CHARMS and PROBAST excel template: Helping authors of prediction models systematic reviews

Take home message

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Background

- Clinical prediction model systematic reviews (**SRs**) are increasingly abundant.
- Data extraction and risk of bias assessment in prediction model SRs is time-consuming.
- CHARMS (*CHecklist for critical Appraisal and data extraction for systematic Reviews of prediction Modelling Studies*) and PROBAST (*Prediction model Risk Of Bias Assessment Tool*) are the standard tools used for these steps in clinical prediction models SRs.

Objective: To describe our Excel template for extracting data, assessing the risk of bias and the applicability of predictive models according to CHARMS and PROBAST.

Implementation: the Excel template

CHARMS

Moons et al, 2014 PLOS Med

Gen	App	RoB	Domain/ Key items	Gaca, 2011
0. Study information				
			0.1 Author	Gaca
			0.2 Publication year	2011
			0.3 Publication identifier (Title/PMID/DOI)	Outcomes for endocarditis surgery in North
			0.4 Publication journal	J Thorac Cardiovasc Surg
			0.5 Model name	STSS score
1. Source of data				✓
			1.1 Source of data	Existing registry
2. Participants				✓
			2.1 Recruitment method	Selective inclusion
			2.2 Recruitment dates	2002 - 2008
			2.3 Study setting	Cardiac surgery centers
			2.4 Study sites (Regions)	North America
			2.5 Study sites (Number of centers)	Unclear
			2.6 Criteria inclusion	All patients with the diagnosis of IE who underwent surgery on the aortic, mitral, and/or tricuspid valves.
			2.7 Criteria exclusion	Sites were excluded if data were missing on age, gender, status of surgery, cardiogenic shock , and endocarditis type. And if more than 20% of
			2.8 Participant description	*Characteristics* / *Values* / *Measures*
			2.8.1 Age of participants	*Age of participants* / 55 (46;66) / Median (IQR)
			2.8.2 Native valve endocarditis	*Native valve endocarditis* / No information / No information
			2.8.3 Valve affected	*Valve affected* / All / Other
			2.8.4 Characteristic 4	
			2.8.5 Characteristic 5	
3. Outcome to be predicted				✓
			3.1 Outcome	In-hospital or 30 days mortality
			3.2 Outcome definition	Death occurring before discharge or within 30 days of surgery.
			3.3 Same outcome definition for all participants	Yes
			3.4 Type of outcome	Single
			3.5 Was the outcome assessed without knowledge of the predictors?	Unclear
			3.6 Were candidate predictors part of outcome?	No
			3.7 Time of outcome ocurrence	30 days or lenght of hospital stay
4. Candidate predictors				✓
			4.1 Number of candidate predictors (or parameters) assessed	38
			4.2 Type of predictors	Patient, surgery and IE related factors
			4.3 Timing of predictors measurement	Pre-operative
			4.4 Predictors definition and measurement similar for all participants	Yes
			4.5 Were predictors assessed blinded for outcome?	No information
			4.6 Handling of continuous predictors	No information
5. Sample size				✓
			5.1 Number of participants	13,617
			5.2 Number of outcomes/events	1,117
			5.3 Number events per variable (EPV) or per parameter (EPP)	29.4

Paper and Excel template

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PROBAST

Wolff et al, 2019 Annals Intern Med

Domain/ Key questions	Gaca, 2011
0. Study information	
0.1 Author	Gaca
0.2 Publication year	2011
0.3 Publication identifier (Title/PMID/DOI)	Outcomes for endocarditis surgery in North Americ
0.4 Publication journal	J Thorac Cardiovasc Surg
0.5 Model name	STSS score
1. Participants	
1.1 Were appropriate data sources used?	Probably Yes
1.2 Were all inclusions and exclusions of participants appropriate?	Probably No
Risk of bias introduced by selection of participants	**High RoB**
Applicability	**Low concern**
Relevant information extracted from CHARMS:	
Source of data	*Existing registry*
Recruitment methods	*Selective inclusion*
Recruitment dates	*2002 - 2008*
Study setting	*Cardiac surgery centers*
Inclusion criteria	*All patients with the diagnosis of IE who underwent surgery on the aortic, mitral, and/or tricuspid valves.*
Exclusion criteria	*Sites were excluded if data were missing on age, gender, status of surgery, cardiogenic shock , and endocarditis type. And if more than 20% of patients had no complication information reported.*
Rationale of bias and applicability rating:	*Excluding complete sites if data were missing in some variables, likely to have introduced bias but it is less important than to exclude individual participants.*
2. Predictors	
2.1 Were predictors defined and assessed in a similar way for all participants?	Yes
2.2 Were predictor assessments made without knowledge of outcome data?	No Information
2.3 Are all predictors available at the time the model is intended to be used?	Yes
Risk of bias introduced by predictors or their assessment	**Low RoB**
Applicability	**Low concern**
Relevant information extracted from CHARMS:	
Predictors definition and measurement similar for all participants	*Yes*
Were predictors assessed blinded for outcome?	*No information*
Timing of predictors measurement	*Pre-operative*
Rationale of bias and applicability rating:	*Excluded complete sites if data were missing in some variables, likely to have introduced bias but less important than excluding individual participants.*

Video tutorial

Key results

- Easier data extraction, risk of bias assessment and applicability evaluation.
- Automatic production of tables and figures of the results, ready for publication.

Example: table with model characteristics automatically produced by the Excel template.

Author, Year	Modelling method	Sample size	Events n (%)	No predictors Cand.	No predictors Final	EPV or EPP	Selection of candidate predictors	Selection of final predictors	Number (%) and handling of missng data	Type of validation	Performance measures		Critical appraisal (PROBAST) P	Pr	O	A
Gaca, 2011	Logistic GEE regression	13,617	1117 (8.2)	38	13	29.4	Based on univariable associations	No information	n (%): 98 (0.7) Method: No information	Int: Random split data Ext : None	Cal: Calibration plot Disc : C-Statistic Ov: Not evaluated	RoB	-	+	+	-
												App	+	+	+	
De Feo, 2012	Logistic regression	440	40 (9.1)	19	6	2.1	Based on univariable associations	No information	n (%): 22 (5.0) Method: No information	Int: None (Apparent performance) Ext : None	Cal: HL test Disc : C-Statistic / AUC graph Ov: Not evaluated	RoB	-	?	+	-
												App	-	+	+	
Martínez-Sellés, 2014	Logistic regression	437	106 (24.3)	Unkown	7	Unknown	Based on univariable associations	Stepwise selection	n (%): Unkown Method: No information	Int: None (Apparent performance) Ext : None	Cal: HL test Disc : C-Statistic / AUC graph Ov: Not evaluated	RoB	+	+	+	-
												App	+	+	+	
Madeira, 2016	Logistic regression	128	21 (16.4)	15	2	1.4	Based on univariable associations	No information	n (%): Unkown Method: No information	Int: None (Apparent performance) Ext : None	Cal: Calibration plot / Slope / CITL / HL test Disc : C-Statistic / AUC graph Ov: Brier score	RoB	?	+	+	-
												App	?	+	+	
Gatti (a), 2017	Logistic regression	361	56 (15.5)	57	5	1.0	Based on univariable associations	Backward elimination	n (%): Unkown Method: No information	Int: Bootstrap Ext : Geographical	Cal: HL test Disc : C-Statistic / AUC graph Ov: Not evaluated	RoB	+	+	+	-
												App	+	?	+	

Video tutorial

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CHARMS and PROBAST at your fingertips: A template for data extraction and risk of bias assessment in systematic reviews of predictive models