## 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. | Page 1/Line 1-4 | Title and abstract |
| Abstract | 2 | D;V | Provide a summary of objectives, study design, setting, participants, sample size, predictors, outcome, statistical analysis, results, and conclusions. | Page 3-5/Line 45-95 | Title and abstract/Paragraph of 1-4 |
| **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. | Page 5-7/Line 97-129 | Introduction/Paragraph of 6-9 |
| | 3b | D;V | Specify the objectives, including whether the study describes the development or validation of the model or both. | Page 5-7/Line 130-139 | Introduction/Paragraph of 6-9 |
| **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. | Page 7/Line 141-152 | Methods/Paragraph of 10-20 |
| | 4b | D;V | Specify the key study dates, including start of accrual; end of accrual; and, if applicable, end of follow-up. | Page 7/Line 141-152 | Methods/Paragraph of 10-20 |
| 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. | Page 7/Line 141-152 | Methods/Paragraph of 10-20 |
| | 5b | D;V | Describe eligibility criteria for participants. | Page 7/Line 141-152 | Methods/Paragraph of 10-20 |
| | 5c | D;V | Give details of treatments received, if relevant. | Page 7/Line 141-152 | Methods/Paragraph of 10-20 |
| Outcome | 6a | D;V | Clearly define the outcome that is predicted by the prediction model, including how and when assessed. | Page 9-10/Line 192-199 | Methods/Paragraph of 10-20 |
| | 6b | D;V | Report any actions to blind assessment of the outcome to be predicted. | Page 9-10/Line 192-199 | Methods/Paragraph of 10-20 |
| Predictors | 7a | D;V | Clearly define all predictors used in developing or validating the multivariable prediction model, including how and when they were measured. | Page 9-10/Line 192-199 | Methods/Paragraph of 10-20 |
| | 7b | D;V | Report any actions to blind assessment of predictors for the outcome and other predictors. | Page 9-10/Line 192-199 | Methods/Paragraph of 10-20 |
| Sample size | 8 | D;V | Explain how the study size was arrived at. | Page 9-10/Line 192-199 | Methods/Paragraph of 10-20 |

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| 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. | Page 9-10/Line 192-199 | Methods/Paragraph of 10-20 |
| Statistical analysis methods | 10a | D | Describe how predictors were handled in the analyses. | Page 11/Line 227-237 | Methods/Paragraph of 10-20 |
| | 10b | D | Specify type of model, all model-building procedures (including any predictor selection), and method for internal validation. | Page 11/Line 227-237 | Methods/Paragraph of 10-20 |
| | 10c | V | For validation, describe how the predictions were calculated. | Page 11/Line 227-237 | Methods/Paragraph of 10-20 |
| | 10d | D;V | Specify all measures used to assess model performance and, if relevant, to compare multiple models. | Page 11/Line 227-237 | Methods/Paragraph of 10-20 |
| | 10e | V | Describe any model updating (e.g., recalibration) arising from the validation, if done. | Page 11/Line 227-237 | Methods/Paragraph of 10-20 |
| Risk groups | 11 | D;V | Provide details on how risk groups were created, if done. | Page 8-9/Line 170-186 | Methods/Paragraph of 10-20 |
| Development vs. validation | 12 | V | For validation, identify any differences from the development data in setting, eligibility criteria, outcome, and predictors. | Page 8-9/Line 170-186 | Methods/Paragraph of 10-20 |
| **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. | Page 11/Line 239-246 | Results/Paragraph of 21-32 |
| | 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. | Page 11/Line 239-246 | Results/Paragraph of 21-32 |
| | 13c | V | For validation, show a comparison with the development data of the distribution of important variables (demographics, predictors and outcome). | Page 11/Line 239-246 | Results/Paragraph of 21-32 |
| Model development | 14a | D | Specify the number of participants and outcome events in each analysis. | Page 12-13/Line 252-275 | Results/Paragraph of 21-32 |
| | 14b | D | If done, report the unadjusted association between each candidate predictor and outcome. | Page 12-13/Line 252-275 | Results/Paragraph of 21-32 |
| 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). | Page 12-13/Line 252-275 | Results/Paragraph of 21-32 |
| | 15b | D | Explain how to the use the prediction model. | Page 12-13/Line 252-275 | Results/Paragraph of 21-32 |
| Model performance | 16 | D;V | Report performance measures (with CIs) for the prediction model. | Page 12-13/Line 252-275 | Results/Paragraph of 21-32 |
| Model-updating | 17 | V | If done, report the results from any model updating (i.e., model specification, model performance). | Page 12-13/Line 252-275 | Results/Paragraph of 21-32 |
| **Discussion** | | | | | |
| Limitations | 18 | D;V | Discuss any limitations of the study (such as nonrepresentative sample, few events per predictor, missing data). | Page 30-31/Line 349-356 | Discussion/Paragraph of 33-39 |

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| Interpretation | 19a | V | For validation, discuss the results with reference to performance in the development data, and any other validation data. | Page 27-30/Line 277-338 | Discussion/Paragraph of 33-39 |
| | 19b | D;V | Give an overall interpretation of the results, considering objectives, limitations, and results from similar studies, and other relevant evidence. | Page 27-30/Line 277-338 | Discussion/Paragraph of 33-39 |
| Implications | 20 | D;V | Discuss the potential clinical use of the model and implications for future research. | Page 30/Line 339-349 | Discussion/Paragraph of 33-39 |
| **Other information** | | | | | |
| Supplementary information | 21 | D;V | Provide information about the availability of supplementary resources, such as study protocol, Web calculator, and data sets. | Supplementary materials | Other information |
| Funding | 22 | D;V | Give the source of funding and the role of the funders for the present study. | Page 2/Line 29-31 | Other information |

* 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.