



Shaping Tomorrow's Nephrology: Insight-Driven Kidney Care

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Abstract Topic : Acute Kidney Injury

FAST-DEC Multimodal Deep Clustering Identifies Reproducible ICU Acute Kidney Injury Subphenotypes and a Phenotype-Specific Benefit of Early Kidney Replacement Therapy

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Objectives : Acute kidney injury (AKI) in intensive care is clinically heterogeneous, yet prior clustering work has rarely integrated multimodal trajectories aligned to AKI onset or demonstrated reproducibility across independent databases.

Methods : We developed Fusion-Aware Self-supervised Temporal Deep Embedded Clustering (FAST-DEC), which fuses baseline covariates with AKI-aligned trajectories of serum creatinine, urine output, and hemodynamics. We derived subphenotypes in Medical Information Mart for Intensive Care (MIMIC)-IV (n=13,153) and externally validated them in eICU Collaborative Research Database (eICU) (n=16,412). We quantified cross-dataset transportability against a tabular-only K-means baseline, evaluated associations with in-hospital mortality and post-AKI kidney replacement therapy (KRT), and assessed incremental prognostic value beyond standard clinical models. Among AKI stage ≥ 2 post-AKI KRT recipients, we estimated subphenotype-specific effects of early (≤ 12 h) versus late KRT using inverse probability-of-treatment weighting (IPTW).

Results : FAST-DEC identified six clinically interpretable AKI subphenotypes with concordant feature profiles and outcome gradients across datasets. Cross-dataset assignment accuracy was 0.875 and 0.850, outperforming tabular-only K-means (0.745 and 0.720). Adding subphenotype assignment modestly improved prediction of in-hospital mortality and post-AKI KRT beyond standard clinical models. In IPTW analyses, early KRT was associated with lower mortality in only one subphenotype (absolute risk reduction 28.1% [11.6–40.5]), while estimates in other subphenotypes were imprecise and crossed the null.

Conclusions : A multimodal, self-supervised deep clustering framework produced transportable and clinically coherent ICU AKI subphenotypes across two large databases. These subphenotypes provided incremental prognostic value and suggested that any survival benefit of early KRT may be concentrated within a specific phenotype, supporting phenotype-enriched precision strategies and trial designs in critical care nephrology.

Figures 1.jpeg



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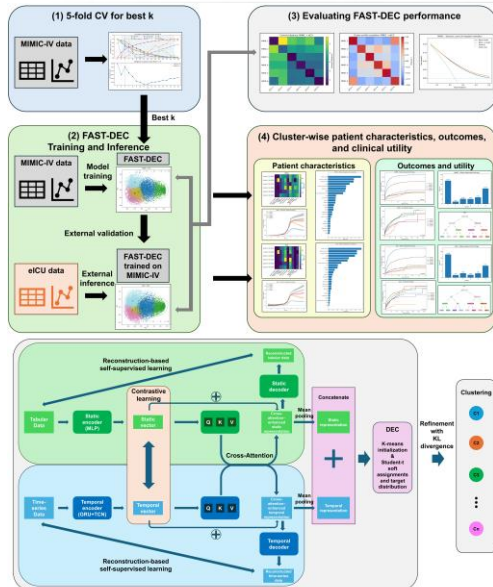


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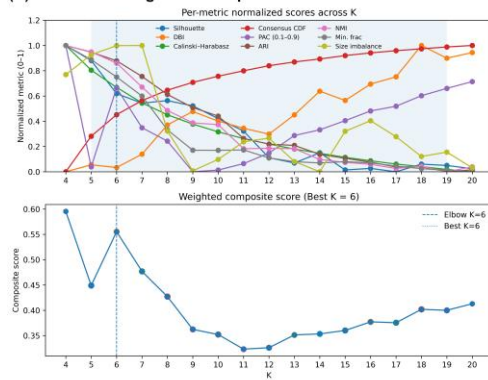
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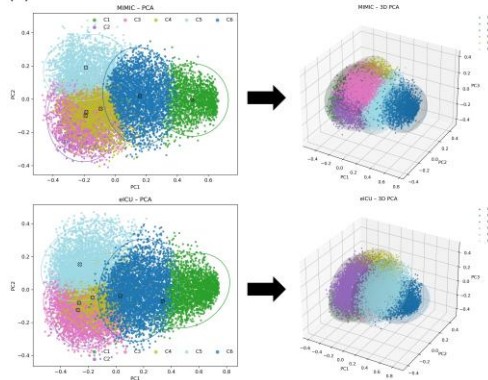
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(A) K selection weighted score plot



(B) PCA



Figures 1.jpeg



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