**Supplementary Table 1 Primary Study Characteristics**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Country** | **Study design** | **Unit type** | **BedN** | **Subjeca** | **Subject N** | **Unit Characteristics** |
| Abassi (2015) | Iran | Cohort/no control | ICU | NR | P | 16 | NR |
| Aloe (2009) | US | Cohort/no control | ICU | 4 | P | NR | Bedside cardiac monitors; visual & auditory alarms ventilator alarms all rooms & satellite telemetry unit. Less restricted visitor access. Dedicated RT, pulmonologist managed, 1 RN & 1 LPN/shift, 7 days/week, 24 hours/day; RT:pt ratio 1:4 |
| Al-Qadheeb (2004) | US | Cohort/control | LTACH | 140 | P | 80 | NR |
| Arslanian-Engoren (2003) | US | Qualitative | ICU | NR | P | 7 | NR |
| Astrachan (1998) | US | Cohort/control | ICU | NR | P, C | 98 | NR |
| Azimi (2015) | Iran | Qualitative | ICU | 12 | P, F | 25 | NR |
| Bagley (1997) | US | Cohort/control | SWU | NR | P | 343 | RN:pt ratio 1 + 2 aides:6-8; RT:pt ratio 1:7-8  |
| Bahadur (1998) | UK | Cohort/no control | ICU | 30 | P | 30 | RN:pt ratio 1:1, PT:pt ratio 3:30, RT:pt ratio 5:30 |
| Bello (2009) | Italy | Cohort/control | ICU | 18 | P | 264 | NR |
| Bissett (2015) | Australia | Cohort/no control | ICU | 22 | P | 43 | NR |
| Bissett (2012) | Australia | RCT | ICU | NR | P | 140 | NR |
| Black (2012) | UK | Cohort/no control | ICU | 27 | P | 146 | NR |
| Bosel (2013) | Germany | RCT | ICU | NR | P | 60 | NR |
| Braus (2016) | US | Before & after | ICU | 24 | P | 203 | NR |
| Burtin (2009) | Belgium | RCT | ICU | NR | P | 67 | NR |
| Carpene (2010) | Italy | Cohort/no control | RICU | 10 | P | 49 | Psychological, speech, nutrition and swallowing services RN:pt ratio 1:4-6, RT:pt 1:4-6, physician 24-hr on duty  |
| Carson (2012) | US | Mixed methods | ICU | NR | P, F, C | 68 | NR |
| Carson (2016) | US | RCT | ICU | NR | P, F | 621 | NR |
| Ceriana (2003a) | Italy | Cohort/no control | RICU | 7 | P | 96 | Rehabilitation hospital, monitoring, & intensive nursing careRN:pt ratio 1:3 (day) 1:6 (night), Dr:pt ratio 1:7, RT:pt ratio 1:7 |
| Ceriana (2003b) | Italy | Cohort/no control | RICU | 7 | P | 108 | NR |
| Ceriana (2010) | Italy | Cohort/no control | HDU | 7 | P | 234 | NR |
| Chen (2011a) | Taiwan | RCT | SWU | NR | P | 34 | NR |
| Chen (2011b) | Taiwan | Cohort/no control | ICU & SWU | NR | P | 102 | NR |
| Chen (2012) | Taiwan | RCT | SWU | NR | P | 27 | NR |
| Chiang (2006) | Taiwan | RCT | HDU | NR | P | 32 | NR |
| Chung (2006) | Taiwan | Cohort/no control | ICU | 32 | P | 95 | NR |
| Clini (1994) | Italy | Cohort/no control | SWU | NR | P | 465 | NR |
| Clini (2011) | Italy | Cohort/no control | HDU | NR | P | 77 | Discharge planning involving nurses & rehabilitation therapists |
| Cox (2012) | US | Before & after | ICU | NR | F | 27 | NR |
| Cox (2015) | US | Mixed methods | ICU | NR | F | 30 | NR |
| Daly (1991) | US | RCT | HDU vs ICU | 8 | P | 25 | Private home-like room, exterior view, family able to stay overnight, limited physical monitoring, family/pt participation in decision making, case management, protocolized care, critical pathways |
| Dasgupta (1999) | US | Cohort/no control | SWU | 6 | P | 212 | Nurses with pulmonary expertise, bedside & central non-invasive monitoring (SpO2, etCO2,ventilator alarms), 24-h RTs, IP approach, RN:pt ratio 1:2-3, RT:pt ratio 1:6 |
| Datta (2004) | US | Cohort/no control | SWU | NR | P | 140 | NR |
| Davis-Martin (1994) | US | Cohort/no control | RICU | NR | F | 24 | Design for family needs (bathrooms, phones in waiting areas) Visiting hours =10 minutes/2 hours, 11AM-7PM family only |
| deBoisblanc (2001) | US | Cohort/no control | ICU | NR | P | 99 | RN:pt ratio 1:2 (recently transferred), 1:4, or 1:6 (on wards) |
| De Jonghe (2004) | France | Cohort/control | ICU | NR | P | 51 | NR |
| De Jonghe (2007) | France | Cohort/control | ICU | NR | P | 95 | NR |
| Diaz-Abad (2012) | US | Cohort/no control | LTACH | NR | P | 19 | Pulmonologist & hospitalist, SLP consult for trach downsizing, laryngoscopy for decannulation, in-hospital sleep lab |
| Dimopoulou (2001) | Greece | Cohort/control | ICU | NR | P | 43 | NR |
| Douglas (1996) | US | RCT | HDU vs ICU | NR | P | 152 | See Daly 1991 |
| Duan (2012) | China | RCT | ICU | 17 | P | 32 | NR |
| Elbouhy (2014) | Egypt | Non-RCT | ICU | NR | P | 40 | NR |
| Faisy (2009) | France | Cohort/control | ICU | 20 | P | 38 | NR |
| Franzosi (2012) | Brazil | Cohort/control | ICU | NR | P | 252 | NR |
| Freeman-Sanderson (2016) | Australia | RCT | ICU | 52 | P | 30 | Physician model: closed ICU |
| Fukuda (2016) | Japan | Cohort/control | ICU | 20 | P | 282 | NR |
| Garnacho-Montero (2005) | Spain | Cohort/control | ICU | NR | P | 64 | NR |
| Girard (1985) | US | Qualitative | ICU | NR | P | 1 | NR |
| Gruther (2010) | Austria | RCT | ICU | NR | P | 33 | NR |
| Henneman (2002) | US | Before & after | ICU | NR | P | 137 | Collaborative IP philosophy  |
| Hermans (2007) | Belgium | RCT | ICU | NR | P | 420 | NR |
| Heyland (1998) | Canada | Cohort/control | ICU | 12 | P | 690 | NR |
| Higgins (1998) | US | Cohort/no control | ICU | NR | P | 20 | NR |
| Ibrahim (2002) | US | Cohort/control | ICU | 19 | P | 110 | Physician model: closed ICU |
| Ibrahim (2012) | Brazil | Cohort/no control | ICU | NR | P | 26 | NR |
| Johnson (2009) | US | Cohort/no control | LTACH | NR | P | 100 | NR |
| Johnson (2008) | US | Cohort/no control | LTACH | 8 | P | 41 | NR |
| Johnson (2004/2006) | Australia | Qualitative | ICU | NR | P | 9 | NR |
| Jolley (2014) | US | Cohort/no control | ICU | 80 | P | 175 | NR |
| Jubran (2010) | US | Cohort/no control | LTACH | NR | P | 72 | NR |
| Jubran (2010) | US | Cohort/control | LTACH | NR | P | 336 | NR |
| Jubran (2013) | US | RCT | LTACH | 56 | P | 312 | RN;pt ratio 1:5-6, RT:pt ratio 1:7-8 |
| Koldobskiy (2014) | US | Cohort/no control | LTACH | 14 | P | 15 | RN;pt ratio 1:4, RT:pt ratio 1:7 |
| Lamas (2016) | US | Qualitative | LTACH | NR | P, F | 50 | NR |
| Leijten (1996) | Dutch | Cohort/control | ICU | 16 | P | 38 | NR |
| Leijten (1995) | Dutch | Cohort/control | ICU | 16 | P | 50 | NR |
| Leung (2015) | Canada | Qualitative | ICU | 38 | C | 16 | Physician model: closed ICU |
| Lu (2016) | China | Cohort/control | ICU | NR | P | 41 | NR |
| Martin (2005) | US | Cohort/no control | LTACH | 18 | P | 49 | IP daily rounds with weekly director-led meetings |
| Mesotten (2004) | Belgium | RCT | ICU | NR | P | 363 | NR |
| Mirzakhani (2013) | US | Cohort/no control | ICU | NR | P | 30 | NR |
| Montagnani (2011) | Italy | Cohort/control | SWU | NR | P | 119 | NR |
| Munoz-Price (2009) | US | ITS | LTACH | 70 | P | 405 | NR |
| Nelson (2007) | US | Cohort/no control | ICU | NR | P, F | 100 | NR |
| Nelson (2006) | US | Cohort/no control | SWU | 14 | P | 203 | IP care supervised by pulmonary/ICU drs with NPs |
| Nelson (2005) | US | Qualitative | SWU | 14 | P, F, C | 25 | NR |
| Nelson (2004) | US | Cohort/no control | SWU | 14 | P | 50 | RN;pt ratio 1:3, care managed by pulmonary/ ICU drs with NPs |
| Nierman (1998) | US | Cohort/no control | SWU | 15 | P | 49 | NR |
| Nierman (1999) | US | Cohort/no control | SWU | NR | P | 55 | NR |
| Nierman (2000) | US | Cohort/control | SWU | 15 | P | 30 | Daily care by NPs in collaboration with primary attending drs |
| O’Bryan (2002) | US | Quality improvement | LTACH | NR | P | 3,007 | In-house hospitalist coverage at night with APNs & PAs for immediate response. Consistent & IP effort & willingness to drive ventilator weaning in very small increments. Staffing to support “24/7” weaning & continual monitoring for tolerance, anxiety, & fatigue. RT 24 hours/day. APN, case manager, or utilization review coordinator to monitor and facilitate progress to timely discharge. RN/LPN:pt ratio 1: 4-6 |
| O’Connor (2009) | US | Cohort/control | SWU | NR | P | 270 | NR |
| O’Shea (2007) | US | Qualitative | NA | NA  | P | 4 | NA study conducted in participant’s home |
| Reames (2016) | US | Cohort/control | HDU | 20 | P | 79 | RN:pt ratio 1:2-3 |
| Roche-Campo (2013) | France | Cross over RCT | ICU | 24 | P | 16 | NR |
| Romero (2010) | Chile | Cohort/control | ICU | NR | P | 40 | NR |
| Rose (2015) | Canada | Survey | ICU | 3317 | P, C | 308 | RN:pt ratio 1:1-2 |
| Roulin (2006) | Swiss | Qualitative | ICU | 18 | C | 19 | NR |
| Roulin (2012) | Swiss | Mixed methods | ICU | 36 | C | 147 | Closed ICU-twice daily medical rounds with discussion of goals, RN:pt 1:1.5-2, Physician/pt 1:6-8 |
| Rudy (1995) | US | RCT | HDU | 7 | P | 220 | Case-manager led care delivery system working in close collaboration with attending dr. Case managers & medical director developed protocols for ventilator weaning, nutrition, pain management, & sedation |
| Rumbak (2004) | US | RCT | ICU | NR | P | 120 | NR |
| Santos (2012) | Brazil | Cohort/no control | ICU | NR | P | 12 | NR |
| Saritas (2013) | Turkey | Cohort/no control | ICU | 11 | P | 40 | NR |
| Scheinhorn (2001) | US | Cohort/control | LTACH | 49 | P | 490 | NR |
| Schmidt (2008) | US | Cohort/control | HDU | 10 | P | 403 | Transitional model -RT & dr on site 24 h/day, protocols & guidelines for weaning, tracheostomy downsizing (speech & oral feeding), & decannulation. RN:pt ratio 1:2, Dr:pt 1:10, RT: 1:10 |
| Schonhofer (1996) | Germany | Cohort/no control | ICU & SWU | 10 | P | 46 | 2 drs & 15 nurses. Environmental noise & optical irritations reduced at night to facilitate sleep, open visiting during day. RN:pt ratio 1:3, Dr:pt ratio 1:7.5 |
| Schonhofer (1999) | Germany | Cohort/no control | ICU | 7 | P | 62 | NR |
| Schonhofer (2002) | Germany | Cohort/no control | RICU | 7 | P | 403 | Closed ICU, weaning team. RN:pt ratio 1:2-3, Dr:pt 1:3 |
| Schulman (2014) | US | Cohort/control | HDU | 14 | P | 148 | Multidisciplinary team (pulmonologist, endocrinologist, medical consultants, APNs, nurses, RTs, PTs, & SLPs |
| Schulman (2016) | US | Cohort/control | HDU | 14 | P | 140 | See Schulman 2014 |
| Silver (2006) | US | RCT | LTACH | NR | P | 86 | NR |
| Smith (1995) | UK | Cohort/no control | RICU | NR | P | 40 | Physician model: open ICU |
| Sterba (2008) | Australia | Cohort/no control | ICU | 20 | P | 12 | Physician model: closed ICU |
| Suntrup (2015) | Germany | RCT | ICU | NR | P | 30 | NR |
| Sutt (2015) | Australia | Cohort/control | ICU | 27 | P | 129 | SLP part-time weekday -open referral tracheostomized patients |
| Teno (2000) | US | Cohort/no control | ICU | NR | P, F, C | 1494 | NR |
| Thomas (2016) | Germany | Cohort/no control | HDU | NR | P | 122 | NR |
| Thomas (2016) | Germany | Cohort/no control | HDU | NR | P | 150 | NR |
| Tosun (2009) | Turkey | Qualitative | ICU | NR | P | 10 | NR |
| Tsara (2015) | Greece | Cohort/no control | HDU | 6 | P | 548 | Pulmonologist & trainee, PT & 2 trained nurses |
| Tsay (2004) | Taiwan | RCT | RICU | NR | P | 52 | NR |
| Tseng (2015) | Taiwan | Cohort/control | SWU | 16 | P | 2403 | RN:pt ratio 1:4, RT:pt ratio 1:8 |
| Wei (2015) | Multiple | RCT | ICU | NR | P | 475 | NR |
| Yaremchuk (2003) | US | Before & after  | LTACH | NR | P | 12 | NR |
| Yuan (2015) | Taiwan | Cohort/control | ICU | NR | P | 3360 | NA -administrative database study |

a P = patient; F = Family; C = clinician

US: United states; UK: United Kingdom; RCT: randomized control trial; ITS: interrupted time series; ICU: intensive care unit; LTACH: long term acute care hospital; SWU: specialized weaning unit; RICU: respiratory ICU; HDU: high dependency unit; NR: not reported; NA: not applicable; RT: respiratory therapist; Pt: patient; RN:-registered nurse; LPN: licensed practical nurse; NP: nurse practitioner, IP: interprofessional; Dr(s): doctor(s); SpO2: peripheral oxygen saturation; etCO2: end-tidal carbon dioxide; SLP: speech language pathologist; APN: advanced practice nurse; PT: physiotherapist

**Supplemental Table 2: Actionable Processes of Care – Primary Studies**

|  |  |  |
| --- | --- | --- |
| **Author, Year** | **Actionable Process of Care-Category** | **Actionable Process of Care - Description** |
| Abassi (2015) | Weaning: methods | Donepezil to promote weaning success by stimulating respiratory drive |
| Aloe (2009) | Discharge planning/timely transferPromote interprofessional communication/decision-making | Maximize throughput to the alternative setting by earlier patient transfer from ED and critical care units. Educate staff to care for complex patients and improve collaborative care process |
| Al-Qadheeb (2004) | Delirium | Scheduled antipsychotic therapy  |
| Arslanian-Engoren (2003) | Manage psychosocial issuesSpiritual support | Addressing psychosocial issues to facilitate ventilator weaning |
| Astrachan (1998) | Consider tracheostomy | Tracheostomy to reduce airway complications |
| Azimi (2015) | DeliriumManaging psychological issuesAssess/treat symptoms | Delirium screening, prevention and treatment, managing psychological issues and symptoms |
| Bagley (1997) | Rehabilitation, mobilization, and physiotherapyWeaning: methods | Weaning program focused on rehabilitation |
| Bahadur (1998) | Rehabilitation, mobilization, and physiotherapy | Mobilize out of bed |
| Bello (2009) | Endocrine dysfunction | Routine measurement of T3, T4 and TSH |
| Bissett (2012) | Weaning: diaphragm/respiratory muscle dysfunction | Inspiratory muscle training |
| Bissett (2015) | Weaning: diaphragm/respiratory muscle dysfunction | Inspiratory muscle training for inspiratory muscle weakness |
| Black (2012) | Weaning: methodsPromote interprofessional communication/decision-making | Weaning plan led by multidisciplinary team with informational continuity improved through weekly team discussions |
| Bosel (2013) | Consider tracheostomy | Early tracheostomy within 1-3 days of intubation |
| Braus (2016) | Provide information/prognosis/family communicationPalliative care involvement | Designated palliative care in the ICU & prognostic communication with family and patient |
| Burtin (2009) | Rehabilitation, mobilization, and physiotherapy | Daily cycling/mobilization |
| Carasa (2004) | Pressure ulcer prevention | Interprofessional pressure ulcer program  |
| Carpene (2010) | Weaning: methodsRehabilitation, mobilization, and physiotherapyDetermine decannulation/extubation readiness | Protocolized weaning and physiotherapyIndividualized assessment for decannulation  |
| Carson (2012) | Provide information/prognosis/family communicationPalliative care involvement | Palliative care led structured family meetings with provision of an CCI informational brochure |
| Carson (2016) | Provide information/prognosis/family communication Palliative care involvement | Information booklet for families specific to CCI with scheduled family meetings including a palliative care specialist |
| Ceriana (2003a) | Rehabilitation, mobilization, and physiotherapy | Intensive rehabilitation program |
| Ceriana (2003b) | Weaning: methodsDecannulation | Decision flow chart for weaning from tracheostomy |
| Ceriana (2010) | Delirium | Institute delirium screening |
| Chen (2011a) | Rehabilitation, mobilization, and physiotherapy | Physical training/rehabilitation over 1 year post ICU |
| Chen (2012) | Rehabilitation, mobilization, and physiotherapy | Exercise training program |
| Chen (2011b) | Manage psychosocial issues | Measurement of conditional fear and anxiety during weaning |
| Chiang (2006) | Rehabilitation, mobilization, and physiotherapy | Active functional rehabilitation |
| Chung (2006) | Determine decannulation/extubation readiness | Cuff leak test to determine laryngeal edema prior to extubation |
| Clini (1994) | Rehabilitation, mobilization, and physiotherapy | Daily rehabilitation including peripheral muscle training |
| Clini (2011) | Weaning: methods | Multidisciplinary care plans for weaning and management of non-weanable patients |
| Cox (2012) | Provide information/prognosis/family communication | Decision aid based on prognostic information |
| Cox (2015) | Provide information/prognosis/family communication | Web-based decision aid  |
| Daly (1991) | Limit physiologic monitoringProvide information/prognosis/family communication | Limit physiological monitoring; involve family in recovery process and decision-making; case management; use of protocols and critical pathways for specific patient conditions  |
| Dasgupta (1999) | Discharge planning | Optimize patient and family instruction for HMV if unable to wean |
| Datta (2004) | Endocrine dysfunction | Measurement of thyroid function |
| Davis-Martin (1994) | Provide information/prognosis/family communication | Identify family member needs  |
| deBoisblanc (2001) | Weaning: methods | Bilevel ventilation as a weaning mode |
| De Jonghe (2004) | ICU acquired weakness | Assess for ICU acquired paresis by measuring strength |
| De Jonghe (2007) | Weaning: diaphragm/respiratory muscle dysfunction | Measure respiratory muscle weakness |
| Diaz-Abad (2012) | Sleep disordered breathing | Assess for sleep disordered breathing |
| Dimopoulou (2001) | Endocrine dysfunction | Screen for functional hypoadrenalism |
| Douglas (1996) | Limit physiologic monitoringProvide information/prognosis/family communicationCase management | Reduce physiologic monitoringInvolve family in decision-making and careUse a case management model |
| Duan (2012) | Weaning: methods | Screen for possibility of NIV as a weaning mode |
| Elbouhy (2014) | Weaning: diaphragm/respiratory muscle dysfunction | Respiratory muscle exercise training sessions |
| Faisy (2009) | Nutrition and metabolic support | Assess for energy & nutrition deficit avoiding large negative energy balance plus access to registered dietitian |
| Franzosi (2012) | Nutrition and metabolic support | Assess adequacy of caloric and protein intake |
| Freeman-Sanderson (2016) | Promote speech/communication | Promotion of speech through early use of speech valve while on pressure support ventilation |
| Fukuda (2016) | Bowel health | Prevention & early management of constipation |
| Garnacho-Montero (2005) | ICU acquired weakness | Evaluation of neurophysiologic status during weaning |
| Gruther (2010) | Rehabilitation, mobilization, and physiotherapy | Early application of muscle stimulation to retard muscle mass loss and to revert muscular atrophy |
| Henneman (2002) | Weaning: methods | Daily interprofessionally developed weaning plan documented on a weaning board and weaning flow sheet |
| Hermans (2007) | Endocrine dysfunction | Intensive insulin therapy |
| Heyland (1998) | Withdrawal of care | Considerations when assessing potential for withdrawal of care |
| Higgins (1998) | Nutrition and metabolic supportAssess/treat symptomsManage psychological issues Promote sleep | Evaluate serum albumin & hemoglobin as markers of nutritional statusMeasure perceived fatigue, depression and sleep-rest |
| Ibrahim (2002) | DVT screening and prophylaxis  | Ultrasound assessment of DVT every 7 days + DVT prophylaxis |
| Ibrahim (2012) | Rehabilitation, mobilization, and physiotherapyWeaning: methods | Standardized rehabilitation programincluding NIV weaning |
| Johnson (2009) | Promote speech/communication | Facilitate early speech through tracheostomy tube management including capping, downsizing and speaking valves  |
| Johnson (2008) | Weaning: monitoring strategies | Transcutaneous CO2 monitoring to guide ventilator management |
| Johnson (2004/2006) | Manage psychological issues DeliriumFamily presence/visitingCommunicationRestoring normalcy | Recognize/support psychological needs due to extended ICU admissionSubthemes: Experiencing hallucinations and nightmares; Being unable to distinguish reality and time; receiving comfort from families and nurses; seeking control over treatments and attempting to communicate |
| Jolley (2014) | Rehabilitation, mobilization, and physiotherapy | Physical therapy consultation |
| Jubran (2010) | Manage psychological issues  | Screen for PTSD |
| Jubran (2010) | Manage psychological issues  | Screen for and treat depression |
| Jubran (2013) | Weaning: methods | Weaning comprising unassisted breathing via trach collar |
| Koldobskiy (2014) | Promote sleep, day/night cycles | Control light patterns to maintain normal circadian rhythm |
| Lamas (2016) | Provide information/prognosis/family communicationFamily supportDischarge planning | Assess patient/family understanding of prognosis, expectations, goals of CCI  |
| Leijten (1996) | ICU acquired weakness | Early identification of polyneuropathy using EMG  |
| Leijten (1995) | ICU acquired weakness | Early identification of polyneuropathy via EMG  |
| Leung (2015) | Promote interprofessional communication/decision-makingFamily supportWithdrawal of care | Enable nursing involvement in decision-making through interprofessional communication |
| Lu (2016) | Weaning: diaphragm/respiratory muscle dysfunction | Assess diaphragm dysfunction via ultrasound |
| Martin (2005) | Rehabilitation, mobilization, and physiotherapy | Whole body and respiratory rehabilitation to facilitate weaning |
| Mesotten (2004) | Endocrine dysfunction | Intensive insulin therapy  |
| Mirzakhani (2013) | Swallowing | Routine assessment of pharyngeal dysfunction/symptomatic aspiration  |
| Montagnani (2011) | Rehabilitation, mobilization, and physiotherapy | Measurement of functional independence (FIM) to guide physical therapy |
| Munoz-Price (2009) | Infection control | Chlorhexidine bathing to reduce catheter associated blood stream infection |
| Nelson (2007) | Provide information/prognosis/family communication | Address informational needs of patients and family |
| Nelson (2006) | Delirium | Screen for delirium/brain dysfunction  |
| Nelson (2005) | Provide information/prognosis/family communicationDischarge planning/timely transferWithdrawal of care | Address informational needs of patients and family and ensure good communication with care team |
| Nelson (2004) | Weaning: methodsAssess/treat symptoms | Consistently apply a detailed care map and weaning protocol with comprehensive symptom assessment |
| Nierman (1998) | Endocrine dysfunction | Assess bone hyperresorption due to vitamin D deficiency and/or immobilization |
| Nierman (1999) | Endocrine dysfunction | Measure testosterone in males |
| Nierman (2000) | Endocrine dysfunction | Assess for and treat bone hyperresorption |
| O’Bryan (2002) | Nutrition and metabolic supportRehabilitation, mobilization, and physiotherapyPromote speech/communicationWeaning methodsSwallowingAssess/treat symptomsPromote interprofessional communication/decision-making | Assess nutritional status within 48 hours of admission &aggressive protein repletion measures to optimize nutritional status; rehabilitation evaluation on admission & aggressive interventions within 2 days of admission; early trials with Passey Muir valves and SLP consultation; bedside swallowing evaluations; consistency of weaning strategies; underlying problems such as pain or anxiety; treat wounds/infection; consultation and recognition of RTs as experts |
| O’Connor (2009) | Determine decannulation/extubation readiness | Guideline/protocol for decannulation |
| O’Shea (2007) | Manage psychological issues | Recognize/support psychological needs due to extended ICU admission |
| Reames (2016) | Rehabilitation, mobilization, and physiotherapy | Evidence-based mobility protocol  |
| Roche-Campo (2013) | Promote sleep | Assess sleep quality and quantity during weaning |
| Romero (2010) | Swallowing | Assessment of swallowing dysfunction  |
| Rose (2015) | Weaning: methodsRehabilitation, mobilization, and physiotherapyAirway clearanceNutrition and metabolic supportPromote speech/communicationAssess/treat symptomsDeliriumProvide information/prognosis/family communicationPalliative care involvementMinimize sedationDischarge planning | Interprofessionally developed weaning and mobilization plans - either individualized or protocol-based; assess need for airway clearance adjuncts; nutritional review; promote communication and early speech; assess swallowing function; assess symptoms including anxiety, pain, dyspnea; screen for delirium; minimize sedation; ensure regular family meetings; enable access to palliative care and ethicists; early consideration of discharge planning |
| Roulin (2006) | Promote interprofessional communication/decision-making | Document detailed patient histories; weekly nurse-led rounds; promote use of patient diaries; use toolkit to promote communication |
| Roulin (2012) | Promote interprofessional communication/decision-makingPromote speech/ communicationRestore normalcy | Conduct nurse led rounds, multidisciplinary case presentations & promote patient-centred careUnderstand the person through patient diaries  |
| Rudy (1995) | Case managementWeaning: methodsNutrition and metabolic supportAssess/treat symptomsMinimize sedation | Case-management approach to establish, coordinate and evaluate care; protocols to guide ventilator weaning, nutrition, pain, and sedation management |
| Rumbak (2004) | Consider tracheostomy | Early tracheostomy (within 48 hours)  |
| Santos (2012) | ICU acquired weakness | Evaluate presence ofcritical illness myopathy and/or neuropathy-diaphragmatic and peripheral weakness using electrophysiology  |
| Saritas (2013) | Assess for ocular disorders | Assess for ocular disorders |
| Scheinhorn (2001) | Weaning: methods | Standardized respiratory therapist driven protocol |
| Schmidt (2008) | Tracheostomy management | Tracheostomy tube malposition  |
| Schonhofer (1996) | Weaning: methods | Weaning process/protocol specific to chronic respiratory failure patients |
| Schonhofer (1999) | Swallowing | Early screening for aspiration in tracheotomised patients using scintigraphy |
| Schonhofer (2002) | Weaning: methods | Weaning protocol |
| Schulman (2014) | Endocrine dysfunction | Protocolized management of glycemic control |
| Schulman (2016) | Endocrine dysfunction | IV pamidronate for bone resorption, hypercalciuria, or hypercalcemia |
| Silver (2006) | Prevent anaemia/limit red blood cell transfusion | Decrease red blood cell transfusion |
| Smith (1995) | Weaning: methods | Multidisciplinary progressive care programme for difficult to wean patients  |
| Sterba (2008) | Weaning: methods | Consider Levosimendan for difficult to wean patients with cardiac dysfunction |
| Suntrup (2015) | Swallowing | Assess and manage dysphagia |
| Sutt (2015) | Promote speech/communication | Promote communication using speaking valves during pressure support ventilation |
| Teno (2000) | Provide information/prognosis/family communication | Assess patient & family goals of careFacilitate understanding of prognosis through good communication |
| Thomas (2016) | Determine extubation/decannulation readiness | Document process of decannulation |
| Thomas (2016) | Rehabilitation and mobilization | Provide physiotherapy & occupational therapy to enable sit to stand in patients with ICU acquired weakness |
| Tosun (2009) | Manage psychological issuesAssess/treat symptomsPromote speech/communicationFamily presence/visiting | Subthemes: Upsetting experiences in ICU; Air hunger feelings (dyspnea, anxiety, fear); Communication experiences; Coping -relatives |
| Tsara (2015) | Weaning: methodsRehabilitation, mobilization, and physiotherapySwallowingNutrition and metabolic supportDetermine extubation/decannulation readinessAirway clearance | Develop individualized plan for respiratory and physical therapy; evaluate swallow and promote early oral feeding; cap trachesotomy tube for 24 hours & evaluate cough effectiveness & speech ability prior to decannulation as well as overnight sleep study or oximetry |
| Tsay (2004) | Assess/treat symptoms | Consider acupressure for management of dyspnea and anxiety  |
| Tseng (2015) | Consider tracheostomy | Consider tracheostomy |
| Wei (2015) | Nutrition and metabolic support | Assess nutritional adequacy |
| Yaremchuk (2003) | Tracheostomy management | Perform tracheostomy change every 2 weeks and evaluate stoma |
| Yuan (2015) | Consider tracheostomy | Perform tracheostomy within 30 days of ventilation |

**Supplemental Table 3 Remaining studies with a control group grouped according to actionable process category**

|  |
| --- |
| ***Assess/Treat Endocrine Dysfunction*** |
| Bello (2009) | Assess for hypothyroidism | Normal thyroid  | MV duration, daysa | 13 (7, 21)f | 10 (4, 14)f |
| Dimopoulou (2001) | ACTH responders | Non-responders | Interleukin (IL)-6a | 48 (42)g | 106 (73)g |
| Hermans (2007)† | Intensive insulin therapy | Usual care | Diagnosis of polyneuropathya | 81 (39)e | 107 (51)e |
| Mesotten (2004)† | Intensive insulin treatment | Usual care | ICU mortalitya | 19 (12)e | 44 (21)e |
| Nierman (2000) | Calcitriol | Calcitriol Plus Pamidronate | Urine N-telopeptide nmol bone collagen equivalents /mmol creatininea  | Baseline: 187 (146)g Therapy: 178 (123)g | 329 (238)g100 (85)g |
| Schulman (2016) | IV Pamidronate | Usual care | Mortalitya | ICU: 0 (0)e 1 year: 7 (20)e | 22 (19)e 66 (56)e |
| Schulman (2014) | High risk hyperglycemia | Low risk hyperglycemia | Mortalitya | Hosp: 17 (28)e1 year: 40 (66)e | 11 (13)e40 (46)e |
| ***Consider Tracheostomy*** |
| Astrachan (1998) | Tracheostomy | Endotracheal tube | Early complicationsc | 7 (14)e | 43 (57)e |
| Bosel (2013)† | Early tracheostomy | Usual care | ICU LOS, daysb | 17 (13, 22)f | 18 (16, 28) f |
| Rumbak (2004)† | Early tracheotomy | Late tracheostomy | Pneumoniaa | 3 (5)h | 15 (25)h |
| Tseng (2015)† | Tracheostomy | Endotracheal tube | Weaning successa | 894 (74)e | 745 (63)e |
| Yuan (2015) | Tracheostomy | No tracheostomy | Successful weaninga | 406 (63)e  | 1581 (58)e |
| ***ICU Acquired Weakness (assess/prevent)*** |
| De Jonghe (2004) | ICU acquired weakness | No ICU acquired weakness | MV duration, daysa | 6 (1, 22)f | 3 (1, 7)f  |
| Garnacho-Montero (2005) | Polyneuropathy | No polyneuropathy | MV duration, daysaWeaning duration, daysa | 34 (12, 99)h15 (1, 74)h | 14 (7, 44)h2 (0, 29)h |
| Leijten (1996) | Polyneuropathy | No polyneuropathy | Weaning durationb | 16.5 (1, 48)h | 9.5 (1, 38)h |
| Leijten (1995) | Polyneuropathy | No polyneuropathy | Normal muscle strength and walking 50 m independently at 1 yeara | 0 (0)e | 5 (42)e |
| ***Weaning –Diaphragm/Respiratory Muscle Dysfunction (assess/treat)*** |
| Bissett (2012) | Inspiratory muscle training | Standard physiotherapy | Inspiratory muscle fatigue resistance & maximum inspiratory pressures | NA (protocol) | NA  |
| De Jonghe (2007) | Extubation ≥7 days | Extubation <7 days | Respiratory & limb muscle strengtha | MIP 30 (20, 38)fMEP 23 (20, 50)fMRC 38 (21, 49)f | 40 (25, 50)f40 (20, 60)f48 (36, 54)f |
| Elbouhy (2014)† | Inspiratory muscle training | Usual care | Weaning successa | 18 (90)e | 11 (55)e |
| Lu (2016) | Diaphragmatic dysfunction  | No diaphragmatic dysfunction  | Diaphragmatic thickening fraction, mma | 14 (4)g | 35 (4)g |
| ***Nutrition and Metabolic Support*** |
| Faisy (2009) | Survivors | Non survivors | Energy deficit, kJa | 4481 (410)i | 5832 (230)i |
| Franzosi (2012) | Adequate intake  | Inadequate intake | Energy administered, kcal/kg/daya | 8 (1, 16)f | 24 (10, 40)f  |
| Wei (2015)† | Low nutritional and high nutritional adequacy | Moderate nutritional adequacy  | 6-month survivala | NR | NR |
| ***Communication*** |
| Freeman-Sanderson (2016)† | Early cuff deflation & in-line speaking valve with MV  | Usual care | Time to return to phonation, daysa | 7j | 18j |
| Sutt (2015) | In-line speech valve  | Usual care | Trach to verbal communication, daysa | 9 (7.3)g | 18 (21.3)g |
| ***Swallowing*** |
| Romero (2010) | Swallowing dysfunction | Normal swallowing | Duration of cannulation, daysa  | 19 (11)g | 2 (4)g |
| Suntrup (2015)† | Electrical pharyngeal stimulation | Sham stimulation | Decannulationa | 15 (75)e | 2 (20)e |
| ***Tracheostomy Management*** |
| Schmidt (2008) | Tracheostomy malposition | No malposition | MV duration, daysa | 25 (13-37)f  | 15 (8-29)f |
| Yaremchuk (2003) | Two weekly trach change | Usual care | Surgical intervention for granulation tissuea | 5 (0.4)e  | 7(1.3)e  |
| ***Delirium and Other Cognitive Dysfunction (screen/prevent/treat)*** |
| Al-Qadheeb (2004) | Antipsychotics | No antipsychotics | DeliriumaPsychiatric evaluationaAs needed antipsychotica1:1 sittera | 24 (77)e18 (58)e12 (39)e12 (39)e | 26 (53)e15 (31)e8 (16)e8 (16)e |
| ***Manage Psychological Issues*** |
| Jubran (2010) | Depressive disorder | No depression  | Weaning failurea | 86 (61)e | 64 (33)e |
| ***Assess/Treat Symptoms (e.g., dyspnea, pain, fatigue)*** |
| Tsay (2004)† | Acupressure | Usual care | Dyspnea & anxiety VASa | NR | NR |
| ***Determine Decannulation/Extubation Readiness*** |
| O’Connor (2009) | Successful decannulation  | No decannulation | LTACH LOSb | 56 (32, 73)f | 61 (26, 94)f |
| ***Promote Timely Transfer*** |
| Aloe (2009)\* | Respiratory step-down | Pre-implementation | Weaning time, daysc  | 2.5d  | 4.6d |
| ***Bowel health*** |
| Fukuda (2016) | Late defecation  | Early defecation | ICU LOS, daysa | 16 (10, 23)f | 12 (9, 19)f |
| ***Withdrawal of Care*** |
| Heyland (1998) | ≥14 days ICU stay | <14 days ICU stay | Total ICU cost per patienta | $37,760 ($16,238)g | $4,291 ($4,837)g |
| ***DVT Screening and Prophylaxis*** |
| Ibrahim (2002) | DVT | No DVT | ICU LOS, daysb | 18.6 (14.6)g | 15.9 (10.4)g |
| ***Infection Control*** |
| Munoz-Price (2009) | Chlorhexidine baths | Usual care | CVC bloodstream infectiona | 3.8/1,000 CVC days | 9.5/1,000 CVC days |
| ***Sleep*** |
| Roche-Campo (2013) | Spontaneous ventilation | Low level PSV | Total sleep time, minutesa | 132 (28, 192)f | 183 (133, 211)f |
| ***Promote Interprofessional Communication/Decision-making*** |
| Roulin (2012) | Dedicated multidisciplinary ward for CCI | Patient-centeredcare program  | Staff satisfaction with care modela | 3j | 3j |
| ***Prevent Anaemia/Limit Red Blood Cell Transfusion*** |
| Silver (2006)† | Erythropoietin | Placebo | RBC transfusions/patientsa | 0 (0, 2)f  | 2 (0, 3)f |

\* Studies assigned more than one actionable process of care.

† Randomized controlled trials

a Statistically significant difference between groups; b No statistically significant difference between groups; c Difference between groups not reported; d average; e n(%), f Median (interquartile range); g Mean (standard deviation); h Median (range); i Mean (standard error); j Median; k mean change.

MV: mechanical ventilation; NA: not applicable; ICU: intensive care unit; 6MWT: 6 minute walk test; HADS: Hospital Anxiety and Depression Scale; FIM: Functional Independence Measure; SDM: substitute decision maker; ACTH: adrenocorticotrophic hormone; NIV: non-invasive ventilation; DVT: deep vein thrombosis; PSV: pressure support ventilation; COPD: chronic obstructive pulmonary disease; LTACH: long-term acute care hospital; HDU: high dependency unit; RT: respiratory therapist; NR: not reported; VAS: visual analog scale.

**Supplemental Table 4 Studies with no control group grouped according to actionable process category**

|  |  |  |  |
| --- | --- | --- | --- |
| **Author, Year** | **Intervention/Exposure**  | **Primary outcome** | **Results** |
| ***Weaning - Methods*** |
| Abassi (2015) | Donezepil | Successful weaning | 11 (69)a patients |
| Bagley (1997)\* | Formal weaning program | Liberated from MV≥ 7 days  | 107 (38)a patients |
| Black (2012)\* | Long-term weaning plan | ICU mortality | Year 1 64%l Year 2 41%; Year 3 24%; Year 4 35%  |
| Carpene (2010)\* | Long-term weaning model | Weaning success | 39 (80)a patients |
| Ceriana (2003b)\* | Decisional flow chart for weaning from tracheostomy  | Tracheotomy removal | 56 (78)a patients |
| Clini (2011) | Daily peripheral muscle training | Weaning success | 55 (71)a patients |
| deBoisblanc (2001) | Bilevel ventilation as final weaning phase | ICU LOS | 21 (10)b days |
| Rose (2015)\* | ICUs providing care to PMV | Care delivery specific to PMV patients | 24 (25)a PMV weaning protocol; 22 (11)a PMV mobilization protocol; 60 (31)a specialized mobility equipment; 23 (11)a communication technology; 44 (29)a routine referral to psych; 34 (17)a discharge follow up. |
| Schonhofer (2002) | Admission to weaning centre | Mortality | 98 (24)a patients |
| Schonhofer (1996) | Weaning failure | Successful weaning | 33 (72)a patients |
| Smith (1995) | Weaning failure patients | Survival to hospital discharge | 38 (90)a patients |
| Sterba (2008) | Levosimendan | Weaning success | 7 (58)a patients |
| ***Rehabilitation, Mobilization, Physiotherapy*** |
| Bahadur (1998) | Tracheostomy | Sitting out of bed during ICU stay | 19 (63)a patients |
| Ceriana (2003a) | RICU outside of an acute care hospital | Weaning success | 27 (68)a patients |
| Clini (1994) | RICU admission | Weaning success | 315 (93)a patients |
| Ibrahim (2012)\* | PSV using NIV device after tracheostomy | ICU discharge | 20 (77)a patients |
| Jolley (2014) | PMV >14 days | Physical therapy consultation | 78 (45)a patients |
| Martin (2005) | PMV referred to ventilatory rehabilitation unit | Impact of aggressive whole-body rehabilitation on muscle strength, functional status & weaning (days) | (Baseline to discharge) upper limb 1.9c vs 3.6c lower limb score 1.5c vs 2.7c  Time to wean 16 (9)b |
| Thomas (2016) | CCI & ICUAW | Independent sit-to-stand function  | 56 (32, 90)e days after rehabilitation began |
| Tsara (2015)\* | Respiratory intermediate unit admission | Successful weaning | 438 (80)a patients |
| ***Provide Information/Prognosis/Family Communication*** *(also includes category of palliative care involvement)* |
| Carson (2012)\* | Printed information brochure | Brochure sensibility testing | Quantitative & qualitative data on brochure’s clinical sensibility & family member CCI knowledge |
| Cox (2015) | Web-based decision aid addressing care goal preferences | Usability & acceptability | Systems Usability Scale score 80 (10)b (excellent) |
| Davis-Martin (1994) | Long ICU stay (family members) | Family needs  | To feel (1) there is hope and (2) hospital personnel care about the patient & (3) To have questions answered honestly |
| Nelson (2007) | CCI  | Questionnaire on communication about CCI | 77 (80)a received no information on functional status; 69 (93)a no information on prognosis |
| Teno (2000) | >14 day ICU stay | Survival at 6-monthsPrognostic discussion with physician | 822 (55)a patients568 (38)a patients |
| ***Endocrine Dysfunction (assess/treat including hyperglycemia, hypothyroidism, adrenal insufficiency, metabolic bone disease)*** |
| Datta (2004) | Failure to wean | Incidence of hypothyroidism | 4 (3)a patients |
| Nierman (1999) | CCI men | Total testosterone | 104 (96)b ng/dL |
| Nierman (1998) | CCI | Prevalence of bone resorption & parathyroid hormone –vitamin D axis abnormalities  | 45 (92)a bone resorption; 19 (42)a - ↑ PTH levels (vit D deficient); 4 (9)a ↓PTH levels (bone hyperresorption) |
| ***Manage Psychological Issues*** |
| Chen (2011a,b) | Repeated weaning failure & PMV | Conditional fear, state anxiety & respiratory function | Significant causal pathways between fear & anxiety (*r* = 0.77; *P* < .001), anxiety & respiratory function (*r* = 0.24; *P* < .05), respiratory function & weaning outcomes (*r* = 0.42; *P*< .001) |
| Jubran (2010) | PMV and successfully weaned | PTSD 3 months after weaning | 5 (12)a patients |
| ***Nutrition and Metabolic Support*** |
| Higgins (1998)\* | CCI | Fatigue | Prevalence 20 (100)a; severe fatigue 9 (45) |
| ***Assess/Treat Symptoms (e.g., dyspnea, pain, fatigue)*** |
| Nelson (2004)\* | CCI | Self-reported symptom burden Condensed memorial Symptom Assessment Scale | Overall distress 2.4 (2, 3)e; physical 2.3 (2, 3)e; psychological 2.8 (2, 4)e |
| ***Delirium and Other Cognitive Dysfunction (screen/prevent/treat)*** |
| Ceriana (2010) | Transfer from ICU to HDU | Delirium incidence | 18 (8) a patients |
| Nelson (2006) | CCI | Prevalence & duration of coma & delirium | 66 (46)a delirium; 61 (30)a comatose throughout stay; 17.9 (1-153)d days in delirium or coma |
| ***Swallowing (assess/treat)*** |
| Mirzakhani (2013) | PMV | Pharyngeal dysfunction predicted by muscle weakness | 21 (70)a with muscle weakness had symptomatic aspiration events |
| Schonhofer (1999) | Weaning failure and tracheostomy | Incidence of aspiration | 18 (29)a patients |
| ***Promote Speech/Communication*** |
| Johnson (2009) | Care pathway with manometry before & after tracheostomy tube changes | Speech valves, downsizing & capping  | Speech valves: 78 (78)a; downsizing: 94 (94)a; capping: 12 (12)a |
| ***Determine Decannulation/Extubation Readiness*** |
| Chung (2006) | Prolonged translaryngeal intubation & percutaneous tracheostomy | Incidence of severe laryngeal edema | 35 (37)a patients |
| Thomas (2016) | ICUAW | Time to successful decannulation  | 59 (36)e days after onset of primary illness |
| ***ICU acquired Weakness (assess/prevent/treat)*** |
| Santos (2012) | PMV & sepsis | Presence of peripheral & diaphragmatic critical illness myopathy &/or neuropathy | Peripheral 9 (75)a; diaphragmatic 8 (67)a |
| ***Weaning –Diaphragm/Respiratory Muscle Dysfunction (assess/treat)*** |
| Bissett (2015) | PMV | Inspiratory muscle endurance | 0.9 (0.3)b Fatigue Resistance Index |
| ***Promote Sleep, day/night cycles*** |
| Koldobskiy (2014) | CCI & PMV | Light stimuli at eye level | Maximum 145 (156)b lux/min yet diurnal variation maintained |
| ***Discharge planning/timely transfer (to an appropriate level of care)*** |
| Dasgupta (1999) | Specialized weaning unit | Weaning success | 127 (60)a patients |
| ***Sleep Disordered Breathing*** |
| Diaz-Abad (2012) | Weaned from PMV | Prevalence of sleep disordered breathing | 18 (95)a patients |
| ***Weaning –Monitoring Strategies*** |
| Johnson (2008) | Tracheostomy with PMV | Transcutaneous CO2 during SBT and overnight off vent | Change >10mmHg during SBT 23%; overnight 42% |
| ***Assess of Ocular Disorders*** |
| Saritas (2013) | ICU stay >7 days | Prevalence of ocular surface problems | Conjunctiva hyperemia: 45 (56)a eyes; mucopurulent/purulent secretion: 29 (36)a, corneal staining: 12 (15)a, corneal filaments: 4 (5)a eyes; keratitis 4 (10)a patients |

a = n(%); b = mean (SD); c= median; d = mean (range); e =median (interquartile range)

\* Studies assigned more than one actionable process of care.

**Supplementary Table 5 Study quality for studies reporting cohorts with controls**

|  |  |
| --- | --- |
| How well did the study minimize the risk of bias or confounding? | n (%) |
| High quality (++) | 2 (6) |
| Acceptable (+) | 15 (45) |
| Unacceptable – reject 0 | 16 (48) |
| Do you think there is clear evidence of an association between exposure and outcome? |  |
| Yes | 13 (39) |
| No | 3 (9) |
| Unclear | 17 (52) |
| Are results directly applicable to the targeted patient group? |  |
| Yes | 33 (100) |
| No | 0 |

**Supplementary Table 6 Quality appraisal of qualitative studies**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Quality Appraisal Questions** | **Arslanian-Engoren (2003)** | **Azimi (2015)** | **Johnson (2004/2006)** | **Lamas (2017)** | **Leung (2017)** | **Nelson (2005)** | **O’Shea (2007)** | **Roulin (2006)** | **Tosun (2009)** |
| 1. Is there a logical fit between stated research aim(s) and method(s) used?  | Yes | Yes | Yes | Yes | Yes  | Yes | Yes | Yes | Yes |
| 2. Was the recruitment strategy appropriate to the aims of the research?  | Yes | No Only briefly in Figure 1 | Yes | Yes | Yes | Yes | Yes | NR | Yes |
| 3. Were ethical issues taken into consideration?  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | NA | Yes  |
| 4. Were the data audio-recorded and transcribed?  | Yes | NR | NR  | Yes | Yes | Yes  | Yes | No | Yes |
| 5. Is there evidence of detailed steps taken in data analysis? (i.e. how codes were assigned / merged/ led to final themes?) | Yes, full detail on process No detail theme generation  | Yes, minimal detail (interview) none observation | No, no detail at all | Yes, minimal detail | Yes | Yes, full detail  | Yes, full detail | No, no detail at all | Yes, but minimal  |
| 6. Did data analysis involve inter-rater or team discussion?  | Yes, but maybe not applied to all analysis | Yes  | NR | Yes  | Yes | Yes  | No  | No | Yes |
| 7. Was there consideration of disconfirming findings?  | No | No | No | No | No | No | Yes | No | Yes, a little  |
| 8. Is there a detailed statement of findings supported by participant narratives?  | Yes | No | Yes | Yes | Yes | Yes | Yes | No | Yes  |
| 9. Is there evidence of a reflexive concern with conduct of the study?  | No | No | No | No | No | Yes | Yes | No | No |
| 9. Is there evidence of analysis and interpretation of findings at a conceptual and theoretical level?  | Yes, but limited | No, relevant  | Yes, relevant | No | Yes, relevant | No, relevant  | Yes, relevant | No, not relevant | No, relevant |

**MEDLINE search strategy**

1 Intensive Care Units

2 Burn Units

3 Coronary Care Units

4 Respiratory Care Units

5 exp Critical Care

6 ((intensive or critical or acute) adj3 care).tw,kw.

7 (ICU or ICUs or SICU or SICUs or CCU or CCUs).tw,kw.

8 (burn? adj3 (unit? or centre? or center?)).tw,kw.

9 ((cardiac or coronary or heart) adj3 (unit? or centre? or center?)).tw,kw.

10 (respiratory adj3 (unit? or centre? or center?)).tw,kw.

11 ((surgical or surger\*) adj3 (unit? or centre? or center?)).tw,kw.

12 (high dependency adj3 (unit? or centre? or center?)).tw,kw.

13 ((stepdown or step-down) adj3 (unit? or centre? or center?)).tw,kw.

14 (HDU or HDUs or SDU or SDUs or EDSDU or EDSDUs).tw,kw.

15 ((special\* or dedicated or intens\*) adj weaning adj3 (unit? or centre? or center? or program\* or ward?)).tw,kw.

16 or/1-15 [INTENSIVE CARE]

17 Chronic Disease/ and Critical Illness/

18 (((chronic\* or persist\*) adj (acute\* or critical\* or intens\*)) and (ill or illness\* or sick or sickness\* or care)).tw,kw.

19 ((long term or longterm or prolong\* or protract\*) adj2 acute care).tw,kw.

20 (LTAC or LTACH).tw,kw.

21 ((extend\* or extensive or lengthy or long or long-term or longterm or prolong\* or protract\*) adj2 (stay or stays or "length of stay\*" or "lengths of stay\*" or LOS)).tw,kw.

22 ((difficult\* or extend\* or extensive or long or long-term or longterm or prolong\* or protract\*) adj2 (ventilat\* or wean\*)).tw,kw.

23 ((long-term or longterm or prolong\* or protract\*) adj2 intensive care).tw,kw.

24 ((long-term or longterm or prolong\* or protract\*) adj2 critical care).tw,kw.

25 ((extend\* or extensive or long-term or longterm or prolong\* or protract\*) adj2 (ICU or ICUs or SICU or SICUs or CCU or CCUs)).tw,kw. (

26 ((extend\* or extensive or long-term or longterm or prolong\* or protract\*) adj2 (HDU or HDUs or SDU or SDUs or EDSDU or EDSDUs)).tw,kw.

27 ((more than 7 days\* or greater than 7 days\* or beyond 7 days\*) adj2 (stay or stays or "length of stay\*" or "lengths of stay\*" or LOS)).tw,kw.

28 ((more than seven days\* or greater than seven days\* or beyond seven days\*) adj2 (stay or stays or "length of stay\*" or "lengths of stay\*" or LOS)).tw,kw.

29 ((8 days\* or 9 days\* or 10 days\* or 11 days\* or 12 days\* or 13 days\* or 14 days\* or 15 days\* or 16 days\* or 17 days\* or 18 days\* or 19 days\* or 20 days\* or 21 days\*) adj2 (ventilat\* or wean\*)).tw,kw.

30 ((eight days\* or nine days\* or ten days\* or eleven days\* or twelve days\* or thirteen days\* or fourteen days\* or fifteen days\* or sixteen days\* or seventeen days\* or eighteen days\* or nineteen days\* or twenty days\* or twenty-one days\*) adj2 (ventilat\* or wean\*)).tw,kw.

31 ((1 week or one week or 2 weeks\* or two weeks\* or 3 weeks\* or three weeks\*) adj2 (ventilat\* or wean\*)).tw,kw.

32 or/17-31 [CHRONIC CRITICAL ILLNESS/CARE/WEANING/VENTILATION]

33 16 and 32 [INTENSIVE CARE & CHRONIC CRITICAL ILLNESS/CARE/WEANING/VENTILATION]

34 exp Child/ not (exp Child/ and exp Adult/)

35 exp Infant/ not (exp Infant/ and exp Adult/)

36 33 not (34 or 35) [CHILD-ONLY REMOVED]

37 exp Animals/ not (exp Animals/ and Humans/)

38 36 not 37 [ANIIMAL-ONLY REMOVED]

39 (comment or editorial or interview or news or newspaper article).pt.

40 (letter not (letter and randomized controlled trial)).pt.

41 38 not (39 or 40) [OPINION PIECES REMOVED]

42 limit 41 to yr="1980-current"

43 limit 42 to english language

**Bibliography of included studies**

1. Abbasi S, Farsaei S, Fazel K, et al. Can donepezil facilitate weaning from mechanical ventilation in difficult to wean patients? An interventional pilot study. Daru 2015;23:23, 2015.

2. Al Qadheeb NS, O'Connor HH, White AC, et al. Antipsychotic prescribing patterns, and the factors and outcomes associated with their use, among patients requiring prolonged mechanical ventilation in the long-term acute care hospital setting. Ann Pharmacother 2013;47(2):181-188.

3. Aloe K, Ryan M, Raffaniello L, et al. Creation of an intermediate respiratory care unit to decrease intensive care utilization. J Nurs Adm 2009;39(11):494-498.

4. Arslanian-Engoren C, Scott LD. The lived experience of survivors of prolonged mechanical ventilation: a phenomenological study. Heart & lung : the journal of critical care 2003;32(5):328-334.

5. Astrachan DI, Kirchner JC, Goodwin WJ, Jr. Prolonged intubation vs. tracheotomy: complications, practical and psychological considerations. Laryngoscope 1988;98(11):1165-1169.

6. Azimi AV, Ebadi A, Ahmadi F, et al. Delirium in prolonged hospitalized patients in the intensive care unit. Trauma Monthly 2015;20(2).

7. Bagley PH, Cooney E. A community-based regional ventilator weaning unit: development and outcomes. Chest 1997;111(4):1024-1029.

8. Bahadur K, Jones G, Ntoumenopoulos G. An observational study of sitting out of bed in tracheostomised patients in the intensive care unit. Physiotherapy 2008;94(4):300-305.

9. Bello G, Pennisi MA, Montini L, et al. Nonthyroidal illness syndrome and prolonged mechanical ventilation in patients admitted to the ICU. Chest 2009;135(6):1448-1454.

10. Bissett B, Leditschke IA, Neeman T, et al. Weaned but weary: one third of adult intensive care patients mechanically ventilated for 7 days or more have impaired inspiratory muscle endurance after successful weaning. Heart & lung : the journal of critical care 2015;44(1):15-20.

11. Bissett BM, Leditschke IA, Paratz JD, et al. Protocol: inspiratory muscle training for promoting recovery and outcomes in ventilated patients (IMPROVe): a randomised controlled trial. Bmj open 2012;2(2):e000813, 002012.

12. Black CJ, Kuper M, Bellingan GJ, et al. A multidisciplinary team approach to weaning from prolonged mechanical ventilation. Br J Hosp Med (Lond) 2012;73(8):462-466.

13. Bosel J, Schiller P, Hook Y, et al. Stroke-related Early Tracheostomy versus Prolonged Orotracheal Intubation in Neurocritical Care Trial (SETPOINT): a randomized pilot trial. Stroke 2013;44(1):21-28.

14. Braus N, Campbell TC, Kwekkeboom KL, et al. Prospective study of a proactive palliative care rounding intervention in a medical ICU. Intensive Care Medicine 2016;42(1):54-62.

15. Burtin C, Clerckx B, Robbeets C, et al. Early exercise in critically ill patients enhances short-term functional recovery. Crit Care Med 2009;37(9):2499-2505.

16. Carpene N, Vagheggini G, Panait E, et al. A proposal of a new model for long-term weaning: respiratory intensive care unit and weaning center. RespirMed 2010;104(10):1505-1511.

17. Carson SS, Cox CE, Wallenstein S, et al. Effect of Palliative Care-Led Meetings for Families of Patients With Chronic Critical Illness: A Randomized Clinical Trial. JAMA : the journal of the American Medical Association 2016;316(1):51-62.

18. Carson SS, Vu M, Danis M, et al. Development and validation of a printed information brochure for families of chronically critically ill Patients. Crit Care Med 2012;40(1):73-78.

19. Ceriana P, Delmastro M, Rampulla C, et al. Demographics and clinical outcomes of patients admitted to a respiratory intensive care unit located in a rehabilitation center. Respiratory Care 2003;48(7):670-676.

20. Ceriana P, Carlucci A, Navalesi P, et al. Weaning from tracheotomy in long-term mechanically ventilated patients: feasibility of a decisional flowchart and clinical outcome. Intensive Care Medicine 2003;29(5):845-848.

21. Ceriana P, Fanfulla F, Mazzacane F, et al. Delirium in patients admitted to a step-down unit: analysis of incidence and risk factors. J Crit Care 2010;25(1):136-143.

22. Chen S, Su CL, Wu YT, et al. Physical training is beneficial to functional status and survival in patients with prolonged mechanical ventilation. J Formos Med Assoc 2011;110(9):572-579.

23. Chen YJ, Jacobs WJ, Quan SF, et al. Psychophysiological determinants of repeated ventilator weaning failure: an explanatory model. Am J CritCare 2011;20(4):292-302.

24. Chen YH, Lin HL, Hsiao HF, et al. Effects of exercise training on pulmonary mechanics and functional status in patients with prolonged mechanical ventilation. Respiratory Care 2012;57(5):727-734.

25. Chiang LL, Wang LY, Wu CP, et al. Effects of physical training on functional status in patients with prolonged mechanical ventilation. PhysTher 2006;86(9):1271-1281.

26. Chung YH, Chao TY, Chiu CT, et al. The cuff-leak test is a simple tool to verify severe laryngeal edema in patients undergoing long-term mechanical ventilation. Crit Care Med 2006;34(2):409-414.

27. Clini E, Vitacca M. From intermediate intensive unit to home care. Monaldi Arch Chest Dis 1994;49(6):533-536.

28. Clini EM, Crisafulli E, Antoni FD, et al. Functional recovery following physical training in tracheotomized and chronically ventilated patients. Respiratory Care 2011;56(3):306-313.

29. Cox CE, Wysham NG, Walton B, et al. Development and usability testing of a Web-based decision aid for families of patients receiving prolonged mechanical ventilation. Ann Intensive Care 2015;5:6, 2015.

30. Cox CE, Lewis CL, Hanson LC, et al. Development and pilot testing of a decision aid for surrogates of patients with prolonged mechanical ventilation. Crit Care Med 2012;40(8):2327-2334.

31. Daly BJ, Rudy EB, Thompson KS, et al. Development of a special care unit for chronically critically ill patients. Heart & lung : the journal of critical care 1991;20(1):45-51.

32. Dasgupta A, Rice R, Mascha E, et al. Four-year experience with a unit for long-term ventilation (respiratory special care unit) at the Cleveland Clinic Foundation. Chest 1999;116(2):447-455.

33. Datta D, Scalise P. Hypothyroidism and failure to wean in patients receiving prolonged mechanical ventilation at a regional weaning center. Chest 2004;126(4):1307-1312.

34. Davis-Martin S. Perceived needs of families of long-term critical care patients: a brief report. Heart & lung : the journal of critical care 1994;23(6):515-518.

35. deBoisblanc MW, Goldman RK, Mayberry JC, et al. Weaning injured patients with prolonged pulmonary failure from mechanical ventilation in a non-intensive care unit setting. Journal of Trauma-Injury Infection and Critical Care 2000;49(2):224-230.

36. De Jonghe B, Bastuji-Garin S, Durand MC, et al. Respiratory weakness is associated with limb weakness and delayed weaning in critical illness. Crit Care Med 2007;35(9):2007-2015.

37. De Jonghe B, Bastuji-Garin S, Sharshar T, et al. Does ICU-acquired paresis lengthen weaning from mechanical ventilation? Intensive Care Medicine 2004;30(6):1117-1121.

38. Diaz-Abad M, Verceles AC, Brown JE, et al. Sleep-disordered breathing may be under-recognized in patients who wean from prolonged mechanical ventilation. Respiratory Care 2012;57(2):229-237.

39. Dimopoulou I, Ilias I, Roussou P, et al. Adrenal function in non-septic long-stay critically ill patients: evaluation with the low-dose (1 micro g) corticotropin stimulation test. Intensive Care Medicine 2002;28(8):1168-1171.

40. Douglas S, Daly BJ, Rudy EB, et al. Survival experience of chronically critically ill patients. NursRes 1996;45(2):73-77.

41. Duan J, Guo S, Han X, et al. Dual-mode weaning strategy for difficult-weaning tracheotomy patients: a feasibility study. Anesth Analg 2012;115(3):597-604.

42. Elbouhy MS, AbdelHalim HA, Hashem AMA. Effect of respiratory muscles training in weaning of mechanically ventilated COPD patients. Egyptian Journal of Chest Diseases and Tuberculosis 2014;63(3):679-687.

43. Faisy C, Lerolle N, Dachraoui F, et al. Impact of energy deficit calculated by a predictive method on outcome in medical patients requiring prolonged acute mechanical ventilation. British Journal of Nutrition 2009;101(7):1079-1087.

44. Franzosi OS, Abrahao CL, Loss SH. Nutritional support and outcomes in critically ill patients after one week in the intensive care unit. RevBrasTerIntensiva 2012;24(3):263-269.

45. Freeman-Sanderson AL, Togher L, Elkins MR, et al. Return of Voice for Ventilated Tracheostomy Patients in ICU: A Randomized Controlled Trial of Early-Targeted Intervention. Crit Care Med 2016;44(6):1075-1081.

46. Fukuda S, Miyauchi T, Fujita M, et al. Risk factors for late defecation and its association with the outcomes of critically ill patients: a retrospective observational study. J Intensive Care 2016;4:33, 2016.

47. Garnacho-Montero J, Amaya-Villar R, Garcia-Garmendia JL, et al. Effect of critical illness polyneuropathy on the withdrawal from mechanical ventilation and the length of stay in septic patients. Crit Care Med 2005;33(2):349-354.

48. Gruther W, Kainberger F, Fialka-Moser V, et al. Effects of neuromuscular electrical stimulation on muscle layer thickness of knee extensor muscles in intensive care unit patients: a pilot study. J Rehabil Med 2010;42(6):593-597.

49. Henneman E, Dracup K, Ganz T, et al. Using a collaborative weaning plan to decrease duration of mechanical ventilation and length of stay in the intensive care unit for patients receiving long-term ventilation. Am J CritCare 2002;11(2):132-140.

50. Heyland DK, Konopad E, Noseworthy TW, et al. Is it 'worthwhile' to continue treating patients with a prolonged stay (>14 days) in the ICU? An economic evaluation. Chest 1998;114(1):192-198.

51. Hermans G, Wilmer A, Meersseman W, et al. Impact of intensive insulin therapy on neuromuscular complications and ventilator dependency in the medical intensive care unit. Am J RespirCritCare Med 2007;175(5):480-489.

52. Higgins PA. Patient perception of fatigue while undergoing long-term mechanical ventilation: incidence and associated factors. Heart & lung : the journal of critical care 1998;27(3):177-183.

53. Ibrahim EH, Iregui M, Prentice D, et al. Deep vein thrombosis during prolonged mechanical ventilation despite prophylaxis. Crit Care Med 2002;30(4):771-774.

54. Ibrahim SG, Silva JM, Borges LG, et al. Use of a noninvasive ventilation device following tracheotomy: an alternative to facilitate ICU discharge? RevBrasTerIntensiva 2012;24(2):167-172.

55. Johnson DC, Batool S, Dalbec R. Transcutaneous carbon dioxide pressure monitoring in a specialized weaning unit. Respiratory Care 2008;53(8):1042-1047.

56. Johnson DC, Campbell SL, Rabkin JD. Tracheostomy tube manometry: evaluation of speaking valves, capping and need for downsizing. Clin Respir J 2009;3(1):8-14.

57. Johnson P. Reclaiming the everyday world: how long-term ventilated patients in critical care seek to gain aspects of power and control over their environment. Intensive Crit Care Nurs 2004;20(4):190-199.

58. Johnson P, St John W, & Moyle W. (2006) Long-term mechanical ventilation in a critical care unit: existing in an Uneveryday world J Adv Nurs 53(5), 551–558

59. Jolley SE, Caldwell E, Hough CL. Factors associated with receipt of physical therapy consultation in patients requiring prolonged mechanical ventilation. Dccn 2014;33(3):160-167.

60. Jubran A, Grant BJ, Duffner LA, et al. Effect of pressure support vs unassisted breathing through a tracheostomy collar on weaning duration in patients requiring prolonged mechanical ventilation: a randomized trial. JAMA; 2013;309(7):671-677.

61. Jubran A, Lawm G, Duffner LA, et al. Post-traumatic stress disorder after weaning from prolonged mechanical ventilation. Intensive Care Medicine 2010;36(12):2030-2037.

62. Jubran A, Lawm G, Kelly J, et al. Depressive disorders during weaning from prolonged mechanical ventilation. Intensive Care Medicine 2010;36(5):828-835.

63. Koldobskiy D, Diaz-Abad M, Scharf SM, et al. Long-term acute care patients weaning from prolonged mechanical ventilation maintain circadian rhythm. Respiratory Care 2014;59(4):518-524.

64. Lamas DJ, Owens RL, Nace RN, et al. Opening the Door: The Experience of Chronic Critical Illness in a Long-Term Acute Care Hospital. Crit Care Med 2017; 45(4):e357-e362.

65. Leijten FS, de Weerd AW, Poortvliet DC, et al. Critical illness polyneuropathy in multiple organ dysfunction syndrome and weaning from the ventilator. Intensive Care Medicine 1996;22(9):856-861.

66. Leijten FS, Harinck-de Weerd JE, Poortvliet DC, et al. The role of polyneuropathy in motor convalescence after prolonged mechanical ventilation. JAMA : the journal of the American Medical Association 1995;274(15):1221-1225.

67. Leung D, Blastorah M, Nusdorfer L, et al. Nursing patients with chronic critical illness and their families: a qualitative study. Nurs Crit Care 2017; 22(4):229-237.

68. Lu Z, Xu Q, Yuan Y, et al. Diaphragmatic dysfunction is characterized by increased duration of mechanical ventilation in subjects with prolonged weaning. Respiratory Care 2016;61(10):1316-1322.

69. Martin UJ, Hincapie L, Nimchuk M, et al. Impact of whole-body rehabilitation in patients receiving chronic mechanical ventilation. Crit Care Med 2005;33(10):2259-2265.

70. Mesotten D, Wouters PJ, Peeters RP, et al. Regulation of the somatotropic axis by intensive insulin therapy during protracted critical illness. J Clin Endocrinol Metab 2004;89(7):3105-3113.

71. Mirzakhani H, Williams JN, Mello J, et al. Muscle weakness predicts pharyngeal dysfunction and symptomatic aspiration in long-term ventilated patients. Anesthesiology 2013;119(2):389-397.

72. Montagnani G, Vagheggini G, Vlad EP, et al. Use of the Functional Independence Measure in People for Whom Weaning From Mechanical Ventilation Is Difficult. PhysTher 2011;91(7):1109-1115.

73. Munoz-Price LS, Hota B, Stemer A, et al. Prevention of bloodstream infections by use of daily chlorhexidine baths for patients at a long-term acute care hospital. Infect Control Hosp Epidemiol 2009;30(11):1031-1035.

74. Nelson JE, Kinjo K, Meier DE, et al. When critical illness becomes chronic: informational needs of patients and families. J Crit Care 2005;20(1):79-89.

75. Nelson JE, Meier DE, Litke A, et al. The symptom burden of chronic critical illness. Crit Care Med 2004;32(7):1527-1534.

76. Nelson JE, Mercado AF, Camhi SL, et al. Communication about chronic critical illness. Arch Intern Med 2007;167(22):2509-2515.

77. Nelson JE, Tandon N, Mercado AF, et al. Brain dysfunction: another burden for the chronically critically ill. Arch Intern Med 2006;166(18):1993-1999.

78. Nierman DM, Mechanick JI. Bone hyperresorption is prevalent in chronically critically ill patients. Chest 1998;114(4):1122-1128.

79. Nierman DM, Mechanick JI. Hypotestosteronemia in chronically critically ill men. Crit Care Med 1999;27(11):2418-2421.

80. Nierman DM, Mechanick JI. Biochemical response to treatment of bone hyperresorption in chronically critically ill patients. Chest 2000;118(3):761-766.

81. O'Bryan L, Von RK, Malila F. Evaluating ventilator weaning best practice: a long-term acute care hospital system-wide quality initiative. AACN Clin Issues 2002;13(4):567-576.

82. O'Connor HH, Kirby KJ, Terrin N, et al. Decannulation following tracheostomy for prolonged mechanical ventilation. J Intensive Care Med 2009;24(3):187-194.

83. O'Shea FM. Prolonged ventilator dependence: Perspective of the chronic obstructive pulmonary disease patient. Clinical Nursing Research 2007;16(3):231-250.

84. Reames CD, Price DM, King EA, et al. Mobilizing Patients Along the Continuum of Critical Care. Dccn 2016;35(1):10-15.

85. Roche-Campo F, Thille AW, Drouot X, et al. Comparison of sleep quality with mechanical versus spontaneous ventilation during weaning of critically III tracheostomized patients. Crit Care Med 2013;41(7):1637-1644.

86. Romero CM, Marambio A, Larrondo J, et al. Swallowing dysfunction in nonneurologic critically ill patients who require percutaneous dilatational tracheostomy. Chest 2010;137(6):1278-1282.

87. Rose L, Fowler RA, Fan E, et al. Prolonged mechanical ventilation in Canadian intensive care units: a national survey. J Crit Care 2015;30(1):25-31.

88. Roulin MJ, Boul'ch MF, Merlani P. Staff satisfaction between 2 models of care for the chronically critically ill. J Crit Care 2012;27(4):426-428.

89. Roulin MJ, Spirig R. Developing a care program to better know the chronically critically ill. Intensive Crit Care Nurs 2006;22(6):355-361.

90. Rudy EB, Daly BJ, Douglas S, et al. Patient outcomes for the chronically critically ill: special care unit versus intensive care unit. NursRes 1995;44(6):324-331.

91. Rumbak MJ, Newton M, Truncale T, et al. A prospective, randomized, study comparing early percutaneous dilational tracheotomy to prolonged translaryngeal intubation (delayed tracheotomy) in critically ill medical patients. Crit Care Med 2004;32(8):1689-1694.

92. Santos PD, Teixeira C, Savi A, et al. The critical illness polyneuropathy in septic patients with prolonged weaning from mechanical ventilation: is the diaphragm also affected? A pilot study. Respiratory Care 2012;57(10):1594-1601.

93. Saritas TB, Bozkurt B, Simsek B, et al. Ocular Surface Disorders in Intensive Care Unit Patients. Scientific World Journal 2013.

94. Scheinhorn DJ, Chao DC, Stearn-Hassenpflug M, et al. Outcomes in post-ICU mechanical ventilation: a therapist-implemented weaning protocol. Chest 2001;119(1):236-242.

95. Schmidt U, Hess D, Kwo J, et al. Tracheostomy tube malposition in patients admitted to a respiratory acute care unit following prolonged ventilation. Chest 2008;134(2):288-294.

96. Schonhofer B, Barchfeld T, Haidl P, et al. Scintigraphy for evaluating early aspiration after oral feeding in patients receiving prolonged ventilation via tracheostomy. Intensive Care Medicine 1999;25(3):311-314.

97. Schonhofer B, Euteneuer S, Nava S, et al. Survival of mechanically ventilated patients admitted to a specialised weaning centre. Intensive Care Medicine 2002;28(7):908-916.

98. Schonhofer B, Mang H, Haidl P, et al. Controlled mechanical ventilation in conscious patients - A concept for patients difficult to wean. Applied cardiopulmonary pathophysiology 1996;6(3):201-215.

99. Schulman RC, Moshier EL, Rho L, et al. Association of glycemic control parameters with clinical outcomes in chronic critical illness. EndocrPract 2014;20(9):884-893.

100. Schulman RC, Moshier EL, Rho L, et al. Intravenous pamidronate is associated with reduced mortality in patients with chronic critical illness. EndocrPract 2016;22(7):799-808.

101. Silver M, Corwin MJ, Bazan A, et al. Efficacy of recombinant human erythropoietin in critically ill patients admitted to a long-term acute care facility: A randomized, double-blind, placebo-controlled trial. Crit Care Med 2006;34(9):2310-2316.

102. Smith IE, Shneerson JM. A progressive care programme for prolonged ventilatory failure: analysis of outcome. Br J Anaesth 1995;75(4):399-404.

103. Sterba M, Banerjee A, Mudaliar Y. Prospective observational study of levosimendan and weaning of difficult-to-wean ventilator dependent intensive care patients. Crit Care Resusc 2008;10(3):182-186.

104. Suntrup S, Marian T, Schroder JB, et al. Electrical pharyngeal stimulation for dysphagia treatment in tracheotomized stroke patients: a randomized controlled trial. Intensive Care Medicine 2015;41(9):1629-1637.

105. Sutt AL, Cornwell P, Mullany D, et al. The use of tracheostomy speaking valves in mechanically ventilated patients results in improved communication and does not prolong ventilation time in cardiothoracic intensive care unit patients. J Crit Care 2015;30(3):491-494.

106. Teno JM, Fisher E, Hamel MB, et al. Decision-making and outcomes of prolonged ICU stays in seriously ill patients. J Am Geriatr Soc 2000;48(5 Suppl):S70-S74.

107. Thomas S, Burridge JH, Pohl M, et al. Recovery of sit-to-stand function in patients with intensive-care-unit-acquired muscle weakness: Results from the General Weakness Syndrome Therapy cohort study. J Rehabil Med 2016;48(9):793-798.

108. Thomas S, Sauter W, Starrost U, et al. Time to decannulation and associated risk factors in the post-acute rehabilitation of critically ill patients with intensive care unit-acquired weakness: a cohort study. European journal of physical & rehabilitation medicine 2016;, 2016 Sep 27.

109. Tosun N, Yava A, Unver V, et al. Experience of patients on prolonged mechanical ventilation: A phenomenological study. Turkiye Klinikleri Journal of Medical Sciences 2009;29(3):648-658.

110. Tsara V, Moisiadis N, Antoniadou M, et al. Characteristics and outcome of patients with difficult weaning from mechanical ventilation: an 18 years' experience of a respiratory intermediate unit attached to a pulmonary department. Hippokratia 2015;19(1):37-40.

111. Tsay SL, Wang JC, Lin KC, et al. Effects of acupressure therapy for patients having prolonged mechanical ventilation support. J Adv Nurs 2005;52(2):142-150.

112. Tseng KL, Shieh JM, Cheng KC, et al. Tracheostomy versus Endotracheal Intubation Prior to Admission to a Respiratory Care Center: A Retrospective Analysis. International Journal of Gerontology 2015;9(3):151-155.

113. Wei X, Day AG, Ouellette-Kuntz H, et al. The association between nutritional adequacy and long-term outcomes in critically ill patients requiring prolonged mechanical ventilation: a multicenter cohort study. Crit Care Med 2015;43(8):1569-1579.

114. Yaremchuk K. Regular tracheostomy tube changes to prevent formation of granulation tissue. Laryngoscope 2003;113(1):1-10.

115. Yuan CR, Lan TY, Tang GJ. Can tracheostomy improve outcome and lower resource utilization for patients with prolonged mechanical ventilation? Chinese medical journal 2015;128(19):2609-2616.

Figure Legend

Supplemental Figure 1: Risk of bias assessment for randomized controlled trials using the Cochrane risk of bias domains.