Comparing the Predictive Power of Heart Failure Hospitalisation Risk Scores Across Different Care Settings

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Abstract— **The organisation of care at diabetes outpatient clinics is typically different from that delivered by general practitioners, it is thus of interest to assess whether there is also a difference in the predictive power of heart failure hospitalisation risk scores developed independently for each subpopulation. To such a purpose, a diabetes outpatient clinic and a primary care datasets (4,736 and 10,404 patients) were considered. A Cox proportional hazard model, an accelerated failure time model, a logistic regression, and a K-nearest neighbours model were trained in each dataset and tested on both. Models developed using primary care data performed well on the corresponding test set but poorly when used in the diabetes outpatient clinic setting (best C = 0.759 vs. 0.615). Models trained on the diabetes outpatient clinic data performed well on the corresponding test set, and their predictive power in the primary care setting was comparable to the one of models developed using primary care data (best C = 0.814 vs. 0.740). Differences in the data used for model training and the methodological approach chosen led to a difference in the predictive power of heart failure hospitalisation risk scores, patient characteristics and methodology should then be considered when translating between healthcare contexts.**

I. Introduction

The prevalence of diabetes continues to increase, leading to a higher incidence of diabetic cardiovascular diseases (CVDs). Heart failure (HF) is one of the most relevant endpoints, because of its high severity and likelihood of hospitalisations. Often, CVDs risk scores for patients with type 2 diabetes (T2D) are developed considering only a specific care setting and a single methodologic approach [1]. It is, thus, not clear if such tools are general enough to maintain good performance across different care settings, and whether performance might depend on model type. This is relevant because diabetic patients may be followed by either or both a specialist in the diabetes outpatient clinic (DOC) setting and their general practitioner in the primary care (PC) setting. These professionals might want to apply risk prediction tools to their patients, despite a marked difference in the latter's baseline risk and comorbidities between the two settings. This study compares the predictive power of HF hospitalisation (HHF) risk scores developed using different methodological approaches in two datasets collected within the same healthcare system but at different levels of care.

II. Methods

Two anonymised datasets were used for the analysis. The first dataset comprised diabetic patients followed up at the DOC of the University Hospital of Padova, while the second one was a PC database (MilleinRete). Patients with an HF before the start of the observation period were excluded from both datasets, resulting in 4,736 DOC patients, and 10,404 PC patients. Each dataset was randomly divided between a training set (85% of its sample size) and a test set (15%), and censored at a fixed prediction horizon (PH) of 3 years. Four predictive models were developed on each dataset: Cox proportional hazard model, accelerated failure time model (AFTM), logistic regression (LR) and K-nearest neighbours (KNN) classifier. The discrimination performance of each model was evaluated on the DOC and the PC test sets using the C-index (C) [2].

This work was supported in part by MIUR (Italian Ministry for Education) under the initiative "Department of Excellence" (Law 232/2016).

III. Results

Results suggest that a model developed considering mainly patients who, had a low risk of HHF, such as those of the PC setting, was not able to correctly predict the HHF risk of patients that typically have a more complicated clinical situation and a higher HHF risk such as those of the DOC setting (C = 0.607 vs. 0.814). On the contrary, a model developed considering mainly patients with a more complicated clinical situation (DOC setting) was still able to pre-emptively identify higher risk patients even if they were part of a different and healthier population (PC setting) (C = 0.740 vs. 0.738). This conclusion does not seem to hold for all model subtypes, as evidenced by the poor performance of AFTM and KNN.

TABLE I
Discrimination Performance (C-index)

	Diabetes outpatient clinic test set	Primary care test set
	Diabetes outpatient clinic models	
Cox	0.814 (0.753 - 0.876)	0.740 (0.641 - 0.839)
AFTM	0.744 (0.665 - 0.823)	0.568 (0.438 - 0.698)
LR	0.814 (0.753 - 0.874)	0.726 (0.621 - 0.831)
KNN	0.801 (0.744 - 0.821)	0.584 (0.506 - 0.662)
	Primary care models	
Cox	0.607 (0.514 - 0.700)	0.738 (0.612 - 0.863)
AFTM	0.587 (0.497 - 0.676)	0.729 (0.606 - 0.851)
LR	0.615 (0.524 - 0.707)	0.759 (0.633 - 0.885)
KNN	0.599 (0.457 - 0.741)	0.741 (0.634 - 0.836)

Harrel's C-index with 95% CIs computed on the DOC and PC test sets.

IV. Discussion and Conclusion

Differences between different care settings may lead to a difference in the predictive power of HHF predictive models and whether this difference is present or not depends not only on the care setting but also on the methodological approach used for the model training. This supports the idea that both patient characteristics and methodology should be considered when attempting to translate between healthcare contexts.

References

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