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Original Article

Effect of Clinical Practice Guideline for Early Mobilization on Limb Muscle Strength in Critically Ill Patients

Metta Kheiawsawang[1], Onsuda Sopaporm[1], Siwakon Sriwicha[1*]

[1] Medical Intensive Care Unit, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Abstract

Background: Intensive care unit (ICU)-acquired weakness is a significant complication affecting approximately 34.1% of ICU patients, leading to muscle atrophy, prolonged hospitalization, and increased mortality. Early mobilization (EM) is a critical nursing practice to mitigate these effects. Despite its benefits, standardized guidelines are often underutilized due to safety concerns and the limited availability of clinical protocols.

Objective: To compare muscle strength and mobility levels in critically ill patients before and after the implementation of a structured EM nursing practice guideline.

Methods: This retrospective descriptive study analyzed 35 critically ill patients at Ramathibodi Hospital's medical ICU (January-December 2024) who received an established EM nursing practice guideline comprising a standardized EM protocol, staff training, and educational media. Outcomes were measured by the Medical Research Council (MRC) sum score and the ICU Mobility Scale (IMS), analyzed via paired *t* tests and Wilcoxon signed rank tests.

Results: Most participants were aged 70-79 years, with acute respiratory distress syndrome (ARDS) and septic shock as primary diagnoses. Following the 5-day EM protocol, muscle strength significantly improved, with mean (SD) MRC scores increasing from 38.77 (12.46) to 47.26 (11.76) ($P < .001$). Functional mobility also showed significant gains ($P < .001$), with 54.3% of patients achieving higher mobility levels and 45.7% remaining stable. Importantly, no decline in mobility level was observed.

Conclusions: This study demonstrated that a structured EM nursing practice guideline is feasible and effective in improving muscle strength and mobility among critically ill patients, supporting its integration into routine ICU nursing care.

Keywords: Early mobilization, Intensive care unit, Critical care nursing, Muscle strength, Rehabilitation

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*** Corresponding Author:** siwakon.sri@mahidol.ac.th

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Introduction

Intensive care unit-acquired weakness (ICU-AW) is a significant complication affecting critically ill patients in ICUs worldwide.[1, 2] This condition can develop at the earliest stage of ICU admission, when patients experience immobility. The incidence of ICU-AW is approximately 34.1%[3] due to increased protein loss from muscles,[2, 4] particularly in patients receiving mechanical ventilation, who experience a 25%-31% reduction in muscle mass per week.[2, 5-8] The result of muscle atrophy and weakness prolongs physical rehabilitation after recovery from critical illness, leading to extended ICU and hospital length of stays, higher costs, and reduced quality of life after discharge.[2, 4, 9]

Moreover, evidence shows that ICU-AW is associated with mortality rates within one year after discharge from the hospital.[10]

Early mobilization (EM) through a range of motion (ROM) exercises for movable joints is an independent nursing role in the prevention and rehabilitation of critically ill patients and can be performed safely within 24 hours after ICU admission when patients meet readiness criteria and achieve physiological stability. When adapted to each patient's abilities, EM helps preserve muscle strength, maintain functional independence for activities of daily living after discharge, and increase patient and family satisfaction with care.[9] International studies on implementing EM with critically ill patients in the United States and Europe show a consistent EM practice rate of 40%-59%, but only 20%-30% have formal clinical practice guidelines.[11] In Latin America, the EM guideline usage rate is 36.1%.[12] Sub-Saharan Africa reports approximately 19.5% adherence to the EM guideline.[13] In Asia, reports indicate that only 24.2% of ICU nurses in China use EM clinical practice guidelines.[14] Despite evidence supporting the benefits of EM, clear practice guidelines remain limited due to resource constraints, insufficient research, organizational barriers, staffing challenges, knowledge gaps, and safety concerns.[15] In Thailand, feasibility studies on implementing EM clinical practice guidelines have demonstrated that they are safe and effective in increasing muscle strength, while advancing patients from complete dependence to independent mobility.[16] However, research remains limited, and standardized protocols have not been broadly implemented. Therefore, this study aimed to evaluate the effectiveness of implementing the structured EM nursing practice guideline on muscle strength and mobility levels in critically ill patients.

The clinical nursing practice guideline for EM of limb muscles focuses on strengthening arm and leg muscles through a range of motion exercises that progressively increase patient mobility levels during ICU admission. The implementation process begins with nursing education, utilizing posters and videos, followed by a systematic assessment of patient readiness (including contraindications and safety criteria), structured mobilization activities, and documentation of limb muscle strength and mobility levels after day 5 of the protocol. The objective of this study was to compare limb muscle strength and level of physical mobility in critically ill patients before and after implementing the guideline.

Methods

Study Design

This study is a retrospective descriptive study aimed at examining the effects of the EM nursing practice guideline on arm and leg muscle strength and mobility level in critically ill patients by comparing pre- and post- outcomes within the same patient group (within-group comparison). The retrospective study design was chosen because the EM nursing practice guideline had been systematically implemented with standardized documentation, enabling quality data analysis without disturbing current patients.

Participants

The study included critically ill patients admitted to the medical ICU at Ramathibodi Hospital from 1 January 2024 to 31 December 2024, who met the safety criteria. The sample size was calculated using G*Power software, version 3.1.9.7, with a power of 0.80, a medium effect size of 0.50, and an αlevel of .05, yielding minimum requirements of 34 participants for parametric tests and 35 for nonparametric tests.

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Participants were included if they were 18 years or older, admitted to the ICU with an initial assessment completed within 24 hours and within 5 days of admission, received the EM nursing practice guideline, passed safety screening, including contraindications and 3-system physiological safety criteria, and had complete documentation in the electronic medical record (EMR).

Participants were excluded based on several criteria. Patients with preadmission inability to ambulate or who were bedridden were excluded, as were those who received neuromuscular blocking agents, had active bleeding, or had fractures. Patients with neurological or neuromuscular diseases, such as myasthenia gravis, Guillain-Barré syndrome, or acute stroke, were also excluded. In addition, patients who demonstrated agitation, defined as a Richmond Agitation-Sedation Scale (RASS) score greater than +1, were not eligible. Cardiovascular instability was another exclusion criterion, including a heart rate below 40 or above 130 beats per minute, new-onset dysrhythmia, shock with a mean arterial pressure below 65 mmHg, or a requirement for high-dose vasopressors (norepinephrine > 0.1 μg/kg/min or dopamine > 10 μg/kg/min). Patients with respiratory instability were likewise excluded, defined as an oxygen saturation (SpO_2) below 88% or mechanical ventilation requiring a fraction of inspired oxygen (FiO_2) of 0.6 or higher and a positive end-expiratory pressure of 10 cmH_2O or higher. Finally, patients with incomplete or illegible medical records were excluded.

Instruments

The data collection tools developed for this study comprised 2 primary sections. The first section recorded demographic and clinical characteristic data, including age, sex, underlying diseases, and reasons for ICU admission. The second section involved the structured EM nursing practice guideline, which included a readiness assessment checklist, an activity documentation form, and educational media such as exercise demonstration posters and instructional videos.

The Early Mobilization Nursing Practice Guideline

This study was developed from clinical practice in the medical intensive care unit. The EM nursing practice guideline was created in January 2022. Subsequently, education was provided to all staff nurses in the medical ICU to ensure understanding and correct application of the guideline in the patient care process. The guideline has been implemented with patients from 1 January 2022, to the present. Bedside nurses, maintaining a 1:1 nurse-to-patient ratio, implemented the guideline for all admitted critically ill patients through a structured process.

The initial patient readiness assessment is conducted within 24 hours of admission, with reassessments performed twice daily until discharge. The guideline comprises 3 components: 1) a readiness assessment evaluating contraindications and 3-system (nervous, respiratory, and cardiovascular) physiological safety criteria; 2) an activity documentation form for recording the Medical Research Council (MRC) sum score and the ICU Mobility Scale (IMS); and 3) educational materials, including demonstration posters and videos. While the protocol applies to all patients, EM activities are performed only by those who meet safety criteria, and muscle strength and mobility levels are evaluated after 5 days of implementation.

The EM activities were structured into 4 progressive levels based on the patient's RASS score and limb movement capability. Level 1 (RASS -5 to -2) included head-of-bed

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elevation to at least 30 degrees, lateral turning every 2 hours, and passive ROM exercises performed twice daily (13 exercises, 10 repetitions each). Levels 2, 3, and 4 involved progressive mobilization tailored to the patient's specific physical capabilities, ranging from passive ROM, active-assistive ROM, active ROM, to sitting on the edge of the bed for at least 20 minutes 3 times per day, and assisting with standing or stepping exercises. All levels included continuous safety monitoring and repositioning every 2 hours.

Data Collection

With approval from the Human Research Ethics Committee at the Faculty of Medicine Ramathibodi Hospital (MURA2025/329), the researchers retrospectively collected data from patients' EMR including: 1) the personal data included age, sex, underlying diseases, and ICU admission diagnoses; 2) muscle strength scores measured by the MRC sum score; and 3) mobility levels assessed using the IMS. All collected data were securely stored with coded identifiers to ensure patient privacy.

Statistical Analysis

Data were analyzed using SPSS, version 11.5 (SPSS Inc). Descriptive statistics, including frequency distributions and percentages, were used to analyze demographic characteristics, such as age and sex, as well as underlying diseases and ICU admission diagnoses. Muscle strength data from the MRC sum score were analyzed using a paired *t* test, as the data were normally distributed. The IMS was analyzed using the Wilcoxon signed rank test due to the nonnormal distribution of the data. Statistical significance was set at a level of $P < .05$ for all analyses.

Results

Demographic Data and Clinical Characteristics

The study included 35 patients, comprising 51.4% males and 48.6% females. Most patients were aged 70-79 years (28.6%), followed by those aged 60-69 years (22.9%) and those 80 years or older (20.0%). Hypertension was the most common underlying disease (62.9%), followed by cardiovascular disease (37.1%), diabetes mellitus (34.3%), end-stage renal disease (34.3%), and malignancy (34.3%). The primary ICU admission diagnoses were acute respiratory distress syndrome (ARDS) with septic shock (31.4%), septic shock (20.0%), and ARDS (17.1%) (Table 1).

Limb Muscles Strength Scores

In a study involving 35 critically ill patients who participated in the EM nursing practice guideline, the mean (SD) MRC sum score was 38.77 (12.46) at baseline. Following the completion of the program, this score increased to 47.26 (11.76). The analysis indicated that the postimplementation MRC sum score was significantly higher than the scores recorded before the implementation (mean difference, 8.49; 95% CI, 5.43-11.55; $P < .001$).

ICU Mobility Scales

The Wilcoxon signed rank test revealed that the postimplementation IMS was significantly larger than the preimplementation scale ($z = -4.014$, $P < .001$). Individual analysis revealed that 19 patients (54.3%) demonstrated improved mobility, 16 patients (45.7%) maintained their baseline ICU mobility level, and no patients experienced a decrease in

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ICU mobility level (negative ranks = 0). These findings indicate that mobility function improved or was maintained in all participants following implementation of the EM program (Table 2).

Table 1. General Characteristics of Participants

Characteristic	No. (%)
Gender	
Female	17 (48.6)
Male	18 (51.4)
Age, y	
18-29	3 (8.6)
30-39	1 (2.9)
40-49	2 (5.7)
50-59	4 (11.4)
60-69	8 (22.9)
70-79	10 (28.6)
≥ 80	7 (20.0)
Top 5 underlying diseases*	
Hypertension	22 (62.9)
Cardiovascular disease	13 (37.1)
Diabetes mellitus	12 (34.3)
End-stage renal disease	12 (34.3)
Malignancy	12 (34.3)
Top 5 ICU admission diagnoses	
ARDS and septic shock	11 (31.4)
Septic shock	7 (20.0)
ARDS	6 (17.1)
Elevate lactate	2 (5.7)
Status epilepticus	2 (5.7)

Abbreviations: ARDS, acute respiratory distress syndrome; ICU, intensive care unit.

* One patient may have more than one underlying disease.

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Table 2. Comparison of ICU Mobility Scales Before and After Program

Rank	No. of Patients	Mean Rank	Sum of Ranks	*z* Score	*P* Value
Negative rank	0	0	0	-4.014	< .001
Positive rank	19	10.0	190.0		
Ties	16	NA	NA	NA	NA
Total	35	NA	NA	NA	NA

Abbreviation: ICU, intensive care unit.

Discussion

The results of this study demonstrated that, following the implementation of the EM nursing practice guideline, critically ill patients showed statistically significant improvements in limb muscle strength scores, increasing from a mean of 38.77 preimplementation to 47.26 postimplementation ($P < .001$). The IMS also increased significantly ($P < .001$). These findings indicate that the structured implementation of the EM guideline is feasible and effectively enhances physical rehabilitation outcomes in critically ill patients.

The findings are consistent with Fazzini et al,[1] who noted that ICU-AW is a common complication in critically ill patients, often driven by rapid protein catabolism and muscle mass loss during the acute phase of illness. Chen et al[4] reported that critically ill patients may experience muscle atrophy rates of 25%-31% per week, particularly those requiring mechanical ventilation. This implementation of EM during the initial treatment phase serves as a critical program to attenuate muscle mass loss and mitigate the risk of ICU-AW by maintaining protein balance and reducing inflammatory responses.

Furthermore, the improvement in IMS reflects successful enhancement of physical function, which correlates with better clinical outcomes. Kasotakis et al[7] demonstrated that patients with higher mobility levels had significantly lower mortality rates and shorter hospital stays. Continuous mobilization prevents immobility-related complications, such as contractures, orthostatic hypotension, and deep vein thrombosis, while promoting physiological benefits, including improved oxygen exchange and systemic circulation.[5, 17, 18]

These findings are corroborated by Schweickert et al,[19] who demonstrated that EM in mechanically ventilated patients resulted in greater independent ambulation before ICU discharge and reduced ventilator days. Similarly, Hodgson et al[20] reported that EM in mechanically ventilated patients across multiple countries was safe and significantly improved physical function. Furthermore, a systematic review by Tipping et al[21] confirmed that active mobilization improves muscle strength and accelerates the return to activities of daily living, while Rawal et al[9] emphasized that initiating mobilization within 48 hours of ICU admission reduces the incidence of ICU-AW. In the Thai nursing context, Jaengsook et al[16] reported that implementing an EM guideline was safe and effectively promoted the progression from passive to active mobility. The mean MRC sum score improvement of 8.49 points observed in this study is consistent in direction and magnitude with these prior studies, supporting the consistency of the implementation's benefit across diverse clinical settings.

The success of this program also highlights the critical role of nurses in systematic implementation. Preimplementation nursing education and standardized patient readiness assessments were key factors contributing to program success, supporting findings by Dubb et al,[15] who identified lack of knowledge, confidence, and safety concerns as significant global barriers to EM implementation. Thus, developing context-specific standardized nursing guidelines is essential for promoting the nurse's role in rehabilitation.

Limitations

As a pragmatic evaluation of a guideline implemented in routine clinical practice, this study reflects real-world feasibility and the independent role of nurses in assessing readiness and delivering care. However, several limitations must be acknowledged. First, the retrospective, single-group design with historical comparison lacks a concurrent control group, which may introduce selection and data-loss bias and limits causal inference. Future studies using prospective randomized controlled trials or propensity score-matched

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analyses would strengthen the level of evidence. Second, although the EM nursing practice guideline has been implemented since January 2022, data recording for MRC and IMS scores was incomplete during 2022-2023. The year 2024 was selected because it provided systematically documented MRC sum scores and IMS data, which facilitated the evaluation of the guideline's effectiveness. Following this initial evaluation of effectiveness, the EM guideline continued to be routinely implemented in clinical practice during 2025-2026. However, MRC sum scores and IMS were no longer routinely recorded in order to reduce the documentation burden on nurses. Importantly, patient readiness and safety assessments before and during mobilization activities continued to be performed consistently. Consequently, complete outcome data for MRC and IMS were unavailable for the 2025-2026 period and could not be included in the present analysis. The relatively small sample size limits the generalizability of the findings. Future research should consider prospective data collection with standardized outcome measurements across a larger cohort to further evaluate the effectiveness and clinical impact of the guideline. Third, while no adverse effects directly related to mobilization were observed, this study did not systematically capture broader adverse events (eg, hemodynamic instability); therefore, the implementation is best described as feasible and free of mobility-related adverse events. Finally, the clinical significance of the MRC sum score improvement was not benchmarked against the minimal clinically important difference (MCID), which future research should incorporate to better contextualize the magnitude of clinical improvement.

Conclusions

This study demonstrated that the implementation of the EM nursing practice guideline is feasible and effectively improves both muscle strength and functional mobility in critically ill patients at the medical ICU of Ramathibodi Hospital. Following the program, patients showed statistically significant increases in MRC sum scores and IMS levels. These findings suggest that a structured nursing approach, incorporating systematic patient readiness assessment and standardized mobilization protocols, can support the progression of physical rehabilitation in critically ill patients. Future prospective studies, ideally incorporating the MCID, are warranted to further evaluate the clinical significance and long-term functional outcomes of this nursing-led EM strategy.

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Additional Information

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Ethics Approval: This study was approved by the Human Research Ethics Committee, Faculty of Medicine, Ramathibodi Hospital, Mahidol University (MURA2025/329 on 8 April 2025).

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Author Contributions:
Conceptualization: Metta Kheiawsawang, Siwakon Sriwicha
Data Curation: Onsuda Sopaporm, Siwakon Sriwicha
Formal Analysis: Metta Kheiawsawang
Investigation: All authors
Methodology: All authors
Project Administration: Metta Kheiawsawang
Resources: All authors
Validation: Ampika Kongphisutkun
Visualization: All authors
Writing – Original Draft: All authors
Writing – Review & Editing: All authors

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