

Effectiveness of implementing modified early warning system for inpatient in general wards of a medical center in Taiwan

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Introduction

- The Modified Early Warning System (MEWS) is a well-validated tool widely used to detect unexpected deterioration of hospitalized patients.
- This study aimed to assess the effectiveness and impact of implementing MEWS for the inpatients who stayed in the general ward (GW).

Methods

- Adult inpatients were retrospectively included between January 2017 and February 2022 (Fig. 1).
- If MEWS score ≥ 7 points, a warning message will automatically send to notify the Rapid Response Team (RRT) members. If the score is 5 or 6 or if the scores of three vital signs are ≥ 1 , a warning is issued, and the nursing staff visits the patient and determines whether RRT members must be notified. Buffer time and Too-early warning were defined to assessing the appropriateness of the warning time (Fig. 2).
- The primary outcome defined unplanned admission(s) to intensive care units (upaICU) as unexpected deterioration.

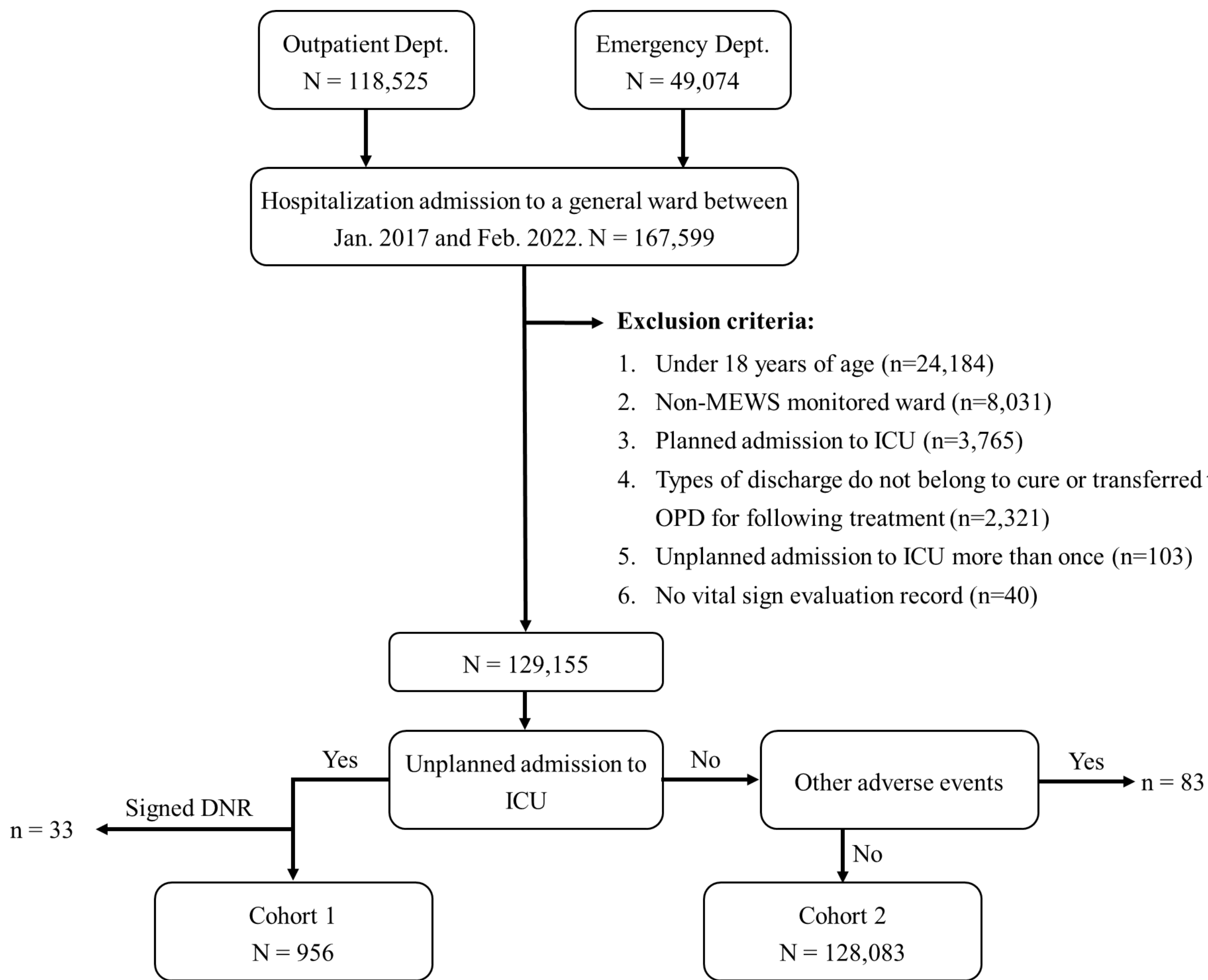


Figure 1. Flowchart of selection of the study cohorts.

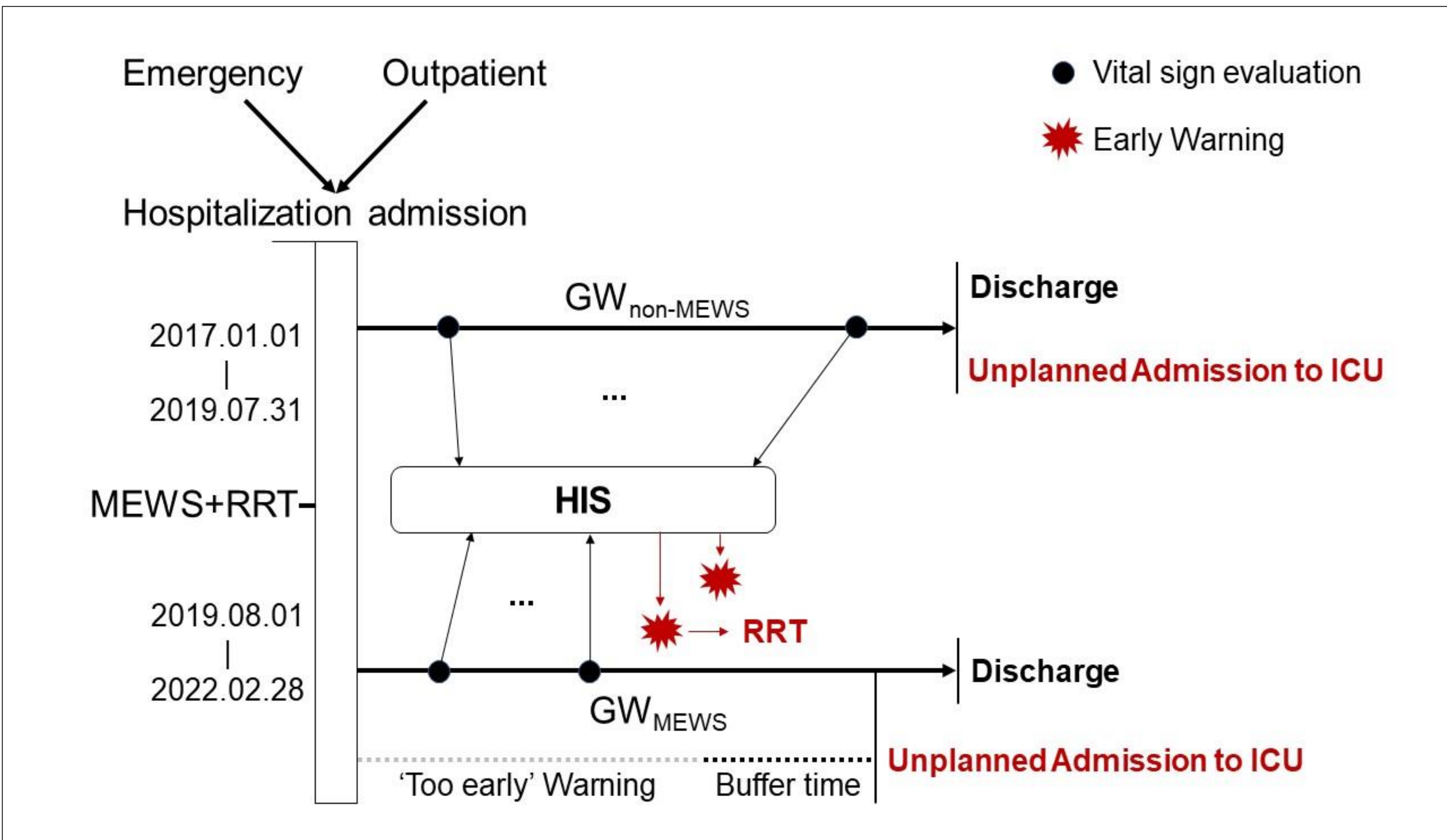


Figure 2. Overview of the study process.

\$GW_{non-MEWS}\$: control group, before MEWS implementation; \$GW_{MEWS}\$: study group, after MEWS implementation. Buffer time: warning within 24 h before unplanned ICU admission; Too-early warning: warning more than 24 h before unplanned ICU admission.

Conclusion

Implementing Modified Early Warning System (MEWS) and Rapid Response Team (RRT) increases the monitoring and intervention by nursing staff and reduces unplanned intensive care units admissions.

Results

- A total of 129,039 inpatients were included and composed of 58,106 \$GW_{non-MEWS}\$ and 71,023 \$GW_{MEWS}\$.
- The numbers of upaICU of \$GW_{non-MEWS}\$ and \$GW_{MEWS}\$ were 488 (.84%) and 468 (.66%), indicating that the implementation significantly reduced the occurrence of unplanned admission to the ICU (\$p<.0001\$).
- 1,551,525 times of MEWS assessments were produced for the \$GW_{MEWS}\$; among these assessments, there were 1,525,720 assessed as true negatives for the "Normal" or "Too early" subgroups, while the remaining 3,678 were assessed as false negatives for "Buffer time". In contrast, among the 22,127 times of MEWS that met the criteria for warning, only 1,568 (7.1%) were in the interval of "Buffer time" (Table 1).
- A total of 24% of all upaICU (230/956) occurred on the first admission day and 36.3% of all upaICU occurred within the first 3 days after admission from the ED (Fig. 3).
- The contributions of each vital sign in the MEWS evaluations demonstrated the respiratory and pulse rates contributed significantly to the MEWS evaluation. (Fig. 4).

Table 1. Predictive performance of the MEWS.

MEWS	Time period		Performance
	Normal inpatients Too early [§]	Buffer time [§]	
No warning	1525720	3678	NPV=99.8%
Warning	20559	1568	PPV=7.1%
Performance	Specificity=98.7%	Sensitivity=29.9%	Accuracy=98.4%

*NPV: Negative predicted value; PPV: Positive predicted value

§The MEWS measurements in "Too early" and "Buffer time" periods were comprised solely from ICU patients

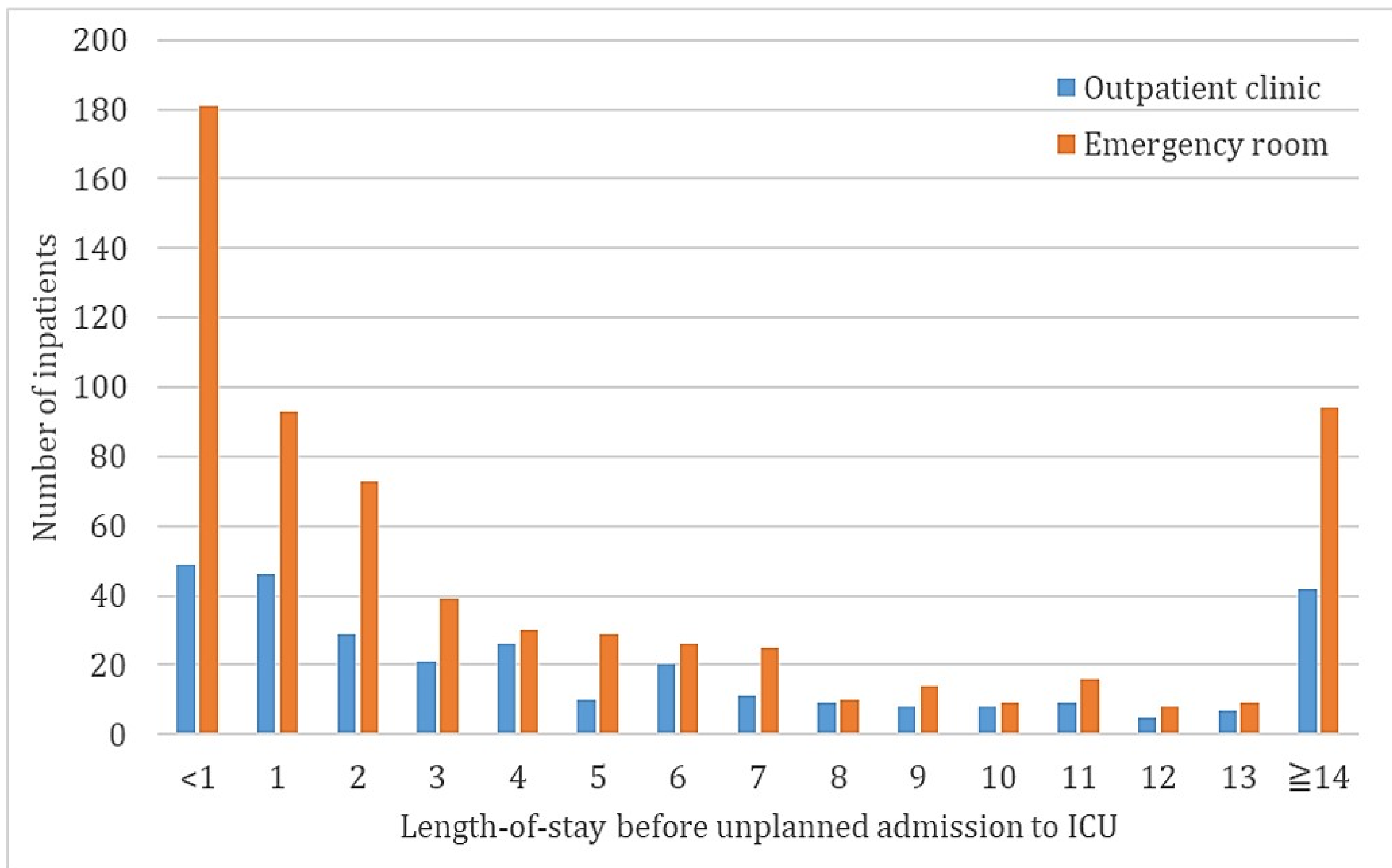


Figure 3. Length of stay of patients before unplanned admission to the ICU from outpatient and emergency departments.

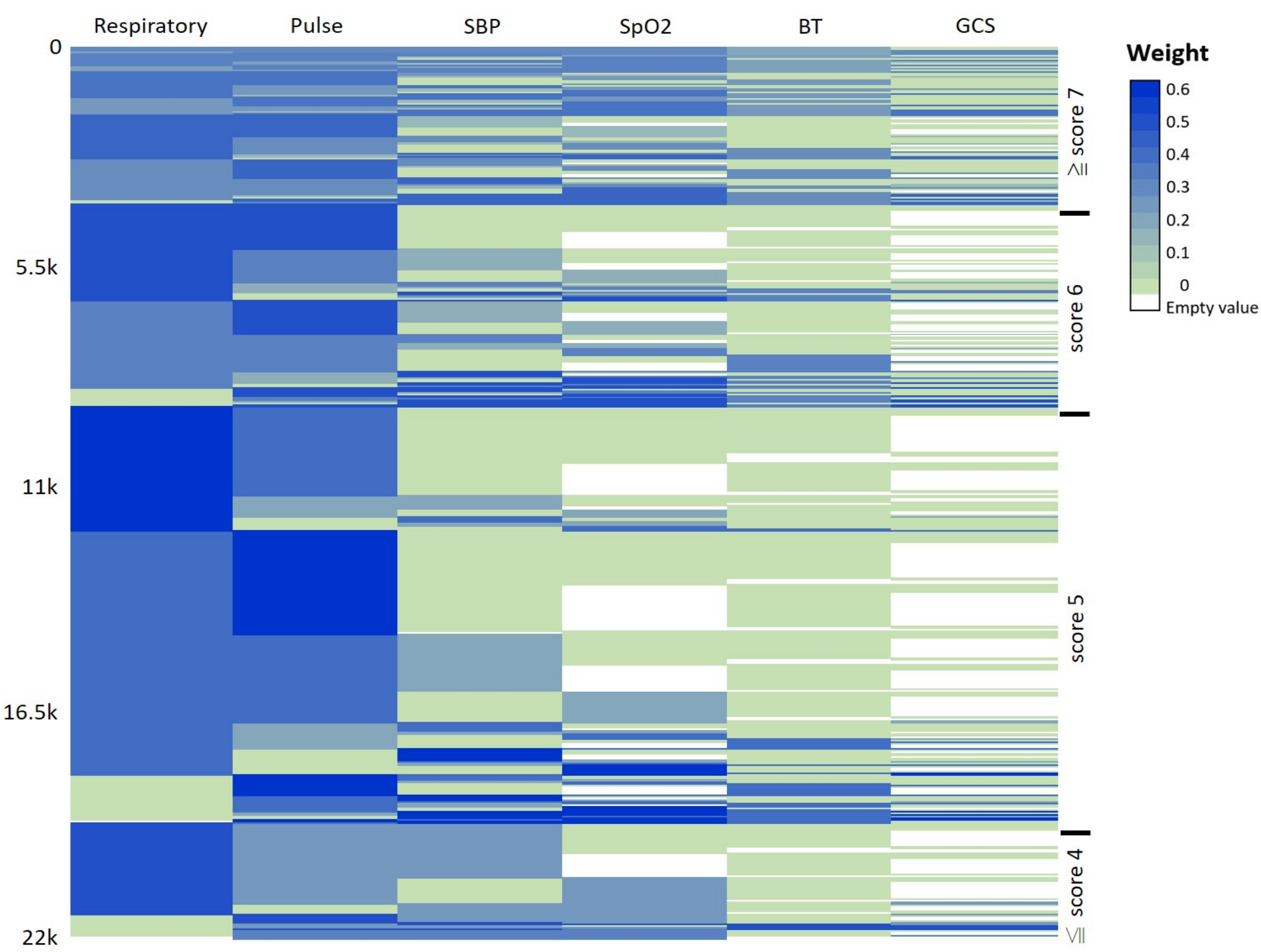


Figure 4. Contributions of each vital sign in the MEWS evaluations that met the warning criteria among the group of patients with unplanned ICU admission.