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MULTI STATE MODELLING OF HEART FAILURE CARE PATH: A POPULATION-BASED INVESTIGATION FROM ITALY

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Abstract

Background: How different risk profiles of Heart Failure (HF) patients can influence multiple readmission rate and outpatients management is widely unknown. To date, several models for predicting adverse outcomes have been developed, but they are mainly focused on a single outcome We propose the application of two different multi state models in real world setting to jointly evaluate the impact of different risk factors on multiple hospital admissions, on Integrated Home Care (IHC) activations, on Intermediate Care Unit (ICU) admissions and on death.

Methods and findings: We propose two multi state models. Each multi state model is characterized by a state space and an intensity transition matrix. A transition is defined as a possible passage from one state to another (in our case, we consider readmission, discharge and death as possible transitions).

The first model (Model 1) concerns only hospitalizations as possible events in patients' clinical history. In the second one (Model 2), we consider both hospitalizations and ICU admission and IHC activation. Through Model 1, we want to detect the determinants of repeated hospitalizations, while, through Model 2, we want to evaluate which patients' profiles are associated with transitions in intermediate care with respect to repeated hospitalizations or death. Both models are characterized by transition specific covariates, adjusting for patient's risk factors.

We identified $4,904$ patients ($4,129$ De Novo and 775 Worsening Heart Failure, WHF) hospitalized for HF from 2009 to 2014, corresponding to $23,665$ events. Among these events, $7,634$ (32%) were HF hospitalizations, $8,329$ (35%) were hospitalization for any cause, $2,303$ (10%) were admission in ICU and $5,399$ (23%) were activation of IHC. $2,714$ (55%) patients died, of these 407 deaths (8% out of the whole cohort) occurred during a HF hospitalization. $1,316$ De Novo HF patients had only one hospitalization and 520 (40% out of $1,316$) died after or during the first, and unique, hospitalization. Advanced age and higher morbidity load, measured by Charlson score, increased the rate of dying and of being rehospitalized (Model 1). Increasing age was also correlated with a longer staying in the hospital (Model 1 and Model 2). Instead, age was inversely related to time spent in IHC (Model 2). The increasing comorbidity load was related to a longer hospital stay and a shorter time spent in IHC (Model 2). WHF condition did not increase the risk of being admitted in ICU/IHC significantly, whereas it was still an important risk factor associated with hospital readmission.

Conclusions: The application of multi state models enables a better identification of two patterns of HF patients. In fact, once adjusted for age and comorbidity load, the WHF condition identifies patients who are more likely to be readmitted several times to hospital, but does not represent an increasing risk factor for activating ICU/IHC. This highlights different ways to manage specific patients patterns of care. In so doing, the results of the paper provide useful healthcare support to patients management in real word context. Our study suggests that the epidemiology of the considered clinical characteristics are more nuanced than traditionally presented with single event by demonstrating their important and versatile role on different patterns of care.

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