TRIPOD Checklist: Prediction Model Development and Validation

Section	Item		Checklist description	Reported on Page Number/Line Number	Reported on Section/Paragraph
Title and abstract					
Title	1	D;V	Identify the study as developing and/or validating a multivariable prediction model, the target population, and the outcome to be predicted.	1/1-4	Title
Abstract	2	D;V	Provide a summary of objectives, study design, setting, participants, sample size, predictors, outcome, statistical analysis, results, and conclusions.	1-2/6-32	Abstract
Introduction					
Background and objectives	3a	D;V	Explain the medical context (including whether diagnostic or prognostic) and rationale for developing or validating the multivariable prediction model, including references to existing models.	3-4/45-77	Introduction/Paragraph 1-3
	3b	D;V	Specify the objectives, including whether the study describes the development or validation of the model or both.	4/78-81	Introduction/Paragraph 3
Methods					
Source of data	4a	D;V	Describe the study design or source of data (e.g., randomized trial, cohort, or registry data), separately for the development and validation data sets, ifapplicable.	4-6/85-116	Methods/Paragraph 1-3
	4b	D;V	Specify the key study dates, including start of accrual; end of accrual; and, if applicable, end of follow-up.	4/87-88	Methods/Paragraph 1
Participants	5a	D;V	Specify key elements of the study setting (e.g., primary care, secondary care, general population) including number and location of centres.	4, 6/86-87, 111-116	Methods/Paragraph 1-3
	5b	D;V	Describe eligibility criteria for participants.	4, 5/88-94	Methods/Paragraph 1
	5c	D;V	Give details of treatments received, if relevant.	N/A. No treatment.	N/A. No treatment.
Outcome	6a	D;V	Clearly define the outcome that is predicted by the prediction model, including how and when assessed.	5/97-107	Methods/Paragraph 2
	6b	D;V	Report any actions to blind assessment of the outcome to be predicted.	N/A.Not involved.	N/A. Not involved.
Predictors	7a	D;V	Clearly define all predictors used in developing or validating the multivariable prediction model, including how and when they were measured.	6-8/129-140,158-172	Methods/Paragraph 5,7, 9,10
	7b	D;V	Report any actions to blind assessment of predictors for the outcome and other predictors.	N/A.Not involved.	N/A.Not involved.
Sample size	8	D;V	Explain how the study size was arrived at.	6-8/111-116,152-155	Methods/Paragraph 2,3, 8

Missing data	9	D;V	Describe how missing data were handled (e.g., complete-case analysis, single imputation, multiple imputation) with details of any imputation method.	5/107,108(Figure 1)	Methods/Paragraph 2
Statistical analysis methods	10a	D	Describe how predictors were handled in the analyses.	9/181-188,190-198	Methods/Paragraph 10-11
	10b	D	Specify type of model, all model-building procedures (including any predictor selection), and method for internal validation.	9/181-188,190-198	Methods/Paragraph 10-11
	10c	V	For validation, describe how the predictions were calculated.	11,12/229-235,248-249	Results/Paragraph 4,7
	10d	D;V	Specify all measures used to assess model performance and, if relevant, to compare multiple models.	N/A.Not involved.	N/A.Not involved.
	10e	V	Describe any model updating (e.g., recalibration) arising from the validation, if done.	N/A.Not involved.	N/A.Not involved.
Risk groups	11	D;V	Provide details on how risk groups were created, if done.	5/95-107	Methods/Paragraph 2
Development vs. validation	12	V	For validation, identify any differences from the development data in setting, eligibility criteria, outcome, and predictors.	10/215-219	Results/Paragraph 14
Results					
Participants	13a	D;V	Describe the flow of participants through the study, including the number of participants with and without the outcome and, if applicable, a summary of the follow-up time. A diagram may be helpful.	5/105-108	Methods/Paragraph 2
	13b	D;V	Describe the characteristics of the participants (basic demographics, clinical features, available predictors), including the number of participants with missing data for predictors and outcome.	10/201-205(Table 1 and STable 1)	Results/Paragraph 1
	13c	V	For validation, show a comparison with the development data of the distribution of important variables (demographics, predictors and outcome).	12/243-246(Table 3)	Results/Paragraph 6
Model development	14a	D	Specify the number of participants and outcome events in each analysis.	11,12/201-202(Table 1) ,243-246(Table 3)	Results/Paragraph 1,6
	14b	D	If done, report the unadjusted association between each candidate predictor and outcome.	11/221-225(Table 2)	Results/Paragraph 4
Model specification	15a	D	Present the full prediction model to allow predictions for individuals (i.e., all regression coefficients, and model intercept or baseline survival at a given time point).	11,12/228-237,248-249	Results/Paragraph 4,7
	15b	D	Explain how to the use the prediction model.	11,12/228-237,247-255	Results/Paragraph 4,7
Model performance	16	D;V	Report performance measures (with CIs) for the prediction model.	11,12/234-240,249-250, 256-258	Results/Paragraph 4-5, 7-8
Model-updating	17	V	If done, report the results from any model updating (i.e., model specification, model performance).	11,12/238-240,256-258	Results/Paragraph 5,8
Discussion					
Limitations	18	D;V	Discuss any limitations of the study (such as nonrepresentative sample, few events per predictor, missing data).	15,16/323-337	Discussion/Paragraph 7

Interpretation	19a	V	For validation, discuss the results with reference to performance in the development data, and any other validation data.	15/315-320	Discussion/Paragraph 6
	19b	D;V	Give an overall interpretation of the results, considering objectives, limitations, and results from similar studies, and other relevant evidence.	14,15/287-292,303-314	Discussion/Paragraph 3,5
Implications	20	D;V	Discuss the potential clinical use of the model and implications for future research.	16/335-357,342-345	Discussion/Paragraph 7
Other information					
Supplementary information	21	D;V	Provide information about the availability of supplementary resources, such as study protocol, Web calculator, and data sets.	6/114-116	Methods/Paragraph 3
Funding	22	D;V	Give the source of funding and the role of the funders for the present study.	17/360-364	Funding

* Items relevant only to the development of a prediction model are denoted by D, items relating solely to a validation of a prediction model are denoted by V, and items relating to both are denoted D;V. We recommend using the TRIPOD Checklist in conjunction with the TRIPOD Explanation and Elaboration document.

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*As the checklist was provided upon initial submission, the page number/line number reported may be changed due to copyediting and may not be referable in the published version. In this case, the section/paragraph may be used as an alternative reference.