Systematic review

To edit the record click *Start an update* below. This will create a new version of the record - the existing version will remain unchanged.

1. * Review title.

Give the title of the review in English

Machine learning-based prediction models for neonatal death

2. Original language title.

For reviews in languages other than English, give the title in the original language. This will be displayed with the English language title.

3. * Anticipated or actual start date.

Give the date the systematic review started or is expected to start.

01/12/2020

4. * Anticipated completion date.

Give the date by which the review is expected to be completed.

21/02/2021

5. * Stage of review at time of this submission.

Tick the boxes to show which review tasks have been started and which have been completed.
Update this field each time any amendments are made to a published record.

Reviews that have started data extraction (at the time of initial submission) are not eligible for inclusion in PROSPERO.
If there is later evidence that incorrect status and/or completion date has been supplied, the published PROSPERO record will be marked as retracted.

This field uses answers to initial screening questions. It cannot be edited until after registration.

The review has not yet started: No

Review stage	Started	Completed
Preliminary searches	Yes	No
Piloting of the study selection process	Yes	No
Formal screening of search results against eligibility criteria	No	No
Data extraction	No	No

Risk of bias (quality) assessment	No	No
Data analysis	No	No

Provide any other relevant information about the stage of the review here.

6. * Named contact.

The named contact is the guarantor for the accuracy of the information in the register record. This may be any member of the review team.

Alvaro Moreira MD, MSc

Email salutation (e.g. "Dr Smith" or "Joanne") for correspondence:
Dr Moreira

7. * Named contact email.

Give the electronic email address of the named contact.

MoreiraA@uthscsa.edu

8. Named contact address

PLEASE NOTE this information will be published in the PROSPERO record so please do not enter private information, i.e. personal home address

Give the full institutional/organisational postal address for the named contact.

7703 Floyd Curl Drive MC-7812, San Antonio, Texas 78229

9. Named contact phone number.

Give the telephone number for the named contact, including international dialling code.

(210) 567-5226

10. * Organisational affiliation of the review.

Full title of the organisational affiliations for this review and website address if available. This field may be completed as 'None' if the review is not affiliated to any organisation.

University of Texas Health Science Center-San Antonio

Organisation web address:
www.uthscsa.edu

11. * Review team members and their organisational affiliations.

Give the personal details and the organisational affiliations of each member of the review team. Affiliation refers to groups or organisations to which review team members belong.
NOTE: email and country now MUST be entered for each person, unless you are amending a published record.

Dr Cheyenne Mangold. University of Texas Health Science Center-San Antonio

Dr Sarah Zoretic. University of Texas Health Science Center-San Antonio

Keerthi Reddy. University of Texas Health Science Center-San Antonio

Dr Kevin Chorath. University of Pennsylvania-Philadelphia

Dr Axel Moreira. Baylor College of Medicine-Houston

Dr Alvaro Moreira. University of Texas Health Science Center-San Antonio

12. * Funding sources/sponsors.

Details of the individuals, organizations, groups, companies or other legal entities who have funded or sponsored the review.

Not applicable

Grant number(s)
State the funder, grant or award number and the date of award

13. * Conflicts of interest.

List actual or perceived conflicts of interest (financial or academic).

None

14. Collaborators.

Give the name and affiliation of any individuals or organisations who are working on the review but who are not listed as review team members. **NOTE: email and country must be completed for each person, unless you are amending a published record.**

15. * Review question.

State the review question(s) clearly and precisely. It may be appropriate to break very broad questions down into a series of related more specific questions. Questions may be framed or refined using PI(E)COS or similar where relevant.

Can machine learning algorithms accurately predict neonatal death?

16. * Searches.

State the sources that will be searched (e.g. Medline). Give the search dates, and any restrictions (e.g. language or publication date). Do NOT enter the full search strategy (it may be provided as a link or attachment below.)

We will search the following:
PubMed, OVID, Cochrane, and Google Scholar

Search Dates: No search date restrictions will be employed.

Language restrictions: No restrictions will be imposed on language.

Search Strategy: (neonate OR newborn OR (infant) AND (death OR mortality) AND (artificial intelligence OR machine learning OR deep learning)

Inclusion: All studies using machine learning algorithms or other forms of artificial intelligence to predict neonatal death.

Restrictions: Studies that include intrauterine death, those that only use maternal factors, and those that include death past the neonatal or hospital period.

17. URL to search strategy.

Upload a file with your search strategy, or an example of a search strategy for a specific database, (including the keywords) in pdf or word format. In doing so you are consenting to the file being made publicly accessible.

Or provide a URL or link to the strategy. Do NOT provide links to your search **results**.

Do not make this file publicly available until the review is complete

18. * Condition or domain being studied.

Give a short description of the disease, condition or healthcare domain being studied in your systematic review.

Neonatal death continues to be an international issue with more than 2.5 million neonates dying within the first month of life and 1 million dying within the first 24 hours of life. Given the world-wide impact of neonatal death and the goals set by the World Health Organization (Every Newborn Action Plan to end Preventable Deaths), the ability to build reliable prediction models with machine learning to recognize patients at higher risk for neonatal death could aid in the early recognition and prevention of these deaths.

19. * Participants/population.

Specify the participants or populations being studied in the review. The preferred format includes details of both inclusion and exclusion criteria.

Inclusion criteria: Preterm infants: all liveborn infants (term and preterm) from birth until discharge from hospital or death.
Exclusion criteria: Children who die outside the neonatal period or limited to only antenatal mortality prediction models

20. * Intervention(s), exposure(s).

Give full and clear descriptions or definitions of the interventions or the exposures to be reviewed. The preferred format includes details of both inclusion and exclusion criteria.

Studies that utilized machine learning to build prediction models.

21. * Comparator(s)/control.

Where relevant, give details of the alternatives against which the intervention/exposure will be compared (e.g. another intervention or a non-exposed control group). The preferred format includes details of both inclusion and exclusion criteria.

If available, results will be compared to logistic regression models

22. * Types of study to be included.

Give details of the study designs (e.g. RCT) that are eligible for inclusion in the review. The preferred format includes both inclusion and exclusion criteria. If there are no restrictions on the types of study, this should be stated.

Retrospective and prospective studies that have greater than 500 patients

23. Context.

Give summary details of the setting or other relevant characteristics, which help define the inclusion or exclusion criteria.

ICU and newborn nursery settings, not limited by country or language

24. * Main outcome(s).

Give the pre-specified main (most important) outcomes of the review, including details of how the outcome is defined and measured and when these measurement are made, if these are part of the review inclusion criteria.

Main outcome: Mortality. Preterm infant: Death during the hospitalization (ICU or nursery stay). Full term infant: death within the first month of life.

Measures of effect
The average concordance (C-statistic) will be calculated for all the models provided in each study and reported with the minimum and maximum.

25. * Additional outcome(s).

List the pre-specified additional outcomes of the review, with a similar level of detail to that required for main outcomes. Where there are no additional outcomes please state 'None' or 'Not applicable' as appropriate to the review

Overall variable importance for the models will be reported.
C-statistic will be stratified according to model and number of variables used in the model.

Measures of effect
C-statistic

26. * Data extraction (selection and coding).

Describe how studies will be selected for inclusion. State what data will be extracted or obtained. State how this will be done and recorded.

Two authors will independently review any titles, abstracts, and full text articles that are thought to meet eligibility criteria. If any disagreements over inclusion criteria, a third author will be the tie breaker. Data extracted from above articles will include database information, study design, study setting, neonatal characteristics, maternal characteristics, machine learning model input variables, model training, machine learning model types, outcomes, neonatal death predictions, and any limitations or gaps in the data.

27. * Risk of bias (quality) assessment.

State which characteristics of the studies will be assessed and/or any formal risk of bias/quality assessment tools that will be used.

Critical Appraisal and Data Extraction for Systematic Reviews of Prediction Modelling Studies (CHARMS) checklist will be used for all machine learning studies and the COCHRANE Bias toolkit will also be used to screen for bias.

28. * Strategy for data synthesis.

Describe the methods you plan to use to synthesise data. This **must not be generic text** but should be **specific to your review** and describe how the proposed approach will be applied to your data.
If meta-analysis is planned, describe the models to be used, methods to explore statistical heterogeneity, and software package to be used.

1. All neonatal predication models and their data will be pooled. Data to be presented will include- number of participants, features used in machine learning models, significant exclusion criteria, timing of data, type of machine learning models, C-statistic for each model, confidence intervals, breakdown of train/test/validation percentages, whether cross validation was used, if calibration plots were supplied, hyperparameter tuning, log regression comparison, and external validation.

2. Continuous data will be presented as mean +/- SD.

3. Meta-analysis will be completed.

4. All studies irrespective of language, journal, or quality of evidence that meet inclusion criteria will be included. The studies should include neonatal death as main outcome, greater than 500 patients, and artificial intelligence to develop a prediction model.

5. Heterogeneity: N/A

6. Risk of bias: quality assessment using Critical Appraisal and Data Extraction for Systematic Reviews of Prediction Modelling Studies (CHARMS) checklist

7. Presentation: Figure: PRISMA Flow, Tables: model characteristics, results per the main outcome

8. Number of studies, number of participants, type of machine learning, and details about the development and use of machine learning model will be included in the table.

9. Limitations regarding AUC and confidence intervals will be stated in the discussion.

29. * Analysis of subgroups or subsets.

State any planned investigation of 'subgroups'. Be clear and specific about which type of study or participant will be included in each group or covariate investigated. State the planned analytic approach.

No analysis of subgroups or subsets is planned.

30. * Type and method of review.

Select the type of review, review method and health area from the lists below.

Type of review

Cost effectiveness	No
Diagnostic	No
Epidemiologic	No
Individual patient data (IPD) meta-analysis	No
Intervention	No
Meta-analysis	Yes
Methodology	No
Narrative synthesis	No
Network meta-analysis	No
Pre-clinical	No
Prevention	No
Prognostic	No
Prospective meta-analysis (PMA)	No

Review of reviews	No
Service delivery	No
Synthesis of qualitative studies	No
Systematic review	Yes
Other	No

Health area of the review

Alcohol/substance misuse/abuse	No
Blood and immune system	No
Cancer	No
Cardiovascular	No
Care of the elderly	No
Child health	Yes
Complementary therapies	No
COVID-19	No
Crime and justice	No
Dental	No
Digestive system	No
Ear, nose and throat	No
Education	No
Endocrine and metabolic disorders	No
Eye disorders	No
General interest	No
Genetics	No
Health inequalities/health equity	No
Infections and infestations	No

International development	No
Mental health and behavioural conditions	No
Musculoskeletal	No
Neurological	No
Nursing	No
Obstetrics and gynaecology	No
Oral health	No
Palliative care	No
Perioperative care	No
Physiotherapy	No
Pregnancy and childbirth	Yes
Public health (including social determinants of health)	No
Rehabilitation	No
Respiratory disorders	No
Service delivery	No
Skin disorders	No
Social care	No
Surgery	No
Tropical Medicine	No
Urological	No
Wounds, injuries and accidents	No
Violence and abuse	No

31. Language.

Select each language individually to add it to the list below, use the bin icon to remove any added in error.

English

There is not an English language summary

32. * Country.

Select the country in which the review is being carried out. For multi-national collaborations select all the countries involved.

United States of America

33. Other registration details.

Name any other organisation where the systematic review title or protocol is registered (e.g. Campbell, or The Joanna Briggs Institute) together with any unique identification number assigned by them.
If extracted data will be stored and made available through a repository such as the Systematic Review Data Repository (SRDR), details and a link should be included here. If none, leave blank.

34. Reference and/or URL for published protocol.

If the protocol for this review is published provide details (authors, title and journal details, preferably in Vancouver format)

Yes I give permission for this file to be made publicly available

35. Dissemination plans.

Do you intend to publish the review on completion?

Yes

36. Keywords.

Give words or phrases that best describe the review. Separate keywords with a semicolon or new line. Keywords help PROSPERO users find your review (keywords do not appear in the public record but are included in searches). Be as specific and precise as possible. Avoid acronyms and abbreviations unless these are in wide use.

Neonatal, mortality, prediction models, machine learning.

37. Details of any existing review of the same topic by the same authors.

If you are registering an update of an existing review give details of the earlier versions and include a full bibliographic reference, if available.

38. * Current review status.

Update review status when the review is completed and when it is published.
New registrations must be ongoing so this field is not editable for initial submission.

Review_Ongoing

39. Any additional information.

Provide any other information relevant to the registration of this review.

40. Details of final report/publication(s) or preprints if available.

Leave empty until publication details are available OR you have a link to a preprint (NOTE: this field is not editable for initial submission).
List authors, title and journal details preferably in Vancouver format.