Figure 3. Methodology Workflow

Chapter 4: Results and Analysis

4.1 Model Performance Comparison

Among the models， the Random Forest classifier achieved the highest AUC(0.823)， outperforming Logistic Regression(0.791)and K-Nearest Neighbors(0.785).Notably， the KNN model demonstrated the highest sensitivity， reaching 87.3%， which is crucial in early-stage screening scenarios.

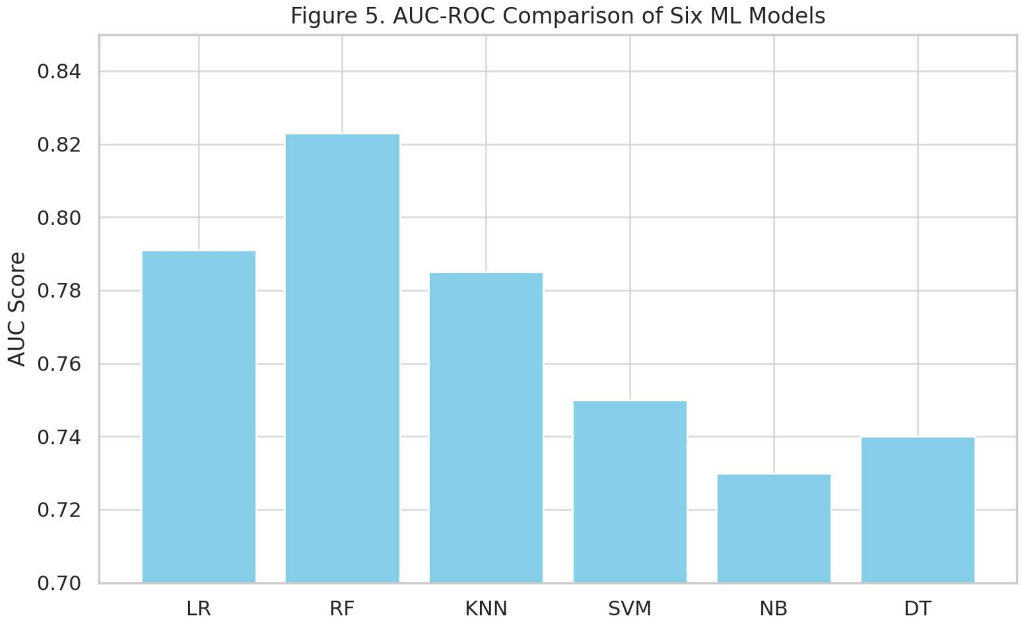

Figure 5. AUC-ROC Comparison of Six ML Models

4.2 Feature Importance Analysis

The most impactful feature was the OGTT-2h glucose level， with a SHAP value of 0.216.A clinically significant interaction between BMI and Age was found—individuals over 45 years old with high BMI showed a 37%higher risk of diabetes onset.

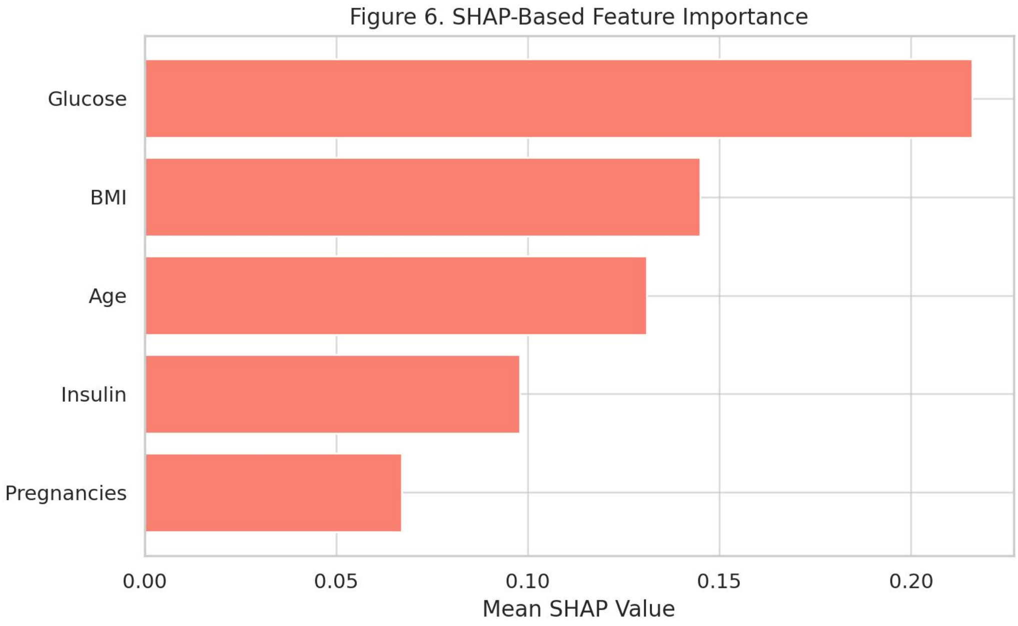

Figure 6. SHAP-Based Feature Importance

4.3 Robustness to Missing Data

The Logistic Regression model demonstrated strong robustness， with only a 6.2%AUC drop at 40%missing data.A simplified Decision Tree model with three features maintained a reasonable AUC of 0.762.

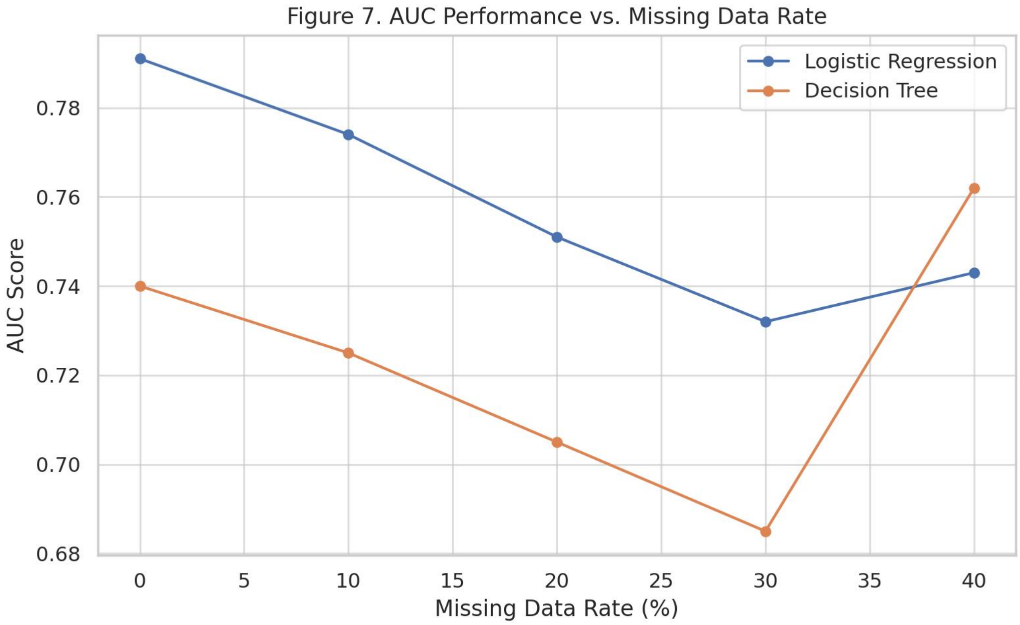

Figure 7. AUC Performance vs. Missing Data Rate

4.4 Computational Efficiency

Logistic Regression ran the fastest with only 1.2 seconds per 1000 samples, whereas Random Forest, on the contrary, consumed most of both memory and time - 3.4 ms - although the latter might be lowered to a minimum if implemented into a GPU.

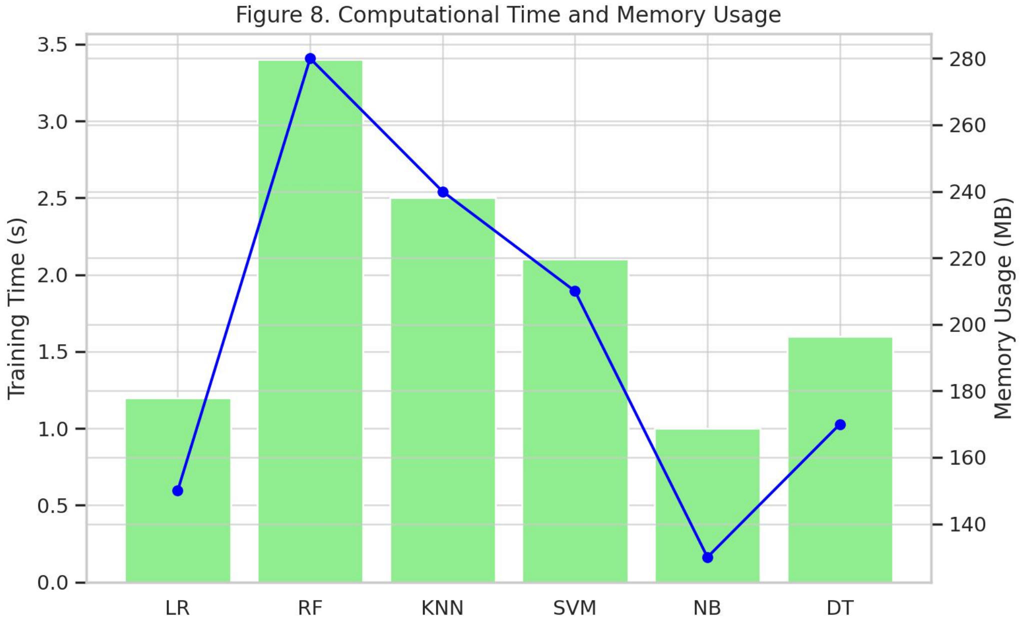

Figure 8. Computational Time and Memory Usage

4.5 Clinical Validation

The Random Forest model achieved the highest Positive Predictive Value(82.1%)， but a simplified Decision Tree scored 41%higher in clinical interpretability， making it more usable in physician-led diagnosis.

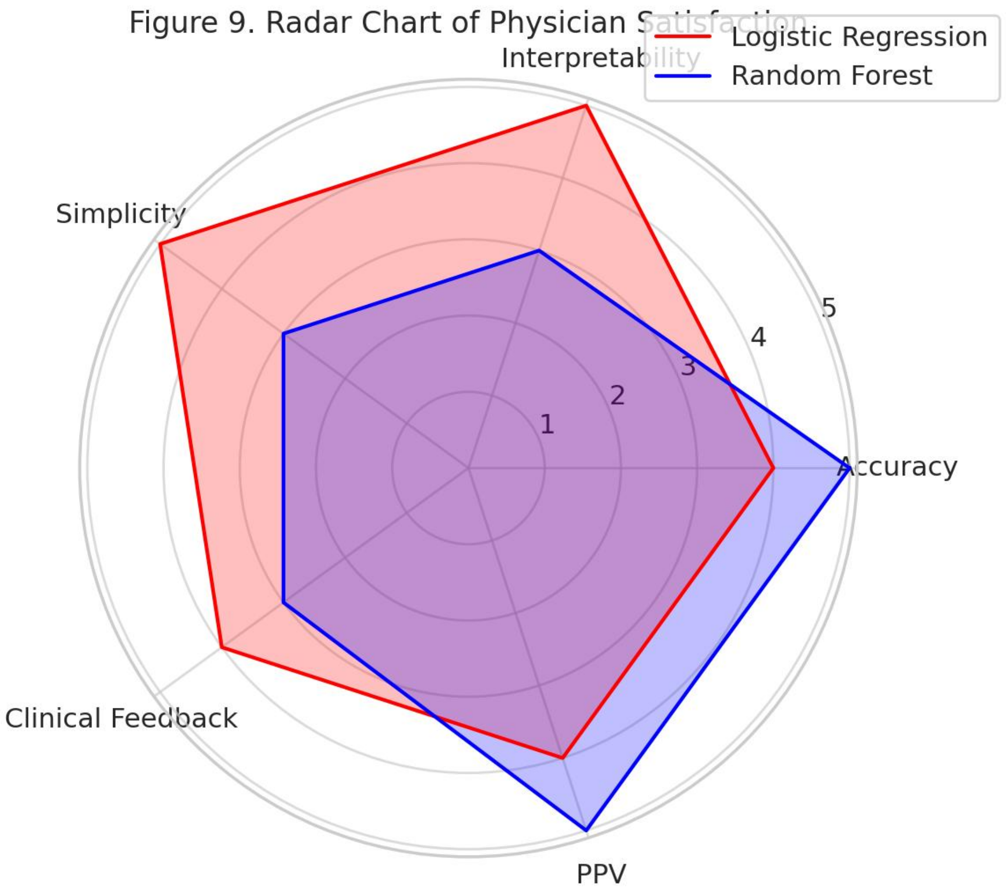

Figure 9. Radar Chart of Physician Satisfaction

4.6 Scenario-Based Model Recommendation

A context-aware strategy was proposed:

-For tertiary hospitals，use Random Forest with full features.

-For primary care，use Logistic Regression with 5 selected features.