Optimizing Head and Neck Cancer Chemotherapy Decisions by Integrating Cox Proportional Hazards Model and Multi-Choice Goal Programming

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Abstract:

Head and neck cancer (HNC) is a prevalent malignancy with high mortality rates, posing significant challenges in clinical treatment. Despite advancements in therapeutic strategies, chemotherapy decision-making remains complex due to disease heterogeneity and patient-specific factors. Current approaches often rely on empirical methods and general clinical guidelines, which may not fully account for individual patient characteristics. To improve survival outcomes and enhance personalized treatment planning, a more systematic and data-driven approach is needed. This study aims to develop an optimized HNC Chemotherapy Decision Support Model (HNC-CDSM) by integrating the Cox Proportional Hazards Model (CPHM) and Revised Multi-Choice Goal Programming (RMCGP). The model leverages Cox regression to identify key survival predictors and applies RMCGP to optimize chemotherapy regimen selection based on multiple clinical objectives, status event-free survival, treatment-related toxicity, and patient performance status. Validation using real-world

clinical data demonstrates that the proposed model will significantly improves survival outcomes, reducing 14-day mortality rates after a last treatment from 14.29% to 10% expectedly, thus offering a more precise and patient-centered chemotherapy strategy. By integrating statistical modeling with multi-objective optimization, this study presents a novel decision-support framework that enhances treatment precision, reduces resource utilization, and improves overall patient outcomes. The proposed HNC-CDSM can be extended to other cancer types, contributing to data-driven decision-making in oncology.

Keywords:

Cox Proportional Hazards Model, Head and Neck Cancer, Chemotherapy Decision Support Model, Revised Multi-Choice Goal Programming, Survival Analysis.