UP AND MOVING: AN INTEGRATIVE REVIEW EVALUATING EARLY MOBILITY IN THE INTENSIVE CARE UNIT

A Scholarly Project

Submitted to the

Faculty of Liberty University

In partial fulfillment of

The requirements for the degree

Of Doctor of Nursing Practice

By

Rachel Elizabeth Huffman,

Liberty University

Lynchburg, VA

November, 2021

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Scholarly Project Chair Approval:

Dorothy Murphy, DNP, FNP-BC, CNE Date

ABSTRACT

Existing literature has highlighted the benefits of early mobility of patients in intensive care units. This integrative review (IR) sought to determine the best methods of early mobility intervention implementation. The search process utilized databases relevant to the selected topic, and the flow of information abstracted from the search process was placed into a PRISMA flow diagram. Additionally, review software was used to manage the collected data, ensuring that the search was documented with precision. To appraise the literature, a matrix was developed. The literature revealed that early mobility programs, protocols, and algorithms were guiding themes noted throughout this IR, accompanied by interventions such as staff education, a multidisciplinary approach, and a formal communication process. Knowledge gained in answering the review question includes implications for hospital-based policy initiatives and subsequently, clinical practice.

Keywords: early mobility, intensive care unit, physical activity, exercise, protocol, algorithm

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SECTION ONE: FORMULATING THE REVIEW QUESTION

Early mobility in the intensive care setting is a concept has been discussed by many clinicians and health care professionals with positive and negative feedback. According to prior literature, there are both short-term and long-term complications associated with immobilization and early mobility efforts have been shown to reduce the occurrence of these issues (Linke et al., 2020). Zhang et al. (2019) conducted a systematic review and meta-analysis to assess the effects of early mobilization on critically ill patients and the current evidence available. Despite some associated adverse events, the conclusions of previous publications reveal that early mobilization in the adult intensive care unit (ICU) poses numerous benefits. These benefits include decreased duration of mechanical ventilation, shortened ICU stay or hospital stay, decreased incidence of delirium, and improved muscle strength (Liu et al., 2019; Zang et al., 2020; Zhang et al., 2019). However, it remains unclear which early mobilization methods produce the best results. The question guiding this integrative review (IR) is: What strategies have been implemented to facilitate early mobilization of patients in ICUs?

Defining Concepts and Variables

For the purposes of this IR, the phrase *early mobilization methods* encompasses the programs, protocols, algorithms, and interventions utilized to facilitate and implement early mobility within ICUs. Anekwe et al. (2020) defined early mobilization operationally, as physical activities that are initiated within 24 to 48 hours after admission to the ICU. Additionally, Bakhru et al. (2016) offered a simple definition of early mobilization as “early exercise of the critically ill patient” (p. 1528).

Rationale for Conducting the Review

A review of literature was conducted to determine what publications already exist regarding early mobility in the ICU. The most effective methods for implementation of early mobility were identified and the most successful methods acknowledged, enabling the phenomenon of interest (early mobilization in the ICU) to be reconceptualized. It is evident within existing literature that early mobility is beneficial for ICU patients, but the key benefit of answering this IR question lies with understanding how to employ early mobility practices and the most successful aspects of implementation.

Purpose and Review Question

The primary question of this IR, is: What strategies have been implemented to facilitate early mobilization of patients in ICUs? Though current literature thoroughly discusses implementation of early mobility, the purpose of this IR is to determine what early mobilization methods have been explored in prior literature that support early mobilization in the ICU. Additionally, this IR deciphers *which* methods are considered to be most successful in implementing and utilizing early mobilization. Methods for implementing early mobility include the use of patient eligibility or exclusion criteria, physician and nurse champions, multidisciplinary cooperation, analgesia and sedation optimization, and staff education.

Formulate Inclusion and Exclusion Criteria

For inclusion in this IR, literature was required to be published between the years 2016 and 2021 and specific to adult patients in the intensive care setting. Studies were also required to involve the phenomenon under investigation: early mobilization. The initial search included all levels of evidence, such as meta-analyses, randomized control trials, and gray literature such as

dissertations and conference proceedings. Exclusion criteria included literature involving the pediatric population, non-ICU units, and subspecialty ICU units.

Conceptual Framework

Whittemore and Knafl (2005) offered a primary methodology for IRs aiming to support evidence-based practice and informed clinical decision-making. Per their framework, during the stage of problem identification, the variables of interest (early mobility methods) and sampling parameters were established. The literature search was methodical and is documented within the methods section of this IR. While evaluating data, specific knowledge or methodological features were extracted. Another point of consideration during data evaluation was the relevance of literature in answering the IR question. This stage truly deciphered if collected data were applicable to the IR question.

Initially, the data were reduced through the extraction and sorting data from primary sources. Then, the extracted data were placed into a matrix. This step in the data analysis process allowed enhanced visualization of patterns and themes across the publications. At this point, a data comparison table was created (Appendix E). Finally, conclusions were drawn through the interpretation and isolation or abstraction of commonalities and differences in the literature, which results in the creation of a diagram (Appendix G). These elements were synthesized, and a new conceptualization of the primary sources and phenomenon of interest emerged. A logical chain of evidence was demonstrated within the results to show a direct connection between the review question and conclusion (Whittemore & Knafl, 2005).

Ethical Considerations

An application was submitted to the Liberty University Institutional Review Board and an approval letter (Appendix C) was obtained before the IR process began. Ethical

considerations for this IR included strict guidelines for the screening, selecting, and sorting process of the literature search or review. Additionally, a precise definition of what is used as literature and an explanation of why these publications were chosen is presented within this IR. The methods by which search strategies were employed was also considered. Additionally, the reviewer completed Collaborative Institutional Training Initiative training (Appendix A).

SECTION TWO: COMPREHENSIVE AND SYSTMATIC SEARCH

Search Organization and Reporting Strategies

During the search process, relevant databases were selected (Toronto & Remington, 2020). PubMed and CINHAL were the databases utilized, and only sources published between 2016 and 2021 were included to ensure the most recent publications were being used. These databases were available and searchable through Liberty University's online Jerry Falwell Library. It is also important to note that search engines were not utilized during this IR to avoid unreliable or unverified sources. Additionally, CADIMA software was used to organize and record the search process and apply inclusion and exclusion criteria along with specific search strings. Initially, titles and abstracts were excluded based on identified keywords. Then, each publication was assessed for content eligibility through a review of the full text. The PRISMA flow diagram was used to illustrate the flow of information through the search process.

The initial database search yielded 178 articles. The primary search string included the key words *early mobilization*, *ICU*, and *protocol*. Thirty-five publications were removed as duplicates, with four publications containing records marked as ineligible by automation tools. At this point, 143 records were screened by the title and abstract. One-hundred and twenty-five of these publications were excluded by the CADIMA software due to unrelated content after a key word search in titles and abstracts, leaving 16 records to be assessed for eligibility through a

screening of the full-text publication. Two publications were excluded because the full-text or associated figures or diagrams were unable to be accessed. One publication was excluded for a lack of implementation practices, and four publications were excluded because they were not applicable in answering the review question.

Terminology

Early mobility is defined as physical activities that are initiated within the first 24 to 48 hours of ICU admission (Anekwe et al., 2020). In one particular article, the term *early* was interchangeable with the term *progressive* in regard to initiating timely mobility practices (Sigler et al., 2016). Additionally, Dasso (2019) defined physical activity as "any bodily movement produced by skeletal muscles that require energy expenditure" (p. 45). The term *exercise* is considered be a category of physical activity but is distinguished by the structure and planning needed to perform repetitive movements necessary to condition a focused area of the body (Dasso, 2019).

SECTION THREE: MANAGING THE COLLECTED DATA

Review software was used to facilitate the organization of search results, and CADIMA software lent support by managing a majority of the review processes. CADIMA allowed the reviewer to add citations from multiple sources while providing a mechanism for data extraction and synthesis. After viewing several software demonstrations were viewed, CADIMA was selected for cost effectiveness and to support an efficient review process.

SECTION FOUR: QUALITY APPRAISAL

Sources of Bias

The use of review software diminished the chance of selection bias and allowed objectivity to be maintained while increasing study validity. Additionally, information bias was

avoided by the careful classification and organization of information using a literature matrix and associated tables. Though there was a possibility for bias with only one reviewer, this risk was offset through the use of review software. Furthermore, the assistance of a librarian was utilized, who referred the reviewer to the SAGE Research Methods website as a reference for avoiding bias.

Appraisal Tools (Literature Matrix)

The primary critical appraisal tool utilized in this IR was a literature matrix (Appendix D). Within the literature matrix, the study's purpose, sample characteristics, methods, results, limitations, and level of evidence were evaluated, with the level of evidence assessed according to Melnyk's framework (Melnyk, 2016). The appraisal yielded high-quality publications pertaining to the review question. The relevance of the data was reviewed to determine which publications truly answered the review question.

Applicability of Results

The applicability of results is documented within the literature matrix through a simple statement of whether the publication is relevant or useful in answering the review question. All nine publications were determined to be relevant in understanding the strategies implemented to facilitate early mobilization of patients in ICUs. Additionally, each publication aligned with the design, ethical considerations, and results necessary to investigate the phenomenon of interest.

SECTION FIVE: DATA ANALYSIS AND SYNTHESIS

Data Analysis Methods

Whittemore and Knafl (2005) also provided the constant comparison method as a means to comprehensively discuss the systematic method in which data was analyzed. Within the constant comparison method, data reduction, data display, data comparison, and conclusion

drawing and verification methods are implemented (Toronto & Remington, 2020). For the data reduction process, the information taken from primary literature sources was broken into categories and subcategories. For instance, categories for this IR include methods used in the implementation of early mobility. The data display phase was accomplished through a visual display of the data, which allowed the detection of emerging patterns or relationships (Appendices E, F, and G). During the data comparison phase, these patterns, differences, and commonalities were examined and identified so they could be compared and contrasted. Finally, the conclusion phase included the development of the final results of the literature review, along with verification of findings by colleagues (Toronto & Remington, 2020). For this IR, the verification of findings was completed by the scholarly project chair.

Descriptive Results

In total, nine peer-reviewed studies were included in this IR: two systematic reviews (Lang et al., 2020; Raurell-Torredà et al., 2021), two randomized controlled trials (Nydahl et al., 2020; Schujmann et al., 2020), one non-randomized controlled trial (Schallom et al., 2020), two cohort studies (Linke et al., 2020; Liu et al., 2019), and two case-control studies (Lai et al., 2017; Sigler et al., 2016). The article matrix, tables, and diagrams that resulted from this IR provide a comprehensive description of the literature. By placing data or information into the matrix, individual study findings were synthesized and structured to ensure transparency and reliability in appraisal and methodological approaches. Additionally, having information synthesized in the table aids in answering the IR question.

Strengths of presented literature include publications with strong levels of evidence according to Melnyk's (2016) framework. All publications were ranked as a Level 4 or higher. The literature also answers the review question by offering multiple methods of early mobility

implementation and describing the associated impact on quality indicators. Additionally, each implementation method is described in detail, offering the possibility of recreation in future clinical practice. However, no gray literature was extracted and analyzed for this IR, though it could have been utilized to answer the review question to the fullest extent.

Synthesis

Strategies for Implementation

Programs, Protocols, and Algorithms. It is evident from this IR that multiple strategies have been implemented to facilitate early mobilization of patients in ICUs. Several overarching themes were extracted from the literature: programs, protocols, and algorithms. A protocol or algorithm seemed to be the general method of choice, with eight of the nine publications using these two methods as their primary approach (Lai et al., 2017; Lang et al., 2020; Linke et al., 2020; Liu et al., 2019; Nydahl et al., 2020; Raurell-Torredà et al., 2021; Schallom et al., 2020; Sigler et al., 2016). Sigler et al. (2016) offered a comprehensive ICU early mobility program which included a progressive mobility protocol. The five guiding principles of this program were: sedation/analgesia optimization, sedation minimization, physical and occupational therapy recruitment, nursing education, and a progressive mobility protocol. Alternatively, Schujmann et al. (2020) provided an early mobility program that did not contain a specific protocol or algorithm, but rather, five levels of exercises and position changes. Exercises ranged from the use of a passive cycle ergometer for 15 minutes for the lower limbs to resisted upper and lower limb exercises. Position changes also ranged from passive up to ambulation without assistance for greater than 20 meters. After a specific level of exercises and position changes were achieved, the patient progressed to the next level.

Staff Education. Often, protocols and algorithms contain the interventions necessary for implementing early mobility. The education and training of staff was an intervention mentioned in five of the nine appraised publications (Lang et al., 2020; Linke et al., 2020; Liu et al., 2019; Nydahl et al., 2020; Sigler et al., 2016). Lang et al. (2020) stated that staff education can aid in defining the staff's relationship with and perceptions of early mobility. It can also dispel any fears of unsafe practices while shaping clinician culture prior to implementation. Liu et al. (2019) highlighted staff education, stating that this intervention began one month prior to their study beginning. The importance of early mobility in the prevention of postintensive care syndrome was discussed, with protocol and simulation training also provided to all ICU staff. Linke et al. (2020) described "an intensive, multimodal education plan that targeted all members of the interdisciplinary team" (p. 1). Strategies for education included: poster displays in common staff areas, communication through email and staff meetings, and face-to-face education. Alternatively, Sigler et al. (2016) specified that nursing education came from physician leadership, who explained the goals and clinical rationale of the early mobility program and encouraged nursing staff to be proactive in reaching these goals. Nydahl et al. (2020) depicted this intervention as training more than educating and described the protocol template that staff were trained to employ.

Multidisciplinary Approach. With similar significance, a multidisciplinary approach was also highlighted in five publications (Lai et al., 2017; Lang et al., 2020; Linke et al., 2020; Liu et al., 2019; Nydahl et al., 2020). In fact, Linke et al. (2020) consider a multidisciplinary approach to be "integral" to the success of the early mobility protocol, stating that stakeholders from every discipline had a voice during protocol development, fostering a collaborative spirit (p. 6). Furthermore, all disciplines were responsible for patient mobility, working together to

achieve mobility goals. Lang et al. (2020) depicted a multidisciplinary approach as collaborative, emphasizing that teamwork is essential. Similarly, Naydahl et al. (2020) partially attributed the success of early mobility implementation to an interprofessional approach, with interprofessional rounds occurring daily to discuss mobility goals. Interprofessional meetings also occurred, in which staff training and discussions of potential barriers for early mobilization were offered.

Clinical Champions. According to Lang et al. (2020) and Nydahl et al. (2020), clinical champions can be essential to improving program implementation, suggesting this intervention be implemented in future trials and clinical practice. Lang et al. (2020) initially stated that clinical champions are recommended facilitators of physical activity and went on to explain that the role of clinical champions is to help drive and model change. Furthermore, in their discussion of recommendations for practice, Nydahl et al. (2020) asserted that "local champions" may be important additions to improve the implementation of protocols and mobilization practices.

Formal Communication Process. Multiple publications indicate that a formal communication process is beneficial for implementation of early mobility, typically occurring between multidisciplinary team members (Linke et al., 2020; Nydahl et al., 2020; Schallom et al., 2020; Sigler et al., 2016). The types of formal communication presented were daily patient-specific mobility planning, a highlighted protocol hung outside each patient's door, pocket cards and laminated posters available at bedside, and printable safety screenings. Each of these items foster communication between multidisciplinary team members regarding mobility goals and the current mobility status, ensuring that the team is harmonious.

Analgesia and Sedation Optimization. Linke et al. (2020), Liu et al. (2019), and Sigler et al. (2016) all discussed the optimization or minimization of analgesia and sedation. Patients are frequently given analgesics or sedatives in the ICU for observed pain and agitation, or as

anticipatory, prior to procedures. A protocol metarule detailed by Linke et al. (2020) states that sedation, along with narcotic use, should be minimized. Instead, agents with minimal central nervous system depression are preferred. Additionally, all patients should have a break from sedation daily. Sigler et al. (2016) coined the term *optimization*, conveying sedation and analgesia optimization as a guiding principle of an early mobilization program. In this study, intern and resident physicians participated in a lecture regarding current analgesia and sedation practices at the beginning of their rotation in the medical ICU. As a result of this program, sedation use was minimized overall, particularly the use of benzodiazepines. Similarly, the use of benzodiazepines and general use of sedation also decreased after implementation of an early mobility protocol (Liu et al., 2019). This intervention allowed for increased participation of patients in early mobility practices.

Criteria for Early Mobilization. Early mobilization criteria can be defined in this IR as the standards by which decisions of early mobilization are made. The literature suggests that categories of criteria are: evaluation, timeframe of initiation, exclusion, safety screening or checklist, Richmond Agitation and Sedation Scale (RASS) and Confusion Assessment Method for the ICU (CAM-ICU) scales, tolerance assessment or monitoring, and cessation. Three publications consider evaluation to be either the physical assessment of a patient, evaluation criteria (such as exclusion and yield), and completion of an interprofessional assessment as part of an algorithm for decision-making (Linke et al., 2020; Nydahl et al., 2020; Raurell-Torredà et al., 2021). Additionally, three publications stated the timeframe of initiation to be within 24 to 72 hours of ICU admission, within 72 hours of mechanical ventilation, or within 48 hours of ICU admission (Lai et al., 2017; Lang et al., 2020; Schujmann et al., 2020).

The literature also suggested that exclusion criteria are an important part of an early mobilization protocol, as are safety screenings or checklists. Exclusion criteria identified by Linke et al. (2020) include the use of paralytics in the past 24 hours, an open chest or abdomen, femoral lines, hemodynamic instability, an unstable fracture, an acute, evolving neurological event, the prone position, an intracranial pressure of more than 20, recent use of the massive transfusion protocol, unstable arrhythmias, and an Fi02 greater than 80% and/or PEEP greater than 14. Lang et al. (2020) also offered safety considerations for neurological, cardiovascular, and respiratory systems, including recommended lines or attachments. Ultimately, Raurell-Torredà et al. (2021) provided an efficient safety criteria checklist (or algorithm) with the goal of keeping patients safe throughout mobilization efforts.

Level of consciousness and mental status are important components to assess prior to early mobility initiation and are typically associated with sedation and delirium. These factors can be measured by the RASS and CAM-ICU scales. This concept is supported by five publications within this IR (Liu et al., 2019; Raurell-Torredà et al., 2021; Schallom et al., 2020; Schujmann et al., 2020; Sigler et al., 2016). Different goals for RASS scores are listed as -1 to +1, -2 to +1, or less than +3. Efforts were made to titrate sedatives in order to obtain the desired RASS score. Additionally, efforts were made to reduce delirium as measured by CAM-ICU scores by decreasing benzodiazepine administration.

Three publications discussed the importance of tolerance monitoring within early mobility implementation (Lai et al., 2017; Lang et al., 2020; Linke et al. 2020). Liu et al. (2019) suggested that the ICU physician should monitor the respiratory and hemodynamic status of the patient, ensuring that any tubes and invasive lines are maintained. However, Liu et al. (2019)

were the only authors to discuss cessation of mobilization, again identifying the ICU physician as the team member who decides whether to stop or continue a session.

Other Interventions. Dedicated mobility equipment, early mobilization order sets with ICU admission, and organizational support were interventions mentioned sporadically throughout appraised publications (Linke et al., 2020; Liu et al., 2019). Linke et al. (2020) suggested that accessible and dedicated mobility equipment may decrease required staff time, and defined this equipment as monitors, intravenous pumps, transport ventilators, and drains. During the implementation period of the Linke et al. (2020) study, the multidisciplinary team met each morning to discuss required equipment to better coordinate mobility efforts. Liu et al. (2019) discussed the timing of mobilization order placement, stating that prior to protocol implementation, orders were written irregularly. However, after protocol implementation, orders for mobilization were automatically placed for all ICU admissions. This type of order entry can also be characterized as an early mobility order set. Linke et al. (2020) also highlighted the benefits of organizational or leadership support, describing it as a "key component of successful early mobility programs" (p. 2).

Impact and Outcomes

A secondary aim of this IR was to determine *which* methods are most successful in implementing and utilizing early mobilization. Analysis revealed that the reviewed publications had several points of commonality as well as variances. Main discussion points included implementation practices, safety, mobility, mortality, number of ICU days, and health care costs. In essence, these points are also quality indicators.

Safety and Mobility. Each publication that mentioned safety within its results depicted a positive safety profile for early mobilization. However, Schallom et al. (2020) concluded that

there were no significant improvements in safety, but rather minimal complications. Therefore, this result was listed as “neutral” within the data comparison table. In the studies in which mobility was addressed, it was unanimous that mobility increased after methods were implemented (Lai et al., 2017; Linke et al., 2020; Liu et al., 2019; Schallom et al., 2020; Schujmann et al., 2020; Sigler et al., 2016). Conversely, multiple articles ascertained that the increase in mobility is likely associated with actual implementation of mobility protocols or programs.

Mortality. None of the selected publications identified mortality in the hypotheses or presented mortality as a study result. This is probably due to the inability to directly correlate early mobilization with an increase or decrease in mortality. The concept of mortality is highly complex and is typically a result of a combination of factors rather than one distinct element.

ICU Length of Stay and Health Care Costs. The matters of hospital costs and length of ICU stay showed mixed results. Four studies revealed a decrease in the length of ICU days as a result of early mobility implementation, while the other five studies were either neutral with no significant increase or decrease or did not mention the subject (Lai et al., 2017; Liu et al., 2019; Schallom et al., 2020; Schujmann et al., 2020). Additionally, three studies (Lai et al., 2017; Lang et al., 2020; Liu et al., 2019) identified a reduction in hospital costs after implementation of early mobility protocols, with the other six studies not mentioning or assessing hospital costs.

SECTION SIX: DISCUSSION

Conclusion

The literature analyzed, critiqued, and compared for the purposes of this IR revealed that early mobility programs, protocols, or algorithms and all associated interventions are not only beneficial but essential in the prevention of ICU-associated weakness. The question guiding this

IR was: What strategies have been implemented to facilitate early mobilization of patients in ICUs? The nine publications appraised in this IR answered the review question to the fullest extent, examining interventions to determine not only which are useful, but also which assist in meeting quality metrics.

Methods for implementation of early mobility include programs, protocols, and algorithms composed of robust interventions. The education and training of staff, along with a multidisciplinary approach, organizational support, and the establishment of clinical champions, is beneficial to not only the implementation of early mobility methods but also the success of these methods. Additionally, the optimization of analgesia and sedation, dedicated mobility equipment, automated early mobility order sets upon ICU admission, and a formal communication process, allow for efficiency of implementation.

Whether it be evaluation, exclusion, cessation, safety screening, tolerance monitoring, RASS and CAM-ICU scores, or timeframe of mobility initiation, each of these criteria or standards are comparable to links in a chain; together, they create a strong system in which early mobility can be executed. Furthermore, an evident increase in general mobility and a decrease in ICU length of stay further support the need for early mobility practices in the clinical setting. In addition to efficacy, most studies showed a high safety profile for early mobility practices with minimal (if any) complications.

Implications for Practice

Out of the four principal domains (research, practice, education, and policy), recommendations from this IR can most affect hospital-based policy initiatives and, subsequently, clinical practice (Toronto & Remington, 2020). When the methods used to

implement early mobility in the ICU are determined, policies can be amended or created to improve not only clinical practice but also patient outcomes.

Future Research

Future research should build upon the success of early mobility implementation strategies and seek to better understand all aspects of the themes and patterns revealed in this IR. Since early mobility implementation in subspecialty ICUs was not included in this review, it may be beneficial for future reviewers to focus on specialized mobility practices.

Dissemination

The review results will be disseminated via publication in Scholar's Crossing, an online platform that presents scholarly works and is affiliated with Liberty University. This IR will also be presented in the form of a poster, as required by the Doctor of Nursing Practice program at Liberty University. Additionally, this information will be placed into a podium presentation format for future use and possibly presented at the research day held by Liberty University's School of Nursing.

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Sigler, M., Nugent, K., Alalawi, R., Selvan, K., Tseng, J., Edriss, H., Turner, A., Valdez, K., & Krause, D. (2016). Making of a successful early mobilization program for a medical intensive care unit. *Southern Medical Journal, 109*(6), 342–345. https://doi.org/10.14423/SMJ.0000000000000472

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Whittemore, R., & Knafl, K. (2005). Methodological issues in nursing research. The integrative review: An updated methodology. *Journal of Advanced Nursing, 52*(5), 546–553.

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Zhang, L., Hu, W., Cai, Z., Liu, J., Wu, J., Deng, Y., Yu, K., Chen, X., Zhu, L., Ma., J., & Qin, Y. (2019). Early mobilization of critically ill patients in the intensive care unit: A systematic review and meta-analysis. *PloS One, 14*(10), Article e0223185. https://doi.org/10.1371/journal.pone.0223185

Appendix A

CITI Program Certificate

CITI PROGRAM

Completion Date 14-Jul-2020
Expiration Date 14-Jul-2023
Record ID 37458953

This is to certify that:

Rachel Huffman

Has completed the following CITI Program course:

Not valid for renewal of certification through CME. Do not use for TransCelerate mutual recognition (see Completion Report).

Biomedical Research - Basic/Refresher (Curriculum Group)
Biomedical & Health Science Researchers (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

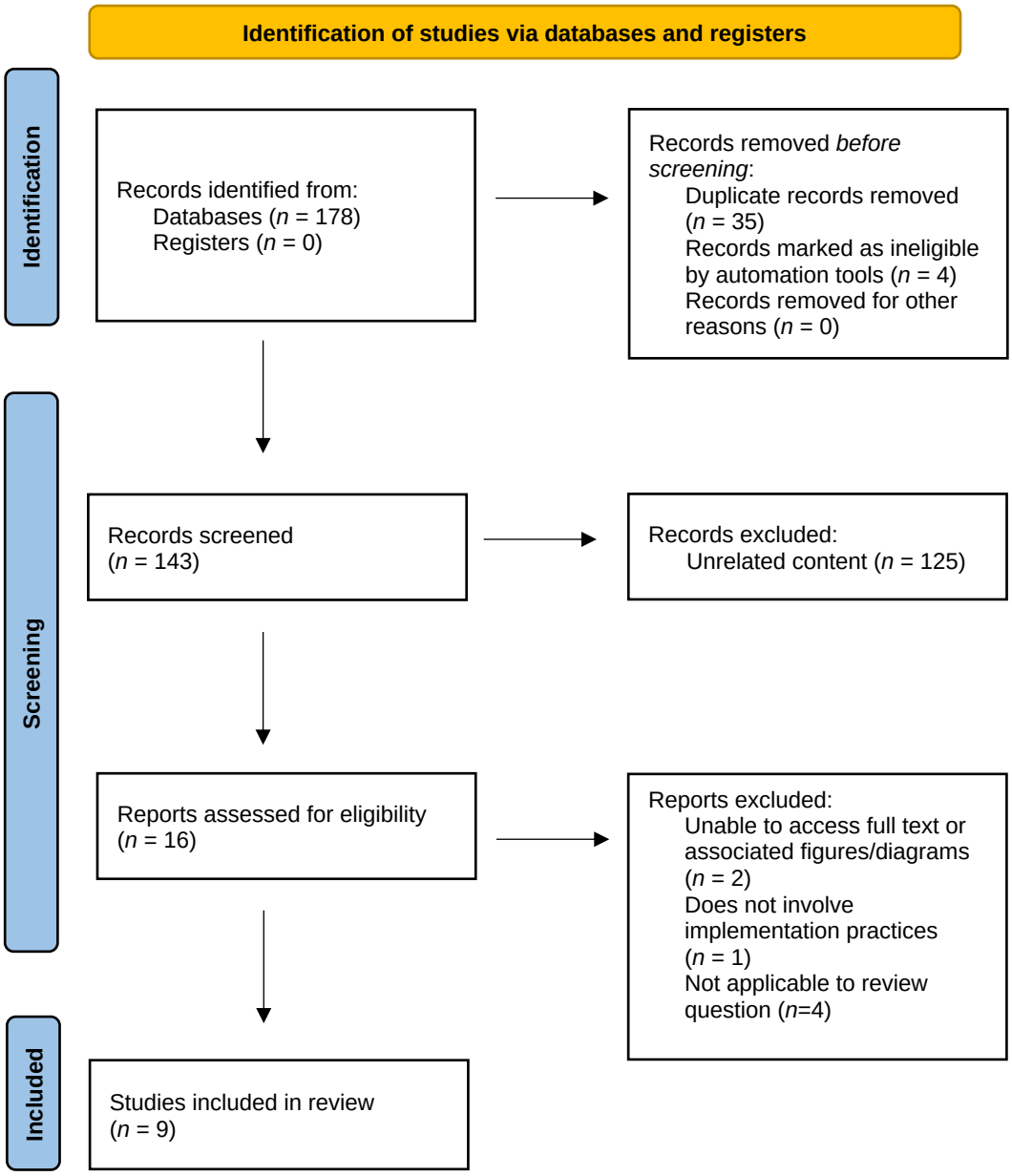
Liberty University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w15d56765-df95-4a7f-b8a1-088b2d6dd944-37458953

Appendix B

PRISMA 2020 Flow Diagram for new systematic reviews which included searches of databases and registers only



Note: Adapted from "The PRISMA 2020 Statement: An updated guideline for reporting systematic reviews," by Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M. Hrobjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). *BMJ (Online), 372*, p. n71. https://doi.org/10.1136/bmj.n71

Appendix C

IRB Approval Letter

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

August 17, 2021

Rachel Huffman
Dorothy Murphy

Re: IRB Application - IRB-FY21-22-136 UP AND MOVING: AN INTEGRATIVE REVIEW EVALUATING EARLY MOBILITY IN THE INTENSIVE CARE UNIT

Dear Rachel Huffman and Dorothy Murphy,

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your project with the data safeguarding methods mentioned in your IRB application.

Decision: No Human Subjects Research

Explanation: Your study is not considered human subjects research for the following reason:

(1) It will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued non-human subjects research status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this determination or need assistance in determining whether possible modifications to your protocol would change your application's status, please email us at irb@liberty.edu.

Sincerely,

G. Michele Baker, MA, CIP

Administrative Chair of Institutional Research
Research Ethics Office

Appendix D

Literature Matrix

Integrative Review Question: What strategies have been implemented to facilitate early mobilization of patients in intensive care units?

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
Lai, C.-C., Chou, W., Chan, K.-S., Cheng, K.-C., Yuan, K.-S., Chao, C.-M., & Chen, C.-M. (2017).	To evaluate effects of a quality improvement program (a multidisciplinary team and protocol) introducing early mobilization, on patient outcomes who are mechanically ventilated	A 19-bed ICU; 153 mechanically ventilated adult ICU patients	Retrospective observational study over one-year time period	• 63 patients were enrolled pre-intervention and 90 patients in the post-protocol group • The post-intervention group revealed less ventilator days and	Level 4: case-control study	• Single-center study • Safety and feasibility were not assessed as part of the study. • Changes in physical function were not measured.	Yes. The early mobilization protocol was divided into four levels with patients being mobilized twice daily, 5 days/week. Though the protocol itself was simple, each outcomes/indicator showed positive results as each phase of the study progressed. The publication is at

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
				decreased ICU length of stay.		• Family involvement in protocol/program was not assessed. • Study was not randomized with blind evaluation.	level 4 of evidence, and provides concrete statistical analysis of study data.
Lang, J. K., Paykel, M. S., Haines, K. J. & Hodgson, C. L. (2020).	To evaluate the methodological quality and thematic completeness of existing clinical practice guidelines which address early	Systematic review of relevant articles from January 2008 to February 2020	Two reviewers; titles and abstracts were screened first, then full-texts	10 publications were included in the review and placed into five key categories: safety concerns, patient capability, motivation and beliefs, team culture, and environmental	Level 1: systematic review of evidence-based clinical practice guidelines	• Two particular publications were not self-identified by the authors as CPG, which may limit the validity.	Yes. The recommendations related to early mobility that were reported in this study include: protocolized rehabilitation, safety criteria or safety screening, progressive mobilization

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
	mobilization of ICU adult patients			factors. Consistencies in the study included: support of early mobilization (it is safe and may reduce costs), collaborative teamwork is necessary, and a protocolized approach should be used.		• The quality of guideline methodology may be underrepresented because the review assessment (using AGREE II tool) was based solely on published information • There is not a commonly accepted definition of early mobility.	algorithm with a gradual approach, creating and reviewing rehabilitation goals, a specific timeframe for initiation, monitoring criteria, and education/training of key EM stakeholders. This study represents a high level of evidence and evaluates existing clinical practice guidelines for early mobility. However, it does not offer an implementation tool for reader review.

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020).	To develop and evaluate a protocol to increase patient mobility in three adult ICUs using an interdisciplinary approach and existing resources	Three adult ICUs in an urban, academic hospital; Representatives for protocol initiation included physicians, nursing, respiratory therapy, physical therapy and occupational therapy	The Iowa Model of Evidence-Based Practice was used for synthesis of literature and intervention planning; retrospective pre- and post-intervention data collection design was used to compare outcomes	There was no change found in ICU length of stay, hospital length of stay, or ventilator days. However, successful implementation of an early mobility protocol led to creation of a mobility protocol toolkit for use across all ICUs	Level 4: cohort study	• This was a single-center project • An advantage at this center included dedicated PT and OT in each ICU • Under-documentation or documentation in a non-queried HER field may have led to overall	Yes. The study provided a mobility protocol toolkit that can be used to answer the review question. Additionally, protocol implementation is supported by an interdisciplinary workgroup. The evidence is scored at level 4, with a well-designed cohort study that spanned multiple ICUs.

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
						underreporting of mobility events	
Liu, J., Ogura, T., Takahashi, K., Nakamura, M., Ohtake, H., Fujiduka, K., Abe, E., Oosaki, H., Miyazaki, D., Suzuki, H., Nishikimi, M.,	To determine whether a progressive early mobilization protocol improves patient outcomes, including in-hospital mortality and total hospital costs	Single tertiary community hospital with a 12-bed closed-mixed ICU • All patients were adult • Preintervention group (January 2014 to May 2015) • Postintervention group (June 2015 to December 2016)	Retrospective preintervention and postintervention quality comparison study; intervention = Maebashi Early Mobility Protocol	Early mobilization protocol significantly associated with decreased mortality, decreased total hospital costs, reductions in ICU and hospital lengths of stay, decreased time of mechanical ventilation, and improved physical function at time of discharge	Level 4: cohort study	• Strict inclusion criteria (only enrolled 17% of ICU patients) • Unmeasured and residual confounding factors may significantly affect the results • The study is retrospectiv	Yes. The Maebashi Early Mobility (EM) Protocol was successfully implemented, with rehabilitation transitioning from complete dependence on physical therapists, to a multidisciplinary approach. Also gives great detail between items compared before and after intervention.

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
Komatsu, M., Lefor, A. K., & Mato, T. (2019).						e, single center, small sample size, nonrandomized, and nonblinded	
Nydahl, P., Gunther, U., Diers, A., Hesse, S., Kerschensteiner, C., Klarmann, S., Borzikowsky, C., & Kopke, S. (2020).	To evaluate the effect of implementation of an early mobility protocol, on the rate of OOB mobilizations among other outcomes of ICU patients	Multicenter, stepped-wedge, cluster-randomized pilot study; 152 patients during the control period and 120 patients during the intervention period	• 5 ICUs • Interprofessional protocol was implemented in a randomized, monthly order • 1-day point prevalence surveys were used to evaluate	• Non-significant increase in OOB mobilizations from 36.2% to 45.8%. • More patients were mobilized at least once daily • No significant changes in	Level 2: singular RCT with multicenter design	• Targeted sample size was not achieved • No long-term outcomes (post-discharge) were assessed • Protocol was adapted, leading to variability	Yes. Protocol was inter-professional and used throughout five ICUs during implementation. High level of evidence, and study implications show that protocols can aid in overcoming the barrier of patient safety.

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
			mobilization of patients • Outcome scored: Level 3 or higher on ICU Mobility Scale • Secondary outcomes: unwanted safety events, mechanical ventilation, delirium, and ICU/hospital days	secondary outcomes • Adherence to protocol was > 90%		of the intervention (possible bias)	
Raurell-Torredà, M., Regaira-	To design an early mobility algorithm for ICU patients	Systematic review of relevant	• Inclusion criteria: articles from 2009 to	• 30 articles included in review	Level 1: well-designed	N/A	Yes. Two early mobility algorithms were designed after a robust review of

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
Martínez, E., Planas-Pascual, B., Ferrer-Roca, R., Martí, J. D., Blazquez-Martínez, E., Ballesteros-Reviriego, G., Vinuesa-Suárez, I., & Zariquiey-Esteva, G. (2021).	and to provide early mobility recommendations for specific ICU subpopulations	articles from 2009 to 2019	2019, adult patients, ICU, studies that include an early mobility intervention (protocol/guide/algorithm) • Multiple databases used	• 21 articles were general guides to early mobility implementation • 7 articles: neurocritical care and/or trauma ICU • 1 article: CRRT • 1 article: ECMO and/or VAD patients • Classification of main topics: patient indicators, adverse events,	systematic review		existing EM protocols and interventions. Recommendations were also provided for patients on CRRT, ECMO or VADs, and neurocritical or trauma patients. This article may be the most beneficial in answering the review question, considering the objectives of both the publication and this IR are similar.

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
				rehabilitation interventions, patient indicators (ICU specific), drugs, organizational aspects, and others • Algorithm of decision-making • Safety criteria checklist			
Schallom, M., Tymkew, H., Vyers, K., Prentice, D., Sona,	To examine the impact of an interdisciplinary mobility protocol	• Implementation occurred in 7 specialty ICUs • 1266 patients before and	• Data was collected on patients in phase 1 who were in the ICU for > 24 hours	• Mobility increased in all ICUs after implementation • Complications occurred in	Level 3: well-designed controlled trial (without randomization)	• By retrospectively reviewing medical records, quality of extracted	Yes. High level of evidence (level 3) and visual representation of screening criteria as well as mobility protocol. Screening criteria was divided

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
C., Norris, T., & Arroyo, C. (2020).		1420 patients after implementation in phase 1 • 258 patients before and 1681 patients after implementation with phase 2	• Timeframe of phase 1 data collection: 2 months before implementation and 2 months after implementation • Data collection in phase 2 was on a random sample of 20% of patients with ICU stay > 3 days • Timeframe of phase 2 data	0.2% of patients • 84% of patients had OOB activity after phase 2 implementation • Significant decrease in ICU length of stay during both phases • 50% of patients were discharged home within one month of hospitalization; 40% in months prior to		data was dependent on documentation. • Fidelity to the intervention implementation	by ICU subtype (MICU vs. surgical/burn/trauma ICU). The protocol was broken down into 4 levels with specific goals. Additionally, the ICU length of stay decreased significantly, with patients also being discharge home more frequently within the first month of hospitalization. – "Introduction of a standardized early mobility protocol increased the number of patients achieving ambulation and

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
			collection: 2 months before and 12 months after implementation	implementation			resulted in additional improved outcomes" (p. e14).
Schujmann, D. S., Gomes, T., Lunardi, A. C., Zoccoler Lamano, M., Fragoso, A., Pimentel, M., Peso, C. N., Araujo, P., & Fu,	To investigate whether patients who participated in an ICU mobility program performed better on functional status, mobility, muscle, and respiratory assessments upon discharge vs.	Randomized controlled trial with blind evaluation; Adult patients with previous functional independence and no contraindications for mobilization	• The experimental group participated in an early/progressive mobility program • 5 levels of activity • Control group received conventional treatment	• Patients in the intervention group had shorter ICU stays • Intervention patients willingly participated more in physical activities • Better performance of intervention	Level 2: well-designed RCT	Difficult to separate the benefits of each specific intervention	Yes. The ICU mobility program consisted of five activity levels aimed at gait reeducation as well as cognitive components. Strong level of evidence (level 2), and visual representation of a program dedicated to early/progressive mobility for ICU patients

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
C. (2020).	patients who received conventional physiotherapy		• Items evaluated: level of activity, functional status, respiratory status, muscle strength, and mobility at discharge from ICU • 49 patients in control group • 50 patients in experimental group	group with the sit-to-stand test and 2-minute walk test • No difference in hospital length of stay • No difference in TUG scores			
Sigler, M., Nugent, K.,	To provide a guideline for ICU early mobilization	32 ICU patients were ambulated while receiving	Subjects were retrospectively assessed and compared	• Patients with increased FiO2 and nonconventio	Level 4: case-control (or	• Single center study	Yes. The program included analgesia/sedation optimization and

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would use to answer review question? (Yes or No) Provide Rationale.
Alalawi, R., Selvan, K., Tseng, J., Edriss, H., Turner, A., Valdez, K., & Krause, D. (2016).	program development and implementation and to describe the patient characteristics and endpoints for participants	mechanical ventilation		nal modes of ventilation successfully ambulated with no adverse events • Mean ambulation distance was 102 ± 152 feet • Retrospective study revealed: decreased length of ICU stay (from 4.8 to 4.1 days)	retrospective study)	• Different barriers for different institutions	sedation minimization, along with a progressive mobility protocol. With a level 4 of evidence, positive outcomes, and practices supported by clinical trials and current guidelines, this study is beneficial. Additionally, the progressive mobility program protocol is provided within the article.

Appendix E

Data Comparison Table

What strategies have been identified to impact early mobilization practices?

Author(s)	Year of publication	Implementation Method(s)	Impact/Outcomes				
			Safety	Mobility	Mortality	Length of ICU stay	Costs
Lai, C.-C., Chou, W., Chan, K.-S., Cheng, K.-C., Yuan, K.-S., Chao, C.-M., & Chen, C.-M.	2017	Multidisciplinary team-initiated protocol • The multidisciplinary team included: physical therapist, critical care nurse, nursing assistant, respiratory therapist, and patient's family. – This was the only study that included the patient's family • Protocol initiated within 72 hours of mechanical ventilation • Occurred twice daily, 5 days/week during family visitation hours (30-minute sessions) • Protocol Levels:	N/A	↑	N/A	↓	↓

		○ Level I: passive extremities movement ○ Level 2: active extremities movement ○ Level 3: sitting position on the bed ○ Level 4: move from bed to a chair bedside bed [*Other significant results: decreased mechanical ventilation days*]					
Lang, J. K., Paykel, M. S., Haines, K. J. & Hodgson, C. L.	2020	A general protocolized or structured approach, including: • Safety criteria or safety screening • A collaborative or multidisciplinary approach • Clinical champions • Progressive mobilization algorithm with a gradual approach • Creating and reviewing rehabilitation goals • A specific timeframe for initiation (24 to 72 hours after ICU admission)	↑	N/A	N/A	N/A	↓

		• Monitoring criteria • Education/training of key EM stakeholders.					
Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G.	2020	Creation of an early mobility protocol, leading to creation of a mobility protocol toolkit across all ICUs within health system. Interventions included: • Minnesota Health ICU Early Mobility Protocol • An interdisciplinary workgroup (nursing, physician, occupational and physical therapy, respiratory therapy, and pharmacy) who met biweekly • Gaining organizational support • Review of literature and practice recommendations by professional groups • Examining workflow of each discipline to optimize and coordinate schedules to facilitate mobility • A formal communication process was developed (daily planning)	↑	↑	N/A	Neutral	N/A

		• Dedicated and accessible mobility equipment • Intensive, multimodal education plan • Considered to be a continued investment in the ICU Liberation Bundle *Protocol:* meta rules, evaluation criteria (exclusion and yield), progression algorithm, and tolerance assessment					
Liu, J., Ogura, T., Takahashi, K., Nakamura, M., Ohtake, H., Fujiduka, K., Abe, E., Oosaki, H., Miyazaki, D., Suzuki, H., Nishikimi, M., Komatsu, M., Lefor, A. K., & Mato, T.	2019	Maebashi Early Mobilization Protocol • Staff were also educated one month prior to study initiation (importance of EM, protocol fundamentals and simulation training). • Orders for rehabilitation/EM were automatically written for all ICU admissions • Multidisciplinary approach with the team consisting of: ICU physician, a nurse, and a physical therapist • Criteria for cessation or continuation of cessation offered for ICU	N/A	↑	↓	↓	↓

		physician monitoring respiratory and hemodynamic status of patient • RASS used to evaluate sedation level					
Nydahl, P., Gunther, U., Diers, A., Hesse, S., Kerschensteiner, C., Klarmann, S., Borzikowsky, C., & Kopke, S.	2020	Interprofessional protocol for early mobilization • Before implementation, all participating ICUs were given information about the study • Mobilization training • Study coordinators (or "superusers") were also trained • Protocol includes inclusion and exclusion criteria with a traffic light system, premobilization checklist, physical assessments standards, safety criteria, and the ICU Mobility Scale • Pocket cards and laminated posters for bedside (to define patients' daily mobility goals)	↑	↑	N/A	Neutral	N/A
Raurell-Torredà, M., Regaira-Martínez, E., Planas-Pascual,	2021	Early mobility algorithms – included algorithm for	N/A	N/A	N/A	N/A	N/A

B., Ferrer-Roca, R., Martí, J. D., Blazquez-Martínez, E., Ballesteros-Reviriego, G., Vinuesa-Suárez, I., & Zariquiey-Esteva, G.		decision-making and safety checklist • Mention early mobility as part of the ABCDEF bundle *Algorithm for decision-making*: • Interprofessional assessment is completed by the nurse, physiotherapist and doctor • Exclusion criteria (example = pending discharge in ≤ 48 hours) • Priority patients highlighted • RASS score • Assess for pain and delirium • Reassess for cooperation after 24 hours *Safety checklist (each point is scored according to the ICU Mobility Scale):* • Myocardial ischemia < 24 hours prior • New arrhythmia < 24 hours prior • Fi02 • Peep					

		• An increase in vasopressor doses < 2 hours prior vs. no changes in 24 hours • Open abdomen or risk of dehiscence • Renal replacement therapy • Response to verbal stimuli vs. moving legs against gravity					
Schallom, M., Tymkew, H., Vyers, K., Prentice, D., Sona, C., Norris, T., & Arroyo, C.	2020	AACN mobility protocol • Mentions early mobility as part of the ABCDEF bundle *Screen for safety:* • Divided into two categories based on ICU subtype (Medical ICU vs. surgical/trauma/burn ICU) and evaluated every 12 hours; boxes available to be checked (easy for printing and communicating with other staff) • Safety criteria evaluated: myocardial stability, oxygenation stability, vasopressor use/vascular access, engages to voice, and neurological stability	Neutral or minimal	↑	N/A	↓	N/A

		Mobility protocol: • Level 1 goal: clinical stability and able to move arm against gravity • Level 2 goal: sitting upright and able to move leg against gravity • Level 3 goal: increase strength and ability to stand with minimal to moderate assist • Level 4 goal: increase strength and distance walked • Each level offers different exercises aimed at helping the patient reach those goals • RASS score documented at least every 4 hours • CAM-ICU documented once per shift • ICU Mobility Scale					
Schujmann, D. S., Gomes, T., Lunardi, A. C., Zoccoler Lamano, M., Fragoso, A., Pimentel, M., Peso, C. N., Araujo, P., & Fu, C.	2020	Early and progressive mobility program • Mobilization began within 48 hours of ICU admission • Physiotherapy occurred twice daily, 5 times per week with each session being approximately 40 minutes	N/A	↑	N/A	↓	N/A

		• RASS goal between -1 and +1 • Five levels (with level 1 being unresponsive to instructions and level 5 as the patient having already completed level 4) • Exercises: passive cycle ergometer, functional electrical stimulation, passive mobilization, stretching, bridge exercise • Position changes: positive position changes, assisted position changes (in bed), assisted bedside sitting, trunk exercises, assisted ambulation, active bedside transfer, sit/stand exercise (10x), ambulation with/without assistance, step climbing, and sitting in chair					
Sigler, M., Nugent, K., Alalawi, R., Selvan, K., Tseng, J., Edriss, H., Turner, A., Valdez, K., & Krause, D.	2016	ICU early mobilization program *Program components:* • Analgesia/sedation optimization with interns and residents receiving	↑	↑	N/A	N/A	N/A

		education on this topic at the beginning of rotations – A focus on analgesia more than sedation (and eliminating benzodiazepines)
		• Sedation minimalization (RASS goal of -2 to -1)
		• Progressive mobility protocol with 8 steps. Protocol was hung by patient's room door as nurse highlighted most recent step reached
		• Physical and occupational therapy recruitment – consulted when a patient reached step 4 of the protocol
		• Nursing education:
		  ○ PT/OT educated nursing on use of therapy equipment
		  ○ Changes in analgesia/sedation strategies
		  ○ Protocol					

*All items listed as N/A are not specifically addressed within the article as outcomes.

Appendix F

Themes and patterns of identified early mobility practices, paired with associated literature

Theme/Pattern	**Associated Publication(s)**
Program	1. Schujmann, D. S., Gomes, T., Lunardi, A. C., Zoccoler Lamano, M., Fragoso, A., Pimentel, M., Peso, C. N., Araujo, P., & Fu, C. (2020) 2. Sigler, M., Nugent, K., Alalawi, R., Selvan, K., Tseng, J., Edriss, H., Turner, A., Valdez, K., & Krause, D. (2016)
Protocol or Algorithm	1. Lai, C.-C., Chou, W., Chan, K.-S., Cheng, K.-C., Yuan, K.-S., Chao, C.-M., & Chen, C.-M. (2017) 2. Lang, J. K., Paykel, M. S., Haines, K. J. & Hodgson, C. L. (2020) 3. Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020) 4. Liu, J., Ogura, T., Takahashi, K., Nakamura, M., Ohtake, H., Fujiduka, K., Abe, E., Oosaki, H., Miyazaki, D., Suzuki, H., Nishikimi, M., Komatsu, M., Lefor, A. K., & Mato, T. (2019) 5. Nydahl, P., Gunther, U., Diers, A., Hesse, S., Kerschensteiner, C., Klarmann, S., Borzikowsky, C., & Kopke, S. (2020) 6. Raurell-Torredà, M., Regaira-Martínez, E., Planas-Pascual, B., Ferrer-Roca, R., Martí, J. D., Blazquez-Martínez, E., Ballesteros-Reviriego, G., Vinuesa-Suárez, I., & Zariquiey-Esteva, G. (2021) 7. Schallom, M., Tymkew, H., Vyers, K., Prentice, D., Sona, C., Norris, T., & Arroyo, C. (2020) 8. Sigler, M., Nugent, K., Alalawi, R., Selvan, K., Tseng, J., Edriss, H., Turner, A., Valdez, K., & Krause, D. (2016)
Intervention	
Staff education	1. Lang, J. K., Paykel, M. S., Haines, K. J. & Hodgson, C. L. (2020) 2. Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020) 3. Liu, J., Ogura, T., Takahashi, K., Nakamura, M., Ohtake, H., Fujiduka, K., Abe, E., Oosaki, H., Miyazaki, D., Suzuki, H., Nishikimi, M., Komatsu, M., Lefor, A. K., & Mato, T. (2019)

	4. Nydahl, P., Gunther, U., Diers, A., Hesse, S., Kerschensteiner, C., Klarmann, S., Borzikowsky, C., & Kopke, S. (2020) 5. Sigler, M., Nugent, K., Alalawi, R., Selvan, K., Tseng, J., Edriss, H., Turner, A., Valdez, K., & Krause, D. (2016)
Multidisciplinary approach	1. Lai, C.-C., Chou, W., Chan, K.-S., Cheng, K.-C., Yuan, K.-S., Chao, C.-M., & Chen, C.-M. (2017) 2. Lang, J. K., Paykel, M. S., Haines, K. J. & Hodgson, C. L. (2020) 3. Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020) 4. Liu, J., Ogura, T., Takahashi, K., Nakamura, M., Ohtake, H., Fujiduka, K., Abe, E., Oosaki, H., Miyazaki, D., Suzuki, H., Nishikimi, M., Komatsu, M., Lefor, A. K., & Mato, T. (2019) 5. Nydahl, P., Gunther, U., Diers, A., Hesse, S., Kerschensteiner, C., Klarmann, S., Borzikowsky, C., & Kopke, S. (2020)
Analgesia and sedation optimization	1. Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020) 2. Liu, J., Ogura, T., Takahashi, K., Nakamura, M., Ohtake, H., Fujiduka, K., Abe, E., Oosaki, H., Miyazaki, D., Suzuki, H., Nishikimi, M., Komatsu, M., Lefor, A. K., & Mato, T. (2019) 3. Sigler, M., Nugent, K., Alalawi, R., Selvan, K., Tseng, J., Edriss, H., Turner, A., Valdez, K., & Krause, D. (2016)
Dedicated mobility equipment	1. Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020)
Early mobilization order set with ICU admission	1. Liu, J., Ogura, T., Takahashi, K., Nakamura, M., Ohtake, H., Fujiduka, K., Abe, E., Oosaki, H., Miyazaki, D., Suzuki, H., Nishikimi, M., Komatsu, M., Lefor, A. K., & Mato, T. (2019)
Organizational support	1. Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020)
Clinical champions	1. Lang, J. K., Paykel, M. S., Haines, K. J. & Hodgson, C. L. (2020) 2. Nydahl, P., Gunther, U., Diers, A., Hesse, S., Kerschensteiner, C., Klarmann, S., Borzikowsky, C., & Kopke, S. (2020)
Formal communication process	1. Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020) 2. Nydahl, P., Gunther, U., Diers, A., Hesse, S., Kerschensteiner, C., Klarmann, S., Borzikowsky, C., & Kopke, S. (2020)

	3. Schallom, M., Tymkew, H., Vyers, K., Prentice, D., Sona, C., Norris, T., & Arroyo, C. (2020) 4. Sigler, M., Nugent, K., Alalawi, R., Selvan, K., Tseng, J., Edriss, H., Turner, A., Valdez, K., & Krause, D. (2016)
Criteria	
Evaluation	1. Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020) 2. Nydahl, P., Gunther, U., Diers, A., Hesse, S., Kerschensteiner, C., Klarmann, S., Borzikowsky, C., & Kopke, S. (2020) 3. Raurell-Torredà, M., Regaira-Martínez, E., Planas-Pascual, B., Ferrer-Roca, R., Martí, J. D., Blazquez-Martínez, E., Ballesteros-Reviriego, G., Vinuesa-Suárez, I., & Zariquiey-Esteva, G. (2021)
Timeframe of initiation	1. Lai, C.-C., Chou, W., Chan, K.-S., Cheng, K.-C., Yuan, K.-S., Chao, C.-M., & Chen, C.-M. (2017) 2. Lang, J. K., Paykel, M. S., Haines, K. J. & Hodgson, C. L. (2020) 3. Schujmann, D. S., Gomes, T., Lunardi, A. C., Zoccoler Lamano, M., Fragoso, A., Pimentel, M., Peso, C. N., Araujo, P., & Fu, C. (2020)
Exclusion	1. Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020) 2. Nydahl, P., Gunther, U., Diers, A., Hesse, S., Kerschensteiner, C., Klarmann, S., Borzikowsky, C., & Kopke, S. (2020) 3. Raurell-Torredà, M., Regaira-Martínez, E., Planas-Pascual, B., Ferrer-Roca, R., Martí, J. D., Blazquez-Martínez, E., Ballesteros-Reviriego, G., Vinuesa-Suárez, I., & Zariquiey-Esteva, G. (2021)
Safety screening/checklist	1. Lang, J. K., Paykel, M. S., Haines, K. J. & Hodgson, C. L. (2020) 2. Nydahl, P., Gunther, U., Diers, A., Hesse, S., Kerschensteiner, C., Klarmann, S., Borzikowsky, C., & Kopke, S. (2020) 3. Raurell-Torredà, M., Regaira-Martínez, E., Planas-Pascual, B., Ferrer-Roca, R., Martí, J. D., Blazquez-Martínez, E., Ballesteros-Reviriego, G., Vinuesa-Suárez, I., & Zariquiey-Esteva, G. (2021) 4. Schallom, M., Tymkew, H., Vyers, K., Prentice, D., Sona, C., Norris, T., & Arroyo, C. (2020)

RASS & CAM-ICU	1. Raurell-Torredà, M., Regaira-Martínez, E., Planas-Pascual, B., Ferrer-Roca, R., Martí, J. D., Blazquez-Martínez, E., Ballesteros-Reviriego, G., Vinuesa-Suárez, I., & Zariquiey-Esteva, G. (2021) 2. Schallom, M., Tymkew, H., Vyers, K., Prentice, D., Sona, C., Norris, T., & Arroyo, C. (2020) 3. Schujmann, D. S., Gomes, T., Lunardi, A. C., Zoccoler Lamano, M., Fragoso, A., Pimentel, M., Peso, C. N., Araujo, P., & Fu, C. (2020) 4. Sigler, M., Nugent, K., Alalawi, R., Selvan, K., Tseng, J., Edriss, H., Turner, A., Valdez, K., & Krause, D. (2016)
Tolerance assessment/monitoring	1. Lang, J. K., Paykel, M. S., Haines, K. J. & Hodgson, C. L. (2020) 2. Linke, C. A., Chapman, L. B., Berger, L. J., Kelley, T. L., Korpela, C. A., & Petty, M. G. (2020) 3. Liu, J., Ogura, T., Takahashi, K., Nakamura, M., Ohtake, H., Fujiduka, K., Abe, E., Oosaki, H., Miyazaki, D., Suzuki, H., Nishikimi, M., Komatsu, M., Lefor, A. K., & Mato, T. (2019)
Cessation	1. Liu, J., Ogura, T., Takahashi, K., Nakamura, M., Ohtake, H., Fujiduka, K., Abe, E., Oosaki, H., Miyazaki, D., Suzuki, H., Nishikimi, M., Komatsu, M., Lefor, A. K., & Mato, T. (2019)

Appendix G

Diagram of themes and patterns of identified early mobility practices