

# Performance Assessment Across Different Care Settings of a Heart Failure Hospitalisation Risk-Score for Type 2 Diabetes Using Administrative Claims

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HHF risk-score use case example

| Age (yrs)       | Female                          | Sulfonylureas   | Treated dyslipidaemia         |
|-----------------|---------------------------------|-----------------|-------------------------------|
| < 45      0     | Yes      -3                     | Yes      1      | Yes      -2                   |
| 46 - 49      5  |                                 |                 |                               |
| 50 - 54      10 | Anticoagulants                  | Insulin         | Chronic pulmonary disease     |
| 55 - 59      15 | Yes      6                      | Yes      6      | Yes      3                    |
| 60 - 64      20 |                                 |                 |                               |
| 65 - 69      25 | Platelet aggregation inhibitors |                 | Ischaemic heart disease       |
| 70 - 74      30 | Yes      3                      |                 | Yes      5                    |
| 75 - 79      35 |                                 |                 |                               |
| 80 - 84      40 | Calcium channel blockers        |                 | Peripheral arterial disease   |
| ≥ 85      45    | Yes      4                      |                 | Yes      5                    |
| Demographic     | Medications                     | Stroke or TIA   | Systemic inflammatory disease |
|                 | Comorbidities                   | Yes      3      | Yes      2                    |
| Risk score      |                                 |                 |                               |
| HHF Risk Group  |                                 | 5-year HHF Risk |                               |
| ≤ 26 points     |                                 | Low             |                               |
| 27 – 52         |                                 | Medium          |                               |
| ≥ 53            |                                 | High            |                               |
|                 |                                 | 1.3%            |                               |
|                 |                                 | 6.7%            |                               |
|                 |                                 | 19.5%           |                               |

Supplementary Figure 1: Point-based risk score covariates and corresponding points. Covariates names are reported in red if demographic, blue if medications, and yellow if comorbidities or pre-existing medical conditions. The black table at the bottom of the figure can be easily used to obtain the HHF risk group and the corresponding 5-years HHF risk after computing the patient specific score.

To illustrate the use of the proposed point-based heart failure hospitalisation risk score described in the figure above, consider a 67-year-old Male patient that suffers from type 2 diabetes treated with insulin, sulfonylureas,

anticoagulants, and calcium channel blockers, with a previous medical history of ischaemic heart disease, peripheral heart disease and systemic inflammatory disease.

The patient specific HHF risk score can be easily computed by summing all points related to covariates with a positive answer (Yes), and those attributed to its age category:

$$\begin{aligned} \text{HHF risk score} &= 6^{\text{th}} \text{Age category} + \text{Insulin} + \text{Sulfonylureas} + \text{Anticoagulants} + \text{Calcium channel blockers} \\ &\quad + \text{ischaemic heart disease} + \text{peripheral arterial disease} + \text{Systemic inflammatory disease} \\ &= 25 + 6 + 1 + 6 + 4 + 5 + 5 + 2 = 54 \end{aligned}$$

Then, the HHF risk group and the corresponding 5-year HHF risk of our considered patient can be obtained from the black table at the bottom of the figure:

$$\text{HHF risk score} = 54 \rightarrow \text{High HHF risk group} \rightarrow 19.5\% \text{ probability of HHF within 5 years}$$

The considered patient is thus at high 5-year HHF risk as 19.5% of patients associated to the same risk group, according to the proposed point-based risk score, developed an HHF within 5 years.

To give another use example consider a 56-year-old Female patient that suffers from type 2 diabetes treated with insulin, platelet aggregation inhibitors and with a treated dyslipidaemia.

The patient specific HHF risk score can be easily computed by summing all points related to covariates with a positive answer (Yes), and those attributed to its age category:

$$\begin{aligned} \text{HHF risk score} &= 4^{\text{th}} \text{Age category} + \text{Female} + \text{Insulin} + \text{Platelet aggregation inhibitors} + \text{Treated dyslipidaemia} \\ &= 15 - 3 + 6 + 3 - 3 = 18 \end{aligned}$$

Then, the HHF risk group and the corresponding 5-year HHF risk of our considered patient can be obtained from the black table at the bottom of the figure:

$$\text{HHF risk score} = 18 \rightarrow \text{Low HHF risk group} \rightarrow 1.3\% \text{ probability of HHF within 5 years}$$

The considered patient is thus at low 5-year HHF risk as 1.3% of patients associated to the same risk group, according to the proposed point-based risk score, developed an HHF within 5 years.

SUPPLEMENTARY TABLE SI  
SET OF POSSIBLE PREDICTORS CHARACTERISTICS OF THE ADMINISTRATIVE DATASET

|                                        | Training Set    | Validation Set | Test Set       |
|----------------------------------------|-----------------|----------------|----------------|
| <b>N. subjects</b>                     | 146,018         | 15,000         | 15,000         |
| <b>Age (years)</b>                     | 67.6 ± 11.5     | 67.6 ± 11.5    | 67.6 ± 11.5    |
| <b>Female sex</b>                      | 60,755 (41.6%)  | 6,251 (41.7%)  | 6,306 (42.0%)  |
| <b>Diabetes duration (years)</b>       | 6.1 ± 5.4       | 6.1 ± 5.4      | 6.1 ± 5.4      |
| <b>Cancer</b>                          | 17,043 (11.7%)  | 1,682 (11.2%)  | 1,707 (11.4%)  |
| <b>Anaemia</b>                         | 865 (0.6%)      | 106 (0.7%)     | 88 (0.6%)      |
| <b>Peripheral arterial disease</b>     | 730 (0.5%)      | 96 (0.6%)      | 73 (0.5%)      |
| <b>Chronic kidney disease</b>          | 1,064 (0.7%)    | 119 (0.8%)     | 108 (0.7%)     |
| <b>Chronic pulmonary disease</b>       | 17,956 (12.3%)  | 1,898 (12.7%)  | 1,851 (12.3%)  |
| <b>Dyslipidaemia</b>                   | 77,222 (52.9%)  | 7,873 (52.5%)  | 7,895 (52.6%)  |
| <b>Complications renal</b>             | 98 (0.07%)      | 4 (0.03%)      | 11 (0.07%)     |
| <b>Infarction</b>                      | 1,869 (1.3%)    | 205 (1.4%)     | 175 (1.2%)     |
| <b>Ischemic heart disease</b>          | 9,978 (6.8%)    | 1,031 (6.9%)   | 1,025 (6.8%)   |
| <b>Stroke or TIA</b>                   | 3,362 (2.3%)    | 382 (2.5%)     | 330 (2.2%)     |
| <b>Systemic inflammatory disease</b>   | 2,299 (1.6%)    | 228 (1.5%)     | 253 (1.7%)     |
| <b>Calcium channel blockers</b>        | 34,840 (23.9%)  | 3,507 (23.4%)  | 3,531 (23.5%)  |
| <b>Beta blockers</b>                   | 38,310 (26.2%)  | 4,059 (27.1%)  | 3,917 (26.1%)  |
| <b>Acarbose</b>                        | 2,265 (1.6%)    | 234 (1.6%)     | 207 (1.4%)     |
| <b>Dpp4i</b>                           | 11,973 (8.2%)   | 1,201 (8.0%)   | 1,226 (8.2%)   |
| <b>ACE inhibitors</b>                  | 92,694 (63.5%)  | 9,503 (63.4%)  | 9,422 (62.8%)  |
| <b>Insulin</b>                         | 26,455 (18.1%)  | 2,840 (18.9%)  | 2,683 (17.9%)  |
| <b>Anticoagulants</b>                  | 14,258 (9.8%)   | 1,432 (9.5%)   | 1,396 (9.3%)   |
| <b>Pioglitazone</b>                    | 8,069 (5.5%)    | 822 (5.5%)     | 845 (5.6%)     |
| <b>Ezetimibe</b>                       | 1,301 (0.9%)    | 120 (0.8%)     | 122 (0.8%)     |
| <b>Sulfonylureas</b>                   | 58,350 (40.0%)  | 6,027 (40.2%)  | 5,923 (39.5%)  |
| <b>Metformin</b>                       | 115,488 (79.1%) | 11,769 (78.4%) | 11,875 (79.2%) |
| <b>Platelet aggregation inhibitors</b> | 55,769 (38.2%)  | 5,764 (38.4%)  | 5,679 (37.9%)  |
| <b>HHF</b>                             | 6,473 (4.4%)    | 673 (4.5%)     | 712 (4.7%)     |

Continuous variables are presented as mean ± standard deviation, binary variables as count (percentage relative to N. subjects).