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Original Research Article

Early mobilization in the surgical intensive care unit: a quality improvement project based in a community hospital - a small team making a big difference

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ABSTRACT

Background: In the ICU Liberation Bundle (A-F) popularized by the Society of Critical Care Medicine (SCCM), the " E" addresses the early mobilization aspect of care. The purpose of this study was to determine the feasibility and benefits of an early mobilization protocol using EMR prompts in our surgical intensive care unit (SICU).
Methods: From March 2017 to October 2017, patients admitted to the SICU, expected to stay longer than 24 hours, were enrolled prospectively to receive an initial PMNR consult and physical therapy sessions prompted by EMR-built best practice alerts (BPA).
Results: Of the 50 patients reviewed, 62% were older than 65 years and 52% of patients were mechanically ventilated. The mean length of stay in the SICU was 10.5 days. The activity level included passive range of motion, extremity exercises and ambulation. 54% tolerated full ambulation, 42% ambulated more than 10 feet. 16% were not stable enough to undergo mobility sessions. No adverse effects were noted.
Conclusions: Early mobilization in the surgical ICU is safe, involves a multi-disciplinary approach, and can be provided with a limited budget. It has the potential to decrease postoperative cognitive dysfunction, length of stay, morbidity, and adverse events post-discharge.

Keywords: Early mobility, SICU, Multi-disciplinary approach, Protocol

INTRODUCTION

Historically, life-saving maneuvers have been performed at the front-end of critical care at the outset of a patient's illness. More recently, the critical care world has been focusing on improving the management on the back-end to optimize patients' recovery and outcomes.1 The components of the ABCDEF Bundle guide the multidisciplinary team and family members as they manage the care of the critically ill: assess, prevent and manage pain; both spontaneous awakening trials and breathing trials; choice of analgesia and sedation; delirium (assess, prevent and manage); early mobility and exercise; and family engagement and empowerment.[1,2] Critically ill adults have limited mobility due to issues including deep sedation, hemodynamic instability, indwelling devices and mechanical ventilation. Surgical patients often have the added burden of recent procedures

and surgical wounds. Prolonged bed rest with subsequent decrease of total muscle mass leads to deleterious effects such as delirium, decubitus ulcers, deep venous thrombosis, and pneumonia, with negative impacts on the quality of life that can manifest years post-discharge. Respecting safety parameters defined by critical care guidelines and using an EMR-based protocol, we studied the impact of implementing a multi-disciplinary quality improvement (QI) project to effectively deliver early goal-directed mobilization to patients in the surgical ICU. Thus, the purpose of this study was to determine the feasibility and benefits of an early mobilization protocol using EMR prompts in our surgical intensive care unit (SICU).

METHODS

A prospective study was conducted of patients admitted to the surgical ICU at Flushing Hospital Medical Center in Flushing over the period of March 2017 to October 2017. All patients who were admitted to the ICU and stayed for longer than 24 hours were selected. Institutional Review Board approval was obtained. Data were derived from PMNR and PT notes with description of activities: passive range of motion, assistive range of motion, dynamic exercises (sitting, standing, rolling, scooting), transfer and ambulation. Gait, balance, strength and endurance were also evaluated. Data were secured on a Microsoft Excel sheet and locked in the investigator's office when not in use. The primary outcome was the number of PMNR evaluations and PT sessions. The secondary outcome was the ability of patients to ambulate while in the SICU. Patient data included demographics, admission diagnosis, comorbidities, ventilator days, PT and PMNR notes specific to activity level types, length of stay in the unit, and discharge disposition. The activity level and determination for mobility protocol advancement were determined by the physical therapist under the guidance of the rehabilitation consultant physician.

The protocol: conception to implementation

The first phase consisted of a preliminary retrospective chart review of ICU patients conducted to evaluate the

extent of the problem, revealing a very limited number of physical medicine and rehabilitation (PMNR) and physical therapy (PT) consultations and sessions: a three-month review revealed 15 consultations in a combined unit of 32 patients. This indicated that a change of culture was required for optimal treatment outcomes.

A multi-disciplinary task force was created with the surgical and medical ICU leadership, nursing, and physician assistant teams. A quality improvement (QI) pilot project protocol centered around early mobility was built and monitored for four weeks to determine its feasibility, safety, ease of use, and applicability. For every SICU patient with an expected ICU length of stay (LOS) of longer than 24 hours, an evaluation order for both PMNR and PT was called in by the ICU team. This approach resulted in increased evaluations and sessions.

The second phase of the pilot project consisted of the creation of a formal protocol. An early mobility best practice advisory (BPA) was created in coordination with the information and technology (IT) department to be displayed in the electronic medical records (EMR) EPIC system at the 24-hour mark of the patient's admission to the SICU. This prompt was linked to a combined PMNR-PT order (Figures 1, 2 and 3). This BPA was designed to reappear every 24 hours if an order was not generated. Once a mobility order was placed, a rehabilitation physician consult was completed within 24 hours with a documented plan of care to be executed by the physical therapy team (Figure 4). A PT evaluation followed within the next 24 hours, and patients were mobilized within 48 hours of their admission to the unit. The input of the PMNR consultant and physical therapist was documented in the EMR and shared with the SICU in person.

The SICU has 24-hour accessibility to physicians, respiratory therapy, and nursing, with limited physical therapy availability from 9 am to 4 pm on weekdays. During these hours, physical therapists rounded on every SICU patient with a mobility order and planned activities as determined by the PMNR specialist. Patients' safety parameters were reassessed daily. The PT consultant, aided by the nurse and/or a member of the SICU team conducted daily sessions until the patient's discharge from the unit. The nurses ensured that all lines and tubes were secure and that the patient remained stable throughout the session.

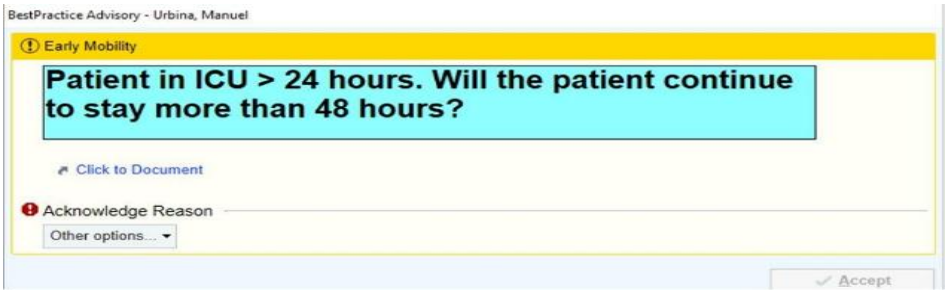


Figure 1: BPA initial prompt.

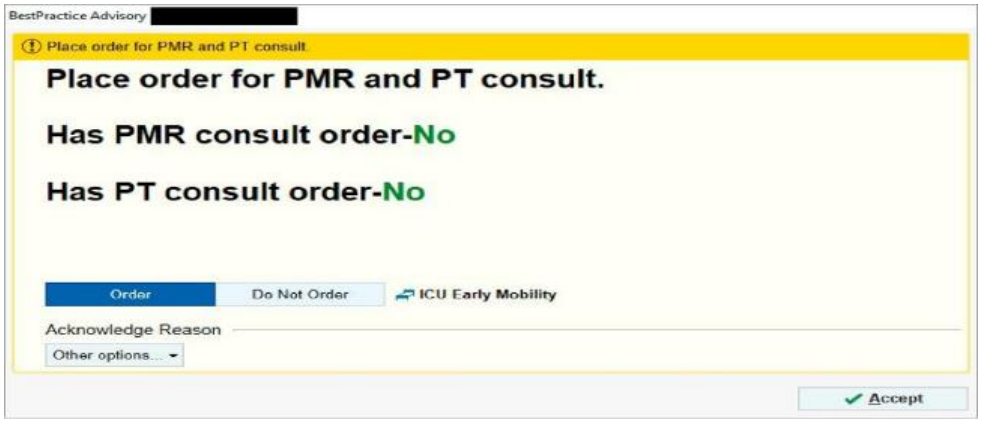


Figure 2: BPA order request prompt.

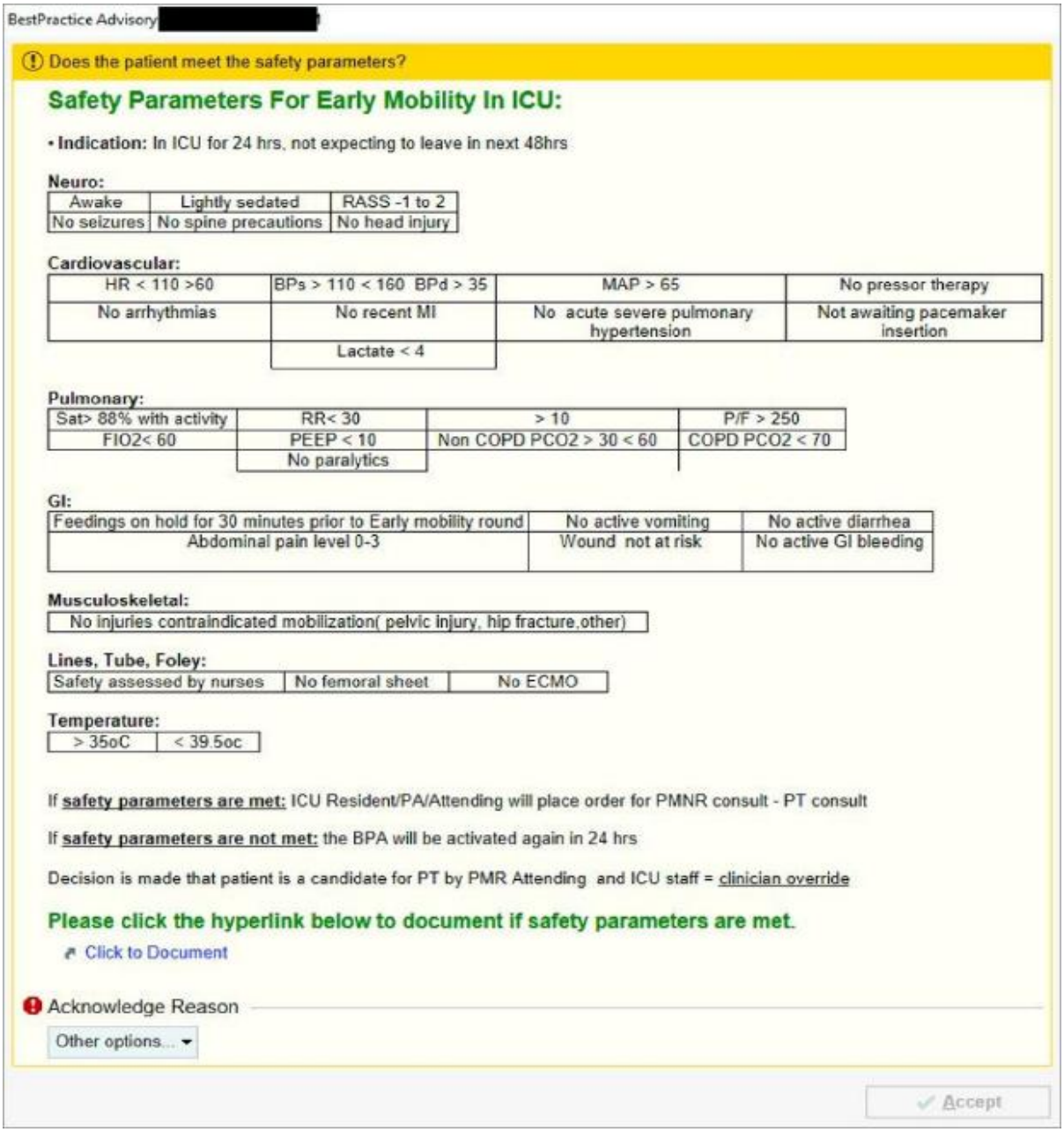
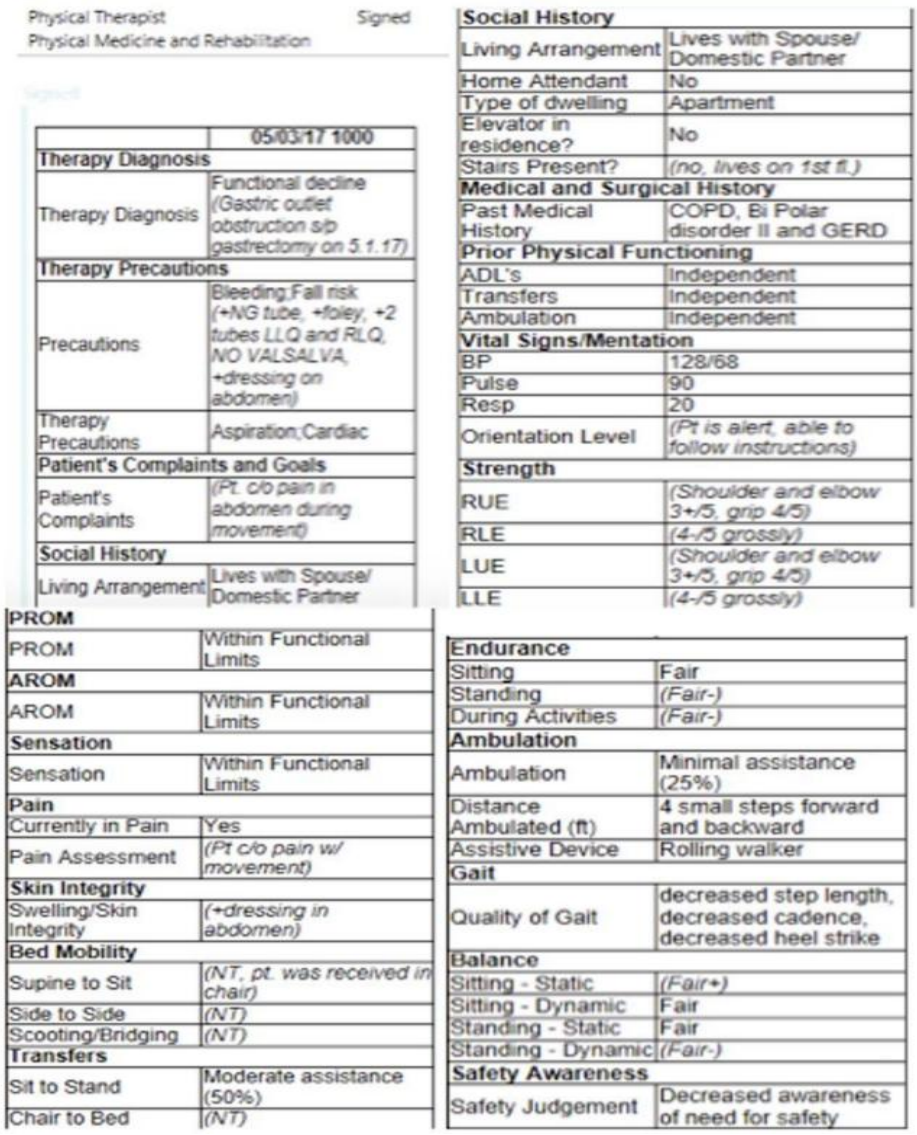


Figure 3: BPA safety parameter assessment.



Physical Therapist Signed
Physical Medicine and Rehabilitation

	05/03/17 1000
Therapy Diagnosis	
Therapy Diagnosis	Functional decline (Gastric outlet obstruction s/p gastrectomy on 5.1.17)
Therapy Precautions	
Precautions	Bleeding;Fall risk (+NG tube, +foley, +2 tubes LLQ and RLQ, NO VALSALVA, +dressing on abdomen)
Therapy Precautions	Aspiration;Cardiac
Patient's Complaints and Goals	
Patient's Complaints	(Pt. c/o pain in abdomen during movement)
Social History	
Living Arrangement	Lives with Spouse/ Domestic Partner

Social History	
Living Arrangement	Lives with Spouse/ Domestic Partner
Home Attendant	No
Type of dwelling	Apartment
Elevator in residence?	No
Stairs Present?	(no, lives on 1st fl.)
Medical and Surgical History	
Past Medical History	COPD, Bi Polar disorder II and GERD
Prior Physical Functioning	
ADL's	Independent
Transfers	Independent
Ambulation	Independent
Vital Signs/Mentation	
BP	128/68
Pulse	90
Resp	20
Orientation Level	(Pt is alert, able to follow instructions)
Strength	
RUE	(Shoulder and elbow 3+/5, grip 4/5)
RLE	(4-/5 grossly)
LUE	(Shoulder and elbow 3+/5, grip 4/5)
LLE	(4-/5 grossly)

PROM	
PROM	Within Functional Limits
AROM	
AROM	Within Functional Limits
Sensation	
Sensation	Within Functional Limits
Pain	
Currently in Pain	Yes
Pain Assessment	(Pt c/o pain w/ movement)
Skin Integrity	
Swelling/Skin Integrity	(+dressing in abdomen)
Bed Mobility	
Supine to Sit	(NT, pt. was received in chair)
Side to Side	(NT)
Scooting/Bridging	(NT)
Transfers	
Sit to Stand	Moderate assistance (50%)
Chair to Bed	(NT)

Endurance	
Sitting	Fair
Standing	(Fair-)
During Activities	(Fair-)
Ambulation	
Ambulation	Minimal assistance (25%)
Distance Ambulated (ft)	4 small steps forward and backward
Assistive Device	Rolling walker
Gait	
Quality of Gait	decreased step length, decreased cadence, decreased heel strike
Balance	
Sitting - Static	(Fair+)
Sitting - Dynamic	Fair
Standing - Static	Fair
Standing - Dynamic	(Fair-)
Safety Awareness	
Safety Judgement	Decreased awareness of need for safety

Figure 4: Physical medicine and rehabilitation/physical therapy note.

The SICU has 24-hour accessibility to physicians, respiratory therapy, and nursing, with limited physical therapy availability from 9 am to 4 pm on weekdays. During these hours, physical therapists rounded on every SICU patient with a mobility order and planned activities as determined by the PMNR specialist. Patients' safety parameters were reassessed daily. The PT consultant, aided by the nurse and/or a member of the SICU team conducted daily sessions until the patient's discharge from the unit. The nurses ensured that all lines and tubes were secure and that the patient remained stable throughout the session.

RESULTS

The pilot project included 50 patients (N=50), 27 male and 23 female. The mean age of patients was 76 years, with 80% of patients (n=40) being 60 years and older. 52% of patients were mechanically ventilated. Admission diagnoses varied in etiology: biliary pancreatic (10), thoracic (2), peripheral vascular (3), carotid (1), bowel resections (7), gastroduodenal non-surgical conditions (6), obstetrics/gynecology (2), genito-urinary (3), hemoperitoneum (4), intra-abdominal abscess (2), incarcerated hernia (1), internal hernia in bariatric (1), and septic shock (2). Ventilator days varied from 1 to 29 days (Table 1).

The length of stay in the SICU ranged from 2 to 29 days. 100% of patients admitted to the SICU were evaluated by the PMNR consultant, and 204 subsequent visits were conducted by the physical therapy team. The activity level ranged from passive range of motion to ambulation using strength, transfer, postural, and extension exercises. 25 of the 50 patients (50%) ambulated in the SICU with distances extending from 1 to 100 feet (Figure 5). Of the 50 total patients, 5 patients died and 2 were transferred to the hospice unit.

Table 1: Characteristics of the study population.

Variables	Study population (n=50)
Age (years)	
1-30	3
31-60	7
61-90	40
Sex	
Female	23
Male	27
Length of stay (days)	
1-15	35
15-30	13
31-40	1
Unknown	1
Physical therapy	
Received	42
Not received	8
Days of OMM (days)	
0-10	47
10-20	3
>20	0
Days on ventilator (days)	
0-10	39
11-20	9
21-30	2
Distance of ambulation	
No ambulation	23
1-40 feet	15
41-80 feet	1
>80 feet	1
Unspecified distance	8
Patient declined	1

Abbreviations: OMM, Osteopathic Manipulative Medicine

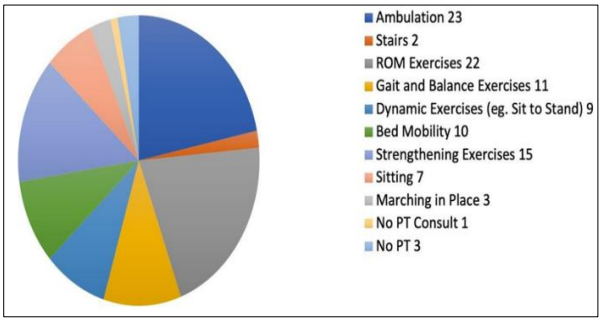


Figure 5: Types of physical therapy activities provided to patients.

DISCUSSION

Traditionally, critical care has focused on performing life-saving maneuvers at the outset of a patient's illness, known as the front-end of critical care. Over the years, an increased incidence of ICU-acquired weakness contributed to a shift in the critical care's focus towards improving the management of the rear-end of the process in order to optimize patients' recovery and outcomes.[1] In 2013, The Society of Critical Care Medicine elaborated the PAD (pain, agitation, delirium) and later PADIS (pain, agitation, delirium, immobility, sleep) guidelines changing the approach from heavy sedation and neuromuscular blockade to more interactive care. The ABCDE "Liberation bundle" in 2017 was the first center around may components: daily awakening and Breathing trials, analgesia, Delirium monitoring, Early mobility and later Family Engagement.[1,2]

A survey by Morandi et al showed that among 1,521 respondents from 47 countries, 57% had implemented the bundle, but 69% had no mobility team (33% PMNR) and only 36% of the respondents assessed ICU-acquired weakness.[3] Knowledge deficits, workload, poor interpersonal skills, and insufficient communication between the disciplines have all been barriers to bundle implementation.[4] The inter-professional team (IPT)

discussion is recognized as a potential way to improve the performance and sustainability of bundles by improving team communication and care coordination among ICU clinicians, patients, and their families.[5] Our hospital has been conducting daily IPT mid-day rounds in the ICU.

Bed rest can lead to rapid deconditioning and muscle atrophy. Even in young healthy adults, a 20–27% decrease in quadriceps muscle strength can be found just after 2 weeks of immobility. In the elderly, the rate of muscle loss is 3-6-fold greater.[4] Immobility increases the production of pro-inflammatory cytokines and reactive oxygen species, muscle proteolysis, and overall muscle loss.[6] One third of patients requiring mechanical ventilation for at least 5 days, may develop ICU-acquired weakness. The consequences of prolonged bedrest are worse in women, those with hyperglycemia, hypoalbuminemia, steroids, or on neuromuscular blocking agents.[7]

The Medical Research Council (MRC) scale grading the strength of various muscle groups in the upper and lower extremities ranges from 0 (complete tetraplegia) to 60 (normal muscle strength), with a score <48 considered diagnostic of ICU-acquired weakness.[8] Muscle biopsies from mechanically ventilated patients show signs of inflammation, necrosis, and replacement of muscle fibers with adipose and connective tissue.[9] In septic patients, systemic inflammation and multiple organ failure lead to muscle weakness and wasting in 50-100% of patients.[10] Diastolic and systolic dysfunction, reduction of cardiac output and diaphragm atrophy can also occur. Within one year of ICU discharge, 50% of survivors experience cognitive and/or physical impairment, posttraumatic stress disorder, pain, fatigue, weight loss, sleep disturbance, anxiety, depression, reduced quality of life, impaired social integration, and loss of employment, termed by the SCCM as post ICU syndrome (PICS).[11,12]

The benefits of early mobility are decreased local cytokine expression and increased expression of anti-apoptotic factors, hence preventing or reversing physical impairments and muscle wasting.[6] The current evidence suggests that early mobilization within 24 to 72 hours from admission to the ICU is associated with the lowest risk of ICU-acquired weakness and improves rehabilitation.[13] It can be done without necessarily increasing the usual ICU staffing and with a low risk of complications. Schweickert et al showed that a daily regimen combined with physical and occupational therapy resulted in an improved return to independent functional status at hospital discharge, shorter duration of ICU-delirium, higher survival, and more days breathing without assistance.[14] Following our protocol, 100% of our patients were evaluated by the PMNR consultants.[14]

The generalization of rehabilitation for patients in the ICU is often challenging, primarily due to safety concerns with an orotracheal tube in place.[6,10] Mobilizing patient has potential hazards, one of which is a fall risk, especially older, obese, and trauma victims with high injury severity score.[7] Muscle weakness is as common as arterial hypotension in the surgical intensive care unit (SICU) and is a by-product of a well-established safety culture. Postoperative problems, such as surgical wounds, postoperative pain, musculoskeletal disorders and medical comorbidities, are additional barriers to early rehabilitation in the SICU. Contraindications for active rehabilitation most often include hemodynamic instability, open abdomen, active bleeding, major bone or spinal injury, increased intracranial pressure, and patient refusal.[15]

On review of prior work on early mobility in the surgical world, we noted that it had been implemented first in the postoperative intensive care of cardiac surgery patients associated with reduced risk of venous thromboembolism and pulmonary emboli, improved pulmonary toilet, prevention of pneumonia, decreased length of stay, reduced deconditioning, and need for rehabilitation. This early work demonstrated that patients the presence of pulmonary artery catheters, arterial lines, chest tubes, and mechanical circulatory support devices should not be considered exclusion criteria for early progressive mobility. Early mobilization also led to quicker extubation and reduced lengths of stay.[16] Schaller et al created a SICU optimal mobilization score (SOMS) based on patients' capacity, with a mobilization goal defined during daily morning rounds.[17]

This study did not require an additional physical therapist, but instead had a facilitator who dedicated up to 15 minutes per patient every day to the intervention.[17] Zomorodi et al built a five-step rehabilitation program using one physical therapist and rehabilitation nurse providing daytime weekday therapy in a 14-bed SICU, starting on the third day after admission to the unit, after completion of a safety checklist similar to ours for the most part. Their patients showed functional improvement, regardless of age, and the program reduced the length of SICU stay when compared with rehabilitation in the MICU.[18] In our study, the mobility team consisted of a physical therapist, the bedside nurse, and the SICU resident/PA when additional help was needed.

Triggers for the nursing staff to progress to ambulation include an improving illness trajectory, device removal, and patient's ability to communicate and express motivation leading to more active movement.[19] The participation of the PT or occupational therapist (OT) in IPT rounds helps evaluate mobility potential, identify, overcome mobilization barriers, and educate team members on safe mobilization in their absence. Clearly displaying the Mobility Levels tool may facilitate practices, leading to increased adherence and improved outcomes. Anderson et al showed that improving communication and teamwork was identified as a strategy to increase mobilization frequency and adherence to the mobility program by 42% of staff, with

a 27-hour reduction in mean ventilator hours and decreased mean hospital and total costs incurred.[5]

In addition, inadequate staffing of physical and occupational therapists in ICUs led to an apparent disconnect between physician orders for patient ambulation and implementation of those orders. A survey addressing the ABCDE bundle in 47 countries reported mobility teams consisting of only a physical therapist (33%); or physical therapist and ICU nurses (17%); or physical therapist, respiratory therapist, and ICU nurses (12%).[3] Costs related to additional nursing staff, dedicated physical therapists (PTs), or occupational therapists (OTs), mobility equipment such as lift chairs or mechanical lifts, represent additional barriers. In one study, the use of at least 1 ancillary staff member such as a nursing assistant, was an additional 1 hour per patient day of nursing care cost estimated at an average nursing wage of $540 per day for a census of 18 patients.[7] Decreased length of stay, decreased needs for rehabilitation facilities and improved functional recovery at discharge can offset the costs of mobility.[7] Our protocol was based on timely PMNR-PT generated orders, discussions in daily IDT rounds in a close-knit unit where nurses, therapists, and physicians were all willing to make early mobility a priority.

Exercises and tools utilized to prevent muscle wasting include passive/assistive range of motion, practicing sitting upright or sitting in a chair, standing, walking and stretching, and strengthening exercises.[7] More recent modalities include neuromuscular electrical stimulation, respiratory muscle training, and cycle ergometry. Neuromuscular electrical stimulation delivers low-voltage electrical impulses through electrodes placed on the skin overlying target muscles, causing passive contraction of one muscle or multiple groups of muscles concurrently mimicking voluntary contraction. Cycle ergometry uses a bedside device on which a supine patient can perform passive, active-assisted, or active in-bed cycling. Passive cycling may limit muscle protein catabolism in unconscious patients.

Morandi et al in their 47-country survey reported daily cycle ergometry (14%), neuromuscular electrical stimulation (6%), and ambulation (32%) tools foster mobility with reduced staffing. The high Fowler upright position in bed can help improve ventilation with better oxygen saturation and decrease in ventilator-associated pneumonia. Moving the patient from the bed to a chair is considered effective mobility if he or she can stand and bear weight. Pedal devices or stretch bands are used in patients sitting, tilt tables move the patient into an upright standing position, improving orthostatic stability. Special beds can stand patients with legs and chest strapped upright, help reduce foot drop, increase leg muscle strength and improve mobility and weaning from ventilation. In this study, we did not use neuromuscular electrical stimulation, or cycle ergometry, but lifts were available. Therapists provided a combination of passive/assistive range of motion, stretching and strengthening exercises, dynamic modalities including sitting, rolling, standing, walking and transferring.

Interestingly, the patient's location can impact early mobility. In a study of 104 respiratory failure patients who required mechanical ventilation for >4 days, transferring a patient to the respiratory intensive care unit with an emphasis on a minimum of one daily ambulation session, increased the number of patients ambulating three-fold compared with pre-transfer rates, despite limited PMR-PT teams.[16] In addition, time allotment to early mobility matters as demonstrated in a study in which changing from originally 4 hours in the morning to 2 hours in the morning and 2 hours in the afternoon made a significant difference. The twice daily schedule reduced the number of patients missing early mobility interventions due to procedures and examinations in the morning, and thereby increased the number of patients who were able to receive early mobility interventions.[17]

Formal, accurate measurements of mobility may lead to a greater understanding of a patient's progression and the efficacy of interventions. Currently available tools include the chelsea critical care physical assessment tool, functional status score for the ICU, ICU mobility scale, Manchester mobility score, perm ICU mobility score, physical function outcome measure and surgical optimal mobilization score.[20] Current practices for monitoring patient mobility include direct human observation and mining of the electronic health record (EHR) documentation of mobility events, which are time and labor-intensive, prone to inaccuracy and involve a notable time lag between patient care and reporting. Young et al created a computer vision system for deep learning-based detection of patient mobilization activities in the ICU. A data set of privacy-safe-video detected patient mobility activities, their duration, and the number of personnel involved, quantifying mobility practices in real-time, with the hope of gaining a level of granularity to standardize practices and protocols.[16] In the present study, patients' progress were assessed based on the PMNR and PT notes and in person communication.

Strengths and limitations

The prospective nature of our project mitigated potential biases and achieved the outcomes we sought. Our intervention, built from an EMR-based early mobility protocol, avoided clinicians missing this key component in the treatment armamentarium. It was supported by a small yet dedicated team and increased the number of PMNR and PT visits by 190%. Through these efforts, we were able to achieve ambulation in a population of mostly ethnically diverse elderly surgical ICU patients with decreased functional status at baseline.

The protocol did not use a mobility tool or a mobility goal. The notes did not attest to The Borg Rate of Perceived Exertion used in other studies to evaluate the

patient's perceived level of fatigue before and after the intervention. This was a pilot study to establish the efficacy and feasibility of a protocol for early patient mobility, conducted in a single center, in a community setting with a small sample size, which limits the interpretation and generalizability of these results.

CONCLUSION

In the intensive care setting, patients were traditionally kept sedated and immobilized due to safety concerns. Rethinking critical care has led to the establishment of new care bundles leaning more towards interactive patients. For change to occur, it is imperative to understand and address the barriers to expansion of early mobility, including, but not limited to, a lack of knowledge, limited tools and personnel, subpar reporting, unclear orders, and undefined goals. Early mobility in the surgical ICU is a safe, multi-disciplinary approach that can be tailored to individual institutions and patients. It is important to maintain the momentum until early mobility becomes routine in all intensive care units, regardless of the setting or team available. It is conducive to a quicker recovery, enhanced patient experience, family satisfaction and improved post ICU quality of life.

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