**Supplemental Table 35. Characteristics of Studies used to answer the following descriptive question: “For adult critically ill patients, is receiving rehabilitation/mobilization performed either in-bed or out-of-bed commonly associated with patient-related safety-events or harm?”**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Author, Yr  | Study Type  | Total n(n/group if applicable) | No. of physical rehabilitation/mobilization Sessions | Potential Safety Events | No. of eventsrequiring management  | Comments |
| **Respiratory** | **Cardiovascular System** | **Neuro** | **MSK** | **Lines**  |
| Observational Studies |
| Stiller 2004 [1] | Prospective Observational | 31 | 69 sessions; functional activities | 17 : SpO2 fall <4%7: SpO2 fall >4% 26: SpO2 increase  | 13: HR drop52: Increased HR19: DBP decreased <20 mmHg1: SBP decreased >20 39:SDBP increased3: DBP decreased >1010: DBP decreased <1045: DBP increased | Not reported | Not reported | Not reported | 3: SpO2 dropped to <88% requiring increase in FiO2 | Increase in FiO2 resolved desaturation without stooping. Mobilization occurred a mean of 29 days after ICU admission (range 1-71 days) |
| Zanni 2010 [2] | Prospective Observational | 32 enrolled;19 received PT/OT  | 50 sessions; functional activities | Number not recorded for changes of -2% to +1% 0 SpO2 < 85% for > 3 min0 unplanned extubations | Not recordedAverage HR changed 6 bpm, range 2-10Average SBP change was 3mmHg, range -4 to +13 | 0 loss of consciousness | 0 falls | 0 devices (arterial, venous hemodialysis, urinary catheters, feeding tubes and chest tube or other/rectal tube) | 0 |  |
| Kho 2012 [3] | Case series | 22 | 42 video game treatments | 0 | 0 | 0 | 0 falls | 0 | 0 |  |
| Berney 2012 [4] | Cohort study | I =74C= 72 (standard care) | I = 641 sessionsNot reported for standard care | 0 | 0 | 0 | 0 | 0  | 0  | “No adverse event occurred in the ICU”First day of exercise was a mean of 7 days after ICU admission (range 5-11) |
| Titsworth 2012 [5] | Observational | 170 I=93 PUMP plus protocolC=77Usual care | Not reported | Not reported | Not reported | Not reported | Reported as incidence:Falls: I=1.31C= 1.39per 1000 patient days | Reported as incidence of critical line pulls (arterial, endotracheal or extraventricular drains)I=0.67C=0.90per 1,000 patient days | 0 | Serious adverse events reported as “none.”Hospital acquired infections (UTI, VAP and CLABSI) decreased in the intervention group although only the decrease in VAP achieved significance |
| Damluji 2013 [6] | Prospective cohort | I = 101 patients received PT.C = 138 patients | I= 253 sessionsof functional activities, A/P ROM, and supine cycle ergometyC= 0 PT sessions  | Not reported | Not reported  | Not reported | Not reported  |  0 events with femoral catheters | 0 | Only reported on adverse events related to femoral lines; None of the 6 potential femoral catheter-related adverse events occurred |
| Sricharoenchai 2014 [7] | Prospective Observational | 1110 patients received PT | 5267 sessions | 0: extubation (ETT or Trach)4: Sp02<85 >3mins | 10: arrhythmias8: MAP>1405: MAP<55 | Not reported | 2: assisted Fall1: injurious Fall | 4 devices including  1 radial arterial catheter; 2 OG feeding tube; 1 chest tube and 0 Venous/dialysis/pheresis catheters | 1 fall resulted in supraorbital laceration requiring debridement and suture. | (Most…) “events resolved quickly …and never required any additional therapy, cost, or LOS.” |
| Balas 2014 [8] | Prospective cohort (pre-post) | 296 received rehab;Pre=146 (prior to ABCDE bundle)Post=150 experienced ABCDE bundle | Pre 70/146 mobilized out of bedPost99/150 mobilized out of bed | Unplanned extubationPre= 7Post = 7 | Not reported | Number of patients who underwent imaging due to change in mental status:Pre 21;Post 17 | Not reported | Not reported | 3 Number of unplanned extubations required re-intubation:1-Pre;2-Post. | The percent of ICU time in restraints: PRE 12.7%; POST 6.9% |
| Lee 2015 [9] | Prospective Observational | 99 received early rehabilitation include functional activities, A/P ROM and EMS | 520 | 6 desaturations11 events with respiratory distress1 tracheostomy removal | 4 events with bradycardia < 40bpm or tachypnea |  Not reported | 0 Falls | 0  | Not determined | Trach removal did not require management4 sessions occurred with “patient intolerance”(i.e., patient request to stop, legs trembling, or diaphoresis) |
| Skinner 2009 [10] | Observation | 12Exercise training protocol | 50 | 0 Sp02 fall > 10% below resting level or SP02 <85%0 tachypnea >35 breaths/min | 0; Sustained HR <50 or >140, or new arrhythmia; hypotension/HTN | Not reported | 0 falls | Not reported | 0 | 0 pale, sweaty or distressed appearance  |
| Trials |
| Burtin 2009 [11] | RCT | 58I=26Passive or active bedside ergometerC=32Usual care including A/P ROM | 425 cycling | 16 desaturations to <900 Respiratory distress leading to intolerable dyspnea | 0 malignant arrhythmia6 SBP>1802 DBP reducing >20%0 new chest pain onset | Not reported | 1 Achilles tendon rupture | Not reported | 1 Achilles tendon rupture | Outcomes of Achilles tendon not reported but assumed to need an intervention |
| Schweickert 2009 [12]Pohlman 2010 [13] | RCT; Safety data were reported in Pohlman (Other data Schweickert) | 104 I=49PT/OT beginning day 1 of ICU C=55Usual care | 498 sessions in the intervention group | 31 desaturation; 20 asynchrony/tachypnea0 extubations | 21 HR increase > 20% | 10 Agitation /Discomfort | 0 falls | 4 devices inadvertently removed | 1 desaturation <80% | Adverse events occurred during 16% of all sessions (80/498) but unclear if or how many events required an intervention. 4% of sessions were stopped earlier as a result of patient instability (usually patient-ventilator asynchrony)Time to PT/OT intervention: I = 1.5 days C = 7.4 days |
| Meesen 2010 [14] | Trial | 21I =11EMS of quadricepsC=10No EMS | Not reported | 0 changes in RR0 changes in Sp02 | 0 events for HR 0 events for SBP or DBP changes | 0 | Not reported | Not reported | 0 | Adverse events reported as “Nil”.All patients were sedated |
| Hanekom 2013 [15] | Pragmatic block controlled trial (quasi RCT) | 193 enrolledI=96Research PTs provided protocolized careC=97Usual PT care | 615 research sessions193 “usual care” sessions | Not reported | 2 hemodynamic instability | Not reported | 1 fall | 2 devices: dislodged peripheral catheters | Not determined  | 6/1000 =0.006 adverse events occurred across all sessions in the intervention group but it is not clear if any adverse events led to management. Most events occurred during a respiratory (e.g. manual hyperventilation, positioning for postural drainage or during percussion/vibration) not mobility session. |
| Brummel 2014 [16] | Trial | 65I: protocolized physical therapy or physical and cognitive therapy. | 543  | Hypoxia reported, number of events not provided | 1: hypertensive urgencyTachycardia reported, number of events not provided | Not reported | 1 back pain | 0  | 1 hypertensive urgency concurrent with back pain. (Intervention implied, not reported) | Serious event did not preclude participation in subsequent study interventions |
| Dong 2014 [17] | RCT | I = 30Functional activities up to two times daily C = 30Information about control activities not reported. | Not reported |  | 1 orthostatic hypotensive event in intervention |  |  |  | 0 serious adverse events  |  |
| Hodgson2016 [18] | RCT | I=29Early goal-directed PTC=21Usual care | Not reported | 0 ETT removal | 0 cardiac arrestHypotension;I = 0 C= 2 | New agitation:I =1 C =2 | 0 falls | Not reported | 0 |  |
| Moss 2016 [19] | RCT | 120 enrolledI =59Intensive therapyC = 61“usual care” | Calculated from mean number of sessions/patient while in ICU: I = 378 sessionsC = 232 sessions | Not reported but see comments | Not reported but see comments | Not reported | Not reported | Not reported | 2: 1 syncopal episode during a PT session1 readmit with polyarthralgia requiring pain management | Reported 13% had vital sign changes during interventions but unclear if changes in HR, SBP, RR, or SpO2 |
| Morris 2016 [20] | RCT | C=300I=150Rehab and A/PROM delivered three times daily and 7 days/weekC=150“usual care” with delivery 5 days/week | I: sessions 3x/day for median of 8 days; calculated as 3600 sessions C: not reported as average or total sessions | Not reported | Not reported | Not reported | 0 falls | 0  | 8 events were categorized as serious (7) or life-threatening (1)I = 3 3vents per estimate 3600 sessions;C = 5 events occurred but sessions not reported  | An additional 16 mild-moderate events occurred; there were no statistical differences in the rate of adverse event occurrence.I = 10C = 6. |

**Yr:** Year; **NR**: Not Reported; **US:** United States; **n**: Number; **I:** Intervention; **C:** Control; **Neuro:** Neurological; **MSK:** Musculoskeletal; **RCT:** Randomized Controlled Trial; **SpO2**:Peripheral capillary oxygen saturation; HR: Heart Rate; **FiO2:** Fraction of Inspired Oxygen; **ETT:** Endotracheal Tube; **MAP:** Mean Arterial Pressure; **BP:** Blood Pressure; **HTN:** Hypertension; **SBP:** Systolic Blood Pressure; **DBP:** Diastolic Blood Pressure; **ICP:** Intracranial Pressure; **Cath:** Catheter; **OG:** Orogastric; **SAE**: Serious Adverse Event; **PT:** Physical therapy; **OT**: Occupational Therapy; **Functional Activities**: rolling, sitting at edge of bed, sit-to-stand, walking, grooming, and bathing; **UTI**: urinary tract infection; **VAP**: ventilator associated pneumonia; **CLABSI** central line associated blood stream infection; **A/P ROM:** Active/passive range of motion; **EMS**: neuromuscular electrical stimulation; **ABCDE** bundle; refers to a bundle of activities recommended by SCCM.

References

1. Stiller K, Phillips A, Lambert P: The safety of mobilisation and its effect on haemodynamic and respiratory status of intensive care patients. *Physiother Theory Pract* 2004, 20(3):175-185.

2. Zanni JM, Korupolu R, Fan E, Pradhan P, Janjua K, Palmer JB, Brower RG, Needham DM: Rehabilitation therapy and outcomes in acute respiratory failure: an observational pilot project. *J Crit Care* 2010, 25(2):254-262.

3. Kho ME, Damluji A, Zanni JM, Needham DM: Feasibility and observed safety of interactive video games for physical rehabilitation in the intensive care unit: a case series. *J Crit Care* 2012, 27(2):219.e211-216.

4. Berney S, Haines K, Skinner EH, Denehy L: Safety and feasibility of an exercise prescription approach to rehabilitation across the continuum of care for survivors of critical illness. *Phys Ther* 2012, 92(12):1524-1535.

5. Titsworth WL, Hester J, Correia T, Reed R, Guin P, Archibald L, Layon AJ, Mocco J: The effect of increased mobility on morbidity in the neurointensive care unit. *J Neurosurg* 2012, 116(6):1379-1388.

6. Damluji A, Zanni JM, Mantheiy E, Colantuoni E, Kho ME, Needham DM: Safety and feasibility of femoral catheters during physical rehabilitation in the intensive care unit. *J Crit Care* 2013, 28(4):535.e539-515.

7. Sricharoenchai T, Parker AM, Zanni JM, Nelliot A, Dinglas VD, Needham DM: Safety of physical therapy interventions in critically ill patients: a single-center prospective evaluation of 1110 intensive care unit admissions. *J Crit Care* 2014, 29(3):395-400.

8. Balas MC, Vasilevskis EE, Olsen KM, Schmid KK, Shostrom V, Cohen MZ, Peitz G, Gannon DE, Sisson J, Sullivan J *et al*: Effectiveness and safety of the awakening and breathing coordination, delirium monitoring/management, and early exercise/mobility bundle. *Crit Care Med* 2014, 42(5):1024-1036.

9. Lee H, Ko YJ, Suh GY, Yang JH, Park C-M, Jeon K, Park YH, Chung CR: Safety profile and feasibility of early physical therapy and mobility for critically ill patients in the medical intensive care unit: Beginning experiences in Korea. *J Crit Care* 2015, 30(4):673-677.

10. Skinner EH, Berney S, Warrillow S, Denehy L: Development of a physical function outcome measure (PFIT) and a pilot exercise training protocol for use in intensive care. *Crit Care Resusc* 2009, 11(2):110-115.

11. Burtin C, Clerckx B, Robbeets C, Ferdinande P, Langer D, Troosters T, Hermans G, Decramer M, Gosselink R: Early exercise in critically ill patients enhances short-term functional recovery. *Crit Care Med* 2009, 37(9):2499-2505.

12. Schweickert WD, Pohlman MC, Pohlman AS, Nigos C, Pawlik AJ, Esbrook CL, Spears L, Miller M, Franczyk M, Deprizio D *et al*: Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial. *Lancet* 2009, 373(9678):1874-1882.

13. Pohlman MC, Schweickert WD, Pohlman AS, Nigos C, Pawlik AJ, Esbrook CL, Spears L, Miller M, Franczyk M, Deprizio D *et al*: Feasibility of physical and occupational therapy beginning from initiation of mechanical ventilation. *Crit Care Med* 2010, 38(11):2089-2094.

14. Meesen RL, Dendale P, Cuypers K, Berger J, Hermans A, Thijs H, Levin O: Neuromuscular electrical stimulation as a possible means to prevent muscle tissue wasting in artificially ventilated and sedated patients in the intensive care unit: A pilot study. *Neuromodulation : journal of the International Neuromodulation Society* 2010, 13(4):315-320; discussion 321.

15. Hanekom S, Louw QA, Coetzee AR: Implementation of a protocol facilitates evidence-based physiotherapy practice in intensive care units. *Physiotherapy* 2013, 99(2):139-145.

16. Brummel NE, Girard TD, Ely EW, Pandharipande PP, Morandi A, Hughes CG, Graves AJ, Shintani A, Murphy E, Work B *et al*: Feasibility and safety of early combined cognitive and physical therapy for critically ill medical and surgical patients: the Activity and Cognitive Therapy in ICU (ACT-ICU) trial. *Intensive Care Med* 2014, 40(3):370-379.

17. Dong Z-H, Yu B-X, Sun Y-B, Fang W, Li L: Effects of early rehabilitation therapy on patients with mechanical ventilation. *World J Emerg Med* 2014, 5(1):48-52.

18. Hodgson CL, Bailey M, Bellomo R, Berney S, Buhr H, Denehy L, Gabbe B, Harrold M, Higgins A, Iwashyna TJ *et al*: A Binational Multicenter Pilot Feasibility Randomized Controlled Trial of Early Goal-Directed Mobilization in the ICU. *Crit Care Med* 2016, 44(6):1145-1152.

19. Moss M, Nordon-Craft A, Malone D, Van Pelt D, Frankel SK, Warner ML, Kriekels W, McNulty M, Fairclough DL, Schenkman M: A Randomized Trial of an Intensive Physical Therapy Program for Patients with Acute Respiratory Failure. *Am J Respir Crit Care Med* 2016, 193(10):1101-1110.

20. Morris PE, Berry MJ, Files DC, Thompson JC, Hauser J, Flores L, Dhar S, Chmelo E, Lovato J, Case LD *et al*: Standardized Rehabilitation and Hospital Length of Stay Among Patients With Acute Respiratory Failure: A Randomized Clinical Trial. *JAMA* 2016, 315(24):2694-2702.