

## TRIPOD Checklist: Prediction Model Development and Validation

| Section                   | Item |     | Checklist description  | Reported on Page Number/Line Number | Reported on Section/Paragraph |
|---------------------------|------|-----|--|-------------------------------------|-------------------------------|
| <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.   |                                     |                               |
| Abstract                  | 2    | D;V | Provide a summary of objectives, study design, setting, participants, sample size, predictors, outcome, statistical analysis, results, and conclusions.  |                                     |                               |
| <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. |                                     |                               |
|                           | 3b   | D;V | Specify the objectives, including whether the study describes the development or validation of the model or both.  |                                     |                               |
| <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.                          |                                     |                               |
|                           | 4b   | D;V | Specify the key study dates, including start of accrual; end of accrual; and, if applicable, end of follow-up.   |                                     |                               |
| 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.   |                                     |                               |
|                           | 5b   | D;V | Describe eligibility criteria for participants.  |                                     |                               |
|                           | 5c   | D;V | Give details of treatments received, if relevant.  |                                     |                               |
| Outcome                   | 6a   | D;V | Clearly define the outcome that is predicted by the prediction model, including how and when assessed.   |                                     |                               |
|                           | 6b   | D;V | Report any actions to blind assessment of the outcome to be predicted.   |                                     |                               |
| Predictors                | 7a   | D;V | Clearly define all predictors used in developing or validating the multivariable prediction model, including how and when they were measured.  |                                     |                               |
|                           | 7b   | D;V | Report any actions to blind assessment of predictors for the outcome and other predictors.   |                                     |                               |
| Sample size               | 8    | D;V | Explain how the study size was arrived at.   |                                     |                               |

|                              |     |     |   |  |  |
|------------------------------|-----|-----|---|--|--|
| 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.  |  |  |
| Statistical analysis methods | 10a | D   | Describe how predictors were handled in the analyses.   |  |  |
|                              | 10b | D   | Specify type of model, all model-building procedures (including any predictor selection), and method for internal validation.   |  |  |
|                              | 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.   |  |  |
|                              | 10e | V   | Describe any model updating (e.g., recalibration) arising from the validation, if done.   |  |  |
| Risk groups                  | 11  | D;V | Provide details on how risk groups were created, if done.   |  |  |
| Development vs. validation   | 12  | V   | For validation, identify any differences from the development data in setting, eligibility criteria, outcome, and predictors.   |  |  |
| <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. |  |  |
|                              | 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.    |  |  |
|                              | 13c | V   | For validation, show a comparison with the development data of the distribution of important variables (demographics, predictors and outcome).  |  |  |
| Model development            | 14a | D   | Specify the number of participants and outcome events in each analysis.   |  |  |
|                              | 14b | D   | If done, report the unadjusted association between each candidate predictor and outcome.  |  |  |
| 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).                           |  |  |
|                              | 15b | D   | Explain how to use the prediction model.  |  |  |
| Model performance            | 16  | D;V | Report performance measures (with CIs) for the prediction model.  |  |  |
| Model-updating               | 17  | V   | If done, report the results from any model updating (i.e., model specification, model performance).   |  |  |
| <b>Discussion</b>            |     |     |   |  |  |
| Limitations                  | 18  | D;V | Discuss any limitations of the study (such as nonrepresentative sample, few events per predictor, missing data).  |  |  |

|                           |     |     |  |  |  |
|---------------------------|-----|-----|--|--|--|
| Interpretation            | 19a | V   | For validation, discuss the results with reference to performance in the development data, and any other validation data.                          |  |  |
|                           | 19b | D;V | Give an overall interpretation of the results, considering objectives, limitations, and results from similar studies, and other relevant evidence. |  |  |
| Implications              | 20  | D;V | Discuss the potential clinical use of the model and implications for future research.  |  |  |
| <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.                      |  |  |
| Funding                   | 22  | D;V | Give the source of funding and the role of the funders for the present study.  |  |  |

\* 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.