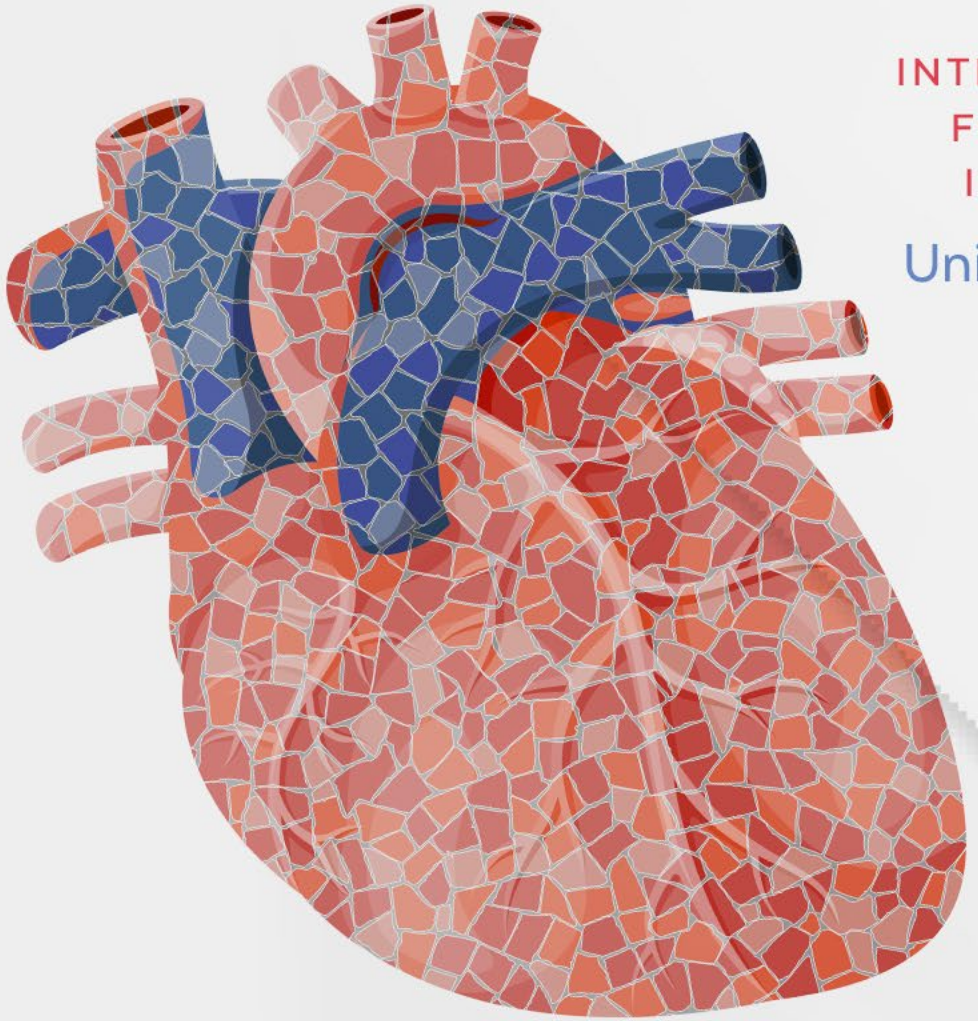


BARCELONA

JUNE 18TH - 20TH

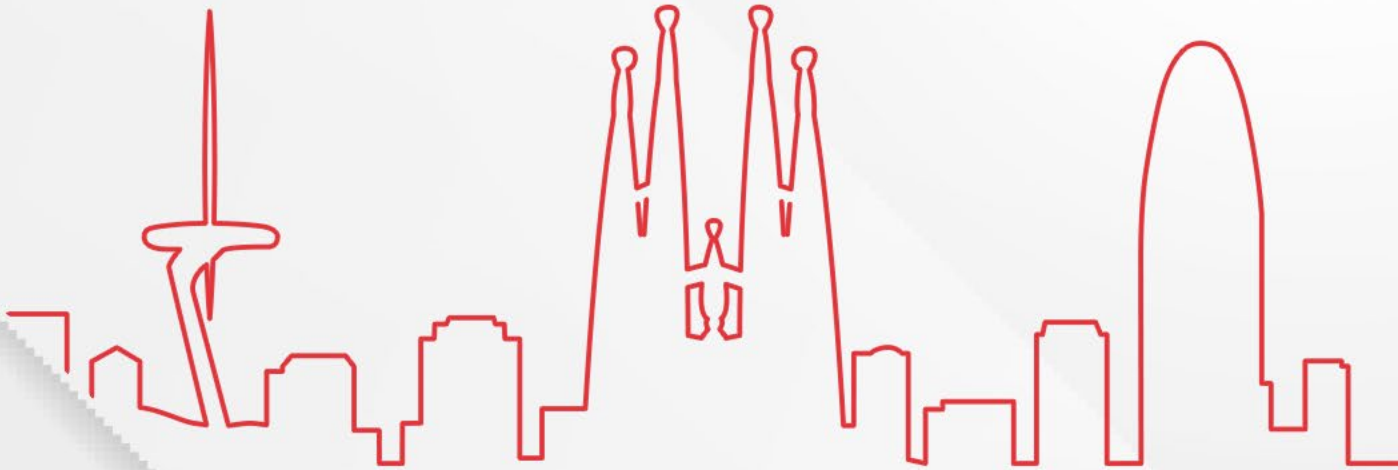
2022

INTERNATIONAL SOCIETY
FOR CARDIOVASCULAR
INFECTIOUS DISEASES

University of Barcelona
Faculty of Medicine

16TH SYMPOSIUM

ISCVID



www.iscvid2022.com

Scores, scores and more scores for cardiac surgery… Do they help us?

Bernard Iung
Bichat Hospital, APHP
Université Paris-Cité
Paris, France

Université Paris Cité

Disclosures

Bernard Iung, ISCVID 2022

- No disclosure

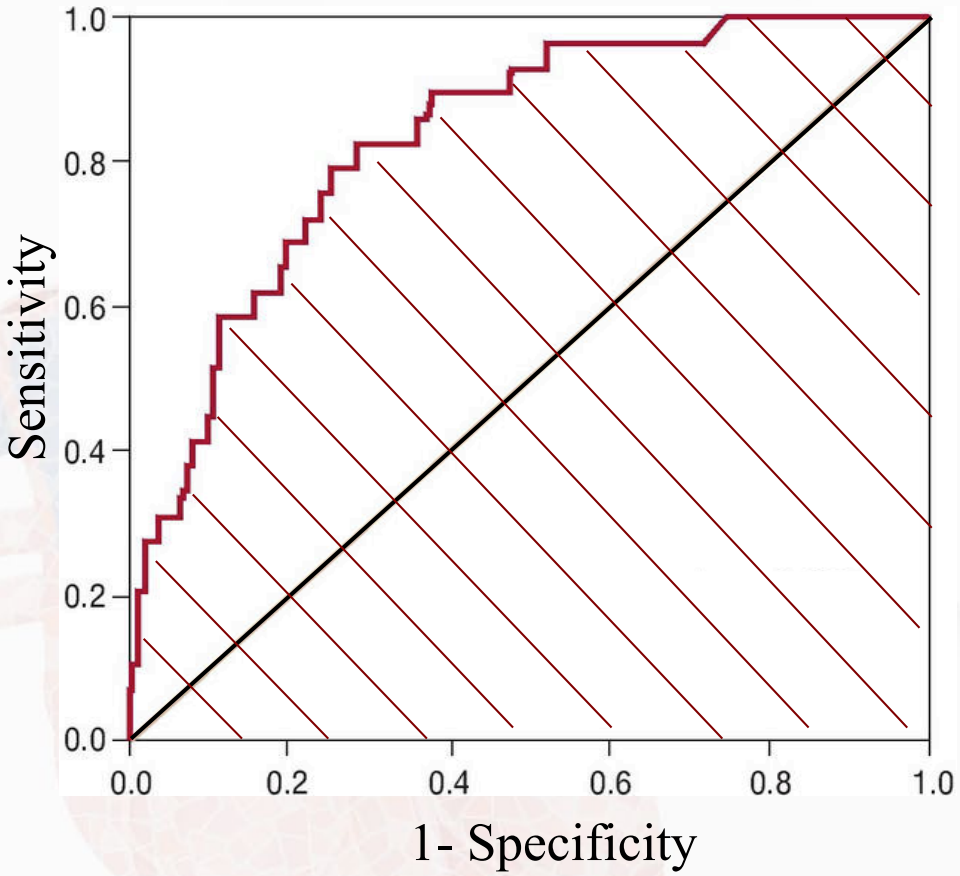
Background

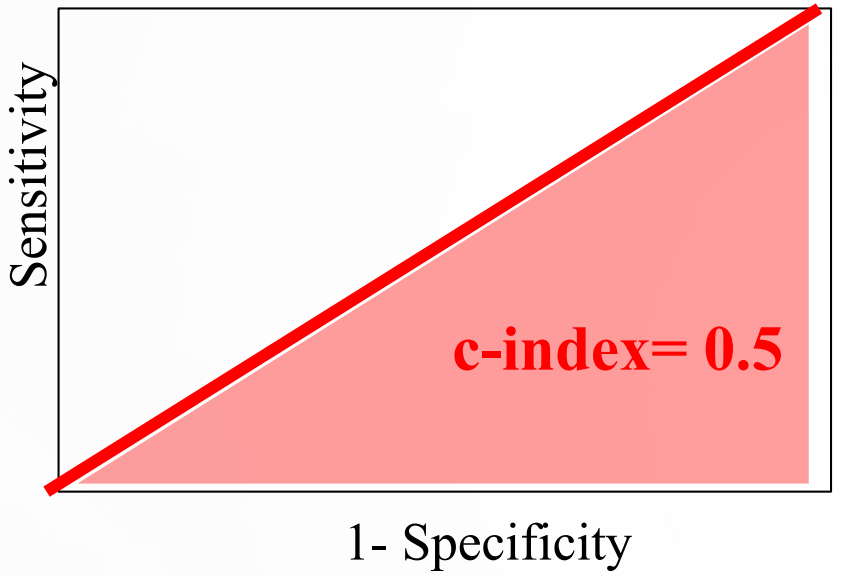
- Multivariate scores are used to provide simple, user-friendly, individualized assessment of risks according to individual patient characteristics.
- Scores have been developed for the prediction of operative mortality after cardiac surgery and are widely used (EuroSCORE and EuroSCORE II, STS).
- Dedicated scores have been developed in infective endocarditis to take into account its particular determinants of operative mortality.
- Main criteria for assessing the predictive performance are discrimination and calibration, ideally assessed in an independent population (external validation vs. internal validation)

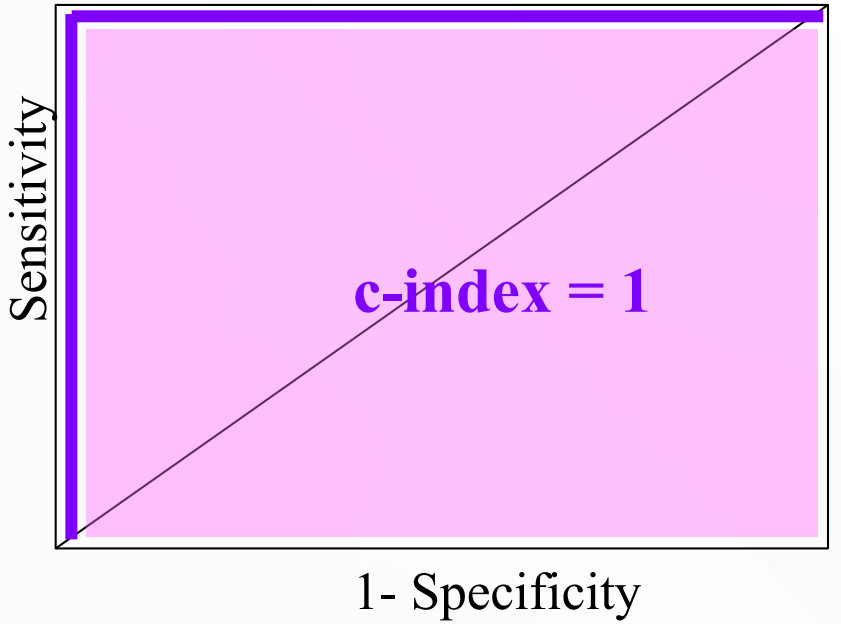
Discrimination

Distinction between low and high risk patients

Area under the ROC curve = c-index (0.5 to 1)







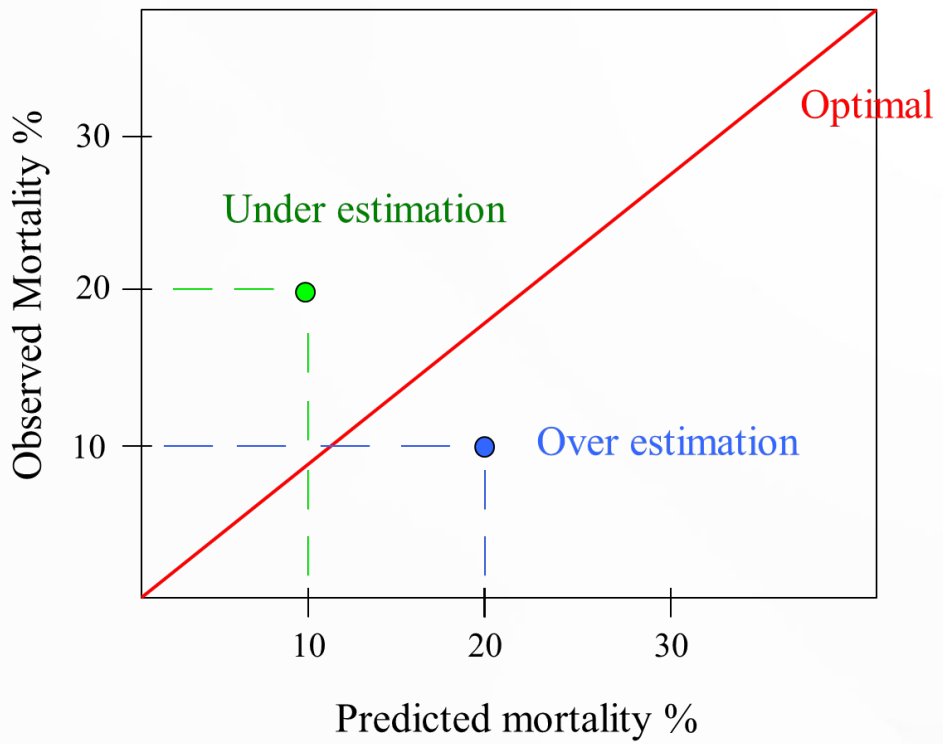
Calibration

Comparison of observed and predicted events

-Overall calibration:
Hosmer-Lemeshow goodness-of-fit test
(highly dependent of population size)

-O/E ratio (oberved/expected)

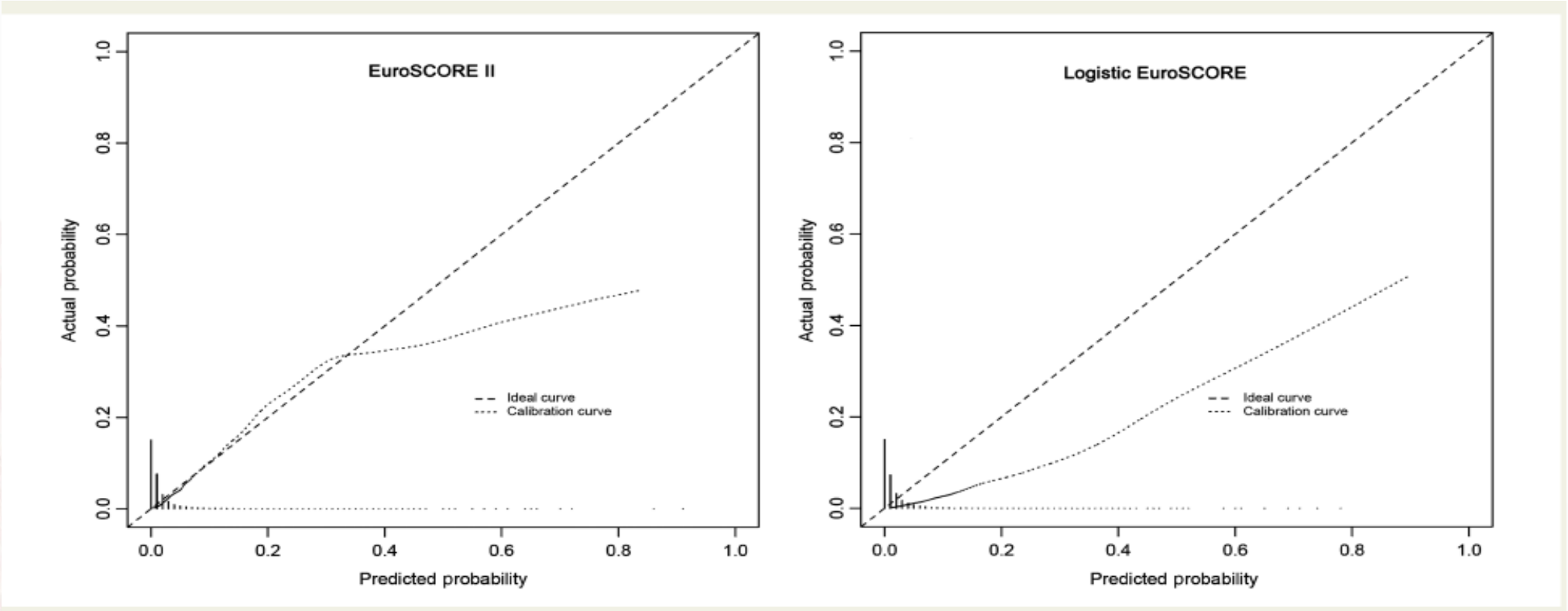
-Calibration according to the risk level: calibration plot.



EuroSCORE I and II

12 325 Patients undergoing cardiac surgery (in-hospital mortality 2.2%)

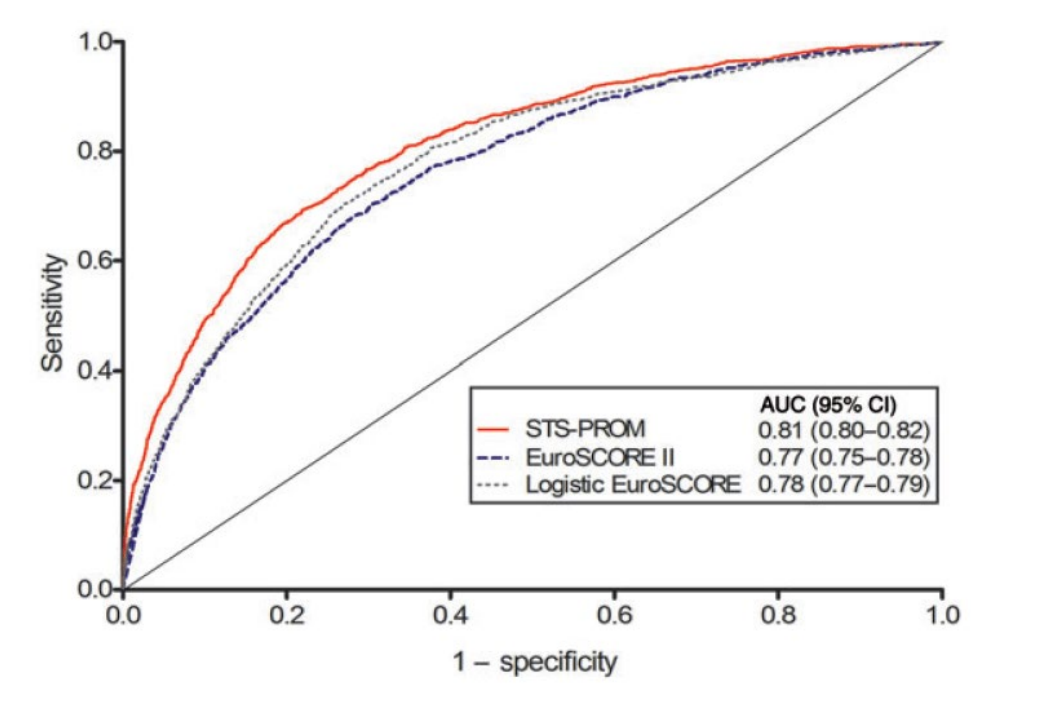
	EuroSCORE II	EuroSCORE I (logistic)
c-index	0.82	0.82

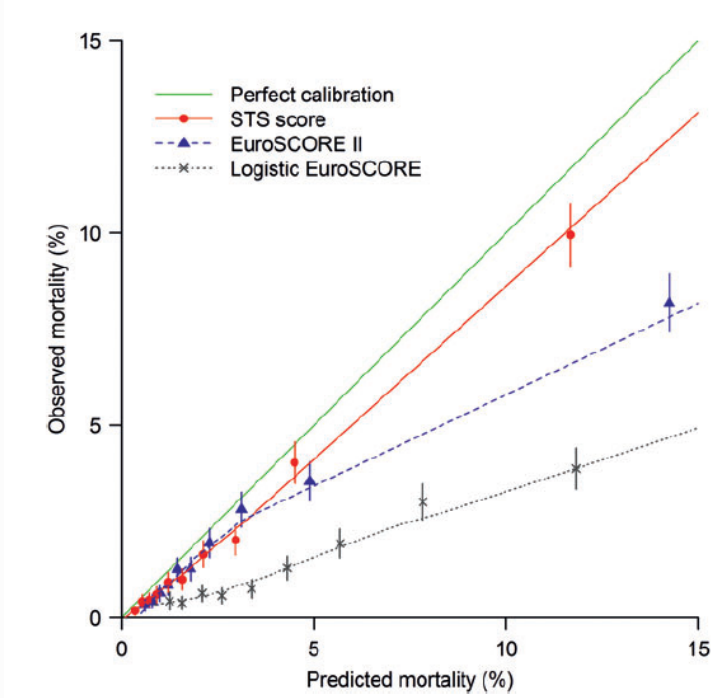


(Barili et al. Eur Heart J 2013;34:22-9)

EuroSCORE and STS

50 588 patients undergoing cardiac surgery in the US (in-hospital mortality 2.1%)





(Osnabrugge et al. Eur J Cardiothorac Surg 2014;46:400-8)

EuroSCORE and STS in Infective Endocarditis

	n=	Mortality (%)	Validation	c-index	Calibration
EuroSCORE I (Madeira et al.)	128	In-hospital: 16.4	External	0.75	p=0.04 (HL)
EuroSCORE II (Madeira et al.)	128	In-hospital: 16.4	External	0.83	p=0.08 (HL)
EuroSCORE II (Patrat-Delon et al.)	149	In-hospital: 21	External	0.78	5-10% underestimation
EuroSCORE II (Gatti et al.)	324	In-hospital: 13.9	External	0.66	p=0.28 (HL)
STS (Gaca et al.)	13 617	30-day: 8.2	Internal	0.76	NA
STS (Gatti et al.)	324	In-hospital: 13.9	External	0.74	p=0.54 (HL)

(HL: Hosmer-Lemeshow)

Madeira et al. Interact Cardiovasc Thorac Surg 2016;22:141-8.
Patrat-Delon et al. Eur J Cardiothorac Surg 2016;49:944-51.
Gatti et al. Scand Cardiovasc J 2019;53:117-24.
Gaca et al. J Thorac Cardiovasc Surg 2011;141:98-106.e2.

Specific Scores in Infective Endocarditis

	n=	n variables	Mortality (%)	Validation	c-index	Calibration
De Feo (De Feo et al.)	440	6	30-day: 9.1	Internal	0.88	NA
PALSUSE (Martinez-Selles et al.)	437	7	In-hospital: 24.3	Internal	0.84	NA
EndoSCORE (Di Mauro et al.)	2715	8	In-hospital: 11.0	Internal	0.85	Corrected U statistic p=0.065
AEPEI score (Gatti et al.)	361	5	In-hospital: 15.5	Internal External	0.78 0.72	p=0.75 (HL)
RISK-E (Olmos et al.)	671	8	In-hospital: 28.6	Internal External	0.82 0.76	p=0.30 (HL) p=0.29 (HL) + calibration plot
APORTEI score (Varela Barca et al.)	1338	11	In-hospital: 25.6	Internal	0.75	p=0. 39 (HL) + calibration plot

(HL: Hosmer-Lemeshow)

De Feo et al. Sci World J 2012;2012:307571.
Di Mauro et al. Int J Cardiol 2017;241:97-102.
Gatti et al. J Am Heart Assoc 2017;6:e004806.
Olmos et al. Heart 2017;103:1435-42.
Varela Barca et al. Eur J Cardiothorac Surg 2020;57:724-31.

AEPEI Score

- 361 patients operated for acute endocarditis (French survey + 1 Italian centre) between 2000 and 2015). External validation sample of 161 patients.
- In-hospital mortality: 15.5%
- Selected variables in the multivariate score
  - BMI > 27 Kg/m²
  - Glomerular filtration rate <50 ml/min
  - NYHA class IV
  - Critical state
- Discrimination
  - c-index (derivation sample): 0.78 [95% CI 0.73-0.84]
  - c-index (validation sample): 0.72 [95% CI 0.64-0.78]
- Calibration (validation sample) : p=0.75 (Hosmer-Lemeshow)

(Gatti et al. J Am Heart Assoc 2017;6:e004806)

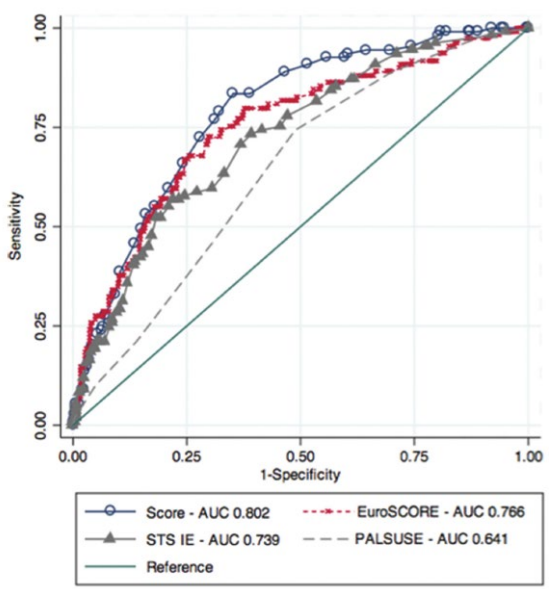
RISK-E Score

- 671 patients operated for acute left-sided infective endocarditis in 3 tertiary Spanish centres between 1996 and 2014.
  - Derivation sample of 424 patients
  - Validation sample of 247 patients
- In-hospital mortality: 28.6%
- Selected variables in the multivariate score
  - Age
  - Prosthetic endocarditis
  - Virulent microorganism (*staphylococcus aureus* or fungi)
  - Septic shock
  - Acute renal insufficiency
  - Cardiogenic shock
  - Periannular complications

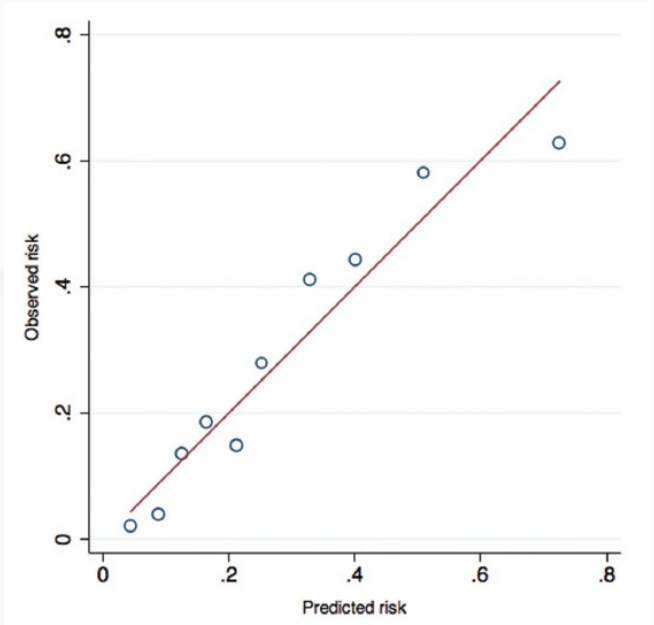
(Olmos et al. Heart 2017;103:1435-42)

RISK-E Score

- Discrimination
  - c-index (derivation sample): 0.82 [95% CI 0.75-0.88]
  - c-index (validation sample): 0.76 [95% CI 0.64-0.88]



- Calibration (entire cohort)



(Olmos et al. Heart 2017;103:1435-42)

APORTEI Score

- 1338 patients operated for acute left-sided infective endocarditis in the Spanish nationwide GAME cohort between 2008 and 2018.
- In-hospital mortality: 25.6%
- Seleted variables in the multivariate score
  - Age
  - Female gender
  - NYHA class >III
  - Renal failure
  - Previous cardiac surgery
  - Prosthetic endocarditis
  - Multivalvular involvement
  - Abscess
  - *Staphylococcus aureus*
  - Cardiogenic shock
  - Urgent surgery

(Varela Barca et al. Eur J Cardiothoracic Surg 2020;57:724-31)

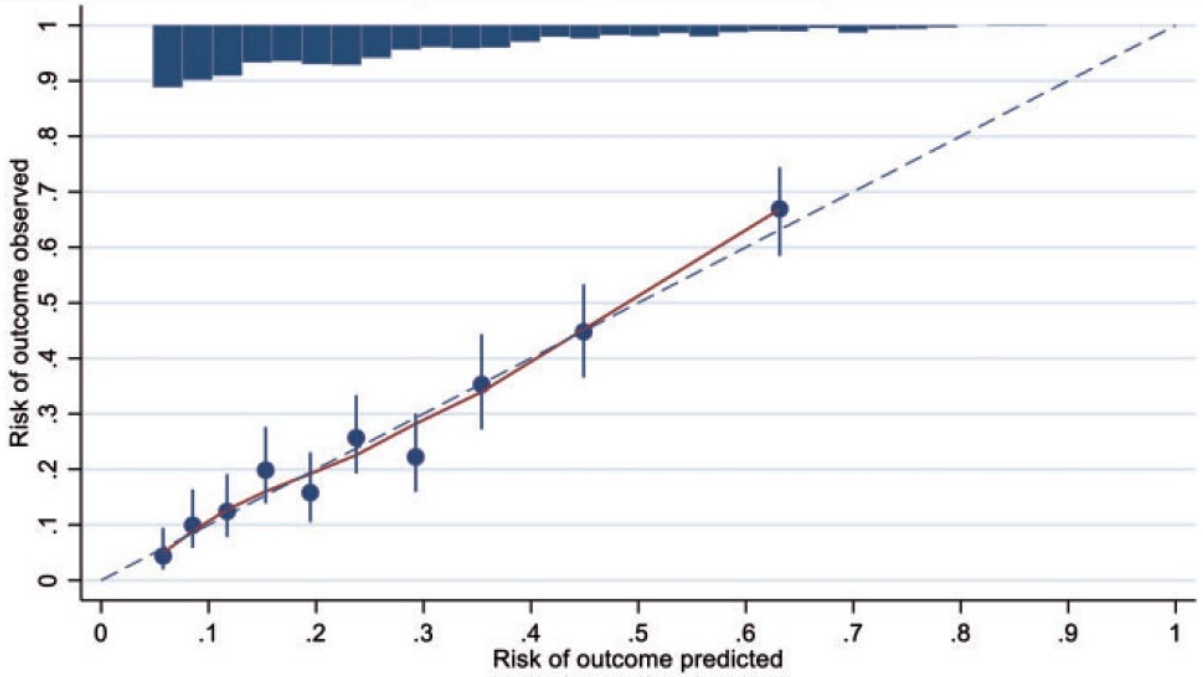
APORTEI Score

- Discrimination (internal validation)

  c-index 0.75 [95% CI 0.72-0.77]

- Calibration

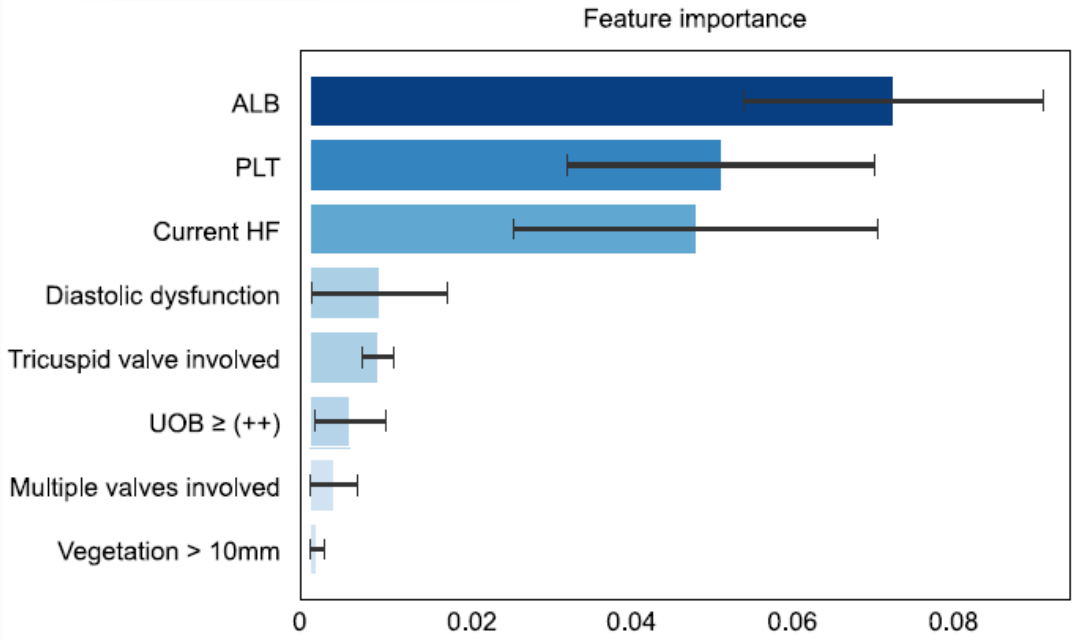
  (internal validation)



(Varela Barca et al. Eur J Cardiothoracic Surg 2020;57:724-31)

Risk Score and Machine Learning

- 752 patients operated for acute endocarditis in 2 Chinese centres between 2013 and 2019.
  - Derivation sample of 276 patients
  - Internal validation sample of 125 patients
  - External validation sample of 75 patients
- 30-day mortality: 7.2%
- 8 variables selected in the XG Boost model
  - c-index (internal validation): 0.81 [95%CI 0.67-0.93]
  - c-index (external validation): 0.82 [95%CI 0.61-0.96]
  - c-index EuroSCORE II (external validation): 0.68 [95%CI 0.37-0.93]



(Luo et al. J Am Heart Assoc 2022;11:e025433)

Risk Scores in IE
External Validation

- Evaluation of risk scores in a single-centre Italian series of 324 patients operated between 1999 and 2018.
- In-hospital mortality: 13.9%

	c-index Initial study	c-index [95% CI] External Validation	Calibration (p Hosmer-Lemeshow) External Validation
De Feo	0.62	0.62 [0.56-0.67]	0.63
PALSUSE	0.84	0.70 [0.65-0.75]	0.70
EndoSCORE	0.85	0.66 [0.61-0.71]	0.28
AEPEI score	0.78 internal 0.72 external	0.79 [0.74-0.83]	0.58
RISK-E	0.82 internal 0.76 external	0.67 [0.61-0.72]	0.37

(Gatti et al. Scand Cardiovasc J 2019;53:117-24)

Risk Scores in IE
External Validation

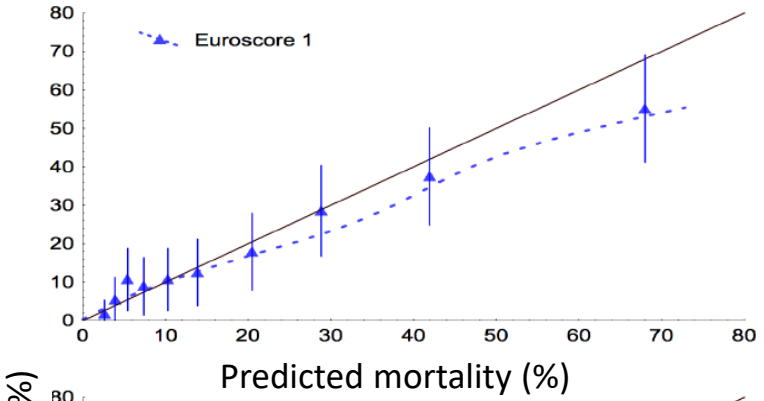
- Evaluation of risk scores in a French series of 553 patients operated between 2006 and 2016.
- In-hospital mortality: 18.5%
- Discrimination

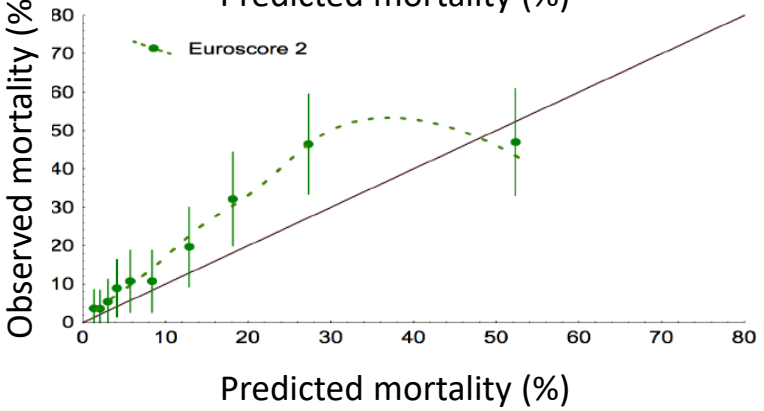
	n=	c-index [95% CI]
EuroSCORE I	552	0.77 [0.72-0.82]
EuroSCORE II	552	0.78 [0.73-0.83]
De Feo	409	0.76 [0.70-0.82]
PALSUSE	552	0.72 [0.67-0.77]
AEPEI score	546	0.73 [0.67-0.78]

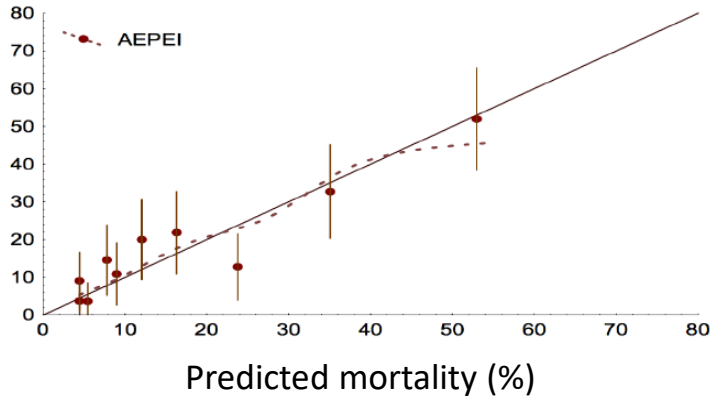
Risk Scores in IE External Validation

- Calibration

	n=	Observed mortality (%)	Predicted mortality (%)	O/E [95% CI]	p (Hosmer-Lemeshow)
EuroSCORE I	552	18.5	19.7	0.94 [0.76-1.14]	0.41
EuroSCORE II	552	18.5	13.1	1.41 [1.15-1.72]	<0.001
AEPEI score	546	17.9	16.9	1.06 [0.86-1.29]	0.054



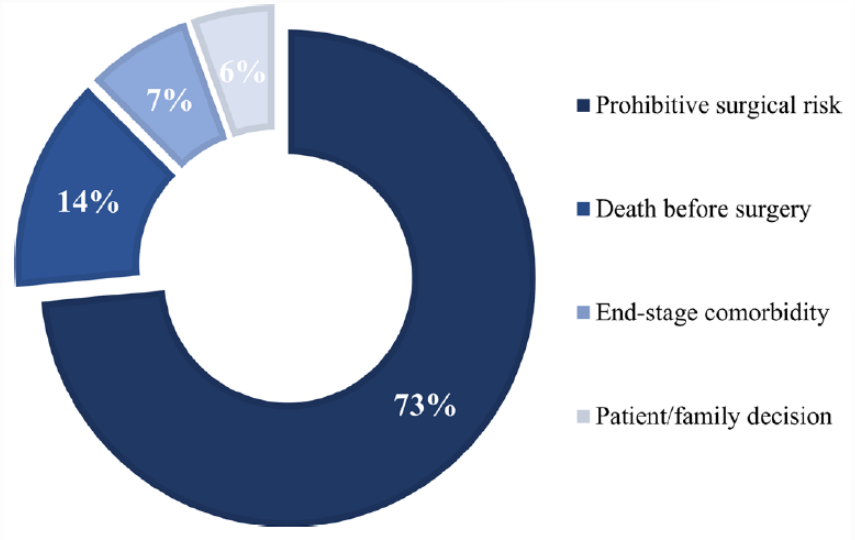




Surgery for Acute IE
Prognostic Impact According to Risk Profile

- 605 patients with left-sided endocarditis: 405 operated on and 200 medically-treated despite indication.

- Reasons for not performing surgery



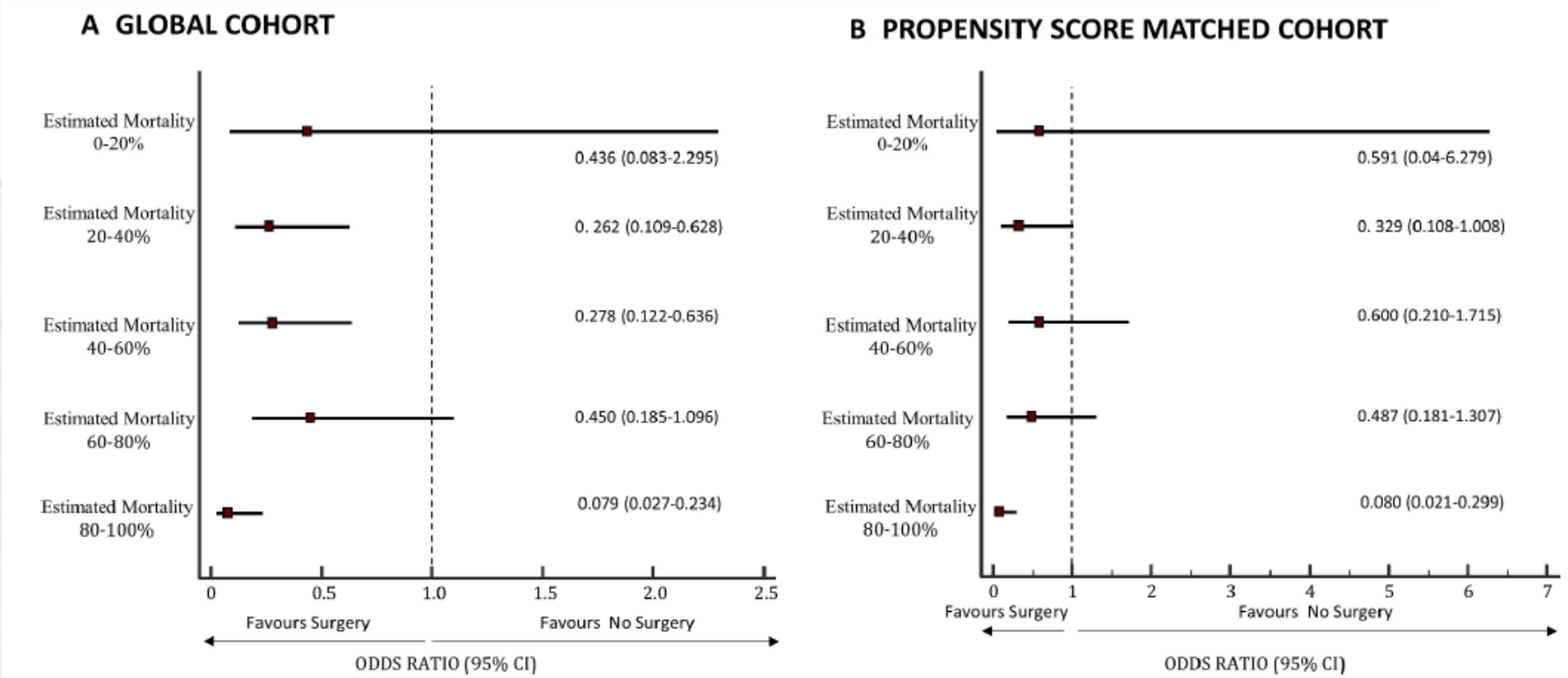
- Surgery was independently associated with lower in-hospital mortality

OR 0.26 [95% CI 0.16-0.42]

(Garcia Granja et al. Heart 2021;107:1987-94)

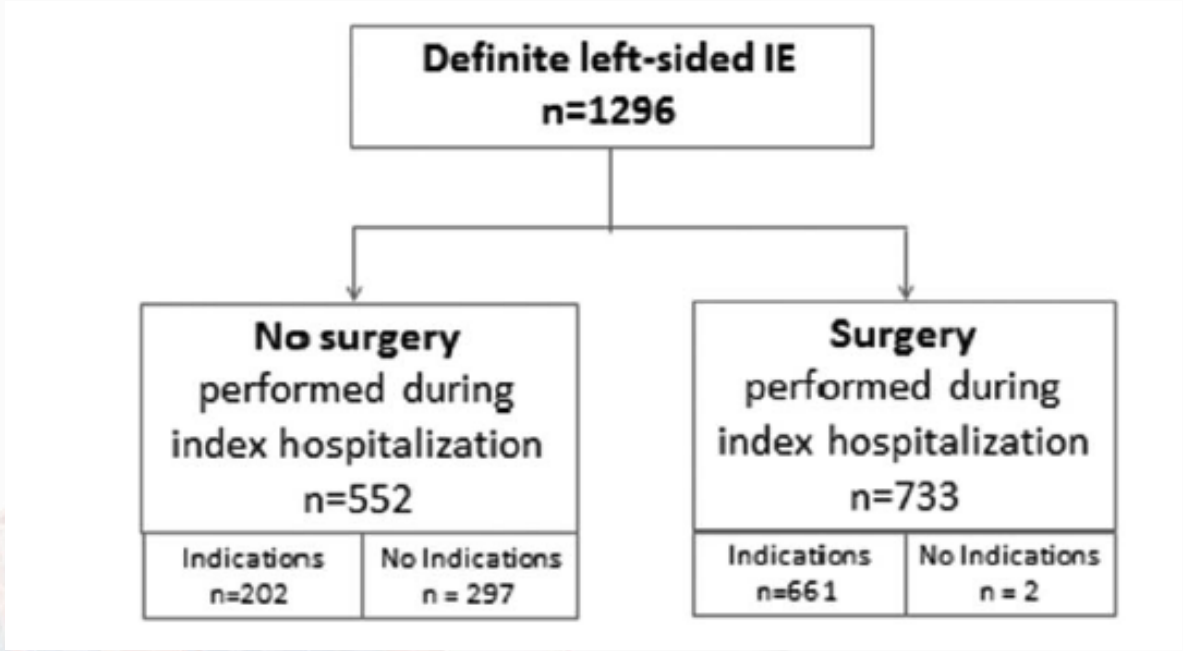
Surgery for Acute IE
Prognostic Impact According to Risk Profile

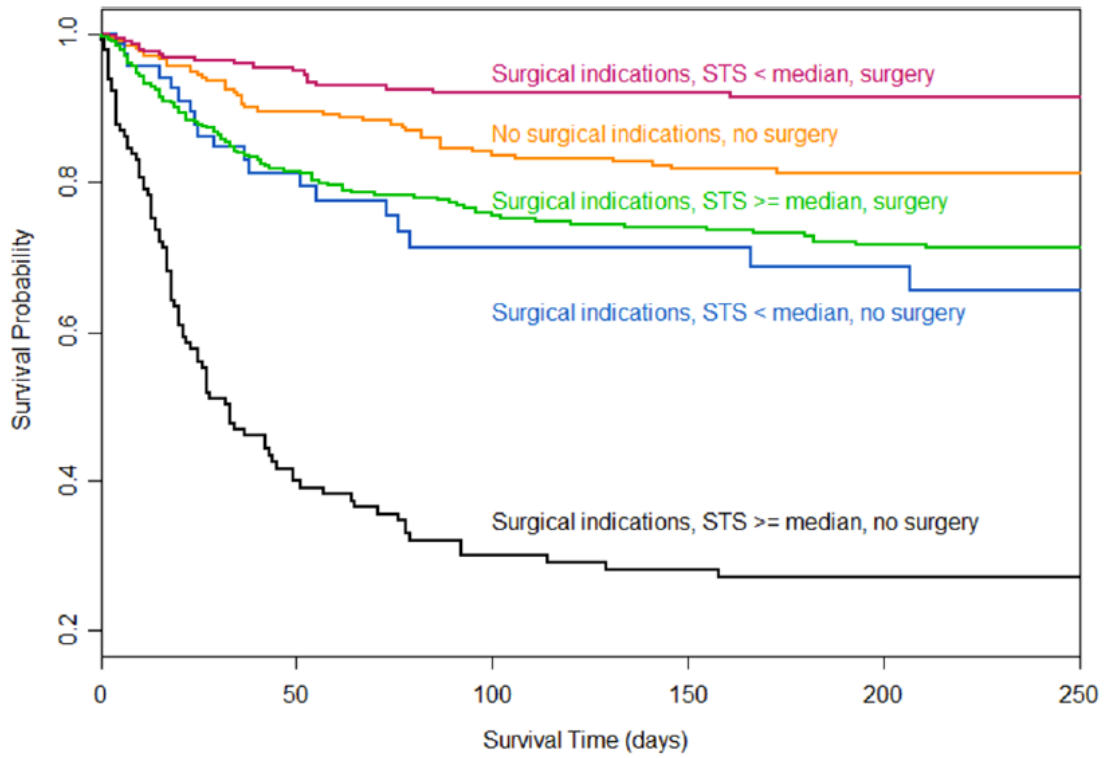
Association between performance of cardiac surgery and predicted in-hospital mortality (ENDOVAL score)



(Garcia Granja et al. Heart 2021;107:1987-94)

Adherence to Guidelines For Surgery in Infective Endocarditis





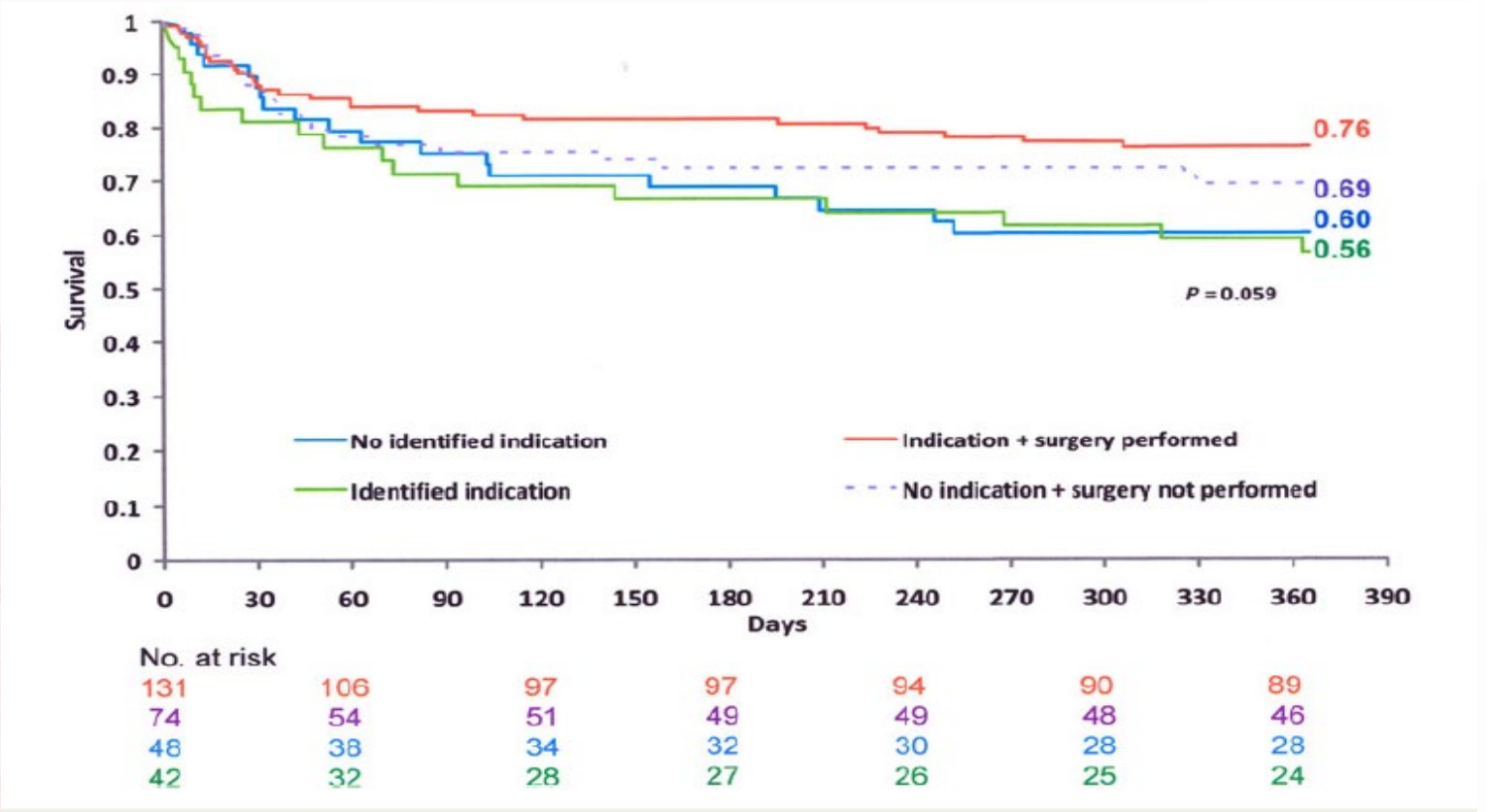
- 74% of pts had an indication for surgery during acute IE
- 57% underwent surgery during acute IE

(Chu et al. Circulation 2015;131:131-40)

Mortality in IE and Adherence to Guidelines

303 patients with definite left-sided native endocarditis from the 2008 French survey

65% had class I or IIa indication for surgery, 46% underwent surgery



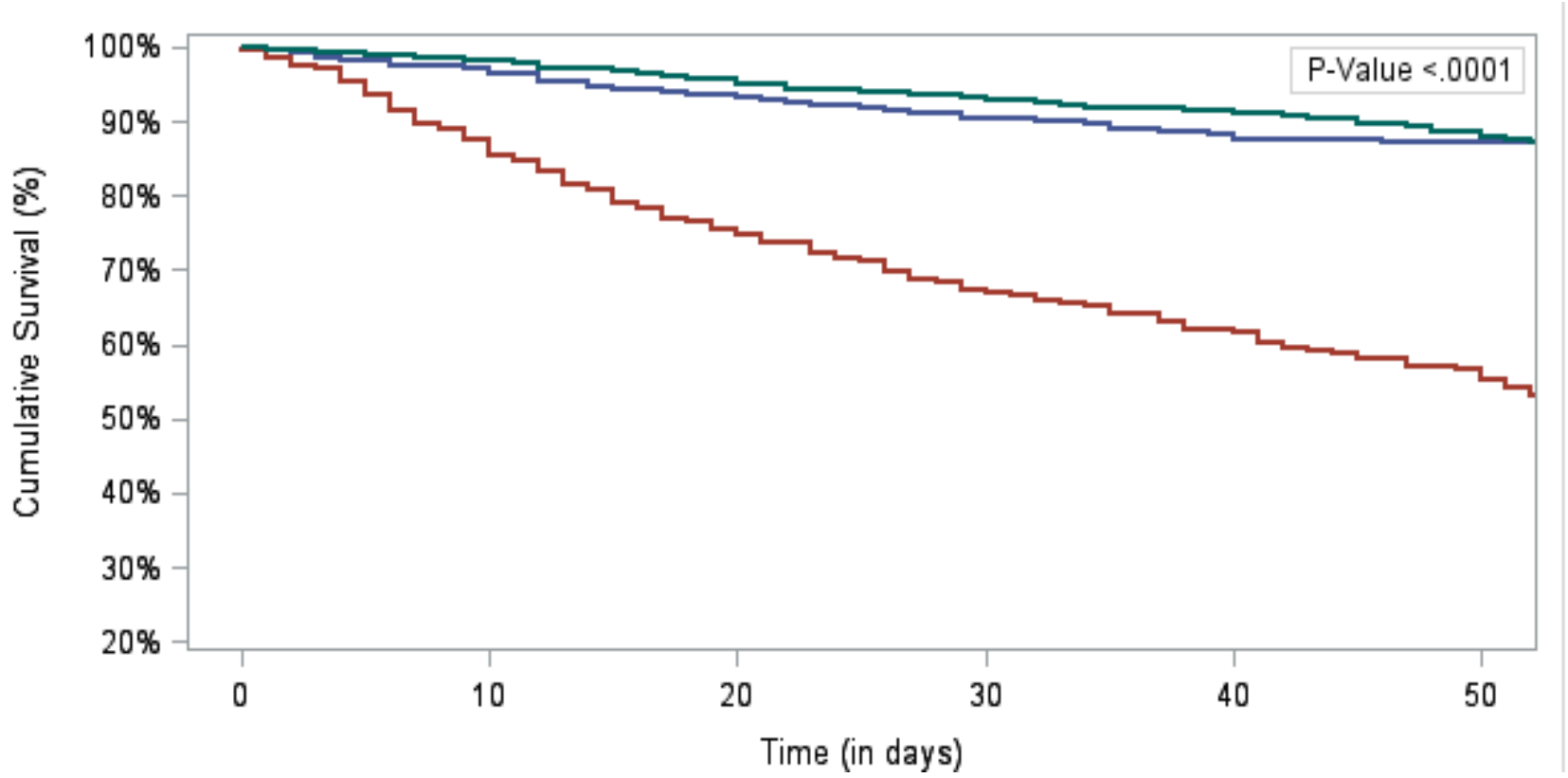
(Iung et al. Eur Heart J 2016;37:840-8)

Mortality in EuroENDO Registry

ESC European Society of Cardiology

3116 patients included in 156 centres from 40 countries (2016-2018)

69% had indication for surgery, 51% underwent surgery



(Habib et al. Eur Heart J 2019;39:3222-32)

Mortality in EuroENDO Registry

ESC European Society of Cardiology

Multivariate predictors of 30-day mortality

	Hazard Ratio	95% CI	p value
Charlson index	1.07	[1.04-1.11]	<0.0001
Creatinine >2mg/dl	1.58	[1.19-2.11]	<0.0017
CHF	2.09	[1.58-2.77]	<0.0001
Vegetation length > 10mm	2.12	[1.64-2.73]	<0.0001
Cerebral complication	2.21	[1.61-3.04]	<0.0001
Abscess	1.50	[1.07-2.10]	0.0186
Indication - not performed	2.84	[2.00-4.03]	<0.001
Indication - performed	0.63	[0.43-0.92]	0.0169

(Habib et al. Eur Heart J 2019;39:3222-32)

Conclusion

- Common risk scores (EuroSCORE II, STS) have a suboptimal performance for the prediction of operative mortality in acute endocarditis.
- Better predictive performance has been reported with specific risk scores. However:
  - Populations sizes are relatively small
  - Most of them have been internally validated
  - Discrimination and calibration decrease when external validation is performed
- Operative risk should be weighed against prognosis without intervention and surgery should not be denied due to high operative risk only.
- Consider validation of scores on large population rather than multiply scores.