Compilation and assessment of models for forecasting the progress of the COVID-19 pandemic in Sweden during 2020

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Citation

Review question
How useful and accurate were published models for forecasting the progress of the Covid-19 pandemic in Sweden in 2020? The specific research questions are:

1. What different types of models for forecasts of the Covid-19 pandemic were published between 2020-01-01 and 2020-12-31 where Sweden is explicitly distinguishable in the results, and

2. What is the accuracy of forecasts of the Covid-19 pandemic published between 2020-01-01 and 2020-12-31 where Sweden is explicitly distinguishable in the results.

Searches
The searches of the literature for the review and compilation were planned using the 'Search Triangle' model (Gusenbaum 2020). Systematic searches will between 21-01-22 and 21-01-29 be performed of databases containing peer-reviewed publications in for the review question relevant areas (PubMed, Cochrane Library, Embase, Love platform / Epistemikos), explorative searches be performed of preprint archives, and look-up searches be performed of the grey literature. The procedure will be reported according to the PRISMA-S protocol (version September, 2020). The systematic search of the peer-reviewed literature will have the goal to identify all relevant records (within the resource constraints) in a transparent and reproducible manner. The exploratory searches of preprint archives will be initiated by submitting a tentative query using a discovery tool (search.bioPreprint) to the archives, then explore the retrieved documents to better understand how to exploit the archive contents, and finally iteratively seek and obtain cues about the next steps until adjustments no longer lead to significant changes in the retrieved set of documents. The exploratory searching will thus be characterized by learning, where the researchers expect to be exposed to different, sometimes contradicting, reports of forecasting models when extracting data from the preprint databases. Finally, a look-up search of the grey literature will be performed. The lookup search — also called “known item search” — will be conducted with a clear goal of retrieving documents from the websites of relevant Swedish and international health service organisations and complemented with document retrieval from reference lists.


Types of study to be included

Inclusion criteria

Studies must report real-world or scenario-based Covid-19 forecasting models involving Swedish populations.

We will include studies that forecast relevant epidemiological outcomes during the Covid-19 pandemic in
2020. We require studies to explicitly forecast a future outcome and include also estimations of key epidemic parameters (for instance R).

Exclusion criteria

- The study does not include original analyses (e.g. review articles, perspective pieces, editorials, recommendations, and guidelines)
- Duplicated studies
- In vitro studies (pure simulations)
- Descriptive epidemiological publications (e.g. describing case positive proportions, total case numbers, descriptive mapping of incidence by geographic information systems)
- Models which only examined effect of interventions (rather than forecasting risk or burden)
- Studies which only present mathematical models or software tools, unless the central aim of the study was to explicitly forecast Covid-19 phenomena

Condition or domain being studied

Participants/population
The total Swedish population.

Intervention(s), exposure(s)

Comparator(s)/control
Forecasts are compared with factual outcomes according to data recorded in healthcare and public health databases.

Main outcome(s)
Covid-19 patient loads in health care; Covid-19 morbidity; Covid-19 mortality; R (Effective reproduction number).

* Measures of effect
Accuracy of correlations between time series of forecasted outcomes and observed outcomes and mean absolute percentage error of forecasted outcomes compared with observed outcomes.

Additional outcome(s)
None.

* Measures of effect
Not applicable.

Data extraction (selection and coding)
The materials for the data extraction will be produced by systematic searches of the peer-reviewed literature, exploratory searches of preprint archives, and look-up searches of the grey literature on the review topic. Titles and abstracts of the retrieved documents will be screened for compliance with the review criteria / inclusion by two independent (blinded) reviewers. Documents found eligible by both reviewers will be directly selected and those discarded by both reviewers excluded from further consideration. In cases of disagreement, full-text articles will be retrieved and new assessment made. If the disagreement remains, it will resolved, first, by internal discussions between the reviewers, and, second, if needed, by a senior researcher. For the data extraction from the final set of selected documents, a tool has been developed for recording from each full text article information about authors’ country of origin, the study design, forecasting
methodology (type of model), study population, sources of data, forecasting period, forecasted outcomes, measures of forecasting accuracy / performance (where applicable), and model documentation. Missing information in the full text article on any data extraction item in the tool will be recorded. One reviewer will initially extract data on each selected article and thereafter two other reviewers will check the extracted data. The article selection and data extraction processes will be documented in Excel spreadsheets.

**Risk of bias (quality) assessment**

The studies reporting a) real-world forecasting models and b) scenario-based forecasting models will be assessed separately. For articles addressing multiple models and not explicitly addressing a single model, all models will be included and assessed. For the quality assessment, we have developed a form based on previous infectious disease forecasting studies, current methodological consensus, and the TRIPOD Exploration and Elaboration document. In summary, the following topics will be assessed at model level: relevance and quality of data, time frame for forecasts, assumptions made, model development methods (verification), and validation. The assessment of assumptions will include reproduction numbers, latency period, incubation period, serial interval, infectious period, population immunity proportions, and interventions during the forecasting period. The model validation will be graded with regards to retrospective / internal validation, prospective / external validation, or no validation. Assessment of the bias evaluation form items will be performed by two independent assessors and an additional senior assessor when disagreements occur. Each model will be provided a a risk of bias (RoB) grading (low / medium / high) for each item in the assessment form. These gradings will be computed to a RoB score for each model.

**Strategy for data synthesis**

Proceeding to the data synthesis stage, all models with a RoB score above the cut-off level will excluded. For the models included in the final set, full model documentation will be retrieved. In each model category, we will assess the forecasting performance of the models. If needed, authors will be asked for the additional information that is required to enable a reliable data synthesis. The data synthesis (quantitative and qualitative) will be guided by a synthesis protocol covering areas ranging from model output corroboration to data evaluation.

**Real-world forecasting studies**

Model output corroboration - Model forecasts will be compared with observed outcomes, also those that were not known when the model was parameterised and reported.

Data evaluation - The quality of numerical data and assumptions used to parameterise the model and of the sources that were used to design the overall model structure will be assessed.

Reproducability - Whether the information about the computerised implementation of the model made available is sufficient to reproduce the reported results will be verified.

**Scenario-based forecasting studies**

Conceptual model evaluation - The (simplifying) assumptions underlying the scenario design and forming its building blocks, including whether the structure, essential theories, and causal relationships are reasonable to form a logically consistent model, will be assessed.

Model output verification - How well the forecasting model output in the scenario matches observations and to what degree calibration was involved in obtaining good fits of model output and data will be assessed. The aim is to ensure that the scenario models respond to virus features and environmental conditions in a sufficiently similar way as their real counterparts.

Data evaluation - The quality of numerical and qualitative data used to parameterise the forecasting models included in the scenario and of the sources used to design the overall scenario structure will be assessed.

**Analysis of subgroups or subsets**
Forecasting studies addressing the populations in Swedish regions and counties will be analysed separately.

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Epidemiologic, Prognostic, Systematic review

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15 February 2021

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Conflicts of interest

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English, Swedish

Country
Sweden

Stage of review
Review Ongoing

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Subject indexing assigned by CRD

Subject index terms
COVID-19; Forecasting; Humans; Pandemics; SARS-CoV-2; Sweden

Date of registration in PROSPERO
19 January 2021

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17 January 2021

Stage of review at time of this submission
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<tr>
<th>Stage</th>
<th>Started</th>
<th>Completed</th>
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<tr>
<td>Preliminary searches</td>
<td>Yes</td>
<td>No</td>
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<td>Piloting of the study selection process</td>
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<td>Formal screening of search results against eligibility criteria</td>
<td>Yes</td>
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<td>Data extraction</td>
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<td>Risk of bias (quality) assessment</td>
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<td>Data analysis</td>
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The record owner confirms that the information they have supplied for this submission is accurate and complete and they understand that deliberate provision of inaccurate information or omission of data may be construed as scientific misconduct.

The record owner confirms that they will update the status of the review when it is completed and will add publication details in due course.

Versions
19 January 2021