

Developing and validating a prognostic model for mortality in patients with heart failure

H. Muhammad-Kamal, B. Iyen, S. Weng

University of Nottingham, Centre for Academic Primary Care, School of Medicine, Nottingham, United Kingdom

Funding Acknowledgement: Type of funding sources: Foundation. Main funding source(s): The Aziz Foundation

Background: Heart Failure (HF) constitutes a major public health problem which remains highly prevalent in the UK and globally. Primary care plays a role in the long-term management of patients with heart failure but there are no clinically useful prognostic models to guide primary care professionals in determining those at increased risk of mortality, who could benefit from appropriate advanced care planning or escalation of treatment. Several predictive models exist but due to several limitations, clinical utility of these in the UK are limited.

Purpose: This study developed and validated a prognostic algorithm, the Nottingham Heart Failure Model, to predict the one-year risk of all-cause mortality in patients with HF.

Methods: This was a retrospective open cohort study using electronic primary care records from the UK Clinical Practice Research Datalink (CPRD) linked with secondary care records from Hospital Episode Statistics (HES) and death registration data from the Office for National Statistics (ONS). Adults with a diagnosis of heart failure were identified and multivariable Cox regression models were used to identify the risk factors that were independently associated with mortality. A prognostic model was developed to predict the one-year risk of mortality in patients with heart failure, and this was validated by bootstrapping 200 samples of the derivation data. The co-

hort was then split into even quartiles based on predicted risk scores from the model. These risk groups ranged from one to four with one indicating the quartile of scores with the lowest risk. Kaplan Meier curves were then produced for each group. The Royston D-statistic was then used to assess the discrimination of these quartiles by quantifying the observed separation between these groups.

Results: A total of 109,577 patients with diagnoses of heart failure were followed up from 1 January 2000 to 31 December. There were 16,437 deaths during the period of follow up. We identified 29 factors which were significantly associated with mortality risk and a prognostic model which incorporated these factors, was developed. The resulting prognostic model obtained a model validation score (C-statistic) of 0.79. The agreement between the observed and predicted proportion of events showed excellent apparent calibration. The D statistic of 1.65 suggests that the model provides a reasonably high amount of prognostic separation.

Conclusion(s): Several patient characteristics including comorbidities, treatments, and biomarkers are significantly associated with heart failure mortality. This new model has the potential to accurately predict heart failure mortality within one year and will enable primary care professionals to better risk stratify their patients with heart failure.

Model	N	AUC (95%CI)
Final Cox-Regression Model	109,577	0.79 (0.79 to 0.80)
Bootstrap Validation	200	0.79 (0.79 to 0.80)
Difference	200	0.0018 (0.00 to 0.01)
Optimism	200	0.79 (0.79 to 0.80)

Metric	N	Unit (SE)
Discrimination (D)	109,577	1.649 (0.013)

Table 1. Validation and Discrimination

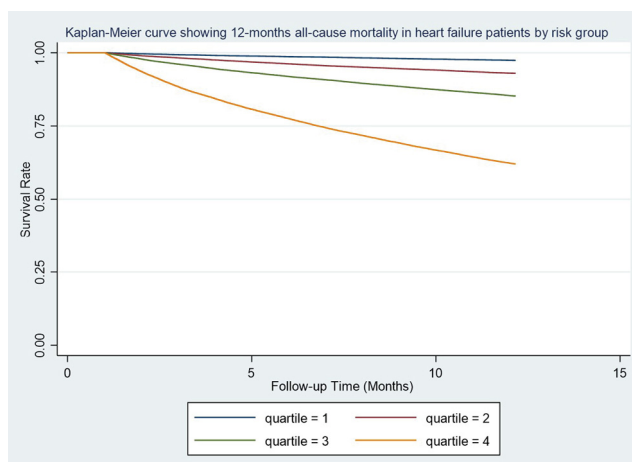


Figure 1. Risk Groups