

Introduction

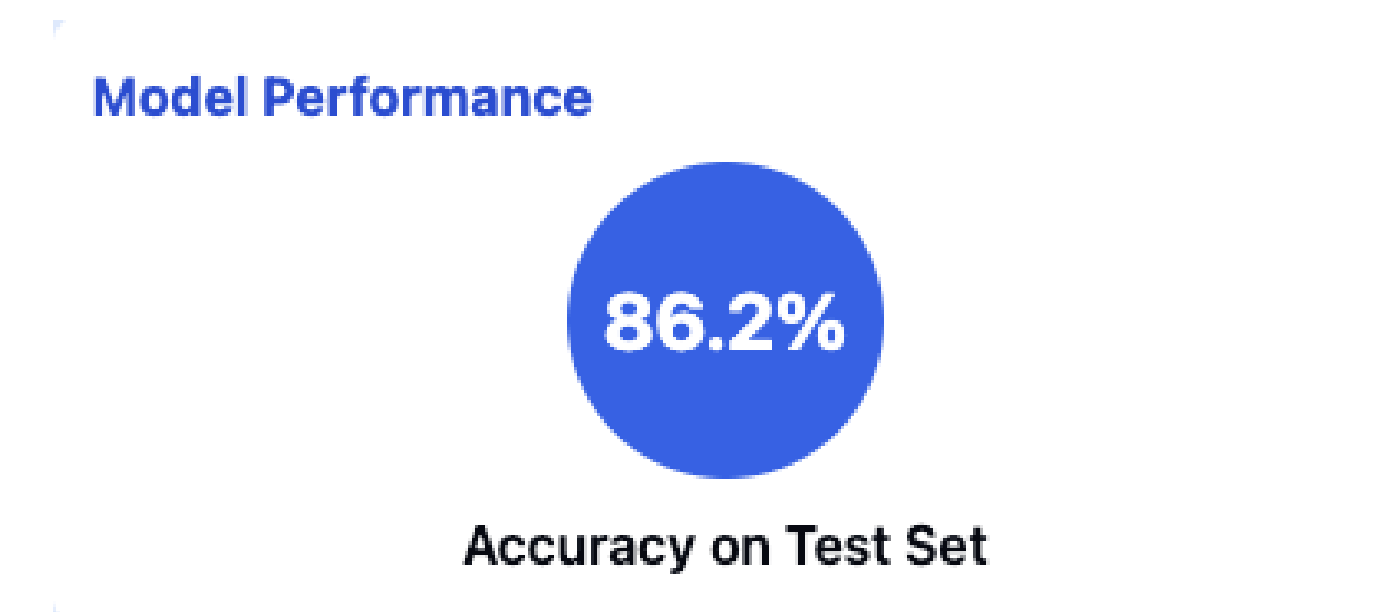
- Lymphedema remains a debilitating complication of cancer treatment despite preventive strategies.
 - Immediate Lymphatic Reconstruction (ILR) reduces but does not eliminate lymphedema risk.
 - Early prediction enables targeted surveillance and timely intervention.
 - AI-driven risk assessment may optimize resource allocation and improve clinical outcomes.
- Objective**
 - To develop an artificial intelligence model using the XGBoost algorithm for predicting lymphedema occurrence following immediate lymphatic reconstruction.

Methods

- Study Design:**
 - Retrospective analysis of patients who underwent ILR following complete axillary lymph node dissection
 - Standardized clinical assessment for lymphedema diagnosis (>10% volume difference between limbs)
 - Regular follow-up intervals with sequential volume measurements
- Inclusion Criteria:**
 - Complete axillary lymph node dissection
 - Successful immediate lymphatic reconstruction
 - Complete follow-up data availability
 - Standardized lymphedema assessment documentation
- XGBoost AI Model Development:**
 - Comprehensive dataset including demographics, surgical parameters, and oncologic treatments
 - Dataset split: Training (70%), Validation (20%), Testing (10%)
 - Python implementation with scikit-learn and XGBoost libraries
 - Hyperparameter optimization through grid search and cross-validation
 - Accuracy metric chosen for model performance evaluation

Results

- Patient Demographics:**
 - 145 patients analyzed, mean follow-up: 1025.8 days (range: 293-1928 days)
 - Predominantly mastectomy patients (82.1%, n=119)
 - Mean age: 54.4 years; Mean BMI: 28.7
- Surgical & Treatment Characteristics:**
 - Mean lymph nodes removed: 15.6 (range: 3-41)
 - Anastomosis types: Intussusception (61.4%), End-to-end (35.9%), Other (2.7%)
 - Mean anastomoses per patient: 1.8; Mean drain duration: 14.2 days
 - Chemotherapy: 93.8% (n=136); Radiation: 89.7% (n=130)
 - Reconstruction: Tissue expander (44.1%), None (35.9%), Oncoplastic (10.3%)
- Clinical Outcomes:**
 - Lymphedema diagnosis rate: 13.1% (n=19)
 - Mean time to lymphedema diagnosis: 532.7 days
- AI Model Performance:**
 - Accuracy on independent test set: 86.20%
 - Robust performance across diverse patient subgroups
 - Consistent prediction across varied reconstruction techniques



- Lymphedema vs. Non-Lymphedema Groups:**
 - Higher BMI in lymphedema patients (31.1 vs. 28.3)
 - Slightly younger lymphedema patients (52.0 vs. 54.8 years)
 - Similar lymph node removal (15.7 vs. 15.6)
 - Higher neoadjuvant chemotherapy in lymphedema group (78.9% vs. 72.2%)
 - Similar radiation therapy rates (89.5% vs. 89.7%)

Discussion

- Clinical Significance:**
 - The 86.2% accuracy demonstrates robust predictive capability for real-world clinical application
 - Lymphedema occurrence rate of 13.1% highlights that risk persists despite preventive ILR
 - Mean time to diagnosis (532.7 days) underscores need for extended surveillance
- Risk Factor Interpretation:**
 - Higher BMI in lymphedema patients (31.1 vs. 28.3) suggests potential modifiable risk factor
 - Similar lymph node removal counts between groups indicates factors beyond surgical extent influence risk
 - Neoadjuvant chemotherapy association warrants targeted monitoring for these patients
- Implementation Considerations:**
 - Model can be integrated into current EHR systems for automated risk stratification
 - Stratified surveillance protocols can be developed based on predicted risk levels
 - AI-assisted decision-making complements clinical judgment
- Comparative Advantages:**
 - First AI model specifically developed for post-ILR lymphedema prediction
 - Incorporates comprehensive surgical variables specific to plastic surgery practice
 - Performance exceeds traditional statistical models reported in the literature

Clinical Implications		
Risk Stratification Identifies high-risk patients despite preventive ILR	Resource Optimization Focuses monitoring on patients who would benefit most	Clinical Decision Support Augments clinical judgment with data-driven assessment

Conclusion

- XGBoost AI model demonstrates robust predictive capability (86.20% accuracy) for post-ILR lymphedema risk.
- The model successfully identifies patients at risk despite preventive lymphatic reconstruction.
- AI prediction tools show promise for enhancing clinical decision-making in lymphedema management.
- Future directions include external validation and integration with multimodal clinical data