



Machine Learning Based Prediction for Nephrotoxicity in Oncology Patients with Chemotherapy

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BACKGROUND

Predicting chemotherapy-induced nephrotoxicity is essential to prevent:

- Treatment interruption.
- Regimen adjustments.
- Increasing risk of chronic kidney disease (CKD)

The study aims:

- To develop machine-learning (ML) prediction models for chemotherapy-associated acute kidney injury (AKI) and acute kidney disease (AKD).
- To support clinicians' decision-making.

METHODS

- **Patients:** receiving cisplatin, carboplatin, ifosfamide, methotrexate, pemetrexed, or gemcitabine
- **Data:** Shuang Ho Hospital, Taipei Veterans General Hospital, and Taipei Medical University Hospital were split into training and validation sets, and data from Wanfang Hospital served as the test set.
- **Algorithm:** Light Gradient Boosting Machines (LGBM) and other algorithms were employed.
- **Model performance:** the area under the receiver operating characteristic curve (AUROC) and other metrics.
- **Fairness assessment:** the equalized odds (EOs) across sensitivity groups.
- **Model explanation:** the Shapley additive explanation (SHAP).

RESULTS

Figure 1. Model performance (AUROC) for ML model.

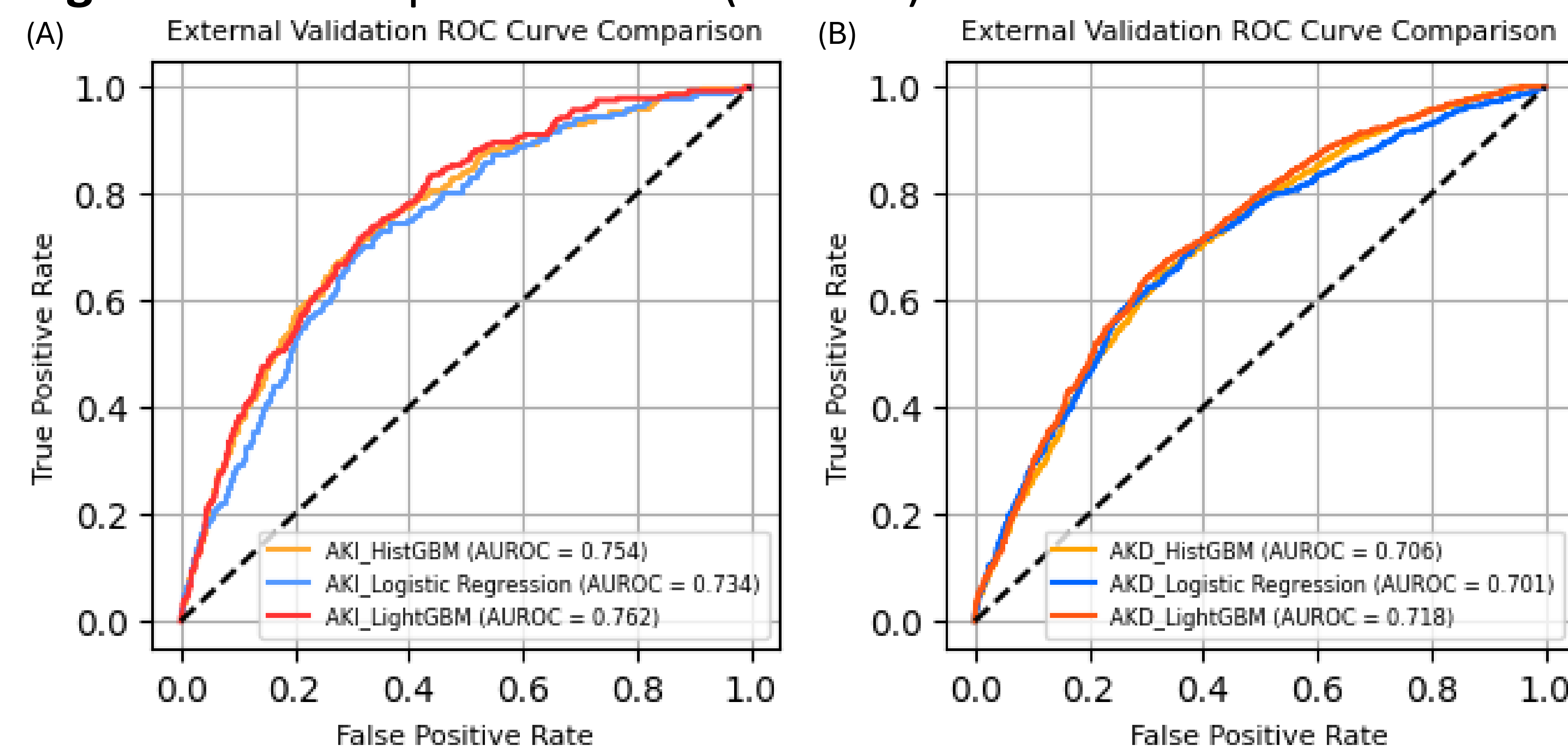
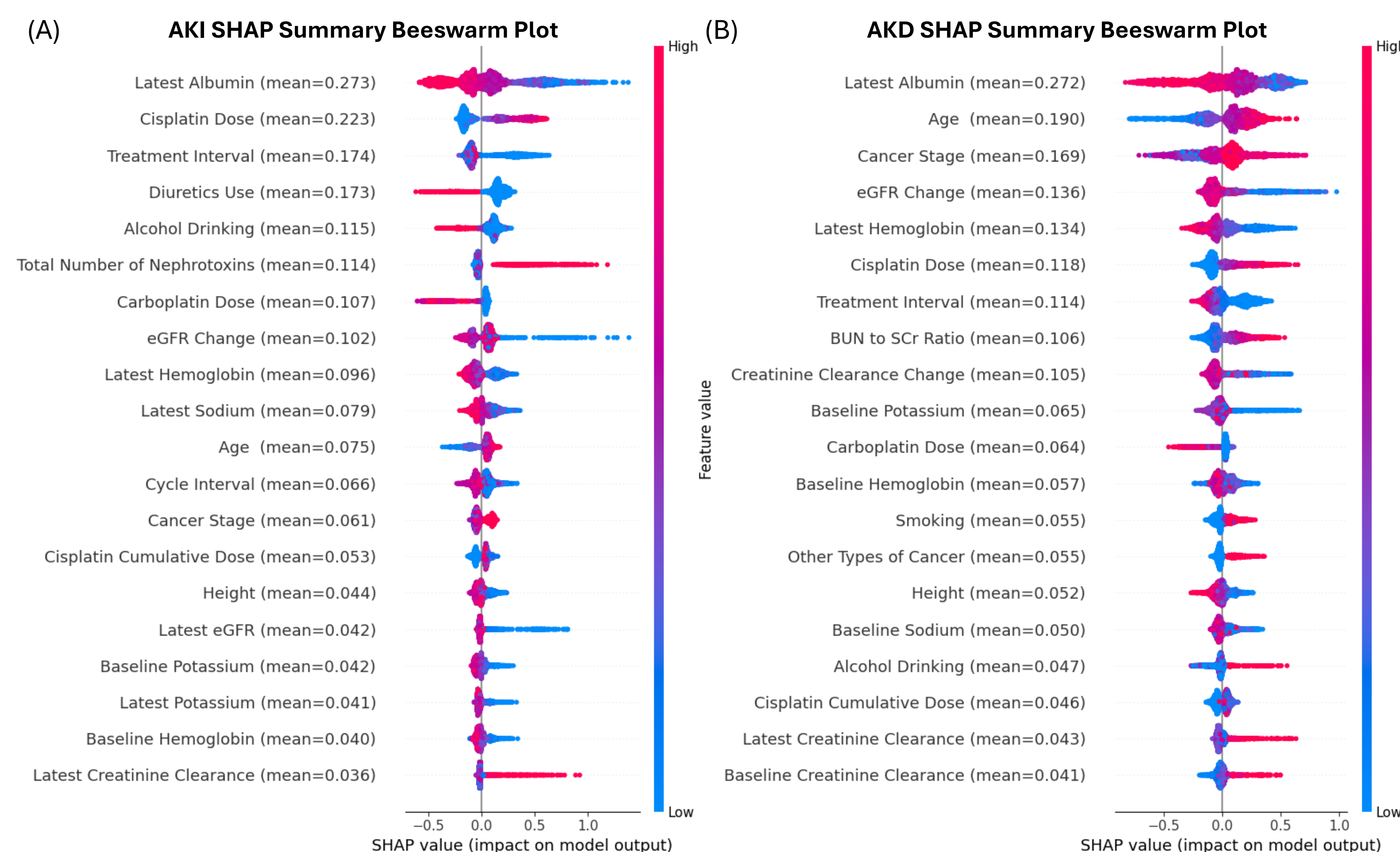


Figure 2. SHAP beeswarm plot for model explanation.



The top five features

- AKI: the latest albumin (alb) level, diuretics use, cisplatin dose, treatment interval, and alcohol use.
- AKD: the latest alb level, age, cancer stage, the difference of eGFR, and the latest hemoglobin level.

Table 1. Fairness assessment for the sensitivity groups.

Fairness Assessment for AKI		AUROC	TPR	FPR	EO
All		0.762	0.286	0.083	-
Gender	Male	0.598	0.271	0.074	V
	Female	0.618	0.333	0.097	V
Age	18-40	0.718	0.500	0.064	V
	40-65	0.612	0.298	0.074	V
	65-	0.576	0.262	0.109	V
Chemotherapeutics	Cisplatin	0.698	0.268	0.106	V
	Carboplatin	0.788	0.257	0.042	V
	Others	0.793	0.429	0.098	V

Fairness Assessment for AKD		AUROC	TPR	FPR	EO
All		0.718	0.503	0.210	-
Gender	Male	0.618	0.435	0.198	V
	Female	0.680	0.590	0.231	V
Age	18-40	0.611	0.466	0.244	V
	40-65	0.641	0.459	0.176	V
	65-	0.654	0.604	0.296	V
Chemotherapeutics	Cisplatin	0.688	0.487	0.248	V
	Carboplatin	0.710	0.476	0.174	V
	Others	0.742	0.582	0.228	V

Both model passed the EO assessment in different genders, ages, and chemotherapeutic groups.

- Threshold set up at the probability that balanced precision and recall.

CONCLUSION

- Established machine learning models to predict AKI and AKD during chemotherapy:
- Could be incorporated in a clinician decision support system
 - Aid in preventing nephrotoxicity in clinical practice.