



Shaping Tomorrow's Nephrology: Insight-Driven Kidney Care

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Predicting Clinical Outcomes in ESKD Patients: A Transformer-Based Survival Analysis Approach

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Objectives : Patients with end-stage kidney disease (ESKD) initiating maintenance hemodialysis continue to experience high mortality despite advances in dialysis care. Prognostic prediction in this population is challenging due to substantial heterogeneity and dynamic, time-dependent changes in clinical risk. Our study proposes an effective method for extrapolating time-varying patterns for better survival prediction.

Methods : We developed Extrapolated Transformer Networks for Survival Analysis (ExtraSurv), a transformer-based survival model designed for time-varying survival prediction. The model incorporates learnable time-extrapolating Multi-Layer Perceptrons to capture dynamic temporal evolution of patient risk. ExtraSurv was evaluated in a real-world cohort of patients initiating hemodialysis. Its performance was compared with that of conventional statistical and deep learning-based survival models using the time-dependent C-index and the time-specific area under the receiver operating characteristic curve.

Results : The proposed model achieved the highest overall time-dependent C-index of 0.779 among all evaluated models, demonstrating superior discrimination of mortality risk. Across prediction horizons from 1 to 7 years after dialysis initiation, ExtraSurv achieved the highest AUROC at five of seven time points. Performance gains were most pronounced at intermediate horizons, where ExtraSurv consistently outperformed all comparator models by a clear margin. In contrast, several baseline models showed declining accuracy at longer horizons, whereas ExtraSurv maintained stable predictive performance.

Conclusions : This study introduces a novel time-varying survival model that extends existing transformer-based approaches by explicitly learning and extrapolating temporal risk patterns. Learnable temporal extrapolation within a transformer framework improves survival prediction accuracy in patients undergoing maintenance hemodialysis.

figure1.png



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