

# External Validation and Calibration of Health Risk Models that Predict Readmission Risk in Patients with Heart Failure



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## BACKGROUND & OBJECTIVES

1

- Heart failure readmission is the most common and costly hospitalization diagnosis.
- High readmission rates may be the result of too early discharge, inadequate patient education, or insufficient post-discharge follow up.
- External validation of seven health risk models for heart failure readmission.



2

## METHODS

- From 118 models, 7 models were selected under strict inclusion criteria: AUC > 0.7, logistic regression, reproducibility, and 20 predictors at maximum: Van Walraven (2010), Zhang (2013), Cubbon (2014), Huynh (2015), Huynh (2015), Huynh (2017), and Leong (2017).
- Lack of full model specification was a major concern.
- We used data from OPERA-HF study which is a Philips-supported (funded), observational study including 2344 features and 1227 patients hospitalized for heart failure at Hull and East Yorkshire Hospitals NHS Trust (UK) between 2012-2018.

0. Data engineering

1. Unadjusted validation

2. Calibration-in-the-large

3. Logistic calibration

4. Model revision with bootstrapping

Table 1. External validation steps

## CONCLUSIONS

4

- Miscalibration leads to misleading or harmful decision making in clinical workflows.
- External validation and calibration are an often-overlooked prerequisite.
- More attention should be devoted on external validation, calibration and standardization as we face major challenges in predictor availability and incomplete model specifications.

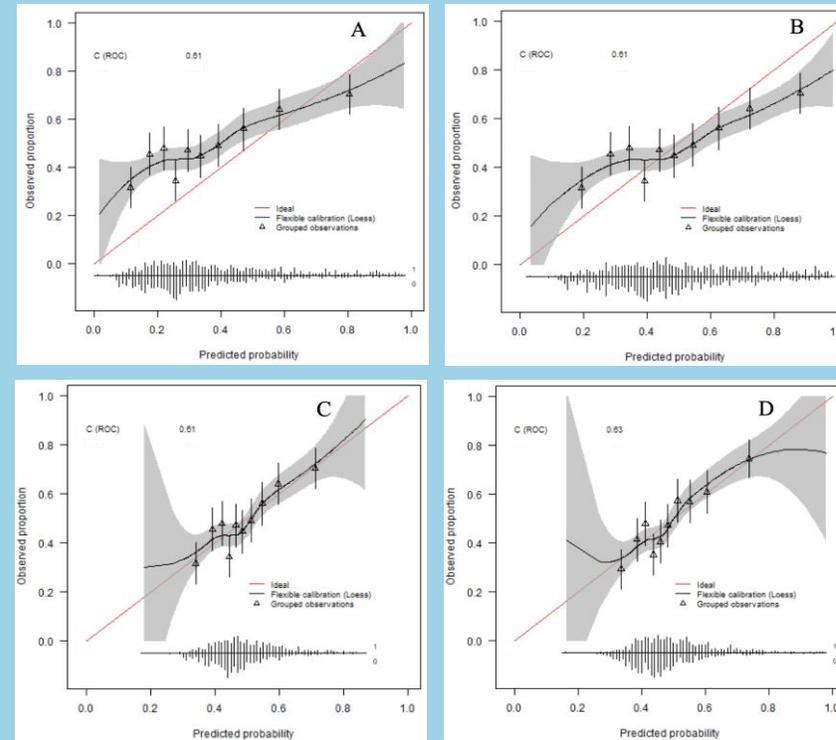


Figure 1. Calibration plots Zhang for (A) unadjusted validation, (B) calibration-in-the-large, (C) logistic calibration, and (D) model revision.

## RESULTS

- With each validation step the fit improved.
- Full model revision maximally achieved AUC of 0.63 (Zhang).
- Achieving discrimination performance as claimed in original publication proved challenging for all seven models.
- Availability of predictors was a major concern as models used different predictors and definitions.



## Take-away messages

5

- External validation and calibration are crucial for the use of health risk models in clinical practice.
- To be able to validate, standardized and complete reporting is required.

