ICHOM 2024
21 - 22 October | Beurs van Berlage, Amsterdam

# Personalised preinterventional risk stratification of mortality, length of stay and hospitalisation costs in transcatheter aortic valve implantation using a machine learning algorithm – a pilot trial


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## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Euroscore II (ESII) is used by clinicians to assist their decision to perform transcatheter aortic valve implant (TAVI) procedures.
⇒ ESII is a generic, non-TAVI-specific metric, and its predictive performance fades for mortality at follow- up longer than 30 days.

## WHAT THIS STUDY ADDS

⇒ Our novel TAVI-specific logistic regression model predicts 1-year mortality better than ESII.
⇒ In this model, the American Society of Anesthesiology (ASA) and Clinical Frailty Scale (CFS) scores were much stronger predictors of 1-year mortality than ESII.

## AFFECT ON RESEARCH, PRACTICE OR POLICY

⇒ Based on this TAVI-specific model, 1-year mortality, length of hospital stay and treatment costs may be predicted before TAVI procedure.
⇒ Heart team members and patients can make informed decisions based on a few key metrics.

## Patients & Methods

- In this **prospective pilot study**, 284 participants with severe aortic valve stenosis who underwent TAVI were enrolled.
- **Standard clinical metrics** and **patient-reported outcome measures** were assessed one day before TAVI.
- Using these data, we tested predictive models with all cause year mortality as the dependent variable.
- Logistic regression with linear and squared terms was identified to be the best model for predictability of TAVI outcome.
- Calculation of logistic regression model → **"ida-TAVId-Score"** (intelligent data-driven TAVI decisions)

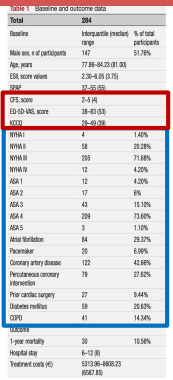


Table 1 Baseline and outcome data

| | Total | 284 | |
|---|---|---|---|
| Baseline | | Interquartile (median) range | % of total participants |
| Male sex, n of participants | | 147 | 51.78% |
| Age, years | | 77.86–84.23 (81.30) | |
| ESII, score values | | 2.30–6.85 (3.75) | |
| GFR² | | 37–55 (53) | |
| CFS, score | | 3–5 (4) | |
| ED-5D-5RL score | | 38–83 (53) | |
| KCCQ | | 29–89 (39) | |
| NYHA I | | 4 | 1.40% |
| NYHA II | | 58 | 20.28% |
| NYHA III | | 205 | 71.68% |
| NYHA IV | | 12 | 4.20% |
| ASA 1 | | 12 | 4.20% |
| ASA 2 | | 17 | 6% |
| ASA 3 | | 43 | 15.10% |
| ASA 4 | | 209 | 73.68% |
| ASA 5 | | 3 | 1.10% |
| Atrial fibrillation | | 84 | 29.37% |
| Pacemaker | | 20 | 6.99% |
| Coronary artery disease | | 122 | 42.66% |
| Percutaneous coronary intervention | | 79 | 27.62% |
| Prior cardiac surgery | | 27 | 9.44% |
| Diabetes mellitus | | 59 | 20.63% |
| COPD | | 41 | 14.34% |
| Outcome | | | |
| 1-year mortality | | 30 | 10.56% |
| Hospital stay | | 6–12 (9) | |
| Treatment costs (€) | | 5313.96–8808.23 (6087.85) | |

## Results

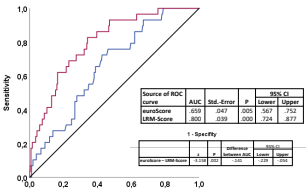
The predictors on which this **LRM-TAVI "ida-TAVId"** score is based are as follows, with **ASA** and **CFS** as the strongest predictors of 1-year mortality:

Table 3 Depicted are the independent variables that emerged as the most important predictors for 1-year mortality and their respective coefficient

| Term | Coefficients | P value | Z value |
|---|---|---|---|
| Constant | −7.0500 | <0.001 | −5.13 |
| Euroscore² | −0.0075 | 0.097 | −1.66 |
| ASA² | 0.5330 | <0.001 | 4.00 |
| CFS² | 0.2177 | <0.001 | 3.51 |
| NYHA * ASA | −0.2429 | 0.013 | −2.47 |
| Euroscore * SPAP | 0.0049 | 0.006 | 2.76 |
| ASA * CFS | −0.3790 | 0.003 | −2.99 |

ASA, American Society of Anesthesiology; CFS, Clinical Frailty Scale; NYHA, New York Heart Association; SPAP, systolic pulmonary artery pressure.

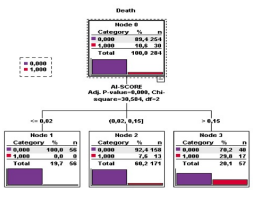
Our logistic regression model score showed **significantly better prediction** accuracy than ESII - **area under the curve = 0.659 vs. 0.800; p = 0.002.**




### 1-year mortality

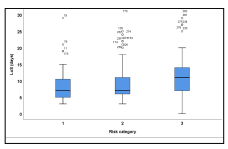
By translating our results to DTA, clinically useful cut-off values regarding 1-year mortality risk stratification emerged:

<0.02 points for **low**
0.02–0.15 for **intermediate**
and >0.15 for **high risk**



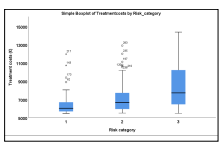

### Length of hospital stay

No significant difference was found between low-risk and intermediate-risk groups. However, LoS **was quite significantly higher** in high-risk patients.



### Treatment costs

Based on risk categories according to the LRM-TAVI score, **treatment costs** were calculated. **Significant differences** were found among **all three** risk groups.



## Conclusions and significance

⇒ **A novel TAVI-specific logistic regression model predicts 1-year mortality better than ESII**

⇒ **In this model, a clinical metric (ASA) and a PRO (CFS) were much stronger predictors of 1-year mortality than ESII**

## Personalized medicine – our next steps

⇒ **Validation of "ida-TAVId-Score" in larger patient cohorts – has already been done**

⇒ **App-development "Decision support instrument" with automated or manual transfer of clinical data and patient-reported outcomes – in progress**


For more information please refer to Open Heart 2024;11:e002540. doi:10.1136/ openhrt-2023-002540