# Determining incidence of early clinical deterioration and related factors in patient after discharging from Intensive Care Unit

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## ABSTRACT

**Objectives:** Identify the incidence and related factors of early clinical deterioration in patients after discharge from intensive care unit (ICU) in the Department of Neurology and Neuro Intensive Care, VietDuc University Hospital

**Methods:** A prospective study was conducted From January 2024 to October 2024. Clinical deterioration is identified by the presence of respiratory failure, requiring intubation or tracheostomy, mechanical ventilation, or high-flow oxygen therapy; or circulatory shock indicated by hypotension requiring vasopressors or vasoconstrictors; or transfer back to the ICU within 96 hours after discharge from the ICU

**Results:** A total of 147 patients were included in this study, with 10.2% of patients experiencing early clinical deterioration after ICU discharge, most within the first 48 hours (83.33%). The admission reason, ICU transfer plan, use of vasopressors at the time of ICU discharge, NEWS, NEWS2, and HEWS scores at the time of ICU discharge were statistically significant predictors of early clinical deterioration ($p < 0.05$).

**Conclusion:** Training healthcare providers, especially ICU nurses, to identify high-risk patients can help reduce the incidence of early clinical deterioration after discharging patients from the ICU, then improving quality of care and patient outcomes.

**Keywords:** early clinical deterioration, intensive care patient, discharge, related factors.

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## I. BACKGROUND

The timely transition of patients from the Intensive Care Unit (ICU) to general wards can enhance patient care quality and safety, while also lowering hospital expenses and optimizing ICU bed utilization [1]. Traditionally, the decision to discharge a patient from the ICU has relied on the clinical judgment of both the ICU physician and the receiving physician in the general ward. However, discharging patients prematurely can increase their risk of medical errors, ICU readmission, extended hospital stays, higher healthcre costs, and elevated mortality rates [2]. Moreover, ICU readmission rates have often been considered as an indicator of ICU quality [3].

Nurses play a vital role in ensuring a smooth transition for patients leaving the ICU. Recognizing early signs of clinical deterioration enables prompt escalation of care, enhances nursing focus and ensures timely communication with physicians or activation of the emergency response teams[4]. Numerous studies have been explored predictive tools that can prevent clinical deterioration due to early ICU discharge[5]. Common tools to prevent clinical decline following early ICU discharge. Commonly used tools in clinical settings include the National Early Warning Scores (NEWS), National Early Warning Scores 2 (NEWS-2), National Early Warning Scores C (NEWS-C), Modified Early Warning Scores (MEWS), Hamilton Early Warning Scores (HEWS), and quick Sepsis-related Organ Failure Assessment (qSOFA). Identifying independent risk factors provides clinicians with valuable insights to support decision-making and safety, targeted interventions for high-risk patients.

However, the incidence of early clinical deterioration and the contributing factors behind it are not yet fully understood. Therefore, we perfomed this study, titled "***Determining prevalence of early clinical deterioration and related factors in patient after discharging from Intensive Care Unit***" with two objectives

*First objective: Determine the prevalence of clinical deterioration in patients after being discharged from the Department of Neurology and Neuro Intensive Care.*

*Second objective: Identify factors associated with clinical deterioration in patients after being discharged from the Department of Neurology and Neuro Intensive Care.*

## II. METHODOLOGY

### 2.1. Participants

- Inclusion criteria:

+ All patients treated in the ICU were transferred to the general wards in the Department of Neurology and Neuro Intensive Care, Viet Duc University Hospital.

+ Patients ≥ 16 years old.

+ Family members agreed for patients participating in study.

- Exclusion criteria:

+ Patients were discharged from the ICU to home, or transferred to another level of care.

+ Patients were discharged from the hospital within 96 hours of leaving the ICU.

### 2.2. Study site

Department of Neurology and Neuro Intensive Care, Viet Duc University Hospital.

### 2.3. Study design

A prospective study.

### 2.4. Time

From January 2024 to December 2024.

### 2.5. Sample

The sampling method was a complete sampling over the period from Febuary 2024

to September 2024. During this time, 147 patients who met the criteria were selected for the study.

### 2.6. Variables

Variables including age, gender, reason for ICU admission, mechanical ventilation during ICU stay, duration of mechanical ventilation, ICU transfer plan, length of ICU stay, NEWS score at ICU discharge, NEWSC score at ICU discharge, HEWS score at ICU discharge, MEWS score at ICU discharge, tracheostomy or endotracheal tube at ICU discharge, Glasgow Coma Scale score at the time of ICU discharge, vasopressors at ICU discharge, early clinical deterioration (defined as with or without occurrence of respiratory failure or circulatory shock within 96 hours after leaving the ICU) and the onset time of early clinical deterioration.

### 2.7. Data collection

The data collectors are registered nurses with at least 3 years of clinical experience, who have been trained in data collection. Data collection will stop when a patient shows signs of early clinical deterioration, or when the patient is transferred to another department within 96 hours without showing early deterioration, or when the patient discharged from ICU for more than 96 hours without signs of early clinical deterioration.

### 2.8. Data analysis

Data was managed and analyzed using SPSS 20.0.

### 2.9. Ethical consideration

Research proposal have been approved by International Review Board of VietDuc University Hospital.

## III. RESULTS

### 3.1. Demographic characteristics of participants

***Table 3.1**. Demographic characteristics of patients (N=147)*

| | Frequency (n) | Percentage (%) |
|---|---|---|
| **Gender** | | |
| Male | **111** | **75.5** |
| Female | 36 | 24.5 |
| **Admission reason** | | |
| Medical conditions | 14 | 9.5 |
| Trauma conditions | 29 | 19.7 |
| Surgical conditions | **104** | **70.8** |
| **Mechanical ventilation during ICU stay** | | |
| Yes | **121** | **82.3** |
| No | 26 | 17.7 |
| **ICU transfer plan** | | |
| Planned | **142** | **96.6** |
| Unplanned | 5 | 3.4 |
| **Endotracheal/tracheostomy tube at the time of ICU discharge** | | |
| Yes | 62 | 42.2 |
| No | **85** | **57.8** |
| **Use of vasopressors at the time of ICU discharge** | | |
| Yes | 12 | 8.2 |
| No | **135** | **91.8** |

Table 3.1 shows that the majority of patients were male (75.5%). Regarding ICU admission reasons, 70.7% of patients were admitted due to surgical conditions, 19.7% due to trauma, and only 9.5% due to medical conditions.

Among the 147 patients, 82.3% required mechanical ventilation during their ICU stay. Most patients (96.6%) were discharged from the ICU according to a planned schedule, while only 3.4%

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were discharged unplanned. Additionally, most patients (57.8%) did not have an endotracheal tube or tracheostomy at the time of ICU transfer, and only 8.2% of patients were on vasopressors at the time of discharge.

***Table 3.2**. Characteristics of patients (N=147)*

| Variables | Mean ± SD | Minimum | Maximum |
|---|---|---|---|
| Age | 43.00 ± 19.24 | 12 | 85 |
| Duration in ICU (days) | 13.85 ± 8.49 | 1 | 42 |
| GCS scores at the time of ICU discharge | 11.43 ± 2.62 | 6 | 15 |
| NEWS at the time of ICU discharge | 4.95 ± 3.19 | 0 | 11 |
| NEWSC at the time of ICU discharge | 5.43 ± 3.33 | 0 | 13 |
| MEWS at the time of ICU discharge | 2.90 ± 1.68 | 1 | 11 |
| HEWS at the time of ICU discharge | 3.30 ± 2.37 | 0 | 8 |

Table 3.2 shows that the average age of the patients was 43.00 ± 19.24. The average length of stay in the ICU was 13.85 ± 8.49 days, with a minimum stay of 1 day and a maximum of 42 days. The average GCS score at the time of ICU discharge was 11.43 ± 2.62. The average NEWS score at ICU discharge was 4.95 ± 3.19, with a range from 0 to 11. The average NEWSC score was 5.43 ± 3.33, ranging from 0 to 13. The average MEWS score was 2.90 ± 1.68, with a minimum of 1 and a maximum of 11. Lastly, the average NEWS score was 3.30 ± 2.37, ranging from 0 to 8.

### 3.2. Early clinical deterioration of patients

***Table 3.3**. Early clinical deterioration (N=147)*

| | | Frequency (n) | Percentage (%) |
|---|---|---|---|
| **Early clinical deterioration** | | | |
| | Yes | **15** | **10,20** |
| | No | 132 | 89,80 |
| **The onset of early clinical deterioration** | | | |
| | First day (24h) | **6** | **40,00** |
| | Second day (48h) | 5 | 33,33 |
| | Third day (72h) | 2 | 13,33 |
| | Fourth day (96h) | 2 | 13,33 |

Table 3.3 indicated that out of 147 patients, 15 (10.2%) experienced early clinical deterioration following ICU discharge, in which majority of patients occurred on the first day (40.00%) and the second day (33.33%) after leaving the ICU.

### 3.3. Related factors to early clinical deterioration

***Table 3.4**. Related factors to early clinical deterioration (N=147)*

| | | Yes (n = 15) | No (n=132) | Total (n=147) | t/ | p value |
|---|---|---|---|---|---|---|
| **Age (years)** | | 50.53 (15.40) | 42.14 (19.49) | 43.00 (19.24) | -1.940 | 0.067 |
| **Gender** | | | | | | |
| | Male | 12 (80.0) | 99 (75.0) | 111 (75.5) | 0.182 | 0.670 |
| | Female | 3 (20.0) | 33 (25.0) | 36 (24.5) | | |
| **Reason for ICU admission** | | | | | | |
| | Medical conditions | 5 (33.3) | 9 (6.8) | 14 (9.5) | 14.816 | **0.001** |
| | Trauma conditions | 5 (33.3) | 24 (18.2) | 29 (19.7) | | |
| | Surgical conditions | 5 (33.3) | 99 (75.0) | 104 (70.7) | | |
| **Mechanical ventilation during ICU stay** | | | | | | |
| | Yes | 10 (67.7) | 111 (84.1) | 121 (82.3) | 2.809 | 0.094 |
| | No | 5 (33.3) | 21 (15.9) | 26 (12.7) | | |
| **Forms of ICU discharge** | | | | | | |
| | Planned | 11 (73.3) | 131 (99.2) | 142 (99.6) | | 0.000 |
| | Unplanned | 4 (26.7) | 1 (0.8) | 5 (3.4) | | |
| **Duration in ICU (days)** | | 9.93 (9.42) | 14.30 (8.30) | 13.85 (8.49) | 1.902 | 0.059 |
| **GCS at the time of ICU discharge** | | 11.53 (2.90) | 11.42 (2.60) | 11.43 (2.62) | -0.163 | 0.871 |
| **NEWS at the time of ICU discharge** | | 6.93 (2.52) | 4.72 (3.19) | 4.95 (3.19) | -2.596 | **0.010** |
| **NEWSC at the time of ICU discharge** | | 7.73 (2.74) | 5.17 (3.29) | 5.43 (3.33) | -2.904 | **0.004** |

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| | | Yes (n = 15) | No (n=132) | Total (n=147) | t/ | p value |
|---|---|---|---|---|---|---|
| **MEWS at the time of ICU discharge** | | 3.47 (1.51) | 2.84 (1.69) | 2.90 (1.68) | -1.373 | 0.172 |
| **HEWS at the time of ICU discharge** | | 5.27 (2.09) | 3.08 (2.30) | 3.30 (2.37) | -3.521 | **0.001** |
| **Endotracheal/tracheostomy tube at the time of ICU discharge** | | | | | | |
| | Yes | 5 (33.3) | 57 (43.2) | 62 (42.2) | 0.536 | 0.464 |
| | No | 10 (66.7) | 75 (56.8) | 85 (57.8) | | |
| **Use of vasopressors at the time of ICU discharge** | | | | | | |
| | Yes | 5 (33.3) | 7 (5.3) | 12 (8.2) | 14.116 | **0.000** |
| | No | 10 (66.7) | 125 (94.7) | 135 (91.8) | | |

Table 3.4 highlights that certain factors, including the reason for ICU admission, the forms of discharging from ICU, and the use of vasopressors at the time of ICU discharge, showed statistically significant associations with early clinical deterioration (= 14.816, p=0.001; p = 0.000; = 14.116, p=0.000). Additionally, NEWS, NEWSC, and HEWS scores at the time of ICU discharge were significantly correlated with early clinical deterioration (t = -2.596, p=0.010; t = -2.904, p = 0.004; t = -3.521, p=0.001).

In contrast, variables such as gender, mechanical ventilation during ICU stay, length of ICU stay, reason for ICU admission, GCS scores, MEWS scores, and the presence of intubation or tracheostomy tubes at the time of ICU discharge did not demonstrate a statistically significant relationship with early clinical deterioration (p > 0.05).

## IV. DISCUSSION

Our study found that 15 out of 147 patients (10.2%) experienced clinical deterioration after being discharged from the ICU. The majority of these events occurred on the first day (40.00%) and the second day (33.33%) following discharge. These results are consistent with findings from Araujo et al., who reported readmission rates of 9.3% in trauma and neurosurgical ICUs and 13.7% in general ICUs[6]. Their study also noted an 18% mortality rate during initial ICU admissions in surgical ICUs, which increased to 48.48% for patients readmitted after discharge, with 40% of deaths occurring within the first seven days. Additionally, the study observed that most ICU readmissions occurred within the first 48 hours, aligning with our findings. In some cases, patients are discharged prematurely due to limited ICU bed availability, as priority is given to more critically ill patients. This can result in clinical decline after discharge and subsequent readmission. To mitigate this problem, it is crucial to implement well-defined clinical criteria for ICU admissions and discharges. Such measures would optimize the duration of ICU care, prevent premature discharge, and ensure high-quality patient care, ultimately reducing ICU readmission rates and associated mortality.

The method of ICU discharge shows a significant statistical relationship with early clinical deterioration. Our results are consistent with previous research, which demonstrates that patients discharged unexpectedly from the ICU face a higher risk of clinical decline compared to those with planned discharges [7]. In our study, 80% of unplanned ICU transfer resulted in clinical deterioration and subsequent readmission. Unplanned discharged are frequently associated with ICU bed shortages, forcing patients to leave the unit before their condition is fully stable. This transition heightens the likelihood of early clinical deterioration due to disparities in care and treatment between the ICU and general wards.

Our study identified a significant statistical association between NEWS, NEWS-C, and HEWS scores at ICU discharge and the occurrence of early clinical deterioration. These results align with previous research, highlighting the usefulness of these scoring systems in predicting early clinical decline [8,9], enabling timely detection of worsening conditions, these tools contribute to more effective care and facilitate prompt ICU readmission for patients at risk. The significance of NEWS at ICU discharge is underscored by its reliance on three respiratory and two cardiovascular parameters, which make up a substantial portion of its scoring criteria. These parameters, considered key vital signs, have been proven to predict clinical deterioration [10]. When these metrics change, particularly when scores increase, it is prudent to re-evaluate the decision to discharge the patient from the ICU. Factors such as elevated heart rate, respiratory rate, and oxygen support needs during the transition from the ICU have been previously identified as independent predictors of early clinical decline. Given its simplicity and practicality, the NEWS score is an effective tool for forecasting outcomes in patients discharged from the ICU.

In our study, we planned to use the NEWS-2 score to evaluate the risk of clinical deterioration in patients with COPD and CO2 retention. However, during data collection, no COPD patients were included in the surgical context, so the NEWS-2 was not applied. The NEWS-C, a variant of NEWS introduced during the COVID-19 pandemic, includes age (over 65) as an independent predictor of clinical deterioration. Older age has been shown to increase the risk of clinical decline[11-13]. In our study, NEW-C also proved valuable in predicting clinical deterioration, with a p-value of 0.004. The HEWS, which is based on similar clinical factors to NEWS, provides a more explicit assessment of delirium, adjusts blood pressure thresholds, and accounts for supplemental oxygen use [9]. In our study, the average HEWS score for the clinical deterioration group was 5.27 ± 2.09, significantly higher than the other group, with a p-value of 0.001. Thus, when assessing these scores, our study found significant differences in the NEWS, NEWS-C, and HEWS scores between the group that experienced clinical deterioration and other group.

Patients who required vasopressors upon ICU discharge were found to have a higher risk of clinical deterioration compared to those who did not need vasopressors (p=0.000). These results align with finding from other studies [5,12]. The use of vasopressors suggests that the patient's overall or cardiovascular condition remains unstable. While these medications may stabilize the patient's hemodynamics temporarily, they might not accurately reflect the patient's true status, as factors like dehydration, impaired heart function, or ongoing schock could be present. These underlying issues contribute to a greater risk of significant deterioration and a higher chance of ICU readmission to a greater risk of significant deterioration and a higher chance of

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ICU readmission in patients using vasopressors.

Our study found no statistically significant relationship between gender and early clinical deterioration, which aligns with several other studies [3,12]. However, another study found a significant association between gender and early deterioration, reporting a higher incidence in males than females [14]. As a result, the effect of gender on early clinical deterioration remains inconclusive. Moreover, factors such as the reason for ICU admission, the use of mechanical ventilation during the ICU stay, the presence of an endotracheal or tracheostomy tube upon ICU discharge, and the GCS score at discharge were not statistically linked to clinical deterioration[12,14]. In contrast, other studies have suggested that these factors are associated with early clinical decline [5]. These differences in findings may be attributed to variations in the assessment tools used, the study locations, research designs, and sample sizes.

Through logistic regression analysis, we identified several key predictors for early clinical deterioration, including the cause of ICU admission, discharge plan, use of vasopressors at discharge, and the NEWS, NEWS-C, and HEWS scores at the time of discharge; these findings are consistent with other research [3,5,12,13]. Our study indicates that patients admitted for medical reasons, those discharged unexpectedly, or those requiring vasopressors at discharge are at a higher risk for early clinical decline after leaving the ICU. These factors serve as important indicators for healthcare providers to monitor closely those patients with one or more of these conditions upon discharge. Our study suggests that more attention should be given to managing underlying medical conditions in trauma patients, as well as increasing ICU resources and bed capacity to avoid premature ICU discharges due to limited bed availability.

## V. CONCLUSION

Through this study of 147 patients in the Department of Neurology and Neuro Intensive Care, we obtained the following key results: The incidence of clinical deterioration ater ICU discharge was 10.2% (15 patients), with the majority occurring within the frist 48 hours (83.33%).

Patients admitted to the ICU due to medical conditions, discharged from the ICU unplanned, and those using vasopressors at ICU discharge were statistically significantly associated with early clinical deterioration. Additionally, NEWS, NEWSC, and HEWS scores at ICU discharge were also statistically significant predictors of early clinical deterioration ($p < 0.05$). Factors such as age, gender, mechanical ventilation during ICU stay, ICU length of stay, ICU admission cause, mechanical ventilation during ICU stay, GCS score at ICU discharge, MEWS score at ICU discharge, and the presence of endotracheal or tracheostomy tubes at ICU discharge showed nno statistically significant association with early clinical deterioration ($p > 0.05$).

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