

POSTER ABSTRACT

A data-driven approach of population segmentation in complex frequent admitters

21st International Conference on Integrated Care, Virtual Conference – May 2021

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Introduction

Increasing trends in population ageing with complex needs has called for a more targeted and coordinated healthcare services. One approach proposed is in understanding population health needs by prioritizing health interventions and facilitating effective healthcare resources planning. In this study, we used a data-driven approach to identify population segments with similar characteristics and needs in the Ageing-In-Place-Community-Care-Team programme, a 3-month multidisciplinary home-based intervention for complex frequent admitters.

Methods

Retrospective data from patients enrolled between June 2016 and February 2017 (N=1012) were extracted from administrative database that included sociodemographic, clinical characteristics, healthcare utilization, and mortality. Partitioning Around Medoids (PAM) clustering algorithm with Euclidean distance was used to derive segments. The optimal number of clusters were determined using Elbow method and internal cluster validation. Internal cluster validation was done by comparing the connectivity, Dunn index and Silhouette coefficient from three different clustering algorithm i.e. hierarchical, k-means, and PAM. The derived segments were then evaluated on their discriminative properties on future healthcare utilization and mortality.

Results

1,012 patients were clustered into three segments based on the segmentation variables i.e. Charlson Comorbidity Index (CCI) and Social Triage (ST). Segment 2 had the highest disease complexity with mean (SD) CCI score of 4.4 (2). Segment 1 had the highest functional and social needs with mean (SD) Activities of Daily Living (ADL) score of 49.1 (37.4), Instrumental ADL score of 2.2 (2.8), and ST score of 7.4 (1.2) with poorer patient/family social support, mental health, compliance and coping mechanism. Using Segment 3 as the reference group, all other segments had significantly higher rate of inpatient admission at 180-day follow-up with Hazard Ratio (HR) of 1.62 ($p<0.001$) and 2.13 ($p<0.001$) for Segment 1 and Segment 2, respectively. Similarly, mortality rate was significantly higher at 180-day follow-up for Segment 1 and Segment 2 (HR:2.48, $p<0.001$ and HR:2.25, $p=0.001$, respectively). All findings were adjusted for age, gender, race, ward class, and number of healthcare utilization at 180-day before enrollment.

Discussions

In this study, the quality of the segmentation outcome was assessed using three criteria: (i) internal validity, to measure the compactness, connectedness, and the separation of the cluster partition; (ii) external validity, to demonstrate its discriminative properties to future healthcare utilization and mortality; and (iii) interpretability, to enable meaningful interpretation and clinical relevance. Our derived segments met these criteria, indicating potential application for health service planning at population level.

Conclusions

The data-driven patient segmentation provides an evidence-based data on healthcare needs that could potentially help policy makers to allocate resources efficiently and develop a more tailored intervention to address the needs.

Lessons learned

It is important to align the segmentation approach/framework with the population segmentation objectives, as segmentation outcomes may differ with varied inputs variables and analysis approach. Selection of variables for segmentation purposes requires iterative processes with contextual knowledge and expertise in data mining and clinical applicability.

Limitations

Interpretability/profiling of each segments is limited to available variables within the database.

Suggestions for future research

Future research may consider including more variables and longer follow-up to better characterize the segments.