FINAL

National Institute for Health and Care Excellence

Pneumonia: diagnosis and management

[K] Evidence review for prognostic accuracy of NEWS2 and PEWS in people with community-acquired pneumonia

NICE guideline NG250

Evidence review: research recommendation developed following this review

September 2025

Final

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Contents

1 Prognostic accuracy and cost-effective outcome prediction of NEWS2 or PEWS

1.1 Review question

In people with confirmed community-acquired pneumonia (presenting to an emergency care setting) what is the accuracy of NEWS2 or PEWS and the risk of mortality or severe illness or differing levels of illness to support the consideration of the most appropriate care setting for these patients?

1.1.1 Introduction

This review aims to evaluate the prognostic accuracy of NEWS2 and PEWS tools for determining which people with pneumonia presenting to emergency care are suitable for particular care pathways for example:

- discharge to general practice
- referral to virtual wards/hospital at home.
- admission to hospital (general ward)
- admission acute respiratory support unit
- admission to ICU

NEWS2

The National Early Warning Score (NEWS)-2 is an early warning scale that is used in emergency departments to identify patients at risk of clinical deterioration and to help establish rapid and timely management. It uses an aggregate scoring system in which a score is allocated to physiological measurements when patients present or are being monitored in hospital. Six physiological parameters form the basis of the scoring system, outlined in figure 1. Risk scores are calculated and categorised into low, low-medium, medium, and high. These categories and suggested clinical responses, as published by the Royal College of Physicians, are outlined in figure 2.

Figure 1 The NEWS scoring system, from the Royal College of Physicians (source: https://www.rcp.ac.uk/improving-care/resources/national-early-warning-score-news-2)

Physiological parameter	Score						
	3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO2 Scale 1 (%)	≤91	92-93	94-95	≥96			
SpO2 Scale 2 (%)	≤83	84-85	86-87	88-92, ≥93 on air	93-94 on oxygen	95-96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			

Systolic blood pressure (mmHg)	≤90	91-100	101-110	111-219			≥220
Pulse (per minute)	≤40		41-50	51-90	91-110	111-130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35		35.1-36	36.1-38	38.1-39	≥39.1	

Figure 2 The NEWS clinical risk categories, from the Royal College of Physicians (source: https://www.rcp.ac.uk/improving-care/resources/national-early-warning-score-news-2)

Clinical risk	Score	Clinical response
Low	Aggregate of 0-4	Ward-based response: • Inform registered nurse, who must assess the patient • Registered nurse decides whether increased frequency of monitoring and/or escalation of care is required
Low-medium	3 in a single parameter	Urgent ward-based response: • Registered nurse to inform medical team caring for the patient, who will review and decide whether escalation of care is necessary
Medium	Aggregate of 5-6	Threshold for urgent response: • Registered nurse to immediately inform the medical team caring for the patient • Registered nurse to request urgent assessment by a clinician or team with core competencies in the care of acutely ill patients • Provide clinical care in an environment with monitoring facilities
High	Aggregate of 7 or more	Urgent or emergency response: • Registered nurse to immediately inform the medical team caring for the patient – this should be at least at specialist registrar level • Emergency assessment by a team with critical care competencies, including practitioner(s) with advanced airway management skills • Consider transfer of care to a level 2 or 3 clinical care facility, ie higher-dependency unit or ICU • Clinical care in an environment with monitoring facilities

Differences between NEWS and NEWS2 tools

NEWS2 is the latest version of NEWS; it was produced in 2012 and updated in 2017. In the original version of NEWS, oxygen saturations (SpO2) receive increasing weights for values of 95% or less, and oxygen therapy receives a flat weight (a score of 2 is added to the aggregate NEW score for any patient requiring supplemental oxygen). However, guidance for the management of patients with type II respiratory failure (T2RF) and those deemed at risk of T2RF before blood gas analysis, suggests lower SpO2 values (88–92%) should be targeted. Consequently, it is suggested that the NEWS SpO2 weighting system is inappropriate for patients with/at risk of T2RF.

NEWS2 includes several modifications to the NEWS vital sign weightings. To account for concerns about NEWS and T2RF, NEWS2 includes a new SpO2 scoring scale for patients with/at risk of T2RF. This scale, termed *SpO_2 scale 2* assigns weights at lower SpO_2 thresholds than NEWS and combines these lower thresholds with weights for the use of supplemental oxygen at higher SpO_2 levels, reflecting the concern of hyperoxia-induced hypercapnic respiratory failure. The NEWS2 updates are outlined in table 1.

Table 1: Updates made to NEWS2

1	The recording of physiological parameters has been reordered to align with the Resuscitation Council (UK) ABCDE sequence
2	The ranges for the boundaries of each parameter score are now shown on the chart
3	The chart has a dedicated section (spo2 Scale 2) for use in patients with hypercapnic respiratory failure (usually due to COPD) who have clinically recommended oxygen saturation of 88–92%
4	The section of the chart for recording the rate of (L/min) and method/device for supplemental oxygen delivery has been improved
5	The importance of considering serious sepsis in patients with known or suspected infection, or at risk of infection, is emphasised. A new score of 5 or more is the key trigger threshold for urgent clinical review and action
6	The addition of 'new confusion' (which includes disorientation, delirium or any new alteration to mentation) to the AVPU score, which becomes ACVPU (where C represents confusion)
7	The chart has a new colour scheme, reflecting the fact that the original red amber–green colours were not ideal for staff with red/green colour blindness

PEWS (source: www.england.nhs.uk/get-involved/cyp/pews)

The Paediatric Early Warning System (PEWS) is a scoring system designed to effectively recognise and respond to the deterioration of children or young people in a healthcare environment. It involves an observation chart and track and trigger system, which captures vital signs such as heart rate or observations such as work of breathing. It gives a total score describing the acuity of the patient and then links the score to specific escalation responses. This system ensures timely interventions, potentially improving outcomes and saving lives.

1.1.2 Summary of the protocol

Table 2: Summary inclusion criteria

Population	Babies over 28 days (corrected gestational age), children, young people (age <18 years) and adults (≥18 years) with confirmed community-acquired pneumonia presenting to an emergency department or other emergency care setting.
Assessment tools	For adults: • NEWS2 • NEWS (as indirect evidence) For children: • PEWS
Outcomes	• Mortality • Admission to hospital • Admission to ICU • Admission to acute respiratory unit • Use of NIV or high flow oxygen • Length of stay (in any of the above settings) • Hospital re-attendance with CAP (as a marker of failure of original decision)
Measures	Discrimination measures: • Concordance (C) statistic, area under the curve (AUC) with 95% confidence interval Calibration measures: • number of observed (O) and expected (E) events • total O:E ratio • calibration slope Where reported the following measures: • adjusted hazard ratios (HR), adjusted odds ratios (OR) or adjusted risk ratios (RR).
Study type	• Prospective or retrospective observational cohorts or cross-sectional studies which evaluate the performance of the risk prediction tools. • External validation studies • Systematic reviews of the above study types

For the full protocol see appendix A.

1.1.3 Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in appendix A and the methods document.

As the evidence-base for NEWS2 was expected to be small, the committee agreed to also include studies that assess the NEWS tool (the first version of the tool introduced in 2012). In this case, the studies assessing the NEWS tool were considered indirect evidence.

The protocol stated the intention to only include studies which used a multivariate analysis which accounts for key confounders. Only 2 studies did this, both of which were indirect evidence on NEWS, so the committee agreed a protocol deviation to remove this requirement to increase the quantity of area under the curve data available from studies without a multivariate analysis.

Once the searches were completed the committee saw that although there were 4 studies that examined NEWS2, only 2 of these had extractable outcomes matching the protocol. As the committee were keen maximise use of the direct evidence on the current version of the NEWS2 tool, a protocol deviation was agreed to extract an additional outcome of 'progression to severe pneumonia'. This was a composite outcome reported by the remaining 2 studies, defined by Muller-Plathe (2024) as 'in-hospital mortality, respiratory failure requiring invasive mechanical ventilation, acute kidney injury requiring kidney replacement therapy, and need for vasopressor therapy' and by Tajarernmuang (2023) a 'respiratory failure requiring mechanical ventilation, circulatory failure requiring vasopressors, or death within 72 hours'. The committee agreed that this outcome encompassed outcomes of interest and therefore it was included in the analysis.

The review protocol specified that, where statistically appropriate, a meta-analytic approach will be used to give an overall summary effect. However, this was not statistically possible due to differences in analysis approaches taken by different studies and the NEWS bands and cut off points used, as this resulted in large heterogeneity in the data. Consequently, a narrative approach has been taken instead comprising evidence statements summarising the findings from individual studies. GRADE was applied individually for each study using the narrative approach.

Declarations of interest were recorded according to NICE's conflicts of interest policy.

1.1.3.1 Search methods

Each evidence review for this guideline had a search conducted in three parts. Part 1 was a single search for all systematic reviews relating to pneumonia published since 2014 that was screened for relevance to all the review questions. Part 2 was tailored to each evidence review. Part 3 covered the cost effectiveness elements of all review questions in a single search.

The searches for systematic reviews on all pneumonia topics published since 2014 were run on 20 November 2023 and re-run on 15 October 2024 in Cochrane Database of Systematic Reviews (CDSR) (Wiley) and Epistemonikos (https://www.epistemonikos.org).

The searches for prognostic evidence were run on 19 September 2024. The search aimed to cover NEWS, NEWS2, MEWS, PEWS and other early warning scores. The following databases were searched: Cochrane Central Register of Controlled Trials (CENTRAL) (Wiley); Embase (Ovid); and MEDLINE ALL (Ovid). Limits were applied to remove animal studies, case reports, conference abstracts, editorials, empty registry entries, letters, news items and references not published in the English language

The database searches were supplemented with additional search methods. Reference list checking and forward citation searching were conducted on Web of Science Core Collection on 19 September 2024 using seed references identified from the scoping searches.

The searches for cost effectiveness evidence were run on 20 November 2023 and re-run on 14 October 2024 for papers published since 2014. The following databases were searched: Econlit (Ovid); Embase (Ovid); International HTA Database (https://database.inahta.org); MEDLINE ALL (Ovid); and NHS Economic Evaluation Database (NHS EED) (CRD). The same limits as in the effectiveness search were used. The validated NICE Cost Utility Filter was used on MEDLINE and Embase. Validated NICE filters were used in MEDLINE and Embase to remove references exclusively set in countries that are not OECD members.

A NICE senior information specialist (SIS) conducted the searches. The MEDLINE strategy was quality assured by another NICE SIS and all translated search strategies were peer reviewed to ensure their accuracy. Both procedures were adapted from the 2015 PRESS Guideline Statement.

Explanatory notes and full search strategies for each database are provided in appendix B.

1.1.4 Prognostic evidence

1.1.4.1 Included studies

A systematic search carried out to identify potentially relevant studies found 880 references (see appendix B for the literature search strategy).

These 880 references were screened at title and abstract level against the review protocol, with 825 excluded at this level.

The full texts of 55 studies, comprising prospective cohorts, retrospective cohorts and cross sectional studies, were ordered for closer inspection. Thirteen of these studies met the criteria specified in the review protocol (appendix A). Four of these studies used NEWS2, 9 used NEWS which were used to supplement the evidence for NEWS2. None of the studies used PEWS. For a summary of the 13 included studies see table 4.

The clinical evidence study selection is presented as a PRISMA diagram in appendix C.

See section 1.1.14 References – included studies for the full references of the included studies.

1.1.4.2 Excluded studies

Details of studies excluded at full text, along with reasons for exclusion are given in appendix J.

1.1.5 Summary of studies included in the prognostic evidence

Table 2 Summary of studies included in the prognostic evidence

Study details	Location	Population	Outcomes	Follow up	Analyses	Quality/Risk of bias (RoB)
NEWS2 studies						
Durantez-Fernandez 2022 Prospective cohort	Spain	N= 1716 Median age: 70 (IQR:54-82) 38.9% female	• Mortality	30 days	• Area under the ROC curve • Odds ratio	Moderate RoB, Moderate concerns about applicability
Kumari 2024 Cross-sectional	Pakistan	N=116 Aged over 12 Mean age: 46.9 (SD:20.5) 35.3% female	• Mortality	Within hospital stay	• Area under the ROC curve	Low RoB, High concerns about applicability
Muller-Plathe 2024 Retrospective cohort	Germany	N=310 Kidney transplant recipients with CAP 43 of which had COVID19 Median age: 58.7 (IQR: 46.8-68.2) 35.8% female	• Severe pneumonia (including death) (non-covid patients) • Mortality (all patients)	28 days	• Area under the ROC curve	High RoB, High concerns about applicability
Tajarernmuang 2023 Prospective cohort	Thailand	N=260 Mean age: 70.84 (SD16.82) 34.23% male	• Severe pneumonia (including death)	72 hours	• Area under the ROC curve	Low RoB, Moderate concerns about applicability
NEWS studies						

Study details	Location	Population	Outcomes	Follow up	Analyses	Quality/Risk of bias (RoB)
Bastidas Goyes 2023 Retrospective cohort	Colombia	N=1651 Mean age:69.7 (SD:20.12) 40.1% female	• Mortality	30 days	• Area under the ROC curve	High RoB, High concerns about applicability
Grudzinska 2019 Retrospective cohort	UK	N=1534 Median age: 76 (IQR:63-85) 49% female	• Mortality • ICU admission • duration of hospitalisation	• 30 days • 90 days • 1 year	• Area under the ROC curve	High RoB, Moderate concerns about applicability
Kakehi 2023 Retrospective cohort	Japan	N=282 Mean age:85.3 (SD:7.9) 54.3% female	• Mortality • duration of hospitalisation	30 days	• Area under the ROC curve • Adjusted hazard ratios: 1. Adjusted for age 2. Adjusted for age, BMI, chronic kidney disease, neoplastic disease, level of care, albumin, urea nitrogen	Moderate RoB, High concerns about applicability
Kaya 2020 Prospective cohort	Turkiye	N=250 Median age:76 (IQR: 56-96) 41.6% female	• Mortality • hospital admission • ICU admission	30 days	• Area under the ROC curve	Low RoB, Moderate concerns about applicability
Lv 2021 Retrospective cohort	China	N=1044 Mean age:79.79 (SD:7.68) 44.6% female	• Mortality • ICU admission	28 days	• Area under the ROC curve	Moderate RoB, High concerns about applicability
Reddy 2024	India	N= 100	• Mortality	30 days	• Area under the ROC curve	Low RoB,

Study details	Location	Population	Outcomes	Follow up	Analyses	Quality/Risk of bias (RoB)
Cross-sectional		Mean age:56 (SD:15) 38% female	• ICU admission			High concerns about applicability
Sbiti-Rohr 2016 Retrospective cohort from an RCT	Switzerland	N= 925 Median age: 73 (IQR:59-82) 58.8% male	• Mortality • ICU admission • Hospital readmission	• 30 days, • 180 days • 6 years.	• Area under the ROC curve • Adjusted odds ratios: 1. Adjusted for age and gender 2. Adjusted for age, gender and comorbidities	Moderate ROB Moderate concerns about applicability
Tuta-Quintero 2024 Retrospective cohort	Colombia	N=3688 Mean age:63.5 (SD:21.39) 40.7% female	• Mortality	• 3 months • 12 months	• Area under the ROC curve	High RoB, High concerns about applicability
Zan 2022 Retrospective cohort	China	N=304 Nonagenarians Mean age:95.2 (SD:2.4) 32.6% female	• Mortality	30 days	• Area under the ROC curve	High RoB, High concerns about applicability

See appendix D for full evidence tables

1.1.6 Summary of the prognostic evidence

1.1.6.1 Area under the ROC curve evidence

Table 5 AUC data summary for mortality at <=30 days

Study	AUC (95% confidence intervals)	Interpretation	Quality
NEWS2			
Durantez-Fernandez 2022	0.834 (0.782 - 0.886)	A very good test	Very low[1]
Kumari 2024	0.725 (0.632 - 0.818)	A moderately good test	Very low[2]
Muller-Plathe 2024	0.741 (0.574 - 0.858)	A moderately good test	Very low[3]
NEWS			
Bastidas Goyes 2023	0.68 (0.65 - 0.72)	A poor test	Very low[4]
Kakehi 2023	0.73 (0.64 - 0.82)	A moderately good test	Very low[5]
Kaya 2020	0.91 (0.809 - 0.943)	A very good test	Low[6]
Lv 2021	0.892 (0.821 - 0.866)	A very good test	Very low[7]
Reddy 2024	0.973 (0.946 - 1)	An excellent test	Very low[8]
Sbiti-Rohr 2016	0.65 (0.58 - 0.72)	A poor test	Very low[9]
Zan 2022	0.509 (0.44 - 0.58)	A very poor test	Very low[10]

1 Downgraded 3 times due to serious concerns about risk of bias, inconsistency and indirectness
2 Downgraded 3 times due to serious concerns about inconsistency and very serious concerns about indirectness and imprecision
3 Downgraded 3 times due to serious concerns about inconsistency and very serious concerns about risk of bias, indirectness and imprecision
4 Downgraded 3 times due to serious concerns about inconsistency and very serious concerns about risk of bias and indirectness
5 Downgraded 3 times due to serious concerns about inconsistency and risk of bias and very serious concerns about indirectness and imprecision
6 Downgraded 2 times due to serious concerns about inconsistency and indirectness
7 Downgraded 3 times due to serious concerns about inconsistency and risk of bias and very serious concerns about indirectness
8 Downgraded 3 times due to serious concerns about inconsistency and imprecision and very serious concerns about indirectness
9 Downgraded 3 times due to serious concerns about inconsistency, risk of bias, indirectness and imprecision
10 Downgraded 3 times due to serious concerns about inconsistency and very serious concerns about risk of bias and indirectness

Table 6 AUC data summary for mortality at >30 days <1 year

Study	AUC (95% confidence intervals)	Interpretation	Quality
NEWS			
Sbiti-Rohr 2016	0.62 (0.57 - 0.67)	A poor test	Very low[1]
Tuta-Quintero 2024	0.61 (0.56 - 0.66)	A poor test	Very low[2]

1 Downgraded 3 times due to serious concerns about inconsistency risk of bias and indirectness
2 Downgraded 3 times due to serious concerns about inconsistency and very serious concerns about risk of bias and indirectness

Table 7 AUC data summary for mortality >= 1 year

Study	AUC (95% confidence intervals)	Interpretation	Quality
NEWS			
Sbiti-Rohr 2016	0.6 (0.57 - 0.64)	A very poor test	Very low[1]
Tuta-Quintero 2024	0.58 (0.55 - 0.61)	A very poor test	Very low[2]

1 Downgraded 3 times due to serious concerns about inconsistency risk of bias and indirectness
2 Downgraded 3 times due to serious concerns about inconsistency and very serious concerns about risk of bias and indirectness

Table 8 AUC data summary for admission to hospital

Study	AUC (95% confidence intervals)	Interpretation	Quality
NEWS			
Kaya 2020	0.71 (0.655 - 0.771)	A moderately good test	Low[1]

1 Downgraded 2 times due to serious concerns about inconsistency and indirectness

Table 9 AUC data summary for admission to ICU

Study	AUC (95% confidence intervals)	Interpretation	Quality
NEWS			
Kaya 2020	0.86 (0.812 - 0.901)	A very good test	Low[1]
Lv 2021	0.976 (0.964 - 0.984)	An excellent test	Very low[2]
Reddy 2024	0.967 (0.934 – 1)	An excellent test	Very low[3]
Sbiti-Rohr 2016	0.73 (0.67 - 0.78)	A moderately good test	Very low[4]

1 Downgraded 2 times due to serious concerns about inconsistency and indirectness
2 Downgraded 3 times due to serious concerns about inconsistency and risk of bias and very serious concerns about indirectness
3 Downgraded 3 times due to serious concerns about inconsistency and imprecision and very serious concerns about indirectness
4 Downgraded 3 times due to serious concerns about inconsistency, risk of bias and indirectness

Table 10 AUC data summary for readmission to hospital

Study	AUC (95% confidence intervals)	Interpretation	Quality
NEWS			
Sbiti-Rohr 2016	0.58 (0.49 - 0.66)	A very poor test	Very low[1]

1 Downgraded 3 times due to serious concerns about inconsistency, risk of bias, indirectness and imprecision

Table 11 AUC data summary for severe disease composite outcome

Study	AUC (95% confidence intervals)	Interpretation	Quality
NEWS2			
Muller-Plathe 2024	0.79 (0.684 - 0.867)	A moderately good test	Very low[1]
Tajarernmuang 2023	0.61 (0.52 - 0.7)	A poor test	Very low[2]

1 Downgraded 3 times due to serious concerns about inconsistency and very serious concerns about risk of bias, indirectness and imprecision
2 Downgraded 3 times due to serious concerns about inconsistency and indirectness and very serious concerns about imprecision

1.1.6.2 Adjusted odds ratios evidence from Sbiti-Rohr 2016

Table 12 Adjusted odds ratios summary

Outcome	Model	OR (95% confidence intervals)	Quality
NEWS			
Mortality <=30 days	Adjusted for age and gender	1.15 (1.05 - 1.25)	Very low[1]
	Adjusted for age, gender and comorbidities	1.1 (1.01 - 1.21)	Very low[2]
Mortality >30 days <1 year	Adjusted for age and gender	1.11 (1.04 - 1.18)	Very low[2]
	Adjusted for age, gender and comorbidities	1.07 (1 - 1.15)	Very low[2]
Mortality >= 1 year	Adjusted for age and gender	1.1 (1.05 - 1.16)	Very low[2]
	Adjusted for age, gender and comorbidities	1.08 (1.02 - 1.13)	Very low[2]
ICU admission	Adjusted for age and gender	1.3 (1.2 - 1.4)	Very low[1]
	Adjusted for age, gender and comorbidities	1.27 (1.18 - 1.37)	Very low[1]
Readmission to hospital	Adjusted for age and gender	1.08 (0.98 - 1.2)	Very low[2]
	Adjusted for age, gender and comorbidities	1.07 (0.97 - 1.18)	Very low[2]

1 Downgraded 3 times due to serious concerns about inconsistency, risk of bias, indirectness and imprecision
2 Downgraded 3 times due to serious concerns about inconsistency, risk of bias and indirectness

1.1.6.3 Adjusted hazard ratios evidence from Kakehi 2023

Table 13 Adjusted hazard ratios summary

Outcome	NEWS category	Model	HR (95% confidence intervals)	Quality
NEWS				
	Medium	Adjusted for age	4.99 (0.58 - 42.77)	Very low[1]

Outcome	NEWS category	Model	HR (95% confidence intervals)	Quality
Mortality <=30 days		Adjusted for age, BMI, chronic kidney disease, neoplastic disease, level of care, albumin, urea nitrogen	5.69 (0.66 - 49.14)	Very low[1]
	High	Adjusted for age	8.87 (1.19 - 66.2)	Very low[1]
		Adjusted for age, BMI, chronic kidney disease, neoplastic disease, level of care, albumin, urea nitrogen	8.69 (1.17 - 64.81)	Very low[1]

1 Downgraded 3 times due to serious concerns about inconsistency and risk of bias and very serious concerns about indirectness and imprecision

1.1.6.4 Evidence statements on duration of hospital stay

Three studies reported evidence on the duration of hospital stay by NEWS category.

- Grudzinska 2019, a retrospective cohort study of 1534 CAP patients, found that higher NEWS scores were associated with an increased length of hospital stay. Patients with low NEWS scores (1-4) had a median hospital stay of 6 days with an IQR of 3-12. Patients with medium NEWS scores (5-6 or ≥3 in a single category) had a median hospital stay of 7 days with an IQR of 4-16. Patients with high NEWS scores (≥7) had a median hospital stay of 8 days with an IQR of 4-14.8.
- Sbiti-Rohr 2016, a retrospective cohort study of 925 CAP patients, found that higher NEWS scores were associated with an increased length of hospital stay. Patients with low NEWS scores (1-4) had a median hospital stay of 6 days with an IQR of 3-10. Patients with medium NEWS scores (5-6 or ≥3 in a single category) had a median hospital stay of 8 days with an IQR of 6-12. Patients with high NEWS scores (≥7) had a median hospital stay of 10 days with an IQR of 5-14.5.
- Kakehi 2023, a retrospective cohort study of 282 older adults with CAP, found that higher NEWS scores were associated with an increased length of hospital stay. Patients with low NEWS scores (1-4) had a mean hospital stay of 21.2 days with a standard deviation of 18.2. Patients with medium NEWS scores (5-6 or ≥3 in a single category) had a mean hospital stay of 26.7 days with a standard deviation of 17.8. Patients with high NEWS scores (≥7) had a mean hospital stay of 27.9 days with a standard deviation of 21.1.

1.1.7 Economic evidence

A single search was performed to identify published economic evaluations of relevance to any of the questions in this guideline update. See Appendix B for the search strategy.

This search retrieved 3,201 studies. Based on title and abstract screening, 3,168 of the studies could confidently be excluded for this question. Thirty-three studies were excluded following the full-text review. See Appendix G for the study selection process.

1.1.7.2 Excluded studies

See Appendix J for a list of excluded studies, with reasons for exclusions.

1.1.8 Summary of included economic evidence

No health economic studies were included.

1.1.9 Economic model

No original health economic modelling was done for this review question.

1.1.12 The committee's discussion and interpretation of the evidence

1.1.12.1. The outcomes that matter most

The committee agreed that mortality at <=30 days was a key outcome, however there was no clear finding that could be interpreted from the evidence for it. The committee felt that admission to hospital or to ICU was least informative as whether a patient is admitted to these settings is more reflective of clinical judgement, standard practices and resources availability of the hospitals the studies took place in rather than a direct outcome of their pneumonia. This was particularly an issue for the 7 studies conducted in non-OECD countries where the circumstances and decisions made are often very different to the UK.

1.1.12.2 The quality of the evidence

Overall, the evidence was very poor quality and inconsistent, which made it difficult for the committee to draw conclusions from. There was no evidence available on PEWS for babies, children, and young people. For adults, the direct evidence of NEWS2 comprised 4 studies which reported only two AUC outcomes, all of which were rated as very low quality. These studies also had drawbacks that made them difficult to apply to a UK context: Durantez-Fernandez 2022 limited their sample to only patients who were considered to be high priority cases at triage; Kumari 2024 included younger people from age 12 rather than just adults and did not follow up after they left hospital; and Muller-Plathe 2024 used a sample of patients who had previously undergone a kidney transplant, some of whom had Covid-19.

Following the methods used by the NICE Sepsis guideline, the committee also looked at indirect evidence from studies of NEWS which could be extrapolated to the updated NEWS2 tool to supplement the evidence base. While the 9 studies of NEWS provided a much larger quantity of evidence, the quality remained poor. All evidence to which GRADE was applied were rated as very low quality, except for the two outcomes reported by Kaya 2020 which were low quality. Mortality at <= 30 days was particularly difficult to draw conclusions from as the AUC data reported by 10 studies (of both NEWS and NEWS2) spanned the full range of interpretation categories, from very poor at 0.509, which is close to chance level, to excellent at 0.973 which is approaching perfection. The committee further discussed this and expressed that the evidence was not sufficient and was inconsistent, making it difficult to base their decisions on. They chose not to make any recommendation on NEWS2 for adults.

1.1.12.3 Benefits and harms

Lay members highlighted concerns around the use of NEWS2 relating to it not always being a good indicator of severity when a patient has comorbidities or complex circumstances. Frailty is an important consideration when assessing risk for older people, in conjunction with the parameters that NEWS2 assesses. For people with chronic illness, their condition at baseline may produce a NEWS2 score that would indicate an emergency in a healthy person. Therefore, it could not function as a rule for determining the level of hospital care in these cases.

The committee noted the lack of evidence for babies, children and young people. They were concerned that the guideline would be out of alignment with current practice if they did not address PEWS and acknowledge its use, as there is no established alternative to PEWS at present. The committee concluded that while a recommendation on PEWS would be useful, there is not a strong enough basis for them to make one at present. They noted there is currently a review of PEWS being conducted by the RCPCH, with the expectation that it will become implemented nationally by NHS England within the next few years: UK Paediatric Early Warning Systems (PEWS) | RCPCH UK Paediatric Early Warning Systems (PEWS) | RCPCH. This may provide a basis for a future recommendation.

The committee also noted that decisions about the assessment, microbiological testing, treatment and management of pneumonia are often based on the stratification of patients by severity, and while well-established processes for this exist for patients with CAP (e.g. CURB-65), there is not an equivalent for HAP. They agreed that further research is needed to externally validate existing models for HAP, or to identify or develop novel methods for stratifying patients by HAP severity. Therefore, they made a recommendation for research in this area.

1.1.12.4 Cost effectiveness and resource use

There was no existing health economic evidence for this review question. The committee felt that the there was no evidence to change the recommendations from the current version in the guideline. As there is no change there will not be a resource impact.

1.1.12.5 Other factors the committee took into account

Mortality at <=30 days was a key outcome and was the outcome with the most evidence available. However, the committee also felt that as CURB65 is a pneumonia specific tool that was established on the basis of its predictive value for mortality, NEWS2 is unlikely to surpass CURB65's usefulness in this area, so would not consider recommending it specifically for use in those with pneumonia. They were instead happy to retain existing recommendations that include clinical judgement and CURB65 scores.
While the committee were unable to recommend NEWS2 directly from the evidence available in pneumonia patients, they were also aware that NEWS2 is used in practice to identify patient deterioration. They noted that it had been recommended in the latest update of the NICE Sepsis guideline. Some clinicians found it beneficial to have a score to indicate when a patient's condition is deteriorating and to evidence their assessment of this, but felt that this

wasn't sufficient to recommend NEWS2 for stratifying patients into levels of care for those with pneumonia and were more likely to use CURB65 because it is pneumonia-specific.

1.1.13 Recommendations supported by this evidence review

No recommendations

1.1.14 References – included studies

1.1.14.1 Prognostic

Durantez-Fernández, C Martín-Conty, JL Polonio-López, B Villamor, MAC Maestre-Miquel, C Viñuela, A López-Izquierdo, R Mordillo-Mateos, L Méndez, FF Soto, CJ Martín-Rodríguez, F (2022) Lactate improves the predictive ability of the National Early Warning Score 2 in the emergency department. AUSTRALIAN CRITICAL CARE 35(6): 677 - 683

Goyes, AB Aponte, C Acosta, D Da Silva, EAB Quintero, ET Gómez, C Flórez, FM Rodríguez, S Alvarez, D Hernández, E Ramírez, L Riveros, P Alvarez, D Forero, J Gutiérrez, F Moscote, A Oke, G (2023) Comparison of the Performance of the CURB-65, A-DROP, and NEWS Scores for the Prediction of Clinical Outcomes in Pneumonia. INFECTIOUS DISEASES IN CLINICAL PRACTICE 31(3)

Grudzinska, Frances S, Aldridge, Kerrie, Hughes, Sian et al. (2019) Early identification of severe community-acquired pneumonia: a retrospective observational study. BMJ open respiratory research 6(1): e000438

Kakehi, Eiichi, Uehira, Ryo, Ohara, Nobuaki et al. (2023) Utility of the New Early Warning Score (NEWS) in combination with the neutrophil-lymphocyte ratio for the prediction of prognosis in older patients with pneumonia. Family medicine and community health 11(2)

Kaya, Aynur Ecevit, Ozkan, Seda, Usul, Eren et al. (2020) Comparison of pneumonia severity scores for patients diagnosed with pneumonia in emergency department. The Indian journal of medical research 152(4): 368-377

Kumari, Neelam, Saifullah, Nausheen, Jafri, Saira et al. (2024) Comparison of NEWS2 and PSI as mortality predictors in patients with community acquired pneumonia. JPMA. The Journal of the Pakistan Medical Association 74(6): 1156-1159

Lv, Chunxin, Chen, Yue, Shi, Wen et al. (2021) Comparison of Different Scoring Systems for Prediction of Mortality and ICU Admission in Elderly CAP Population. Clinical interventions in aging 16: 1917-1929

Muller-Plathe, Moritz, Osmanodja, Bilgin, Barthel, Georg et al. (2024) Validation of risk scores for prediction of severe pneumonia in kidney transplant recipients hospitalized with community-acquired pneumonia. Infection 52(2): 447-459

Reddy, D.V.P., Vijayakumari, V., Kumar, R.S. et al. (2024) Comparison of Pneumonia-specific Scores, Sepsis Score and Generic Score in Predicting the Severity of Community-acquired Pneumonia: A Cross-sectional Study. Journal of Clinical and Diagnostic Research 18(4): oc15-oc19

Sbiti-Rohr, Diana, Kutz, Alexander, Christ-Crain, Mirjam et al. (2016) The National Early Warning Score (NEWS) for outcome prediction in emergency department patients with community-acquired pneumonia: results from a 6-year prospective cohort study. BMJ open 6(9): e011021

Tajarernmuang, Pattraporn, Sanwirat, Pimchanok, Inchai, Juthamas et al. (2023) The National Early Warning Score 2(NEWS2) to Predict Early Progression to Severe Community-Acquired Pneumonia. Tropical medicine and infectious disease 8(2)

Tuta-Quintero, Eduardo, Bastidas, Alirio R, Guerron-Gomez, Gabriela et al. (2024) Performance of risk scores in predicting mortality at 3, 6, and 12 months in patients diagnosed with community-acquired pneumonia. BMC pulmonary medicine 24(1): 334

Zan, Yumin, Song, Weiwei, Wang, Yu et al. (2022) Nomogram for predicting in-hospital mortality of nonagenarians with community-acquired pneumonia. Geriatrics & gerontology international 22(8): 635-641

1.1.14.2 Economic

No economic studies were included.

Appendices

Appendix A – Review protocols

Review protocol for RQ2.2: In people with confirmed community-acquired pneumonia (presenting to an emergency care setting) what is the accuracy and cost-effective outcome prediction of NEWS2 or PEWS, to support decisions making for patients at first presentation according to who would be suitable for a particular care pathway

Review question	In people with confirmed community-acquired pneumonia (presenting to an emergency care setting) what is the accuracy of NEWS2 or PEWS and the risk of mortality or severe illness or differing levels of illness to support the consideration of the most appropriate care setting for these patients?
Objective	To evaluate the prognostic accuracy of NEWS2 and PEWS tools for determining which people with pneumonia presenting to emergency care are suitable for particular care pathways for example: - discharge to general practice - referral to virtual wards/hospital at home. - admission to hospital (general ward) - admission acute respiratory support unit - admission to ICU
Searches	**Overall approach** The searches will comprise the following elements: • a combined search for cost effectiveness evidence covering all review questions in this guideline.

	• a combined search for systematic reviews covering all review questions in this guideline. • searches for evidence specific to this review question. **Searches for cost effectiveness evidence** A combined search will be undertaken to cover the cost effectiveness aspects of all the review questions in a single search. The following databases will be searched for the cost effectiveness evidence: • Econlit via Ovid • Embase via Ovid • International HTA database via INAHTA website • MEDLINE ALL via Ovid The sensitive version of the validated NICE cost utility filter will be applied to the MEDLINE and Embase search strategies (Hubbard et al., 2022 [doi: 10.1186/s12874-022-01796-2]). Searches for cost effectiveness evidence will be limited to 2014-current (the searches for NICE guideline CG191 were completed in March 2014). The MEDLINE and Embase searches will be limited to evidence from Organisation for Economic Co-operation and Development (OECD) member states using the validated NICE filter (Ayiku et al., 2021 [doi: 10.5195/jmla.2021.1224]). **Combined search for systematic reviews**

	The search for systematic reviews relating to all review questions in this guideline will cover reviews published since the searches for NICE guideline CG191 were completed in March 2014. The sources for this will be: • Cochrane Database of Systematic Reviews (CDSR) via Wiley • Epistemonikos via https://www.epistemonikos.org/ This is the standard NICE practice agreed by the Guidelines Methods Group in September 2022 for identifying systematic reviews for routine guideline searches. **Searches specific to this review question** The searches for evidence specific to this review question will use the following databases: • Cochrane Central Register of Controlled Trials (CENTRAL) via Wiley • Embase via Ovid • MEDLINE ALL via Ovid The principal search strategy will be developed in MEDLINE and then adapted, as appropriate, for use in the other sources listed, taking into account their size, search functionality and subject coverage. To ensure records potentially relevant to the parameters set out in sections 6-10 below are not missed the following will be checked as required: • The reference lists of any appropriate studies identified from the combined systematic reviews search covering all questions in this guideline. • Later citations of any key trials, reviews or protocols identified in the combined systematic reviews search,

	scoping searches for this guideline, evidence reviews for previous NICE guidelines or the searches specific to this review question. The guideline committee or other stakeholders could also be asked if they are aware of any other potentially relevant studies that could be considered. The searches will not include any date limits. **Managing all search results** Database functionality will be used, where available, to exclude from all searches: • Animal studies • Editorials, letters, news items and commentaries • Conference abstracts and posters • Registry entries for ongoing clinical trials or those that contain no results • Theses and dissertations • Papers not published in the English language. With the agreement of the guideline committee, the searches will be re-run 6-8 weeks before final submission of the review and further studies retrieved for inclusion. The information services team at NICE will quality assure the principal search strategy and peer review the other strategies. Any revisions or additional steps will be agreed by the review team before being implemented. The full search strategies for all databases will be published in the final review.
Condition or domain being studied	Community-acquired pneumonia

Population	People with confirmed community acquired pneumonia presenting to emergency departments, or other emergency care setting. Inclusion: Babies over 28 days (corrected gestational age), children, young people (age <18 years) and adults (≥18 years) with confirmed community-acquired pneumonia presenting to an emergency department or other emergency care setting. • CAP is defined as pneumonia that is acquired outside hospital Exclusion: • Babies up to and including 28 days (corrected gestational age). • People with hospital-acquired pneumonia. • People with COVID-19 pneumonia. • People who acquire pneumonia while intubated (ventilator-associated pneumonia). • People who are severely immune-compromised (have a primary immune deficiency or secondary immune deficiency related to HIV infection, or severe drug or systemic disease-induced immunosuppression, for example, people who have taken immunosuppressant cancer therapy or undergone organ transplantation). • People in whom pneumonia is an expected terminal event. • People with non-pneumonic infective exacerbations of bronchiectasis. • People with non-pneumonic infective exacerbations of chronic obstructive pulmonary disease.

	• People with pneumonia associated with cystic fibrosis. • People with aspiration pneumonia as a result of inhaling a large bolus of gastric contents.
Prognostic tools of interest	For adults: - NEWS2 (will include studies that use NEWS if there are insufficient papers using NEWS2) As the evidence base for NEWS2 tool is expected to be small, studies on NEWS tool will also be included as indirect evidence (these studies will be downgraded for indirectness in the GRADE analysis). For children: - PEWS
Outcomes to be predicted	• Mortality • Admission to hospital • Admission to ICU • Admission to acute respiratory unit • Use of NIV or high flow oxygen • Length of stay (in any of the above settings) • Hospital re-attendance with CAP (as a marker of failure of original decision) Discrimination measures: • Concordance (C) statistic, area under the curve (AUC) with 95% confidence interval Calibration measures: • number of observed (O) and expected (E) events • total O:E ratio • calibration slope Where reported the following measures: • adjusted hazard ratios (HR), adjusted odds ratios (OR) or adjusted risk ratios (RR).

Types of study to be included	• Prospective or retrospective observational cohorts or cross-sectional studies which evaluate the performance of the risk prediction tools. These studies should include a multivariate analysis which accounts for key confounders. Key confounders will vary based on each risk factor but should at least include age and sex. • External validation studies • Systematic reviews of the above study types Case-control studies, derivation studies, and internal validation studies will be excluded.
Other exclusion criteria	None
Context	
Secondary outcomes (important outcomes)	None
Data extraction (selection and coding)	All references identified by the searches and from other sources will be uploaded into EPPI reviewer and de-duplicated. 10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer. The full text of potentially eligible studies will be retrieved and will be assessed in line with the criteria outlined above. Any disagreements will be resolved by discussion with other members of the technical review team. A standardised form will be used to extract data from studies (see Developing NICE guidelines: the manual section 6.4). Study investigators may be contacted for missing data where time and resources allow.

	The priority screening functionality within the EPPI-reviewer software will not be used for this review.
Risk of bias (quality) assessment	Risk of bias will be assessed using the appropriate checklist as described in Developing NICE guidelines: the manual. These may include: - Risk of Bias in Systematic Reviews (ROBIS) for systematic reviews: - PROBAST for risk prediction modelling for a prognosis
Strategy for data synthesis	**Approach to meta-analysis** Where appropriate, C statistic data and O:E ratios will be meta-analysed (separately) using Cochrane Review Manager (RevMan5). Summary statistics will be reported from the meta-analyses with their 95% confidence intervals in forests plots and adapted GRADE tables. For the ROC data, the thresholds for indicating whether a test has good discrimination will be as follows: >0.50 - 0.60 indicates a very poor test >0.61-0.70 indicates a poor test >0.71- 0.80 indicates a moderate test >0.81 to 0.92 indicates a very good test and >0.92 to 1.00 indicates an excellent test Where appropriate, hazard ratios will be pooled using the generic inverse-variance method. Adjusted odds ratios, hazard ratios and risk ratios from multivariate models will only be pooled if the same set of factors are used across multiple studies and if the same thresholds to measure factors were used across studies.

	Where data can be disambiguated it will be separated into the subgroups identified in section 17 (below). Pooled relative risks will be calculated for dichotomous outcomes (using the Mantel–Haenszel method) reporting numbers of people having an event. Absolute risks will be presented where possible. Fixed- and random-effects models (der Simonian and Laird) will be fitted for all outcomes, with the presented analysis dependent on the degree of heterogeneity in the assembled evidence. Fixed-effects models will be deemed to be inappropriate if one or both of the following conditions is met: - Significant between study heterogeneity in methodology, population, intervention or comparator was identified by the reviewer in advance of data analysis. - The presence of significant statistical heterogeneity in the meta-analysis, defined as $I^2 \geq 50\%$. Random effects meta-analysis will be used when the I^2 is 50% or greater. **Approach to GRADE** A modified approach will be applied using the GRADE framework. Evidence from cohorts will initially be rated as high-quality, and then assessed according to the same criteria as described in the standard GRADE criteria (risk of bias, inconsistency, imprecision and indirectness).
Analysis of sub-groups	The following groups will be considered separately if data are available:

	• Age: 0-1; 1-5; 5-18; Adults, or other age groups defined by the studies
Type and method of review	☐ Intervention ☐ Diagnostic ☒ Prognostic ☐ Qualitative ☐ Epidemiologic ☐ Service Delivery ☐ Other (please specify)

Appendix B – Literature search strategies

Background and development

Overall approach

Each evidence review for this guideline has a search conducted in three parts:

- Part 1: Systematic review searches

A single search for all systematic reviews relating to pneumonia published from 2014-current was done separately in November 2023 and re-run in October 2024. The results were screened for relevance to all the review questions. The potentially relevant results from this search were also used to create the seed references for reference list checking and forward citation searching for the prognostic evidence searches.

- Part 2: Prognostic evidence searches

This search was developed separately and tailored to each evidence review. The search was completed on 19 September 2024.

- Part 3: Cost effectiveness searches

A single search covering the cost effectiveness elements of all review questions was done separately in November 2023 and re-run in October 2024. This was a top-level search for all cost utility studies published from 2014-current.

Search design and peer review

A NICE Senior Information Specialist (SIS) conducted the literature searches for each part.

This search report is based on the requirements of the PRISMA Statement for Reporting Literature Searches in Systematic Reviews (for further details see: Rethlefsen M et al. PRISMA-S. *Systematic Reviews*, 10(1), 39).

The MEDLINE strategies below were quality assured (QA) by a trained NICE SIS. The principal search strategies were developed in MEDLINE (Ovid interface) and adapted, as appropriate, for use in the other sources listed in the protocol, taking into account their size, search functionality and subject coverage. All translated search strategies were peer reviewed by another SIS to ensure their accuracy. The QA procedures were adapted from the Peer Review of Electronic Search Strategies Guideline Statement (for further details see: McGowan J et al. PRESS 2015 Guideline Statement. *Journal of Clinical Epidemiology*, 75, 40-46).

Review management

All search results were managed in EPPI-Reviewer v5. Duplicates were removed in EPPI-R5 using a two-step process. First, automated deduplication is performed using a high-value algorithm. Second, manual deduplication is used to assess ‘low-probability’ matches. All decisions made for the review can be accessed via the deduplication history.

Search limits, restrictions and filters

Formats

Limits were applied in adherence to standard NICE practice (as set out in the Identifying the evidence chapter of the manual) and the eligibility criteria listed in the review protocol to exclude:

- Animal studies
- Case reports
- Conference abstracts and posters
- Editorials, letters, news items and commentaries
- References not published in the English language
- Registry entries for ongoing clinical trials or those that contain no results
- Theses and dissertations.

The limit to remove animal studies in the searches was the standard NICE practice, which has been adapted from:

> Dickersin K, Scherer R & Lefebvre C. (1994) Systematic Reviews: Identifying relevant studies for systematic reviews. *BMJ*, 309(6964), 1286.

OECD countries

For the Cost Effectiveness (Part 3) searches, the validated NICE OECD filters were used in MEDLINE and Embase to remove records exclusively set in countries that are not members of the Organisation for Economic Co-operation and Development (OECD), in line with the search protocol. The filters were used without amendment. The filters are not available for the other databases used. The OECD filter was not applied to the Systematic Review (Part 1) or Effectiveness (Part 2) searches.

> Ayiku L et al. (2021) The NICE OECD countries' geographic search filters: Part 2 - Validation of the MEDLINE and Embase (Ovid) filters. *Journal of the Medical Library Association*, 109(4), 583–589.

Date limits

A date limit of 2014-current was applied to the Systematic Review (Part 1) and Cost Effectiveness (Part 3) searches. This date limit was used because the searches for NICE CG191 Pneumonia in adults: diagnosis and management (published in December 2014) were last run on 17 March 2014.

No date limits were applied to the Effectiveness searches (Part 2).

Study-type filters

The Systematic Review (Part 1) searches had no filters, as the content for CDSR and Epistemonikos is pre-filtered.

The searches for Effectiveness (Part 2) had no filters, as these prediction tools had not been considered previously.

Cost effectiveness searches

In line with the protocol, the validated NICE Cost Utility Filter was used in the MEDLINE and Embase searches for Cost Effectiveness (Part 3). The sensitive version of the filter was selected and it was used without amendment. Subject coverage in the Econlit, International HTA Database and NHS EED databases is already pre-specified and so it is not appropriate to apply filters in them.

Hubbard W et al. (2022) Development and validation of paired MEDLINE and Embase search filters for cost-utility studies. *BMC Medical Research Methodology*, 22(1), 310.

Key decisions

Part 1: Systematic review searches

This search was conducted according to the standard NICE practice since the "Proposal to limit systematic review (SR) searching for routine guideline searches" was accepted by the NICE Guideline Methods Group (GMG) in September 2022. This process means that only sources which aggregate systematic reviews are searched in addition to the Cochrane Database of Systematic Reviews. The methods used to aggregate reviews for Epistemonikos are sufficiently sensitive with higher precision (Rada et al., 2020) compared to using standard Boolean search filters in general medical databases (Lee et al., 2012). Testing during scoping showed that other aggregators of systematic reviews, such as the Campbell Collaboration, Dopher and Health Evidence, would not be relevant for inclusion in this protocol.

Lee E. et al. (2012) An optimal search filter for retrieving systematic reviews and meta-analyses. *BMC Medical Research Methodology,* 12(1), 51.

Rada G et al. (2020) Epistemonikos: a comprehensive database of systematic reviews for health decision-making. *BMC Medical Research Methodology*, 20, 286.

Parts 1-3: Pneumonia terms

The same set of pneumonia terms was developed in November 2023 to use in all evidence reviews for this guideline. These terms aimed to cover all the included populations named in the final scope (section 3.1), namely babies over 28 days (corrected gestational age), children, young people and adults with suspected or diagnosed community-acquired or hospital acquired pneumonia.

A set containing 183 items was created to test the comprehensiveness of the searches. The 183 records were derived from the papers included in CG191 and the papers included in the 10 most recent Cochrane reviews about pneumonia.

The search terms built on the search strategies developed for NICE CG191 Pneumonia in adults and two antibiotic prescribing guidelines (NG138 and NG139).

The CG191 searches had a line to NOT out the MeSH term "pneumonia, ventilator-associated". This was not retained in the search as it was inadvertently excluding relevant

papers that discussed several types of pneumonia (e.g. see PMIDs 29722052 or 32822880 or 28655326 or 34823043).

The CG191 searches truncated the free text to pneumoni* but this was amended following clinical advice that pneumonia is a form of pneumonitis but not all pneumonitis is pneumonia.

The CG191 searches had an additional line describing chest infection. It was not necessary to retain this line in order to retrieve any of the 183 items in the test set and so it was removed, which reduced the population search by around 41,000 results in MEDLINE.

The previous strategies could not be used directly because of changes to Medical Subject Headings (MeSH) since 2019. Using the previous searches would now retrieve all MEDLINE results about COVID-19, as well as pneumonia. It is now necessary to choose individual MeSH headings from the hierarchy. The choice of headings was made in conjunction with the technical team in the scoping searches in October 2023. Headings for Aspiration, Lipid, Enzootic and Swine Pneumonia, as well as Pneumocystis and COVID-19 were not included. This approach reduced the number of results with just the population terms from 340,000 with the CG191 approach to 124,000. None of the test set were lost by adopting this approach.

Seven options were then tested to optimise the precision of the pneumonia free-text terms. The options tested the feasibility of excluding free-text terms for aspects known to be out of scope (such as COVID-19 or ventilator-associated pneumonia). None of the options made a sufficient difference to the volume to justify making the strategies much more complicated and risk missing relevant papers (the most plausible option only reduced the entire pneumonia literature from 227,500 to 225,900 results). The option to add further free text to define the relevant types of pneumonia (such as bacterial pneumonia) was rejected as it risked missing relevant papers because some abstracts just referred to treating pneumonia, without specifying which type or subtype it was.

At the committee meeting GCOMM1 on 20 December 2023 feedback was received from the committee that rickettsial and cryptogenic organizing pneumonia were not relevant to the UK context and could safely be removed from the search strategies. These terms feature in the Part 1 systematic review and Part 3 cost effectiveness searches as these were completed before the meeting (and were retained in the re-runs for consistency).

The same approach to subject headings was applied in Embase, although the COVID-19 headings are not part of the pneumonia hierarchy in Emtree. The following headings from the pneumonia hierarchy were not chosen: Acute chest syndrome, Acute lupus pneumonitis, Allergic pneumonitis, Aspiration pneumonia, Chemical pneumonitis, Enzootic pneumonia, Eosinophilic pneumonia, Loeffler pneumonia, Experimental pneumonia, Lung infiltrate, Pneumonic effusion, Radiation pneumonia, Parasitic pneumonia, Pneumocystis pneumonia, Pulmonary candidiasis, Pulmonary toxoplasmosis, Legionnaire disease, Pulmonary actinomycosis, Ventilator associated pneumonia, Ventilator associated bacterial pneumonia, Checkpoint inhibitor pneumonitis, and Severe acute respiratory syndrome. Searches after 20/12/23 also excluded Rickettsial pneumonia and Bronchiolitis obliterans organizing pneumonia.

The same free-text terms developed initially in MEDLINE were used in Embase.

Part 2: Prognostic evidence searches

The strategies are in the structure:

Pneumonia AND (Early Warning Scores OR NEWS OR NEWS2 OR MEWS OR PEWS) AND Limits

It was feasible to screen all of the results and so it was not necessary to include search terms to define the emergency care setting or to add study-type filters. There were some false hits for searching for "news" but a more focussed version was tested and it missed two potentially relevant results.

Part 1: Systematic review searches

Database results

Databases	Date searched	Database platform	Database segment or version	No. of results downloaded
Cochrane Database of Systematic Reviews (CDSR)	20/11/2023	Wiley	Cochrane Database of Systematic Reviews Issue 11 of 12, November 2023	177
Epistemonikos	20/11/2023	Epistemonikos	Version available on 20/11/23	2096

Re-run results

Databases	Date searched	Database platform	Database segment or version	No. of results downloaded
Cochrane Database of Systematic Reviews (CDSR)	15/10/2024	Wiley	Cochrane Database of Systematic Reviews Issue 10 of 12, October 2024	8
Epistemonikos	15/10/2024	Epistemonikos	Version available on 15/10/2024	2571

Search strategy history

Database name: Cochrane Database of Systematic Reviews (CDSR)

Searches	
#1	[mh ^pneumonia] or [mh ^bronchopneumonia] or [mh ^pleuropneumonia] or [mh ^"pneumonia, bacterial"] or [mh ^"chlamydial pneumonia"] or [mh ^"pneumonia, mycoplasma"] or [mh ^"pneumonia, pneumococcal"] or [mh ^"pneumonia, rickettsial"] or [mh ^"pneumonia, staphylococcal"] or [mh ^"pneumonia, necrotizing"] or [mh ^"pneumonia, viral"] or [mh ^"organizing pneumonia"] or [mh ^"cryptogenic organizing pneumonia"] or [mh ^"healthcare-associated pneumonia"] 5252
#2	(pneumonia or pneumonias or bronchopneumon* or pleuropneumon*):ti,ab 15137

Searches
#3 #1 or #2 16754
#4 #1 or #2 in Cochrane Reviews 244
#5 #1 or #2 with Cochrane Library publication date Between Jan 2014 and Nov 2023, in Cochrane Reviews 177
Note: in the re-run Line #5 was changed to #1 or #2 with Cochrane Library publication date Between Nov 2023 and Oct 2024, in Cochrane Reviews.

Database name: Epistemonikos

Searches
These are the lines as they were input into the interface for the re-run:
1 title:(bronchopneumonia* OR pleuropneumonia* OR broncho-pneumonia OR pleuro-pneumonia or broncho-pneumonias OR pleuro-pneumonias OR "broncho pneumonia" OR "pleuro pneumonia" or "broncho pneumonias" OR "pleuro pneumonias")
2 abstract:(bronchopneumonia* OR pleuropneumonia* OR broncho-pneumonia OR pleuro-pneumonia or broncho-pneumonias OR pleuro-pneumonias OR "broncho pneumonia" OR "pleuro pneumonia" or "broncho pneumonias" OR "pleuro pneumonias")
3 title:(pneumonia OR pneumonias)
4 abstract:((pneumonia OR pneumonias) AND (HAP OR nosocomial* OR crossinfect* OR cross-infection OR cross-infected OR cross-infecting OR "cross infection" OR "cross infected" OR "cross infecting" or hospitalised* or hospitalized* or hospitalisation* or hospitalization*))
5 abstract:((pneumonia OR pneumonias) AND ("healthcare acquire" OR "healthcare acquired" OR "healthcare acquiring" OR "healthcare onset" OR "healthcare associate" OR "healthcare associated" OR "healthcare associating"))
6 abstract:((pneumonia OR pneumonias) AND ("health care acquire" OR "health care acquired" OR "health care acquiring" OR "health care onset" OR "health care associate" OR "health care associated" OR "health care associating"))
7 abstract:((pneumonia OR pneumonias) AND ("hospital acquire" OR "hospital acquired" OR "hospital acquiring" OR "hospital onset" OR "hospital associate" OR "hospital associated" OR "hospital associating"))
8 abstract:((pneumonia OR pneumonias) AND ("inpatient acquire" OR "inpatient acquired" OR "inpatient acquiring" OR "inpatient onset" OR "inpatient associate" OR "inpatient associated" OR "inpatient associating"))
9 abstract:((pneumonia OR pneumonias) AND (healthcare-acquire OR healthcare-acquired OR healthcare-acquiring OR healthcare-onset OR healthcare-associate OR healthcare-associated OR healthcare-associating))
10 abstract:((pneumonia OR pneumonias) AND (health-care-acquire OR health-care-acquired OR health-care-acquiring OR health-care-onset OR health-care-associate OR health-care-associated OR health-care-associating))
11 abstract:((pneumonia OR pneumonias) AND (hospital-acquire OR hospital-acquired OR hospital-acquiring OR hospital-onset OR hospital-associate OR hospital-associated OR hospital-associating))
12 abstract:((pneumonia OR pneumonias) AND (inpatient-acquire OR inpatient-acquired OR inpatient-acquiring OR inpatient-onset OR inpatient-associate OR inpatient-associated OR inpatient-associating))
13 abstract:((pneumonia OR pneumonias) AND (CAP OR community* OR communities* OR outpatient* OR nonhospital* OR "non hospital" OR non-hospital OR "non hospitalised" OR non-hospitalised OR "non hospitalized" OR non-hospitalized OR "non hospitalisation" OR non-hospitalisation OR "non hospitalization" OR non-hospitalization))

Searches
14 abstract:((pneumonia OR pneumonias) AND (bacterial* OR chlamydial* OR mycoplasma* OR pneumococcal* OR rickettsial* OR staphylococcal* OR staphylococcus* OR necrotiz* OR necrotis* OR viral* OR organizing* OR organising* OR cryptogenic* OR bilateral* OR granulomatous* OR infectious* OR interstitial* OR neonatal* OR obstructive* OR lobar* OR escherichia* OR haemophilus* OR hemophilus* OR influenzae* OR nocardiosis* OR streptococcus* OR streptococcal*)) **This is the final search as formatted by Epistemonikos:** title:((bronchopneumonia* OR pleuropneumonia* OR broncho-pneumonia OR pleuro-pneumonia OR broncho-pneumonias OR pleuro-pneumonias OR "broncho pneumonia" OR "pleuro pneumonia" OR "broncho pneumonias" OR "pleuro pneumonias")) OR abstract:((bronchopneumonia* OR pleuropneumonia* OR broncho-pneumonia OR pleuro-pneumonia OR broncho-pneumonias OR pleuro-pneumonias OR "broncho pneumonia" OR "pleuro pneumonia" OR "broncho pneumonias" OR "pleuro pneumonias")) OR title:((pneumonia OR pneumonias)) OR abstract:(((pneumonia OR pneumonias) AND (HAP OR nosocomial* OR crossinfect* OR cross-infection OR cross-infected OR cross-infecting OR "cross infection" OR "cross infected" OR "cross infecting" OR hospitalised* OR hospitalized* OR hospitalisation* OR hospitalization*))) OR abstract:(((pneumonia OR pneumonias) AND ("healthcare acquire" OR "healthcare acquired" OR "healthcare acquiring" OR "healthcare onset" OR "healthcare associate" OR "healthcare associated" OR "healthcare associating"))) OR abstract:(((pneumonia OR pneumonias) AND ("health care acquire" OR "health care acquired" OR "health care acquiring" OR "health care onset" OR "health care associate" OR "health care associated" OR "health care associating"))) OR abstract:(((pneumonia OR pneumonias) AND ("hospital acquire" OR "hospital acquired" OR "hospital acquiring" OR "hospital onset" OR "hospital associate" OR "hospital associated" OR "hospital associating"))) OR abstract:(((pneumonia OR pneumonias) AND ("inpatient acquire" OR "inpatient acquired" OR "inpatient acquiring" OR "inpatient onset" OR "inpatient associate" OR "inpatient associated" OR "inpatient associating"))) OR abstract:(((pneumonia OR pneumonias) AND (healthcare-acquire OR healthcare-acquired OR healthcare-acquiring OR healthcare-onset OR healthcare-associate OR healthcare-associated OR healthcare-associating))) OR abstract:(((pneumonia OR pneumonias) AND (health-care-acquire OR health-care-acquired OR health-care-acquiring OR health-care-onset OR health-care-associate OR health-care-associated OR health-care-associating))) OR abstract:(((pneumonia OR pneumonias) AND (hospital-acquire OR hospital-acquired OR hospital-acquiring OR hospital-onset OR hospital-associate OR hospital-associated OR hospital-associating))) OR abstract:(((pneumonia OR pneumonias) AND (inpatient-acquire OR inpatient-acquired OR inpatient-acquiring OR inpatient-onset OR inpatient-associate OR inpatient-associated OR inpatient-associating))) OR abstract:(((pneumonia OR pneumonias) AND (CAP OR community* OR communities* OR outpatient* OR nonhospital* OR "non hospital" OR non-hospital OR "non hospitalised" OR non-hospitalised OR "non hospitalized" OR non-hospitalized OR "non hospitalisation" OR non-hospitalisation OR "non hospitalization" OR non-hospitalization))) OR abstract:(((pneumonia OR pneumonias) AND (bacterial* OR chlamydial* OR mycoplasma* OR pneumococcal* OR rickettsial* OR staphylococcal* OR staphylococcus* OR necrotiz* OR necrotis* OR viral* OR organizing* OR organising* OR cryptogenic* OR bilateral* OR granulomatous* OR infectious* OR interstitial* OR neonatal* OR obstructive* OR lobar* OR escherichia* OR haemophilus* OR hemophilus* OR influenzae* OR nocardiosis* OR streptococcus* OR streptococcal*))) **Results:** Total: 48055 Apply Publication Year limits of 2014-2024: 30820 Download 1: Apply Publication type - Systematic Review: 2307 Download 2: Apply Publication type - Broad Synthesis: 223 Download 3: Apply Publication type - Structured Summary: 41

Searches
Note: The re-run search covered the whole timespan 2014-2024 as the phrases in the free text were updated to use a version with a hyphen and to spell out the words rather than truncating them. The main search had used Publication Year limits of 2014-2023.

Part 2: Prognostic evidence searches

Database results

Databases	Date searched	Database platform	Database segment or version	No. of results downloaded
Cochrane Central Register of Controlled Trials (CENTRAL)	19/9/2024	Wiley	Cochrane Central Register of Controlled Trials Issue 8 of 12, August 2024	13
Embase	19/9/2024	Ovid	Embase 1974 to 2024 September 18	346
MEDLINE ALL	19/9/2024	Ovid	Ovid MEDLINE(R) ALL 1946 to September 18, 2024	343

Additional search techniques

Databases	Date searched	Database platform	Database segment or version	No. of results downloaded
Forward citation searching	19/9/2024	Web of Science (WOS) Core Collection (1990-present)	Data updated 2024-09-16	235
Reference list checking	19/9/2024	Web of Science (WOS) Core Collection (1990-present)	Data updated 2024-09-16	195

Search strategy history

Database name: Cochrane Central Register of Controlled Trials (CENTRAL)

Searches
#1 [mh ^pneumonia] or [mh ^bronchopneumonia] or [mh ^pleuropneumonia] or [mh ^"pneumonia, bacterial"] or [mh ^"chlamydial pneumonia"] or [mh ^"pneumonia, mycoplasma"] or [mh ^"pneumonia, pneumococcal"] or [mh ^"pneumonia, staphylococcal"]

Searches
or [mh ^"pneumonia, necrotizing"] or [mh ^"pneumonia, viral"] or [mh ^"organizing pneumonia"] or [mh ^"healthcare-associated pneumonia"] 4465
#2 (pneumonia or pneumonias or bronchopneumon* or pleuropneumon*):ti,ab 16255
#3 #1 or #2 17503
#4 [mh ^"early warning score"] 12
#5 (Early Warning Score*):ti,ab 343
#6 (NEWS2 or NEWS-2 or MEWS or NEWS or EWS or PEWS):ti,ab 1283
#7 {or #4-#6} 1428
#8 #3 and #7 85
#9 ((clinicaltrials or trialsearch* or trial-registry or trials-registry or clinicalstudies or trialsregister* or trialregister* or trial-number* or studyregister* or study-register* or controlled-trials-com or current-controlled-trial or AMCTR or ANZCTR or ChiCTR* or CRiS or CTIS or CTRI* or DRKS* or EU-CTR* or EUCTR* or EUDRACT* or ICTRP or IRCT* or JAPIC* or JMCTR* or JRCT or ISRCTN* or LBCTR* or NTR* or ReBec* or REPEC* or RPCEC* or SLCTR or TCTR* or UMIN*):so or (ctgov or ictrp)):an 534051
#10 #8 not #9 23
#11 "conference":pt 247486
#12 #10 not #11 13
#13 #10 not #11 in Trials 13

Database name: Embase

Searches
1 pneumonia/ or bilateral pneumonia/ or bronchopneumonia/ or granulomatous pneumonia/ or infectious pneumonia/ or interstitial pneumonia/ or necrotizing pneumonia/ or neonatal pneumonia/ or obstructive pneumonia/ or organizing pneumonia/ or bacterial pneumonia/ or community acquired pneumonia/ or health care associated pneumonia/ or exp lobar pneumonia/ or virus pneumonia/ or chlamydial pneumonia/ or escherichia coli pneumonia/ or haemophilus influenzae pneumonia/ or pulmonary nocardiosis/ or mycoplasma pneumonia/ or exp staphylococcal pneumonia/ or exp streptococcus pneumonia/ or hospital acquired pneumonia/ 331644
2 (pneumonia or pneumonias or bronchopneumon* or pleuropneumon*).ti,ab. 246340
3 1 or 2 417859
4 exp early warning score/ 2353
5 Early Warning Score*.ti,ab. 2928
6 (NEWS2 or NEWS-2 or MEWS or NEWS or EWS or PEWS).ti,ab. 37619
7 or/4-6 39345
8 3 and 7 592
9 nonhuman/ not human/ 5532664
10 8 not 9 590
11 limit 10 to english language 538
12 (letter or editorial).pt. 2165405
13 11 not 12 512
14 Case report/ 3041468
15 13 not 14 466

Searches
16 (conference abstract* or conference review or conference paper or conference proceeding).db,pt,su. 6020566
17 15 not 16 346

Database name: MEDLINE ALL

Searches
1 pneumonia/ or bronchopneumonia/ or pleuropneumonia/ or pneumonia, bacterial/ or chlamydial pneumonia/ or pneumonia, mycoplasma/ or pneumonia, pneumococcal/ or pneumonia, staphylococcal/ or pneumonia, necrotizing/ or pneumonia, viral/ or organizing pneumonia/ or healthcare-associated pneumonia/ 126108
2 (pneumonia or pneumonias or bronchopneumon* or pleuropneumon*).ti,ab. 166561
3 1 or 2 236803
4 early warning score/ 470
5 Early Warning Score*.ti,ab. 1902
6 (NEWS2 or NEWS-2 or MEWS or NEWS or EWS or PEWS).ti,ab. 34343
7 or/4-6 35087
8 3 and 7 409
9 Animals/ not (Animals/ and Humans/) 5225416
10 8 not 9 409
11 limit 10 to english language 387
12 limit 11 to (letter or historical article or comment or editorial or news or case reports) 44
13 11 not 12 343

Additional search techniques

Forward citation searching and reference list checking

Date of search	19/9/24
How the searches were managed	Forward citation searching and reference list checking were done separately as two different operations using the same sources, seed references and decision-making criteria and so they are reported in a single table here.
How the seed papers were identified	Identified from the scoping searches.
Databases used	Web of Science (WOS) Core Collection (1990-present) • Science Citation Index Expanded (1990-present) • Social Sciences Citation Index (1990-present) • Arts & Humanities Citation Index (1990-present) • Emerging Sources Citation Index (2019-present)

Date of last update	Data updated 2024-09-16
How results were managed	Only those references that could be accessed through the NICE subscription to WOS were added to the search results. Duplicates were removed from the marked list in WOS before downloading the results.
How the results were selected	Did not make any decisions based on the location of the study. Did not include any papers that were about application of these tools. Did not include any papers about COVID-19. Did not include any papers that were about epidemiology. Did not include guidelines, systematic reviews, animal studies, conferences, letters or editorials. Did not include anything that was not written in English.
List of seed papers used	Bradman K et al. (2014) Predicting patient disposition in a paediatric emergency department. *Journal of Paediatrics & Child Health*, 50(10), E39-44. Bradman K & Maconochie I (2008) Can paediatric early warning score be used as a triage tool in paediatric accident and emergency?. *European Journal of Emergency Medicine*, 15(6), 359-60. Chapman SM & Maconochie I K (2019) Early warning scores in paediatrics: an overview. *Archives of Disease in Childhood*, 104(4), 395–399. Lillitos PJ et al.(2016) Can paediatric early warning scores (pews) be used to guide the need for hospital admission and predict significant illness in children presenting to the emergency department? an assessment of pews diagnostic accuracy using sensitivity and specificity. *Emergency Medicine Journal*, 33(5), 329-37. Lv C et al. (2021) Comparison of Different Scoring Systems for Prediction of Mortality and ICU Admission in Elderly CAP Population. *Clinical Interventions in Aging*, 16, 1917–1929. Mahmoodpoor A et al. (2022) Prognostic value of national early warning score and modified early warning score on intensive care unit readmission and mortality: a

	prospective observational study. *Frontiers in Medicine*, 9, 938005. Monaghan A (2005) Detecting and managing deterioration in children. *Paediatric Nursing*, 17(1), 32-5 Sbiti-Rohr D et al. (2016) The National Early Warning Score (NEWS) for outcome prediction in emergency department patients with community-acquired pneumonia: results from a 6-year prospective cohort study. *BMJ Open*, 6(9), e011021. Tajarernmuang P et al. (2023) The National Early Warning Score 2(NEWS2) to Predict Early Progression to Severe Community-Acquired Pneumonia. *Tropical Medicine and Infectious Disease*, 8(2), 68. Zhou HJ et al. (2020) Outcome prediction value of National Early Warning Score in septic patients with community-acquired pneumonia in emergency department: a single-center retrospective cohort study. *World Journal of Emergency Medicine*, 11(4), 206-215.
No. of forward citation searching results	235
No. of reference list checking results	195

Part 3: Cost effectiveness searches

Database results

Databases	Date searched	Database platform	Database segment or version	No. of results downloaded
Econlit	20/11/2023	Ovid	Econlit 1886 to November 11, 2023	90
Embase	20/11/2023	Ovid	Embase 1974 to 2023 November 17	2288
International HTA Database	20/11/2023	INAHTA	Version available on 20/11/23 with 21319 records	30
MEDLINE ALL	20/11/2023	Ovid	Ovid MEDLINE(R) ALL 1946 to November 17, 2023	1534

Databases	Date searched	Database platform	Database segment or version	No. of results downloaded
NHS Economic Evaluation Database (NHS EED)	20/11/2023	CRD	Archived – last updated 31 March 2015	11

Re-run results

Databases	Date searched	Database platform	Database segment or version	No. of results downloaded
Econlit	14/10/2024	Ovid	Econlit 1886 to October 03, 2024	6
Embase	14/10/2024	Ovid	Embase 1974 to 2024 October 11	306
International HTA Database	14/10/2024	INAHTA	Version available on 14/10/24 with 23533 records	6
MEDLINE ALL	14/10/2024	Ovid	Ovid MEDLINE(R) ALL 1946 to October 11, 2024	157

Search strategy history

Database name: Econlit

Searches	
1	(pneumonia or pneumonias or bronchopneumon* or pleuropneumon*).af. 150
2	limit 1 to yr="2014 -Current" 90
Note: in the re-run Line 2 was changed to limit 1 to yr="2023 -Current".	

Database name: Embase

Searches	
1	pneumonia/ or bilateral pneumonia/ or bronchopneumonia/ or granulomatous pneumonia/ or infectious pneumonia/ or interstitial pneumonia/ or necrotizing pneumonia/ or neonatal pneumonia/ or obstructive pneumonia/ or exp organizing pneumonia/ or bacterial pneumonia/ or community acquired pneumonia/ or health care associated pneumonia/ or hospital acquired pneumonia/ or exp lobar pneumonia/ or virus pneumonia/ or chlamydial pneumonia/ or escherichia coli pneumonia/ or haemophilus influenzae pneumonia/ or pulmonary nocardiosis/ or mycoplasma pneumonia/ or rickettsial pneumonia/ or exp staphylococcal pneumonia/ or exp streptococcus pneumonia/ 314875
2	(pneumonia or pneumonias or bronchopneumon* or pleuropneumon*).ti,ab. 232562
3	1 or 2 395881

Searches
4 cost utility analysis/ 12471
5 quality adjusted life year/ 35716
6 cost*.ti. 195365
7 (cost* adj2 utilit*).tw. 12784
8 (cost* adj2 (effective* or assess* or evaluat* or analys* or model* or benefit* or threshold* or quality or expens* or saving* or reduc*)).tw.385741
9 (economic* adj2 (evaluat* or assess* or analys* or model* or outcome* or benefit* or threshold* or expens* or saving* or reduc*)).tw. 66452
10 (qualit* adj2 adjust* adj2 life*).tw. 27335
11 QALY*.tw. 26801
12 (incremental* adj2 cost*).tw. 28720
13 ICER.tw. 13032
14 utilities.tw. 15135
15 markov*.tw. 40152
16 (dollar* or USD or cents or pound or pounds or GBP or sterling* or pence or euro or euros or yen or JPY).tw.72706
17 ((utility or effective*) adj2 analys*).tw. 37800
18 (willing* adj2 pay*).tw. 14735
19 (EQ5D* or EQ-5D*).tw. 26137
20 ((euroqol or euro-qol or euroquol or euro-quol or eurocol or euro-col) adj3 ("5" or five)).tw. 5262
21 (european* adj2 quality adj3 ("5" or five)).tw. 996
22 or/4-21 635358
23 3 and 22 7788
24 afghanistan/ or africa/ or "africa south of the sahara"/ or albania/ or algeria/ or andorra/ or angola/ or argentina/ or "antigua and barbuda"/ or armenia/ or exp azerbaijan/ or bahamas/ or bahrain/ or bangladesh/ or barbados/ or belarus/ or belize/ or benin/ or bhutan/ or bolivia/ or borneo/ or exp "bosnia and herzegovina"/ or botswana/ or exp brazil/ or brunei darussalam/ or bulgaria/ or burkina faso/ or burundi/ or cambodia/ or cameroon/ or cape verde/ or central africa/ or central african republic/ or chad/ or exp china/ or comoros/ or congo/ or cook islands/ or cote d'ivoire/ or croatia/ or cuba/ or cyprus/ or democratic republic congo/ or djibouti/ or dominica/ or dominican republic/ or ecuador/ or el salvador/ or egypt/ or equatorial guinea/ or eritrea/ or eswatini/ or ethiopia/ or exp "federated states of micronesia"/ or fiji/ or gabon/ or gambia/ or exp "georgia (republic)"/ or ghana/ or grenada/ or guatemala/ or guinea/ or guinea-bissau/ or guyana/ or haiti/ or honduras/ or exp india/ or exp indonesia/ or iran/ or exp iraq/ or jamaica/ or jordan/ or kazakhstan/ or kenya/ or kiribati/ or kosovo/ or kuwait/ or kyrgyzstan/ or laos/ or lebanon/ or liechtenstein/ or lesotho/ or liberia/ or libyan arab jamahiriya/ or madagascar/ or malawi/ or exp malaysia/ or maldives/ or mali/ or malta/ or mauritania/ or mauritius/ or melanesia/ or moldova/ or monaco/ or mongolia/ or "montenegro (republic)"/ or morocco/ or mozambique/ or myanmar/ or namibia/ or nauru/ or nepal/ or nicaragua/ or niger/ or nigeria/ or niue/ or north africa/ or oman/ or exp pakistan/ or palau/ or palestine/ or panama/ or papua new guinea/ or paraguay/ or peru/ or philippines/ or polynesia/ or qatar/ or "republic of north macedonia"/ or romania/ or exp russian federation/ or rwanda/ or sahel/ or "saint kitts and nevis"/ or "saint lucia"/ or "saint vincent and the grenadines"/ or saudi arabia/ or senegal/ or exp serbia/ or seychelles/ or sierra leone/ or singapore/ or "sao tome and principe"/ or solomon islands/ or exp somalia/ or south africa/ or south asia/ or south sudan/ or exp southeast asia/ or sri lanka/ or sudan/ or suriname/ or syrian arab republic/ or taiwan/ or tajikistan/ or tanzania/ or thailand/ or timor-leste/ or togo/ or tonga/ or "trinidad and tobago"/ or tunisia/ or turkmenistan/ or tuvalu/ or uganda/ or exp ukraine/ or exp united arab emirates/ or uruguay/ or exp uzbekistan/ or

Searches
vanuatu/ or venezuela/ or viet nam/ or western sahara/ or yemen/ or zambia/ or zimbabwe/ 1716014
25 exp "organisation for economic co-operation and development"/ 2774
26 exp australia/ or "australia and new zealand"/ or austria/ or baltic states/ or exp belgium/ or exp canada/ or chile/ or colombia/ or costa rica/ or czech republic/ or denmark/ or estonia/ or europe/ or exp finland/ or exp france/ or exp germany/ or greece/ or hungary/ or iceland/ or ireland/ or israel/ or exp italy/ or japan/ or korea/ or latvia/ or lithuania/ or luxembourg/ or exp mexico/ or netherlands/ or new zealand/ or north america/ or exp norway/ or poland/ or exp portugal/ or scandinavia/ or sweden/ or slovakia/ or slovenia/ or south korea/ or exp spain/ or switzerland/ or "Turkey (republic)"/ or exp united kingdom/ or exp united states/ or western europe/ 3801223
27 european union/ 31487
28 developed country/ 35727
29 or/25-28 3834983
30 24 not 29 1561961
31 23 not 30 6971
32 limit 31 to english language 6647
33 (letter or editorial).pt. 2081948
34 32 not 33 6549
35 Case report/ 2939178
36 34 not 35 6182
37 nonhuman/ not human/ 5325269
38 36 not 37 6027
39 (conference abstract* or conference review or conference paper or conference proceeding).db,pt,su. 5742113
40 38 not 39 4181
41 limit 40 to yr="2014 -Current" 2288
Note: in the re-run Line 41 was changed to limit 40 to dc=20231101-20241014.

Database name: International HTA Database

Searches
1 (pneumonia or pneumonias or bronchopneumon* or pleuropneumon*)[abs] AND (English)[Language] FROM 2014 TO 2023 15
2 (pneumonia or pneumonias or bronchopneumon* or pleuropneumon*)[Title] AND (English)[Language] FROM 2014 TO 2023 7
3 ("pneumonia"[mh] or "bronchopneumonia"[mh] or "pleuropneumonia"[mh] or "pneumonia bacterial"[mh] or "chlamydial pneumonia"[mh] or "pneumonia mycoplasma"[mh] or "pneumonia pneumococcal"[mh] or "pneumonia rickettsial"[mh] or "pneumonia staphylococcal"[mh] or "pneumonia necrotizing"[mh] or "pneumonia viral"[mh] or "organizing pneumonia"[mh] or "cryptogenic organizing pneumonia"[mh] or "healthcare-associated pneumonia"[mh]) AND (English)[Language] FROM 2014 TO 2023 21
4 1 OR 2 OR 3 30
Note: in the re-run the date was changed to FROM 2023 TO 2024.

Database name: MEDLINE ALL

Searches
1 pneumonia/ or bronchopneumonia/ or pleuropneumonia/ or pneumonia, bacterial/ or chlamydial pneumonia/ or pneumonia, mycoplasma/ or pneumonia, pneumococcal/ or pneumonia, rickettsial/ or pneumonia, staphylococcal/ or pneumonia, necrotizing/ or pneumonia, viral/ or organizing pneumonia/ or cryptogenic organizing pneumonia/ or healthcare-associated pneumonia/ 125178
2 (pneumonia or pneumonias or bronchopneumon* or pleuropneumon*).ti,ab. 159311
3 1 or 2 229286
4 Cost-Benefit Analysis/ 93463
5 Quality-Adjusted Life Years/ 15940
6 Markov Chains/ 16047
7 exp Models, Economic/ 16244
8 cost*.ti. 146284
9 (cost* adj2 utilit*).tw. 7812
10 (cost* adj2 (effective* or assess* or evaluat* or analys* or model* or benefit* or threshold* or quality or expens* or saving* or reduc*)).tw.279720
11 (economic* adj2 (evaluat* or assess* or analys* or model* or outcome* or benefit* or threshold* or expens* or saving* or reduc*)).tw. 47585
12 (qualit* adj2 adjust* adj2 life*).tw. 18059
13 QALY*.tw. 14611
14 (incremental* adj2 cost*).tw. 17628
15 ICER.tw. 6134
16 utilities.tw. 9537
17 markov*.tw. 32169
18 (dollar* or USD or cents or pound or pounds or GBP or sterling* or pence or euro or euros or yen or JPY).tw.54722
19 ((utility or effective*) adj2 analys*).tw. 25292
20 (willing* adj2 pay*).tw. 9954
21 (EQ5D* or EQ-5D*).tw. 13646
22 ((euroqol or euro-qol or euroquol or euro-quol or eurocol or euro-col) adj3 ("5" or five)).tw. 3930
23 (european* adj2 quality adj3 ("5" or five)).tw. 723
24 or/4-23 506237
25 3 and 24 3855
26 afghanistan/ or africa/ or africa, northern/ or africa, central/ or africa, eastern/ or "africa south of the sahara"/ or africa, southern/ or africa, western/ or albania/ or algeria/ or andorra/ or angola/ or "antigua and barbuda"/ or argentina/ or armenia/ or azerbaijan/ or bahamas/ or bahrain/ or bangladesh/ or barbados/ or belize/ or benin/ or bhutan/ or bolivia/ or borneo/ or "bosnia and herzegovina"/ or botswana/ or brazil/ or brunei/ or bulgaria/ or burkina faso/ or burundi/ or cabo verde/ or cambodia/ or cameroon/ or central african republic/ or chad/ or exp china/ or comoros/ or congo/ or cote d'ivoire/ or croatia/ or cuba/ or "democratic republic of the congo"/ or cyprus/ or djibouti/ or dominica/ or dominican republic/ or ecuador/ or egypt/ or el salvador/ or equatorial guinea/ or eritrea/ or eswatini/ or ethiopia/ or fiji/ or gabon/ or gambia/ or "georgia (republic)"/ or ghana/ or grenada/ or guatemala/ or guinea/ or guinea-bissau/ or guyana/ or haiti/ or honduras/ or independent state of samoa/ or exp india/ or indian ocean islands/ or indochina/ or indonesia/ or iran/ or iraq/ or jamaica/ or jordan/ or kazakhstan/ or kenya/ or kosovo/ or kuwait/ or kyrgyzstan/ or laos/ or lebanon/ or liechtenstein/ or lesotho/ or liberia/ or libya/ or madagascar/ or malaysia/

Searches
or malawi/ or mali/ or malta/ or mauritania/ or mauritius/ or mekong valley/ or melanesia/ or micronesia/ or monaco/ or mongolia/ or montenegro/ or morocco/ or mozambique/ or myanmar/ or namibia/ or nepal/ or nicaragua/ or niger/ or nigeria/ or oman/ or pakistan/ or palau/ or exp panama/ or papua new guinea/ or paraguay/ or peru/ or philippines/ or qatar/ or "republic of belarus"/ or "republic of north macedonia"/ or romania/ or exp russia/ or rwanda/ or "saint kitts and nevis"/ or saint lucia/ or "saint vincent and the grenadines"/ or "sao tome and principe"/ or saudi arabia/ or serbia/ or sierra leone/ or senegal/ or seychelles/ or singapore/ or somalia/ or south africa/ or south sudan/ or sri lanka/ or sudan/ or suriname/ or syria/ or taiwan/ or tajikistan/ or tanzania/ or thailand/ or timor-leste/ or togo/ or tonga/ or "trinidad and tobago"/ or tunisia/ or turkmenistan/ or uganda/ or ukraine/ or united arab emirates/ or uruguay/ or uzbekistan/ or vanuatu/ or venezuela/ or vietnam/ or west indies/ or yemen/ or zambia/ or zimbabwe/ 1312779
27 "organisation for economic co-operation and development"/ 565
28 australasia/ or exp australia/ or austria/ or baltic states/ or belgium/ or exp canada/ or chile/ or colombia/ or costa rica/ or czech republic/ or exp denmark/ or estonia/ or europe/ or finland/ or exp france/ or exp germany/ or greece/ or hungary/ or iceland/ or ireland/ or israel/ or exp italy/ or exp japan/ or korea/ or latvia/ or lithuania/ or luxembourg/ or mexico/ or netherlands/ or new zealand/ or north america/ or exp norway/ or poland/ or portugal/ or exp "republic of korea"/ or "scandinavian and nordic countries"/ or slovakia/ or slovenia/ or spain/ or sweden/ or switzerland/ or turkey/ or exp united kingdom/ or exp united states/ 3515662
29 european union/ 17814
30 developed countries/ 21444
31 or/27-30 3531767
32 26 not 31 1222696
33 25 not 32 3418
34 limit 33 to english language 3185
35 limit 34 to (letter or historical article or comment or editorial or news or case reports) 181
36 34 not 35 3004
37 Animals/ not (Animals/ and Humans/) 5137547
38 36 not 37 2921
39 limit 38 to yr="2014 -Current" 1534
Note: in the re-run the following lines were used:
38 36 not 37
39 limit 38 to ed=20231101-20241014
40 limit 38 to dt=20231101-20241014
41 39 or 40

Database name: NHS Economic Evaluation Database (NHS EED)

Searches
1 MeSH DESCRIPTOR Pneumonia 252
2 MeSH DESCRIPTOR bronchopneumonia 1
3 MeSH DESCRIPTOR pleuropneumonia 0
4 MeSH DESCRIPTOR pneumonia, bacterial 90
5 MeSH DESCRIPTOR chlamydial pneumonia 0
6 MeSH DESCRIPTOR pneumonia, mycoplasma 3

Searches
7 MeSH DESCRIPTOR pneumonia, pneumococcal 48
8 MeSH DESCRIPTOR pneumonia, rickettsial 0
9 MeSH DESCRIPTOR pneumonia, staphylococcal 10
10 MeSH DESCRIPTOR pneumonia, necrotizing 0
11 MeSH DESCRIPTOR pneumonia, viral 9
12 MeSH DESCRIPTOR Cryptogenic Organizing Pneumonia 0
13 MeSH DESCRIPTOR healthcare-associated pneumonia 0
14 (pneumonia) OR (pneumonias) 1118
15 (bronchopneumon*) OR (pleuropneumon*) 3
16 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 1120
17 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15) IN NHSEED 425
18 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15) IN NHSEED FROM 2014 TO 2024 11
Note: no re-run required as the database has been archived and not updated since 31 March 2015.

Appendix C – Prognostic evidence study selection

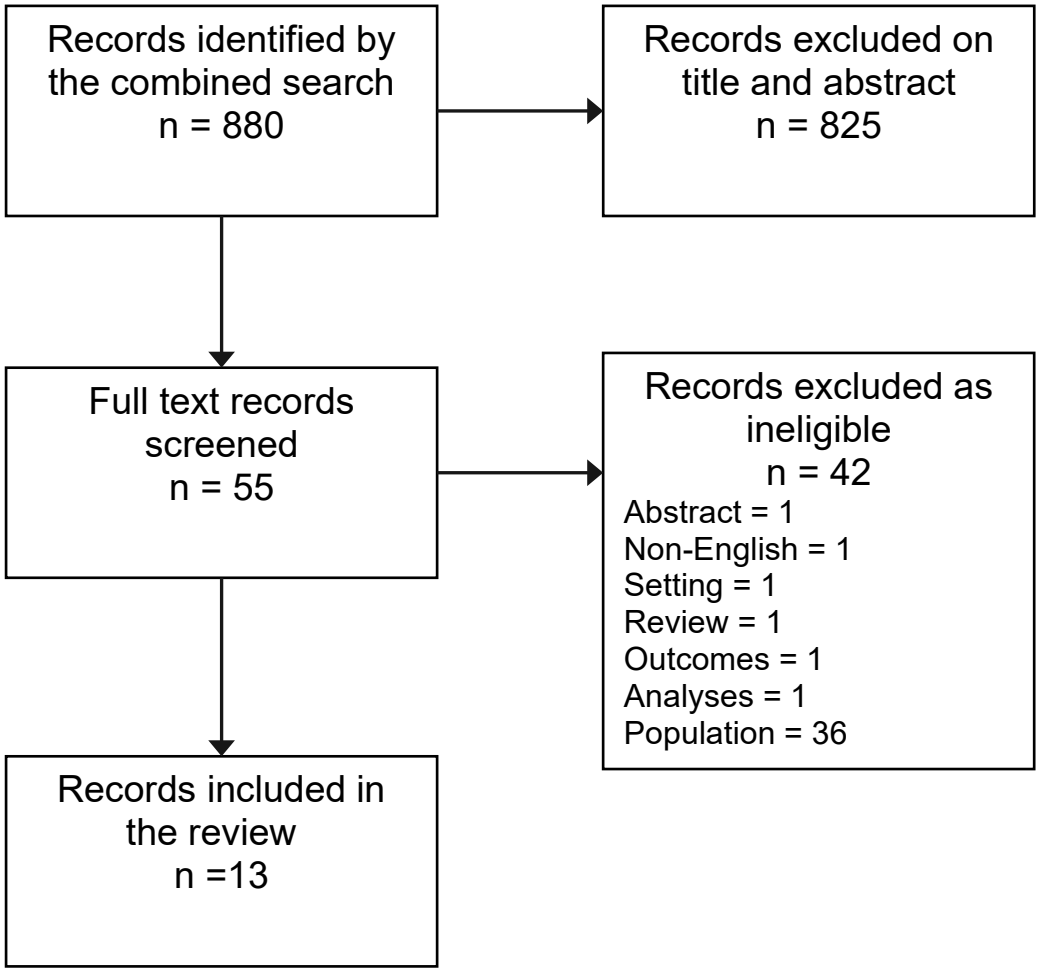


Figure 3 Study selection for prognostic evidence

Appendix D – Prognostic evidence

Durantez-Fernández, 2022

Bibliographic Reference	Durantez-Fernández, C Martín-Conty, JL Polonio-López, B Villamor, MAC Maestre-Miquel, C Viñuela, A López-Izquierdo, R Mordillo-Mateos, L Méndez, FF Soto, CJ Martín-Rodríguez, F; Lactate improves the predictive ability of the National Early Warning Score 2 in the emergency department; AUSTRALIAN CRITICAL CARE; 2022; vol. 35 (no. 6); 677 - 683

Study Characteristics

Study design	Prospective cohort study
Study details	Study location: Spain Study setting: Emergency department Study dates: November 1, 2019 to September 30, 2020 Sources of funding: Gerencia Regional de Salud de Castilla y Leon (Spain)
Inclusion criteria	Aged over 18 transferred by ambulance to ED venous lactate measurement within 1 h after admission High priority at triage
Exclusion criteria	medical comorbidities with imminent risk of death Pregnancy No medical reports available Under 18s psychiatric illness cardiorespiratory arrest on arrival
Number of participants and recruitment methods	1716 participants from a total of 3081 screened cases, recruited from ambulance arrivals to ED.
Length of follow-up	2, 7, 14, and 30 days

Loss to follow up	119, not included in final cohort
Outcome(s) of interest	The main outcome was the cumulative in-hospital mortality in the different time frames included in the evaluation (at 2, 7, 14, and 30 days) after ED attendance for any cause. Hospitalisation and ICU were secondary outcomes
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS2
Covariates adjusted for in the multivariable regression modelling	None
Additional comments	

Population characteristics

Study-level characteristics

Characteristic	Study (N = 1716)
% Female	38.9
Median age (IQR)	70 (54 to 82)
NEWS2 score median (IQR)	5 (2 to 8)

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	Moderate due to retrospective design and lack of blinding
Overall Risk of bias and Applicability	Concerns for applicability	Moderate due to selection of participants (Only including those who were considered high priority at triage)

Bastidas Goyes, 2023

Bibliographic Reference	Goyes, AB Aponte, C Acosta, D Da Silva, EAB Quintero, ET Gómez, C Flórez, FM Rodríguez, S Alvarez, D Hernández, E Ramírez, L Riveros, P Alvarez, D Forero, J Gutiérrez, F Moscote, A Oke, G; Comparison of the Performance of the CURB-65, A-DROP, and NEWS Scores for the Prediction of Clinical Outcomes in Pneumonia; INFECTIOUS DISEASES IN CLINICAL PRACTICE; 2023; vol. 31 (no. 3)

Study Characteristics

Study design	Retrospective cohort study
Study details	Study location: Colombia Study setting: emergency department, general ward hospitalization, and intensive care unit in a tertiary care health institution Study dates: January 2012 to December 2020 Sources of funding: funded by the universities to which the authors are affiliated: Faculty of Medicine, Universidad de La Sabana; and Clínica Universidad de La Sabana, Chía, Colombia
Inclusion criteria	Aged over 18 Diagnosed CAP All necessary measurements taken at admission
Exclusion criteria	Cardiac decompensation with pneumonia superimposed on pulmonary oedema Pulmonary embolism Pneumonia ruled out Other respiratory illness exacerbated chronic obstructive pulmonary disease, asthmatic crisis, pharyngotonsillitis, tuberculosis, and exacerbated interstitial lung disease, among others patients referred from other hospital centres or chronic care homes patients with arterial blood gas measurements after mechanical ventilation

Number of participants and recruitment methods	Data from medical records were taken from 1651 subjects for the A-DROP, NEWS, and CURB-65 scores.
Length of follow-up	30 days
Loss to follow up	Unclear
Outcome(s) of interest	30-day mortality associated with pneumonia
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS
Covariates adjusted for in the multivariable regression modelling	none
Additional comments	Odds ratios presented without confidence intervals

Population characteristics

Study-level characteristics

Characteristic	Study (N = 1651)
% Female	40.1
Mean age (SD)	69.7 (20.12)
% Comorbidities - Arterial hypertension	59
% Comorbidities - Smoker	30.7
% Comorbidities - chronic heart failure	21.6
% Comorbidities - Cerebrovascular disease	9.9
% Comorbidities - Chronic lung disease	31.9
% Comorbidities - DM without target organ damage	13.8
% Comorbidities - Chronic kidney disease, mild	7.8
% Comorbidities - Chronic kidney disease, moderate-severe	7.5
% Comorbidities - Tumour	10.1
% Comorbidities - Leukaemia	1.4
% Comorbidities - Dementia	14.8

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	High due to issues with analysis and reporting and retrospective design
Overall Risk of bias and Applicability	Concerns for applicability	High due to non-OECD country and NEWS

Grudzinska, 2019

Bibliographic Reference	Grudzinska, Frances S; Aldridge, Kerrie; Hughes, Sian; Nightingale, Peter; Parekh, Dhruv; Bangash, Mansoor; Dancer, Rachel; Patel, Jaimin; Sapey, Elizabeth; Thickett, David R; Dosanjh, Davinder P; Early identification of severe community-acquired pneumonia: a retrospective observational study.; BMJ open respiratory research; 2019; vol. 6 (no. 1); e000438

Study Characteristics

Study design	Retrospective cohort study
Study details	Study location: Birmingham, UK Study setting: a large, adult tertiary hospital Study dates: between October 2014 and January 2016 Sources of funding: FSG is funded by NIHR, DPD and DP are funded by NIHR West Midlands Comprehensive Research Network, DRT is funded by the MRC and BLF, and ES is funded by NIHR, Wellcome Trust and Alpha 1 Foundation.
Inclusion criteria	Aged over 18 Diagnosed CAP
Exclusion criteria	hospital acquired pneumonia no new infiltrates in relevant radiological investigations
Number of participants and recruitment methods	A total of 2895 patients were coded as having CAP and 1545 were included in the final analysis. 1534 had a NEWS score.
Length of follow-up	30 days
Loss to follow up	Unclear
Outcome(s) of interest	intensive care admission, length of hospital stay, in hospital, 30-day, 90-day and 365-day all-cause mortality.
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS
Covariates adjusted for in the multivariable regression modelling	Sensitivity analyses for missing data
Additional comments	Characteristics table for participants with NEWS.

	No confidence intervals provided for AUROC.

Population characteristics

Study-level characteristics

Characteristic	Study (N = 1534)
% Female	49
Median age (IQR)	76 (63 to 85)
Comorbidities (%) at least 1	89
% Comorbidities - Cardiovascular disease	38.1
% Comorbidities - Chronic pulmonary disease	20.1
% Comorbidities - Diabetes	15.4
% Comorbidities - Metabolic disease	13.2
% Comorbidities - Solid tumour malignancy	11.7
% Comorbidities - Gastrointestinal disease	11.2
% Comorbidities - Rheumatological disease	11.1
% Comorbidities - Dementia	10.9
% Comorbidities - Psychiatric disorder	10.4

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	High due to issues with analysis and reporting, and retrospective design.
Overall Risk of bias and Applicability	Concerns for applicability	Moderate due to NEWS

Kakehi, 2023

Bibliographic Reference	Kakehi, Eiichi; Uehira, Ryo; Ohara, Nobuaki; Akamatsu, Yukinobu; Osaka, Taeko; Sakurai, Shigehisa; Hirotani, Akane; Nozaki, Takafumi; Shoji, Keisuke; Adachi, Seiji; Kotani, Kazuhiko; Utility of the New Early Warning Score (NEWS) in combination with the neutrophil-lymphocyte ratio for the prediction of prognosis in older patients with pneumonia.; Family medicine and community health; 2023; vol. 11 (no. 2)

Study Characteristics

Study design	Retrospective cohort study
Study details	Study location: Japan Study setting: General hospital Study dates: between 1 April 2018 and 31 March 2020 Sources of funding: The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors
Inclusion criteria	Diagnosed CAP Healthcare associated pneumonia Older adults >=65
Exclusion criteria	severe immunosuppression other than corticosteroid patients referred from other hospital centres or chronic care homes the presence of empyema, pulmonary tuberculosis, pulmonary oedema, pulmonary thromboembolism or non-infectious interstitial pneumonia Previous antibiotics treatment with a corticosteroids, or chemotherapy within the preceding 90 days or radiotherapy the presence of liver disease or a haematological disorder that might affect the incidences of inflammation measured missing baseline data regarding any element of the NEWS
Number of participants and recruitment methods	446 people of ≥65 years of age were diagnosed with pneumonia, of whom 164 were excluded (76 because of treatment with antibiotics, 17 because of corticosteroid use, 44 because of the presence of a haematological disease, 7

	because of the presence of a liver disease and 20 because of missing data), leaving 282 for inclusion in the final analysis.
Length of follow-up	30 days
Loss to follow up	Unclear
Outcome(s) of interest	The primary outcome was 30-day mortality following a diagnosis of pneumonia and the secondary outcome was the length of hospital stay.
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS
Covariates adjusted for in the multivariable regression modelling	age, BMI, chronic kidney disease, neoplastic disease, level of care, albumin, urea nitrogen
Additional comments	

Population characteristics

Study-level characteristics

Characteristic	Study (N = 282)
% Female	54.3
Mean age (SD)	85.3 (7.9)
% Comorbidities - Dementia	65.2
% Comorbidities - Cerebrovascular disease	34.8
% Comorbidities - Congestive heart failure	21.6
% Comorbidities - Chronic respiratory disease	20.2
% Comorbidities - Chronic kidney disease	5.6
% Comorbidities - Neoplastic disease	2.8

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	Moderate due to retrospective design
Overall Risk of bias and Applicability	Concerns for applicability	High due to limited participant sample (Older adults >=65) and NEWS

Kaya, 2020

Bibliographic Reference	Kaya, Aynur Ecevit; Ozkan, Seda; Usul, Eren; Arslan, Engin Deniz; Comparison of pneumonia severity scores for patients diagnosed with pneumonia in emergency department.; The Indian journal of medical research; 2020; vol. 152 (no. 4); 368-377

Study Characteristics

Study design	Prospective cohort study
Study details	Study location: Turkey Study setting: Emergency department of Ankara Dışkapı Yıldırım Beyazıt Training and Research Hospital, Study dates: between October 1, 2015 and May 1, 2016 Sources of funding: None
Inclusion criteria	Aged over 18 Diagnosed CAP new or worsening of pre-existing infiltration in the chest X-ray and at least two of the symptoms associated with pneumonia (cough, sputum, dyspnoea and pleuritic chest pain)
Exclusion criteria	hospital acquired pneumonia Aspiration pneumonia Tuberculosis Pulmonary embolism Pulmonary oedema
Number of participants and recruitment methods	During the study period, 314 patients diagnosed with pneumonia were recruited. Thirteen patients with hospital-acquired pneumonia and 29 patients with aspiration pneumonia were excluded from the study. A total of 272 patients who met the criteria were included.
Length of follow-up	30 days
Loss to follow up	Twenty two patients who met the study criteria were lost to follow up.
Outcome(s) of interest	Mortality, ICU admission, hospital admission,
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS

Covariates adjusted for in the multivariable regression modelling	none

Population characteristics

Study-level characteristics

Characteristic	Study (N = 250)
% Female	41.6
Median age (IQR)	76 (56 to 96)
% Comorbidities - COPD	39.2
% Comorbidities - Hypertension	38.8
% Comorbidities - Diabetes	24.4
% Comorbidities - Cardiovascular disease	18
% Comorbidities - Congestive heart failure	12.4
% Comorbidities - Cerebrovascular disease	10.4

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	Low
Overall Risk of bias and Applicability	Concerns for applicability	Moderate due to NEWS

Kumari, 2024

Bibliographic Reference	Kumari, Neelam; Saifullah, Nausheen; Jafri, Saira; Ahmed, Aziz; Jawad, Nadia; Ahmed, Naseem; Comparison of NEWS2 and PSI as mortality predictors in patients with community acquired pneumonia.; JPMA. The Journal of the Pakistan Medical Association; 2024; vol. 74 (no. 6); 1156-1159

Study Characteristics

Study design	Cross-sectional study
Study details	Study location: Karachi, Pakistan Study setting: The pulmonology ward of Jinnah Postgraduate Medical Centre Study dates: June to November 2020 Sources of funding: None
Inclusion criteria	Diagnosed CAP Aged over 12
Exclusion criteria	hospital acquired pneumonia COVID-19 Aspiration pneumonia Tuberculosis Pulmonary embolism Pulmonary oedema
Number of participants and recruitment methods	Through non-probability convenience sampling, a total of 116 hospitalised patients were recruited.
Length of follow-up	Within hospital stay
Loss to follow up	N/a
Outcome(s) of interest	In hospital mortality
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS2
Covariates adjusted for in the	None

multivariable regression modelling	
Additional comments	

Population characteristics

Study-level characteristics

Characteristic	Study (N = 116)
% Female	35.5
Mean age (SD)	46.9 (20.5)

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	Low
Overall Risk of bias and Applicability	Concerns for applicability	High *(Due to age range of participants, follow up period and non-OECD setting)*

Lv, 2021

Bibliographic Reference	Lv, Chunxin; Chen, Yue; Shi, Wen; Pan, Teng; Deng, Jinhai; Xu, Jiayi; Comparison of Different Scoring Systems for Prediction of Mortality and ICU Admission in Elderly CAP Population.; Clinical interventions in aging; 2021; vol. 16; 1917-1929

Study Characteristics

Study design	Retrospective cohort study
Study details	Study location: China Study setting: Minhang Hospital Study dates: from 1 January 2018 to 1 January 2020 Sources of funding: The authors received no financial support for the research, authorship, and/or publication of this article.
Inclusion criteria	Diagnosed CAP Older adults >=65
Exclusion criteria	treatment with a corticosteroids, or chemotherapy within the preceding 90 days or radiotherapy immunosuppression HIV positive heart failure living in a nursing home
Number of participants and recruitment methods	Data from the electronic medical records in Minhang Hospital, Fudan University were recorded. Information including age, gender, comorbidities, hospitalization days, consciousness state, vital signs, and laboratory variables within 24 hours of admission were collected. Aforementioned variables were used to determine qSOFA, CURB-65, MEWS and NEWS scores were calculated according to the physiological and laboratory variables. In total, 1044 patients were selected for this study.
Length of follow-up	28 days
Loss to follow up	Unclear
Outcome(s) of interest	Mortality, ICU admission
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS

Covariates adjusted for in the multivariable regression modelling	None

Population characteristics

Study-level characteristics

Characteristic	Study (N = 1044)
% Female	44.6
Mean age (SD)	79.79 (7.68)
% Comorbidities - Hypertension	40.8
% Comorbidities - Cerebrovascular disease	24.9
% Comorbidities - Diabetes	21.3
% Comorbidities - Electrolyte disturbance	20.5
% Comorbidities - Coronary heart disease	19.2
% Comorbidities - Congestive heart failure	14.9
% Comorbidities - Chronic kidney disease	8.2
% Comorbidities - Cancer	6

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	Moderate due to retrospective design
Overall Risk of bias and Applicability	Concerns for applicability	High due to limited sample (Older adults >=65), non-OECD country, and NEWS

Muller-Plathe, 2024

Bibliographic Reference	Muller-Plathe, Moritz; Osmanodja, Bilgin; Barthel, Georg; Budde, Klemens; Eckardt, Kai-Uwe; Kolditz, Martin; Witzenrath, Martin; Validation of risk scores for prediction of severe pneumonia in kidney transplant recipients hospitalized with community-acquired pneumonia.; Infection; 2024; vol. 52 (no. 2); 447-459

Study Characteristics

Study design	Retrospective cohort study
Study details	Study location: Germany Study setting: Charité–Universitätsmedizin Berlin Study dates: Between 01.01.2006 and 31.03.2022 Sources of funding: Open Access funding enabled and organized by Projekt DEAL.
Inclusion criteria	Aged over 18 Diagnosed CAP Functioning kidney transplant No other hospital admission in past 28 days
Exclusion criteria	No clinical data available from the first 48 h after initial admission Pneumonitis induced by immunosuppressive regimen Aspiration pneumonia Infarction pneumonia Cardiac decompensation with pneumonia superimposed on pulmonary oedema Missing data on immunosuppressive medication at the time of admission Documented treatment restrictions No medical reports available
Number of participants and recruitment methods	Screened proprietary electronic health record and transplant database for patients with pneumonia. Reviewed all medical records of the respective 1103 medical cases with suspected CAP to include only patients meeting the CAP definition. 310 patients included in analysis. These included 43 with covid19.

Length of follow-up	28 days
Loss to follow up	226/310 had complete analysis including NEWS2
Outcome(s) of interest	The primary endpoint was severe pneumonia, a composite endpoint consisting of in-hospital mortality, respiratory failure requiring invasive mechanical ventilation (IMV), acute kidney injury (AKI) requiring kidney replacement therapy (KRT), and need for vasopressor therapy. The secondary outcomes were in-hospital mortality, 28-day mortality, ICU admission, IMV, high-fow nasal cannula (HFNC) or non-invasive mechanical ventilation (NIV)
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS2
Covariates adjusted for in the multivariable regression modelling	None
Additional comments	Analyses for non-covid patients only extracted where possible

Population characteristics

Study-level characteristics

Characteristic	Study (N = 310)
% Female	35.8
Median age (IQR)	58.7 (46.8 to 68.2)
% Comorbidities - Diabetes	31.1
% Comorbidities - Hypertension	92.6
% Comorbidities - Coronary artery disease	25.8
% Comorbidities - History of myocardial infarction	9.7
% Comorbidities - Peripheral artery disease	8.7
% Comorbidities - History of stroke	6.8
% Comorbidities - COPD	8.7
% Comorbidities - Asthma	1.6
% Comorbidities - Malignancy	21
% Comorbidities - Liver disease	18.2
Transplant age (years) Median (IQR)	4 (1.5 to 7.5)

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	High due to retrospective design and COVID19 patients
Overall Risk of bias and Applicability	Concerns for applicability	High due to transplant sample comorbidity

Reddy, 2024

Bibliographic Reference	Reddy, D.V.P.; Vijayakumari, V.; Kumar, R.S.; Rao, C.H.R.N.B.; Gowtham, S.; Perumal, S.; Comparison of Pneumonia-specific Scores, Sepsis Score and Generic Score in Predicting the Severity of Community-acquired Pneumonia: A Cross-sectional Study; Journal of Clinical and Diagnostic Research; 2024; vol. 18 (no. 4); oc15-oc19

Study Characteristics

Study design	Cross-sectional study
Study details	Study location: India Study setting: Department of Pulmonary Medicine, Government Hospital for Chest and Communicable Diseases, Study dates: from April 2023 to September 2023 Sources of funding: Not stated
Inclusion criteria	Diagnosed CAP
Exclusion criteria	COVID-19 Tuberculosis Under 18s HIV positive healthcare associated pneumonia ventilator associated pneumonia progressive malignancy patients without radiological infiltration
Number of participants and recruitment methods	One hundred patients who meet the inclusion criteria were selected using the consecutive sampling method.
Length of follow-up	30 days
Loss to follow up	Unclear
Outcome(s) of interest	mortality, ICU admission
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS

Covariates adjusted for in the multivariable regression modelling	none

Population characteristics

Study-level characteristics

Characteristic	Study (N = 100)
% Female	38
Mean age (SD)	56 (15)
% Comorbidities - Diabetes	21
% Comorbidities - Hypertension	33
% Comorbidities - Congestive heart failure	1
% Comorbidities - Cerebrovascular disease	1
% Comorbidities - Heart disease	5
% Comorbidities - COPD	3

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	Low
Overall Risk of bias and Applicability	Concerns for applicability	High due to *non-OECD and NEWS*

Sbiti-Rohr, 2016

Bibliographic Reference	Sbiti-Rohr, Diana; Kutz, Alexander; Christ-Crain, Mirjam; Thomann, Robert; Zimmerli, Werner; Hoess, Claus; Henzen, Christoph; Mueller, Beat; Schuetz, Philipp; The National Early Warning Score (NEWS) for outcome prediction in emergency department patients with community-acquired pneumonia: results from a 6-year prospective cohort study.; BMJ open; 2016; vol. 6 (no. 9); e011021

Study Characteristics

Study design	Retrospective cohort study Retrospective analysis of RCT cohort
Study details	Study location: Switzerland Study setting: secondary or tertiary care, academic or non-academic hospitals Study dates: October 2006 to March 2008 Sources of funding: The Swiss National Science Foundation (grant number SNF 3200BO-116177/1), Santé Suisse and the Gottfried and Julia Bangerter-Rhyner Foundation.
Inclusion criteria	Aged over 18 Diagnosed CAP Presenting at emergency department
Exclusion criteria	Language restriction or dementia precluding informed consent Intravenous drug abuse severe immunosuppression other than corticosteroid chronic antibiotic therapy medical comorbidities with imminent risk of death hospital acquired pneumonia
Number of participants and recruitment methods	analysis of data from 925 patients included in a previous randomised-controlled non-inferiority trial with a 6-year follow-up. NEWS was calculated retrospectively on admission data.
Length of follow-up	Median follow-up was 6.1 years. Data points were set at 30 days, 180 days and 6 years.
Loss to follow up	Unclear

Outcome(s) of interest	all-cause mortality within 6 years of follow-up. Secondary outcomes were adverse clinical outcome defined as intensive care unit (ICU) admission, empyema and unplanned hospital readmission all occurring within 30 days after admission.
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS
Covariates adjusted for in the multivariable regression modelling	• age and gender (model 1) • age, gender and main comorbidities (chronic obstructive pulmonary disease (COPD), congestive heart failure, neoplastic disease, diabetes mellitus, coronary artery disease, cerebrovascular disease, peripheral artery occlusive disease (PAOD), chronic renal failure) (model 2).

Population characteristics

Study-level characteristics

Characteristic	Study (N = 925)
% Female	41.2
Median age (IQR)	73 (59 to 82)
% Comorbidities - Congestive heart failure	17.2
% Comorbidities - Chronic renal failure	22.3
% Comorbidities - Diabetes	17.5
% Comorbidities - COPD	30.5
% Comorbidities - Neoplastic disease	12.8
% Comorbidities - Cerebrovascular disease	8.9
% Comorbidities - Coronary artery disease	19.8
% Comorbidities - Peripheral arterial occlusive disease	5.1
PSI - Class I	11.2
PSI - Class II	15
PSI - Class III	19.5
PSI - Class IV	37.9
PSI - Class V	16.3
CURB-65 - Class 0	22.3
CURB-65 - Class 1	27.4
CURB-65 - Class 2	33.1
CURB-65 - Class 3	14.5
CURB-65 - Class 4	2.7
CURB-65 - Class 5	0.1

PSI= pneumonia severity index; CURB-65= confusion, blood urea nitrogen, respiratory rate, blood pressure, age >=65

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	Moderate due to retrospective design
Overall Risk of bias and Applicability	Concerns for applicability	Moderate due to NEWS

Tajarernmuang, 2023

Bibliographic Reference	Tajarernmuang, Pattraporn; Sanwirat, Pimchanok; Inchai, Juthamas; Phinyo, Phichayut; Limsukon, Atikun; The National Early Warning Score 2(NEWS2) to Predict Early Progression to Severe Community-Acquired Pneumonia.; Tropical medicine and infectious disease; 2023; vol. 8 (no. 2)

Study Characteristics

Study design	Prospective cohort study
Study details	Study location: Thailand Study setting: Chiang Mai University Hospital Study dates: October 2020 to December 2021 Sources of funding: No external funding
Inclusion criteria	Aged over 18 Diagnosed CAP
Exclusion criteria	severe CAP who met at least one of two IDSA/ATS major criteria at admission Pregnancy COVID-19
Number of participants and recruitment methods	260 patients were enrolled upon presentation to the emergency department.
Length of follow-up	Mortality within 72 hours.
Loss to follow up	Unclear
Outcome(s) of interest	Early progression to severe pneumonia, defined as the progression of the disease to respiratory failure requiring mechanical ventilation, circulatory failure requiring vasopressors, or death within 72 h after admission.
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS2
Covariates adjusted for in the multivariable regression modelling	None

Additional comments	The main outcome was early progression to severe pneumonia, defined as the progression of the disease to respiratory failure requiring mechanical ventilation, circulatory failure requiring vasopressors, or death within 72 h after admission. Cannot separate elements for meta-analysis.

Population characteristics

Study-level characteristics

Characteristic	Study (N = 260)
% Female - Early progression	69.8
% Female - Non-progression	64.7
Mean age (SD) - Early progression	70.6 (15.4)
Mean age (SD) - Non-progression	70.9 (17.2)

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	Low
Overall Risk of bias and Applicability	Concerns for applicability	Moderate due to non-OECD

Tuta-Quintero, 2024

Bibliographic Reference	Tuta-Quintero, Eduardo; Bastidas, Alirio R; Guerron-Gomez, Gabriela; Perna-Reyes, Isabella; Torres, Daniela; Garcia, Laura; Villanueva, Javier; Acuna, Camilo; Mikler, Eathan; Arcila, Juan; Chavez, Nicolas; Riviera, Allison; Maldonado, Valentina; Galindo, Maria; Fernandez, Maria; Schloss, Carolina; Reyes, Luis Felipe; Performance of risk scores in predicting mortality at 3, 6, and 12 months in patients diagnosed with community-acquired pneumonia.; BMC pulmonary medicine; 2024; vol. 24 (no. 1); 334

Study Characteristics

Study design	Retrospective cohort study
Study details	Study location: Colombia Study setting: two hospitals emergency departments Study dates: from January 2010 to January 2020 Sources of funding: Universidad de la Sabana Grant MED-326-2022
Inclusion criteria	Aged over 18 Diagnosed CAP had spent at least 6 h in the emergency room admitted to the ICU due to this same condition
Exclusion criteria	No medical reports available nosocomial infection Survival less than 30 days
Number of participants and recruitment methods	7454 potentially eligible subjects were identified, of which 3688 were included in the analysis after excluding those with clinical presentations incompatible with pneumonia. A total of 3688 were included in the final analysis.
Length of follow-up	3, 6, and 12 months
Loss to follow up	Unclear
Outcome(s) of interest	Mortality at 3, 6, and 12 months
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS

Covariates adjusted for in the multivariable regression modelling	None

Population characteristics

Study-level characteristics

Characteristic	Study (N = 3688)
% Female	40.7
Mean age (SD)	63.5 (21.39)
% Comorbidities - Hypertension	46.1
% Comorbidities - chronic heart failure	12.1
% Comorbidities - acute myocardial infarction	4.6
% Comorbidities - Cerebrovascular disease	7
% Comorbidities - COPD	25.5
% Comorbidities - Diabetes	11.5
% Comorbidities - Chronic kidney disease	5.5
% Comorbidities - Cancer	6.4
% Comorbidities - Asthma	2.1
% Comorbidities - immunosuppression	4

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	High due to retrospective design and sample selection
Overall Risk of bias and Applicability	Concerns for applicability	High due to non-OECD and NEWS

Zan, 2022

Bibliographic Reference	Zan, Yumin; Song, Weiwei; Wang, Yu; Shao, Jiaofang; Wang, Zhiyong; Zhao, Weihong; Wu, Jianqing; Xu, Wei; Nomogram for predicting in-hospital mortality of nonagenarians with community-acquired pneumonia.; Geriatrics & gerontology international; 2022; vol. 22 (no. 8); 635-641

Study Characteristics

Study design	Retrospective cohort study
Study details	Study location: China Study setting: Jiangsu Provincial People's Hospital and Jiangsu Provincial Hospital of Chinese Medicine Study dates: between 2014 and 2020 Sources of funding: This work was funded by National Key R&D Program of China (2018YFC2002100, 2018YFC2002102); National Natural Science Foundation of China (81871100); Scientific Research Project of Jiangsu Provincial Health Commission (H2019036, LGY2017071); Elderly Health Research Project of Jiangsu Provincial Health Commission (LX2021002)
Inclusion criteria	Diagnosed CAP Older adults >=90
Exclusion criteria	bronchiectasis with infection, lung abscess, radiation pneumonia, Pneumocystis carinii pneumonia, active tuberculosis, cystic pulmonary fibrosis recent hospitalization in past 15 days autoimmune diseases concurrent infection at another site history of advanced treatments within a month, such as radiation therapy, chemotherapy, surgery, biological therapy or immunosuppressive therapy
Number of participants and recruitment methods	Data retrospectively collected from the medical records included age, gender, vital signs and the patient's medical history. In total, 304 patients with CAP aged over 90 years were included in this study.
Length of follow-up	30-day
Loss to follow up	unclear

Outcome(s) of interest	30-day hospital mortality
Prognostic factors or risk factor(s) or sign(s)/symptom(s)	NEWS
Covariates adjusted for in the multivariable regression modelling	No modelling for NEWS
Additional comments	

Population characteristics

Study-level characteristics

Characteristic	Study (N = 304)
% Female	32.6
Mean age (SD)	95.2 (2.4)
% Comorbidities - Cerebrovascular disease	50
% Comorbidities - Congestive heart failure	29.3
% Comorbidities - COPD	22.7
% Comorbidities - Diabetes	23
% Comorbidities - Chronic kidney disease	13.2
% Comorbidities - Dementia	15.1

Critical appraisal - GDT Crit App - PROBAST tool

Section	Question	Answer
Overall Risk of bias and Applicability	Risk of bias	High due to very restricted sample and retrospective design
Overall Risk of bias and Applicability	Concerns for applicability	High due to *Non-OECD and NEWS*

Appendix E – Forest plots

No forest plots were created from the evidence.

Appendix F – GRADE tables

Table 14 GRADE table of AUC outcomes for mortality at <=30 days

Quality assessment							No of patients	Effect estimate (95% CI)	Quality
Study	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other			
NEWS2									
Durantez-Fernandez 2022	Prospective cohort	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	1716	0.834 (0.782 - 0.886)	Very low
Kumari 2024	Cross-sectional	Not serious	Serious[c]	Very serious[e]	Very serious[h]	n/a	116	0.725 (0.632 - 0.818)	Very low
Muller-Plathe 2024	Retrospective cohort	Very serious[b]	Serious[c]	Very serious[e]	Very serious[g]	n/a	310	0.741 (0.574 - 0.858)	Very low
NEWS									
Bastidas Goyes 2023	Retrospective cohort	Very serious[b]	Serious[c]	Very serious[e]	Not serious	n/a	1651	0.68 (0.65 - 0.72)	Very low
Kakehi 2023	Retrospective cohort	Serious[a]	Serious[c]	Very serious[e]	Very serious[h]	n/a	282	0.73 (0.64 - 0.82)	Very low
Kaya 2020	Prospective cohort	Not serious	Serious[c]	Serious[d]	Not serious	n/a	250	0.91 (0.809 - 0.943)	Low

Lv 2021	Retrospective cohort	Serious[a]	Serious[c]	Very serious[e]	Not serious	n/a	1044	0.892 (0.821 - 0.866)	Very low
Reddy 2024	Cross-sectional	Not serious	Serious[c]	Very serious[e]	Serious[i]	n/a	100	0.973 (0.946 - 1)	Very low
Sbiti-Rohr 2016	Retrospective cohort	Serious[a]	Serious[c]	Serious[d]	Serious[f]	n/a	925	0.65 (0.58 - 0.72)	Very low
Zan 2022	Retrospective cohort	Very serious[b]	Serious[c]	Very serious[e]	Not serious	n/a	304	0.509 (0.44 - 0.58)	Very low

a. Downgraded once because the study was rated moderate risk of bias
b. Downgraded twice because the study was rated high risk of bias
c. Downgraded once for inconsistency: single study
d. Downgraded once because the study was rated as having moderate concerns about applicability
e. Downgraded twice because the study was rated as having high concerns about applicability
f. Downgraded once because 95%CI crosses one threshold of classification accuracy
g. Downgraded twice because 95%CI crosses two thresholds of classification accuracy
h. Downgraded twice because 95%CI crosses one threshold of classification accuracy and the sample size is small (<500)
i. Downgraded once because the sample size is very small (<250)

Table 15 GRADE table of AUC outcomes for mortality at >30 days <1 year

Quality assessment							No of patients	Effect estimate (95% CI)	Quality
Study	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other			
NEWS									

Sbiti-Rohr 2016	Retrospective cohort	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	925	0.62 (0.57 - 0.67)	Very low
Tuta-Quintero 2024	Retrospective cohort	Very serious[b]	Serious[c]	Very serious[e]	Not serious	n/a	3688	0.61 (0.56 - 0.66)	Very low

a. Downgraded once because the study was rated moderate risk of bias
b. Downgraded twice because the study was rated high risk of bias
c. Downgraded once for inconsistency: single study
d. Downgraded once because the study was rated as having moderate concerns about applicability
e. Downgraded twice because the study was rated as having high concerns about applicability

Table 16 GRADE table of AUC outcomes for mortality at >=1 year

Quality assessment							No of patients	Effect estimate (95% CI)	Quality
Study	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**			
NEWS									
Sbiti-Rohr 2016	Retrospective cohort	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	925	0.6 (0.57 - 0.64)	Very low
Tuta-Quintero 2024	Retrospective cohort	Very serious[b]	Serious[c]	Very serious[e]	Not serious	n/a	3688	0.58 (0.55 - 0.61)	Very low

a. Downgraded once because the study was rated moderate risk of bias
b. Downgraded twice because the study was rated high risk of bias
c. Downgraded once for inconsistency: single study
d. Downgraded once because the study was rated as having moderate concerns about applicability
e. Downgraded twice because the study was rated as having high concerns about applicability

Table 17 GRADE table of AUC outcomes for admission to hospital

Quality assessment							No of patients	Effect estimate (95% CI)	Quality
Study	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other			
NEWS									
Kaya 2020	Prospective cohort	Not serious	Serious[c]	Serious[d]	Not serious	n/a	250	0.71 (0.655 - 0.771)	Low

c. Downgraded once for inconsistency: single study
d. Downgraded once because the study was rated as having moderate concerns about applicability

Table 18 GRADE table of AUC outcomes for admission to ICU

Quality assessment							No of patients	Effect estimate (95% CI)	Quality
Study	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other			
NEWS									
Kaya 2020	Prospective cohort	Not serious	Serious[c]	Serious[d]	Not serious	n/a	250	0.86 (0.812 - 0.901)	Low
Lv 2021	Retrospective cohort	Serious[a]	Serious[c]	Very serious[e]	Not serious	n/a	1044	0.976 (0.964 - 0.984)	Very low
Reddy 2024	Cross-sectional	Not serious	Serious[c]	Very serious[e]	Serious[i]	n/a	100	0.967 (0.934 – 1)	Very low
Sbiti-Rohr 2016	Retrospective cohort	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	925	0.73 (0.67 - 0.78)	Very low

a. Downgraded once because the study was rated moderate risk of bias
c. Downgraded once for inconsistency: single study
d. Downgraded once because the study was rated as having moderate concerns about applicability
e. Downgraded twice because the study was rated as having high concerns about applicability

i. Downgraded once because the sample size is very small (<250)

Table 19 GRADE table of AUC outcomes for readmission to hospital

Quality assessment							No of patients	Effect estimate (95% CI)	Quality
Study	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other			
NEWS									
Sbiti-Rohr 2016	Retrospective cohort	Serious[a]	Serious[c]	Serious[d]	Serious[f]	n/a	925	0.58 (0.49 - 0.66)	Very low

a. Downgraded once because the study was rated moderate risk of bias
c. Downgraded once for inconsistency: single study
d. Downgraded once because the study was rated as having moderate concerns about applicability
f. Downgraded once because 95%CI crosses one threshold of classification accuracy

Table 20 GRADE table of AUC outcomes for severe disease composite outcome

Quality assessment							No of patients	Effect estimate (95% CI)	Quality
Study	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other			
NEWS2									
Muller-Plathe 2024	Retrospective cohort	Very serious[b]	Serious[c]	Very serious[e]	Very serious[h]	n/a	310	0.79 (0.684 - 0.867)	Very low
Tajarernmuang 2023	Prospective cohort	Not serious	Serious[c]	Serious[d]	Very serious[h]	n/a	260	0.61 (0.52 - 0.7)	Very low

b. Downgraded twice because the study was rated high risk of bias
c. Downgraded once for inconsistency: single study
d. Downgraded once because the study was rated as having moderate concerns about applicability
e. Downgraded twice because the study was rated as having high concerns about applicability
h. Downgraded twice because 95%CI crosses one threshold of classification accuracy and the sample size is small (<500)

Table 21 GRADE table of Adjusted odds ratios evidence from Sbiti-Rohr 2016, a retrospective cohort study OF NEWS.

Quality assessment							No of patients	Effect estimate (95% CI)	Quality
Outcome	Model	Risk of bias	Inconsistency	Indirectness	Imprecision	Other			
Mortality <=30 days	Adjusted for age and gender	Serious[a]	Serious[c]	Serious[d]	Serious[j]	n/a	925	1.15 (1.05 - 1.25)	Very low
	Adjusted for age, gender and comorbidities	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	925	1.1 (1.01 - 1.21)	Very low
Mortality >30 days <1 year	Adjusted for age and gender	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	925	1.11 (1.04 - 1.18)	Very low
	Adjusted for age, gender and comorbidities	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	925	1.07 (1 - 1.15)	Very low
Mortality >= 1 year	Adjusted for age and gender	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	925	1.1 (1.05 - 1.16)	Very low
	Adjusted for age, gender and comorbidities	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	925	1.08 (1.02 - 1.13)	Very low
ICU admission	Adjusted for age and gender	Serious[a]	Serious[c]	Serious[d]	Serious[j]	n/a	925	1.3 (1.2 - 1.4)	Very low
	Adjusted for age, gender and comorbidities	Serious[a]	Serious[c]	Serious[d]	Serious[j]	n/a	925	1.27 (1.18 - 1.37)	Very low
Readmission to hospital	Adjusted for age and gender	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	925	1.08 (0.98 - 1.2)	Very low

	Adjusted for age, gender and comorbidities	Serious[a]	Serious[c]	Serious[d]	Not serious	n/a	925	1.07 (0.97 - 1.18)	Very low

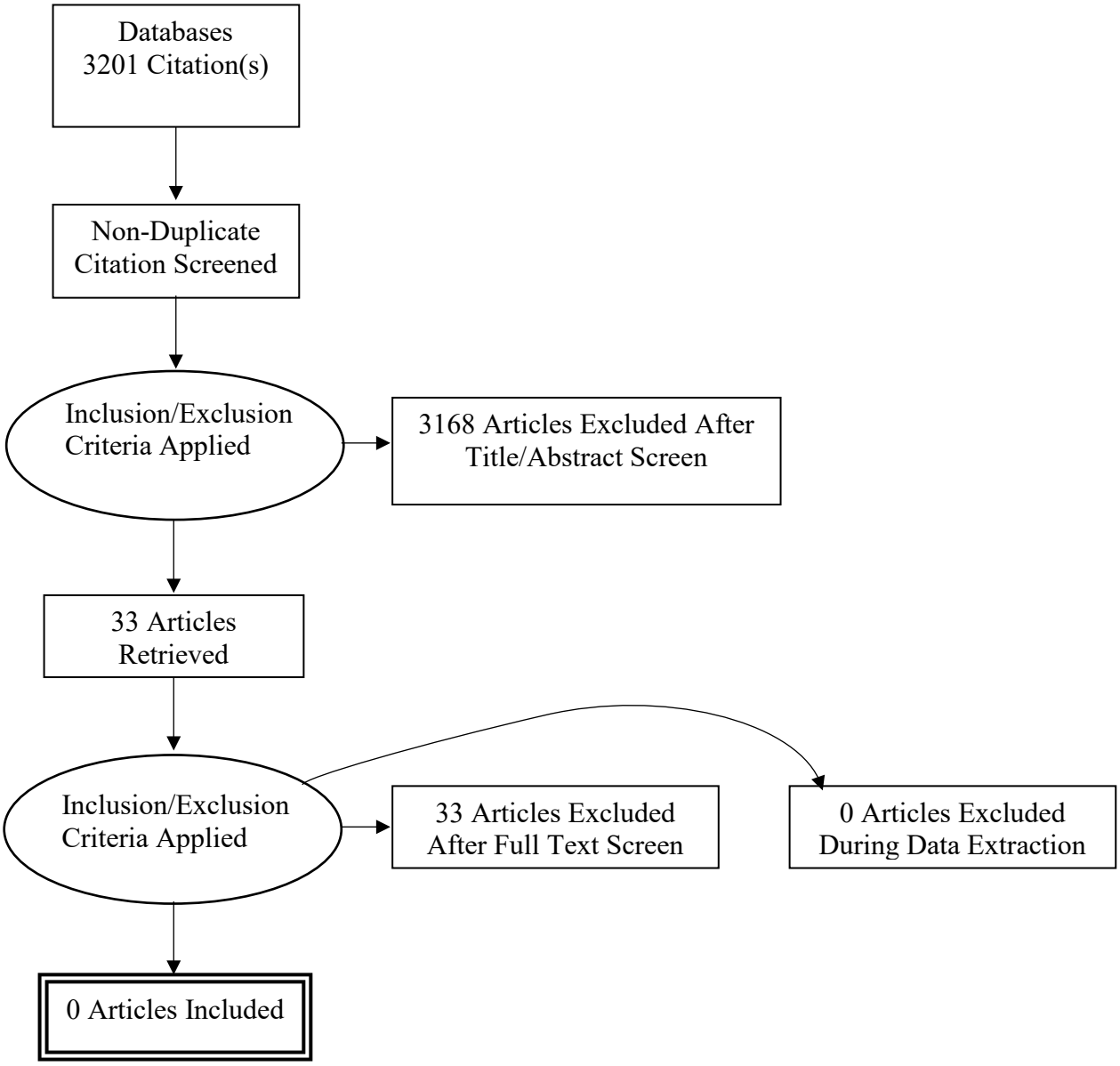
a. Downgraded once because the study was rated moderate risk of bias
c. Downgraded once for inconsistency: single study
d. Downgraded once because the study was rated as having moderate concerns about applicability
j. Downgraded once as 95%CI crosses one clinical decision threshold (1.25)

Table 22 GRADE table of Hazard odds ratios evidence from Kakehi 2023, a retrospective cohort study of NEWS

Quality assessment							No of patients	Effect estimate (95% CI)	Quality
Outcome	**Model**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**			
Mortality <=30 days	Medium NEWS Adjusted for age	Serious[a]	Serious[c]	Very serious[e]	Very serious[k]	n/a	282	4.99 (0.58 - 42.77)	Very low
	Medium NEWS Adjusted for age, BMI, chronic kidney disease, neoplastic disease, level of care, albumin, urea nitrogen	Serious[a]	Serious[c]	Very serious[e]	Very serious[k]	n/a	282	5.69 (0.66 - 49.14)	Very low
	High NEWS Adjusted for age	Serious[a]	Serious[c]	Very serious[e]	Very serious[k]	n/a	282	8.87 (1.19 - 66.2)	Very low
	High NEWS Adjusted for age, BMI, chronic kidney disease, neoplastic disease, level of care, albumin, urea nitrogen	Serious[a]	Serious[c]	Very serious[e]	Very serious[k]	n/a	282	8.69 (1.17 - 64.81)	Very low

a. Downgraded once because the study was rated moderate risk of bias
c. Downgraded once for inconsistency: single study
e. Downgraded twice because the study was rated as having high concerns about applicability
k. Downgraded once as 95%CI are very large

Appendix G – Economic evidence study selection



Appendix H – Economic evidence tables

No studies were included in this review question.

Appendix I – Health economic model

No original health economic modelling was done for this review question.

Appendix J – Excluded studies

Prognostic

Study	Code [Reason]
Abbott, Tom E. F. Vaid, Nidhi Ip, Dorothy Cron, Nicholas Wells, Matt Torrance, Hew D. T. Emmanuel, Julian (2015) A single-centre observational cohort study of admission National Early Warning Score (NEWS). RESUSCITATION 92: 89 - 93	- Population is not specified as pneumonia
Agarwal, D Alam, S Mazahir, R Singh, RR Maini, B (2022) Utility of Pediatric Early Warning Sign Score in Predicting Outcome of PICU Admissions at a Suburban Tertiary Care Hospital. JOURNAL OF PEDIATRIC INTENSIVE CARE	- Population is not specified as pneumonia *15% pneumonia*
Alam, N. Vegting, I. L. Houben, E. van Berkel, B. Vaughan, L. Kramer, M. H. H. Nanayakkara, P. W. B. (2015) Exploring the performance of the National Early Warning Score (NEWS) in a European emergency department. RESUSCITATION 90: 111 - 115	- Population is not specified as pneumonia
Alhmoud, B Bonnici, T Patel, R Melley, D Williams, B Banerjee, A (2021) Performance of universal early warning scores in different patient subgroups and clinical settings: a systematic review. BMJ OPEN 11(4)	- Population is not specified as pneumonia *No pneumonia specific papers reviewed*
Badriyah, Tessy Briggs, James S. Meredith, Paul Jarvis, Stuart W. Schmidt, Paul E. Featherstone, Peter I. Prytherch, David R. Smith, Gary B. (2014) Decision-tree early warning score (DTEWS) validates the design of the National Early Warning Score (NEWS). RESUSCITATION 85(3): 418 - 423	- Population is not specified as pneumonia
Berg, Are Stuwitz, Inchley, Christopher Stephen, Fjaerli, Hans Olav et al. (2020) Assessing Severity in Pediatric Pneumonia: Predictors of the Need for Major Medical Interventions. Pediatric emergency care 36(4): e208-e216	- Conference abstract
Brabrand, Mikkel and Henriksen, Daniel Pilsgaard (2018) CURB-65 Score is Equal to NEWS for Identifying Mortality Risk of Pneumonia Patients: An Observational Study. Lung 196(3): 359-361	- No suitable analyses
Bradman, K Borland, M Pascoe, E (2014) Predicting patient disposition in a paediatric emergency department. JOURNAL OF PAEDIATRICS AND CHILD HEALTH 50(10): E39 - E44	- Population is not specified as pneumonia
Bradman, Kate Maconochie, Ian (2008) Can paediatric early warning score be used as a triage tool in paediatric accident and emergency?. EUROPEAN JOURNAL OF EMERGENCY MEDICINE 15(6): 359 - 360	- Population is not specified as pneumonia

Study	Code [Reason]
Candel, Bart G J, de Groot, Bas, Nissen, Soren Kabell et al. (2023) The prediction of 24-h mortality by the respiratory rate and oxygenation index compared with National Early Warning Score in emergency department patients: an observational study. European journal of emergency medicine : official journal of the European Society for Emergency Medicine 30(2): 110-116	- Population is not specified as pneumonia *Did not differentiate between Covid and non-Covid in the sample*
Castagno, E Balbo, M Procacci, A Parisi, A Paglia, F Bergese, I Versace, A Bondone, C (2023) Early warning scores for clinical deterioration in pediatric patients: a literature review. ASSISTENZA INFERMIERISTICA E RICERCA 42(3): 137 - 151	- Study not reported in English
Chaiyakulsil, C Pandee, U (2015) Validation of pediatric early warning score in pediatric emergency department. PEDIATRICS INTERNATIONAL 57(4): 694 - 698	- Population is not specified as pneumonia
Chen, Lan Zheng, Han Chen, Lijun Wu, Sunying Wang, Saibin (2021) National Early Warning Score in Predicting Severe Adverse Outcomes of Emergency Medicine Patients: A Retrospective Cohort Study. JOURNAL OF MULTIDISCIPLINARY HEALTHCARE 14: 2067 - 2078	- Population is not specified as pneumonia
Cheng, Y Zhang, XL Zhang, JY Lu, GP (2022) The application of pediatric early warning score (PEWS) in emergency observation room. JOURNAL OF PEDIATRIC NURSING-NURSING CARE OF CHILDREN & FAMILIES 66: 1 - 5	- Population is not specified as pneumonia *19.8% pneumonia*
Covino, M Sandroni, C Della Polla, D De Matteis, G Piccioni, A De Vita, A Russo, A Salini, S Carbone, L Petrucci, M Pennisi, M Gasbarrini, A Franceschi, F (2023) Predicting ICU admission and death in the Emergency Department: A comparison of six early warning scores. RESUSCITATION 190	- Population is not specified as pneumonia
Eckart, A Hauser, SI Kutz, A Haubitz, S Hausfater, P Amin, D Amin, A Huber, A Mueller, B Schuetz, P (2019) Combination of the National Early Warning Score (NEWS) and inflammatory biomarkers for early risk stratification in emergency department patients: results of a multinational, observational study. BMJ OPEN 9(1)	- Population is not specified as pneumonia
Elencwajg, M Grisolía, NA Meregalli, C Montecuco, MA Montiel, MV Rodríguez, GM Serviddio, CC (2020) Usefulness of an early warning score as an early predictor of clinical deterioration in hospitalized children. ARCHIVOS ARGENTINOS DE PEDIATRIA 118(6): 399 - 404	- Population is not specified as pneumonia
Engebretsen, S Bogstrand, ST Jacobsen, D Vitelli, V Rimstad, R (2020) NEWS2 versus a single-parameter	- Population is not specified as pneumonia

Study	Code [Reason]
system to identify critically ill medical patients in the emergency department. RESUSCITATION PLUS 3	
Gold, DL Mihalov, LK Cohen, DM (2014) Evaluating the Pediatric Early Warning Score (PEWS) System for Admitted Patients in the Pediatric Emergency Department. ACADEMIC EMERGENCY MEDICINE 21(11): 1249 - 1256	- Population is not specified as pneumonia
Gulec, Tolgahan, Yilmaz, Sarper, Ak, Rohat et al. (2023) Can we recognize severe community-acquired pneumonia without pneumonia severity index? Use of modified qSOFA with procalcitonin. Heliyon 9(9): e19937	- Outcome to be predicted do not match that specified in the protocol *NEWS used to diagnose CAP, but no prognostic outcomes*
Hannon, C Roland, D O'Sullivan, R (2022) Prediction of Pediatric Patient Admission/Discharge in the Emergency Department Irish Pediatric Early Warning Score, Pediatric Observation Priority Score, and Irish Children's Triage System. PEDIATRIC EMERGENCY CARE 38(6): E1320 - E1326	- Population is not specified as pneumonia
Kivipuro, M Tirkkonen, J Kontula, T Solin, J Kalliomäki, J Pauniaho, SL Huhtala, H Yli-Hankala, A Hoppu, S (2018) National early warning score (NEWS) in a Finnish multidisciplinary emergency department and direct vs. late admission to intensive care. RESUSCITATION 128: 164 - 169	- Population is not specified as pneumonia
Kolic, Ivana Crane, Smiley McCartney, Suzanne Perkins, Zane Taylor, Alex (2015) Factors affecting response to National Early Warning Score (NEWS). RESUSCITATION 90: 85 - 90	- Population is not specified as pneumonia
Lee, SB Kim, DH Kim, T Kang, C Lee, SH Jeong, JH Kim, SC Park, YJ Lim, D (2020) Emergency Department Triage Early Warning Score (TREWS) predicts in -hospital mortality in the emergency department. AMERICAN JOURNAL OF EMERGENCY MEDICINE 38(2): 203 - 210	- Population is not specified as pneumonia
Lillitos, PJ Hadley, G Maconochie, I (2016) Can paediatric early warning scores (PEWS) be used to guide the need for hospital admission and predict significant illness in children presenting to the emergency department? An assessment of PEWS diagnostic accuracy using sensitivity and specificity. EMERGENCY MEDICINE JOURNAL 33(5): 329 - 337	- Population is not specified as pneumonia
Lin, Jilei, Zhang, Yin, Song, Anchao et al. (2021) Comparison of a new predictive model with other critical scores for predicting in-hospital mortality among children with pneumonia-related bacteremia. Journal of investigative medicine : the official publication of the	- Population is not specified as pneumonia *Bacteremia*

Study	Code [Reason]
American Federation for Clinical Research 69(7): 1339-1343	
Liu, Vincent X. Lu, Yun Carey, Kyle A. Gilbert, Emily R. Afshar, Majid Akel, Mary Shah, Nirav S. Dolan, John Winslow, Christopher Kipnis, Patricia Edelson, Dana P. Escobar, Gabriel J. Churpek, Matthew M. (2020) Comparison of Early Warning Scoring Systems for Hospitalized Patients With and Without Infection at Risk for In-Hospital Mortality and Transfer to the Intensive Care Unit. JAMA NETWORK OPEN 3(5)	- Population is not specified as pneumonia
Ma, XM Liu, YY Du, MQ Ojo, O Huang, LJ Feng, XH Gao, Q Wang, XH (2021) The accuracy of the pediatric assessment triangle in assessing triage of critically ill patients in emergency pediatric department. INTERNATIONAL EMERGENCY NURSING 58	- Population is not specified as pneumonia
Maeta, S., Mizukami, S., Tomita, Y. et al. (2022) The effectiveness of Modified Early Warning Score (MEWS) using individual-specific range in predicting pneumonia hospitalization among nursing home residents in Japan: Comparison with National Early Waring Score (NEWS). Acta Medica Nagasakiensia 65(3): 89-94	- Not set in emergency department *Nursing homes*
Martín-Rodríguez, F López-Izquierdo, R Vegas, CD Sánchez-Soberón, I Delgado-Benito, JF Martín-Conty, JL Castro-Villamor, MA (2020) Can the prehospital National Early Warning Score 2 identify patients at risk of in-hospital early mortality? A prospective, multicenter cohort study. HEART & LUNG 49(5): 585 - 591	- Population is not specified as pneumonia
Nannan Panday, R.S., Minderhoud, T.C., Alam, N. et al. (2017) Prognostic value of early warning scores in the emergency department (ED) and acute medical unit (AMU): A narrative review. European Journal of Internal Medicine 45: 20-31	- Systematic review checked for references
Niu, X Tilford, B Duffy, E Kobayashi, H Ryan, K Johnson, M Page, B Martin, C Caldwell, R Mahajan, P (2016) Feasibility and Reliability of Pediatric Early Warning Score in the Emergency Department. JOURNAL OF NURSING CARE QUALITY 31(2): 161 - 166	- Population is not specified as pneumonia
Romaine, ST Sefton, G Lim, E Nijman, RG Bernatoniene, J Clark, S Schlapbach, LJ Pallmann, P Carrol, ED (2021) Performance of seven different paediatric early warning scores to predict critical care admission in febrile children presenting to the emergency department: a retrospective cohort study. BMJ OPEN 11(5)	- Population is not specified as pneumonia
Saberian, P Abdollahi, A Hasani-Sharamin, P Modaber, M Karimialavijeh, E (2022) Comparing the prehospital NEWS with in-hospital ESI in predicting 30-day severe	- Population is not specified as pneumonia

Study	Code [Reason]
outcomes in emergency patients. BMC EMERGENCY MEDICINE 22(1)	
Seiger, N Maconochie, I Oostenbrink, R Moll, HA (2013) Validity of Different Pediatric Early Warning Scores in the Emergency Department. PEDIATRICS 132(4): E841 - E850	- Population is not specified as pneumonia
Shafi, OM Rondon, JDD Gulati, G (2020) Can the Pediatric Early Warning Score (PEWS) Predict Hospital Length of Stay?. CUREUS JOURNAL OF MEDICAL SCIENCE 12(11)	- Population is not specified as pneumonia
Smith, Gary B. Prytherch, David R. Meredith, Paul Schmidt, Paul E. Featherstone, Peter I. (2013) The ability of the National Early Warning Score (NEWS) to discriminate patients at risk of early cardiac arrest, unanticipated intensive care unit admission, and death. RESUSCITATION 84(4): 465 - 470	- Population is not specified as pneumonia
Solanki, A Batra, P Bhaskar, V Harit, D (2023) Comparison of Emergency Severity Index Version 4 and Modified Pediatric Early Warning Score as Triage Models in the Pediatric Emergency of a Tertiary Care Public Sector Hospital. INDIAN PEDIATRICS 60(11): 917 - 921	- Population is not specified as pneumonia
Viglino, D., L'her, E., Maltais, F. et al. (2020) Evaluation of a new respiratory monitoring tool "Early Warning ScoreO2" for patients admitted at the emergency department with dyspnea. Resuscitation 148: 59-65	- Population is not specified as pneumonia *28.9% pneumonia*
von Saint Andre-von Arnim, Amelie O, Kumar, Rashmi K, Oron, Assaf P et al. (2021) Feasibility of Family-Assisted Severity of Illness Monitoring for Hospitalized Children in Low-Income Settings. Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies 22(2): e115-e124	- Population is not specified as pneumonia *60% pneumonia*
Zachariasse, JM Nieboer, D Maconochie, IK Smit, FJ Alves, CF Greber-Platzer, S Tsolia, MN Steyerberg, EW Avillach, P van der Lei, J Moll, HA (2020) Development and validation of a Paediatric Early Warning Score for use in the emergency department: a multicentre study. LANCET CHILD & ADOLESCENT HEALTH 4(8): 583 - 591	- Population is not specified as pneumonia
Zhou, Hai-Jiang; Lan, Tian-Fei; Guo, Shu-Bin (2020) Outcome prediction value of National Early Warning Score in septic patients with community-acquired pneumonia in emergency department: A single-center retrospective cohort study. World journal of emergency medicine 11(4): 206-215	- Population is not specified as pneumonia *Sepsis cohort with CAP rather than CAP cohort*

Economic

Study	Code [Reason]
Akyil, Fatma Tokgoz, Hazar, Armagan, Erdem, Ipek et al. (2015) Hospital Treatment Costs and Factors Affecting These Costs in Community-Acquired Pneumonia. Turkish thoracic journal 16(3): 107-113	- Study does not contain a relevant intervention *Costing study, does not compare interventions*
Andrews, Annie Lintzenich, Simpson, Annie N, Heine, Daniel et al. (2015) A Cost-Effectiveness Analysis of Obtaining Blood Cultures in Children Hospitalized for Community-Acquired Pneumonia. The Journal of pediatrics 167(6): 1280-6	- US study
Antunes, C, Pereira, M, Rodrigues, L et al. (2020) Hospitalization direct cost of adults with community-acquired pneumonia in Portugal from 2000 to 2009. Pulmonology 26(5): 264-267	- Study does not contain a relevant intervention *Costing study, does not compare interventions*
Asti, L, Bartsch, S M, Umscheid, C A et al. (2019) The potential economic value of sputum culture use in patients with community-acquired pneumonia and healthcare-associated pneumonia. Clinical microbiology and infection : the official publication of the European Society of Clinical Microbiology and Infectious Diseases 25(8): 1038e1-1038e9	- US study
Buendia, Jefferson A and Patino, Diana Guerrero (2023) Corticosteroids for the treatment of respiratory infection by Mycoplasma pneumoniae in children: A cost-utility analysis. Pediatric pulmonology 58(10): 2809-2814	- Non OECD country *Columbia*
Cammarota, Gianmaria; Vetrugno, Luigi; Longhini, Federico (2023) Lung ultrasound monitoring: impact on economics and outcomes. Current opinion in anaesthesiology 36(2): 234-239	- Does not contain a population of people with only pneumonia, includes people with acute respiratory failure *Unclear if the patients are intubated* - US study *Unclear if the study is US or Europe* -Abstract only
Ceyhan, Mehmet, Ozsurekci, Yasemin, Aykac, Kubra et al. (2018) Economic burden of pneumococcal infections in children under 5 years of age. Human vaccines & immunotherapeutics 14(1): 106-110	- Study does not contain a relevant intervention *Non-comparative costing analysis*
Cisco, Giulio, Meier, Armando N, Senn, Nicolas et al. (2024) Cost-effectiveness analysis of procalcitonin and lung ultrasonography guided antibiotic prescriptions in primary care. The European journal of health economics : HEPAC : health economics in prevention and care	- setting in primary care whereas the review was in secondary care

Study	Code [Reason]
Costa, Nadege, Hoogendijk, Emiel O, Mounie, Michael et al. (2017) Additional Cost Because of Pneumonia in Nursing Home Residents: Results From the Incidence of Pneumonia and Related Consequences in Nursing Home Resident Study. Journal of the American Medical Directors Association 18(5): 453e7-453e12	- Study does not contain a relevant intervention *Non-comparative costing analysis*
Hyams, Catherine; Williams, O Martin; Williams, Philip (2020) Urinary antigen testing for pneumococcal pneumonia: is there evidence to make its use uncommon in clinical practice?. ERJ open research 6(1)	- Review article but not a systematic review, all primary studies were check for relevance
Ito, Akihiro, Ishida, Tadashi, Tokumasu, Hironobu et al. (2017) Impact of procalcitonin-guided therapy for hospitalized community-acquired pneumonia on reducing antibiotic consumption and costs in Japan. Journal of infection and chemotherapy : official journal of the Japan Society of Chemotherapy 23(3): 142-147	- Not a relevant study design *Costing study not a cost utility study*
Javanbakht, Mehdi, Moradi-Lakeh, Maziar, Mashayekhi, Atefeh et al. (2022) Continuous Monitoring of Respiratory Rate with Wearable Sensor in Patients Admitted to Hospital with Pneumonia Compared with Intermittent Nurse-Led Monitoring in the United Kingdom: A Cost-Utility Analysis. PharmacoEconomics - open 6(1): 73-83	- Study does not contain a relevant intervention *Continuous monitoring versus intermittent monitoring, NEWS used in both arms*
Khole, Aalok V, Dionne, Emily, Zitek-Morrison, Emily et al. (2023) Cefepime extended infusion versus intermittent infusion: Clinical and cost evaluation. Antimicrobial stewardship & healthcare epidemiology : ASHE 3(1): e119	- US study
Latif, Marina, Guo, Ning, Tereshchenko, Larisa G et al. (2023) Association of hospital spending with care patterns and mortality in patients hospitalized with community-acquired pneumonia. Journal of hospital medicine 18(11): 986-993	- Study does not contain a relevant intervention *US costing study with no comparative interventions*
Leem, Ah Young, Jung, Won Jai, Kang, Young Ae et al. (2014) Comparison of methicillin-resistant Staphylococcus aureus community-acquired and healthcare-associated pneumonia. Yonsei medical journal 55(4): 967-74	- Not a relevant study design *Not a health economic study*
Macaya, M.C.; Ridulfo, A.H.; Ramirez-Santana, M. (2015) Comparison of costs and health outcomes of users with community-acquired pneumonia treated at home or in traditional hospitalization: An exploratory study of 40 cases. Value in Health Regional Issues 8: 112-115	- Study not reported in English *Reported in Spanish*
McKinnell, James A, Corman, Shelby, Patel, Dipen et al. (2018) Effective Antimicrobial Stewardship Strategies for	- Study does not contain a relevant intervention

Study	Code [Reason]
Cost-effective Utilization of Telavancin for the Treatment of Patients With Hospital-acquired Bacterial Pneumonia Caused by Staphylococcus aureus. Clinical therapeutics 40(3): 406-414e2	*US study that compares different antibiotics rather than length of treatments*
Meacock, Rachel, Sutton, Matt, Kristensen, Soren Rud et al. (2017) Using Survival Analysis to Improve Estimates of Life Year Gains in Policy Evaluations. Medical decision making : an international journal of the Society for Medical Decision Making 37(4): 415-426	- Study does not contain a relevant intervention *Modelling survival not cost effectiveness of treatment*
Miners, Lisa, Huntington, Susie, Lee, Nathaniel et al. (2023) An economic evaluation of two PCR-based respiratory panel assays for patients admitted to hospital with community-acquired pneumonia (CAP) in the UK, France and Spain. BMC pulmonary medicine 23(1): 220	- Not a relevant study design *Cost consequence study*
Patel, Archana B, Bang, Akash, Singh, Meenu et al. (2015) A randomized controlled trial of hospital versus home based therapy with oral amoxicillin for severe pneumonia in children aged 3 - 59 months: The IndiaCLEN Severe Pneumonia Oral Therapy (ISPOT) Study. BMC pediatrics 15: 186	- Non OECD country *India*
Pliakos, Elina Eleftheria, Andreatos, Nikolaos, Tansarli, Giannoula S et al. (2019) The Cost-Effectiveness of Corticosteroids for the Treatment of Community-Acquired Pneumonia. Chest 155(4): 787-794	- US study
Prasath, T.M., Ramachandran, V., Geetha, S. et al. (2019) Hidden Markov model-based cough sound analysis for classification of asthma and pneumonia in pediatric. Drug Invention Today 11(7): 1692-1695	- Full text paper not available
Przybilla, Jens, Ahnert, Peter, Bogatsch, Holger et al. (2020) Markov State Modelling of Disease Courses and Mortality Risks of Patients with Community-Acquired Pneumonia. Journal of clinical medicine 9(2)	- Study does not contain a relevant intervention *Does not include costs*
Reynolds, Courtney A, Finkelstein, Jonathan A, Ray, G Thomas et al. (2014) Attributable healthcare utilization and cost of pneumonia due to drug-resistant streptococcus pneumonia: a cost analysis. Antimicrobial resistance and infection control 3: 16	- Study does not contain a relevant intervention *Looking at different antibiotics not the length of the courses*
Rozenbaum, Mark H, Mangen, Marie-Josee J, Huijts, Susanne M et al. (2015) Incidence, direct costs and duration of hospitalization of patients hospitalized with community acquired pneumonia: A nationwide retrospective claims database analysis. Vaccine 33(28): 3193-9	- Study does not contain a relevant intervention *Costing analysis without comparators*
Shi, Honghao, Guo, Wanjie, Zhu, He et al. (2019) Cost-Effectiveness Analysis of Xiyanping Injection	- Study does not contain a relevant intervention

Study	Code [Reason]
(Andrographolide Sulfonate) for Treatment of Adult Community Acquired Pneumonia: A Retrospective, Propensity Score-Matched Cohort Study. Evidence-based complementary and alternative medicine : eCAM 2019: 4510591	*Andrographolide Sulfonate injection*
Shiri, Tinevimbo, Khan, Kamran, Keaney, Katherine et al. (2019) Pneumococcal Disease: A Systematic Review of Health Utilities, Resource Use, Costs, and Economic Evaluations of Interventions. Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research 22(11): 1329-1344	- Study does not contain a relevant intervention *Vaccines and antibiotics (not length of treatment)*
Sultana, Marufa, Sarker, Abdur Razzaque, Ali, Nausad et al. (2019) Economic evaluation of community acquired pneumonia management strategies: A systematic review of literature. PloS one 14(10): e0224170	- Study does not contain a relevant intervention *Different antibiotics in adults and bubble continuous positive airway pressure in newborns*
Tesfaye, Solomon H, Loha, Eskindir, Johansson, Kjell Arne et al. (2022) Cost-effectiveness of pulse oximetry and integrated management of childhood illness for diagnosing severe pneumonia. PLOS global public health 2(7): e0000757	- Non OECD country *Ethiopia*
Torres, Antoni, Bassetti, Matteo, Welte, Tobias et al. (2020) Economic analysis of ceftaroline fosamil for treating community-acquired pneumonia in Spain. Journal of medical economics 23(2): 148-155	- Study does not contain a relevant intervention *Different antibiotics not different durations*
Wagner, A P, Enne, V I, Livermore, D M et al. (2020) Review of health economic models exploring and evaluating treatment and management of hospital-acquired pneumonia and ventilator-associated pneumonia. The Journal of hospital infection 106(4): 745-756	- Study does not contain a relevant intervention *Different antibiotics not different durations*
Xie, Xuanqian; Sinclair, Alison; Dendukuri, Nandini (2017) Evaluating the accuracy and economic value of a new test in the absence of a perfect reference test. Research synthesis methods 8(3): 321-332	Included in review question 4.2
Zhang, Shanshan, Sammon, Peter M, King, Isobel et al. (2016) Cost of management of severe pneumonia in young children: systematic analysis. Journal of global health 6(1): 010408	- Study does not contain a relevant intervention *Costing study with no outcomes*

Appendix K– Research recommendations – full details

K1.1 Research recommendation

In people with hospital-acquired pneumonia, what is the most clinically effective and cost-effective assessment tool or method for stratifying disease severity?

K1.1.1 Why this is important

The evidence on the prognostic accuracy of the National Early Warning Score (NEWS)-2 (NEWS2) for adults with pneumonia and Paediatric Early Paediatric Early Warning System (PEWS) for children with pneumonia was very limited and the committee were not able to make recommendations. The committee noted that CURB65 is validated and can be used alongside clinical judgement to assess the severity of community-acquired pneumonia. They noted that further research is needed to either externally validate existing models for HAP, or to identify or develop novel methods for stratifying patients by HAP severity.

K1.1.2 Rationale for research recommendation

Importance to 'patients' or the population	It is important to be able to adequately stratify those with hospital-acquired pneumonia to ensure that their care is undertaken in the most appropriate clinical setting and level of care.
Relevance to NICE guidance	There are recommendations relating to the assessment of community-acquired pneumonia. As hospital-acquired pneumonia often has poorer outcomes then community-acquired. It would help support the care decisions for this group of patients.
Relevance to the NHS	Assessment support for this group may enable the placement of those with hospital-acquired pneumonia, ensuring appropriate care and possibly more rapid discharge of patients.
National priorities	Low
Current evidence base	None available
Equality considerations	Babies are at high risk of developing serious illness, and pneumonia is more common in children under 5 and older people.

K1.1.3 Modified PICO table

Population	Babies over 28 days (corrected gestational age), children, young people (age <18 years) and adults (≥18 years) presenting to primary care with hospital-acquired pneumonia
Intervention	Assessment tools

Comparator	Other methods of assessment, clinical judgement alone
Outcome	• Admission to hospital • Admission to ICU • Length of hospital stay • Re-presentation to primary care • Cost-effectiveness
Study design	Prospective cohort studies External validation studies
Timeframe	1 month
Additional information	None