ILCOR 10 Steps to improve IHCA – A Single Early Warning Sign System with Broad Clinical Reach and Low Activation Threshold for Clinically Deterioration Outperforms the National Early Warning Score Markedly Reducing In-Hospital Cardiac Arrests

Background:

The National Early Warning Score (NEWS) is widely utilized to identify patients at risk of adverse outcomes, including cardiac arrests, unplanned ICU admissions, and deaths.[1-4] NEWS is a point-based system assessing blood pressure, pulse rate, respiratory rate, oxygenation, need of oxygen, mental status, and body temperature, recommending specific actions according to total point summation, with Rapid Response System (RRS) activation for ≥ 7 points. NEWS was selected to be included in the new Federal Electronic Health Record throughout the VA enterprise. However, despite the ability to identify patients at risk of adverse outcomes, NEWS and other early warning signs have not demonstrated to reduce these adverse outcomes.[2,3,5] A Cochrane Systematic Review published in 2021[3] concluded that based on currently available evidence no strong recommendations could be made regarding the effectiveness of Early Warning Systems and RRS.

Steps Taken:

At our institution, we developed a Single Early Warning Sign (SEWS) system for RRS activation (Figure 1). SEWS includes 14 signs and prompts RRS activation for any one sign not requiring point summation. Once RRS is activated, the patient is assessed by an ICU nurse with an ICU resident within < 10 minutes followed by discussion with the ICU attending and disposition. Of the 14 SEWS, only six have representation in NEWS. Accordingly, our SEWS system operates with a wider scope and lower threshold for RRS activation than NEWS.

We analyzed 182 RRS activations and the corresponding clinical dispositions using our SEWS system from July 1, 2022, to August 21, 2023, and compared the activation thresholds and dispositions that would have occurred had NEWS been used. For a given SEWS with a comparable NEWS sign, we assigned the maximal points to the equivalent NEWS sign.

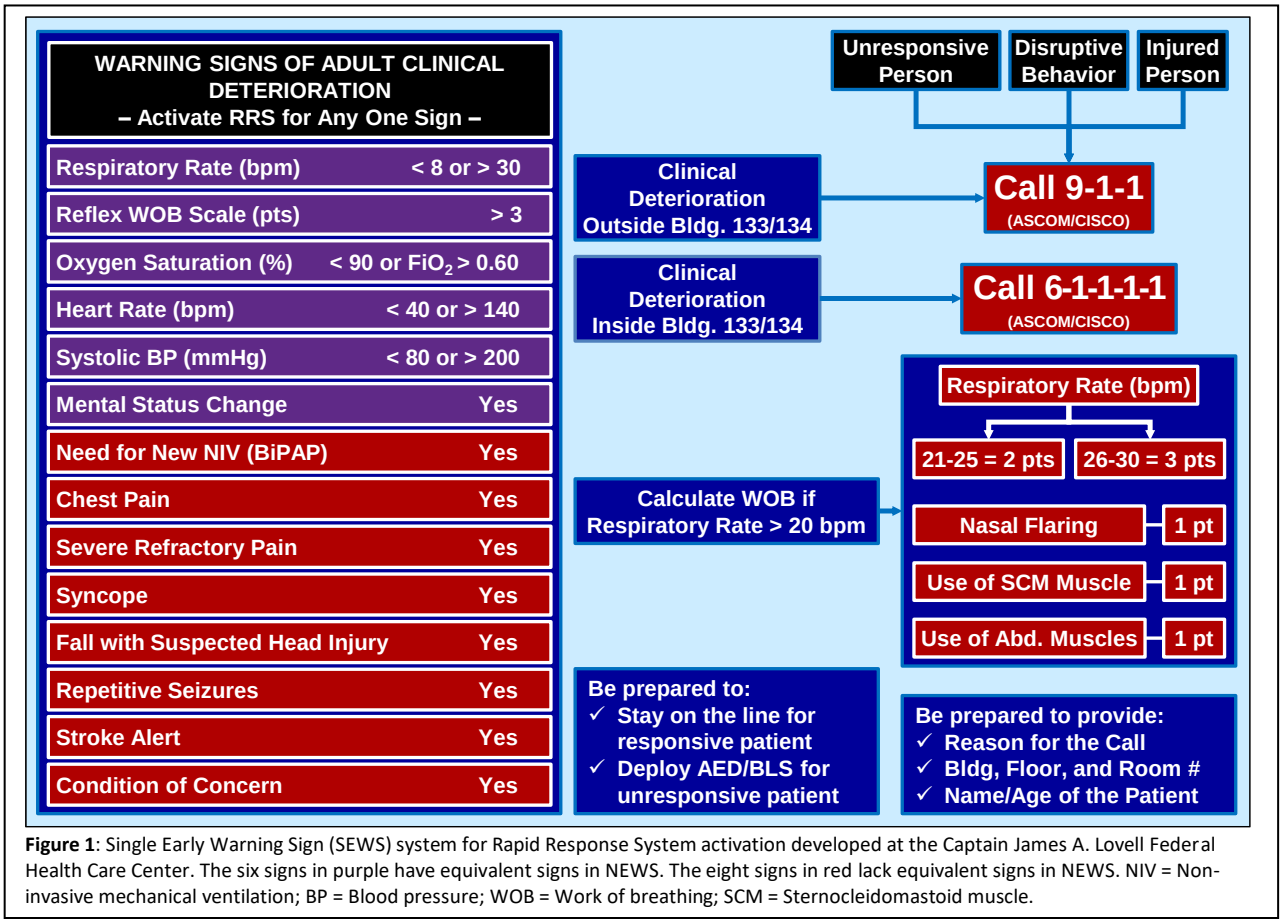

Figure 1: Single Early Warning Sign (SEWS) system for Rapid Response System activation developed at the Captain James A. Lovell Federal Health Care Center. The six signs in purple have equivalent signs in NEWS. The eight signs in red lack equivalent signs in NEWS. NIV = Non-invasive mechanical ventilation; BP = Blood pressure; WOB = Work of breathing; SCM = Sternocleidomastoid muscle.

Challenge:
Our SEWS system was developed "organically" over more than two decades by the ICU team after recognizing the importance of early treatment of patients deteriorating outside the ICU to avoid further deterioration and eventual cardiac arrest. The benefit to the patients and the ICU team removed barriers for implementation and fostered a culture of patient safety spreading from the ICU team to our entire facility.

Results:
The 182 RRS activations were responsive to 245 SEWS with 45 (24.7%) activations including more than one SEWS. Only 59.6% of the activations had an equivalent sign in NEWS with 40.4% of the activations triggered by signs not present in NEWS, including "Condition of Concern" which was the most frequent activation sign after "Mental Status Change" (Figure 2A). Of the 182 RRS activations, 122 patients (67%) were transferred to a higher level of care including 58 (31.9%) to ICU, mostly from the general medical ward, and 57 (31.3%) to the Emergency Department for evaluation, mostly from our nursing home. Only 59 patients (32.4%) remained at their site of origin.

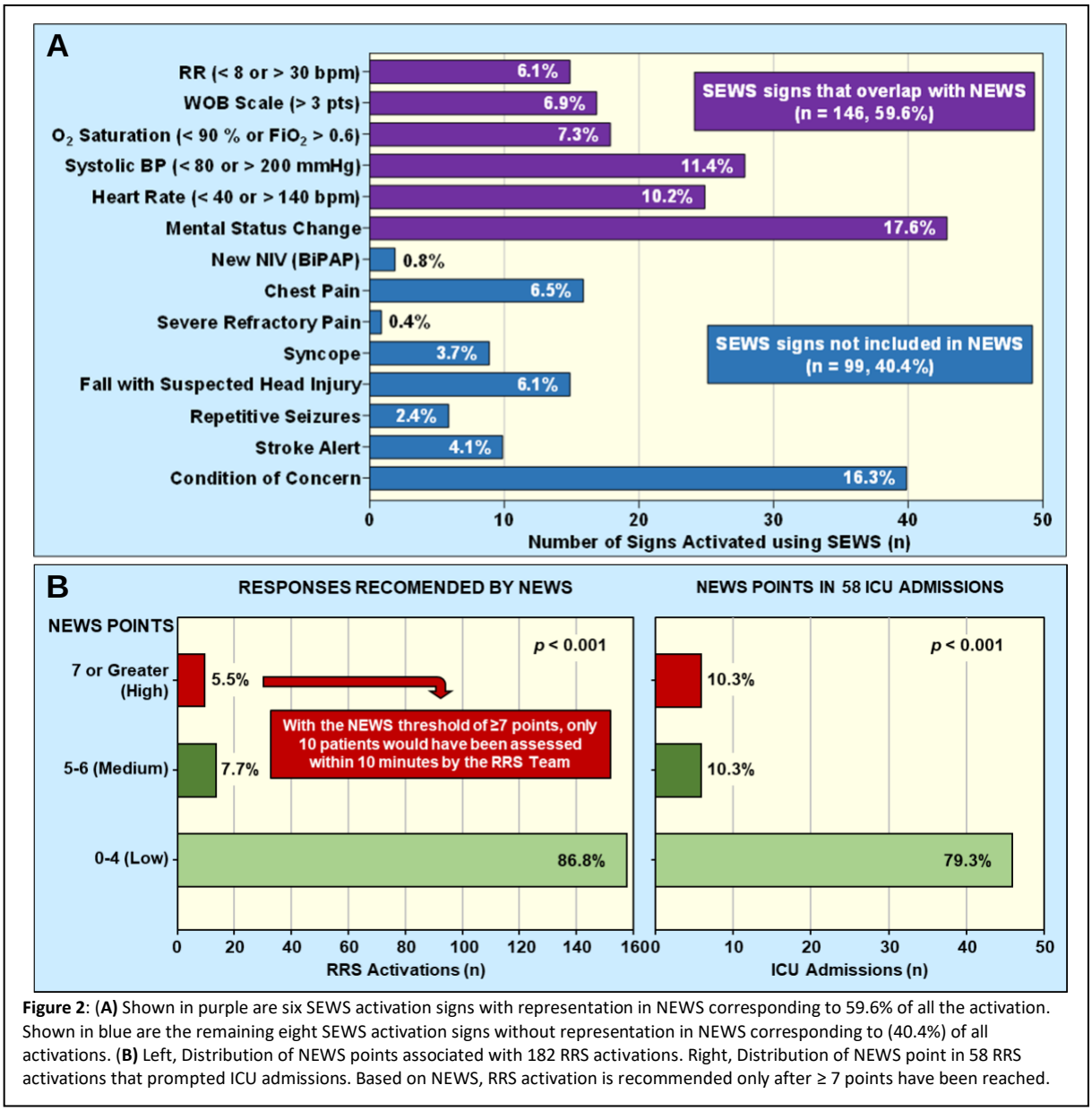

Figure 2: (**A)** Shown in purple are six SEWS activation signs with representation in NEWS corresponding to 59.6% of all the activation. Shown in blue are the remaining eight SEWS activation signs without representation in NEWS corresponding to (40.4%) of all activations. (**B)** Left, Distribution of NEWS points associated with 182 RRS activations. Right, Distribution of NEWS point in 58 RRS activations that prompted ICU admissions. Based on NEWS, RRS activation is recommended only after ≥ 7 points have been reached.

Figure 2B-Left, shows that using NEWS, only 10 of the 182 patients (5.5%) would have reached the ≥ 7-point threshold for RRS activation. Most of the patients (158 patients, 86.8%) scored between 0 and 4 NEWS points at the time of RRS activation, which is defined as low, recommending not to drive interventions or simply increase the frequency of vital signs measurement. Figure 2B-Right, shows 58 patients admitted to ICU after RRS activation. Only 6 (10.3%) of these patients reached the NEWS threshold for RRS activation and 46 (79.3%) were classified as low risk despite the decision of ICU admission, which would have delayed evaluation by the RRS team until further clinical deterioration.

During the period of our analysis, there were three in-hospital cardiac arrests (IHCA) for 3554 hospital admissions to areas covered by our RRS resulting in an incidence of 0.8 per 1000 hospitalizations. A study by Bradley *et al*. published in 2017 reported a median IHCA incidence of 4.0 per 1000 hospitalizations in 101 VA hospitals, ranging from 1.4 to 11.8 per 1000 hospitalizations.[5]

Outlook:

The reported failure of NEWS to impact outcomes in hospitalized patients at risk of cardiac arrest, unplanned ICU admissions, and deaths[2] can be attributed to the narrow scope of warning signs and the considerably high threshold for RRS activation, consequently delaying the recognition and treatment of patients who are deteriorating. In addition, NEWS is prone to "alarm fatigue" and studies have reported that frontliner nurses end up ignoring it.[2] In contrast, our SEWS system outperformed NEWS and was associated with a markedly low IHCA incidence. The superior performance was attributed to its broad clinical reach and substantially lower activation threshold for RRS activation prompting earlier recognition and treatment of patients suffering clinical deterioration.

We believe that national healthcare initiatives, including RRS implementation, should (1) be driven by solid scientific evidence that demonstrates improvement in patient outcome, (2) ensure that they do not disrupt and/or stifle local initiatives but instead encourage innovation, and (3) that assessment of their performance be primarily based on outcome measurements instead of process measurements (e.g., incidence of IHCA, unplanned ICU admissions, and deaths).

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