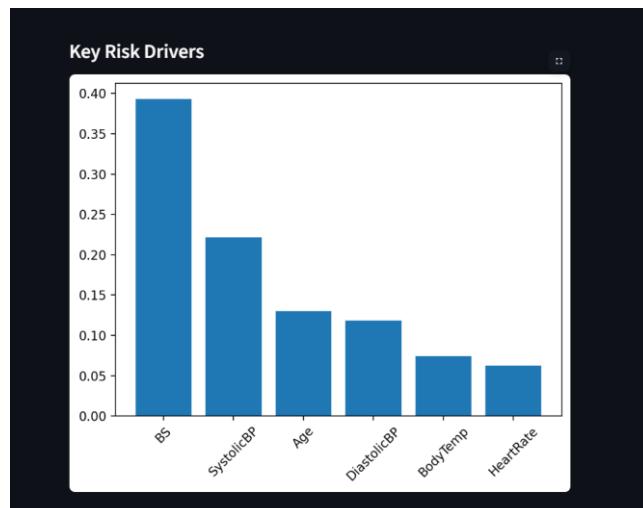
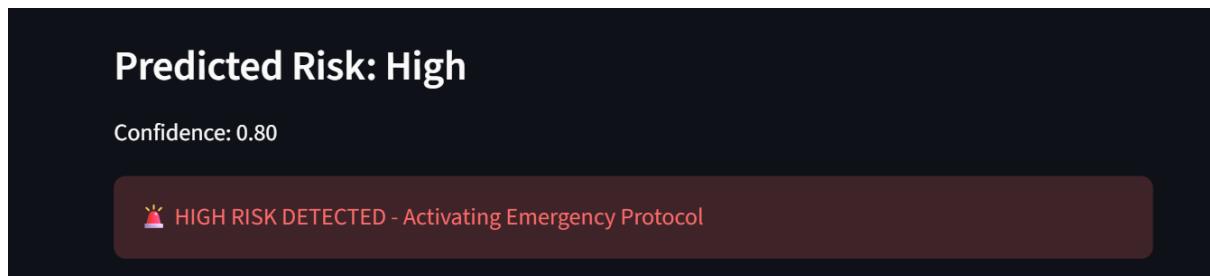
6. Explainable AI

The system displays feature importance to help healthcare workers understand why a prediction was made.

Key Risk Drivers:

1. Blood Sugar (~39%)
2. Systolic Blood Pressure (~22%)
3. Age (~13%)

This aligns with medical knowledge that hypertension and gestational diabetes are major contributors to maternal complications.



7. Emergency Donor Matching System

When a High Risk case is detected, the Life-Link module activates donor matching.

Donor filtering criteria:

- Compatible blood group
- Hemoglobin > 12.5 g/dL
- Age between 18–50
- Status = Available

Compatibility follows standard transfusion rules:

- O-negative → universal donor
- AB-positive → universal recipient

This ensures medically safe and eligible donor selection.

The screenshot shows a user interface for donor matching. At the top, there is a dropdown menu labeled "Blood Group" with "O-" selected. Below it is a button labeled "Check Compatible Donors". The main area displays a title "Compatible Donors for O-". A message box states "Only medically eligible and blood-compatible donors are shown." Below this, a table lists two compatible donors:

	Name	BloodGroup	Age	Hemoglobin	Status
0	Asha	O-	22	13.5	Available
7	Ravi	O-	24	14	Available

8. System Architecture

The system has three main layers:

1. Frontend (Streamlit)

- User-friendly interface
- Real-time alerts
- Risk visualization

2. Prediction Layer

- Random Forest classification
- Probability threshold control

- Feature importance extraction

3. Emergency Dispatch Layer

- Donor compatibility filtering
- Emergency display dashboard

The modular design allows easy future expansion to SQL or cloud databases.

9. Ethical Considerations

- No sensitive patient data is stored.
- Donor availability can be toggled (consent-based).
- The model uses physiological features only, reducing bias.
- Probability threshold prevents false panic.

The system is designed to support, not replace, medical professionals.

10. Conclusion

Maternal-Guard & Life-Link demonstrates how AI can support maternal healthcare by combining:

Risk Prediction + Explainability + Emergency Donor Matching

The system provides early warning for maternal complications and ensures faster access to compatible donors during emergencies.

With further integration into hospital systems, this approach can improve maternal survival rates and strengthen rural healthcare infrastructure.