Supplementary materials

Table 1. Comparison of model performances according to different balancing techniques.

Technique	Model	Accuracy	AUC	Notes on Metrics
None	Gaussian Naive Bayes	0.636	0.788	Baseline performance without resampling; AUC indicates moderate discrimination despite low accuracy.
	Multinomial Naive Bayes	0.764	0.788	Accuracy was higher than GNB, while AUC was equivalent, suggesting similar ranking capacity.
	Bernoulli Naive Bayes	0.727	0.629	Lower AUC indicates limited class separation when predictors are treated in binary form.
	Logistic Regression	0.545	0.776	Accuracy was low, but AUC remained acceptable, indicating sensitivity to classification threshold.
	Random Forest	0.764	0.694	Accuracy was relatively high, but lower AUC suggests weaker discrimination between mortality timing groups.
	Decision Tree	0.673	0.512	AUC was close to random classification, indicating poor discriminative ability.
	Support Vector Machine	0.727	0.800	Highest AUC among the imbalanced models, suggesting comparatively better discrimination without resampling.
	Neural Network	0.727	0.729	Moderate performance, with no advantage over simpler classifiers in the imbalanced setting.
	Hill Climbing Bayesian Network	0.236	0.500	Performance was equivalent to random discrimination after Bayesian Network structure learning.
	PC Algorithm Bayesian Network	0.236	0.500	Performance was equivalent to random discrimination using the constraint-based structure learning approach.

SMOTE	Gaussian Naive Bayes	0.818	0.788	Accuracy improved after oversampling, although AUC remained unchanged compared with baseline GNB.
	Multinomial Naive Bayes	0.727	0.765	Moderate discrimination after synthetic oversampling.
	Bernoulli Naive Bayes	0.727	0.535	AUC remained low, indicating limited benefit from SMOTE for this model.
	Logistic Regression	0.636	0.706	Resampling improved accuracy compared with baseline LR, but AUC decreased.
	Random Forest	0.764	0.747	AUC improved compared with the imbalanced RF model.
	Decision Tree	0.818	0.671	Accuracy improved, but AUC remained moderate, suggesting possible threshold or class-distribution effects.
	Support Vector Machine	0.818	0.800	Accuracy improved while AUC remained equal to baseline SVM.
	Neural Network	0.764	0.741	Moderate improvement relative to the imbalanced neural network model.
ADASYN	Gaussian Naive Bayes	0.818	0.847	Highest AUC overall, indicating the best discrimination among the evaluated model-resampling combinations.
	Multinomial Naive Bayes	0.673	0.741	Moderate discrimination, but lower accuracy than GNB under ADASYN.
	Bernoulli Naive Bayes	0.673	0.618	Limited benefit from ADASYN when using Bernoulli Naive Bayes.
	Logistic Regression	0.673	0.753	Acceptable AUC, but no clear advantage over simpler ADASYN-based alternatives.
	Random Forest	0.764	0.794	Strong discrimination after adaptive oversampling, close to SVM and GNB performance.

	Decision Tree	0.727	0.612	Modest accuracy but weak AUC, indicating limited discriminative stability.
	Support Vector Machine	0.818	0.824	Strong performance, with the second-highest AUC among ADASYN-based models.
	Neural Network	0.764	0.741	Moderate performance, with no clear advantage over simpler models.
Random Oversampling	Gaussian Naive Bayes	0.764	0.812	AUC improved compared with baseline GNB, suggesting benefit from simple oversampling.
	Multinomial Naive Bayes	0.727	0.800	Strong AUC despite moderate accuracy.
	Bernoulli Naive Bayes	0.673	0.629	Performance remained limited, similar to the imbalanced Bernoulli NB model.
	Logistic Regression	0.545	0.765	AUC was acceptable, but accuracy remained low.
	Random Forest	0.673	0.700	Moderate AUC, with lower accuracy than baseline RF.
	Decision Tree	0.673	0.512	AUC remained close to random classification.
	Support Vector Machine	0.673	0.835	High AUC despite lower accuracy, suggesting threshold-dependent performance.
	Neural Network	0.727	0.718	Moderate performance without clear improvement over baseline NN.
SMOTE+Tomek	Gaussian Naive Bayes	0.818	0.788	Accuracy improved, but AUC remained equivalent to baseline GNB.
	Multinomial Naive Bayes	0.727	0.765	Similar to SMOTE alone, with moderate discrimination.
	Bernoulli Naive Bayes	0.727	0.547	AUC remained low despite data cleaning with Tomek links.
	Logistic Regression	0.764	0.729	Accuracy improved substantially, but AUC was only moderate.

	Random Forest	0.818	0.800	Strong combined accuracy and AUC after hybrid resampling.
	Decision Tree	0.727	0.612	Moderate accuracy but weak discrimination.
	Support Vector Machine	0.818	0.812	Strong performance, with high accuracy and AUC.
	Neural Network	0.764	0.741	Moderate performance like SMOTE and ADASYN neural network results.
SMOTE+ENN	Gaussian Naive Bayes	0.818	0.694	Accuracy remained high, but AUC decreased, suggesting weaker class separation.
	Multinomial Naive Bayes	0.636	0.673	Lower performance compared with SMOTE and SMOTE+Tomek.
	Bernoulli Naive Bayes	0.582	0.512	AUC was close to random discrimination.
	Logistic Regression	0.545	0.624	Limited performance after combined over- and under-sampling.
	Random Forest	0.673	0.776	AUC remained acceptable despite lower accuracy.
	Decision Tree	0.636	0.624	Weak-to-moderate discrimination.
	Support Vector Machine	0.636	0.741	Moderate AUC, but lower accuracy than other SVM-resampling combinations.
	Neural Network	0.582	0.647	Limited performance, suggesting that SMOTE+ENN did not improve NN classification.

Note. Accuracy and AUC values were calculated on the independent test set. Resampling methods were applied only to the training data, while the original test set was preserved for model evaluation. Bayesian Network models were evaluated on the original imbalanced dataset after discretization of numerical variables and are therefore reported only under the “None” condition.