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| **CRITICALLY APPRAISED TOPIC**  **(P)** Patient/Population: 74 year old male with pneumonia in the ICU  **(I)** Interventions: Early mobility  **(C)** Comparison: Bedrest  **(O)** Outcome: Length of stay |

**FOCUSED CLINICAL QUESTION**

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| Is early mobility more effective than typical bedrest in decreasing length of stay in a 74 year old male with pneumonia in the ICU? |

**AUTHOR**

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| **Prepared by** | Carson Matthews | **Date** | 11/28/2022 |
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**CLINICAL SCENARIO**

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| In the acute care setting at Duke Hospital during my third clinical rotation, I evaluated and treated a 74 year old male admitted to the ICU with pneumonia. He was on Optiflow and required a non-rebreather mask intermittently. His SpO2 remained < 92% throughout the evaluation and dropped in the low 80s on multiple occasions during bed level mobility. SpO2 quickly returned to the high 80s and low 90s after donning the non-rebreather mask. This topic is important to clinicians because length of stay is something that healthcare systems are constantly concerned about and physical therapists know the importance of physical activity in reducing overall deconditioning, even for severely ill populations. We need physicians and nurses to “buy in” to early mobility protocols to help their patients get out of the hospital sooner and with higher functional abilities, if research proves this to be true when compared to typical bedrest in the ICU. |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

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| Eight studies met the inclusion and exclusion criteria. This includes 4 randomized controlled trials, 2 prospective cohort studies, 1 retrospective comparison study, and 1 meta-analysis and systematic review   * For every 10% increase in compliance of the ABCDEF bundle (Awakening and Breathing coordination, Choice of drugs, Delirium monitoring and management, Early mobility, and Family engagement), there was a 7% higher odds of survival and 15% higher hospital survival rate. Additionally, delirium, coma, and mechanical ventilation duration was decreased.2 * Bedside cycle ergometer implementation in the ICU improved the 6-minute walk test, isometric quadriceps force, and SF-36 score at hospital discharge.3 * An early mobility protocol which utilizes an interdisciplinary team approach to rehabilitation in the ICU is beneficial for functional outcomes, length of stay, mortality, and total hospital costs.5,6 * An early mobility protocol which utilizes a progressive approach to physical activity levels in the ICU is beneficial for functional outcomes and length of stay.7 * The adverse event rate for patients utilizing bedside cycle ergometers in the ICU is 0.16%.8 |

**CLINICAL BOTTOM LINE**

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| An early mobility protocol should be implemented in the older adult population who have been admitted to the ICU due to respiratory distress or any other acute illness. The early mobility protocol should be progressive in nature and involve the interdisciplinary team in the ICU to improve functional outcomes, length of stay, mortality, and reduce total hospital costs. |

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| ***This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor*** |

*The above information should fit onto the first page of your CAT*

**SEARCH STRATEGY**

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| **Terms used to guide the search strategy** | | | |
| **P**atient/Client Group | **I**ntervention (or Assessment) | **C**omparison | **O**utcome(s) |
| Older adult, male, intensive care unit, ICU, pneumonia | Early Mobility, early mobil\*, physical therapy, physiotherapy | Bedrest, bed rest | LOS, length of stay, intensive care unit-acquired weakness, ICU-acquired weakness, ICU-AW, mortality |

**Final search strategy (history):**

*Show your final search strategy (full history) from PubMed. Indicate which “line” you chose as the final search strategy.*

* Early mobility
* Early mobil\*
* (Physical therapy OR physiotherapy) AND ICU
* (Physical therapy OR physiotherapy OR early mobil\*) AND (ICU OR intensive care unit)
* ICU AND length of stay
* Early mobility AND ICU
* (Early mobil\*) AND ICU
* (ICU OR intensive care unit) AND (LOS OR length of stay)
* Early mobility AND ICU AND pneumonia NOT surgery
* (Early mobil\*) AND (bedrest OR bed rest)
* (Early mobil\*) AND (bedrest OR bed rest) AND (intensive care unit-acquired weakness OR ICU-acquired weakness OR ICU-AW)
* (Early mobil\*) AND (bedrest OR bed rest) AND (intensive care unit-acquired weakness OR ICU-acquired weakness OR ICU-AW) AND mortality
* (Early mobil\*) AND (bedrest OR bed rest) NOT pediatrics
* (Early mobil\*) AND (bedrest OR bed rest) NOT pediatrics AND older adult
* (Early mobil\*) AND (bedrest OR bed rest) NOT pediatrics AND male
* (Early mobil\*) AND (ICU OR intensive care unit) AND (LOS OR length of stay)
* (Early mobil\*) AND (ICU OR intensive care unit) AND (LOS OR length of stay) AND pneumonia

*In the table below, show how many results you got from your search from each database you searched.*

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| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (if applicable)** |
| **Pub Med**  **CINAHL**  **Cochrane**  **PEDro** | 387  215  575  19 | **Limits:**   * Ages 19 and up (190 results) * Articles since 2017 (109 results) * Articles in English (107 results) * Only systematic reviews, meta analyses, and randomized control trials (35 results)   **Limits:**   * Articles since 2017 (134 results) * Ages 65 and older (9 results)   **Limits:**   * Articles since 2020 (99 results) * “Lungs and airway” topic (8 results)   **Limits:**   * Articles since 2017 (14 results) |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| * Admitted to the ICU * > 18 years old * Cardiovascular and respiratory stability |
| **Exclusion Criteria** |
| * Cognitive impairments prior to ICU admission * BMI > 50 * Unstable cervical fracture * Amputation |

**RESULTS OF SEARCH**

**Summary of articles retrieved that met inclusion and exclusion criteria**

*For each article being considered for inclusion in the CAT, score for methodological quality on an appropriate scale, categorize the level of evidence, indicate whether the relevance of the study PICO to your PICO is high/mod/low, and note the study design (e.g., RCT, systematic review, case study).*

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| **Author (Year)** | **Risk of bias (quality score)\*** | **Level of Evidence\*\*** | **Relevance** | **Study design** |
| AVERT Trial Collaboration group, 2017 | PEDro Score: 8/10 | Level 2 | Low | Randomized Controlled Trial |
| Barnes-Daly MA, Phillips G, Ely EW, 2017 | RoB 2 Score: “Some Concerns” | Level 3 | Moderate | Prospective cohort quality improvement initiative |
| Burtin C, Clerckx B, Robbeets C, et al, 2009 | PEDro Score: 4/10 | Level 3 | Moderate | Randomized Controlled Trial |
| Fossat G, Baudin F, Courtes L, et al, 2018 | PEDro Score: 7/10 | Level 2 | Moderate | Randomized Clinical Trial |
| Liu K, Ogura T, Takahashi K, et al, 2019 | RoB 2 Score: “Some Concerns” | Level 3 | High | Retrospective preintervention and postintervention quality comparison study |
| Morris PE, Goad A, Thompson C, et al, 2008 | RoB 2 Score: “Low” | Level 3 | High | Prospective cohort study |
| Schujmann DS, Teixeira Gomes T, Lunardi AC, et al, 2020 | PEDro Score: 6/10 | Level 2 | High | Randomized Controlled Trial |
| Takaoka A, Utgikar R, Rochwerg B, Cook DJ, Kho ME, 2020 | RoB 2 Score: “Low” | Level 1 | Moderate | Systematic Review and Meta-analysis |

\*Indicate tool name and score

\*\*Use Portney Table 36-1: Summary of Levels of Evidence (2020). If downgraded, indicate reason why.

**BEST EVIDENCE**

The following 2 studies were identified as the ‘best’ evidence and selected for critical appraisal. Rationale for selecting these studies were:

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| * Liu K, Ogura T, Takahashi K, et al. A Progressive Early Mobilization Program Is Significantly Associated With Clinical and Economic Improvement: A Single-Center Quality Comparison Study. *Crit Care Med*. 2019;47(9):e744-e752. doi:10.1097/CCM.0000000000003850 * Schujmann DS, Teixeira Gomes T, Lunardi AC, et al. Impact of a Progressive Mobility Program on the Functional Status, Respiratory, and Muscular Systems of ICU Patients: A Randomized and Controlled Trial. *Crit Care Med*. 2020;48(4):491-497. doi:10.1097/CCM.0000000000004181   Both of the studies that I choose as being the “best” evidence and selected for critical appraisal were closely related to my PICO statement and clinical scenario. Even though these two articles don’t exactly match my PICO statement, correlations can be found because they both study the core concept of the PICO statement which is early mobility with critically ill patients. For example, my PICO addresses length of stay and how this is affected by early mobilization but this is not a core outcome in both of these articles. By reading further, length of stay is mentioned in both of these articles, it’s just not the highlighted and emphasized outcome they were focused on tracking. The things both articles were focused on tracking were things like muscular weakness and functional status. When diminished, both of which have profound consequences on the patients length of stay as explained in both articles. Both studies focused on early mobility protocols that could be implemented via the interdisciplinary team to foster better communication, “buy in” amongst clinicians, and a standardized approach to apply to all patients. |

**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of (A Progressive Early Mobilization Program Is Significantly Associated With Clinical and Economic Improvement) by (Liu et al., 2019)**

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| **Aim/Objective of the Study/Systematic Review:** |
| The aim of this study by Liu et al. was to determine if the Maebashi early mobilization protocol could result in reduced mortality and reduced total hospital costs when it was implemented for patients in the ICU. |
| **Study Design**  [e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]  Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| The study by Liu et al. was a retrospective preintervention and postintervention quality comparison study. The study had a small sample size of 391 patients that were included, was not randomized, with no comparison group, and was not blinded. The authors gathered the data retrospectively based on an article which was cited in the study (23) and was written by Liu et al. The primary outcomes that the authors were concerned with were hospital mortality and total hospital cost. Other outcomes that were assessed included: percentage of patients that attained each specific level of the protocol, number of days to reach this level of the protocol, adverse events, mechanical ventilation duration, ICU length of stay, hospital length of stay, percentage of independent ambulators at discharge, and the patients designated setting following discharge. The Functional Independence Measure (FIM) was measured at the beginning of rehabilitation and then again at hospital discharge. The Sequential Organ Failure Assessment (SOFA) was also assessed at the ICU admission and upon discharge from the ICU. |
| **Setting**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| The study was conducted at Japan Red Cross Maebashi Hospital which is a 560 bed tertiary-care community hospital in Japan. Patients were evaluated and treated in the 12 bed ICU. |
| **Participants**  [N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]  Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| During the time that the study was being conducted, the ICU admitted 2,0401 patients. Of these patients, 1,557 were eligible to participate in the study. The study included 391 patients, 204 patients in group A and 187 patients in group B. Group A was defined as the “preintervention group” and group B was defined as the “postintervention group.” Baseline characteristics were provided in the article and the authors stated that there “were no significant differences” between groups. The median age for group A was 72 years old and the median age for group B was 73 years old. There were 143 males in group A and 61 females. In group B, there were 124 males and 64 females. Median body mass index (BMI) was 22 kg/m2 for both groups. In group A, 180 participants were ambulatory prior to admission and 164 were in group B. Additionally, there were 133 participants receiving mechanical ventilation in group A and 112 in group B. Patients were included if they were > 18 years old and had been admitted to the ICU at the Japan Red Cross Maebashi Hospital. Patients were excluded if they had an admission diagnosis of an unstable pelvic fracture, any condition which limited mobility, degenerative neuromuscular disease, post cardiopulmonary arrest syndrome, acute cerebrovascular disease, or acute cardiovascular disease. Patients were also excluded if they were discharged from the ICU within two days of their admission. The authors gathered the data retrospectively based on an article which was cited in the study (23) and was written by Liu et al. |
| **Intervention Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| This article was a retrospective preintervention and postintervention quality comparison study. Group A was the preintervention group and this included patients from January 2014 until May 2015. A retrospective comparison study compares groups of people, this being group A and group B. Group A, the preintervention group, is the control group in this study because they didn’t receive the early mobility protocol. |
| *Experimental* |
| This article was a retrospective preintervention and postintervention quality comparison study. Group B was the postintervention group and this group encompassed patients from June 2015 until December 2016. A retrospective comparison study compares groups of people, this being group A and group B. Group B, the postintervention group, is the experimental group in this study because they received the early mobility protocol. The Maebashi early mobility protocol follows a specific algorithm in its implementation. Orders for rehabilitation are automatically written upon a patients admission. The ICU physician use the algorithm to determine the rehabilitation level the patient warrants and then sends a referral to the ICU nurse and physical therapist to initiate an evaluation and treatment. The ICU physician also adjusts the amount of sedation the patient is receiving to attain a Richmond Agitation Sedation Scale (RASS) of -1 or 0 prior to rehabilitation. The rehabilitation time is scheduled and coordinated between physicians, nurses, and physical therapists. ICU physicians monitor vital signs throughout the session to ensure safety. The algorithm that places the patient in a specified level in the early mobility protocol is based on cardiovascular status, respiratory status, muscle strength, and consciousness. The patient is in level 1 if they have an FiO2 > 0.6 and a positive end-expiratory pressure (PEEP) >10. They are also placed in level 1 if they have required treatment of an arrythmia, myocardial infarction (MI), or have had their catecholamine dosage increased in the previous 2 hours. Lastly, they are designated to level 1 if they have a RASS score of < -3. Patients are placed in level 2 of the protocol if they cannot move their arms or legs against gravity. Level 3 is appropriate when patients can move their arm against gravity. When patients can move their leg against gravity, they are designated to level 4 and patients are placed in level 5 when they can perform the level 4 criteria or due to physicians orders. Patients who are placed in level 1 will be limited to passive bed exercises, passive range of motion, and total assistance transfers. Patients in level 2 will use the cycle ergometer, perform active range of motion, and participate in upright sitting in the bed. Patients in level 3 will perform short sitting on the edge of the bed. In level 4, patients will transfer from the bed to a chair. Finally, patients in level 5 will perform standing activities, stepping/marching in place, and gait. A physical therapist leads the rehabilitation session in patients who are in level 1. In level 2, a physical therapist and ICU nurse lead the rehabilitation session. In levels 3, 4, and 5, a physical therapist, charge nurse, and ICU physician are all three helping to lead the session. The early mobility protocol requires all patients to receive rehabilitation seven days per week for at least 20 minutes and the first session is either the day of ICU admission or the following day. |
| **Outcome Measures**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| The primary outcomes that the authors evaluated were hospital mortality and total hospital cost. Secondary outcomes that were assessed included: percentage of patients that attained specific levels of the protocol, number of days to reach the defined level of the protocol, adverse events, mechanical ventilation time span, ICU length of stay, hospital length of stay, percentage of independent ambulators at discharge, and the destination after discharge. The Functional Independence Measure (FIM) was measured at the beginning of rehabilitation and then again at hospital discharge. The Sequential Organ Failure Assessment (SOFA) was also assessed at the ICU admission and upon discharge from the ICU. The FIM is an outcome measure which consists of a seven point ordinal scale that includes 18 items and can be used to track functional progress during an inpatient stay and evaluate disability. The two subscales are motor and cognition. The motor subscale consists of eating, grooming, bathing, upper body dressing, lower body dressing, toileting, bladder management, bowel management, transfers to and from the bed, chair, or wheelchair, transfers to and from the toilet, transfers to and from the bath or shower, ambulation or wheelchair mobility, and stairs. The cognition subscale includes comprehension, expression, social interaction, problem solving, and memory. A score of seven would indicate complete independence and a score of one would equate to total assistance for each subscale. The total FIM score would be between 18 and 126, motor subscale score would be between 13 and 91, and cognition subscale score would be between 5 and 35. The SOFA scoring is based on six different scores from critical bodily systems including: cardiovascular, respiratory, hepatic, coagulation, renal, and neurologic. Each category listed is scored on a 0-4 scale, so the scores range from 0-24 points, 0 being the best and 24 being the worst. The ICU physician administers the SOFA in the ICU and the physical therapist administers the FIM in the ICU as well. |
| **Main Findings**  [Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. You may summarize results in a table but you must explain the results with some narrative.] |
| Table 1. Summary of outcomes measured   |  |  |  |  | | --- | --- | --- | --- | | Outcome Measure | Group A | Group B | *p* value | | Patients who received rehabilitation | 122 (60%) | 171 (91%) | < 0.01 | | Patients who could get out of bed | 62 (30%) | 146 (78%) | < 0.01 | | Patients who could stand during ICU stay | 28 (14%) | 83 (44%) | < 0.01 | | Patients who could ambulate during ICU stay | 7 (3.4%) | 40 (21%) | < 0.01 | | Days from ICU admission to first session | 2.9 [2.0-4.0] | 1.2 [0.8-2.0] | < 0.01 | | Days from ICU admission to first out of bed | 5.1 [3.7-8.1] | 2.0 [1.3-2.9] | < 0.01 | | Days from ICU admission to first standing | 4.8 [3.8-7.1] | 2.2 [1.5-3.7] | < 0.01 | | Days from ICU admission to first ambulating | 4.7 [3.8-5.5] | 2.0 [1.5-3.0] | 0.09 | | Mechanical ventilation days | 5.0 [2.7-8.9] | 3.0 [1.9-6.0] | < 0.01 | | ICU length of stay (days) | 6.5 [4.6-10.3] | 5.4 [4.3-7.8] | < 0.01 | | Hospital length of stay (days), including death | 32.6 [18.5-57.1] | 25.4 [15.8-46.2] | 0.53 | | Hospital length of stay (days), survivors | 34.4 [20.4-57.4] | 27.3 [16.2-46.2] | 0.02 | | Independently ambulators at hospital discharge | 106 (52%) | 124 (66%) | < 0.01 | | FIM (sum) at hospital discharge | 82 [45-108] | 95 [54-118] | 0.09 | | FIM (motor) at hospital discharge | 56 [23-76] | 68 [30-84] | 0.05 | | FIM (cognition) at hospital discharge | 29 [19-35] | 30 [19-35] | 0.70 | | FIM (sum) gap between admission and discharge | 48 [13-69] | 57 [21-80] | < 0.01 | | FIM (motor) gap between admission and discharge | 37 [7-57] | 46 [17-67] | < 0.01 | | FIM (cognition) gap between admission and discharge | 8 [0-17] | 6 [0-17] | 0.26 | | Patients receiving continuous analgesia | 149 (73%) | 124 (66%) | 0.16 | | Patients receiving continuous sedation | 144 (70%) | 115 (62%) | 0.07 | | Days of continuous sedation | 2.8 [1.3-6.2] | 2.2 [1.2-3.7] | 0.03 | | Patients receiving continuous benzodiazepines | 74 (36%) | 45 (24%) | 0.01 | | Days of benzodiazepines | 1.8 [0.8-4.5] | 0.8 [0.5-1.8] | < 0.01 | | Discharge home | 83 (53%) | 86 (52%) | 0.20 | | Discharged to another hospital and rehab center | 63 (40%) | 70 (42%) | 0.07 | | Discharged to nursing facility | 10 (6.4%) | 10 (6.0%) | 0.51 | | SOFA (sum) at ICU admission | 7.0 [4.0-10.0] | 7.0 [4.0-10.0] | 0.23 | | SOFA (sum) maximum during ICU stay | 8.0 [5.0-11.0] | 8.0 [5.0-11.0] | 0.87 | | SOFA (sum) at ICU discharge | 3.0 [2.0-5.0] | 2.0 [1.0-4.0] | < 0.01 | | Change in SOFA at ICU admission and maximum | 0 [0-2.0] | 0 [0-1.0] | < 0.01 | | Change in SOFA at ICU admission and ICU discharge | 3.0 [0-5.0] | 4.0 [2.0-6.0] | < 0.01 | | Change in SOFA at maximum and ICU discharge | 4.0 [2.0-6.0] | 5.0 [2.0-7.0] | < 0.01 | | In-hospital mortality | 48 (24%) | 21 (11%) | < 0.01 | | Total hospital cost | $29,220 | $22,706 | < 0.01 |   \*[interquartile range]  Group B demonstrated significant reductions in the number of patients who were receiving benzodiazepines and the duration they received them. Significant differences in the primary outcomes were observed in the study when comparing group A and group B. Mortality decreased from 24% to 11% and total hospital cost decreased from $29,220 to $22,706. The authors applied a segmented regression model to the total cost of the hospital and it was concluded that before the early mobility protocol was implemented, there was an increasing trend in costs. The early mobility protocol reversed this trend and found that its implementation resulted in a decrease of total hospital cost, more specifically, $5,167 in savings per patient (95% CI, $1,069-$8,304; p = 0.02), which equates to a 27% decrease from the cost preintervention. Rehabilitation outcomes were all significantly improved when the early mobility program was initiated including the amount of patients who were able to get out of bed, stand, and ambulate. The protocol also allowed the interdisciplinary team to be more efficient with each patient because rehabilitation orders were written upon the patients arrival which caused the authors to see a significant reduction in time lapse between ICU admission and initiation of rehabilitation. ICU length of stay decreased by 17% and the time spent on mechanical ventilation was reduced by 40%. Additionally, for survivors of the ICU, their hospital length of stay was also reduced by 17%. SOFA scores were reduced at the time of ICU discharge when comparing group A to group B, especially cardiovascular and respiratory scores. There was a strong correlation seen with positive changes in SOFA scores and the initiation of the early mobility protocol which may contribute to the lower mortality rate in group B. There were no adverse events reported that required further medical intervention. The authors also emphasized the role that “buy in” played within the interdisciplinary team and the positive ICU culture that resulted secondary to the “buy in.” One month prior to the study, ICU staff was educated on the importance of early mobility, the algorithm of the protocol, and simulated the protocol through training. This facet of the study should be an essential part of any hospital system implementing this program because positive culture involving early mobility in the ICU is absent in a lot of hospital systems. |
| **Original Authors’ Conclusions**  [Paraphrase as required. If providing a direct quote, add page number] |
| Based on the findings in the study by Liu et al., the authors state on page e751 that “This single-center historical quality comparison study shows that hospital mortality and total hospital costs are significantly decreased after the introduction of a progressive early mobility program in the ICU.” The authors go on to mention, “For external validation and further investigation of causality, a multicenter, prospective, randomized controlled study, including data for all ICU patients, is warranted.” |
| **Critical Appraisal** |
| **Validity**  [Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| This retrospective preintervention and postintervention quality comparison study was a level 3 study which had high relevance and a RoB 2 Score determined there was “Some Concerns” in regard to the risk of bias, which damages the internal validity of the article. One of the main strengths of this study is the fact that the authors used length of stay in the ICU and in the hospital as an outcome measure which was what my PICO question and clinical scenario was based on. Additionally, the article also looked at various other outcome measures that, in totality, impact the length of stay such as functional milestones, mechanical ventilation duration, medication, and mortality. Moreover, the financial implications were also a primary outcome measure that was assessed in this study, which is directly related to length of stay because the longer the patient stays in the hospital, the more services they will require, and this drives up hospital costs. Baseline characteristics were not significantly different between groups and the authors provided a table to further delineate the attributes. The article did have some weaknesses that reflect the RoB 2 score, which was stated above, and elicits the question of bias. The study had a small sample size of 391 patients that were included, was not randomized, with no comparison group, and was not blinded. The authors did not provide confidence intervals with the primary and secondary outcome measure results, although an interquartile range was provided. Additionally, only 17% of ICU patients were enrolled in this study which may limit its external validity and generalization to other ICUs due to the strict nature of the inclusion criteria. There were also a disproportionate amount of males in the study, 70% in group A and 66% in group B. Another weakness of this study is that it excluded patients with functional deficits prior to admission, more specifically, any condition which limited mobility. It’s important to include this patient population, especially those with functional deficits because these are the patients who need physical therapy services more often, especially in the ICU, because the effects of bed rest can be extremely debilitating to their already impaired mobility. Finally, the authors used median values as their measure of central tendency for baseline characteristics. For a value like BMI, the results can be skewed by a very high value which is neglected by a median measure. |
| **Interpretation of Results**  [This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| Based on the results of the study by Liu et al. an early mobility protocol which utilizes an interdisciplinary team approach to rehabilitation in the ICU is beneficial for functional outcomes, length of stay, mortality, and total hospital costs. I don’t think the risk of bias should be underestimated in this study which is why I believe a randomized controlled trial should be conducted to further investigate this approach to patients in the ICU. At the very least, the results show that a specific early mobility protocol allows patients to be seen quicker by a rehabilitation team compared to standardized care. In totality, the results seem promising but more research is warranted. |
| **Applicability of Study Results**  [Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.] |
| This study is highly applicable to the clinical scenario because 12% of subjects in group A and 14% of subjects in group B that were studied had been admitted to the ICU secondary to respiratory failure and the median age for group A was 72 years old and the median age for group B was 73 years old. Both of these variables accurately describe the patient in my clinical scenario. The education provided to the ICU staff on the early mobility protocol was critical to its implementation because it fostered “buy in” from the interdisciplinary team, promoted communication between professions, and positively improved the early mobility culture in the ICU. Without this “buy in,” clinicians are reluctant to accept the positive results that are derived from the early mobility protocol which includes improved efficiency, a shortened length of stay, decreased mortality, improved functional status, and total hospital savings. When clinicians believe something will benefit their patient, I believe they will do whatever means necessary to ensure that is true. |

**(2) Description and appraisal of (Impact of a Progressive Mobility Program on the Functional Status, Respiratory, and Muscular Systems of ICU Patients) by (Schujmann et al., 2020)**

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| **Aim/Objective of the Study/Systematic Review:** |
| The aim of the study by Schujmann et al. was to determine if an early mobility program in the ICU resulted in improved functional status, muscle strength, mobility, and respiratory function at the time of discharge when compared to patients who received standardized care. |
| **Study Design**  [e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]  Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| This study by Schujmann et al. was a randomized clinical trial which randomly allocated a total of 135 patients to either the intervention group or control group, 68 and 67, respectively. Some of these patients couldn’t be analysed because of various factors including discharge before evaluation or death. The study analysed of a total of 99 patients. The intervention group had 50 patients and the control group had 49 patients. The study consisted of an independent statistician performing the randomization which utilized a computer system randomizer and numbered brown envelopes with the group assignment inside. The evaluator was blinded to the specific group assignments. Clinicians and patients were not blinded due to the type of intervention being administered and lack of feasibility. Initiation of treatment in the intervention group began within 48 hours of admission into the ICU. Both the intervention and control group received treatment five times per week with the intervention group receiving conventional treatment in the morning and the early mobility protocol in the afternoon for approximately 40 minutes each while the control group received standardized care in the morning and afternoon. The main outcome that was measured was functional status via the Barthel Index and ICU Mobility Scale following discharge from the ICU. Other measures that were considered included respiratory function, muscle strength, physical activity levels during their ICU stay, ICU length of stay, and hospital length of stay. Patients were followed-up three months after their ICU discharge to perform a subsequent Barthel Index score to assess functional status. The Barthel Index scores were categorized into two groups by functional status at 85 points. To assess the level of activity and its effect on the Barthel Index group schism which was adjusted for age and number of days spent in the ICU, a logistic regression model was used. |
| **Setting**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| Patients were recruited and research was performed in the ICU at Central Institute of Hospital das Clinicas which is affiliated with the University of Sao Paulo in Brazil. |
| **Participants**  [N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]  Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| There were a total of 135 patients who were randomly allocated to the intervention group (68) or control group (67). Some of these patients couldn’t be analysed because of various factors including discharge before evaluation or death. In the intervention group, 10 patients were discharged before 3 days, 1 patient was discharged before an evaluation was performed, and 11 patients died. In the control group, 5 patients were discharged before 3 days, 2 patients were discharged before an evaluation was performed, and 7 patients died. All of these patients listed above were not able to be analysed in the study. There were 99 participants in the study who were analysed that were admitted to the ICU, 49 patients were randomly assigned to the control group and 50 were randomly assigned to the intervention group by an independent statistician using a computer system and brown envelopes to ensure randomization, concealment, and reduce the risk of bias. The evaluator was blinded to the specific group assignments. Patients were who were recruited were > 18 years old who scored 100 points on the Barthel Index in the previous two weeks before their ICU admission. Patients were excluded from this study who had previously been hospitalized at any other hospital, had neurologic deficits, spent < 4 days in the ICU, had an amputation prior to their ICU admission, medical status contraindicated mobilization, or had cognitive deficits which would impair the understanding of tests and commands. The median age of the intervention group and control group was 55 years old and 48 years old, respectively (*p*=0.02). There were 19 patients in the control group and 14 patients in the intervention group who were > 60 years old (*p*=0.3). The control group consisted of 26 males and 23 females while the intervention group consisted of 23 males and 27 females. Patients that were analysed in this study who were admitted to the ICU secondary to respiratory pathology was very high, 22 patients for the control group and 23 patients for the intervention group (*p*=0.9). The control group consisted of 17 patients on mechanical ventilation and the intervention group included 23 patients who were mechanically ventilated (*p*=0.3) while the duration of mechanical ventilation was 2.5 days and 2.0 days for the control group and intervention group (*p*=0.6), respectively. No significant differences were found between groups at baseline. For follow-up, 39 subjects from the control group and 40 subjects from the intervention group were contacted. |
| **Intervention Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| Both the intervention and control group received treatment five times per week with the control group receiving standardized care in the morning and afternoon in the ICU for a duration which was determined by the individual physical therapist. No equipment was utilized for the control group. Conventional interventions included active mobilization, positioning, transfers, tolerance to upright positioning, and ambulation. |
| *Experimental* |
| Initiation of treatment in the intervention group began within 48 hours of admission into the ICU. Both the intervention and control group received treatment five times per week with the intervention group receiving conventional treatment in the morning and the early mobility protocol in the afternoon for approximately 40 minutes each session under the direction and supervision of a physical therapist. Conventional interventions included active mobilization, positioning, transfers, tolerance to upright positioning, and ambulation. The authors used a specific early mobility protocol for this study in which each patient was individually evaluated to determine the appropriate level within the protocol that early mobility should be implemented, as well as its intensity and duration. To place each patient in the appropriate level of the protocol, responsiveness and muscle strength was assessed during the evaluation. Level 1 consisted of patients who were not responsive to instructions. Level 2 consisted of patients who were responsive to instructions and their muscle strength was < 3/5. Level 3 included patients who were responsive to instructions and their muscle strength was > 3/5. Level 4 consisted of patients who had completed the previous level (level 3). Finally, level 5 consisted of patients who had completed the previous level (level 4). The early mobility protocol was broken down into two parts regarding the intervention aspect: exercise and posture. For patients in level 1, they participated in passive movements via a cycle ergometer using bilateral lower extremities for 15 minutes, 20 minutes of functional electrical stimulation (FES) to the quadriceps, passive range of motion of bilateral upper extremities, and passive stretching to bilateral upper and lower extremities. Posture was addressed through passive positional changes. Patients in level 2 of the early mobility protocol participated in active-assisted movements via a cycle ergometer using bilateral lower extremities for 15 minutes, FES to the quadriceps for 20 minutes, active-assisted upper extremity exercises for 1 set and 10 repetitions (1x10), and bridges for 1x10. Posture was addressed by active-assisted positioning changes in bed, active-assisted sitting edge of bed, trunk exercises, standing tolerance, and ambulation. Patients in level 3 participated in resistance training for bilateral upper extremities using 0.5 kg weights for 1x10, active cycle ergometer training for 10 minutes, bridges for 2x10, and patients were also able to engage in a videogame session. Postural changes in level 3 include: actively moving from supine to short sitting at the edge of bed, sit to stand for 1x10, standing and/or gait (< 20 meters), and sitting up in chair. Level 4 consisted of resistance training for bilateral upper extremities using 0.5 kg weights for 2x10, active cycle ergometer training for 10 minutes, bridges for 2x10, and a videogame session. Postural changes in level 4 include: active short sitting at the edge of the bed, standing and gait (> 20 meters), negotiating 5 stairs, and sitting up in a chair. Finally, patients in level 5 of the early mobility protocol participated in resistance training for bilateral upper extremities using 1.0 kg weights for 2x10, bridges for 3x10, and patients were also able to engage in a videogame session. Postural changes in level 5 include: sustained sitting edge of bed and sustained standing without assistance, gait training without the assistance of a physical therapist (may use assistive device) for > 20 meters, negotiating 5 stairs, and sitting up in a chair. Each patient was re-assessed daily for functional changes and to evaluate the need to progress levels. |
| **Outcome Measures**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| The main outcome that was measured was functional status via the Barthel Index and ICU Mobility Scale following discharge from the ICU. Other measures that were considered included respiratory function, muscle strength, mobility, physical activity levels during their ICU stay, ICU length of stay, and hospital length of stay. Respiratory function was assessed using a maximal inspiratory pressure (MIP) and a maximal expiratory pressure (MEP) test utilizing a manovacuometer. Spirometry was also implemented to evaluate the patients forced expiratory volume in one second (FEV1), forced vital capacity (FVC), and the maximal voluntary ventilation (MVV). Muscular strength was assessed peripherally via a handgrip dynamometer. The anterior tibialis muscles, medial gastrocnemius muscles, and vastus lateralis muscles were all evaluated using electromyography (EMG). Mobility was evaluated using the Timed Up and Go Test (TUG), sit to stand, and 2-Minute Walk Test. The patients physical activity level was assessed by an accelerometer which was placed on a unilateral lower extremity until discharge from the ICU. It tracked when the patient was “inactive” as well as when the patient was participating in “light” and “moderate” intensity exercise. Patients were followed-up three months after their ICU discharge to perform a subsequent Barthel Index score to assess functional status. The Barthel Index is an ordinal scale which is used for assessing mobility and activities of daily living (ADL). The scoring consists of the clinicians level of assistance on 10 mobility and ADL tasks. In the article, the Barthel Index scores were categorized into two groups by functional status at 85 points. A patient who scored > 85/100 was considered “independent” and those who scored < 85/100 were considered “not independent.” The ICU Mobility scale has 11 categories and is scored on a 0-10 scale where a score of “0” means the patient is unable to move and lying in bed. A score of “10” is when the patient is ambulating independently without an assistive device. This outcome measure is used to assess the most advanced form of mobility in the ICU. The patients were evaluated, treated, and tested with specific physical therapists but these clinicians varied between groups. |
| **Main Findings**  [Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.] |
| Table 2. Summary of outcomes measured upon discharge from the ICU   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Outcome Measure | Control Group | Intervention Group | *p* value | 95% Confidence Interval | | Physical Activity Level |  |  |  |  | | Inactive | 95.7 | 92.3 | < 0.001 | 2.42-4.44 | | Light | 3.85 | 6.4 | < 0.001 | -3.47 to -1.7 | | Moderate | 0.3 | 1.012 | < 0.001 | -0.9 to -0.5 | | Intense | 0.03 | 0.15 | 0.002 | -0.1 to -0.04 | | Steps per day | 591 | 1,539 | < 0.001 | -1,302 to -592 | | Function |  |  |  |  | | Barthel Index | 76 | 97 | < 0.001 | -26.3 to -14.5 | | ICU Mobility Scale | 7 | 9.8 | < 0.001 | -2.9 to -1.8 | | Independent Patients | 44% | 96% | < 0.001 |  | | Muscle Assessment |  |  |  |  | | Handgrip strength | 16 kg | 18 kg | 0.09 | -6.16-1.36 | | Sit to stand | 5 reps | 8 reps | < 0.001 | 4.1-1.3 | | TUG | 21 sec | 18 sec | 0.4 | -3.8-9.5 | | Stationary Walk | 25 reps | 53 reps | < 0.001 | -36 to -18 | | EMG Anterior Tibialis | 0.29 | 0.26 | 0.2 | -0.17-0.02 | | EMG Vastus Lateralis | 28 | 29 | 0.3 | -3.4-1.18 | | EMG Medial Gastroc | 0.31 | 0.34 | 0.1 | -0.05-0.12 | | Respiratory Assessment |  |  |  |  | | MVV | 45 | 55 | 0.03 | -19.15 to -0.6 | | FEV1 | 1.6 | 2.2 | 0.2 | -1.8-0.5 | | FVC | 1.8 | 1.99 | 0.06 | -0.72-0.04 | | MIP | 57 cm H20 | 62 cm H20 | 0.4 | -16.6-6.8 | | MEP | 48 cm H20 | 55 cm H20 | 0.1 | -16-1.5 | | Length of stay (LOS) |  |  |  |  | | ICU LOS | 8 | 5 | 0.003 | 0.93-5.18 | | Hospital LOS | 19 | 16 | 0.1 | -1.43-9.73 |   Patients were followed-up three months after their ICU discharge to perform a subsequent Barthel Index score to assess functional status. For the follow-up, 39 subjects from the control group and 40 subjects from the intervention group were contacted via telephone. A score of > 85/100 on the Barthel Index was indicative of “functional independence.” In the intervention group, 39/40 were considered functionally independent (97.5%). In the control group, 29/39 were considered functionally independent (74.4%). Both of which had a *p* value of 0.003. The intervention group was more physically active as a percentage of the total time spent in the ICU during their hospital stay than the control group, 7.55% and 4.18%, respectively (*p* < 0.001). The authors found a positive correlation of higher Barthel Index scores when patients were more physically active during their ICU stay because every 1% increase in activity equated to a 35% increased chance of functional independence (> 85/100 Barthel Index score). Additionally, it was found that when patients participated in the early mobility protocol, they were 22 times more likely to achieve functional independence. Almost 90% of patients were able to advance to level 5 of the protocol which reflects the accelerated functional progress due to the higher intensity activity that is required of level 5. No adverse events were reported during this study. |
| **Original Authors’ Conclusions**  [Paraphrase as required. If providing a direct quote, add page number] |
| Based on the findings in the study by Schujmann et al., the authors state on page 6 that “An early and progressive mobilization program for ICU patients may improve functional outcomes upon discharge and 3 months following hospitalization.” The authors go on to mention that the progressive nature of the early mobility protocol “proved to protect against the loss of functional status and reduce the duration of ICU stay.” |
| **Critical Appraisal** |
| **Validity**  [Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| This randomized controlled trial was a level 2 study which had high relevance and a 6/10 PEDro score to assess risk of bias. This PEDro score is considered “good” which reflects a lower risk of bias and higher internal validity of the article. The randomization and concealment was an integral component of the study because this adds to the internal validity and our ability to confidently generalize the results of this study to other populations or settings, which shows strong external validity. One of the main strengths of this study is the fact that the authors used length of stay in the ICU and in the hospital as an outcome measure which was what my PICO question was based on. Additionally, the article also looked at various other outcome measures that, in totality, impact the length of stay such as muscle strength, respiratory function, functional status, mobility, and physical activity level. Another strength of this study was the 3 month follow-up that the researchers conducted. Many other articles which look at this topic neglect a long-term impairment evaluation. This study conducted a 3 month follow-up which allowed the authors to determine a Barthel Index score for patients and assess their functional status in the long-term. Finally, the patients that were analysed in this study who were admitted to the ICU secondary to respiratory pathology was very high, 22 patients for the control group and 23 patients for the intervention group (*p*=0.9). The clinical scenario mentioned earlier pertained to an older male with respiratory distress and this was the population that I sought to target. A weakness of this study is that it only included previously healthy patients and excluded patients with chronic illnesses or those with functional deficits prior to admission. It’s important to include these specific populations, especially those with chronic diseases because those are the individuals who will be seeking healthcare more often and they are the people who will require an ICU stay more frequently because of their poorer health. Another weakness of the article is the difference in the number of patients who were admitted to the ICU following surgery, 6 patients in the control group and 16 patients in the intervention group. The fact that significantly more patients who participated in the intervention group had received surgery as part of their hospital stay could skew the results because pain and surgical precautions may be a limiting factor when early mobility is initiated. |
| **Interpretation of Results**  [This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| The reduced risk of bias and strong internal and external validity secondary to the randomization and concealment is an essential component of this study because it allows us to trust the results and apply them to other populations and settings, although a more liberal approach to inclusion/exclusion criteria is desired. The results of the article show that an early mobility protocol which utilizes a progressive approach to physical activity levels in the ICU is beneficial for functional outcomes and length of stay. The key variable to the results is the difference in physical activity between groups. This is the main differentiator in the stark contrast between the control group and the intervention group because only when physical activity was increased did we see the positive results ensue. |
| **Applicability of Study Results**  [Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.] |
| This study is highly applicable to the clinical scenario because many of the subjects that were studied had been admitted to the ICU secondary to respiratory symptoms. A total of 22 patients in the control group and 23 patients in the intervention group (*p*=0.9) were admitted to the ICU secondary to respiratory pathology. Additionally, there were 19 patients in the control group and 14 patients in the intervention group who were > 60 years old (*p*=0.3). This reflects the older age of the patient in my clinical scenario. The feasibility and practicality of this intervention is straightforward and simple because the main goal is to increase the patients physical activity. Sure, there are nuances and details which are important to consider but physical activity was the main variable which was positively correlated with the improved functional outcomes and length of stay. |

**SYNTHESIS AND CLINICAL IMPLICATIONS**

[Synthesize the results, quality/validity, and applicability of the two studies reviewed for the CAT. Future implications for research should be addressed briefly. Limit: 1 page.]

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| Overall, both studies included in this CAT utilized early mobility protocols in the ICU which were progressive in nature and both articles sought to initiate treatment as early as possible following ICU admission to reduce the risk functional mobility deficits, prolonged length of stay, and many other consequences of bedrest. Additionally, both articles are highly applicable to the clinical scenario due to the high number of older adults included as well as the high number of patients which were admitted to the ICU secondary to respiratory pathology.  The article by Liu et al. demonstrated that the early mobility protocol resulted in a reduction in total hospital cost, more specifically, a reduction of $5,167 per patient which equated to a 27% decrease in cost. Mortality was also decreased 56.25% after the implementation of the early mobility protocol. ICU length of stay was positively impacted by the intervention due to the 17% reduction in duration (days) that was noted.  The article by Schujmann et al. demonstrated that the early mobility protocol resulted in increased levels of physical activity. These increased levels of physical activity caused the patients to have improved functional status at discharge which was evident in the 60% increase that was noted with sit to stand repetitions, 27.6% increase in Barthel Index score, 40% increase in ICU Mobility Scale score, and increased chance of functional independence by 35% with every 1% increase in activity. Additionally, the ICU length of stay and hospital length of stay decreased 37.5% and 15.8%, respectively.  Both studies had strict inclusion and exclusion criteria which limited our understanding of how early mobility affects a diversity of patient populations. Future studies should include more patients with chronic diseases and mobility deficits to assess the impact of this type of intervention on populations that require healthcare more often. Future studies should also assess the effects of specific levels of physical activity to determine the proper dosage of exercise that is most beneficial for specific patient populations and diagnoses.  The interdisciplinary team is an integral component of early mobility in the ICU and its implementation. Education should be provided, similar to the study by Liu et al., to promote “buy in” by the ICU staff because this type of intervention takes a team effort and collaboration between many healthcare professionals. An ICU culture which is accepting and proactive about early mobility is essential because everyone knows their role in the protocol and is aware of what is required of themselves to attain the desired results.  Based on the two studies described above by Liu et al. and Schujmann et al., I conclude that an early mobility protocol should be implemented in the ICU for critically ill older adults. Early mobility in the ICU mitigates the consequences of bedrest and is superior to standardized care in terms of functional mobility, length of stay, mortality, and total hospital cost. To maximize its potential, the interdisciplinary team must collaborate effectively and efficiently to implement an early mobility program and promote a culture in this setting that’s energized to take on such a task. But, as seen in the two articles presented above, the results of an early mobility program are worthwhile and can have a lasting impact on patients, even in the long-term. As physical therapists, we can be the clinicians that bring this topic and literature to the forefront of intensive care medicine. We not only can be the clinicians, we should be the clinicians that advocate and promote this research to bring about positive change in our patients lives who are critically ill. |

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[List all references cited in the CAT]

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