

Impact of Geographic Disparity on 10-year Mortality in the SYNTAXES Trial, According to the SYNTAX Score II 2020 and Applying Machine Learning (Gradient Boosting Model)

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Disclosure

- The authors are nothing to declare concerning this presentation.

Background

- Treatment outcome following revascularization of complex coronary artery disease differs between countries. The aims of the present study were to evaluate the impact of geographic disparity on all-cause death at 10 years.

Methods

- The design and the primary results of the SYNTAX study have been reported previously. Briefly, all-comer patients with de novo 3 vessel disease and/or left main coronary artery disease deemed to be eligible for both PCI and CABG were enrolled and randomized to either CABG (n=897) or PCI (n=903) with the TAXUS drug-eluting stent (Boston Scientific, Marlborough, MA, USA).

We divided the region following the United Nation geoscheme

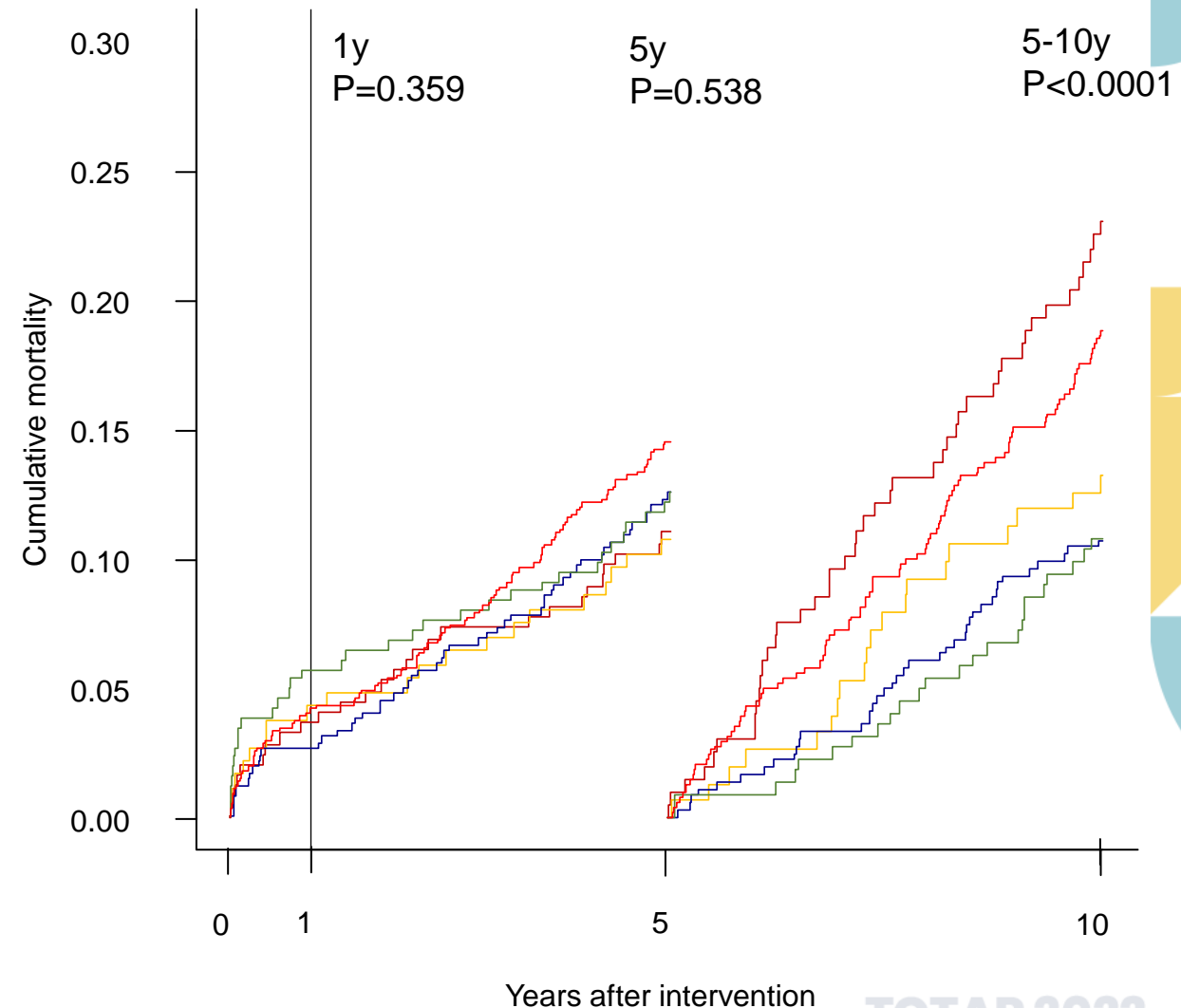
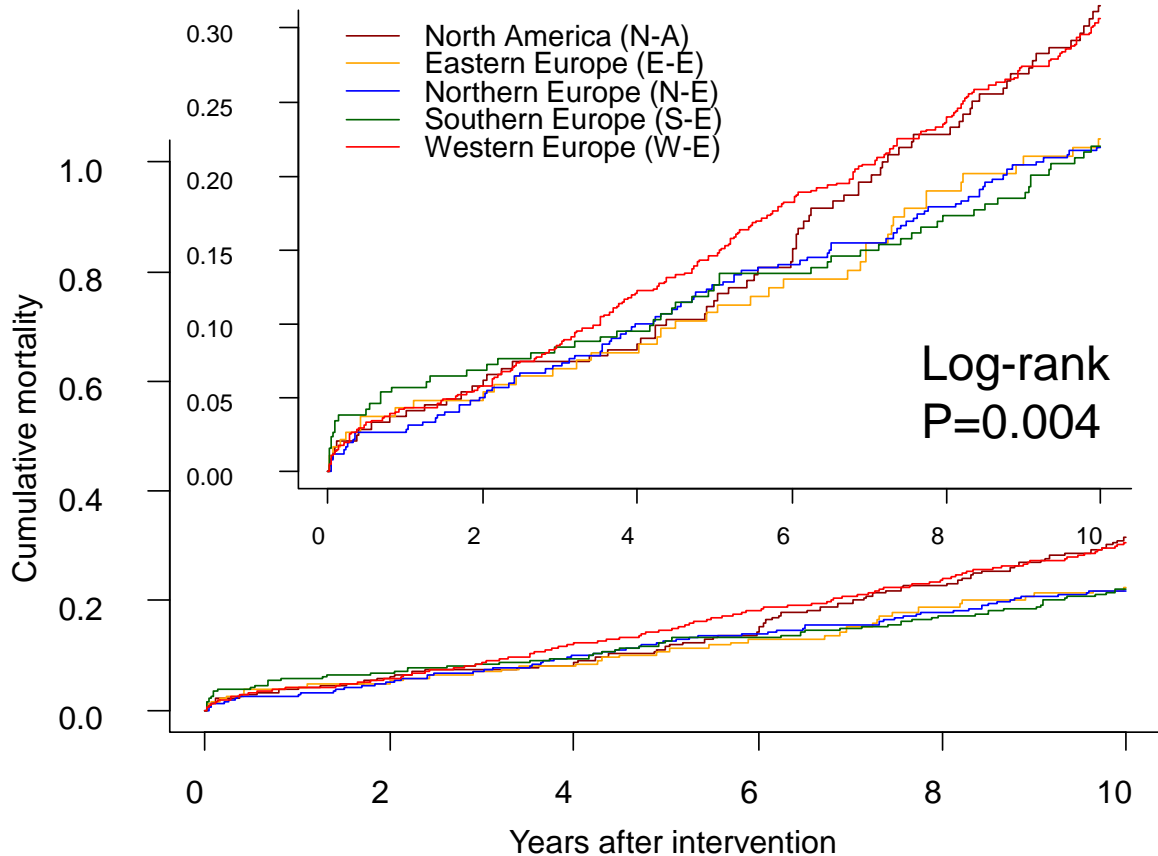
- North America (N-A), E-E (Poland, Hungary, Czech), N-E (United Kingdom, Sweden, Norway, Latvia, Finland, and Denmark), S-E (Spain, Portugal, and Italy), and W-E (Netherlands, Germany, France, Belgium, and Austria), and subdivided in each country).
- Divided entire population (n=1800) was as follows; N-A (n=245), E-E (n=189), N-E (n=425), S-E (n=263), and W-E (n=678).



Pre procedural characteristics

| Region | W-Europe | N-America | E-Europe | N-Europe | S-Europe |
|-----------------------------------|----------|-----------|----------|----------|----------|
| Pt number | 678 | 245 | 189 | 425 | 263 |
| Age | 65.31 | 65.07 | 62.20↓ | 65.21 | 66.44 |
| Male (%) | 79.6 | 65.3↑ | 76.2 | 81.4 | 79.1 |
| Body mass index | 27.56 | 30.24↑ | 28.80↑ | 27.74 | 26.94↓ |
| Anemia (%) | 24.2 | 49.6↑ | 19.6 | 22.3 | 29.8 |
| Medically treated Diabetes (%) | 25.4 | 31.8 | 29.1 | 16.0↓ | 30.0 |
| Insulin use (%) | 9.4 | 13.9 | 11.1 | 7.1 | 12.5↑ |
| Hypertension (%) | 70.9 | 64.1 | 75.1 | 61.4↓ | 58.9↓ |
| Current smoker (%) | 21.6 | 23.8 | 19.1 | 19.1 | 16.1 |
| COPD (%) | 8.1 | 10.2 | 9.0 | 8.2 | 8.4 |
| Dyslipidemia (%) | 74.9 | 79.5 | 77.2 | 88.8↑ | 67.3↓ |
| CrCl (ml/min/1.73m ²) | 84.55 | 95.42↑ | 93.29↑ | 85.14 | 78.14↓ |
| LVEF (%) | 61.94 | 55.52↓ | 57.23↓ | 55.97↓ | 56.53↓ |
| Prev. MI (%) | 27.6 | 23.3 | 38.6↑ | 39.1↑ | 38.8↑ |
| Prev. heart failure (%) | 2.2 | 7.8↑ | 3.7 | 7.5↑ | 3.8 |
| Prev. stroke (%) | 3.6 | 8.6↑ | 3.2 | 3.8 | 4.2 |
| Prev. PVD (%) | 10.9 | 13.1 | 7.9 | 6.8↓ | 10.3 |
| Num. of lesions | 4.40 | 3.75↓ | 4.45 | 4.28 | 4.87↑ |
| LMCAD (%) | 36.9 | 56.3↑ | 31.7 | 40.2 | 32.7 |
| 3VD (%) | 63.1 | 43.7↓ | 68.3 | 59.8 | 67.3 |
| Anatomical SS /points | 29.08 | 25.68↓ | 28.22 | 28.59 | 31.26↑ |
| Euro SCORE /points | 3.74 | 4.18↑ | 3.10↓ | 3.53 | 4.34↑ |
| SS II 2020 score /points | 27.80 | 28.46 | 21.81↓ | 25.11↓ | 28.68 |

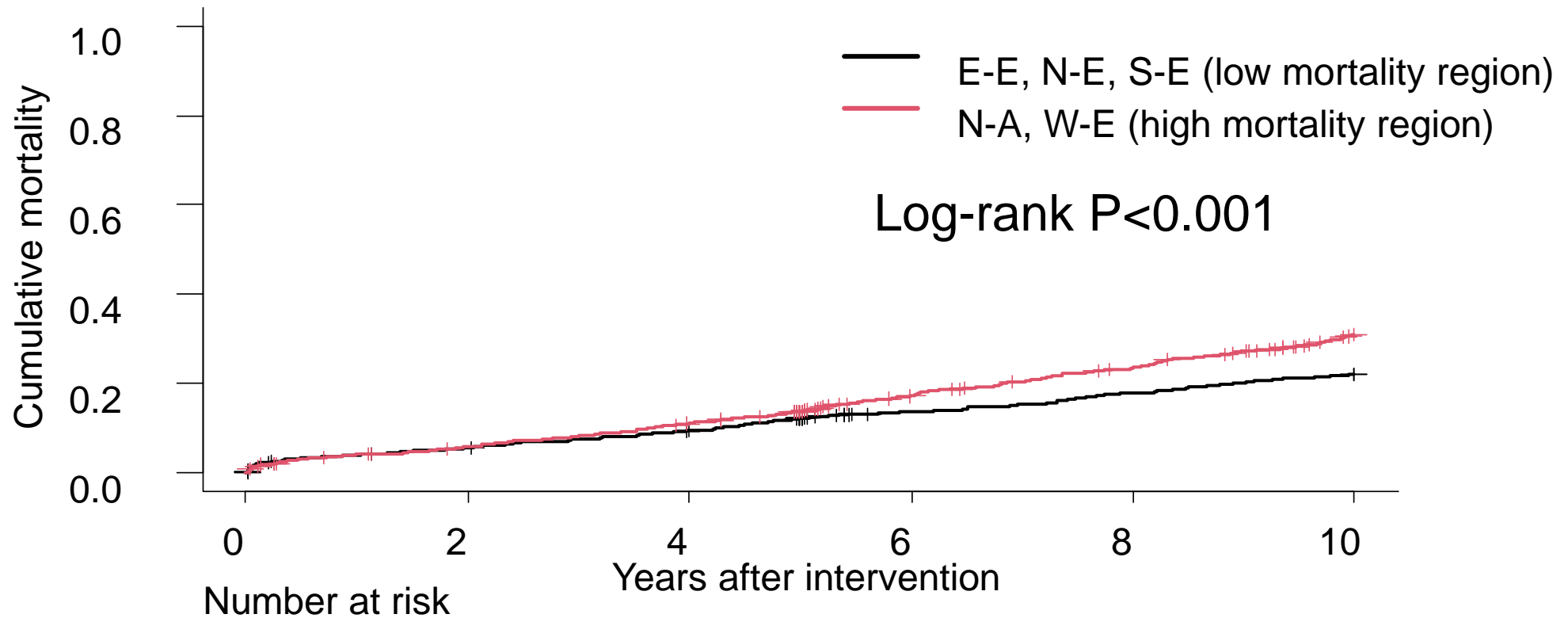
Survival curve of 10-year mortality – stratified by 5 regions –



Number at risk

| | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|
| N-A | 245 | 228 | 221 | 191 | 170 | 144 |
| E-E | 189 | 178 | 170 | 147 | 137 | 131 |
| N-E | 425 | 400 | 379 | 359 | 343 | 325 |
| S-E | 263 | 245 | 237 | 221 | 211 | 199 |
| W-E | 678 | 631 | 587 | 518 | 479 | 426 |

Survival curve of 10-year mortality in low and high mortality region

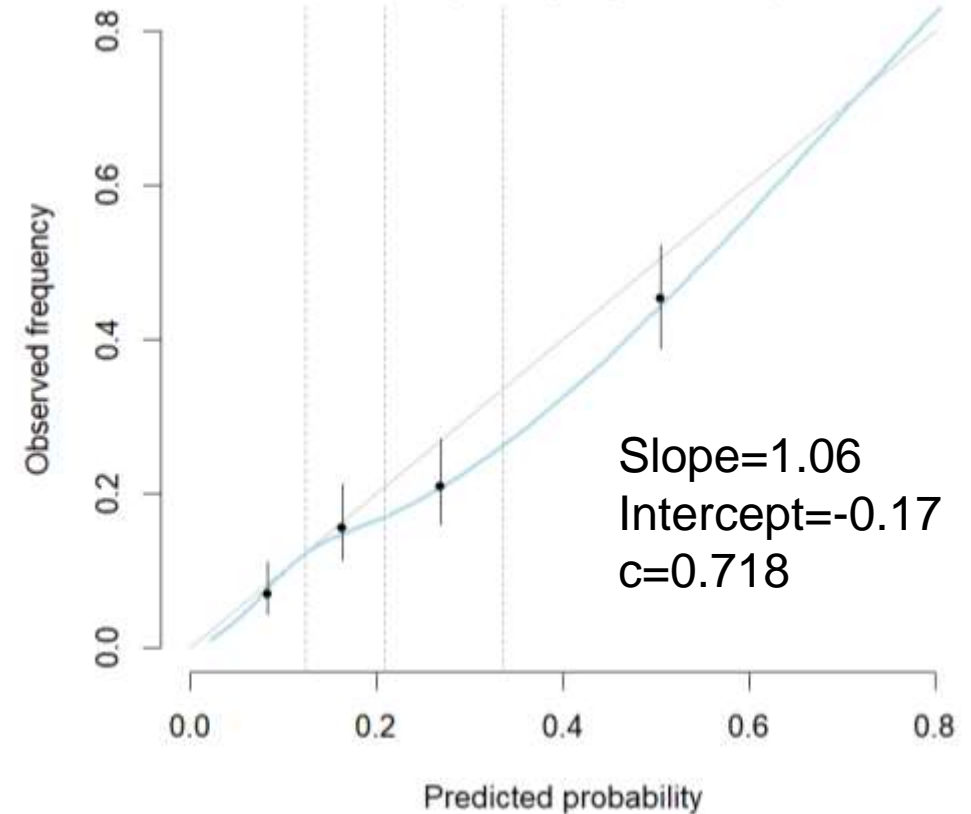
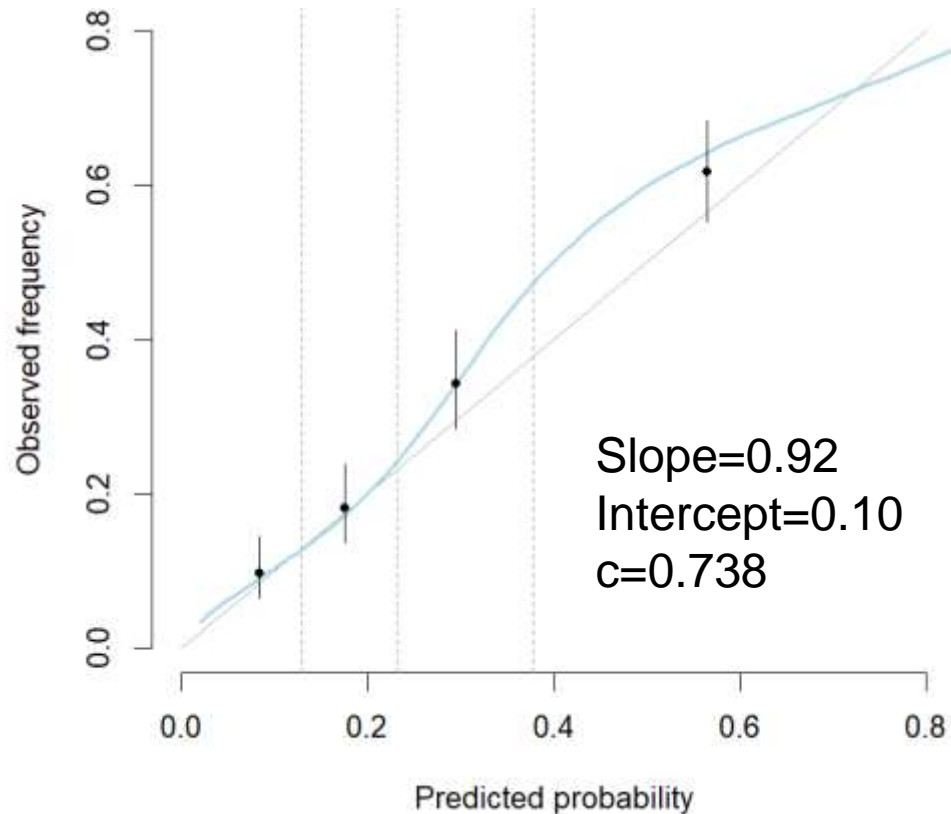


| | | | | | | |
|---------------|-----|-----|-----|-----|-----|-----|
| E-E, N-E, S-E | 877 | 823 | 786 | 727 | 691 | 655 |
| N-A, W-E | 923 | 859 | 808 | 709 | 649 | 570 |

Calibration curve to predict 10y mortality using **SSII2020** – high vs low mortality region

N-A, W-E (high mortality region)

E-E, N-E, S-E (low mortality region)



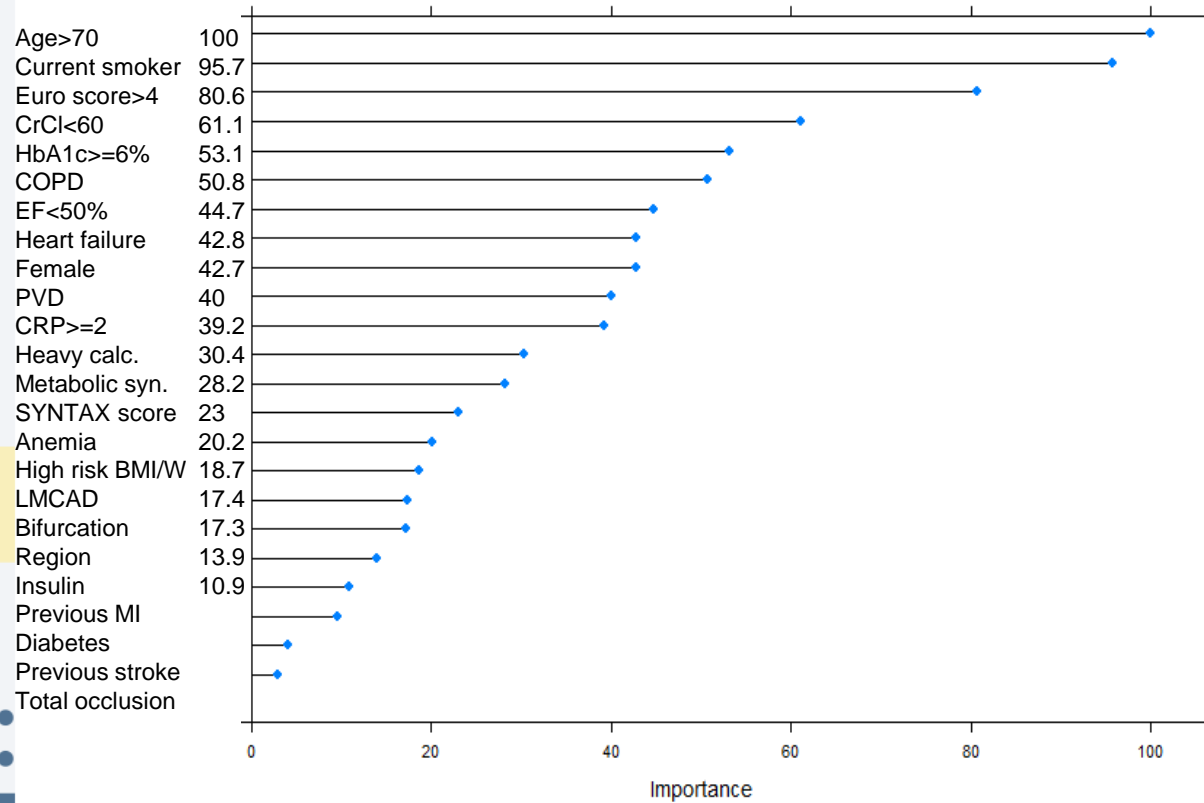
Can machine learning model including regional difference can overcome over- or underestimation of 10y death in SSI2020?

Considered factors for model construction = Known risk factors as categorical variables

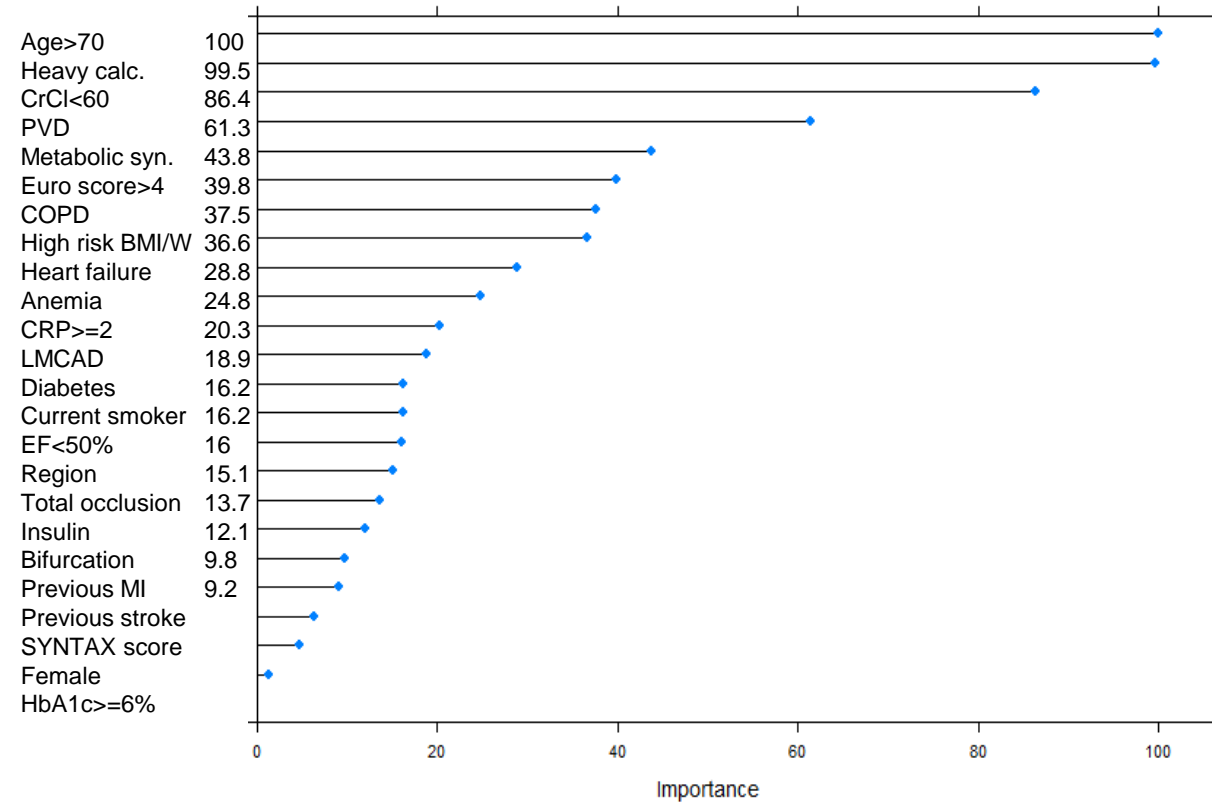
- Objective: Prediction of 10y mortality in SYNTAXES trial
- Considered 24 risk factors are following;
- Age \geq 70, female, CrCl $<$ 60ml/min/1.73m², EF $<$ 50%, COPD, PVD, previous MI, previous heart failure, previous Stroke, Current smoker (at the time of inclusion), LMCAD, bifurcation lesion, total occlusion, heavy calcification, SYNTAX score \geq 33, Euro score $>$ 4, Metabolic syndrome, high-risk BMI & waist combination, anaemia, medically treated diabetes, Insulin use, HbA1c \geq 6%, CRP \geq 2mg/L, high-risk region.
- PCI and CABG model was separately constructed.
- To full fill the missing data, we used single imputation.
- We used the gradient boosting model (GBM) for prediction.

Variable importance in each arm using ML

PCI



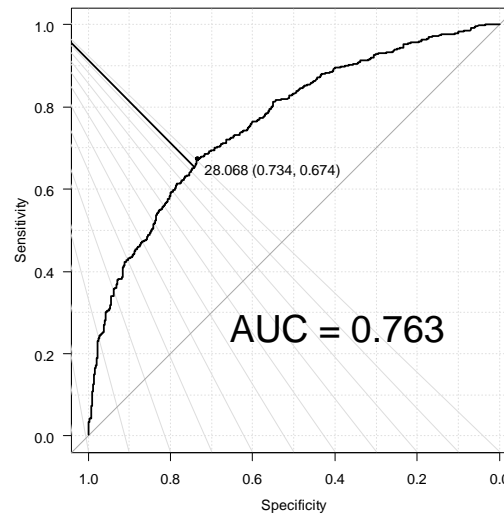
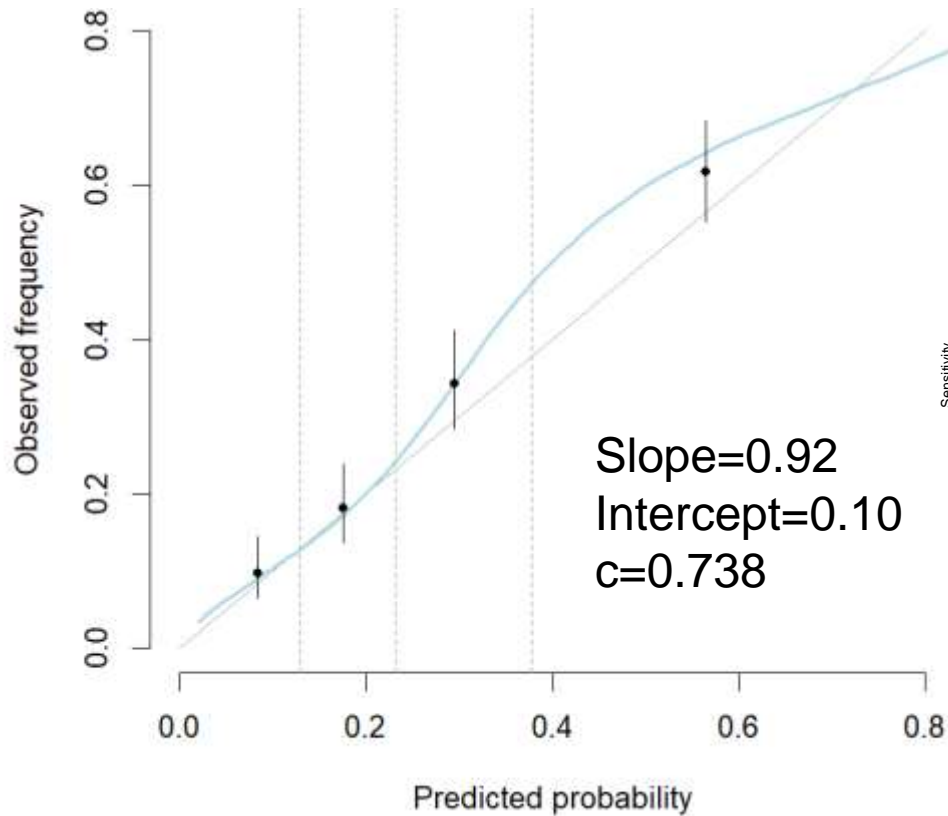
CABG



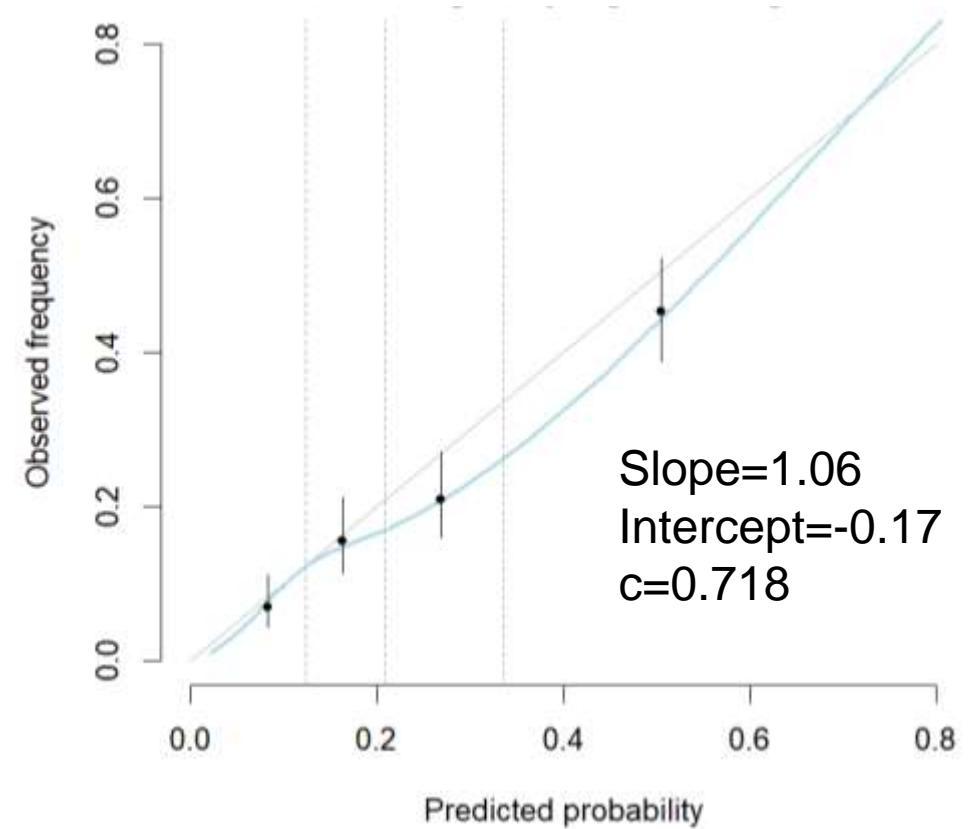
Calibration curve to predict 10y mortality using **SSII2020** – high vs low mortality region

N-A, W-E (high mortality region)

E-E, N-E, S-E (low mortality region)



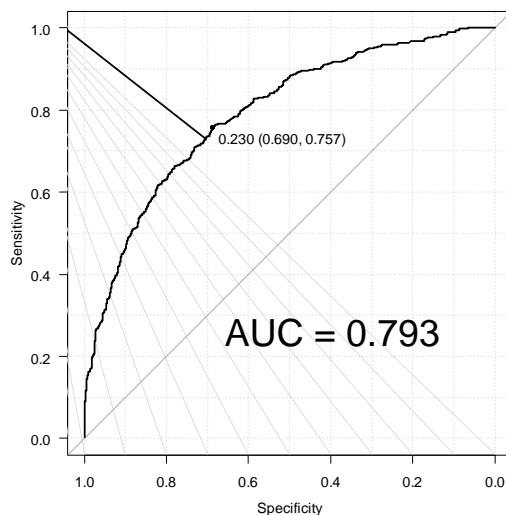
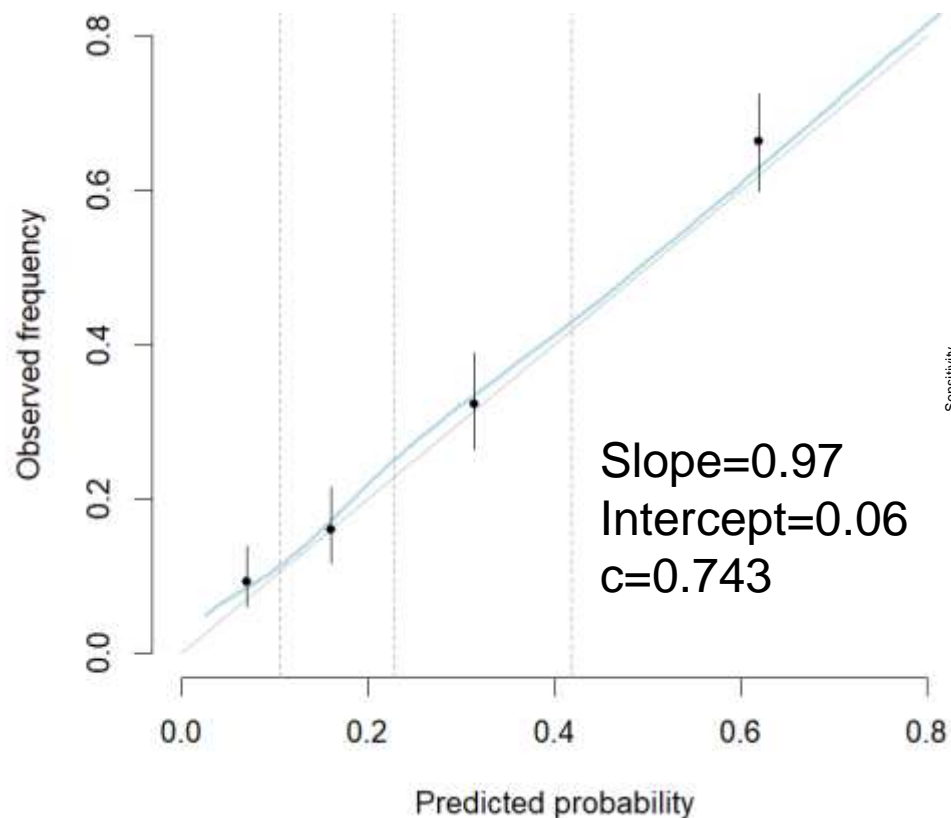
Whole population



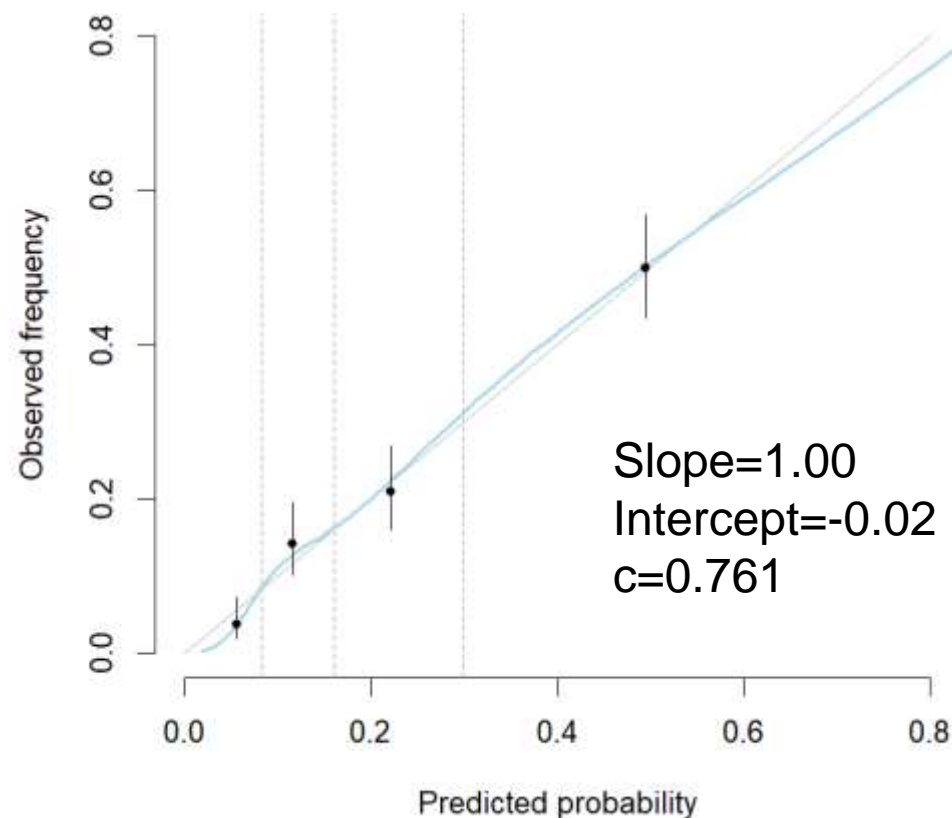
Calibration curve to predict 10y mortality using **GBM** - high vs low mortality region

N-A, W-E (high mortality region)

E-E, N-E, S-E (low mortality region)



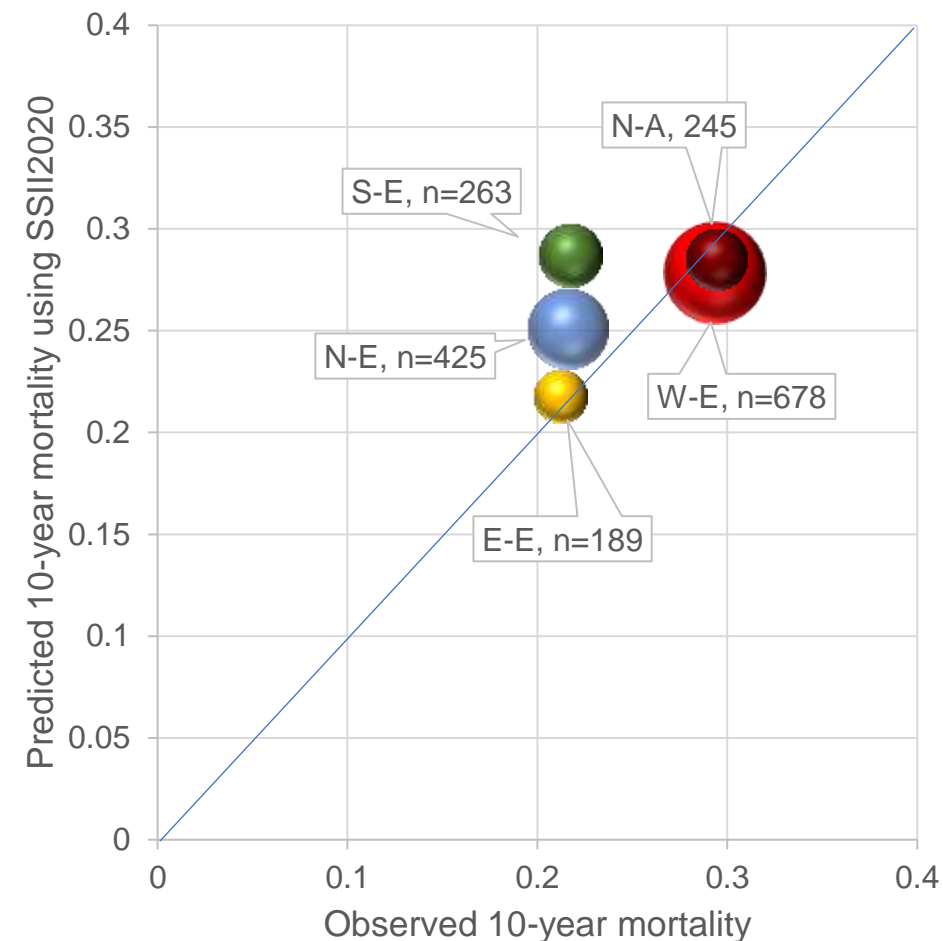
Whole population



Did new GBM become better predictor for 10-year death in each region than SSII2020?

*SYNTAX score II 2020 (SSII2020)**

| Factor | W-E | N-A | E-E | N-E | S-E |
|---|-------|-------|-------|-------|-------|
| N | 678 | 245 | 189 | 425 | 263 |
| OBSERVED 10y mortality | 29.4% | 29.4% | 21.2% | 21.6% | 21.7% |
| PREDICTED by SS II 2020 score | 27.8% | 28.5% | 21.8% | 25.1% | 28.7% |

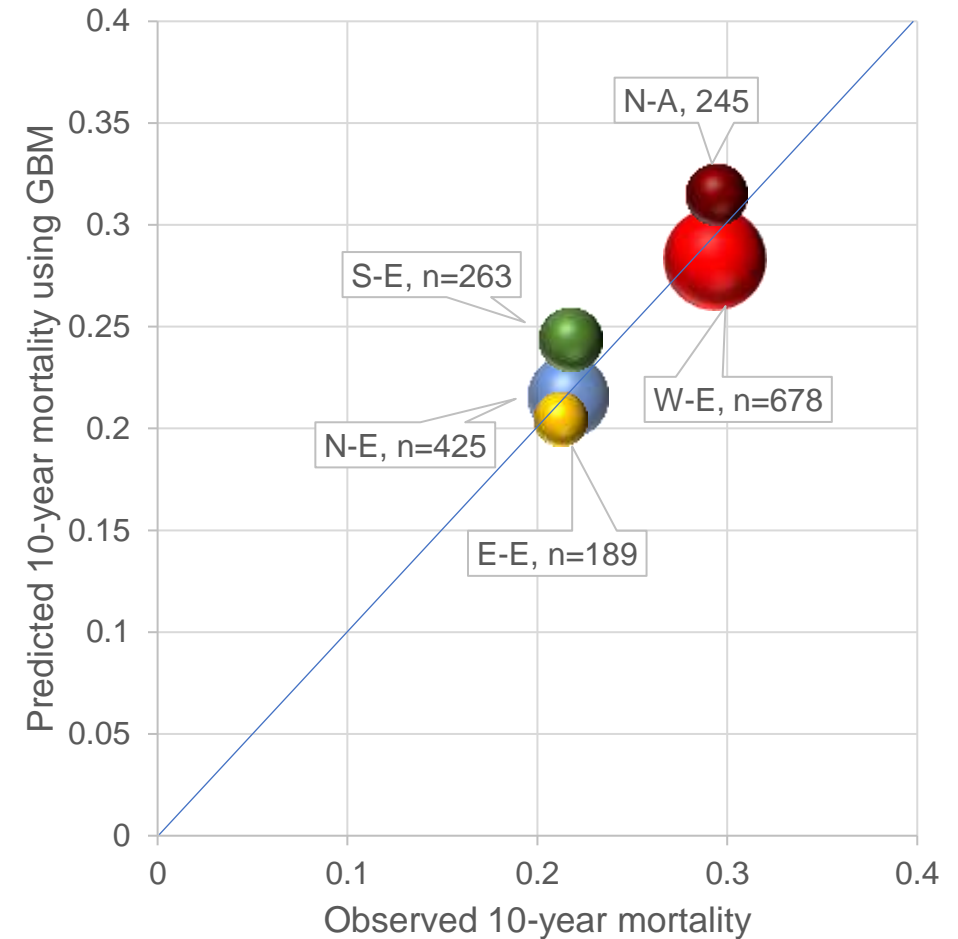


* Takahashi K, Serruys PW, et.al. Lancet. 2020 Oct 31;396(10260):1399-1412.

Did new GBM become better predictor for 10-year death in each region than SSII2020?

Gradient boosting model (GBM)

| Factor | W-E | N-A | E-E | N-E | S-E |
|---|--------------|--------------|--------------|--------------|--------------|
| N | 678 | 245 | 189 | 425 | 263 |
| OBSERVED 10y mortality | 29.4% | 29.4% | 21.2% | 21.6% | 21.7% |
| PREDICTED by SS II 2020 score | 27.8% | 28.5% | 21.8% | 25.1% | 28.7% |
| PREDICTED by GBM score | 28.3% | 31.5% | 20.5% | 21.6% | 24.4% |



Conclusion / Take-home Message

- Geography is a determinant factor of the long-term prognosis of coronary artery disease following revascularization.
- Ten year mortality in N-A and W-E was higher than that in the other European regions.
- Including geographic disparity, machine learning could predict the 10-year mortality of the intercontinental SYNTAX trial more accurately than the SYNTAX score II 2020.