## 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. | 1/1-2 | Title |
| Abstract | 2 | D;V | Provide a summary of objectives, study design, setting, participants, sample size, predictors, outcome, statistical analysis, results, and conclusions. | 1/1-2 | 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. | 4/56-83 | Introduction/1-4 |
| | 3b | D;V | Specify the objectives, including whether the study describes the development or validation of the model or both. | 4/83-86 | Introduction/4 |
| **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. | 5/89-96 | Methods/1 |
| | 4b | D;V | Specify the key study dates, including start of accrual; end of accrual; and, if applicable, end of follow-up. | 5/89-96 | Methods/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. | 5/89-96 | Methods/1 |
| | 5b | D;V | Describe eligibility criteria for participants. | 5/89-96 | Methods/1 |
| | 5c | D;V | Give details of treatments received, if relevant. | 5/89-96 | Methods/1 |
| Outcome | 6a | D;V | Clearly define the outcome that is predicted by the prediction model, including how and when assessed. | 5/98-101 | Methods/2 |
| | 6b | D;V | Report any actions to blind assessment of the outcome to be predicted. | 5/98-101 | Methods/2 |
| Predictors | 7a | D;V | Clearly define all predictors used in developing or validating the multivariable prediction model, including how and when they were measured. | 5-6/103-126 | Methods/3 |
| | 7b | D;V | Report any actions to blind assessment of predictors for the outcome and other predictors. | 5-6/103-126 | Methods/3 |
| Sample size | 8 | D;V | Explain how the study size was arrived at. | NA | NA |

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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. | 5/111-113 | Methods/3 |
| Statistical analysis methods | 10a | D | Describe how predictors were handled in the analyses. | 5-6/114-121 | Methods/3 |
| | 10b | D | Specify type of model, all model-building procedures (including any predictor selection), and method for internal validation. | 5-6/104-126 | Methods/3 |
| | 10c | V | For validation, describe how the predictions were calculated. | 6/121-126 | Methods/3 |
| | 10d | D;V | Specify all measures used to assess model performance and, if relevant, to compare multiple models. | 6/121-126 | Methods/3 |
| | 10e | V | Describe any model updating (e.g., recalibration) arising from the validation, if done. | 6/121-126 | Methods/3 |
| Risk groups | 11 | D;V | Provide details on how risk groups were created, if done. | 5/98-101 | Methods/2 |
| Development vs. validation | 12 | V | For validation, identify any differences from the development data in setting, eligibility criteria, outcome, and predictors. | 6/121-126 | Methods/3 |
| **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. | 6/130-140 Figure1 | Results/1 |
| | 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. | 6-7/130-147 | Results/1 |
| | 13c | V | For validation, show a comparison with the development data of the distribution of important variables (demographics, predictors and outcome). | Table2 | Results/1 |
| Model development | 14a | D | Specify the number of participants and outcome events in each analysis. | 6/132-133 | Results/1 |
| | 14b | D | If done, report the unadjusted association between each candidate predictor and outcome. | NA | 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). | Table2 | Results/2 |
| | 15b | D | Explain how to the use the prediction model. | 7/150-163 Table2 | Results/2 |
| Model performance | 16 | D;V | Report performance measures (with CIs) for the prediction model. | Table2 | Table2 |
| Model-updating | 17 | V | If done, report the results from any model updating (i.e., model specification, model performance). | Figure4/5 | Figure4/5 |
| **Discussion** | | | | | |
| Limitations | 18 | D;V | Discuss any limitations of the study (such as nonrepresentative sample, few events per predictor, missing data). | 10-11/265-276 | Discussion/9 |

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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. | 8/183-186 | Discussion/1 |
| | 19b | D;V | Give an overall interpretation of the results, considering objectives, limitations, and results from similar studies, and other relevant evidence. | 8,10/183-186,246-262 | Discussion/1,8 |
| Implications | 20 | D;V | Discuss the potential clinical use of the model and implications for future research. | 10/274-283 | Discussion/9-10 |
| **Other information** | | | | | |
| Supplementary information | 21 | D;V | Provide information about the availability of supplementary resources, such as study protocol, Web calculator, and data sets. | NA | NA |
| Funding | 22 | D;V | Give the source of funding and the role of the funders for the present study. | NA | NA |

* 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.