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Dynamic Outcomes-Based Clustering of Disease Trajectory in Mechanically Ventilated Patients

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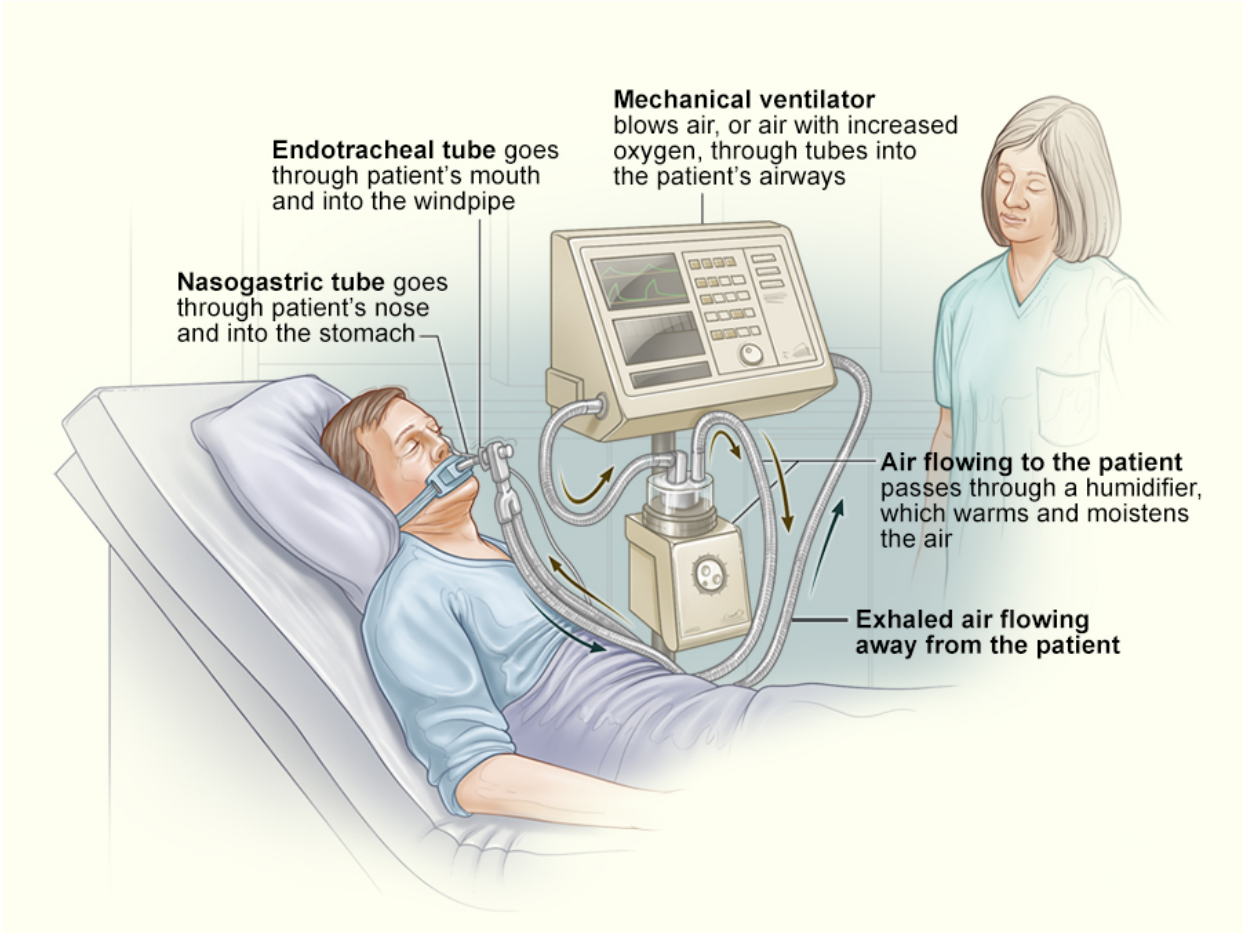
Mechanical Ventilation



Why Cluster Patients?

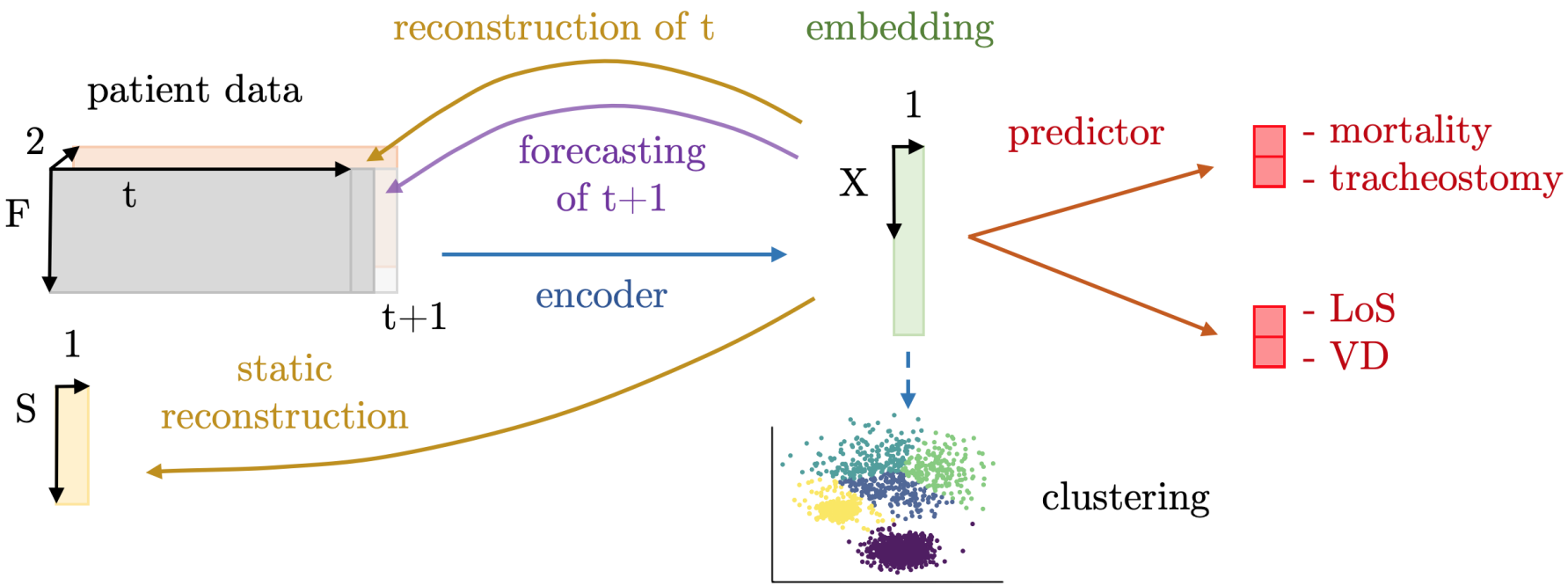
- Patients on mechanical ventilation are highly heterogeneous.
- Clustering would help to generate:
  - Interpretable early warning systems.
  - Further understanding of disease trajectories.
  - Early categorisation of patients for intervention studies.

Data: Electronic Health Records in Intensive Care

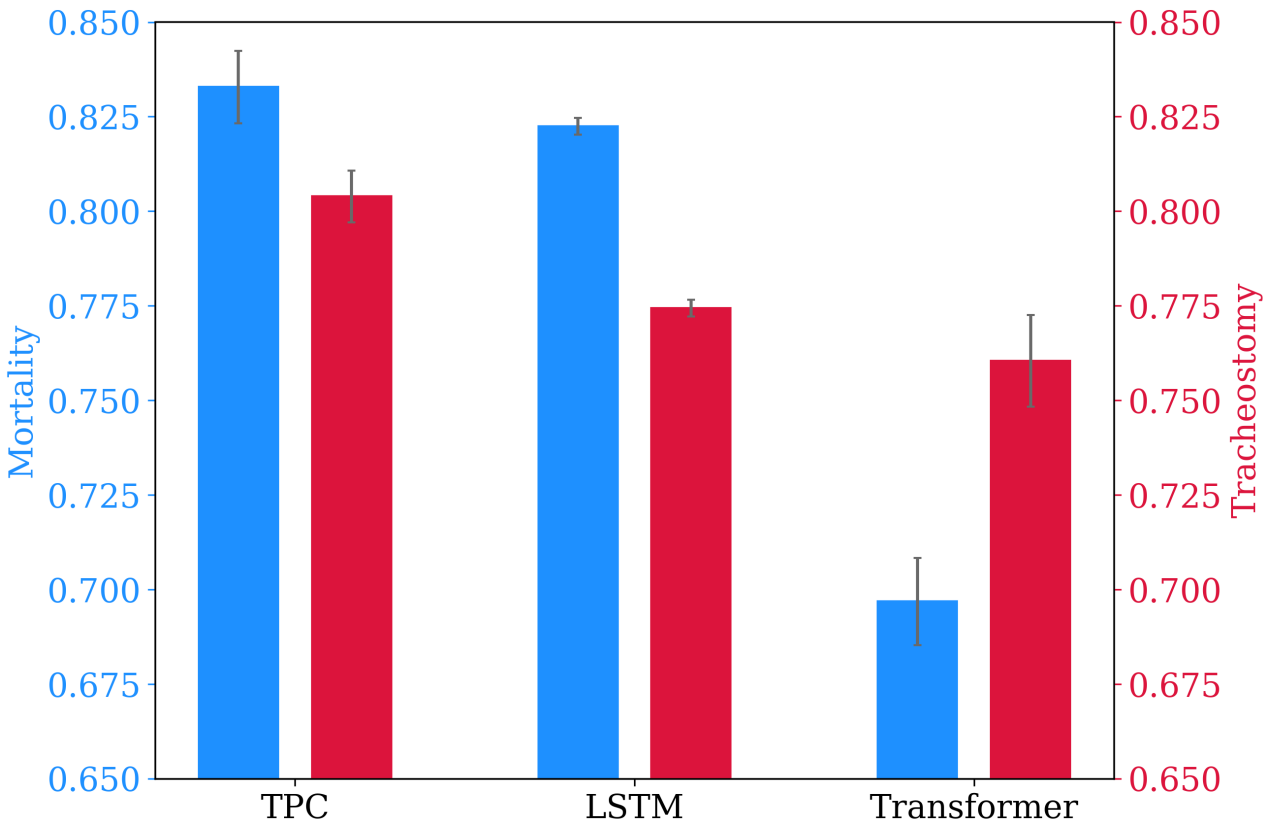
AmsterdamUMCdb

- 14,836 ventilation episodes.
- Contains:
  - Vital Signs e.g. heart rate, blood pressure
  - Lab Results e.g. blood glucose
  - Demographics e.g. age, sex, ethnicity

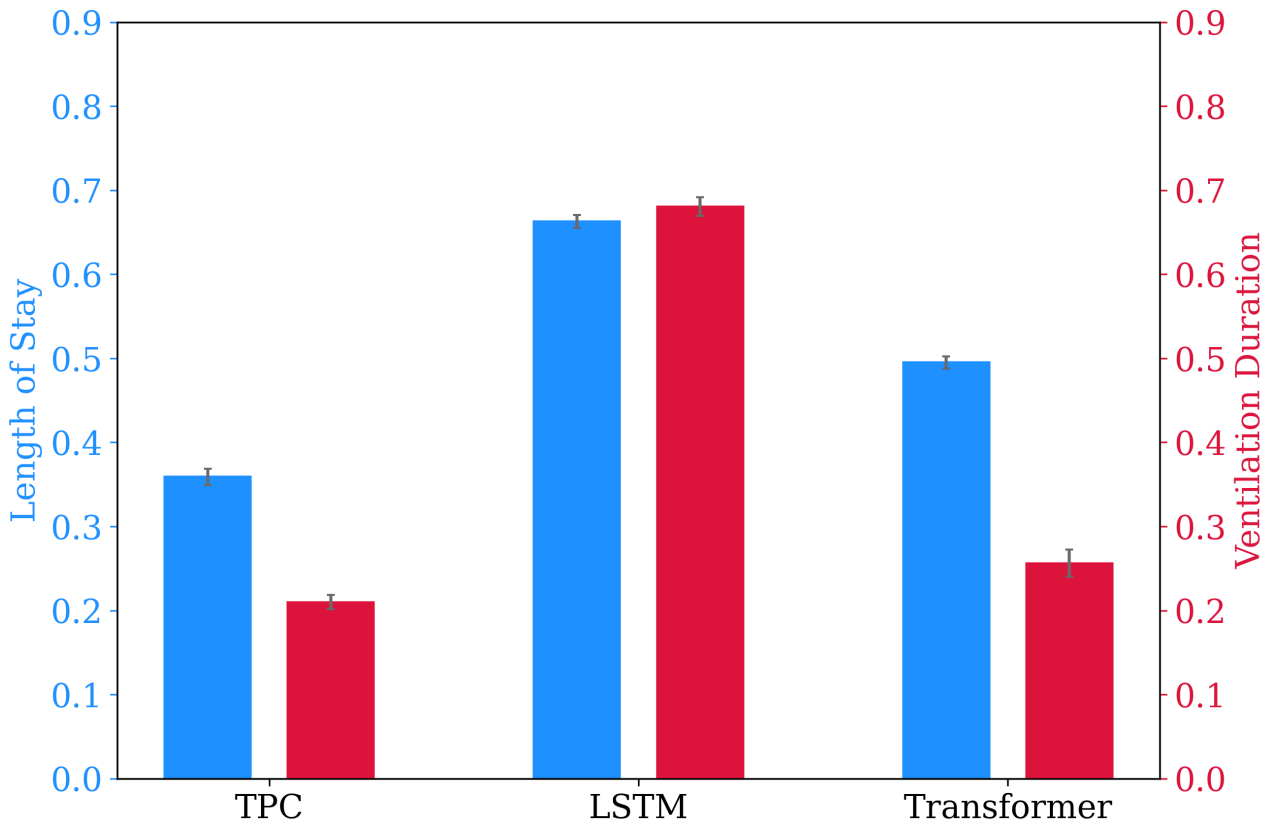
Methods


reconstruction of t
embedding
patient data
2
F
t
t+1
forecasting
of t+1
encoder
1
X
predictor
- mortality
- tracheostomy
- LoS
- VD
1
S
static
reconstruction
clustering

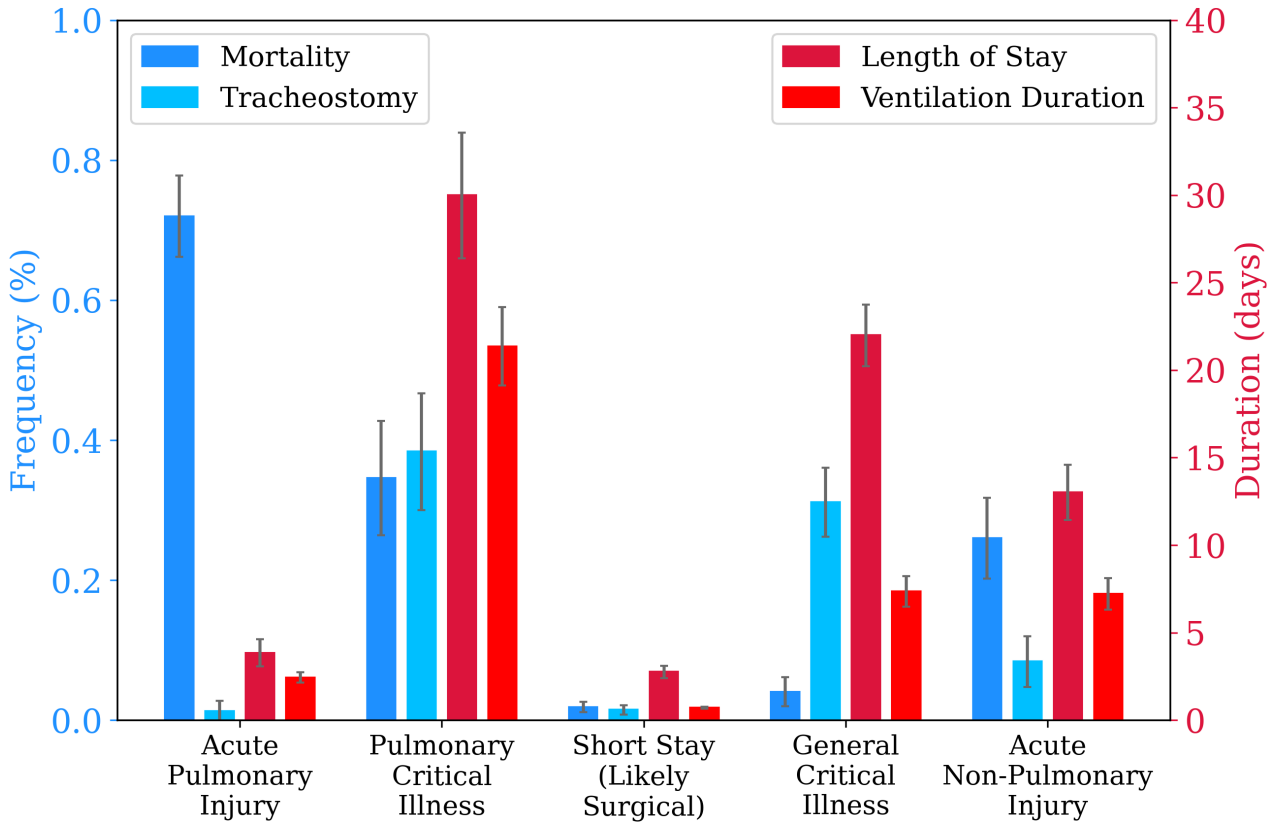
Outcome Task Performance: Binary



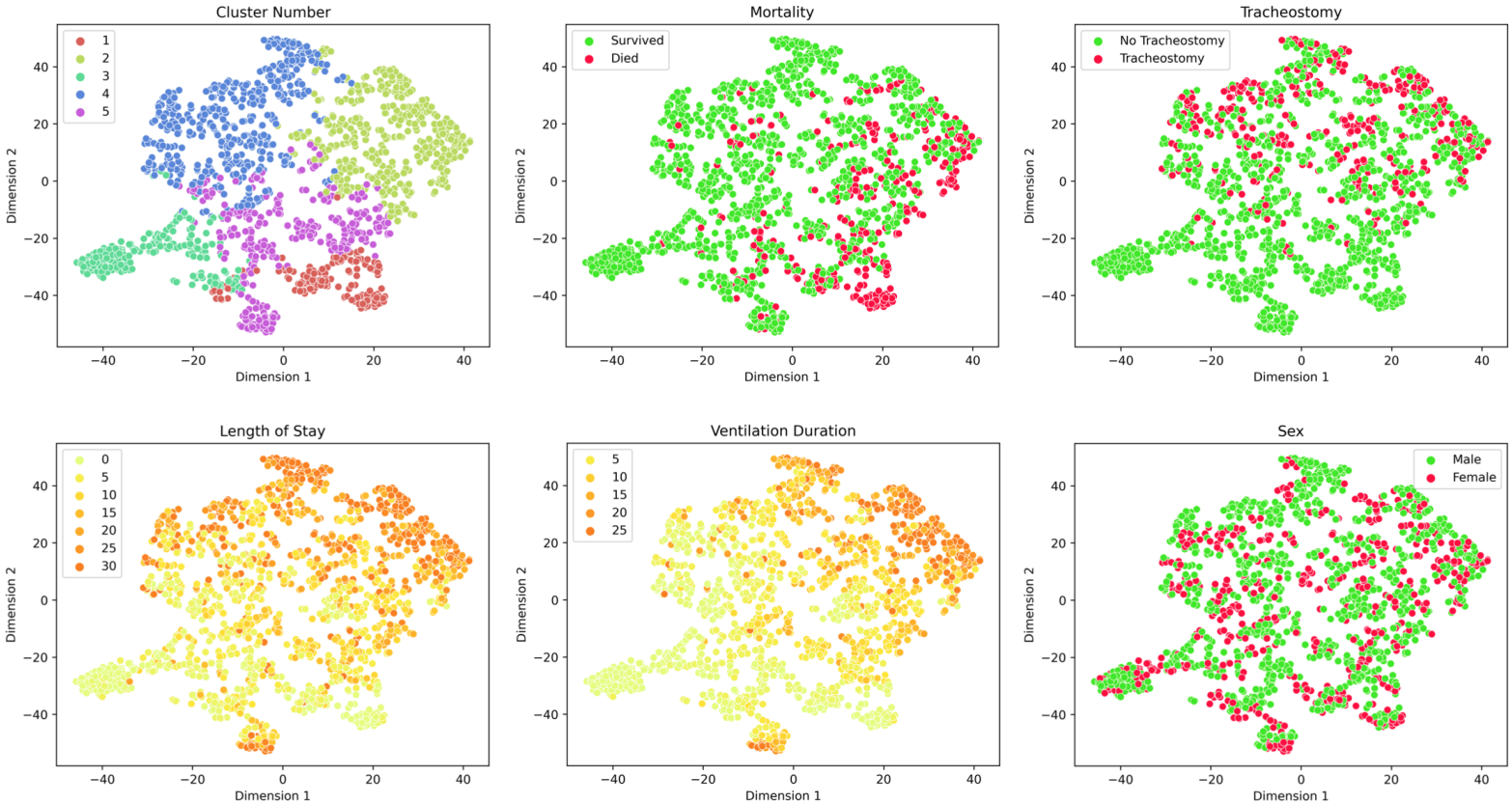
Outcome Task Performance: Duration



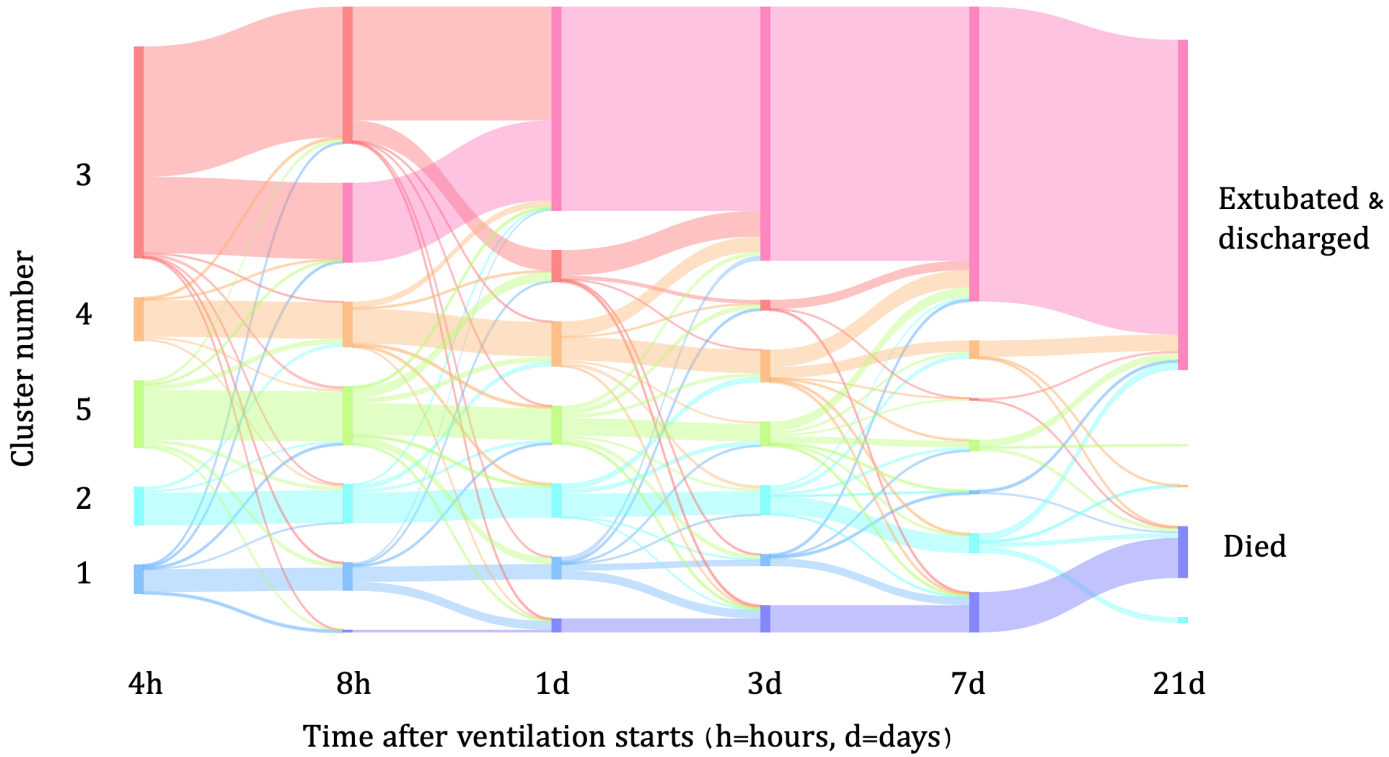
Cluster Analysis



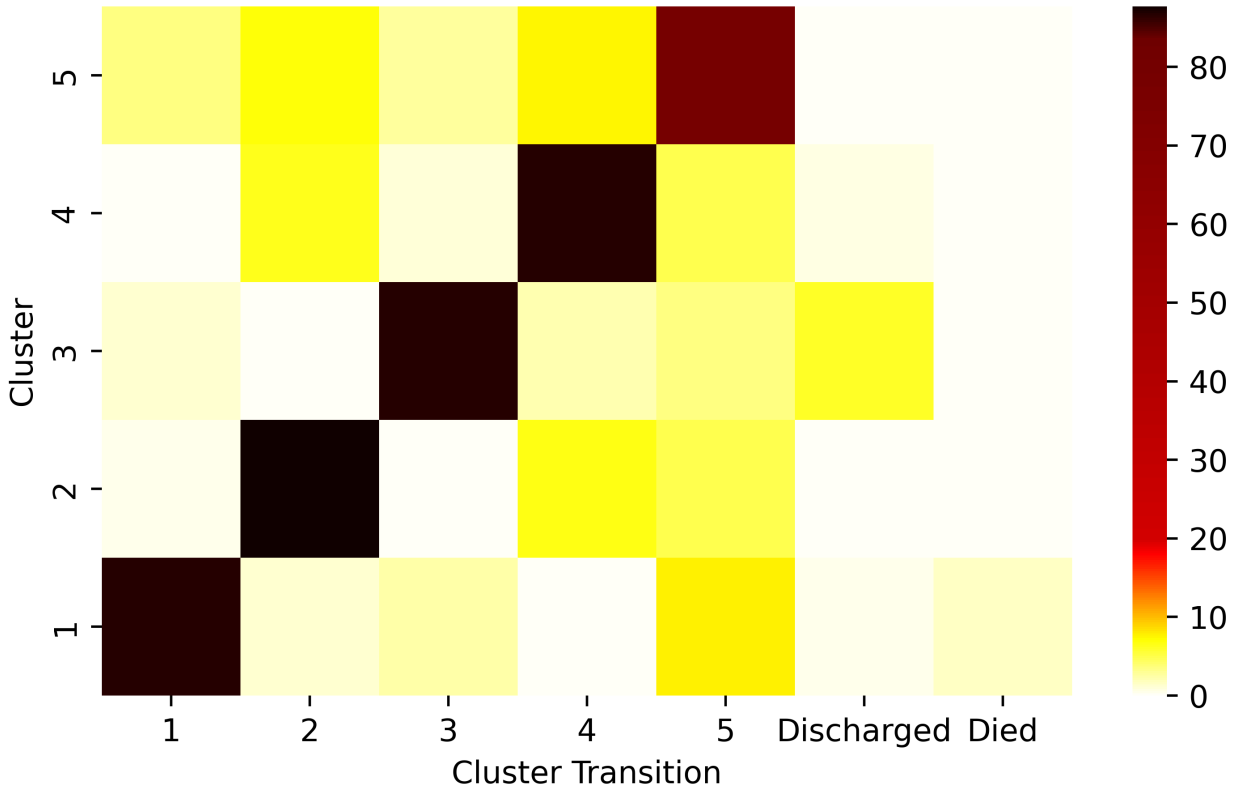
Latent Space Visualisation



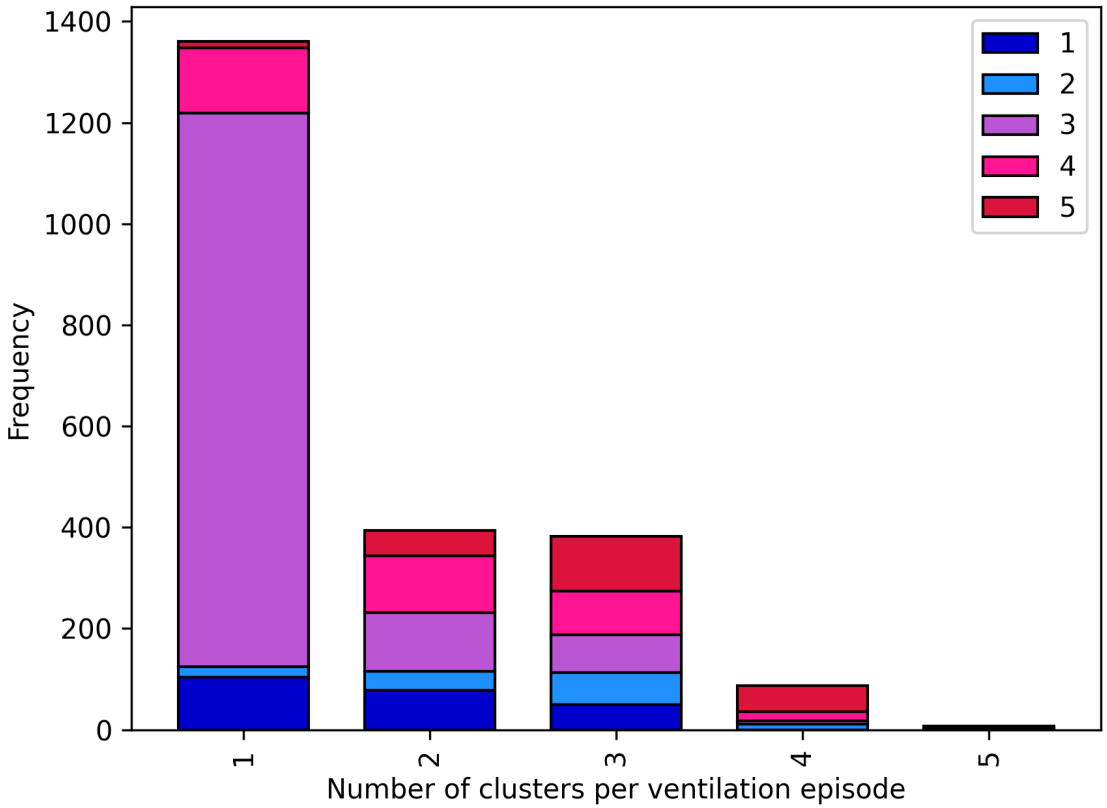
Patient Trajectories



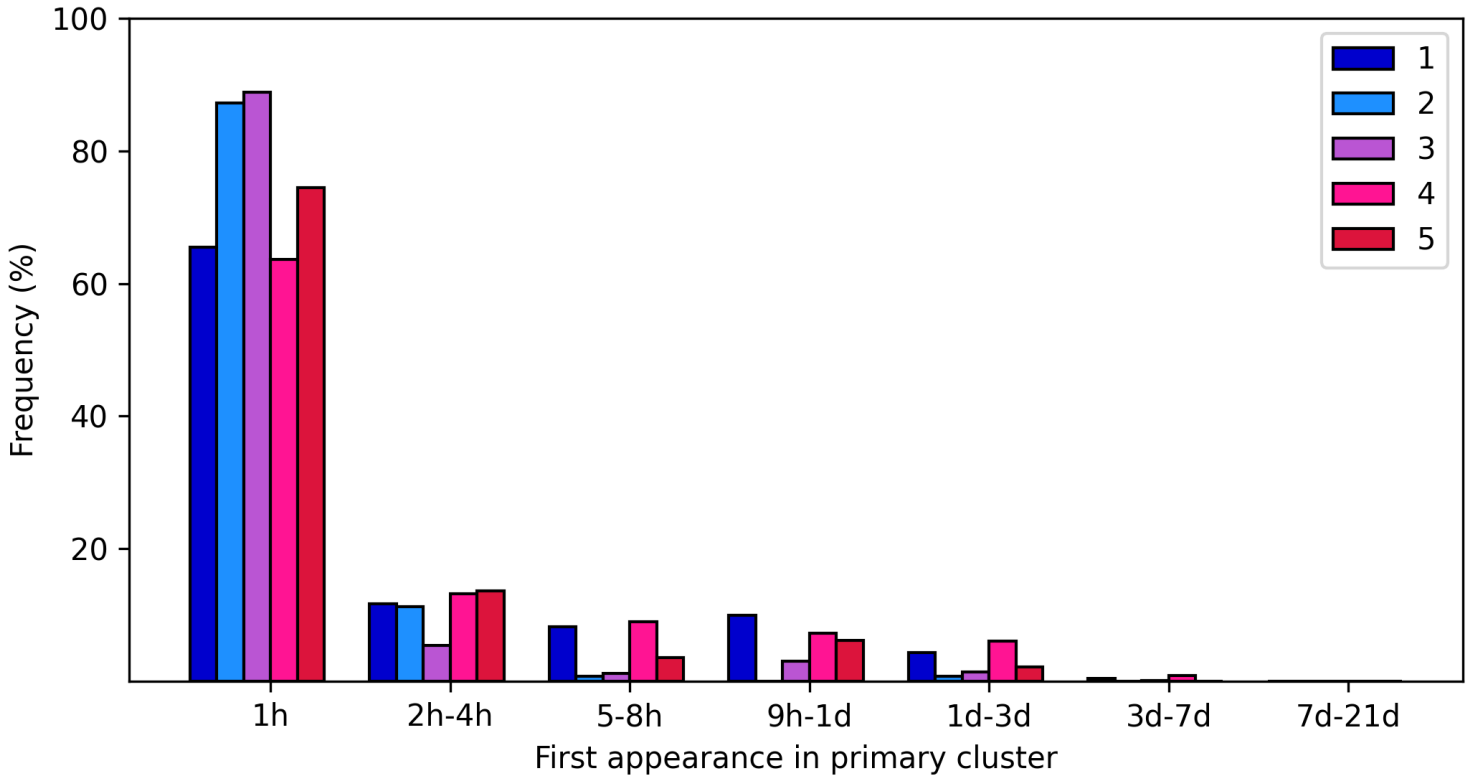
The clusters are remarkably stable over time



Most patients only appear in one cluster



This happens very early in their admission

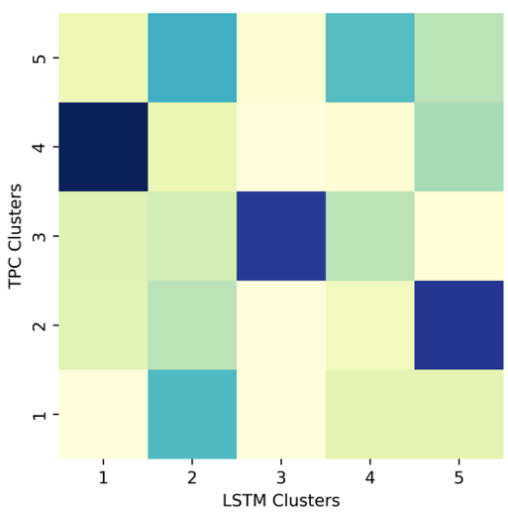


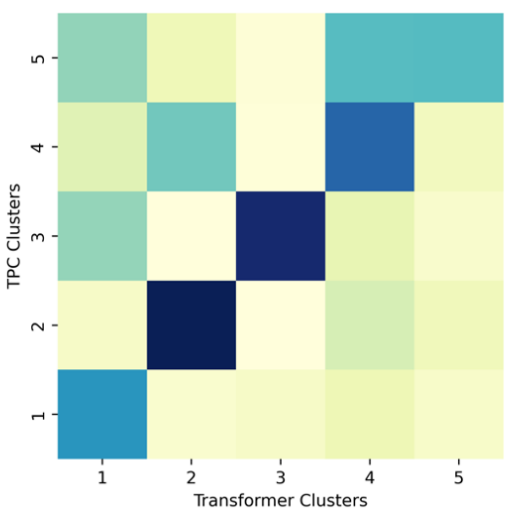
Cluster Reliability

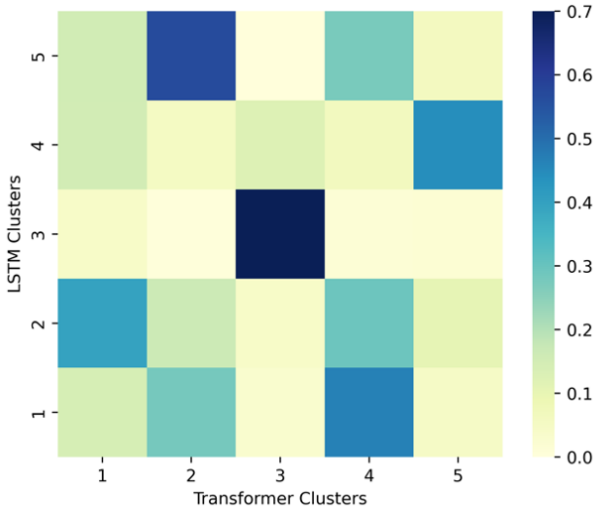
We tested:

- Alternative encoders
- Different initialisation seeds
- Varying the number of clusters

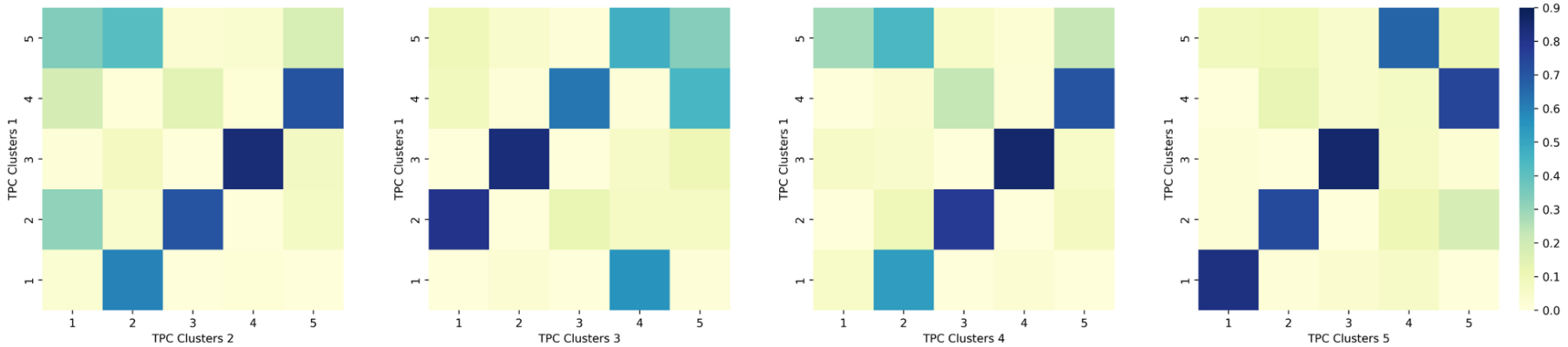
Alternative Encoders



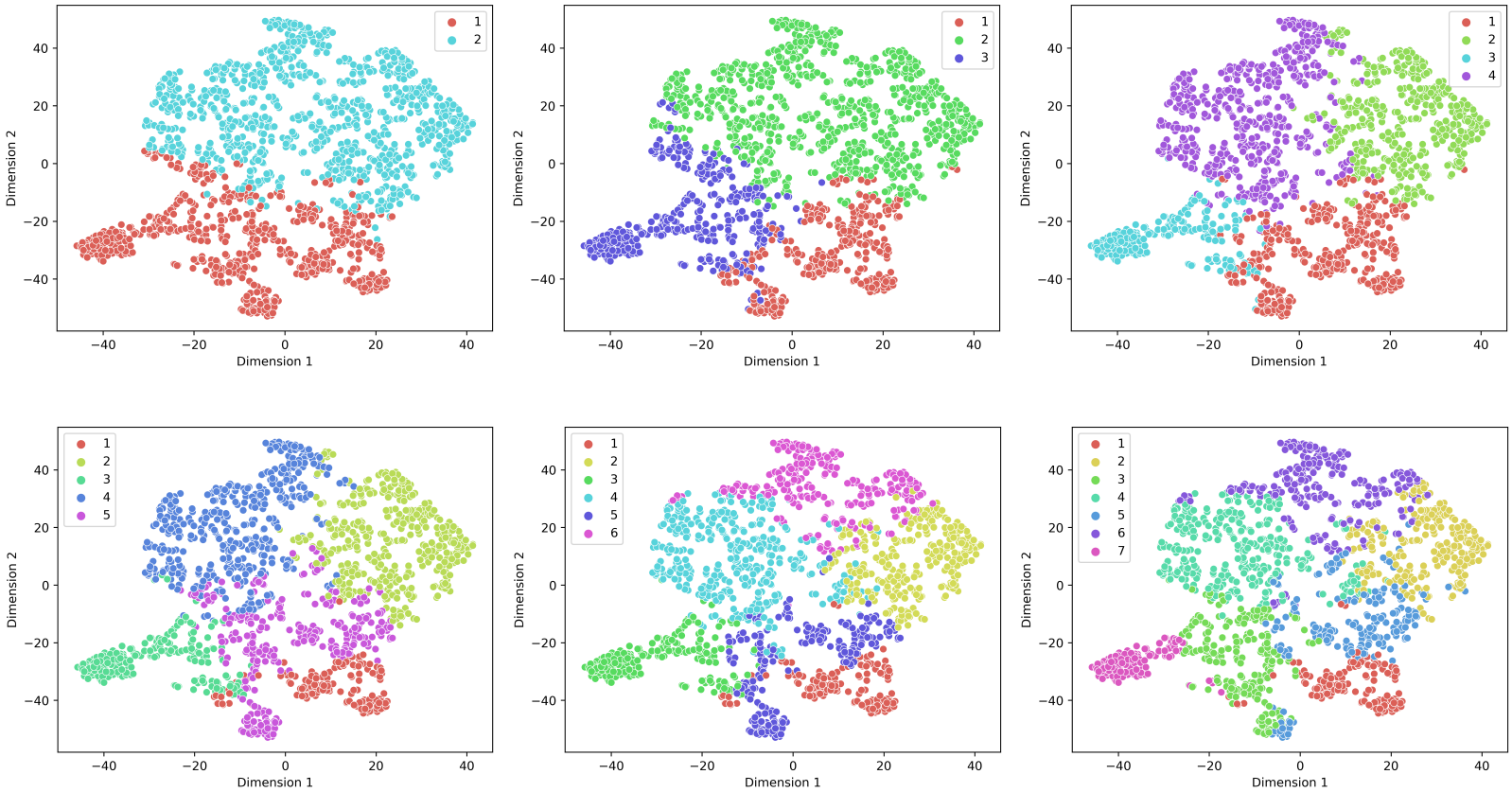




Different Initialisation Seeds



Number of Clusters



“Stable” Cluster Transitions

Transition	Count	Median Time	Mortality (%)	Tracheostomy (%)	Urgency (%)	VD	LoS
3→1	17	3	76.5	0.0	47.1	0.5	0.7
5→1	29	16	51.7	10.3	55.2	4.3	5.3
1→3	28	11	10.7	0.0	67.9	1.0	2.6
5→3	46	9	15.2	4.3	41.3	1.2	6.5
2→4	28	17	10.7	21.4	42.9	6.2	12.8
5→4	27	10	11.1	7.4	48.1	3.4	9.1
1→5	25	3	44.0	4.0	68.0	3.9	6.5
3→5	15	4	13.3	13.3	53.3	1.9	4.6
4→5	15	56	26.7	26.7	46.7	6.6	11.5

Summary

1. The TPC model outperforms alternative encoders.

2. We can generate clinically interpretable clusters.

3. The clusters are remarkably stable across time, and membership is determined early on.

4. Stable cluster transitions do occur, and are an important avenue for future work.

Thank you!

To my funders:

- The Armstrong Fund
- The Frank Elmore Fund
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Ioana Bica, Prof. Pietro Liò and Dr Ari Ercole

...and to W3PHIAI!

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