2014

Early Mobilization in ICU Patients

Alex Hunter
Marshall University, hunter115@marshall.edu

Leslie Johnson
Marshall University

William Willis
Marshall University, willis23@marshall.edu

Alberto Coustasse
Marshall University, coustassehen@marshall.edu

EARLY MOBILIZATION IN ICU PATIENTS

Alex Hunter, Marshall University
Leslie Johnson, Marshall University
William Willis, Marshall University
Alberto Coustasse, Marshall University

ABSTRACT

Introduction: *Bed rest or immobilization is frequently part of treatment for patients in the intensive care unit with critical illness. The average intensive care unit length of stay was 3.3 days and for every day spent in an intensive car unit bed, the average patient spent an additional 1.5 days in a non-intensive care unit bed. Daily costs have increased more than 30% from 2000-2005 with an average daily cost of $3518. Weaning from mechanical ventilation has been correlated with increased intensive care unit and hospital length of stay. Mechanical ventilation has been correlated with the development of intensive care unit-acquired weakness and delirium. The purpose of this research was to analyze the effects of early mobilization for patients in the intensive care unit to determine if it has an impact on the length of stay, cost of care and medical complications.*
Methodology: *The methodology for this study was a literature review. Five electronic data bases were utilized with 27 articles were referenced for this research.*
Results: *Intensive care unit length of stay was reduced with statistical significance in several studies examining early mobilization. Limited research on cost of intensive care unit stay indicated savings potential with early mobilization. Early mobilization was shown to decrease delirium by 2 days, reduce risk of readmission or death, and reduce ventilator assisted pneumonia, central line and catheter infections.*
Discussion/Conclusion: *Early mobilization for decreased length of stay in the intensive care unit exhibited mixed results. When implementing early mobilization in the intensive care unit, total costs were shown to decrease and fewer medical complications were noted. Early mobilization should become a standard of care for critically ill, but stable patients in the intensive care unit.*

INTRODUCTION

Critically ill patients often survive because of the care received in the Intensive Care Unit (ICU), but are often plagued with costly physical and psychological sequelae that may be worsened with immobility. Bed rest or immobilization is frequently part of treatment, due to pharmacologically induced sedation and/or Mechanical Ventilation (MV) (Drolet, et al., 2012). Hippocrates may have implied that pain is relieved by bed rest, but modern day researchers have found that bed rest is potentially harmful with complications of pulmonary edema, atelectasis, bone demineralization, muscle wasting, vasomotor instability, constipation, back pain, pressure ulcers, contractures and blood clots (Lipshutz & Gropper, 2013).

Length of Stay (LOS) in the ICU has been used as a measure of resource utilization because it is surprisingly consistent among most diagnoses (Arabi, Venkatesh, Haddad, Shimemeri, & Malik, 2002). LOS has been documented as short as 24 hours, and as long as 132 days (Arabi, et al., 2002). Weaning from MV has been correlated with increased ICU and hospital LOS. The ICU houses less than ten percent of total hospital beds, yet ICU care represents one third of total health care costs (Shorr, 2002). Daily costs have increased more than 30% from 2000-2005 with an average daily cost of $3,518 (Halpern & Pastores, 2010). Neuromuscular weakness, or ICU Acquired Weakness (ICU-AW), as well as, impaired physical function are two long term complications that ICU survivors often face (Desai, Law, & Needham, 2011).

ICU-AW has been defined as bilateral weakness, ranging from severe to paralysis, with or without a loss in deep tendon reflexes (Brummel, et al., 2012). Developing ICU-AW has been attributed to sepsis, immobility, multiple

organ failure, hyperglycemia, and corticosteroid use (Brummel, et al., 2012). In patients mechanically ventilated for greater than seven days, evidence has shown up to 58% suffer with ICU-AW (Griffiths & Hall, 2010).

The most frequent primary admission diagnoses to the ICU include acute myocardial infarction, respiratory distress, coronary artery bypass grafting, congestive heart failure, cerebrovascular accident or intracranial hemorrhage, other cardiovascular dysfunction, pneumonia, sepsis, Urinary Tract Infection (UTI), diabetic ketoacidosis, and gastrointestinal bleeding (Lilly, Zuckerman, Badawi, & Riker, 2011). Lilly, et al., (2011) attempted to provide benchmarks for critical care practice in the United States (US) by examining 243,553 adult admissions in 271 ICUs, found that the average ICU LOS was 3.3 days and that for every day spent in an ICU bed, the average patient spent an additional 1.5 days in a non-ICU bed.

A multitude of life sustaining measures such as catheters, monitors, and sedative medications mixed with unstable vital signs, electrolyte imbalances, unusual sleeping patterns, and even abnormal behaviors, make early mobilization intimidating (Adler & Malone, 2012). Avoidance of bed rest with early mobilization is a potential option to reduce weakness acquired during ICU stay, but intensive Physical Therapy (PT), including ambulation, is often avoided in mechanically ventilated patients (Truong, Fan, Brower, & Needham, 2009). Low level of patient mobility is a common practice in the ICU, with 27% of ICU patients receiving PT, and only 6% of mechanically ventilated patients receiving PT (Needham, Wang, Desai, Mendez-Tellez, & Dennison, 2007). A systematic review by Adler and Malone (2012) concluded that mobilization can safely occur within two to four days of intubation in critically ill, but stable ICU patients. Early mobilization has recently been associated with improvements in respiratory function, level of consciousness, functional independence, cardiovascular fitness and psychological well-being (Drolet, et al., 2012).

Respiratory failure was the most common reason patients were admitted to the ICU, because of the need for MV. According to Ely, et al., (2004) specific medical complications, including delirium, were associated with an increased ICU stay and with MV. Delirium is an acute mental status change with inattention, and either disorganized thinking or an alerted level of consciousness (Thomason, et al., 2005). Delirium has been found in up to 32% of ICU patients, rising to 77% in mechanically ventilated patients (Cavellazzi, Sadd, & Marik, 2012). Ely, et al., (2004) demonstrated an increased hospital LOS of ten days in those patients who developed delirium.

The purpose of this research was to analyze the effects of early mobilization for patients in the ICU to determine if it has an impact in the LOS, cost of care, and medical complications.

METHODOLOGY

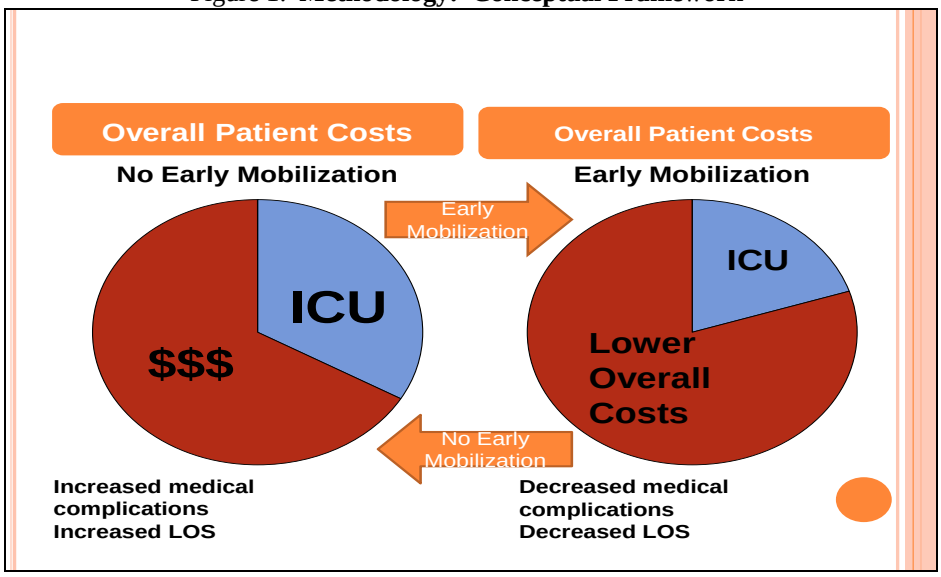
The primary hypothesis of this study state, critically ill patients who participate in early mobilization activities had shorter LOS and decreased cost of care. The secondary hypothesis includes patients in the ICU had fewer medical complications with early mobilization.

The methodology for this study was a literature review. The West Virginia University library on the Charleston Area Medical Center Memorial Campus in Charleston, West Virginia was used for full text articles, utilizing the PubMed, EbscoHost, ProQuest and CINHAL databases. Google was used when articles could not be located through the above databases. Key terms used in the search included ‘ICU’ AND ‘early mobilization’, AND ‘cost’, OR ‘length of stay’, OR ‘acquired weakness’ OR ‘complications’. The Physical Therapy Journal was also explored. The search was limited to articles published 2002 through April 2013. Articles were limited to the English language. Primary and secondary data were included from original articles, research studies, and reviews. Relevant articles were selected after review of abstracts was performed. Twenty-seven articles were chosen for this research. This search was completed by AH and LJ and validated by AC.

The conceptual framework for this research is illustrated in Figure 1. The authors argue that early

mobilization in the ICU can decrease ICU LOS thus decreasing the patient's overall hospital LOS and medical complications contributing to an overall decrease in cost of care. Without early mobilization, patient will stay sicker for longer periods and the cost to patients, hospitals and insurance companies will be greater.

Figure 1. **Methodology: Conceptual Framework-**



RESULTS

ICU LOS with Early Mobilization

One of the first studies investigating early mobilization in ICU patients with Acute Respiratory Failure (ARF) was a prospective cohort study in a university medical ICU (MICU) (Morris, et al., 2008). The protocol group was initiated into the protocol within 48 hours of MV with the mobility team, while the usual care group received Passive Range Of Motion (PROM) daily by the bedside nurse. Both ICU and hospital LOS were significantly different between the protocol and usual care group (Morris, et al., 2008), (Table 1).

Table 1. LOS Results in ICU with Early Mobilization

Author	Design	PT Interventions	Findings
Morris, et al., 2008	• Prospective Cohort Study • Protocol n=165 • Usual Care n=165 n=330 • Single Center • ARF MV≤48 hours	• Mobilization program 7 says/week by mobility team (PT, RN, NA) • Starting with PROM and progressing with transfers and sitting vs usual care	1. ICU LOS Protocol: 5.5 days vs. usual care 6.9 days (p=.025) 2. Hospital LOS protocol 11.2 days vs usual care 14.5 days care (p=.006)
Burtin, et al., 2009	• Randomized controlled trial • n=90 • 67 Computed	• Treatment initiated on ICU day 5, given	*NO difference noted in ICU or Hospital LOS or vent weaning time

Author	Design	PT Interventions	Findings
	• 36 Control • 31 Treatment Group	another 7day stay likely • Both groups received UE/LE therapy exercises and functional training • Treatment group had an additional cycling session for 20 minutes total duration 5 days a week	
Malkoc, et al., 2009	• Intervention Study with Control from retrospective chart review • n= 510 • 277 intervention • 233 control	• Intervention group received chest PT with individualized activities ranging from exercise to mobility twice per day 5 days/week • Control group received standard nursing care	1. Ventilator dependent days Intervention:14.0+/-5.9 p<0.005 Control: 20.0+/- 6.1 p<0.005 2. ICU LOS Intervention: 15.8+/-8.5 Control: 25.5+/-4.5
Schweickert, et al., 2009	• Prospective • Randomized controlled trial N=104 All patients completed study • 2 Centers MV ≤ 72 hours • Expected to cont MV least 24 hours • 55 Control • 49 Intervention	• Treatment group ext mobilization day of enrollment • Sedatives interrupted o Control – PT/OT Delivered when ordered (typically not sooner than 2 weeks on a mechanical vent)	1. LOS ICU • Treatment: 5.9 • Control: 7.9 p=0.08 2. Hospital LOS • Treatment: 13.5 • Control: 12.9 p=.93
Needham, et al., 2012	• Seven month prospective before and after quality improvement project • Prospective QI case controlled o n=57 o 27 pre QI o 30 post QI • Single Center • Patients MV 4 days or more	• Creating positions for FT PT/OT and PT Rehab Aide • Established guidelines for safe early mobility or PT/OT • PRN sedatives vs. continuous infusions • Default activity level of as tolerated instead of bed rest	1. ICU LOS reduced by 2.1 days 2. Hospital LOS reduced by 3.1
Ronnebaum, et al., 2012	• Retrospective chart review o n=28	• SPT=Standard Physical Therapy when deemed appropriate	1. Mean ICU LOS a. SPT 24.9 +/-13.7 days b. MP 13.3 +/- 6.3 days c. p=.007

Author	Design	PT Interventions	Findings
	o 13 patients SPT o 15 patients MP • Diagnosis of non-neurological respiratory failure and were put on MV upon admission	• MP=Early Mobility protocol involving interdisciplinary team and daily meetings • PT evaluation to occur within 24 hours in MP group	2. Mean MV days a. SPT 30.9 +/- 20 days b. MP 14.5 +/- 8.7 days c. p=.007 3. Mean interval until the initiation of PT a. SPT 12.9 +/- 9.7 days b. MP 6.1 +/- 4.6 days c. p=.02
Titsworth, et al., 2012	Single Institution Prospective Intervention trial	• Pump plus (progressive upright mobility program) • Other rehab activities • Transfer in 2 months	1. LOS before mobility program implementation 12 to 8.6 days after ($p \leq 0.01$) 2. Reduction in Neuro ICU LOS from 4.0 to 3.46 (13% difference) ($p \leq .004$) 3. 0.02% reduction in LOS with each unit increase in mobility score measured

Key: ARF= acute respiratory failure, MV= mechanical ventilation/mechanically ventilated, QI= quality improvement, PT= Physical Therapy, OT= Occupational Therapy, FT= full time, RN= registered nurse, NA= nursing assistant, PRN= as needed UE= Upper Extremity, LE= Lower Extremity

A randomized controlled trial of 90 critically ill patients examined the effects of bedside cycling and demonstrated no significant difference between control and experimental groups in ICU or hospital LOS (Burtin, et al., 2009). Of importance to note with this study, is that both groups received strengthening and functional training, but the treatment group received an extra 20 minutes of cycling per day in a supine or semi-recumbent position (Table 1).

The impact of PT in ICU LOS in a preeminent Turkish Hospital was examined in ventilator dependent patients (Malkoc, Karadibak, & Yildirim, 2009). The control group received only standard nursing care, and the experimental group participated twice per day five days per week in the chest physiotherapy program individualized to each patient, and included activities ranging from postural drainage to exercise and mobilization (Table 1).

The efficacy of combining early sedation interruption with PT and Occupational Therapy (OT) was investigated in a randomized controlled trial with the intention to treat all 104 mechanically ventilated patients (Schweickert, et al., 2009). Computer generated randomization occurred with blinding of therapists to treatment assignment. This two center study used computer randomization and blinding of therapists, with initiation of early exercise and progressive mobilization in patients who had been on the ventilator less than 72 hours, but were expected to remain on the ventilator at least 24 more hours. The control group received sedation interruption with therapy as ordered by the primary team, typically not initiated until patients were mechanically ventilated for 14 days or more. ICU LOS and hospital LOS were not significantly different in this study (Table 1).

A seven month prospective study before and after quality improvement project was conducted in a 16 bed MICU in an academic setting which studied early rehabilitation in patients with acute respiratory failure (Needham, et al., 2010). This single center study targeted patients who had been ventilated 4 or more days. Interventions were not specific to a protocol, but instead, consisted of creating positions for therapists and a Rehabilitation Aide (RA), establishing guidelines for safe and early mobilization, and altering standards for sedatives from continuous to as needed and changing activity orders from bed rest to as tolerated (Table 1).

A systematic review investigating outcomes of mobilization in patients requiring MV was conducted using many of the already mentioned studies (Li, Peng, Zhu, Zhang, & Xi, 2012). Using 17 eligible studies, the authors

found that active mobilization may positively impact the ability to wean from the vent and may decrease both ICU and hospital LOS (Li, et al., 2012).

Ronnebaum, Weir, & Hilsabeck (2012) completed a retrospective chart review study comparing the effectiveness of a Mobility Protocol (MP) utilizing daily meetings with an interdisciplinary team to safely initiate early mobilization when stable with Standard Physical Therapy (SPT). Twenty-eight charts were reviewed of patients in respiratory failure requiring MV (Table 1).

An early mobility program, titled PUMP Plus, was initiated in the neurointensive care unit at Shands Hospital at the University of Florida from April 1, 2010 through July 31, 2010 (Titsworth, et al., 2012). Unless it was clinically contraindicated, the study population of 3291 patients was automatically enrolled in the early mobility program of progressive mobility. Results of the PUMP Plus study demonstrated a statistically significant decrease in hospital LOS from 12 days before the mobility protocol implementation to 8.6 days after, a decrease in neurointensive care LOS by 13 % from 4.0 days before mobility implementation to 3.4 days after and a correlation between LOS and mobility score (Table 1).

A financial model was developed using data from existing studies and from the actual implementation of early mobilization in the MICU at Johns Hopkins Hospital (Lord, et al., 2013). Data from this study of early mobilization in the ICU indicated a 22% reduction in stay with an average of 5.4 days before intervention and 3.9 days post intervention (Lord, et al., 2013).

Cost of Care with early mobilization in ICU

According to Dasta, et al., (2005), patients requiring MV in the last quarter of 2002 accrued higher hospital costs with an average of $47,158 compared to those patients not requiring MV with an average of $23,707. Average daily ICU cost studied in 2002 were highest day one and day two, stabilizing on day three as evidenced by $7,728 +/- 8,509 day one, $3,872 +/- 4,223 day two and $3,436 +/- 3,550 day three (Dasta, et al., 2005).

In 2008, Morris, et al., examined early ICU mobilization in the treatment of ARF, finding the total direct inpatient cost for patients in the protocol group to be $6,805,082 with an average patient cost of $41,142, while the total cost for the usual care group was $7,309,871, with an average patient cost of $44,302.

Ronnenbaum, et al., (2012), performed a retrospective chart review in 2008 compared the effectiveness of a Mobility Protocol (MP) with Standard PT (SPT) demonstrated an average difference of 11.6 days fewer in the ICU in the MP protocol, as well as a $22,000 savings per patient in the MP.

The financial model created using data from the Johns Hopkins Hospital early mobilization implementation identified three areas of costs associated with early ICU mobilization which included personnel, training, and equipment (Lord, et al., 2013), (Table 2).

Table 2.

Admissions Per Year	Estimated Savings
200	$34,134
600	$224,378
900	$358,475
2000	$645,951

The Impact of Early Mobilization in ICU on Medical Complications

The randomized controlled trial by Schweickert, et al., (2009) demonstrated a significant difference in reduction of days of ICU delirium, 2 days in the treatment group compared to 4 days in the control group, and in ICU acquired paresis at hospital discharge, 31% treatment group compared to 49% control group.

In a cohort study of 280 acute respiratory failure survivors, using parent data from a prior study, Morris, et al., (2011) found that patients who did not participate in an early mobilization group were statistically significant with 1.77 odds ratio (OR) of readmission or death.

The PUMP Plus study demonstrated a 60% decrease in hospital acquired infections (such as Ventilator Associated Pneumonia (VAP), central line infections and catheter associated UTI's) with increased mobility scores, but no significant difference was noted in pressure ulcer development (Titsworth, et al., 2012).

DISCUSSION

Early mobilization for decreased LOS in the ICU exhibited some mixed results as discussed below. When implementing early mobilization in the ICU costs were shown to decrease. Fewer medical complications occurred with the implementation of early mobilization in the ICU.

While the sample size for the PUMP Plus study was large (n= 3291), data was only collected for 2 weeks prior to the initiative and for 2 weeks after the initiative, with pre sample size of 77 and post sample size of 93 (Titsworth, et al., 2012). The PUMP Plus study used the iMOVE mobility assessment tool, which was noted to be both valid and sensitive. This study hypothesized that increased mobility would be correlated with decreased pressure sore incidence, as had been shown in other studies, but it did not, likely due to low prevalence of pressures in this unit.

While the PUMP Plus study was conducted in a neurointensive care, it provides external validity to our study regarding progressive mobilization with ventilated and non-ventilated patients.

ICU-AW is common following critical illness and often the recovery is incomplete, as demonstrated in a 5 year post illness study of survivors of acute respiratory distress syndrome, which showed normal pulmonary function, but reduced 6 Minute Walk Distance (6MWD) compared to normal averages, representing long lasting physical impairment. Muscle wasting and fatigue have been documented as functional limitations at one year post ICU discharge, with 6MWD results being 66% of predicted values, with only 49% of survivors able to return to work (Titsworth, et al., 2012). So, while this research indicates possible immediate cost savings with early mobilization in the ICU, the total cost of ICU illness to full recovery is unknown.

It has been suggested that total ICU costs are related to LOS, but frequently ICU costs are fixed, representing overhead costs of running a hospital, and these costs do not change regardless of LOS (Kahn, Rubenfeld, Rohrbach, & Fuchs, 2008). For example, in a retrospective cohort study of all patients undergoing MV for at least 48 hours in the ICU at the Hospital of the University of Pennsylvania in Philadelphia fiscal year 2006, reducing ICU and hospital stay for all patients would save $673,941 in variable costs, which was only 0.9% of total hospital costs (Kahn, et al., 2008).

While the earlier mobilization study by Ronnebaum, et al., (2012), sounds convincing with shorter LOS and $22,000 per patient savings, this study is a retrospective chart review study with a small sample size. This study demonstrated shorter MV days with earlier mobilization, and inferred reduced ventilator assisted pneumonia and decreased blood stream infections with its supporting literature.

Burtin, et al., (2009) found no difference in ICU or hospital LOS with the cycling intervention. It can be argued that both groups received strengthening exercise and functional mobility training so while supine or semi-recumbent cycling had an impact on 6MWD and the functional task of improving sit to stand, no change in LOS was noted.

The Turkish study by Malkoc, et al., (2009) demonstrated promise with reduced ventilator days and reduced ICU LOS with the use of PT, but the arguments lacked conviction, as the supporting research in the document was before 2002. The validity is questioned as the experimental group was extubated within 14 days, and the control group was dependent on ventilatory support longer, extubated within 20 days.

Morris, et al., (2011) used survey follow up to determine results regarding readmission rates and death rates. This method provides questionable reliability, as the reader cannot be certain the survey was filled out by the appropriate person, or that the survey was filled out accurately. Only 8% were lost to follow up according to the research.

Li, et al., (2012) performed a systematic review of mobilization in ventilated patients in the ICU and may have noted some success with ventilator weaning and LOS, but the study limitations were significant due to considerable heterogeneity and limited methodological quality. Researcher bias may have impacted results in the work by Needham, et al., (2012), as Dr. Needham has produced much research regarding the success of early mobilization in the ICU. Other study limitations include small sample sizes with high numbers lost to follow up, as well as, high rate of mortality in the population studied.

Hospital systems are under increased pressure to produce quality outcomes and reduced costs. Utilization of early mobilization can likely reduce LOS, hospital costs and medical complications. Changing the culture of bed rest in the ICU is possible and valuable. The cost of early mobilization could be further reduced by training lower paid staff such as mobility technicians rather than higher paid therapists or nurses. Patients on MV should be mobilized as

soon as they are medically stable to minimize complications.

Further research should focus on longitudinal studies to determine the entire cost of care with adequate follow up to determine functional status in the home and in the community. Other research could examine true ICU and hospital costs and how patient volumes and turnover rates impact those costs. And, because quality plays an increasing role in reimbursement, time of critical illness discharge should be investigated to ensure discharges occur at the appropriate time to avoid readmissions.

CONCLUSION

While the cost saving benefit is not fully realized by the research available, early mobilization has the potential to reduce LOS and medical complications. Early mobilization in the ICU would likely benefit patients, hospitals and insurance companies. Because of its benefits, early mobilization in the ICU should become a standard of care due to the potential reduction in medical complications.

REFERENCES

Adler, J., & Malone, D. (2012). Early mobilization in the Intensive Care Unit: A systematic review. *Cardiopulmonary Physical Therapy Journal, 23*(1), 5-13.

Arabi, Y., Venkatesh, S., Haddad, S., Shimemeri, A., & Malik, S. (2002). A prospective study of prolonged stay in the intensive care unit: predictors and impact on resource utilization. *International Journal for Quality in Health Care, 14*(5), 403-410.

Brummel, N., Jackson, J., Girard, T., Pandharipande, P., Schiro, E., Work, B., & al., e. (2012). A combined early cognitive and physical rehabilitation program for people who are critically ill: the activity and cognitive therapy in the intensive care unit (ACT-ICU) trial. *Physical Therapy Journal, 92*(12), 1580-1592.

Burtin, C., Clerckx, B., Robbeets, C., Ferdinande, P., Langer, D., Troosters, T., & al., e. (2009). Early exercise in critically ill patients enhances short-term functional recovery. *Critical Care Medicine, 37*(9), 2499-2505.

Cavellazzi, R., Sadd, M., & Marik, P. (2012). Delirium in the ICU: an overview. *Annals of Intensive Care, 49*(2), 1-11.

Dasta, J., McLaughlin, T., Mody, S., & Piech, C. (2005). Daily cost of an intensive care unit day: The contribution of mechanical ventilation. *Critical Care Medicine, 33*(6), 1266-1271.

Desai, S., Law, T., & Needham, D. (2011). Long-term complications of critical care. *Critical Care Medicine, 39*(2), 371-379.

Drolet, A., DeJuilio, P., Harkless, S., Henricks, S., Waters, C., & Wiliams, S. (2012). Move to improve: the feasibility of using an early mobility protocol to increase ambulation in the intensive and intermediate care setttings. *Physical Therapy Journal, 93*(2), 1-11.

Ely, E., Shintani, A., Truman, B., Speroff, T., Gordon, S., Harrell, F., & al., e. (2004). Delirium as a predictor of mortality in mechanically ventilated patients in the intensive care unit. *Journal of the American Medical Association, 291*(14), 1753-1762.

Griffiths, R., & Hall, J. (2010). Intensive care united-acquired weakness. *Critical Care Medicine, 38*(3), 779-787.

Halpern, N., & Pastores, S. (2010). Critical medicine in the United States 2000-2005: An analysis of bed numbers, occupency rates, payer mix and costs. *Critical Care Medicine, 38*(1), 65-71.

Kahn, J., Rubenfeld, G., Rohrbach, J., & Fuchs, B. (2008). Cost savings attributable to reductions in

intensive care unit length of stay for mechanically ventilated patients. *Medical Care, 46*(12), 1226-1233.

Li, A., Peng, X., Zhu, B., Zhang, Y., & Xi, X. (2012). Active mobilization for mechanically ventilated pateints: a systematic review. *Archives of Physical Medicine and Rehabilitation, 93*(11), 1081-1087.

Lilly, C., Zuckerman, I., Badawi, O., & Riker, R. (2011). Benchmar data from more than 240,000 adults that reflect the current practice of critical care in the United States. *Chest, 140*(5), 1232- 1242.

Lipshutz, A., & Gropper, M. (2013). Aquired neuromuscular weakness and early mobilization in the Intensive Care Unit. *Anesthesiology, 118*(1), 202-214.

Lord, R., Mayhew, C., Korupolu, R., Mantheiy, E., Friedman, M., Palmer, J., & al., e. (2013 йил March). ICU early physical rehabilitation programs: financial modeling of cost savings. *Critical Care Medicine, 41*(3), 1-8.

Malkoc, M., Karadibak, D., & Yildirim, Y. (2009). The effect of physiotherapy on ventilatory dependency and the length of stay in an intensive care unit. *International Journal of Rehabilitation Research, 32*(1), 85- 88.

Morris, P., Goad, A., Thompson, C., Taylor, K., Harry, B., Passmore, L., & al., e. (2008). Early intensive care unit mobility therapy in the treatment of acute respiratory failure. *Critical Medicine, 36*(8), 2238-2244.

Needham, D., Korupolu, R., Zanni, J., Pradhan, P., Colantuoni, E., Palmer, J., & al., e. (2010). Early physical medicine and rehabilitation for patients with acute respiratory failure: A quality improvement project. *Archives of Physical Medicine and Rehabilitation, 91*(4), 536-542.

Needham, D., Wang, W., Desai, S., Mendez-Tellez, P., & Dennison, C. (2007). Intensive care unit exposures for long-term outcomes research: development and description of exposures of 150 patients with acute lung injury. *Journal of Critical Care, 22*(4), 275-284.

Ronnebaum, J., Weir, J., & Hilsabeck, T. (2012). Earlier mobilization decreases the length of stay in the intensive care unit. *Journal of Acute Care Physical Therapy, 3*(2), 204-210.

Schweickert, W., Pohlman, M., Nigos, C., Pawlik, A., Esbrook, C., Spears, L., & al., e. (2009). Early physical and occupational therapy in mechanically ventilated, critically ill patients; a randomised controlled

Shorr, A. (2002). An update on cost-effectiveness analysis in critical care. *Current Opinion in Critical Care, 8*(3), 337-343.

Thomason, J., Shintani, A., Peterson, J., Pun, B., Jackson, J., & Ely, E. (2005). Intensive care unit delirium is an independent predictor of longer hospital stay: a prospective analysis of 261 non-ventilated patients. *Critical Care , 9*(5), R375-R381.

Titsworth, W., Hester, J., Correia, T., Reed, R., Guin, P., Archibald, L., & al., e. (2012). The effect of increased mobility on morbidity in the neurointensive care unit. *Journal of Neurosurgery, 116*(6), 1379- 1388.

Truong, A., Fan, E., Brower, R., & Needham, D. (2009). Bench-to-bedside review: Mobilizing patients in the intensive care unit-from pathophysiology to clinical trials. *Critical Care, 13*(4), 216-224.

Weill-Engerrer, S., Meaume, S., Lahou, A., Piette, F., Saint-Jean, O., Sachet, A., & al, e. (2004). Risk factors for deep vein thrombosis in inpatients aged 65 and older; a cased controlled multicenter study. *Journal of the American Geriatric Society, 52*(8), 1299-1304.