

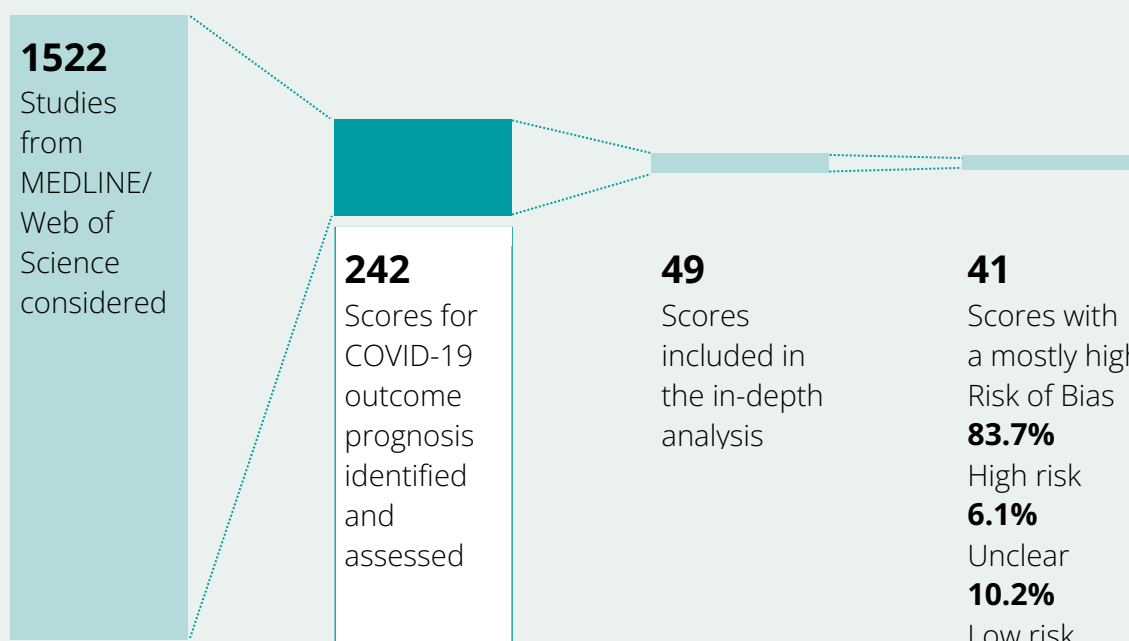
# A Systematic Review of Predictor Composition, Outcomes, Risk of Bias, and Validation of COVID-19 Prognostic Scores

Katharina S Appel, Ramsia Geisler, Daniel Maier, Olga Miljukov, Sina M Hopff, J Janne Vehreschild. *Clinical Infectious Diseases*, ciad618, <https://doi.org/10.1093/cid/ciad618>

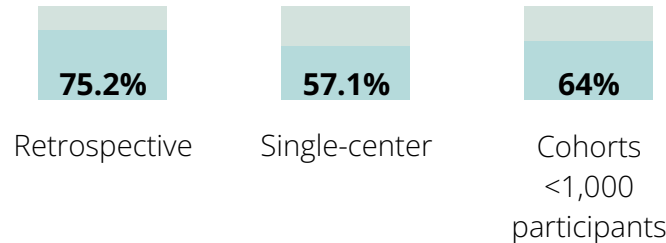
**Objectives** To identify COVID-19 scores for daily clinical care, provide an effective overview for decision-makers, and pave the way for future pandemic preparedness.

**Methods** A systematic review was performed, to identify the scores for confirmed or clinically assumed COVID-19 cases. An assessment and risk of bias (ROB) analysis was conducted for scores fulfilling predefined criteria.

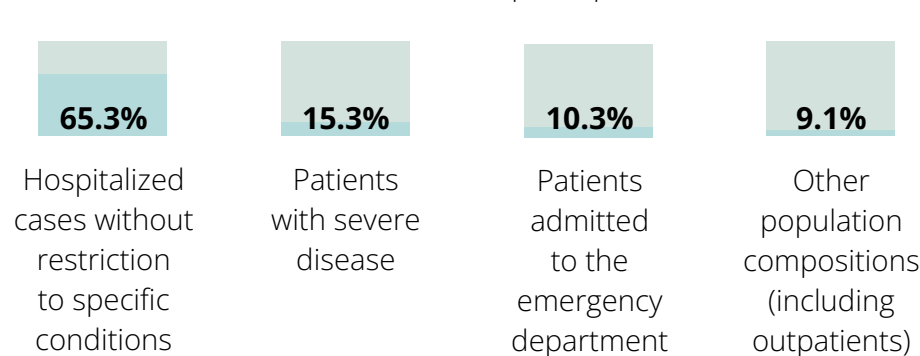
## Results



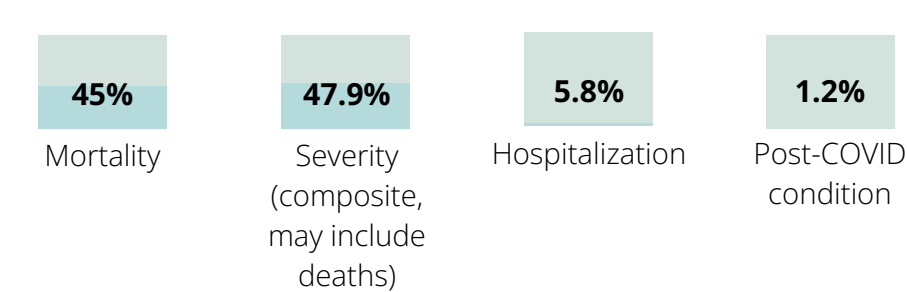
### Data basis



### Populations included



### Predicted outcomes



## Conclusion

The application and translation of most existing COVID scores appear unreliable. Guided development and predictor selection would have improved the generalizability of the scores and may enhance pandemic preparedness in the future.

## What makes a good score

### Database



Model development based on large, multi-center cohorts with prospective design and heterogeneous population characteristics

Ensure the dataset is representative of the population for whom the score is intended

The study should be specifically designed for the development of the model

Use of broadly available and representative predictors for the respective application scenario from different categories



Small sample size, single-center cohort, retrospective data, eventually from electronic health record only

A cohort consists of a non-representative subpopulation

Reuse of data from other sources

Use of very specific, non-generalizable predictors; use of only a very restricted number or type of predictors

### Expertise



Involvement of clinical experts and literature review of predictors in general preparatory steps and predictor selection



Only data-driven modelling without clinical expertise on plausibility

### Analysis



Multivariable analysis regression methods

Assessment of both discrimination and calibration measures

Internal validation procedures, possibly with temporally or geographically distinct samples

Handling of missing data: multiple imputation



Univariable models without predictor interaction

Only do one or nothing lead to misleading, uncalibrated results

No validation, only random subsamples for validation increase the risk for overfitting of the model

Complete case analysis, meaning to only use those cases with complete records

## Important Learnings

Focus on collaborative research, bundle resources and expertise → consortia such as ORCHESTRA

Adhere to reporting guidelines such as TRIPOD to increase transparency and reproducibility

Compliance with model development guidelines or recommendations

## Exemplary guideline recommendations

Cowley et al. Methodological standards for the development and evaluation of clinical prediction rules: a review of the literature. *Diagn Progn Res* 2019.



Collins et al. Transparent reporting of a multivariable prediction model for individual prognosis or diagnosis (TRIPOD): the TRIPOD statement. *BMJ* 2015.



Moons et al. PROBAST: A Tool to Assess Risk of Bias and Applicability of Prediction Model Studies: Explanation and Elaboration. *Ann Intern Med* 2019.

