

BMJ Open Modifications to the National Early Warning Score: a scoping review protocol

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ABSTRACT

Introduction The National Early Warning Score (NEWS/2) system was developed to enable the detection and early intervention of patients at risk of clinical deterioration. It has demonstrated good accuracy in identifying imminent critical outcomes but has limitations in its applicability to various patient types and its ability to predict upcoming deterioration beyond 24 hours. Various studies have attempted to improve its predictive accuracy and clinical utility by modifying or adding variables to the standard NEWS/2 system. The purpose of this scoping review is to identify modifications to the NEWS and NEWS2 systems (eg, the inclusion of additional patient demographic, physiological or other characteristics) and how those modifications influence predictive accuracy to provide an evidence base for subsequent improvement of the system.

Methods and analysis The review will be structured using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews and the Population, Intervention, Comparator, Outcome, and Study frameworks. Six databases (PubMed, ScienceDirect, Embase, CINAHL, Web of Science and Cochrane Library) will be searched in April 2024 for articles published in English. Article screening and data extraction will be conducted by two independent reviewers, with any conflicts resolved by discussion. The analysis will be descriptive to provide a summary of modifications identified and their influence on the predictive accuracy of NEWS/NEWS 2.

Ethics and dissemination Ethical approval is not required as data will be obtained from already published sources. Findings from this study will be disseminated via publication in a peer-reviewed journal.

INTRODUCTION

Patients who deteriorate or experience acute illness while in hospital are at significant risk of poor outcomes.^{1 2} To improve detection and timely response to deteriorating patients and reduce the risk of death, cardiac arrest or the need for intensive care within 24 hours, the National Early Warning Score (NEWS) was developed.³ NEWS (and its revised version, NEWS2) uses routinely collected physiological variables to monitor patients

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This review will address a gap in the literature by delivering a review of efforts to improve the accuracy and impact of National Early Warning Score (NEWS) and NEWS2 by incorporating additional variables, which may strengthen the system's efficacy without adding a disproportionate burden to those using it.
- ⇒ This review will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews framework to ensure rigour.
- ⇒ Methodological limitations common to all scoping reviews apply, namely, the possibility that some relevant studies are missed despite efforts to mitigate this risk and risk of bias evaluation being out of scope at this stage.

at risk of clinical deterioration. NEWS and NEWS2 have demonstrated a good ability to predict mortality within 24 hours, providing a useful tool for improving documentation and identifying clinical deterioration, improving communication between clinicians and enabling escalation and early intervention.⁴ Although it is widely used in the UK and abroad, the current NEWS system still has room for improvement to better enable timely identification of deteriorating patients.⁵

There are a variety of limitations and areas for improvement within the NEWS system. One is that it requires measurement to be performed by trained professionals, but it may be delegated to less qualified staff, given trained professionals' heavy workloads and the time-consuming monitoring process.^{4 6} Such delegation constitutes a deviation from the specified usage of the system and may compromise accuracy. NEWS is also not tailored to individuals or their specific conditions, which may result in false alarms or lower accuracy beyond detecting immediate deterioration.⁴ Several recent reviews

Table 1 Population, Intervention, Comparator, Outcome and Study framework

Population	Adults of any age, demographic characteristics and clinical presentation who are being monitored in pre-hospital or hospital settings in any country will be included.
Intervention	Studies evaluating the use of modifications or additions of other predictor variables (eg, age) to the NEWS or NEWS2
Comparator	No comparator required
Outcome	The primary outcome will be the types of characteristics that are being incorporated into the NEWS risk prediction model. Secondary outcomes will include study and patient characteristics, assessments of accuracy, sensitivity and specificity (independently or in comparison to the standard NEWS) and evidence of the impact of the modifications or additions.
Study type	All study types that describe the development or evaluation of a relevant intervention will be eligible for inclusion, including protocols. Reviews, meta-analyses and conference or poster abstracts where no full text is available will be excluded.

have been conducted that examined the benefits and drawbacks of the NEWS system, the mechanisms that influence its appropriate use in care settings, its ability to predict mortality at different times or cut-off values and its accuracy in predicting deterioration in patients with particular conditions (eg, COVID-19) or particular settings.^{4 6–11} These reviews provide valuable insights into the use, accuracy and impact of NEWS and NEWS2. Critical areas identified for future research include improving NEWS2's clinical value⁴ (eg, its ability to predict deterioration in patients with low NEWS scores who later die in hospital¹¹), incorporating additional routinely collected variables¹⁰ and examining how digital technologies could facilitate longitudinal monitoring.^{4 10}

One notable gap in the literature is a review of efforts to improve the accuracy and impact of NEWS and NEWS2 by incorporating additional variables, for example, age, which may strengthen the system's efficacy without adding a disproportionate burden to those using it. One review that aimed to provide an overview of early warning score systems touched on this issue by capturing the most common predictors used in such systems, but it included any type of early warning system.⁷ As it was not specific to NEWS and NEWS2, the review could not investigate how the widely adopted system could be modified to improve predictive accuracy. Our driving research question is: Can the accuracy of the current NEWS2 scoring

system be improved in its ability to predict critical patient outcomes? This scoping review aims to shed light on how patient demographic, physiological or other characteristics are being incorporated with NEWS to support risk prediction of clinical deterioration.

METHODS

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR; online supplemental appendix A)¹² and the Population, Intervention, Comparator, Outcome and Study (PICOS) framework¹³ were used to build the search strategy (see table 1) and provide a framework for the review.

Search strategy

Six databases will be searched in April 2024 to identify references for screening: PubMed, ScienceDirect, Embase, CINAHL, Web of Science and Cochrane Library. Keywords and relevant MeSH terms were identified based on an initial review of related studies and previous systematic reviews^{9 11 14} and selected to focus specifically on modifications to the established alert score (rather than the wider area of rapid response systems). These terms were categorised into two key themes to provide a structure for the search: NEWS (MeSH OR Keywords) AND Additional

Table 2 Search string

Category	MeSH	Keywords (in title or abstract)
NEWS	Early Warning Score	"NEWS2" OR "national early warning system" OR "national early warning score" OR "track and trigger" OR "early warning score" OR "early warning system"
Additional variables	Epidemiologic Factors OR Demography	"Physiological variables" OR "physiological parameters" OR "observational data" OR "patient observation" OR "patient characteristic" OR "demographic" OR "age" OR "sex" OR "gender" OR "comorbidit*" OR "frail" OR "deprivation" OR "diastolic blood pressure" OR "urine" OR "urea" OR "oxygen therapy" OR "blood parameters" OR "physiological measures" OR "blood biomarkers" OR "ethnicity" OR "add" OR "extra" OR "supplement" OR "other factors" OR "modify" OR "modified" OR "adjusted" OR "amended"

Table 3 Article information and data extraction

Article information	Data to be extracted
General study information	▶ Year of publication ▶ Sample size ▶ Study type ▶ Target patient population
Modifications to NEWS/2	▶ Variables added ▶ Variables removed ▶ Weighting/scoring changes ▶ Type of variables added (eg, demographic and physiological) ▶ Number of changes ▶ Reason for the particular modification made (if given)
Evaluation	▶ Outcome measures – Performance: accuracy, sensitivity, specificity, Area Under the Receiver Operating Characteristic (AUROC), etc. ▶ Performance compared to standard NEWS/2 ▶ Impact on patient outcomes ▶ Impact on clinical service deliver

NEWS, National Early Warning Score.

variables (MeSH OR Keywords) (table 2). A sample search string and the number of references retrieved in PubMed are provided in online supplemental appendix B.

Inclusion criteria

All studies that examine the modification of the NEWS or NEWS2 systems, applied to adults of any age, will be eligible for inclusion. There are no eligibility restrictions based on the type of additional variables or factors that could be incorporated into the standard NEWS systems. Studies will be eligible for inclusion as long as they discuss and justify a proposed change to the standard NEWS systems with the aim of improving accuracy or clinical impact—it is not required that the change be an addition of a variable, and simplified versions of the NEWS systems, or versions that vary the weighting of particular variables in the scoring system, will also be eligible for inclusion. This could include protocols as well as studies that evaluate the accuracy of the revised system (independently or compared with the standard system).

Exclusion criteria

Studies that focus on Track and Trigger or Early Warning Score systems that are not NEWS or NEWS2 will be excluded. This will be done to focus the scope of the review on one widely used system and enable comparability among the included studies. Abstracts with no full text will be excluded, as will any duplicates. Studies that are not published in English will not be eligible for inclusion, due to the language capabilities of the authors.

Screening and article selection

The citation management software EndNote 21 will be used to store the references, remove duplicates and conduct an initial automated screening based on keywords. The keywords and structure of this initial search will be recorded in the appendices of the final review. To

ensure that the automated screening does not inadvertently remove relevant studies, a selection of studies that were identified as eligible in the preliminary review will be used as ‘check’ references. After each screening pass in EndNote 21, we will check to ensure that these references have not been excluded. If they have, the screening terms will be revised and the pass re-run. After the automated screening, the remaining titles and abstracts will be screened in Rayyan. Finally, a full-text review will be conducted, and articles will be excluded with reasons. This process will be summarised in a PRISMA flow diagram.

Data extraction

Data will be extracted from the included studies by two independent reviewers based on predetermined outcomes (table 3). Any disagreement will be resolved by discussion between reviewers until a consensus is reached.

Data analysis and synthesis

The data extracted from the included studies will be analysed descriptively to provide a summary of the variables that are being incorporated into NEWS/2 to improve accuracy and the evidence of their impact on accuracy and clinical value. A meta-synthesis of qualitative, contextual information (including the rationale for making particular modifications or adding particular variables and the impact of the change on patient outcomes or the process of collecting and calculating NEWS/2 data) will also be conducted, given sufficient data in the papers.

Patient and public involvement

None.

ETHICS AND DISSEMINATION

As the data for this study will be obtained from published sources, ethical approval is not required. A report of this

scoping review will be submitted for publication in a peer-reviewed journal in order to disseminate its findings publicly.

Contributors The review protocol was conceived and drafted by MM-I, with input from EM, CP and VR. VR, CP, LT, CC, AA and EM contributed revisions. As guarantor, EM takes responsibility for the content.

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Appendix A. PRISMA-ScR Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM
TITLE		
Title	1	Identify the report as a scoping review.
ABSTRACT		
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.
INTRODUCTION		
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.
METHODS		
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.
RESULTS		

Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.
DISCUSSION		
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.
Limitations	20	Discuss the limitations of the scoping review process.
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.
FUNDING		
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.

Appendix B. Sample Search Strings

Database	Search string	Results
PubMed	((Early Warning Score[MeSH Terms]) OR ("NEWS2" OR "national early warning system" OR "national early warning score" OR "track and trigger" OR "early warning score" OR "early warning system")) AND ((Epidemiologic Factors OR Demography[MeSH Terms]) OR ("Physiological variables" OR "physiological parameters" OR "observational data" OR "patient observation" OR "patient characteristic" OR "demographic" OR "age" OR "sex" OR "gender" OR "comorbidit*" OR "frail" OR "deprivation" OR "diastolic blood pressure" OR "urine" OR "urea" OR "oxygen therapy" OR "blood parameters" OR "physiological measures" OR "blood biomarkers" OR "ethnicity" OR "add" OR "extra" OR "supplement" OR "other factors" OR "modify" OR "modified" OR "adjusted" OR "amended"))	1,760