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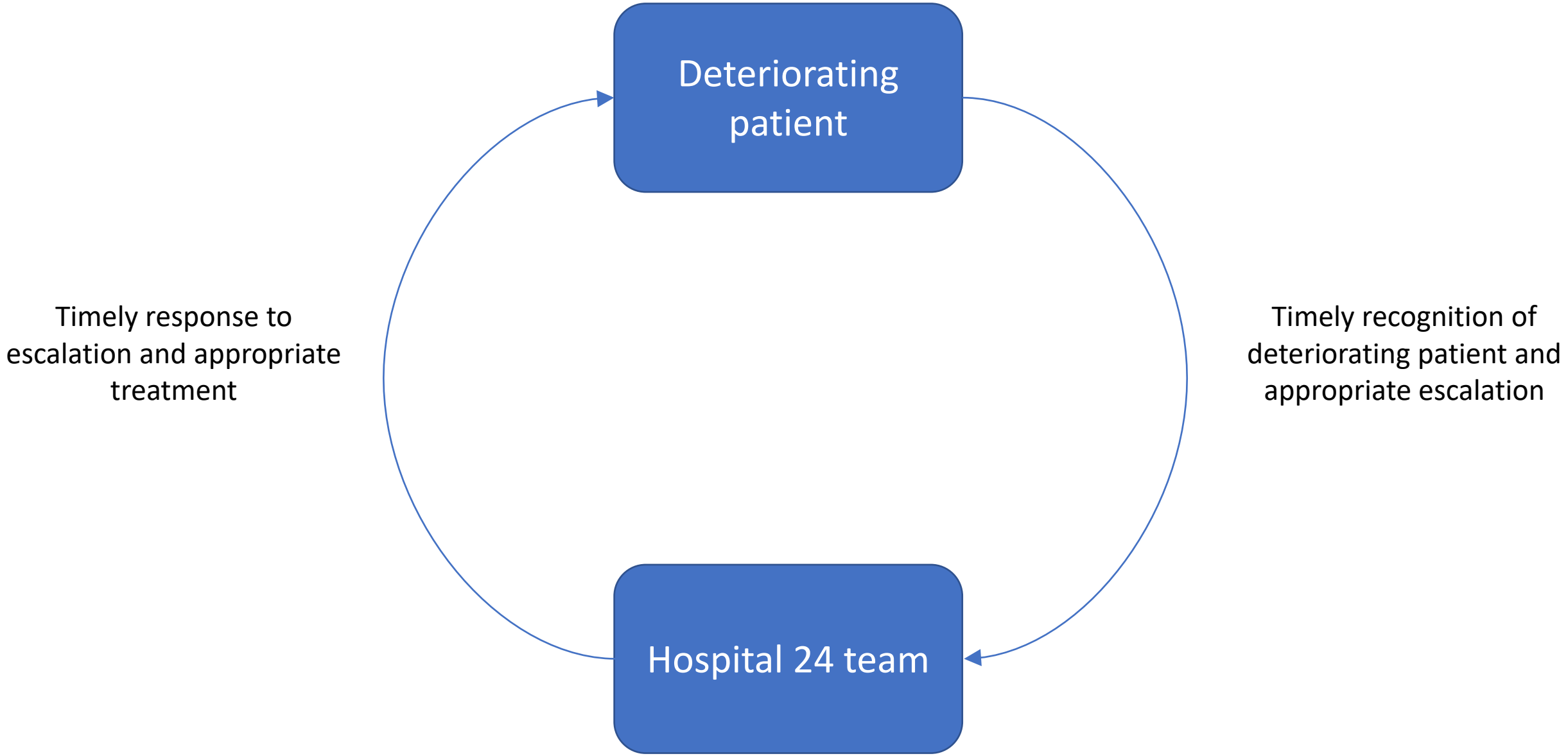
Deteriorating patient
Timely recognition of deteriorating patient and appropriate escalation
Hospital 24 team
Timely response to escalation and appropriate treatment

Physiological parameter	Score 3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO_2 Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO_2 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)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

National Early Warning Score-2, Royal College of Physicians 2017

NEW score	Clinical risk	Response
Aggregate score 0–4	Low	Ward-based response
Red score Score of 3 in any individual parameter	Low–medium	Urgent ward-based response*
Aggregate score 5–6	Medium	Key threshold for urgent response*
Aggregate score 7 or more	High	Urgent or emergency response**

* Response by a clinician or team with competence in the assessment and treatment of acutely ill patients and in recognising when the escalation of care to a critical care team is appropriate.

**The response team must also include staff with critical care skills, including airway management.

National Early Warning Score-2, Royal College of Physicians 2017

Problems with NEWS-2

NEWS-2 is simple and easy to use but:

- Only gives a snapshot view rather than trends over time.
- Many false alarms leading to extra work
- Can sometimes miss deteriorating patients

Developing a Dynamic Early Warning Score (DEWS) with AI and big data

- Nottingham University Hospitals has recorded clinical observations using an electronic task management system since 2015 (Nervecentre).
- 1100 admission episodes annotated manually by clinical researchers to extract “clinically significant deterioration (CSD)” events.
- Events matched to date and time-stamped clinical observations.
- Dataset split into training and validation sets.

	National Early Warning Score-2 (NEWS-2)	Dynamic Early Warning Score (DEWS)
Number of input variables	7	38
Input variables	Heart rate Respiratory rate Systolic blood pressure Temperature Oxygen saturations Supplementary oxygen (yes/no) Consciousness (ACVPU)	Raw values of observations Difference from previous value Rolling average Rolling SD Slope category
Scoring system	Score from 0 to 3 for each variable, added to produce a total from 0 to 20	Logistic regression model producing a continuous output from 0 to 1
Development	Expert consensus	Trained against outcome of clinician-defined deterioration

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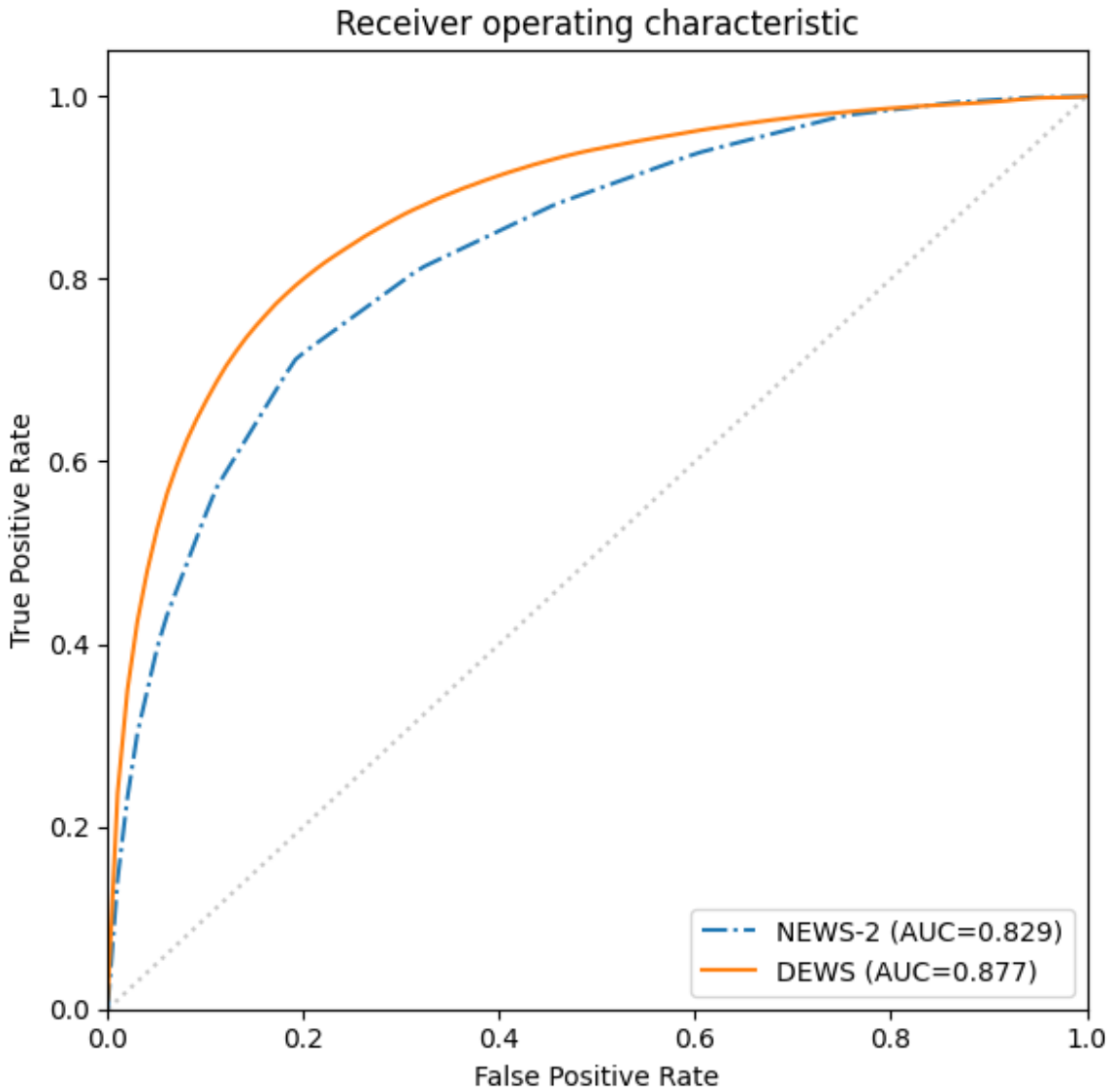
Respiratory Research

RESEARCH Open Access

Dynamic early warning scores for predicting clinical deterioration in patients with respiratory disease

Sherif Gonem[1,2*], Adam Taylor[3], Grazziela Figueredo[3,4], Sarah Forster[2], Philip Quinlan[3], Jonathan M. Garibaldi[4], Tricia M. McKeever[2] and Dominick Shaw[1,2]



Implementation challenges

- How to move DEWS from the research setting into a live clinical workflow?
- Work on-going to develop a Qliksense application to present DEWS alongside NEWS-2 in real-time.
- Prototype application working well but needs more frequent data updates.
- Eventual goal would be to incorporate into a task management system such as Nervecentre rather than having a separate application.