

# TRIPOD Checklist: Prediction Model Development and Validation

| Section/Topic                | Item | Checklist Item  | Page |
|------------------------------|------|---|------|
| <b>Title and abstract</b>    |      |   |      |
| 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    |
| Abstract                     | 2    | D;V Provide a summary of objectives, study design, setting, participants, sample size, predictors, outcome, statistical analysis, results, and conclusions.   | 1-2  |
| <b>Introduction</b>          |      |   |      |
| 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.      | 2-3  |
|                              | 3b   | D;V Specify the objectives, including whether the study describes the development or validation of the model or both.   | 2    |
| <b>Methods</b>               |      |   |      |
| 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, if applicable.                               | 2    |
|                              | 4b   | D;V Specify the key study dates, including start of accrual; end of accrual; and, if applicable, end of follow-up.  | 2    |
| 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.  | 2    |
|                              | 5b   | D;V Describe eligibility criteria for participants.   | 2-3  |
|                              | 5c   | D;V Give details of treatments received, if relevant.   | NA   |
| Outcome                      | 6a   | D;V Clearly define the outcome that is predicted by the prediction model, including how and when assessed.  | 4    |
|                              | 6b   | D;V Report any actions to blind assessment of the outcome to be predicted.  | NA   |
| Predictors                   | 7a   | D;V Clearly define all predictors used in developing or validating the multivariable prediction model, including how and when they were measured.   | 4    |
|                              | 7b   | D;V Report any actions to blind assessment of predictors for the outcome and other predictors.  | NA   |
| Sample size                  | 8    | D;V Explain how the study size was arrived at.  | 4    |
| 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.  | NA   |
| Statistical analysis methods | 10a  | D Describe how predictors were handled in the analyses.   | 4    |
|                              | 10b  | D Specify type of model, all model-building procedures (including any predictor selection), and method for internal validation.   | 4    |
|                              | 10c  | V For validation, describe how the predictions were calculated.   |      |
|                              | 10d  | D;V Specify all measures used to assess model performance and, if relevant, to compare multiple models.   | 4    |
|                              | 10e  | V Describe any model updating (e.g., recalibration) arising from the validation, if done.   | NA   |
| Risk groups                  | 11   | D;V Provide details on how risk groups were created, if done.   | NA   |
| Development vs. validation   | 12   | V For validation, identify any differences from the development data in setting, eligibility criteria, outcome, and predictors.   | NA   |
| <b>Results</b>               |      |   |      |
| 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. | NA   |
|                              | 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.    | NA   |
|                              | 13c  | V For validation, show a comparison with the development data of the distribution of important variables (demographics, predictors and outcome).  | NA   |
| Model development            | 14a  | D Specify the number of participants and outcome events in each analysis.   | NA   |
|                              | 14b  | D If done, report the unadjusted association between each candidate predictor and outcome.  | NA   |
| 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).                             | NA   |
|                              | 15b  | D Explain how to use the prediction model.  | NA   |
| Model performance            | 16   | D;V Report performance measures (with CIs) for the prediction model.  | NA   |
| Model-updating               | 17   | V If done, report the results from any model updating (i.e., model specification, model performance).   | NA   |
| <b>Discussion</b>            |      |   |      |
| Limitations                  | 18   | D;V Discuss any limitations of the study (such as nonrepresentative sample, few events per predictor, missing data).  | 4-5  |
| Interpretation               | 19a  | V For validation, discuss the results with reference to performance in the development data, and any other validation data.   | NA   |
|                              | 19b  | D;V Give an overall interpretation of the results, considering objectives, limitations, results from similar studies, and other relevant evidence.  | NA   |
| Implications                 | 20   | D;V Discuss the potential clinical use of the model and implications for future research.   | 4-5  |
| <b>Other information</b>     |      |   |      |
| Supplementary information    | 21   | D;V Provide information about the availability of supplementary resources, such as study protocol, Web calculator, and data sets.   | 6    |
| Funding                      | 22   | D;V Give the source of funding and the role of the funders for the present study.   | 5    |

\*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.