# Using Automated National Early Warning Score (NEWS) 2 in Early Detection of in-Hospital Patient Deterioration

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## 1. ABSTRACT

National Early Warning Score (NEWS) 2 was developed by the Royal College of Physicians to be used as early detection of in-hospital patient deterioration. The score has been shown to improve prognosis and triage efficiency. While the benefit of using a triage system has been established, in the real world, inefficient manual data entry and human error contribute to possible delays in identifying patients requiring intensive care transfers. Our team wanted to create an automated predictive model using informatics to improve the quality of patient care and healthcare provider workflow efficiency to identify high-risk patients who would benefit from early interventions by rapid-response teams.

## 2. Rationale & Background

The rationale of National Early Warning Score (NEWS) 2 use in early detection of in-hospital patient deterioration can be summed up in two main reasons:

1. Improving prognosis: 3-9 % of all hospitalized patients will demonstrate some type of indication for deterioration [1]. Patients who deteriorate and require urgent transfers to ICU or other escalation of care do worse than those with non-urgent transfers [2]. NEWS2 is designed to predict cardiac arrest and death within 48 hours [3].

2. Triage efficiency: Using an automated predictive model to identify high-risk patients for whom the rapid-response teams could implement the interventions was associated with decreased mortality, according to a study from 2020 [4].

## 3. Charter

**3.1. Problem Statement**: Inefficient manual data entry and human error contributing to possible delays in identifying patients requiring ICU transfers prior to patient deterioration.

**3.2. Aim Statement:** To improve the quality of patient care, and

healthcare provider workflow efficiency through using an automated predictive model to identify high-risk patients who would benefit from early interventions by rapid-response teams.

**3.3. Target Population**: All patients admitted to the hospital and require routine vital sign measurement, excluding pediatric patients and pregnant women.

**3.4. Evidence-Based Guidelines**: Royal College of Physicians. National Early Warning Score (NEWS) 2: Standardising the assessment of acute-illness severity in the NHS. Updated report of a working party. London: RCP, 2017 [5].

**3.5. Decision Support Tools**: The National Early Warning Score 2 (NEWS2) [5].

**3.6. Workflow Tools**: Automated alert system based on NEWS-2 score.

**3.7. Clinical Information Management System**: Customizable interface, automated alert and trigger manager, Electronic Healthcare Record (EHR) and dashboard for tracking vital signs, NEWS-2 score, and patient's outcome metrics

**3.8. Education Materials**: Healthcare provider (Residents, Physicians, Nurses, Pharmacists) and Patients' Families.;

**3.9. Outcome Metrics**: Qualitative: user satisfaction, and quantitative: return of investment.

**4. Protocol**

NEWS-2 is a scoring system using physiological parameters to identify acutely ill hospitalized patients [5]. A score of 0, 1, 2 or 3 is allocated to each parameter (Figure 1) [5]. A higher score means the parameter is further from the normal range [5]. Appropriate clinical responses are given for threshold (trigger) levels, with a recommendation for action (Table 1) [5].



**Figure 1**: NEWS-2 physiological parameters and score from © Royal College of Physicians 2017 [5].

**Table 1:** Risk and recommended action adopted from © Royal College of Physicians 2017 [5].

| Score/risk | Action |
|---|---|
| Low risk (score = 1 - 4) | Prompt assessment by ward nurse to decide on change to frequency of monitoring or escalation of clinical care. |
| Low to medium risk (score of 3 in any single parameter) | Urgent review by ward-based doctor to determine cause and to decide on change to frequency of monitoring or escalation of clinical care. |
| Medium risk (score = 5 - 6) | Urgent review by ward-based doctor or acute team nurse to decide on escalation to critical care team. |
| High risk (score ≥7) | Emergency assessment by critical care team, usually leading to patient transfer to higher-dependency care area. |

## 5. Current Workflow Status

The current workflow starts with a nurse measuring vitals, documenting them in EHR, calculating the score based on the previous slide, then documenting the score and making a decision (Figure 2). Some of the issues with the current status include missing scores due to missing vital documentation or inconsistent action.

## 6. Design Elements and Future Implementation

If we follow the Learning Health System, we start from 5 o'clock, showing our learning community of nurses, physicians and IT (Figure 3) [6]. For computing the knowledge, we will need an add-on function to the existing EHR. This will require a triggering event which is the vitals, to calculate the score and trigger alert. The trigger management will be using logic statements from the original protocol. The alert will be interruptive for a score of 5 and above, and the user is given options to choose from them. The deactivation function will be discussed in modification later. The timeframe is about 6-9 months, including a 3-4 month's education phase with ongoing data collection.

## 7. Wireframe / User Interface

We start with the input of the vital signs; then, the system will calculate the score and give a recommendation (Figure 4). The user will be able to document the action from the options menu, and if they choose to ignore the alert, they will have to fill in free text reason.

The bottom right of Figure 4 shows how it will be highlighted on the tracking board for the charge nurse.

## 8. Challenges Encountered and How to Address

As for the challenges, we divided them up into three categories, technical, human factor and cost-related (Figure 5).

For the technical part, obviously, the issue with privacy and security which should be covered by existing hospital policies. The hospital generator should cover any issue with any power shutdown. For downtime, the score will be done manually, and during uptime, we will follow the existing hospital procedure.

For the human factor, some of it affects the alternative approach if the EHR is in downtime or power is off. To ensure accurate measurement and proper use of the manual protocol, we will implement education and training. Another human factor is timely entered, and this is one of the future modifications to sync up the vital machine with the system. Alert fatigue is one of the important challenges and might affect the uptake for which constant review of the data and reason for ignoring the alert will help improve the function.

As for the cost, it will include installation, configuration and maintenance, and the cost will roughly be 40,000-120000 USD and should be offset by a decrease in the cost of ICU admission and hospital length of stay.
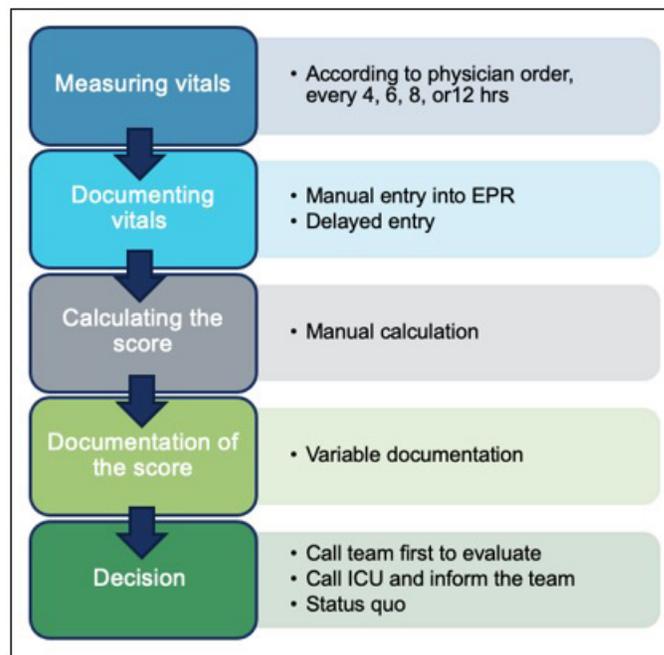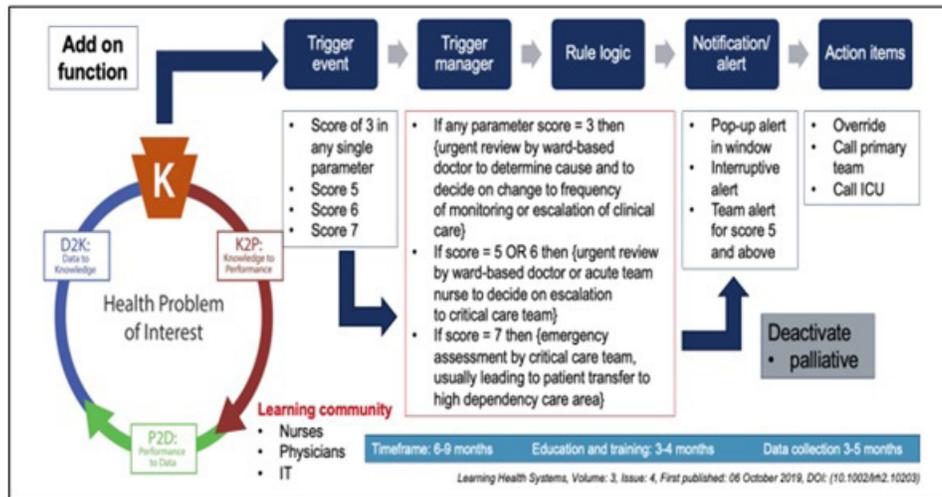


**Figure 2**: Current workflow

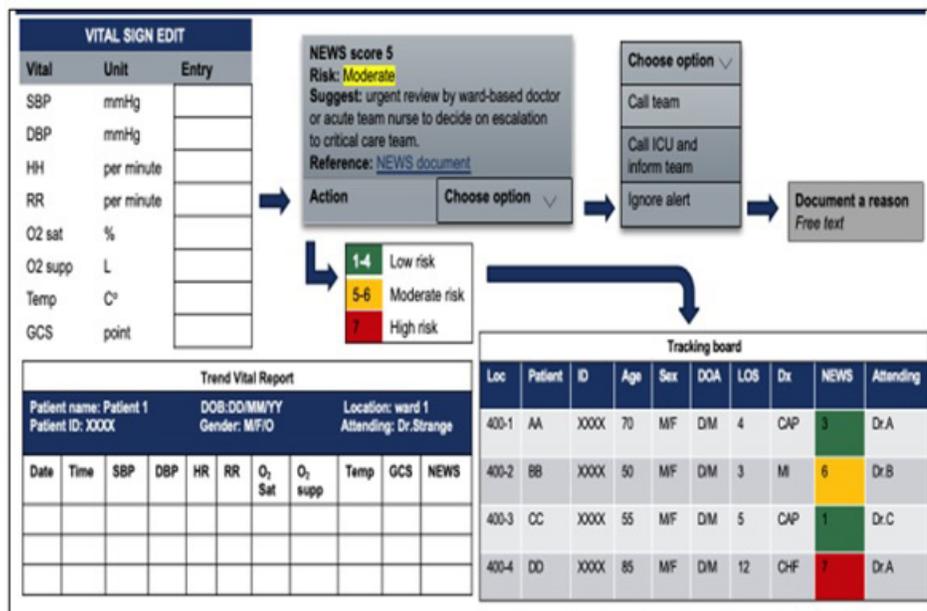**Figure 3**: Design elements and future implementation



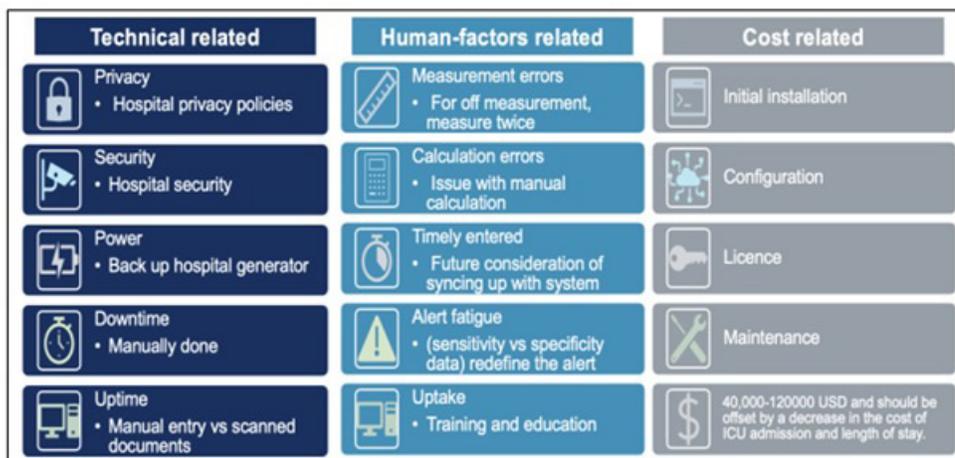**Figure 4**: Wireframe/user interface



**Figure 5**: Challenges encountered and how to address them

## 9. Approach to Evaluation and Metrics Used to Track Success

Our approach to evaluation includes both qualitative and quantitative to meet our goal of reducing avoidable harm and making the service more efficient (Table 2).

The metrics that will be focusing on include the process to identify reasons for alert overridden and output metrics to achieve a goal of 30 % reduction in the number of patients requiring ICU transfer and number of codes blue pre- and post-implementation.

For the second goal, we will focus on the outcome metrics to achieve 70% user satisfaction and a 30% reduction in cost. Also, reducing the time spent to 150 seconds when using automated process compared to the current workflow time [7]. This will ensure sustainability, and the inherent nature of the EHR will make it easier to scale.

**Table 2:** Approach to evaluation and metrics used to track success

| GOAL | EVALUATION | | | | | |
| | QUALITATIVE | | | QUANTITATIVE | | |
| | Metrics | Type | KPI | Metrics | Type | KPI |
|---|---|---|---|---|---|---|
| Reducing avoidable harm | Reason alerts overridden | Process | Decrease overridden alerts | Number of patients requiring ICU transfer(pre/post) | output | 30% reduction |
| | | | | Number of code blue(pre/post) | output | 30% reduction |
| Making services more efficient | User satisfaction (pre/post) | Outcome | 70% satisfaction | Return of investment | Outcome | 30% reduction |
| | | | | Time spent (pre/post) | Structure | 3 minutes 35 seconds vs 50 seconds* |
| Time took to capture and record the 6 psychological parameters and calculate a NEWS manually vs Using the technology. | | | | | | |
| **KPI:** Key performance indicators | | | | | | |
| 1. Wong D, Bonici T, Knight J, Gerry S, Turton J, Watkinson P. A ward-based time study of paper and electronic documentation for recording vital sign observations *J Am Med inform Assoc*. 2017; 24(4):717-721. doi:10.1093/jamia/ocw186 | | | | | | |

## 10. Discussion

Integrating the NEWS-2 scoring system into the exiting hospital EHR to create an automated alert system will help decrease errors and predict in-hospital deterioration for early intervention. The idea can be elevated further to use data collected to refine its accuracy and serve its aim with internal validation. Given that we are dealing with an electronic system, an alternative approach needs to be established to ensure the manual operation is optimal via education and training during downtime.

The NEWS 2 scoring system may not be accurate in the COVID-19 population, which has been shown to have high false trigger rates [8]. Another consideration when designing the system is to consider the patient's baseline condition for which the action is deferred to clinical judgment and bedside assessment. While the NEWS-2 score aims to identify early deterioration of in-hospital patients, manual deactivation of the alert for palliative patients is warranted in the design to align with the goals of care.

Lastly, full automation of the system to include automatically capturing the vital signs and transferring the data via Bluetooth or paring to EHR is ideal for bypassing the manual entry of vital signs and ensuring timely entered vitals.

## 11. Acknowledgment

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