



Topic Exploration Report

Topic explorations are designed to provide a high-level briefing on new topics submitted for consideration by Health Technology Wales. The main objectives of this report are to:

- Determine the quantity of evidence available for a technology of interest.
- Identify any gaps in the evidence.
- Inform decisions on topics that warrant fuller assessment by Health Technology Wales (HTW).

Topic exploration report number	TER478
Topic	National Early Warning Score systems (NEWS and NEWS2) for adult patients across the acute care pathway
Summary of findings	<p>The National Early Warning Score (NEWS) is a track and trigger system to assess illness severity and risk of deterioration for patients in acute episodes of care. It is unclear how NEWS and NEWS2 compare in terms of accuracy and effectiveness. NEWS2 has received endorsement from NHS England for identifying acutely ill patients in hospitals in England. However, the Topic Proposer has highlighted that the earlier version, NEWS, is used in NHS Wales.</p> <p>Systematic reviews have evaluated different versions of NEWS in adult patients, assessing accuracy and effectiveness, and the ability to predict absolute mortality at different times and cut-offs values, including in the pre-hospital setting. Results were similar for NEWS and NEWS2 in terms of predicting short-term mortality. Prediction of longer-term mortality was considered unreliable.</p> <p>A systematic review assessing prognostic accuracy on predicting clinical deterioration for patients with Covid-19 reported better pooled sensitivity and specificity for NEWS2 compared to NEWS. Prognostic performance of NEWS2 varied across subgroups. Prediction of clinical deterioration within 72 hours was better than that during hospitalisation. NEWS2 also had worse sensitivity, but better specificity in less severe disease (<10% mortality).</p> <p>A systematic review evaluating prognostic accuracy for mortality in patients with infections outside of the intensive care unit was unable to make valid conclusions on NEWS2, but noted that evidence varied across subgroups for NEWS, with lower sensitivity in older patients (≥ 70 years old). The authors also reported that in patients with sepsis or more severe conditions, NEWS was more sensitive but less specific in predicting mortality.</p>

A further systematic review only considering NEWS2 also reported excellent sensitivity and specificity in predicting short-term (two-day) mortality in the pre-hospital and emergency settings.

There is a lack of economic evidence on the use of NEWS and NEWS2.

Introduction and aims

The National Early Warning Score (NEWS) was developed by the Royal College of Physicians (2017) in the United Kingdom, adapted from the Vitalpac™ Early Warning Score (ViEWS). It is a track and trigger system to assess illness severity and risk of deterioration for patients in acute episodes of care in the UK.

NEWS was created to standardise the process of recording, scoring and responding to changes in routinely measured physiological parameters in acutely ill patients. NEWS2 is the latest version of NEWS, which includes a redefinition of altered mental status and the points awarded for oxygen saturation. These changes were based on expert opinion rather than data. NEWS and NEWS2 are both used across all healthcare settings in acute care. It is unclear how the two versions compare in terms of accuracy and effectiveness. Furthermore, there have been inconsistent findings reported regarding the accuracy of NEWS2.

Health Technology Wales researchers searched for evidence on National Early Warning Score systems for adult patients, focussing on evaluating how NEWS2 compares to the earlier version, NEWS.

Evidence overview

The Royal College of Physicians (2017) made recommendations on the use of NEWS/NEWS2. Digital systems may be used with both. Integrated software systems that output NEWS scores were considered by the National Institute for Health and Care Excellence (NICE) in Medtech innovation briefing (MIB205) and are outside of the scope of this Topic Exploration Report.

Systematic reviews have evaluated different versions of NEWS in adult patients, assessing the accuracy and effectiveness, and the ability to predict absolute mortality at different times and cut-offs values, including in the pre-hospital setting. There is a paucity of economic evidence.

Guidance and advice

The Royal College of Physicians (2017) made recommendations on the use of NEWS/NEWS2, noting that NEWS2 is due for review in 2023. They recommend the use of the standardised NEWS2 observation chart for the routine recording of clinical observations across the NHS, stipulating that this should eventually replace the existing NEWS chart. The NEWS2 chart should replace the wide variety of charts already in use for temperature, pulse and respiration rate. The core of the chart should be consistent nationally, whilst the rest of the chart can be customised to reflect other key parameters not incorporated, such as urine output and pain scores, according to the clinical environment. The Royal College of Physicians state that NEWS/NEWS2 can and should be used alongside validated scoring systems such as the Glasgow Coma Scale (GCS) or disease-specific systems as dictated by patient need. The Royal College of Physicians recommend that NEWS/NEWS2 should not be used in children or in women who are pregnant because the physiological response to acute illness can be modified. It should be used with caution in patients with spinal cord injury due to disturbances of the autonomic nervous system which may render NEWS unreliable.

Evidence overview

NEWS2 has received formal endorsement from NHS England and NHS Improvement to become the early warning system for identifying acutely ill patients (including those with sepsis) in hospitals in England. However, the Topic Proposer has highlighted that the earlier version, NEWS, is used in NHS Wales. The Royal College of Physicians recommends that future research be directed towards evaluating the efficiency of the NEWS/NEWS2 in improving clinical response times and clinical outcomes in patients with acute illness, including in the primary care setting.

Evidence reviews

A systematic review by Holland and Kellett (2022) examined variation in the ability of different versions of NEWS in adult patients to predict absolute mortality at different times and cut-offs values. Most studies were from the UK and USA, with the number of observations reported ranging from 89 to 6,222,740. However, the majority of studies reported only on the performance of one scoring system (NEWS only: 96; ViEWS [NEWS precursor] only: 5; NEWS2 only: 16; NEWS and NEWS2: 4; NEWS2 and ViEWS: 1). The average area under the Receiver Operating Characteristic curve (AUC) for mortality declined from 0.897 (95% CI 0.895 to 0.899) at 24 hours to 0.761 (95% CI 0.754 to 0.768) at 30 days following NEWS recording. Results were similar for NEWS2 (0.848 [95% CI 0.811 to 0.885] at 24 hours to 0.686 [95% CI 0.664 to 0.708] at 30 days and ViEWS (0.886 [95%CI 0.877 to 0.895] at 24 hours). The authors note that the marginal inferiority of NEWS for 24-hour mortality could be due to NEWS2 having low patient numbers, and all being emergency patients early in treatment. Studies with a low overall mortality had a higher AUC for 24-hour mortality, as did general ward patients compared to patients seen earlier in their treatment. Holland and Kellett (2022) concluded that NEWS reliably identifies patients most and least likely to die within 24 hours, but that many patients identified to have a low risk of imminent death die within 30 days. They reported that NEWS mortality predictions beyond 24-hours are unreliable.

Guan et al. (2022) carried out a systematic review and meta-analysis to assess the predictive abilities of five commonly used EWS scores (NEWS, NEWS2, Modified Early Warning Score [MEWS], Rapid Acute Physiological Score [RAPS], and Cardiac Arrest Risk Triage [CART]). Overall, the meta-analysis included 18,270 and 71,658 patients from the emergency department and prehospital settings, respectively. Results for NEWS2 in the emergency department were not reported. In the pre-hospital setting, NEWS2 had diagnostic odds ratios (DORs) to predict short term (up to three days) mortality of 14.06 (95% CI 9.09 to 21.75, I² = 0%), 12.26 (95%, CI 8.58 to 17.64, I² = 4.4%), and 20.37 (95% CI 13.16 to 31.52, I² = 0%), at score cut-offs of five, seven and nine, respectively. NEWS at a cut-off point ≥ 7 had a DOR of 11.63 (95%, CI 9.75 to 13.88, I² = 0%) to predict this outcome, which was not statistically different than NEWS2 with the same cut-off point. NEWS2 prediction of 30-day mortality in the pre-hospital setting was not reported; however, results showed that NEWS could not accurately predict this outcome (DOR 2.58 (95% CI 0.59 to 11.21).

A systematic review and meta-analysis by Zhang et al. (2021b) searched for studies between December 2019 and March 2021 to assess prognostic accuracy of NEWS2 on predicting clinical deterioration for patients with Covid-19. A total of 18 studies (NEWS2: 11, NEWS: 7; 6,922 participants) were included. NEWS2 showed better pooled sensitivity and specificity compared to NEWS (sensitivity: 0.82 [95% CI 0.75 to 0.87] vs 0.75 [95% CI 0.63 to 0.84], respectively; specificity: 0.67 [95% CI 0.58 to 0.75] vs 0.65 [95% CI: 0.52 to 0.76], respectively). The NEWS2 AUC was 0.82 (95% CI 0.79 to 0.85) as compared to 0.76 (95% CI 0.72 to 0.79) for NEWS. The positive likelihood ratio (PLR) and negative likelihood ratio (NLR) for NEWS2 were 2.50 (95% CI 1.96 to 3.20) and 0.27 (95% CI 0.20 to 0.37), respectively. Prognostic performance of NEWS2 varied across subgroups. Prediction of clinical deterioration within 72 hours was better than that during hospitalisation (AUC: 0.86 vs 0.80). In less severe disease (mortality <10% as compared to $\geq 10\%$), NEWS2 had worse sensitivity (0.79 [95% CI 0.67 to 0.87] vs 0.82

Evidence overview

[95% CI 0.72 to 0.89], respectively), but better specificity (0.76 [95% CI 0.62 to 0.86] vs 0.63 [95% CI 0.51 to 0.47 (95% CI in paper appears to contain a typographical error)], respectively.

Zhang et al. (2021a) carried out a systematic review and meta-analysis on the prognostic accuracy of NEWS/NEWS2 for mortality in patients with infections outside of the intensive care unit. A total of 21 studies (107,008 participants) were included, including studies from the UK. The authors were unable to develop reliable conclusions on NEWS2 as only three studies evaluated that version. However, the pooled sensitivity, specificity and AUC of NEWS were 0.71, 0.60 and 0.70, respectively. There was evidence that prognostic performance varied across different subgroups. In older patients (≥ 70 years old) sensitivity was worse (0.55: 95% CI 0.41 to 0.67) and AUC was significantly lower compared to those < 70 years old (0.63 vs 0.72, $Z = 3.562$, $p < 0.001$). The authors also reported that in patients with sepsis or more severe conditions (mortality rate $\geq 10\%$), NEWS was more sensitive but less specific in predicting mortality. For UK studies, NEWS was less sensitive (0.62 vs 0.75) and the AUC was lower, although this was not statistically significant (AUC: 0.68 vs 0.71, $Z = 0.653$, $P = 0.514$).

Burgos-Esteban et al. (2022) have reported a systematic review on the effectiveness of early warning systems for early severity assessment in outpatient emergency care. Eleven articles were selected, and the authors give some insight into potential conclusions, but very few results were provided. Three studies evaluated the predictive ability of various scoring systems and found no significant differences in their results.

Wei et al. (2023) performed a systematic review and meta-analysis on the accuracy of NEWS2 in predicting mortality in prehospital and emergency settings (30 studies, including Europe; 185,835 participants). The pooled sensitivity for predicting mortality was 0.81 (95% CI 0.76 to 0.84) at two days, 0.76 (95% CI 0.68 to 0.83) at 30 days and 0.72 (95% CI 0.61, 0.80) in-hospital. Specificity was 0.81 (95% CI 0.78 to 0.84) at two days, 0.69 (95% CI 0.59 to 0.78) at 30 days and 0.78 (95% CI 0.49 to 0.93) in-hospital. AUC was 0.88 (95% CI 0.85 to 0.90) at two days, 0.80 (95% CI 0.76 to 0.83) at 30 days and 0.78 (95% CI 0.74 to 0.82) in-hospital. The authors conclude that NEWS2 has excellent sensitivity and specificity in predicting early (two-day) mortality in the pre-hospital and emergency settings; however poor performance in predicting 30-day and in-hospital mortality was highlighted. The predictive performance of NEWS2 was more reliable when the cut-off value was ≥ 4 .

Economic evidence

The Department of Health (2020) report included consideration of the economic impact of Irish NEWS2 (INEWS v2). It is important to note that different systems are used in Ireland compared to the UK and the report refers to INEWS/INEWS v2 specifically. The report highlights that many of the recommendations made represent existing good practice and are therefore cost neutral. The report states that it is not possible to estimate savings related to improved outcomes until a national evaluation takes place to include economic impact. It is also noted that inadequate monitoring, and subsequent failure to recognise patient deterioration, may increase financial costs associated with adverse outcomes and, in some cases, legal claims.

We identified a systematic review of economic evidence on the use of early warning systems in adult patients in acute healthcare settings (Murphy et al. 2018). Only one paper was sourced via the systematic review, with four grey literature studies also included in the report. Three were Irish studies considering INEWS. The authors concluded that the economic evidence is limited and that further research was required.

Areas of uncertainty

- NEWS2 has received formal endorsement from NHS England and NHS Improvement to become the early warning system for identifying acutely ill patients (including those with sepsis) in hospitals in England. However, the Topic Proposer has highlighted that the earlier version, NEWS, is used in NHS Wales.
- Digitisation, associated automatic testing and integrated software systems results in complex systems that are difficult to evaluate and compare.
- Heterogeneity of studies in the systematic reviews adds uncertainty to the evidence and conclusions.
- There was evidence that the prognostic performance of NEWS and NEWS2 varied across different subgroups. Certain populations may require modified versions of NEWS/NEWS2.
- The Royal College of Physicians recommend that further research is carried out to evaluate the efficiency of NEWS in improving clinical response times and clinical outcomes in patients with acute illness, including in the primary care setting. They recommend that NEWS is used to catalyse an expansion of research into the effectiveness of novel interventions, diagnostics and care pathways in acute care in the NHS. An update is expected from the Royal College of Physicians during 2023.
- There is a lack of economic evidence on the use of NEWS and NEWS2 in acute care.
- It is unclear how much education and training is required to use NEWS/NEWS2. The Royal College of Physicians state that demonstrable competency in the use of NEWS should be a mandatory requirement and form part of mandatory training for all healthcare staff engaged in the assessment and monitoring of acutely ill patients across the NHS.

Literature search results

Health technology assessments, guidance and advice

Department of Health. (2020). Irish National Early Warning System V2 (NCEC National Clinical Guideline No. 1). Available at: <https://www.gov.ie/en/collection/cc5faa-national-early-warning-score-news/> [Accessed 21 June 2023].

It is important to note that different systems are used in Ireland compared to the UK and the report refers to Irish NEWS (INEWS/INEWS v2) specifically.

Health Information and Quality Authority. (2015). Health technology assessment of the use of information technology for early warning and clinical handover systems. Available at: <https://www.hiqa.ie/reports-and-publications/health-technology-assessment/hta-it-early-warning> [Accessed 21 June 2023].

It is important to note that different systems are used in Ireland compared to the UK. This report refers to the use of Information Technology, such as electronic NEWS.

NICE. (2020). National Early Warning Score systems that alert to deteriorating adult patients in hospital. Medtech innovation briefing (MIB205). National Institute for Health and Care Excellence. Available at: <https://www.nice.org.uk/advice/mib205> [Accessed 20 June 2023].

This advice covers integrated software systems that output the National Early Warning Score (NEWS) for adult patients in hospital. The technologies included KEWS300 (Syncrophi Systems Ltd), Med eTrax (Med eTrax), Patientrack (Patientrack [UK] Ltd), SEND (Sensyne Health) and CareFlow Vitals (formerly Vitalpac & The Learning Clinic, now produced by System C Healthcare). The MIB does not compare the use of NEWS/NEWS2 to standard care.

NICE. (2016). VitalPAC for assessing vital signs of patients in hospital. Medtech innovation briefing (MIB79). National Institute for Health and Care Excellence. Available at: <https://www.nice.org.uk/advice/mib79> [Accessed 20 June 2023].

This advice has been updated and replaced by MIB205.

Royal College of Physicians. (2017). National Early Warning Score (NEWS) 2: Standardising the assessment of acute-illness severity in the NHS. Updated report of a working party. Available at: <https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2> [Accessed 20 June 2023].

Website states that NEWS2 is due for review in 2023.

Evidence reviews and economic evaluations

Burgos-Esteban A, Gea-Caballero V, Marín-Maicas P, et al. (2022). Effectiveness of Early Warning Scores for Early Severity Assessment in Outpatient Emergency Care: A Systematic Review. *Front Public Health*; 10: 894906. doi: <https://doi.org/10.3389/fpubh.2022.894906>.

Guan G, Lee CMY, Begg S, et al. (2022). The use of early warning system scores in prehospital and emergency department settings to predict clinical deterioration: A systematic review and meta-analysis. *PLoS One*. 17(3): e0265559. doi: <https://doi.org/10.1371/journal.pone.0265559>.

Holland M, Kellett J. (2022). A systematic review of the discrimination and absolute mortality predicted by the National Early Warning Scores according to different cut-off values and prediction windows. *European Journal of Internal Medicine*; 98:15-26. doi: <https://doi.org/10.1016/j.ejim.2021.12.024>.

Murphy A, Cronin J, Whelan R, et al. (2018). Economics of Early Warning Scores for identifying clinical deterioration-a systematic review. *Irish Journal of Medical Science* ;187(1): 193-205. doi: <https://doi.org/10.1007/s11845-017-1631-y>.

Wei S, Xiong D, Liang X et al. (2023). The accuracy of the National Early Warning Score 2 in predicting early death in prehospital and emergency department settings: a systematic review and meta-analysis. *Annals of Translational Medicine*; 11(2): 95. doi: <https://doi.org/10.21037/atm-22-6587>.

Zhang K, Zhang X, Ding W, et al. (2021a). National Early Warning Score does not accurately predict mortality for patients with infection outside the intensive care unit: A Systematic Review and Meta-Analysis. *Frontiers in Medicine* 15; 8: 704358. doi: <https://doi.org/10.3389/fmed.2021.704358>.

Zhang K, Zhang X, Ding W et al. (2021b). The prognostic accuracy of National Early Warning Score 2 on predicting clinical deterioration for patients with COVID-19: a systematic review and meta-analysis. *Frontiers in Medicine*. doi: <https://doi.org/10.3389/fmed.2021.699880>.

Ongoing research

No relevant ongoing studies that have recently closed or are due to complete in the next 6-12 months were identified.

Date of search

June 2023

Concepts used

Acute care; adult; National Early Warning Scores; NEWS; NEWS2; vital signs.

Proposed research question and evidence selection criteria (if selected)

Proposed Research question	Is National Early Warning Score 2 (NEWS2) clinically and cost effective compared to the earlier version, NEWS, for adult patients across the acute care pathway
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	Inclusion criteria	Exclusion criteria
Population	<ul style="list-style-type: none"> • Acutely ill adult patients 	<ul style="list-style-type: none"> • Children • Pregnant women
Intervention	<ul style="list-style-type: none"> • NEWS2 	<ul style="list-style-type: none"> • Non-NEWS scoring systems • Integrated software systems that output NEWS score (as covered by MIB205)
Comparison/ Comparators	<ul style="list-style-type: none"> • NEWS 	<ul style="list-style-type: none"> • Non-NEWS scoring systems • Integrated software systems that output NEWS score (as covered by NICE MIB205)
Outcome measures	<ul style="list-style-type: none"> • Sensitivity • Specificity • Area under curve (AUC) • Diagnostic odds ratio (DOR) • Positive likelihood ration (PLR) • Negative likelihood ratio (NLR) 	
Study design	<ul style="list-style-type: none"> • Any. Ideally systematic reviews/RCTs. Economic studies. 	

Proposed speciality	Health service organisation and delivery
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