Respiratory Emergency in Daily Practice Workshop, 17 February 2022

The 19th Scientific Respiratory Medicine Meeting
PIPKRA 2022
Pertemuan Ilmiah Pulmonologi & Kedokteran Respirasi

Early Warning System of Respiratory Distress and Failure

Irandi Putra Pratomo, M.D., Ph.D.

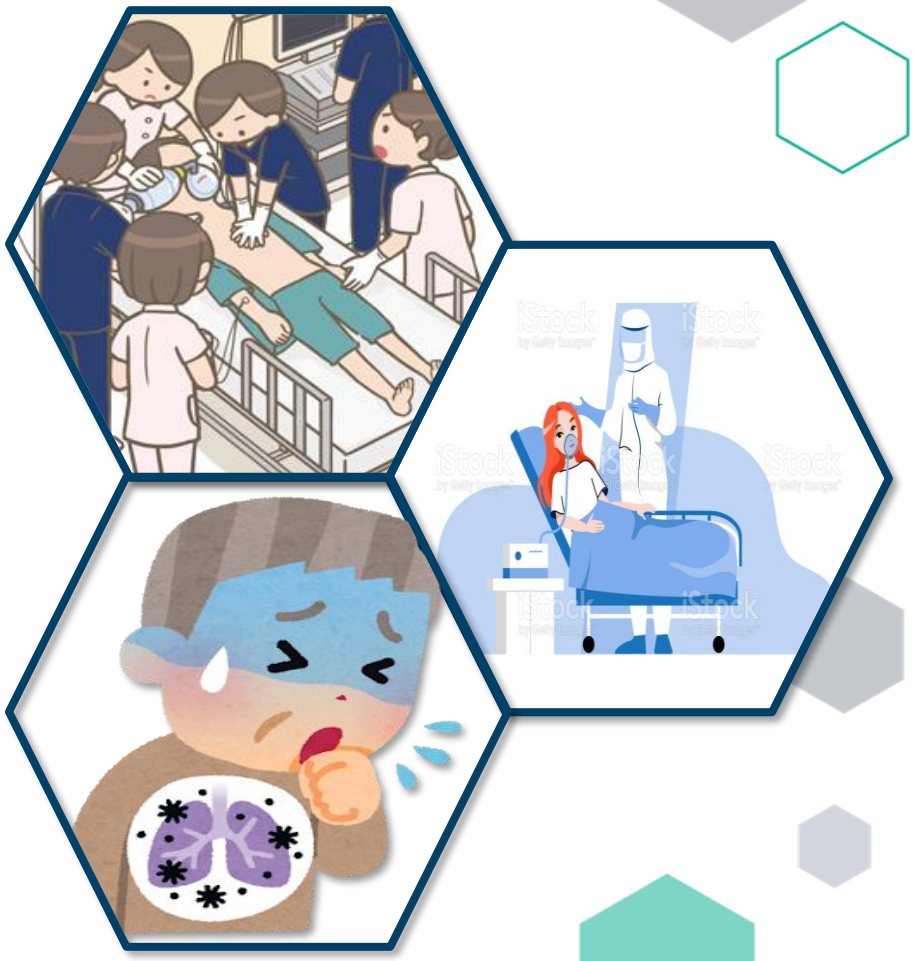
Department of Pulmonology and Respiratory Medicine, Faculty of Medicine, Universitas Indonesia
Pulmonology and Respiratory Medicine Staff Group, Universitas Indonesia Hospital, Universitas Indonesia

Presentation Outline

What and Why Early Warning System?

How and When to Use Early Warning System?

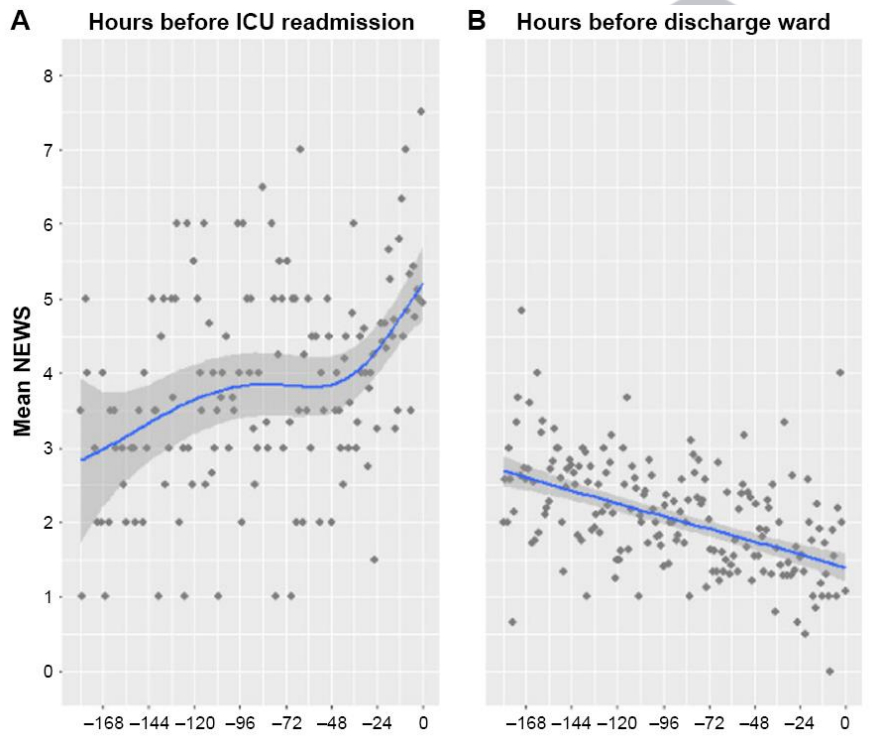
How Early Warning System
Performs in Respiratory Distress and Failure?



What and Why Early Warning System?

What is Early Warning System?

Problem! In-patients usually show **progressive signs** for clinical deterioration several hours or days before a severe critical event → **diagnostic and treatment delay.**



- **Early Warning Systems/Scores (EWS)** → **identify in-hospital patients** at risk for deterioration → **early detection**
- Enables **timely activation** of hospital's rapid response team (RRT) or *Tim Medis Reaksi Cepat (TMRC)* → **prompt treatment**

https://doi.org/10.1016/j.resuscitation.2015.02.009
https://doi.org/10.2147/TCRM.S192630

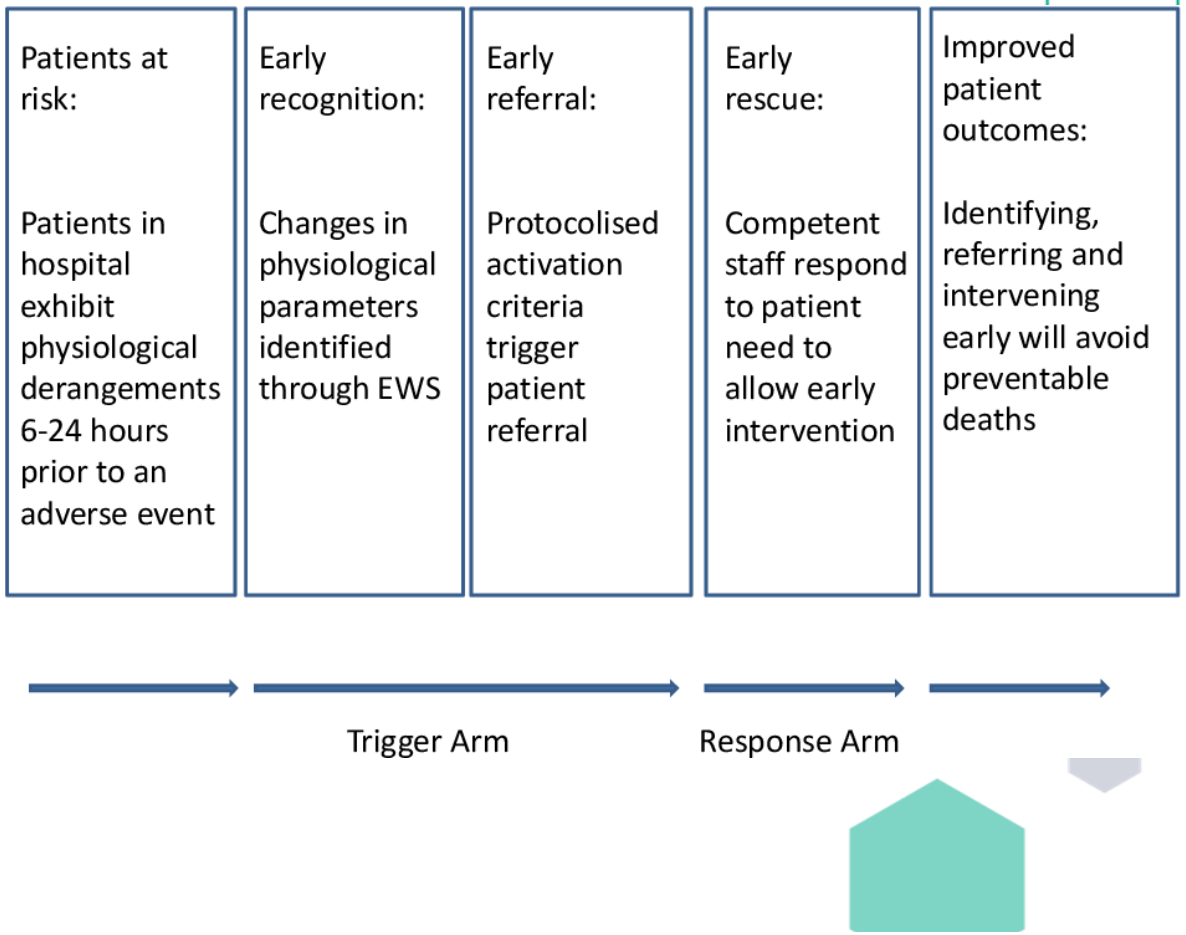
What and Why Early Warning System?

Why use Early Warning System?

Traditionally → **relies on extreme change** (vital signs, consciousness, shortness of breath, hypoxic, vigorous pain) → not standardized & maybe too late → **reactive approach**

EWS → an attempt for a preventive approach

Help to initiate an **immediate intervention** such as an increase of clinical monitoring, protocolized escalation, and need for step-up in unit care.



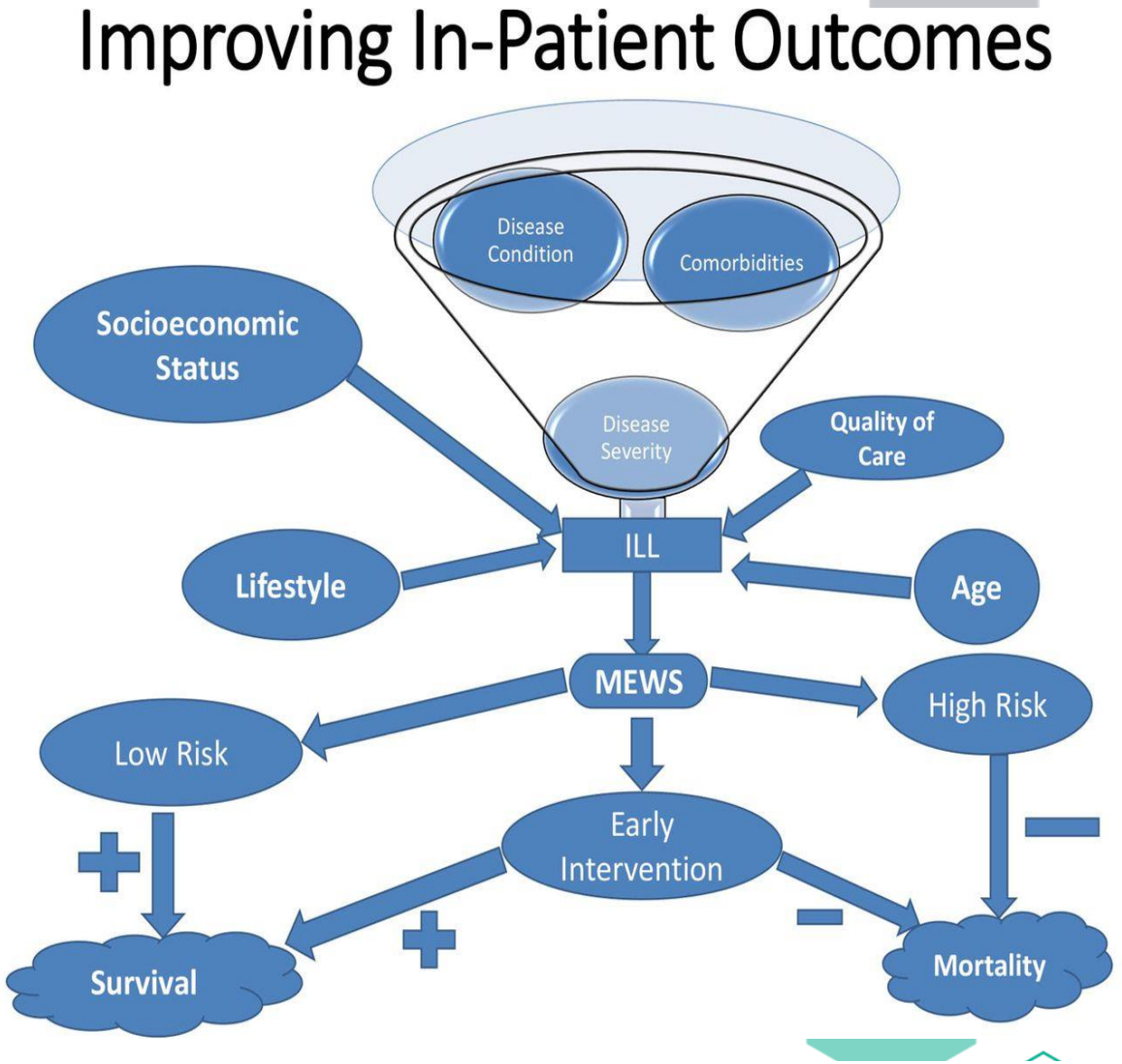
https://dx.doi.org/10.1136%2Fbmjopen-2017-019268
https://doi.org/10.1111/jan.13398

When should Early Warning System be Used?

Hospital Setting:

- Initial assessment of acute illness or at risk of deteriorating
- Those suspected of having sepsis
- Continuous monitoring throughout patient's stay in hospital

EWS act as **a part of the wider assessment** to identify deterioration early and priorities resources in times of surge.



https://dx.doi.org/10.1136%2Fbmjopen-2017-019268
https://doi.org/10.1101/2020.08.05.20169219

Types of Early Warning Scores and How to Use Them

- Many EWS have been developed over the years, from only two variables to the most complex which used **multitude of parameters**
- Most EWS use **weighed scoring based on a numerical grade** to a vital sign range (i.e., systolic blood pressure, heart and respiratory rate, SpO_2, degree of consciousness) to obtain a **summed score to identify at patient at risk**

Most used EWS for adult patients in Indonesia:

- National Early Warning System (NEWS) – NHS UK
- National Early Warning System Version 2 (NEWS2) – NHS UK
- Nursing Early Warning Score System (NEWSS) – Stony Brook University Medical Center, NY, USA

https://doi.org/10.1016/j.resuscitation.2012.12.016
https://doi.org/10.7861/clinmedicine.19-3-260
https://doi.org/10.1097/01.NURSE.0000410304.26165.33

Types of Early Warning Scores

1. National Early Warning System (NEWS) – NHS UK

Developed by Royal College of Physicians and adopted by NHS UK in 2012.

The NEWS is a physiological score comprising of **six parameters**:

- Respiratory rate
- Oxygen saturations
- Temperature
- Systolic Blood Pressure
- Heart Rate
- Degree of consciousness

Scoring and weighting → Trigger thresholds → Clinical response

https://doi.org/10.1016/j.resuscitation.2012.12.016

Types of Early Warning Scores

1. National Early Warning System (NEWS) – NHS UK

PHYSIOLOGICAL PARAMETERS	3	2	1	0	1	2	3
Respiration Rate	≤8		9 - 11	12 - 20		21 - 24	≥25
Oxygen Saturations	≤91	92 - 93	94 - 95	≥96			
Any Supplemental Oxygen		Yes		No			
Temperature	≤35.0		35.1 - 36.0	36.1 - 38.0	38.1 - 39.0	≥39.1	
Systolic BP	≤90	91 - 100	101 - 110	111 - 219			≥220
Heart Rate	≤40		41 - 50	51 - 90	91 - 110	111 - 130	≥131
Level of Consciousness				A			V, P, or U

Scoring

NEW scores	Clinical risk
0	Low
Aggregate 1–4	
RED score* (Individual parameter scoring 3)	Medium
Aggregate 5–6	
Aggregate 7 or more	High

Trigger

https://doi.org/10.1016/j.resuscitation.2012.12.016

Types of Early Warning Scores

News score	Frequency of monitoring	Clinical response
0	Minimum every 12 hours	Continue routine monitoring of national early warning scores (NEWS) with every set of observations
Total (1-4)	Minimum every 4-6 hours	Inform registered nurse, who must assess the patient Registered nurse to decide if increased frequency of monitoring and/or escalation of clinical care is required
Total (≥5, or 3 in one variable)	Increased frequency to a minimum of once an hour	Registered nurse to urgently inform the medical team caring for the patient Urgent assessment by a clinician with core competencies to assess acutely ill patients Clinical care in an environment with monitoring facilities
Total (≥7)	Continuous monitoring of vital signs	Registered nurse to immediately inform the medical team caring for the patient - this should be at least at specialty trainee level Emergency assessment by a clinician team with critical care competencies, which also includes practitioner(s) with advanced airway skills Consider transfer of clinical care to a level 2 or 3 care facility - that is, a higher dependency or intensive care unit

Clinical Response

https://doi.org/10.1016/j.resuscitation.2012.12.016

Types of Early Warning Scores

2. National Early Warning System Version 2 (NEWS2) – NHS UK

Following NEWS, the scoring chart has been **updated to NEWS2** as follows:

- The ranges for the boundaries of each parameter score are now shown on the chart
- The chart has a dedicated section (SpO_2 Scale 2) for use in patients with hypercapnic respiratory failure (usually due to COPD) who have clinically recommended oxygen saturation of 88–92%
- The section of the chart for recording the rate of (L/min) and method/device for supplemental oxygen delivery has been improved

https://doi.org/10.7861/clinmedicine.19-3-260

Types of Early Warning Scores

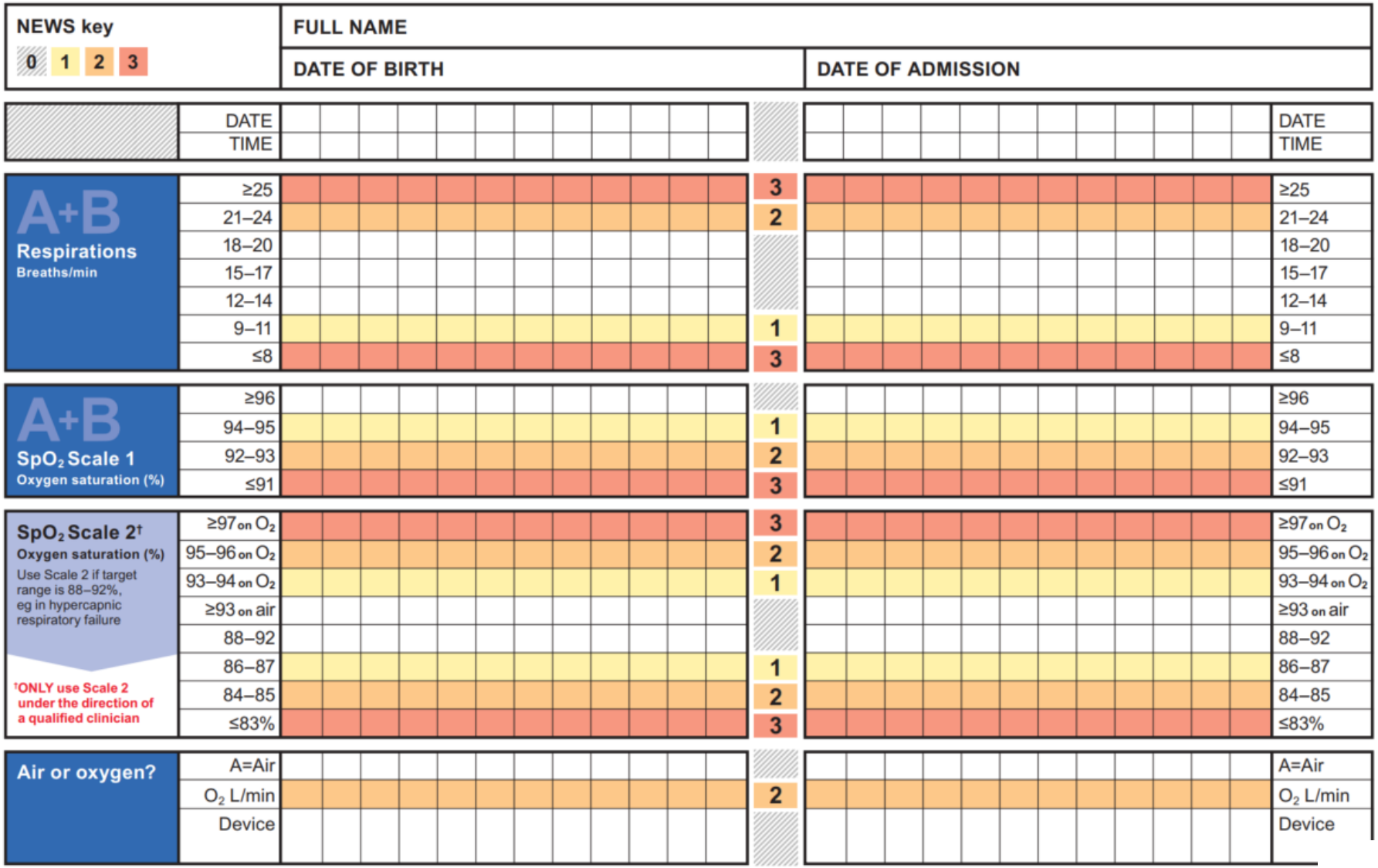
2. National Early Warning System Version 2 (NEWS2) – NHS UK

		Score	
A+B SpO$_2$ Scale 1 Oxygen saturation (%)	≥96		≥96
	94–95	1	94–95
	92–93	2	92–93
	≤91	3	≤91
SpO$_2$ Scale 2† Oxygen saturation (%) Use Scale 2 if target range is 88–92%, eg in hypercapnic respiratory failure	≥97 on O$_2$	3	≥97 on O$_2$
	95–96 on O$_2$	2	95–96 on O$_2$
	93–94 on O$_2$	1	93–94 on O$_2$
	≥93 on air		≥93 on air
	88–92		88–92
†ONLY use Scale 2 under the direction of a qualified clinician	86–87	1	86–87
	84–85	2	84–85
	≤83%	3	≤83%
Air or oxygen?	A=Air		A=Air
	O$_2$ L/min	2	O$_2$ L/min
	Device		Device

Scoring for SpO2 scale 1 and Scale 2

https://doi.org/10.7861/clinmedicine.19-3-260

Types of Early Warning Scores

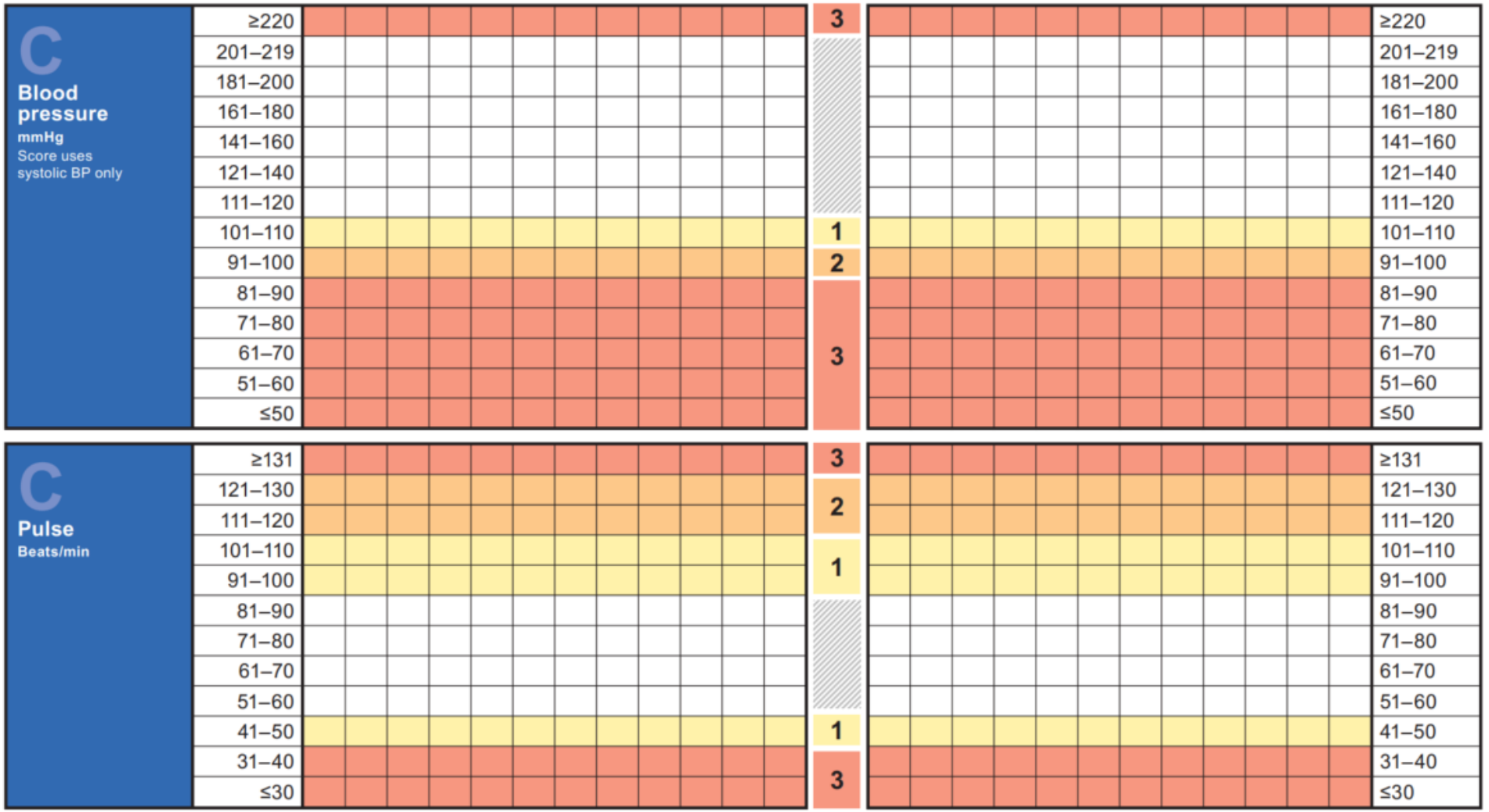


NEWS key 0 1 2 3	FULL NAME / DATE OF BIRTH		DATE OF ADMISSION	
	DATE / TIME			DATE / TIME
A+B Respirations Breaths/min	≥25	3		≥25
	21–24	2		21–24
	18–20			18–20
	15–17			15–17
	12–14			12–14
	9–11	1		9–11
	≤8	3		≤8
A+B SpO_2 Scale 1 Oxygen saturation (%)	≥96			≥96
	94–95	1		94–95
	92–93	2		92–93
	≤91	3		≤91
SpO_2 Scale 2† Oxygen saturation (%) Use Scale 2 if target range is 88–92%, eg in hypercapnic respiratory failure †ONLY use Scale 2 under the direction of a qualified clinician	≥97 on O_2	3		≥97 on O_2
	95–96 on O_2	2		95–96 on O_2
	93–94 on O_2	1		93–94 on O_2
	≥93 on air			≥93 on air
	88–92			88–92
	86–87	1		86–87
	84–85	2		84–85
	≤83%	3		≤83%
Air or oxygen?	A=Air			A=Air
	O_2 L/min	2		O_2 L/min
	Device			Device

Scoring part 1

https://doi.org/10.7861/clinmedicine.19-3-260

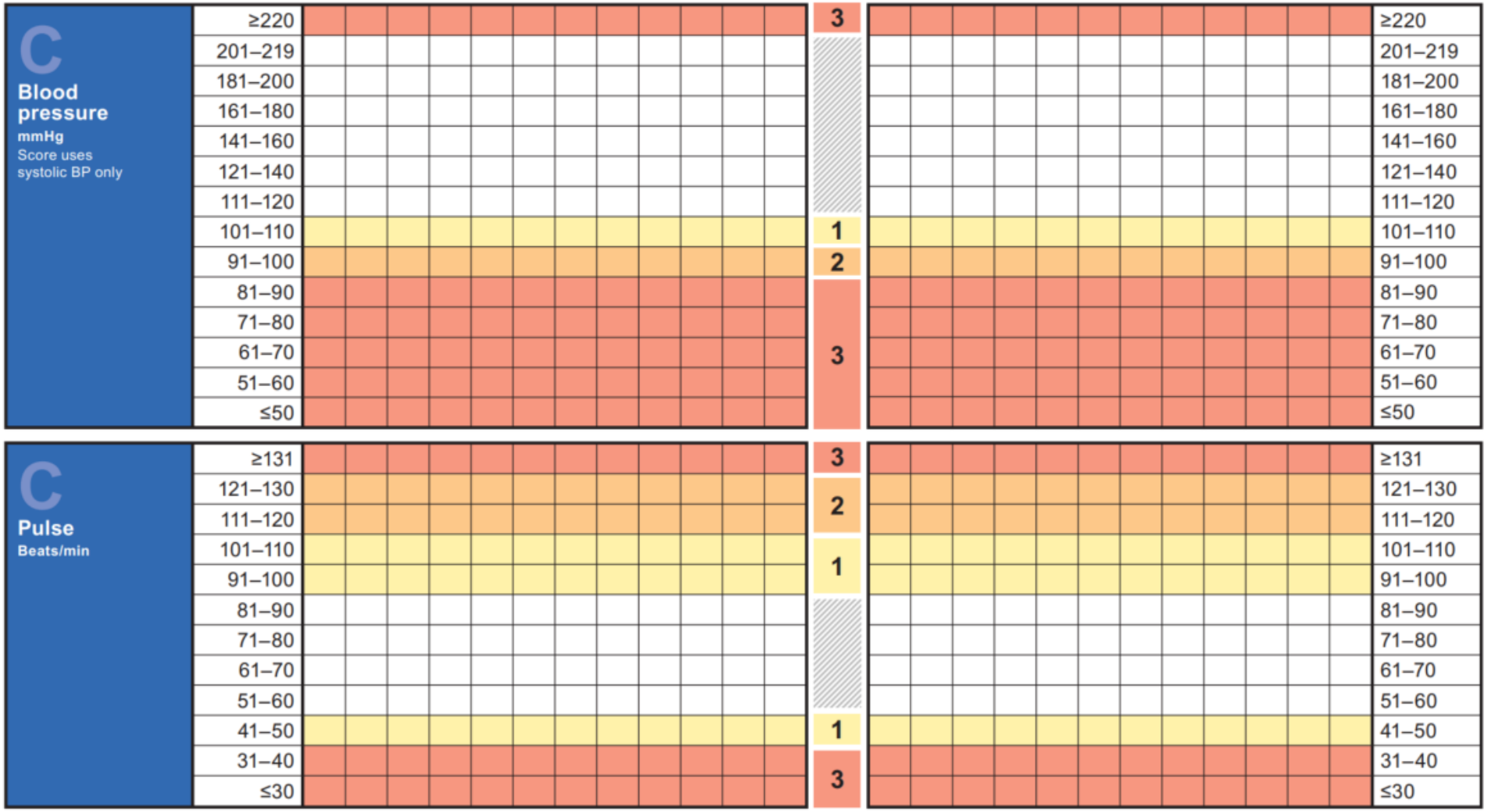
Types of Early Warning Scores



Scoring part 2

https://doi.org/10.7861/clinmedicine.19-3-260

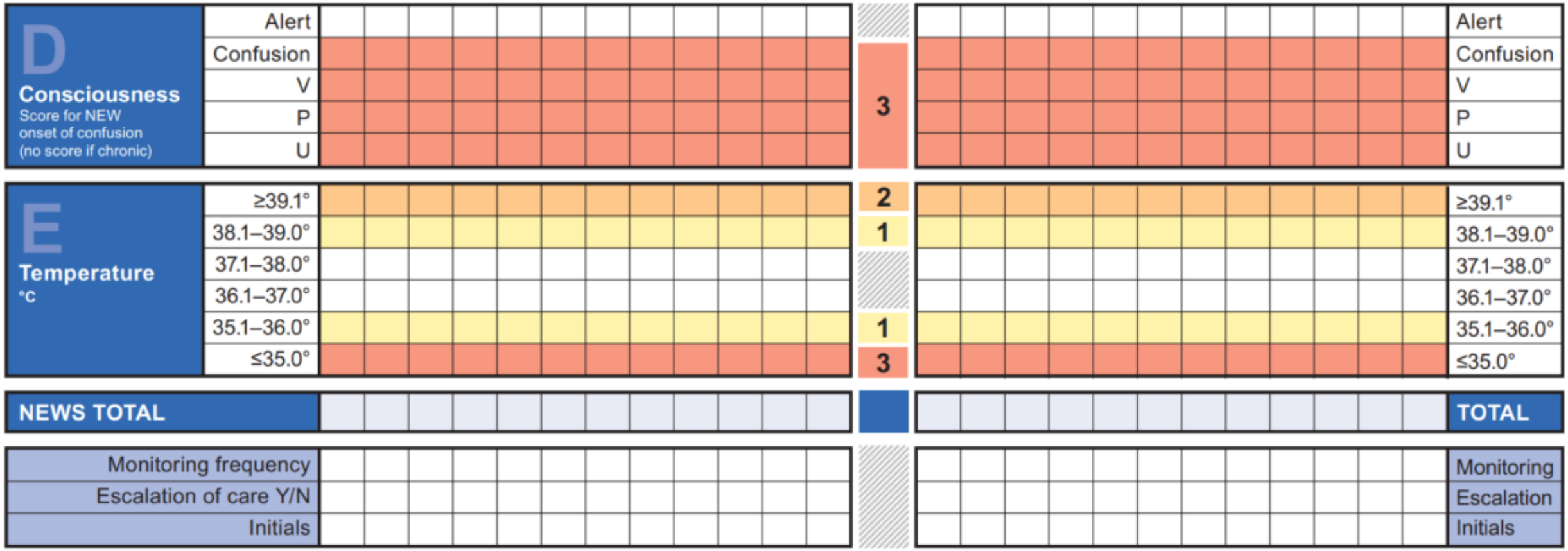
Types of Early Warning Scores



Scoring part 3

https://doi.org/10.7861/clinmedicine.19-3-260

Types of Early Warning Scores



D Consciousness Score for NEW onset of confusion (no score if chronic)	Alert												3		Alert
	Confusion														Confusion
	V														V
	P														P
	U														U
E Temperature °C	≥39.1°												2		≥39.1°
	38.1–39.0°												1		38.1–39.0°
	37.1–38.0°														37.1–38.0°
	36.1–37.0°														36.1–37.0°
	35.1–36.0°												1		35.1–36.0°
	≤35.0°												3		≤35.0°
NEWS TOTAL															TOTAL
Monitoring frequency															Monitoring
Escalation of care Y/N															Escalation
Initials															Initials

Scoring part 4

https://doi.org/10.7861/clinmedicine.19-3-260

Types of Early Warning Scores

2. National Early Warning System Version 2 (NEWS2) – NHS UK

NEW score	Frequency of monitoring	Clinical response
0	Minimum 12 hourly	• Continue routine NEWS monitoring
Total 1–4	Minimum 4–6 hourly	• Inform registered nurse, who must assess the patient • Registered nurse decides whether increased frequency of monitoring and/or escalation of care is required
3 in single parameter	Minimum 1 hourly	• Registered nurse to inform medical team caring for the patient, who will review and decide whether escalation of care is necessary
Total 5 or more Urgent response threshold	Minimum 1 hourly	• 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
Total 7 or more Emergency response threshold	Continuous monitoring of vital signs	• 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

Trigger and clinical response

https://doi.org/10.7861/clinmedicine.19-3-260

Types of Early Warning Scores

3. NEWSS – Stony Brook University Medical Center, USA

Stony Brook University Medical Center (SBUMC), NY, USA developed a single center Early Warning System and published it in 2012.

Since then, **many hospitals in Indonesia has used this version of EWS and renamed it as Nursing Early Warning System Scoring (NEWSS).**

Compared to NEWS and NEWS version 2, NEWSS contained **only 5 parameters:**

- Respiratory rate
- Heart rate
- Systolic blood pressure
- Degree of consciousness
- Temperature

https://doi.org/10.1097/01.nurse.0000410304.26165.33

Types of Early Warning Scores

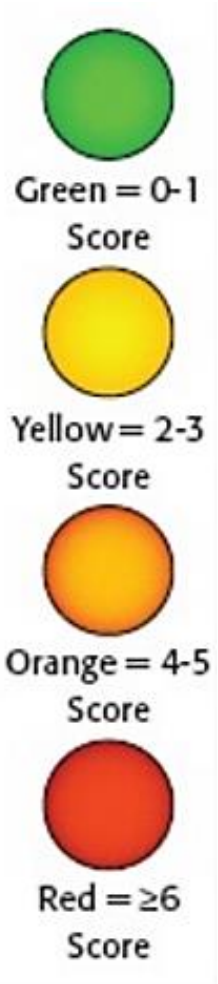
	3	2	1	0	1	2	3
Respiratory rate per minute		Less than 8	8	9-17	18-20	21-29	≥ 30
Heart rate per minute		Less than 40	40-50	51-100	101-110	111-129	≥ 130
Systolic blood pressure	≤ 70	71-80	81-100	101-159	160-199	200-220	> 220
Conscious level (AVPU)	Unrespon-sive	Responds to pain	Responds to voice	Alert	Agitation or confusion	New onset of agitation or confusion	
Temperature		< 95.0° F (35.0° C)	95.0-96.8° F (35.05-36° C)	96.9-100.4° F (36.05-38° C)	100.5-101.3° F (38.05-38.5° C)	≥ 101.4° F (38.55° C)	

Scoring

https://doi.org/10.1097/01.nurse.0000410304.26165.33

Types of Early Warning Scores

Trigger and clinical response



Yellow → reassessment by nurse on duty. If it was confirmed that the score is accurate → determine intervention, document assessment and intervention in the medical record, reassess within 2 hours

Orange → reassessment by nurse and notification of the resident → resident alerts the change to the senior resident and attending healthcare provider → medical staff takes appropriate action. The direct care nurse reassesses the patient within 1 hour

Red → notification of the **rapid response team and resident** → alerts the senior resident and attending healthcare provider → all respond to the patient's bedside. The rapid response team and primary care team collaborate on the patient's plan of care. The direct care nurse reassesses the patient within 1 hour.

https://doi.org/10.1097/01.nurse.0000410304.26165.33

How EWS Performs in Respiratory Distress and Failure?

EWS in COVID-19

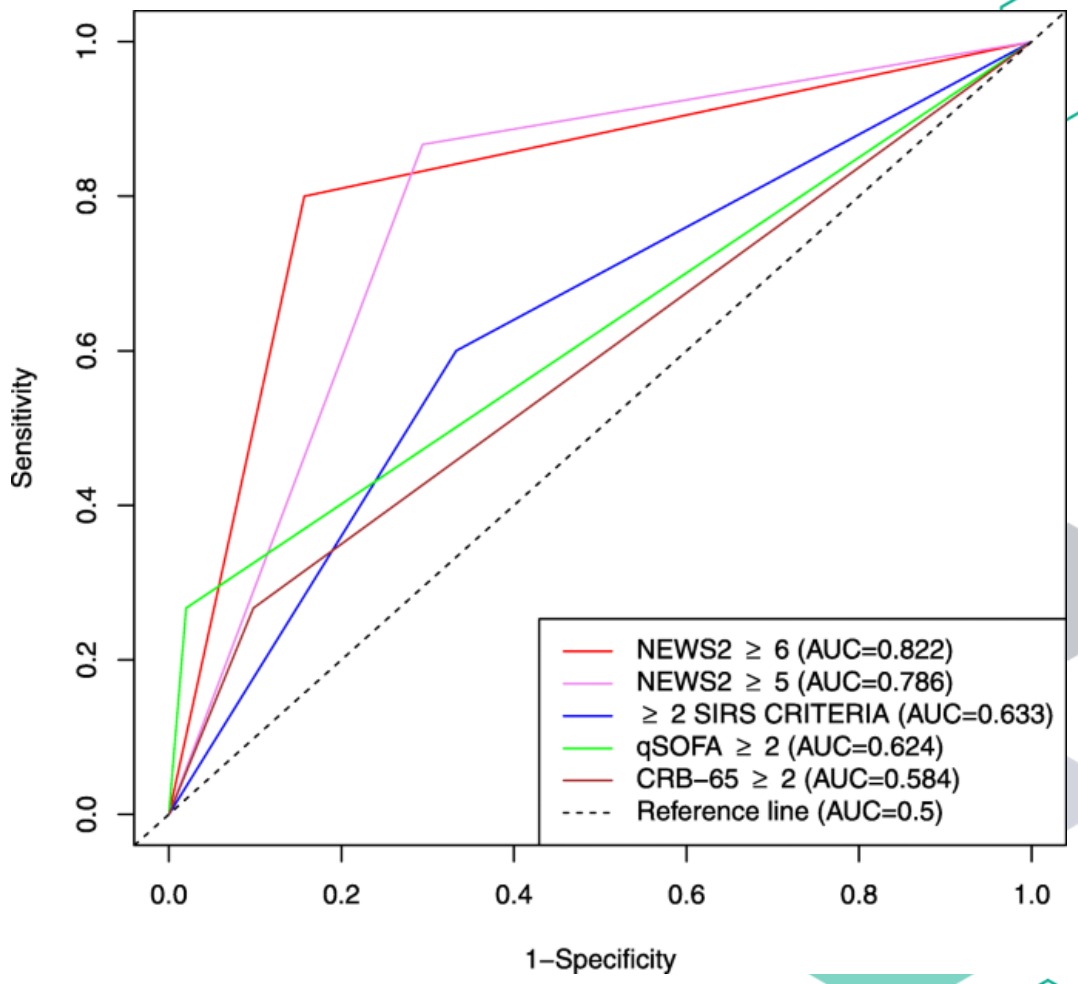
National Early Warning Score 2 (NEWS2) on admission predicts severe disease and in-hospital mortality from Covid-19 – a prospective cohort study

Marius Myrstad, Håkon Ihle-Hansen, Anders Aune Tveita, Elizabeth Lyster Andersen, Ståle Nygård, Arnljot Tveit & Trygve Berge

Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine **28**, Article number: 66 (2020)

The study calculated sensitivity and specificity for **NEWS2 scores ≥5 and ≥ 6 (AUC >0.75),** quick Sequential Organ Failure Assessment (qSOFA) score ≥ 2, ≥2 Systemic Inflammatory Response Syndrome (SIRS) criteria, and CRB-65 score ≥ 2

NEWS2 score at hospital admission predicted severe disease and in-hospital mortality, and was superior to other widely used clinical risk scores in patients with covid-19.



https://doi.org/10.1186/s13049-020-00764-3

How EWS Performs in Respiratory Distress and Failure?

EWS in COVID-19

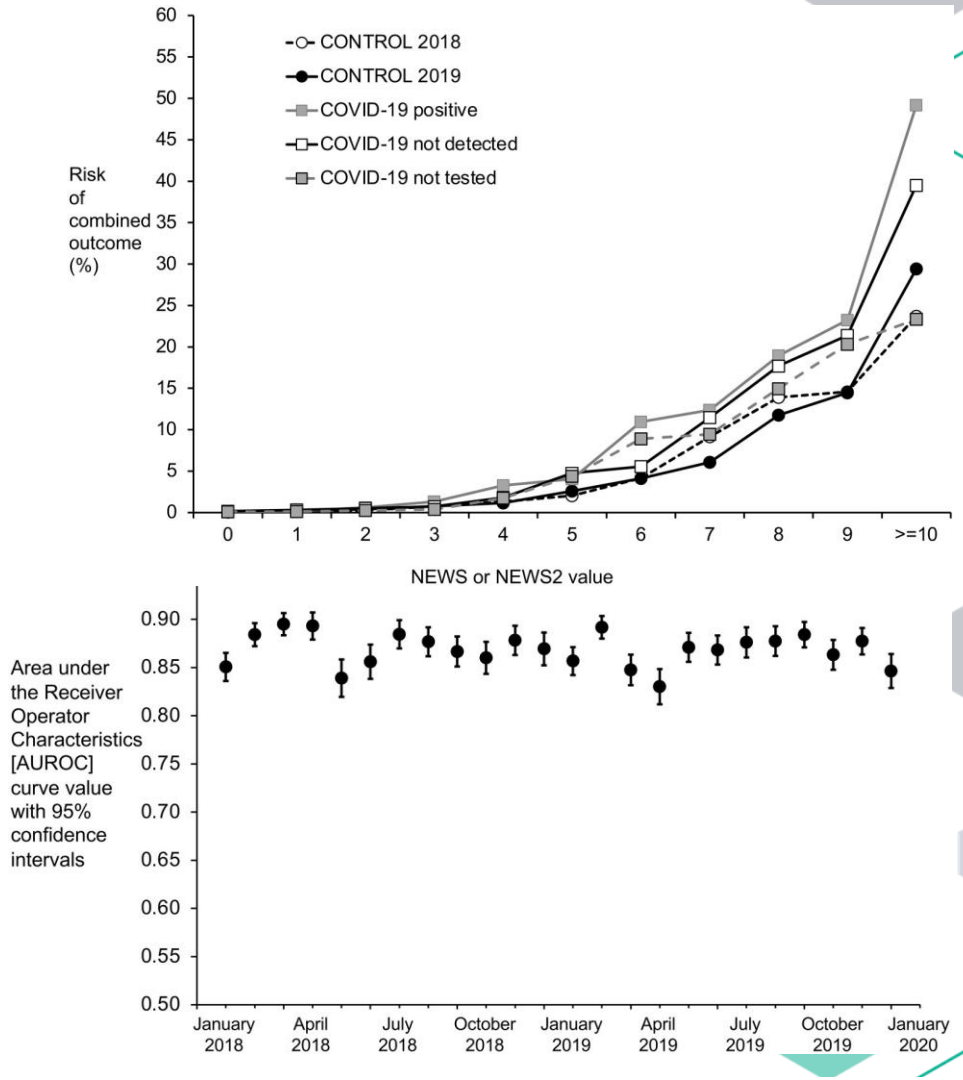
Resuscitation. 2021 Feb; 159: 150–157. PMCID: PMC7648887
Published online 2020 Nov 8. doi: 10.1016/j.resuscitation.2020.10.039 PMID: 33176170

The performance of the National Early Warning Score and National Early Warning Score 2 in hospitalised patients infected by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)

Ina Kostakis,[a] Gary B. Smith,[b,*] David Prytherch,[a] Paul Meredith,[c] Connor Price,[a] Anoop Chauhan,[d] and

•Area under the receiver operating characteristic (AUROC) curve is used to evaluate the performance of NEWS or NEWS2 to discriminate the combined outcome of either death or intensive care unit (ICU) admission within 24 h.

•**NEWS or NEWS2 performance was good and similar in all cohorts (range = 0.842–0.894)** suggests that amendments to NEWS or NEWS2, such as the addition of new covariates or the need to change the weighting of existing parameters, are unnecessary when evaluating patients with COVID-19.



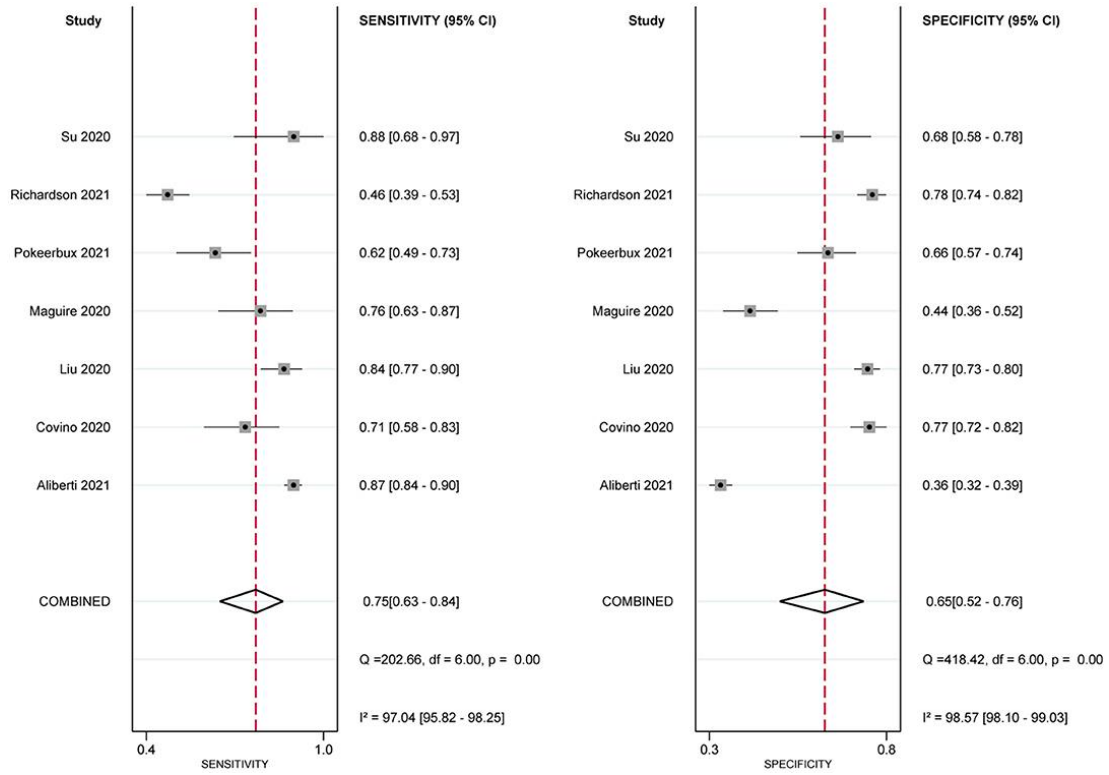
https://doi.org/10.1016/j.resuscitation.2020.10.039

How EWS Performs in Respiratory Distress and Failure?

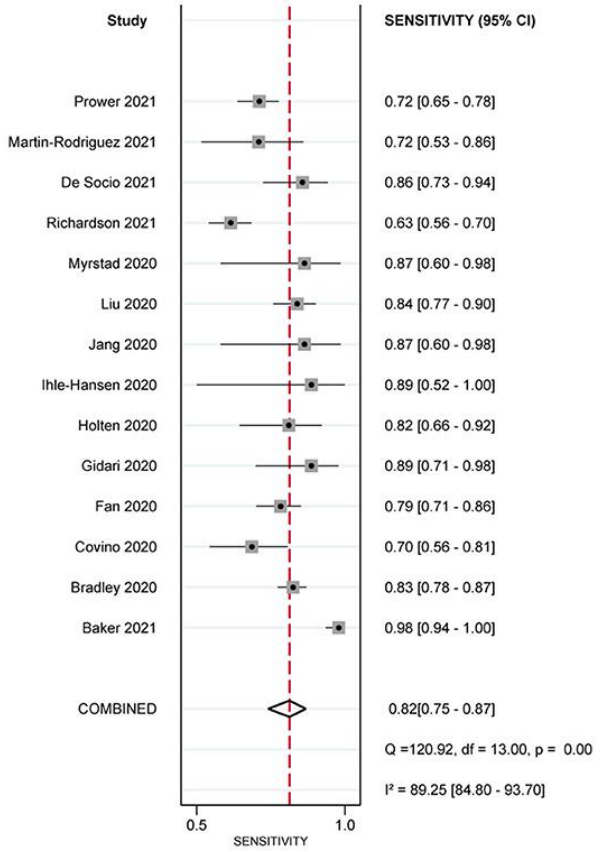
Front Med (Lausanne). 2021; 8: 699880.
Published online 2021 Jul 9. doi: 10.3389/fmed.2021.699880
PMCID: PMC8298908
PMID: 34307426

The Prognostic Accuracy of National Early Warning Score 2 on Predicting Clinical Deterioration for Patients With COVID-19: A Systematic Review and Meta-Analysis

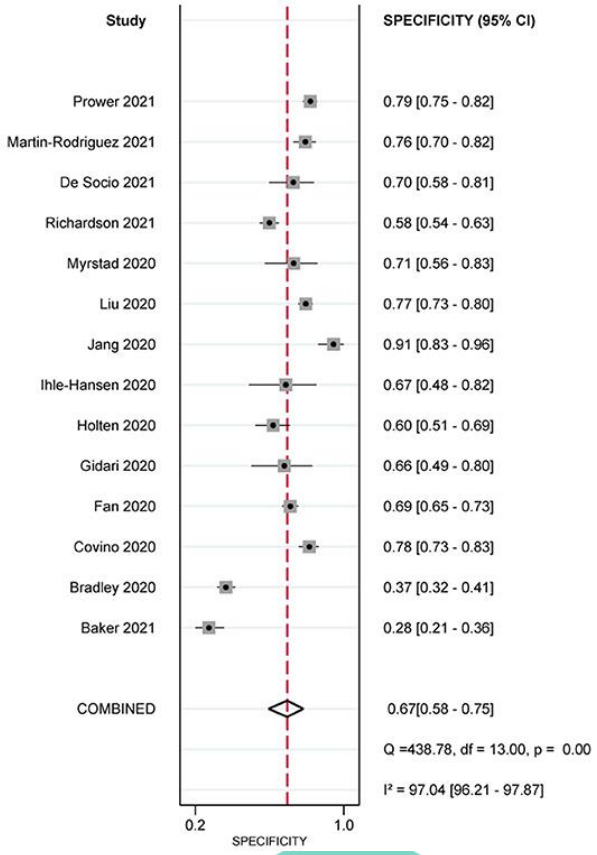
Kai Zhang,[1,†] Xing Zhang,[1,2,†] Wenyun Ding,[3,†] Nanxia Xuan,[1] Baoping Tian,[1] Tiancha Huang,[1] Zhaocai Zhang,[1] Wei Cui,[1] Huaqiong Huang,[3,*] and Gensheng Zhang[1,*]



NEWS



NEWS2

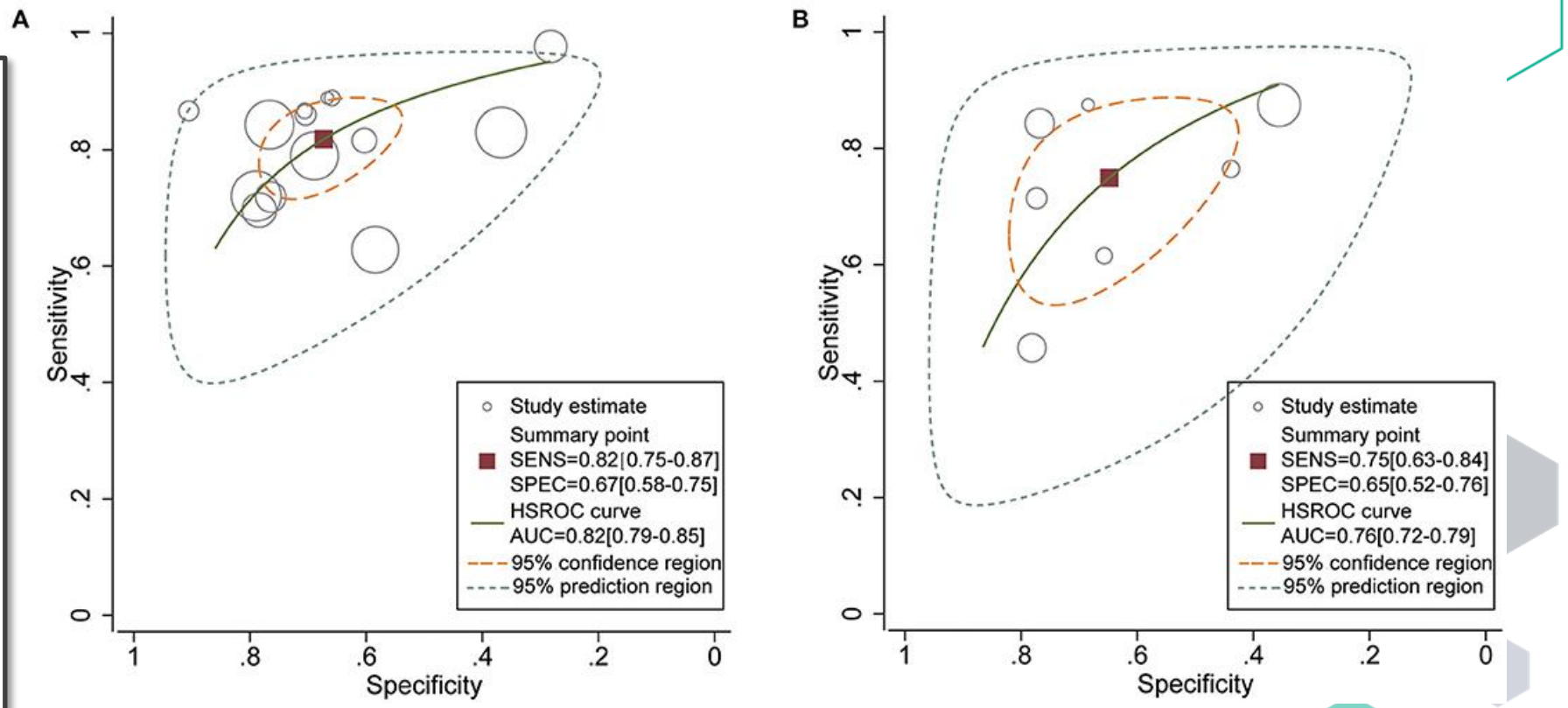


https://dx.doi.org/10.3389%2Ffmed.2021.699880

How EWS Performs in Respiratory Distress and Failure?

EWS in COVID-19

- Eighteen studies, 6,922 participants
- NEWS2 → **pooled sensitivity, specificity, and AUC were 0.82, 0.67, and 0.82, respectively**
- Adding new SpO_2 scoring scale for patients with hypercapnic respiratory failure → better sensitivity (0.82 vs. 0.75) and discrimination (0.82 vs. 0.76) vs NEWS
- **NEWS2 sensitivity: 0.88 for predicting short-term deterioration within 72 h**



NEWS2 → moderate sensitivity and specificity in predicting the deterioration of patients with COVID-19. The development of enhanced or modified NEWS may be necessary.

https://dx.doi.org/10.3389%2Ffmed.2021.699880

How EWS Performs in Respiratory Distress and Failure?

What are the problems with existing EWS in relation to COVID-19?

- NEWS2 and older EWS → **focus on sepsis** → assigns significant value to tachycardia and hypotension
- Cardiovascular compromise is **relatively uncommon in early stage** of COVID-19
- While respiratory rate may rise as COVID-19 patients deteriorate, there are reports of occult **paradoxical** hypoxemia/**happy hypoxia** (tachypnoea and increased work of breathing, experience of dyspnea are absent)

- Most novel prognostic and EWSs for COVID-19 have been developed without prospective external validation in large and diverse patient cohorts → **overestimation**

Hence, there is a need to develop EWS that can predict respiratory distress or failure specifically

http://dx.doi.org/10.1136/postgradmedj-2021-140086

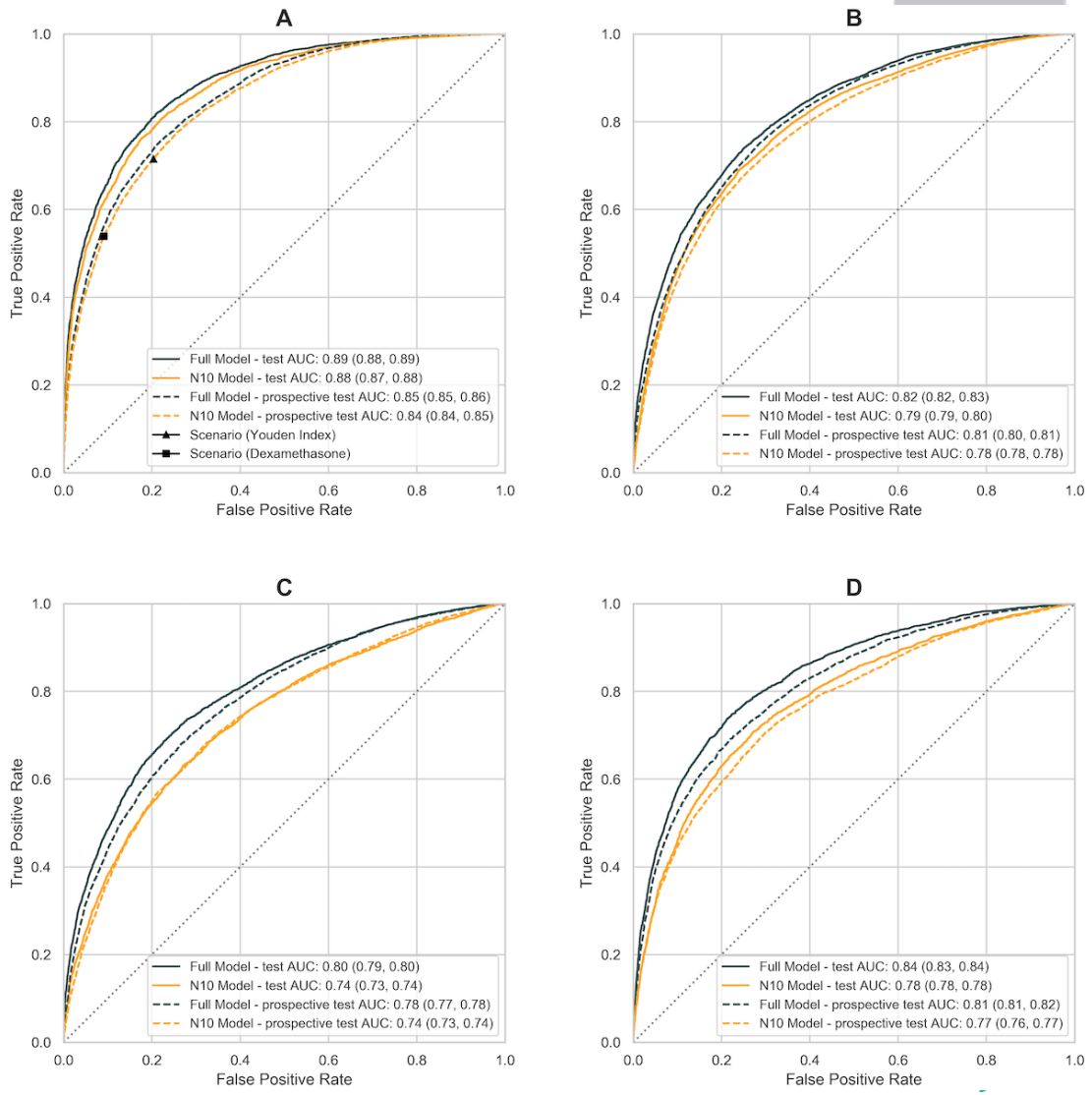
How EWS Performs in Respiratory Distress and Failure?

Future of EWS and COVID-19

The Development and Validation of Simplified Machine Learning Algorithms to Predict Prognosis of Hospitalized Patients With COVID-19: Multicenter, Retrospective Study

Fang He[1,2], BChE, PhD; John H Page[3], MD, SCD; Kerry R Weinberg[2], BSc, MBA, MSci; Anirban Mishra[2], BSc, MSc

- 3.7 million patients. The ML algorithms demonstrated high accuracy (AUC 0.89, 95% CI 0.89-0.89 on the test data set [n=10,752]), consistent prediction through the second wave of the pandemic from September to November (AUC 0.85, 95% CI 0.85-0.86)
- Use 10 predictors: age, blood urea nitrogen, SpO2, systolic and diastolic BP, respiration rate, pulse, temperature, albumin, and major cognitive disorder excluding stroke.



https://doi.org/10.2196/31549

How EWS Performs in Respiratory Distress and Failure?

Critics upon EWS in Hypercapnic Respiratory Failure (type II)

- Concern in NEWS → high score in patients with Hypercapnic Respiratory Failure (HCRF) might encourage inappropriate use of supplemental oxygen
- NEWS2 offers a SpO_2 chart specifically for patients with HCRF as compared to the previous version → the recommended SpO_2 range is 88%-92%
- Critics by Hodgson et al → validity of NEWS2 → SpO_2 scale to patients with acute exacerbations of chronic obstructive disease (AECOPD) reduced the sensitivity in detecting acutely ill patients compared with the original NEWS.

https://doi.org/10.7861/clinmedicine.19-1-94
https://doi.org/10.7861/clinmedicine.18-5-371

How EWS Performs in Respiratory Distress and Failure?

Critics upon EWS in Hypercapnic Respiratory Failure (type II)

- They have inappropriately applied the new SpO_2 scale 2 to all patients with AECOPD at first assessment, instead of the HCRF patients for whom the scale is specifically designed → overestimation of SpO_2 scale

- **The NEWS2 SpO2 scale 2 should not be used for the initial assessment of patients with AECOPD**

https://doi.org/10.7861/clinmedicine.19-1-94
https://doi.org/10.7861/clinmedicine.18-5-371

Conclusion

- Early warning score (EWS) or “Track or Trigger” are used to identify the deteriorating patient and reduce incidence of adverse events
- Commonly used EWS in **Indonesia are NEWS, NEWS 2, and NEWSS**
- The use of EWS should be accompanied with **proper understanding and training of medical staffs** and prompt clinical response
- **NEWS and NEWS 2 provide moderate accuracy for predicting COVID-19 outcomes**
- There is a need for development of better EWS for COVID-19 and **other respiratory diseases.**
- **Indonesia health system has also yet to adopt the newer EWS**

Thank You for Your Kind Attention

This presentation slide will be made available and downloadable at
https://s.id/dokterparu