Prediction model studies Risk Of Bias Assessment Tool: PROBAST

Karel Moons
Robert Wolff, Penny Whiting, Jos Kleijnen, Marie Westwood, Sue Mallett, Richard Riley
Prediction

Prediction = foreseeing / foretelling
... (probability) of something that is yet unknown

Largely 2 situations in medicine:
... probability of future conditions/situations = prognosis
... probability of result of a more invasive/costly reference (gold) standard test that is not yet done = diagnosis
Prediction model

Combination of more than 2 predictors (variables, covariates, determinants) which convert observed values in individual to absolute probability…

...of having (!) a particular disease $\rightarrow$ diagnosis

... of developing (!) particular health state $\rightarrow$ prognosis

... within a certain time (hours, days, weeks, years)

Dying, complication, disease progression, hospitalised, QoL, pain, therapy response
Prediction modeling extremely popular

- 1000’s clinical prediction models
- also for same outcome / target population
  - About or over 100 CVD outcomes; diabetes; head injury; breast cancer
Systematic reviews of prediction model studies

• All these models can’t be (as) good
• Which one to advocate or use?
• Numerous reviews in past decade
  – Eg. S. Mallet; G. Collins; E. Steyerberg; W. Bouwmeester
  – (Very) poor reporting
  – (Very) poor methods
  – Each SR: own search strategy, own checklist data extraction; HARDLY EVER risk of bias assessment
PROBAST

• Prediction model studies Risk Of Bias Assessment Tool

• Other initiatives:
  – TRIPOD statement: reporting of studies developing or validating multivariable prediction model
  – Checklist for data extraction and framing SR question
Development of PROBAST

Delphi procedure using 41 panel members (see end)

Various Rounds: currently round 4

- Round 1 (February 2013):
  - Which prediction model study types to be covered
  - Structure
Which prediction model studies?

*Predictive factor studies* - which predictors contribute to prediction of particular prognostic/diagnostic outcome – often using multivariable modelling -- aim not to develop a prediction model for *individualised* predictions

*Model development studies* – to develop prediction model(s) from data at hand: identify important predictors; estimate multivariable predictor weights; construct model for *individualised* predictions; quantify predictive performance in development set; internal validation.

*Model validation studies* – test (validate) predictive performance of previously developed model in participant data other than development set – sometimes combined in development study – sometimes followed by updating/revision model

*Model impact studies* -- quantify effect/impact actually *using* model on participant/physician behaviour and management; on health outcomes or cost-effectiveness of care -- relative to not using the model → comparative studies.
Which prediction model studies?

- Predictive factor studies: QUIPS 2 -- assessing bias in studies of prognostic factors (Haydn et al)

- Model impact studies: comparative, intervention studies – different risk assessment → Cochrane Risk of Bias tool

- PROBAST model development and validation studies – Diagnostic + prognostic models
Structure of PROBAST

- Conform QUADAS (2)
- Domain based: each with section risk of bias and applicability

**Risk of bias**: extent to which primary study results in unbiased estimates of model performance (e.g. coefficients, calibration, discrimination or (re)classification) for intended use and target population.

**Applicability**: extent to which model from a primary study matches the review question.
Carl, do you want to mention/include the "support for judgement" section as well?
That is the short extraction at the beginning of each domain aimed to be helpful when answering the signaling questions.
Robert Wolff; 10/07/2013
Development of PROBAST

- Round 1 (February 2013): Study types + structure
- Round 2 (March 2013): Which domains?
PROBAST: domains

1. Participant selection
2. Outcome
3. Predictors
4. Sample size and flow
5. Analysis
Development of PROBAST

- Round 3 (May 2013): Domains 1 and 2
- Defining the key/signaling items per domain
Development of PROBAST

- Round 4 (July 2013): Domains 3 and 4
- Round 5 (fall 2013): Domain 5
Development of PROBAST

- PROBAST hopefully 2014 in print
- Workshop next Cochrane collaboration
PROBAST group

Doug Altman, University of Oxford
Patrick Bossuyt, University of Amsterdam
Gary Collins, University of Oxford
Nancy Cook, Harvard University
Gennaro D’Amico, Ospedale V Cervello
Thomas Debray, University of Utrecht
Jon Deeks, University of Birmingham
Joris de Groot, University of Utrecht
Emanuele di Angelantonio, University of Cambridge
Tom Fahey, Royal College of Surgeons in Ireland
Paul Glasziou, Bond University
Frank Harrell, Vanderbilt University
Jill Hayden, Dalhousie University
Martin Heymans, University of Amsterdam
Lotty Hooft, University of Amsterdam
Chris Hyde, Peninsula Technology Assessment Group
John Ioannidis, Stanford University
Alfonso Iorio, McMaster University
Stephen Kaptoe, University of Cambridge
Jos Kleijnen*, Kleijnen Systematic Reviews
Andre Knottnerus, University of Maastricht
Mariska Leeflang, University of Amsterdam
Susan Mallett*, University of Oxford
Carl Moons*, University of Utrecht
Frances Nixon, NICE
Michael Pencina, University of Boston
Pablo Perel, London School of Hygiene and Tropical Medicine
Bob Philips, CRD
Hans Reitsma, University of Utrecht
Rob Riemsmma, Kleijnen Systematic Reviews
Richard Riley*, University of Birmingham
Maroeska Rovers, University of Utrecht
Anne Rutjes, University of Bern
Willi Sauerbrei, University of Freiburg
Stefan Sauerland, IQWiG
Fülöp Scheibler, IQWiG
Rob Scholten, University of Amsterdam
Ewoud Schuit, University of Utrecht
Ewout Steyerberg, University of Rotterdam
Toni Tan, NICE
Gerben ter Riet, University of Amsterdam,
Danielle van der Windt, Keele University
Yvonne Vergouwe, University of Rotterdam
Andrew Vickers, Memorial Sloan-Kettering Cancer Center,
Marie Westwood*, Kleijnen Systematic Reviews
Penny Whiting*, Kleijnen Systematic Reviews
Robert Wolff*, Kleijnen Systematic Reviews
Angela Wood, University of Cambridge

* denotes steering group members