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## Preventing neuromuscular deconditioning in critically ill patients

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PREVENTING NEUROMUSCULAR DECONDITIONING  
IN CRITICALLY ILL PATIENTS

by

SHAHZIA A. LAKHANI

A thesis submitted in partial fulfillment of the requirements  
for the Honors in the Major program in Nursing  
in the College of Nursing  
and in The Burnett Honors College  
at the University of Central Florida  
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## ABSTRACT

Critically ill patients can be prescribed bed rest as a therapeutic intervention. Immobility from bed rest can cause neuromuscular deconditioning and weakness. Preventing immobility by implementing mobilization activities may prevent these complications from occurring. Currently, mobility protocols are lacking. The purpose of this literature review is to analyze the evidence related to mobilizing patients in the Intensive Care Unit (ICU). In the future, a standard mobility protocol should be instituted for critically ill patients indicating when and how to begin mobilization. The efficacy of mobility protocols relies on an interdisciplinary team for positive outcomes to prevent complications of inactivity and promote patient safety. Future implementation of mobilization can decrease patients' lengths of stay and extensive rehabilitation from inactivity. Nursing education, practice and research should focus on interventions to prevent complications of immobility by identifying mobilization techniques, safety approaches and the use of protocols.

This thesis is dedicated to my mother, the motivation for my thesis. She is a strong woman who endured a long hospital stay with many complications.

This is also for my father who encouraged and supported my quest.

My sister—Saeeda Lakhani is the reason for my high spirits.

Lastly, to my uncle who I always keep in my thoughts and prayers.

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Thank you to the College of Nursing faculty for the knowledge and support throughout the program. I thank the nurses, professors, and instructors who precepted, guided, and brought out the best in me. Lastly, to my friends in nursing school, you will make great nurses!

“I think one's feelings waste themselves in words; they ought all to be distilled into actions which bring results.”

--Florence Nightingale

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## INTRODUCTION

Medical providers may prescribe bed rest for critically ill patients as a therapeutic measure. Bed rest, defined as not walking or transferring from bed to chair, provides benefits of decreasing physical activity while lowering oxygen requirements of the body (Dean, 2008). However, patients with critical illness confined to bed rest can be at a greater risk for secondary complications that can lead to impaired physical mobility. If the patient is restricted, risk of atrophy may increase. Atrophy, the weakness and wasting away of musculature, occurs with decreased physical effort and immobility, leading to neuromuscular deconditioning (Asher, 1947). Nurses implement mobility interventions, in part, to prevent muscle weakness and atrophy, as well as prevent neuromuscular deconditioning. Mobility interventions also prevent pressure ulcers and muscle contractures, provide adequate respiratory drainage to prevent pneumonia, and maintain muscle health. Common interventions include turning every two hours, providing range of motion and assisting in activities of daily living (ADLs). If mobility interventions are not performed, protein breakdown can lead to a decreased muscle mass, disuse atrophy, and joint instability (Chang, Boots, Hodges & Paratz, 2004). Patients confined to bed rest can also encounter long-term effects such as loss of balance, stamina and strength. In a study by Brown (2004), approximately 29% of patients studied had a decline in ADLs while bed rest was ordered for 33% of patients. These problems are often not evident until the time of discharge. Interventions performed by a nurse, on



admission, can decrease a client's length of stay and prevent or minimize readmission from complications associated with immobility (Chang et al., 2004).

## **Significance**

Continuous bed rest, without mobilization that is appropriate for a patient's condition, can cause muscular weakness. This weakness can contribute to unsteady gait and an increased risk of falls (Morris et al., 2008). Although preventing falls is a top safety priority for nurses, nurses may refrain from mobilizing patients. This is due to time constraints and/or a lack of resources. When properly utilized, mobilization interventions will limit deconditioning, improve patient outcomes, and improve quality of life (Morris, 2007). Identifying evidence-based interventions provides guidance for nursing practice to prevent neuromuscular deconditioning.

## **Problem**

Current research indicates mobilization is imperative for improving patient outcomes and should be an important component of care. However, the literature provides variable direction for mobilization practices in the clinical setting. The best practices for what techniques to use, whom to mobilize, and when to mobilize have not been well articulated in nursing literature and standard practice guidelines are not available (Morris, 2007). Although many techniques are available, only a few are employed. In the medical surgical intensive care units of three hospitals, researchers tested the use of the hospital's standard for turning patients every two hours. Researchers found that 49.3% of patients remained without a change in body

positioning for greater than two hours (Krishnagopalan et al., 2002). Of the 74 patients studied, half of the patients remained supine for up to 8 hours (Krishnagopalan et al., 2002). Nurses may have lack of resources such as limited time despite that turning is an intervention to improve patient outcomes while on bed rest.

Safety is a very important factor in critically ill patients with equipment. Nurses may refrain from mobilizing patients if they have perceived dangers of dislodging equipment. Safety concerns should be addressed to promote positive outcomes for patients and avoid secondary complications of immobility. Further, protocols are unavailable which can provide direction for which techniques to use and important safety aspects. Given this information, nurses should be educated about the effects of activity to promote patient health.

## **Purpose**

The purpose of this literature review is to analyze the evidence related to mobilizing critically ill patients. Use of progressive mobilization therapy can improve or maintain muscle mass and prevent deconditioning. This review also conveys mobilization techniques, safe implementation and the use of a mobility protocol. The thesis serves to provide direction for future research on mobilization practices in the critical care setting.

## Method

A review of interdisciplinary research was performed from Cumulative Index of Nursing and Allied Health (CINAHL) Plus with Full-Text, MEDLINE, and the Cochrane Database of Systematic Reviews (CDSR) to determine the interventions that result in best practices for patients to reduce complications from immobility. Key terms used were as follows: Intensive Care Unit and Ambulation (n= 101), Intensive care unit and early mobilization (n = 171), mobility protocol and critical care (n = 9) in which studies were dated only as far back as 15 years indicating contemporary practices. Inclusion criteria focused on studies that evaluated mobilization activities for critically ill patients on bed rest, peer reviewed articles, and those written in the English language. Exclusion criteria were patients not in critical care settings.

## FINDINGS

Many interventions to promoting mobility to prevent neuromuscular deconditioning are available for use. Certain mobility activities should be incorporated into their hospital stay dependent upon the patient's abilities. During their hospital stay, safety is top priority for nurses especially during mobilization. Establishing mobility protocols can also determine clear guidelines for which activities should be used and how to address safety concerns for patients. A table of evidence of the studies is presented (Table 1).

### **Types of Interventions**

#### *Range of Motion*

Range of motion (ROM) exercises have been the most commonly used mobility intervention for many years to provide positive effects on joints and muscle integrity (Winkelman, Higgins & Chen, 2005). ROM applies repetitive motions of flexion and extension to a joint within limits of that particular joint to reduce potential for joint contractures (Doherty & Steen, 2010). Without the ROM, the muscle may stiffen up and prove difficult to stretch (Doherty and Steen, 2010). If immobility of a joint occurs, it will lead to stasis of the synovial fluid and increased pressure (Doherty and Steen, 2010). The pressure will cause pain, tension, and reduced range of the joint (Doherty and Steen, 2010). To prevent these

effects of inactivity, two types of ROM are used in the clinical setting, passive and active.

Passive ROM is defined as a caregiver providing the exercises with the patient while stabilizing the joint used. Patients hospitalized with muscular weakness will require more passive types of mobilizations especially if they also have a decreased level of consciousness (Winkelman, Higgins and Chen, 2005).

Active ROM is completed by the patient with minimal assistance from a physical therapist or nurse. For patients unable to perform the exercises independently, passive ROM can be facilitated instead. For active ROM, the objective is to maintain comfort while allowing active resistance exercise under supervision. Thus, to achieve maximum participation, medications such as sedatives, neuromuscular blocking agents and anxiolytics should be minimized or stopped. Active ROM can provide as a stepping stone for other activities and patients may be progressed as they become more physiologically stable (Doherty and Steen, 2010; Timmerman, 2007; Winkelman et al., 2005).

Therapeutic activity often begins with ROM exercises. To measure the frequency of activity that a sample of 20 patients received, researchers studied stable ICU patients with a 5-15 day length of stay. Using an actigraphy device placed on the dominant hand of the patient, ROM and turning activity was measured in two separate 4-hour observations. Typical activity was recorded in patients on different days and times of the week. In 11 of 20 patients undergoing

observation, ROM exercises occurred more than other types of mobility. During observation hours, researchers found that ROM exercises were done more once a day for an average of 8 minutes (Winkelman, Higgins and Chen, 2005).

The use of ROM in studies varies in duration of repetitions to joints. Morris et al. (2008) completed 5 repetitions per joint while Schweickert et al. (2009) used 10 repetitions per joint. Resistance exercises were seen to double muscular protein synthesis up to 24 hours post-exercise (Ferrando et al., 1997). Providing parameters for the duration and frequency differed between studies but the effects of ROM assisted patients in progressing to further activity.

### *Dangling and Chair Sitting*

ROM exercises can progress slowly into dangling as soon as patients can tolerate the activity. Dangling refers to having the patient sit independently on the side of the bed with feet touching the floor if possible. Elevating the head of the bed for the patient will mimic a chair position and the staff should support their upper body as the patient is asked to sit on the side of the bed. If the patient cannot tolerate transferring into a chair, a mechanical lift device can be used to position the patient into a reclining chair (Timmerman, 2007).

If a patient is unable to tolerate dangling, the patient would not be able to tolerate progressing to standing. Keeping a chair close to the bed will provide easy transfer. In a pilot study of 51 interviewed nurses, responses indicated that dangling was not performed with doctor's orders as it was not routinely ordered

(Lane, Winslow, Woods and Dixon, 1997). To promote activity tolerance for patients being mobilized to dangle for the first time, nurses would pre-medicate for pain. To maintain activity, nurses stated that they would encourage slow, deep breathing with presence of indicators of intolerance such as changes in vital signs (Lane, Winslow, Woods and Dixon, 1997).

When the patient has capability to lift his/her legs, mobility can then be advanced to taking 1 or 2 steps to a recliner chair (Timmerman, 2007). If the patient cannot tolerate taking steps to the chair, the nurse can keep the chair close to the bed and pivot the patient with one movement. Chair sitting should be used to assess how the patient can tolerate the upright position; one to two hours is the desired time (Lane, Winslow, Woods & Dixon, 1997). Monitoring the amount of time spent in the upright position can be used to determine the patient's tolerance to the activity by comparing the timeframe with each subsequent chair sitting.

### *Ambulation*

Ambulation has been found to be safe for ICU patients when physiologically stable (Bailey et al., 2007). However, nurses may perceive the patient to be too critical to tolerate activity. A study by Thomsen, Snow, Rodriguez and Hopkins (2008) used distance of ambulation as a measure of patient tolerance to the activity by comparing the distance each time to see progression in activity. The researchers assessed the patients each day and determined neurologic, respiratory and circulatory criteria for each individual. When each patient met the criteria of stable

vital signs and ability to stand, patients sat at bedside, transferred to a chair and ambulated with a walker. Researchers concluded that the majority of patients treated with early activity, after determining physiologic stability, had the ability to ambulate more than 100 feet by ICU discharge (Bailey et al., 2007). Thomsen et al. (2008) also found that when patients were given opportunities to ambulate, their capability to mobilize increased three-fold.

Ambulating an individual has its hazards as well. Bailey et al. (2007) assessed 103 respiratory patients for early activity such as chair sitting, bed side sitting and ambulating. Maintaining patient safety was a particular focus in this study. When an individual encountered oxygen de-saturation or hypotension in the study, they were given oxygen and were asked to lie down until vital signs stabilized. However, no major adverse events or increased lengths of stay occurred. The nurse to patient ratio allowed for assessment and availability to the physical therapy staff if needed (Bailey et al., 2007).

In Bailey et al. (2007), comorbid illnesses did not change the amount of time that a patient could walk as they participated despite their age, condition, equipment attachments or oxygen needs. The muscles which help maintain posture, ambulation and transfers are specifically affected by immobility as they are not being used during bed rest and their muscular strength may decrease 1 to 1.5% with each day of bed rest (Rochester, 2009). The prolonged bed rest can result in atrophy, reduction in muscle mass, and lower endurance (Rochester, 2009). To avoid



the effects of prolonged bed rest, patients should begin the progressive mobilization with a goal of ambulating by discharge. This can help eliminate the need for extensive rehabilitation after discharge and help the patient live independently to increase quality of life.

## **Devices**

### *Bed Side Cycle Ergometry*

Bedside cycle ergometers are stationary cycles that allow continuous mobilization while simultaneously adjusting the intensity for a patient's response to the exercise (Burtin et al, 2009). Ergometers can be used for passive, active-assisted or active training practical for immobilized or sedated critically ill patients. In a randomized controlled trial by Burtin et al. (2009), daily exercise sessions ranging from 30-40 minutes with a bedside ergometer were examined for safety and effectiveness.

Ninety medical-surgical ICU patients were enrolled in the study if they had a stable cardio-respiratory status and a predicted ICU length of stay of more than 7 days. In addition to the standard sessions of physical therapy, the treatment group or the patients receiving interventions (n=45), used the ergometer for 20 minutes each day, 5 days a week. By discharge, patients in the treatment group had improved isometric quadriceps force, median 6-minute walk distance and improved physical function (Burtin et al., 2009). These physical therapy sessions include bedside cycle ergometry patients who have also received passive ROM.

### *Tilt Table*

Tilt table therapy was used for patients who have had extensive bed rest and needed to be reintroduced to being in vertical position if unable to stand independently (Chang et al., 2004). Fifteen stable individuals used tilt table therapy with their physiotherapist (Chang et al., 2004). The therapy included passive tilt at an angle of 70 degrees for five minutes (Chang et al., 2004). Patients standing with assistance of the tilt table can progress to different levels of mobilization when continuously monitored and assessed. Physiotherapists' use of the tilt table was found to prevent contractures in use by 86.2%, re-educate muscle for 67.2% of physiotherapists, and prevent muscular atrophy by 56.9% of physiotherapists (Chang et al., 2004). Patients were monitored for blood pressure, heart rate, and oxygen saturation as well as level of consciousness after completing a session of tilting.

Tilting patients can reflect standing vertically if standing independently cannot be tolerated (Morris, 2007). Musculoskeletal benefits have been recognized with tilting when used with ROM to measure effectiveness (Chang et al., 2004). Contraindications for tilting have not been published but Chang et al. did not tilt patients with lower limb fractures or labile blood pressures (2004). Physiotherapists surveyed were divided about tilting patients on inotropic medications. Guidelines for monitoring blood pressure, heart rate, and oxygen saturation to standardize the use of tilt tables can improve patient outcomes and safety (Chang et al., 2004).

Overall, the researchers found that tilt table therapy has short term effects which reintroduce the patient into vertical position which also helped to increase arousal in the study.

### *Specialty Beds*

If a patient is too unstable to manually turn, a less “aggressive” turning mechanism that is advised by clinicians is kinetic rotational therapy (KRT). KRT is primarily used for respiratory patients but the turning motion for the patient can serve as initiating treatment for mobility that is more delicate than manually turning a patient (Vollman, 2004). KRT also allows the patient to be turned even when the nurse’s resources of time may be limited.

In a study performed by Ahrens, Kollef, Stewart and Shannon (2004), nurses were asked to implement protocols for patients allowing rotation for at least 18 hours a day. Rotation of at least 40° occurred to both left and right sides of a bed (Ahrens et al., 2004). The bed can also be set to gradually rotate depending on the stability of the patient. Therefore, to monitor the patient’s tolerance to turning, the bed rotation can be increased each hour by 10° (Timmerman, 2007). Eligibility criteria for patients in the study performed by Ahrens et al (2004) included a Glasgow Coma Scale less than 11 of 15 and those that required mechanical ventilation with a ratio of arterial oxygen concentration to the fraction of inspired oxygen less than 250. Patients did not receive KRT if they were hemodynamically unstable, had an unstable pelvic fracture, had intracranial pressure monitoring or

were receiving dialysis (Ahrens et al., 2004). However, if the patient was eligible for KRT, and they have been able to tolerate it with stability, they can progress to higher intensity mobility interventions such as ambulating (Timmerman, 2007).

Another type of specialty bed is manufactured by Hill-Rom that provides continuous lateral rotational therapy (CLRT). In comparison to KRT, CLRT rotates patients side to side in a turn of less than 40° (Ahrens et al., 2004). When caring for critically ill patients that have respiratory illnesses and require proper drainage of secretions, CLRT can facilitate removal of secretions to avoid the risk of ventilator associated pneumonia. In the same fashion, the lateral rotation can assist in progressive mobilization as the patient stabilizes (Washington & Macnee, 2005).

When an individual does not meet the criteria any longer for CLRT, while being stable enough to be positioned upright, he/she is eligible to discontinue the therapy (Vollman, 2004). This therapy has been shown to reduce the patient's length of stay which makes it cost-effective (Vollman, 2004). Although researchers indicate that these specialty beds are expensive, the outcome indicates otherwise. Patients placed appropriately on CLRT (n=22) had approximately a mean of 15 ICU days with a mean cost of \$34,902. For patients not appropriately placed (n=33) on CLRT, had a mean of 19 ICU days and approximately \$10,000 more in ICU costs for the patient. The CLRT allowed fewer days in the ICU and cost less which was beneficial for patients and the hospital. When appropriately placed on CLRT, costs were decreased by \$18,908 (n=24) (Washington & Macnee, 2005).

According to Washington and Macnee (2005), hazards such as muscle atrophy had reduced although it does not indicate a reduction in mortality rate for patients. A protocol for use of these specialty units has been developed from their study but it is suggested to use a standard protocol to reduce the hazards of immobility (Washington & Macnee, 2005).

## **Implementation**

### *Physiologic Parameters*

Nurses must be aware of body system responses that the patient may display before, during and after mobilization (Stiller, 2007). Mobilizing a patient can cause increases in heart rate and blood pressure and a marked decrease in oxygen saturation. Stiller (2007) has provided guidelines to assess patient safety which can also indicate their tolerance to the activity. Knowledge of the patient's baseline vitals as well as continuous monitoring can help staff to note if the patient needs to be at rest for vitals to return to baseline (Stiller, 2007). According to Bailey et al. (2007), if the systolic blood pressure rises above 200mmHg and the diastolic falls below 90mmHg, mobilization is contraindicated. If the diastolic blood pressure increases, it should be a minimal rise above baseline (Stiller, 2007). When mobilizing an elderly patient, the nurse must be knowledgeable about orthostatic hypotension and ways to avoid it. Orthostatic hypotension occurs as a decrease in blood pressure when a patient changes positions (Thomas et al., 2002). During activity, the clinical manifestations of orthostatic hypotension and syncope may

present but monitoring for nausea, dizziness, pallor and decreased consciousness (Winslow, Lane and Woods, 1995). The nurse can monitor the patient during activity to avoid symptoms of orthostatic hypotension and keep him / her close to a chair or bed to rest (Thomas et al., 2002).

While performing mobilization activities, the patient should never hold his/her breath as this can cause a critically ill patient to faint (Dean, 2008). A percutaneous O<sub>2</sub> monitor can be used to monitor signs of activity intolerance (Stiller, 2007). Maintaining appropriate levels of oxygen, the nurse must also monitor the patient's level of consciousness for apprehension or lethargy which can result in fainting (Thomas et al., 2002).

Using care while mobilizing a patient with various attachments such as intravenous lines or respiratory devices can prevent detachment (Stiller, 2007). Staff should be available to assist the nurse in keeping the patient safe while ambulating or transferring. When a patient remains in bed for an extensive length of time, he/she is at risk for falls and may require a fall risk assessment. During Bailey et al.'s (2007) study, only five of 103 patients studied had "fall to the knee" events and those occurred without any injury.

### *Mobility Protocols*

Mobility protocols have been suggested as a guide to progression of activity. A mobility program should begin when the patient can tolerate activity and be reevaluated after each activity is completed. A protocol that provides

recommendations to guide care by enhancing mobility safely can be useful for clinical staff.

In a study by Pohlman et al (2010), patients had daily interruption of sedation for physical and occupational therapy until they achieved independent functional status. During mechanical ventilation, patients began with active ROM and progressed to activities of daily living, sitting, standing and walking (Pohlman et al., 2010). These mobility activities can be incorporated and patients can progress as they become physiologically stable. Patients can be turned every two hours and nurses can perform passive ROM for patients who may be sedated or unable to perform active movement. If a patient is mechanically ventilated, their head of bed should be elevated no less than 30 degrees unless orders indicate otherwise. After the patient has tolerated ROM, he/she can continue by sitting on the bed with their feet dangling but should be planted on the floor if possible. Once the patient can bear weight and lift his/her leg against gravity they can be pivoted into a close chair for 1-2 hours. Ambulation with assistance after they can take steps to return to bed should be encouraged and progress to walking independently. (Timmerman, 2007) Morris et al. (2008) found that protocol patients' lengths of stay in an ICU were, on average, 5.5 days (n=165) compared to 6.9 days for patients not on protocol (n=165). The protocol patients remained in bed for 5 days whereas the "usual care patients" remained in bed for 11.3 days. The use of a mobility protocol also indicated that

55.1% studied in Morris et al. (2008) were physiologically capable of advancing to ambulation during their hospital stay.

Although preventing weakness is important, patients should be excluded from the mobility protocol if they have cannot tolerate any activity without a dramatic change as defined by normal limits in physiologic parameters. Patients with respiratory conditions should be monitored closely but excluded from the protocol if their FiO<sub>2</sub> (fraction of inspired oxygen) is greater than 60% and their respiratory rate is greater than 35 breaths per minute (Timmerman, 2007).

Perme and Chandrashekar (2009) offer insights into early mobility programs that can improve overall strength by discharge. Early activity has been known to assist in weaning mechanically ventilated patients from support and can reduce pulmonary muscle complications. After determining what the patient can tolerate, a program can be developed into four phases. Phase 1 of the program, determined by Perme and Chandrashekar (2009), includes patients who may have unstable conditions. These individuals can begin exercises in the supine position and advanced to turning in bed and sitting. Phase 2 allows patients that can tolerate standing with assistance while they are capable of “walking reeducation”. Patient participation is necessary as they will be monitored to increase their time sitting to measure tolerance of activities. Phase 3 focuses on patients that can soon begin a walking program. As the patient will begin exerting themselves, the therapists should ensure that patients are not holding their breath during activity and deep



respirations should be encouraged. For individuals transferring out of the ICU who may still have marked weakness, phase 4 provides training for their limitations while being promoted to work on endurance and strength training. Appropriate physiologic parameters were determined as a resting heart rate less than 110 beats per minute and a mean arterial blood pressure between 60 mmHg and 110 mmHg to be stable for activity. During all phases of this mobility program, supplemental oxygen should be available (Perme and Chandrashekar, 2009).

### *Team Responsibility*

According to Krishnagopalan, Johnson, Low & Kaufman (2002), nurses underutilized mobility interventions while 97% of patients were not turned every 2 hours, the minimum standard of the study. It is imperative that nurses determine when the patient is physiologically stable to begin dangling and chair sitting to prevent weakness. The use of chemical or physical restraints can prolong a patient's length of stay if the nurse does not determine when weaning of the sedation can occur (Timmerman, 2007). According to Rochester (2009), a majority of mobility interventions are completed by nurses instead of physical therapists. As the advocate for the patient, the nurse can motivate and assess the patient's well-being. If the nurse fears the patient will fall, progressive mobilization should begin by turning the patient and raising the head of the bed. The use of a mobility protocol can benefit the nurse and patient by incorporating activity into the plan of care.

A physical therapist is a crucial member of the multidisciplinary team. Schweickert et al. (2009) researched the outcomes of daily physical therapy (PT) initiated within 3 days of admission. Patients with daily PT displayed independent functioning by discharge (Schweickert et al., 2009). Physical therapists can provide ROM exercises, strengthening, positioning, and education, however, the physical therapists role is not specified for the ICU (Perme and Chandrashekar, 2009). For mechanically ventilated critical care patients, early activity performed by therapists requires specialization (Perme and Chandrashekar, 2009). To progress the patient from bed rest to weight bearing and walking, gait should be assessed with activity tolerance (Perme and Chandrashekar, 2009).

The use of a multidisciplinary team to monitor and mobilize the patient can result in more activity sessions throughout the day (Morris et al., 2008). The expertise of physical therapists in mobility and the ability of nurses to incorporate holistic care will provide better outcomes.

### *Timing*

Although there is a lack of a uniform definition of when “early” mobilization occurs, the sooner the patient is mobilized, the better the outcomes. Early mobilization is dependent on patients’ conditions but if mobilized early, time of inactivity would decrease to subsequently avoid deconditioning of muscles. Once a patient is hemodynamically stable and their physiologic parameters allow mobilization, they must be evaluated on how well they can tolerate further exertion

(Perme and Chandrashekar, 2009). Mobility should not be an afterthought or be thought of as referral to physical therapy rehabilitation after discharge.

### *Impact*

Lengths of stay are dependent on how critical a patient is and what measures are implemented to reduce complications. For every adverse event that occurs, such as nosocomial illnesses, a patient's hospital length of stay can increase by 4-9 days and increase the cost by \$18,000 (Washington and Macnee, 2005). Morris et al. (2008) found that the average cost per usual care patient (n=165) was \$44,302 while the average cost of a patient undergoing mobility protocol (n=165) was \$41,142.

An individual's quality of life (QOL) is determined by researchers as "living the best possible life after illness." After discharge, patients rated QOL of life negatively in surveys if their physical functioning was limited. Issues with mobility can hinder a patient's ability to perform activities of daily living such as climbing stairs or walking short distances (Bergen, 2005).

Fortunately, QOL can be improved through critical care nurses assisting patients in their transition to other units or discharge. Critical care nurses can also assist in mobility interventions when the patient is stable although it is not considered priority when they are ill. Managing their comfort level as well as monitoring the effects of neuromuscular blocking agents which prevent mobility can facilitate a smoother transition to discharge for a more positive QOL (Bergen, 2005).

## DISCUSSION

This literature review aims to provide nursing interventions for critical care nurses to prevent secondary complications of immobility in critical patients. It serves to inform and educate nurses concerning which techniques can be beneficial to progressively mobilize patients. The goal is to return the patient to his/her functional status prior to hospitalization without allowing weakness to occur (Bailey, 2007). Although mobilization is thought to provide benefits, there is limited evidence of the intensity, duration and frequency of interventions. Turning a patient every two hours can serve as a basis to progress mobility to dangling and chair sitting. If a patient is unable to maintain their blood pressure in a particular safe range, the activity should slowly progress using different techniques (Bailey, 2007). Unfortunately, without these physiologic parameters and guidelines for when to initiate mobility, patient providers can hesitate to begin mobilization activities.

## LIMITATIONS

Research focusing on mobility interventions was limited and difficult to access. Expanding search terms to specific mobilization activity would give more precise and diverse research on each intervention. Reviewing more studies about when to begin mobility interventions would help to identify effects of timing. This may be a reflection of a newly evolving concept. Studies used in this review were focused for critically ill patients that were mechanically ventilated but not all

patients can apply to those criteria. Additional articles that were not able to be located were not included in this review and might have given different insight to this broad topic.

## RECOMMENDATIONS FOR NURSING

### **Research**

The available nursing research specific to mobility is limited. The importance of mobility is discussed but does not focus on how nurses should implement the interventions. While nurses may understand the importance of mobility, the intensity, duration and frequency of the interventions is not as clear. Current research does not describe the frequency of patient turning although many hospital units have standardized turning every two hours.

Definitions of “early” mobilization can provide the initial guidelines and support to direct nursing practice. Future research should also set clear guidelines and roles for nursing involvement compared to other members of a multidisciplinary team. If further research is conducted, larger samples of critically ill patients should be used to help nurses direct their mobility practices with evidence.

### **Practice**

In critical care settings, nurses should be informed about the newest evidence to include in their practice. Evidence based practice of mobility interventions can guide a nursing staff to perform by set guidelines. Although negative outcomes can present from immobilization, mobilization activities are not performed by clinical staff as directed (Krishnagopalan, et al., 2002). Research has shown probability of

nurses utilizing a protocol increases implementation of interventions (Washington & Macnee, 2005). These guidelines can promote better outcomes for patients when optimum timing is defined by the unit. The nursing “toolbox” should be utilized when nurses have different mobility techniques available for use referring to the ability to best fit the patient’s needs.

## **Education**

Range of motion exercises are taught in many nursing curriculum as a basis for mobility. However, utilizing basic techniques for mobility may not positively affect the patient who is critically ill. Nursing students can be taught the most recent knowledge of the best techniques to initiate mobility with evidence based research. The idea of progressive mobility can educate students about gauging a patient’s ability for activity that is backed by research. Student nurses must learn to advocate for their patients by utilizing available research for best practices. Furthermore, continuing education for practicing nurses regarding activity can focus on all types of mobility interventions. Nurses should be taught through hospital in-service education meetings about the benefits of mobility. Different techniques and safety aspects should be addressed through a protocol by nurse educators on critical care units.

## SUMMARY

Mobility interventions performed by an interdisciplinary team can prevent neuromuscular deconditioning and weakness in patients. Identifying the safety concerns of mobility can help providers mobilize patients with minimal harm. When a nurse is also aware of a patient's baseline physiologic parameters such as oxygen saturation, heart rate, blood pressure and respiratory rate, mobilization interventions should be considered if patients are deemed stable. Focusing on these vital signs can indicate if the patient can tolerate activity and be progressed (Dean, 2008). Patients should be encouraged continue progressive therapy and build upon what they were able to do. Interventions such as ROM, dangling and chair sitting, ambulation and the use of devices should be used to prevent neuromuscular deconditioning. Health care staff should rely on evidence based practice and standardized mobility protocol that can guide interventions for patients.



## APPENDIX A: TABLE OF EVIDENCE

Table 1. Table of Evidence

Article with Author and Year	Sample	Intervention Details and Data Analysis	Results and Key Findings	Strengths (S) and Weaknesses(W)	Nursing Implications
Ahrens et al (2004)  Effect of kinetic therapy on pulmonary complications	Medical, Surgical, Trauma ICU (n=234)	Provide kinetic bed therapy to reduce pulmonary complications and costs of ICU stay	Decrease in costs for patients with kinetic bed therapy.	S: Large sample size, include variables of costs and lengths of stay W: Many patients did not receive the full 18 hour rotation	Nurses may monitor patients to see if they are tolerating the intervention and following protocol.
Bailey et al (2007)  Early activities in respiratory failure patients	Respiratory ICU (n= 103)	Assess patients for early activity events and record activities implemented such as bed sitting, chair sitting and ambulating.	Early activity can prevent neuromuscular complications. Majority of survivors ambulated > 100ft at discharge	S: High rates of activity participation number of pts who ambulated prior to discharge. No objective measures for muscle strength. W: lacking control group and random	During implementation, monitor and prevent falls, tube removal, systolic >200mmHg or <90mmHg and an oxygen saturation <80%

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<p>Brown et al (2004)</p> <p>Prevalence and outcomes of low mobility in hospitalized older patients</p>	n=498	<p>Comparing patients' mobility as low, intermediate and high.</p> <p>Found bed rest was ordered for 33% of patients</p>	<p>Adverse outcomes for patients were associated with low mobility and lead to complications.</p> <p>Approximately 29% of patients had decline in ADLs.</p>	<p>S: assessment of mobility through hospital stay through observing nurse, research personnel were blinded for collection of data</p> <p>W: No 24-hour observation of pts</p>	<p>Nurses may underestimate mobility of pts (according to study)</p> <p>Thus, nurses should ask patients what they are able to do determine mobility levels accordingly</p>
<p>Burtin et al (2009)</p> <p>Early exercise in critically ill patients enhances short-term functional recovery.</p>	<p>Medical-Surgical ICU</p> <p>n=90</p>	<p>Two groups: receiving physiotherapy and daily passive or active motion session of upper and lower limbs but treatment group receives bed side use of ergometer 20 mins/day</p>	<p>Bed-side exercise improved recovery, self-perceived functional status and muscle force at discharge</p>	<p>S: Pts were cardio-respiratory stable</p> <p>W: While assuring safety, sessions were cut shorter or resulted in early exercise cessation</p>	<p>Monitor vitals before, during and after exercise.</p> <p>Educate and motivate patient to prepare for sessions</p>

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<p>Chang et al (2004)</p> <p>Standing with assistance of a tilt table in intensive care: A survey of Australian physiotherapy practice</p>	General ICU n=86	<p>Tilt table (63.8% used for neurologic conditions and long term ICU stay pts)</p> <p>Angle of tilt influenced by cardiovascular stability, anxiety, pain and comfort</p>	Use of tilt table had more musculoskeletal benefits with more arousal than changes in ventilation for patients.	Combined tilt table and mobilization to compare differences	Encourage use of tilt table to increase arousal, muscle strength depending on cardiovascular stability
<p>Ferrando et al (1997)</p> <p>Resistance exercise maintains skeletal muscle protein synthesis during bed rest.</p>	n=11	<p>Infuse with stable isotopes. Isotonic knee exercise with repetitions &amp; rest between sets to promote restoration of CK. Bouts of resistance training has been shown to double protein synthesis up to 24h post exercise</p>	<p>Bed rest resulted in 46% decrease in muscle protein synthesis.</p> <p>Muscle strength and chronic stimulation through activity of skeletal muscle protein synthesis cannot be assumed</p> <p>Muscular stimulation through resistance exercise can improve strength.</p>	<p>Limited data in spaceflight</p> <p>Small sample</p> <p>Simulated with healthy pts(men)</p>	Encourage physical therapy with resistance exercise to MDs of patients on prolonged bed rest

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Krishnagopalan et al (2002)  Checking protocol of turning patients every two hours	Medical-Surgical ICU n=74	Specialty beds can have positive outcomes on length of stay, skin breakdown, and mortality	Most patients are not turned every two hours, reappraisal is needed	Found that there is a problem to be addressed Tried to blind caregivers but intention was known and data did not accurately reflect the care rendered. Low response rate on surveys	Need to use EBP for turning patient every two hours or specialty beds if not utilized
Lane et al (1997)  Dangling practices of 51 nurses: a pilot project	n=51	Nurses implemented dangling without doctors orders. Nurses pre-medicated and assessed patients periodically.	Patients tolerated practices well with nurses intervening when necessary.	S: explanation of practices	Monitor patients for changes and evaluate outcomes through patient response to dangling practices.

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Morris et al (2008) Early intensive care unit mobility therapy in the treatment of acute respiratory failure	Medical ICU n =330 protocol (n=165) usual care (n=165)	Early mobility with increased physical therapy	Patients with early activity and increased physical therapy had decreased lengths of stay	Mobility protocol was limited in delivery within ICU. Nursing unit assigned patients rather than randomized	Mobility team after ventilation used earlier physical therapy to decreased length of stay
Pohlman et al (2010)	Medical ICU (n=49)	Patients underwent daily interruption of sedation until they were could independently function.	Patients sat in bed, were up in a chair, stood and ambulated during interruption of sedation with little effects of ventilator asynchrony or agitation.	S: Identification of barriers and premature interruption effects  W: sample size	Therapy of daily interruption of sedation begins with active range of motion and education about progressing ADLs while patient is awake.

Article with Author and Year	Sample	Intervention Details and Data Analysis	Results and Key Findings	Strengths (S) and Weaknesses(W)	Nursing Implications
Schweikert et al., (2009) Early physical and occupational therapy in mechanically ventilated, critically ill patients	ICU n=104 (intervention (n=49)  control (n=55))	Early exercise and mobilization during interrupted sedation	Early interruption of sedation and physical therapy resulted in better functional outcomes at discharge, lower delirium rate and less days on ventilator	S: Randomized design S: Use of control group W/L: interventions didn't allow blinding= increased risk for bias	Monitor compliance when weaning and monitoring for secondary effects of intervention
Stiller et al (2004)  The safety of mobilization and its effects on hemodynamic and respiratory status of intensive care patients	General ICU (n=31)	Monitoring patient changes during mobilization activities to determine best implementation practices	Patients had significant changes in heart rate and blood pressure with decreases in oxygen saturation which nurses monitored to determine how to progress activity.	S: Implementing plan for monitoring patients' vital signs  W: Small sample size	Screen through process to determine if patient is eligible to be mobilized

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Thomsen et al (2008) Patients with respiratory failure increase ambulation after transfer to an intensive care unit where early activity is a priority	Respiratory ICU (n=104)	Applied early activity protocol to patients transferred to the RICU for patients needing >4 days of mechanical ventilation	Sedatives reduced the time to ambulate and mobilize the patients. When patients were transferred, the number of patients ambulating increased three-fold.	S: Sample size, guidelines of protocols to initiate  W:Only discusses patients who were transferred	Implementing mobility activities early can reduce time of mechanical ventilation
Washington et al (2005)  Evaluation of outcomes: the effects of continuous lateral rotation therapy	General ICU Phase I (n=22) Phase II (n=57)	Incorporating use of continuous lateral rotation therapy in plan of care to ease mobilization	Patients receiving continuous lateral rotation therapy (CLRT) had fewer ICU and overall hospital days. Protocols incorporating use of CLRT was more cost effective.	S: Sample size Use of phases to implement change	Monitoring response and use of CLRT. Ensure appropriate use as it can decrease costs.



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Winkelman et al (2005)  Activity in the Chronically Critically Ill	General ICU n=20	Turning and ROM initiated by a nurse Termed “therapeutic activity”	More data research required to establish relationship of outcomes with therapeutic activity.	No episodes of equipment failure or loss Actigraphy needs further study	Therapeutic activity needs more research but thought to be promoted to decrease hazards of increased length of stay.

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