



# Occupational therapist-guided cognitive interventions in critically ill patients: a feasibility randomized controlled trial

## Interventions cognitives dirigées par l'ergothérapeute chez les patients admis à l'unité des soins intensifs : une étude randomisée contrôlée de faisabilité

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Received: 2 November 2021 / Revised: 25 June 2022 / Accepted: 21 July 2022 / Published online: 16 November 2022  
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### Abstract

**Purpose** Intensive care unit (ICU) delirium is a common complication of critical illness requiring a multimodal approach to management. We assessed the feasibility of a novel occupational therapist (OT)-guided cognitive intervention protocol, titrated according to sedation level, in critically ill patients.

**Methods** Patients aged  $\geq 18$  yr admitted to a medical/surgical ICU were randomized to the standard delirium prevention protocol or to the OT-guided cognitive intervention protocol in addition to standard of care. The

target enrolment number was  $N = 112$ . Due to the COVID-19 pandemic, the study enrolment period was truncated. The primary outcome was feasibility of the intervention as measured by the proportion of eligible cognitive interventions delivered by the OT. Secondary outcomes included feasibility of goal session length (20 min), participant clinical outcomes (delirium prevalence and duration, cognitive status, functional status, quality of life, and ICU length of stay), and a description of methodological challenges and solutions for future research.

**Results** Seventy patients were enrolled and 69 patients were included in the final analysis. The majority of OT-guided sessions (110/137; 80%) were completed. The mean (standard deviation [SD]) number of sessions per patient was 4.1 (3.8). The goal session length was achieved (mean [SD], 19.8 [3.1] min), with few sessions (8/110; 7%) terminated early per patient request.

**Conclusion** This novel OT-guided cognitive intervention protocol is feasible in medical/surgical ICU patients. A larger randomized controlled trial is required to determine the impact of such a protocol on delirium prevalence or duration.

**Study registration** [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov) (NCT03604809); registered 18 June 2018.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s12630-022-02351-9>.

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### Résumé

**Objectif** Le délirium est une complication courante à l'unité des soins intensifs et requiert une prise en charge multimodale. Nous avons évalué la faisabilité d'un nouveau protocole d'intervention cognitive dirigé par l'ergothérapeute, titré en fonction du niveau de sédation, chez des patients gravement malades.

**Méthode** Les patients âgés  $\geq 18$  ans admis dans une USI médico-chirurgicale ont été randomisés à suivre le protocole standard de prévention du délirium ou le protocole d'intervention cognitive dirigé par l'ergothérapeute, en plus du standard de soins. La cible de recrutement était  $N = 112$ . En raison de la pandémie de COVID-19, la période de recrutement de l'étude a été raccourcie. Le critère d'évaluation principal était la faisabilité de l'intervention telle que mesurée par la proportion d'interventions cognitives admissibles prodiguées par l'ergothérapeute. Les critères d'évaluation secondaires comprenaient la faisabilité de la durée cible de la séance (20 min), les issues cliniques des participants (prévalence et durée du délirium, état cognitif, état fonctionnel, qualité de vie et durée de séjour à l'USI), ainsi qu'une description des défis méthodologiques et des solutions pour les recherches futures.

**Résultats** Soixante-dix patients ont été recrutés et 69 patients ont été inclus dans l'analyse finale. La majorité des séances dirigées par l'ergothérapie (110/137; 80 %) ont été complétées. Le nombre moyen (écart type [ET]) de séances par patient était de 4,1 (3,8). L'objectif de durée de la séance a été atteint (moyenne [ET], 19,8 [3,1] min), avec quelques séances (8/110; 7 %) interrompues prématurément à la demande du patient.

**Conclusion** Ce nouveau protocole d'intervention cognitive dirigé par l'ergothérapie est réalisable chez les patients en soins intensifs médicaux et chirurgicaux. Une étude randomisée contrôlée plus vaste est nécessaire afin de déterminer l'impact d'un tel protocole sur la prévalence ou la durée du délirium.

**Enregistrement de l'étude** [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov) (NCT03604809); enregistrée le 18 juin 2018.

**Keywords** critical care · cognitive intervention · delirium · intensive care unit · occupational therapy

Intensive care unit (ICU) delirium is an acute neurologic disorder characterized by inattention, disorganized thinking, and a fluctuating course of altered level of consciousness commonly observed during critical illness.<sup>1–4</sup> Intensive care unit delirium is associated with a longer duration of mechanical ventilation, long-term cognitive impairment, increased healthcare costs, increased morbidity, and is an independent risk factor for mortality during hospitalization.<sup>4–8</sup>

ICU delirium management and prevention requires a multimodal approach including both pharmacologic and nonpharmacologic options.<sup>9</sup> Guidelines endorse early detection of delirium using validated screening tools, such as the Intensive Care Delirium Screening Checklist (ICDSC)<sup>10</sup> as well as the use of a multicomponent bundle

to shorten or reduce delirium, such as the ABCDEF bundle (Assess, prevent, and manage pain; Both spontaneous awakening trials and spontaneous breathing trials; Choice of analgesia and sedation; Delirium assessment, management and prevention; Early mobility and exercise; and Family engagement and empowerment).<sup>3, 9</sup>

Nonpharmacologic strategies are feasible in critically ill patients including sleep promotion activities, orientation, early mobility, and activities of daily living.<sup>11, 12</sup> Cognitive interventions, as part of a delirium prevention strategy, are specific therapies focusing on the domains of cognitive functioning impacted by delirium such as memory, attention and concentration, and executive function.<sup>1, 13–15</sup> Components of cognitive interventions consist of cognitive training, stimulation, and rehabilitation.<sup>1, 14, 16, 17</sup> However, there is a lack of evidence for the use of cognitive interventions in critically ill patients for the prevention or management of delirium.<sup>1</sup>

Occupational therapy includes interventions that treat physical, cognitive, emotional or psychological domains.<sup>18</sup> Occupational therapists (OTs) have advanced education and training in the domains of cognitive assessment, treatment, rehabilitation and the relationship between a patient's cognitive skills, performance, and environment and are uniquely qualified to deliver this specialized care to critically ill patients.<sup>19</sup> Nevertheless, in most ICUs, the OT role is centred on physical mobility and rehabilitation rather than on cognitive complications of critical illness such as delirium; therefore, the potential and scope of the OT role may not be fully utilized.<sup>18</sup>

Our initial objective was to conduct a randomized controlled trial (RCT) to determine the effect of the standard of care ICU delirium prevention strategies (i.e., the ABCDEF bundle) with the addition of early OT-guided cognitive interventions titrated according to the Richmond Agitation and Sedation Scale (RASS) on delirium duration and prevalence.<sup>20</sup> Because of the COVID-19 pandemic, the study was terminated before goal recruitment could be reached. Therefore, we report a feasibility analysis of the data. The primary outcome reported is feasibility of the protocol as measured by the proportion of eligible interventions delivered. Secondary outcomes included feasibility of goal session length from the patient's perspective, participant clinical outcomes (delirium, cognitive status, functional status, quality of life [QOL], and ICU length of stay), and a description of methodological challenges and solutions for future research.

## Methods

This feasibility RCT is reported according to the Consolidated Standards of Reporting Trials statement: extension to randomized pilot and feasibility trials, and the

Guidelines for Reporting Trial Protocols and Completed Trials Modified due to the COVID-19 Pandemic and Other Extenuating Circumstances (Electronic Supplementary Material [ESM] eAppendix 1).<sup>21, 22</sup> The study was terminated for the following reasons: 1) pandemic surges and high volumes of critically ill patients altered the baseline standard of care (i.e., usual delirium prevention practices) while strict visitation guidelines limited family presence, and 2) the projected effects of the pandemic on critical care resources and investigator/OT responsibilities to patient care (ESM eAppendix 1). Thus, the original target recruitment ( $N = 112$ ) was not achieved. For these reasons, the trial was underpowered to report efficacy of the study intervention on delirium prevalence and duration, and a feasibility analysis was chosen. To mitigate the effects of lost data, funding, and time investment, we changed the trial objectives to measure feasibility of the protocol by describing the proportion of eligible cognitive interventions delivered by the OT.<sup>22</sup> The study was conducted at South Health Campus, in a ten-bed medical/surgical ICU in Calgary, AB, Canada and was approved by the Conjoint Health Research Ethics Board, University of Calgary (REB19-1904; 10 December 2019), and the Health Research Ethics Board, University of Alberta (Pro00083213; 28 October 2018).

#### Participant selection and description

Informed consent was obtained from study participants or their substitute decision makers (SDM). All patients aged 18 yr or older admitted to the ICU were assessed for eligibility. Exclusion criteria included a diagnosis of primary direct brain injury, a prior diagnosis of dementia-related illness, a prior diagnosis of developmental disability, pre-existing cognitive impairment, patients requiring palliative care, an anticipated ICU stay less than 48 hr, non-English speaking patients, patients with severe communication disorders, plasmapheresis patients, patients with severe hearing or visual impairment, and patients transferred from another ICU. Based on departmental guidance to minimize exposure, patients with COVID-19 were added as an exclusion criterion in March 2020.

#### Randomization and blinding

Patients were randomized into the control arm (i.e., standard of care) or the experimental arm, which included usual delirium prevention practices *plus* OT-guided cognitive interventions (Fig. 1; see ESM eAppendices 2 and 3 for institution delirium prevention practices). A computer-generated list of random numbers with simple 1:1 randomization was used to allocate

participants to the control group or the experimental group. The allocation sequence was concealed from study investigators and research assistants enrolling participants in the trial. Allocations were placed in sequentially numbered, sealed opaque envelopes, which were only opened following enrolment. Due to the nature of the intervention, it was not possible for study participants or the OT to be blinded. Study investigators and research assistants conducting outcome measures were blinded to the patient assignment.

#### Study intervention

The interventions were conducted Monday to Friday twice daily for 20 min, starting on the first weekday after enrolment, via face-to-face contact with an OT. Sessions were terminated if the patient became agitated or did not meet physiologic parameters such as ordered heart rate, respiratory rate, or blood pressure goals.

The four main components of the protocol were family or loved one-directed interventions; cognitive stimulation; cognitive training; and cognitive rehabilitation (Fig. 1). The intervention was titrated to the patient's level of sedation using the RASS (ESM eAppendix 4).<sup>20</sup> The following interventions were conducted at all levels of sedation: 1) family education and participation in interventions, 2) stress management strategies for the patient and family, 3) cognitive stimulation activities, and 4) informal cognitive assessment. Informal cognitive assessment was completed throughout the session, guiding the cognitive training, stimulation and rehabilitation activities chosen by the therapist based on the patient's ability.

#### Data collection

Patient data were obtained from hospital electronic medical records validated for use in research (Sunrise Clinical Manager version 18.4, Allscripts Healthcare, LLC, Chicago, IL, USA; eCritical MetaVision version 5.46, iMDsoft, Tel Aviv, Israel).<sup>23</sup> Study data were collected and managed using REDCap electronic data capture tools hosted at the University of Calgary, Calgary, AB, Canada.<sup>24</sup>

#### Outcome measures

Delirium prevalence and duration were measured using the ICDSC<sup>10</sup> (ESM eAppendix 5). The ICDSC was conducted twice daily (once per shift) by the primary registered nurse (RN). All critical care RNs in our department are trained to score delirium using the ICDSC. Moreover, a provincial delirium initiative developed an ICDSC dashboard used

<b>OT Guided Cognitive Interventions</b>	
Two sessions daily, Monday to Friday 20 minutes per session	
<b>RASS</b>	
<b>-5/-4</b>	<ul style="list-style-type: none"> <li>• Discussion and education with family in presence of patient</li> <li>• Cognitive stimulation interventions such as orientation and sensory stimulation</li> <li>• Stress management information and practice</li> <li>• Orientation</li> </ul>
<b>-3/-2</b>	<ul style="list-style-type: none"> <li>• Discussion and education with family in presence of patient</li> <li>• Cognitive stimulation interventions such as orientation and sensory stimulation</li> <li>• Stress management information and practice</li> <li>• Orientation</li> </ul>
<b>-1/0/+1</b>	<ul style="list-style-type: none"> <li>• Discussion and education with patient and family</li> <li>• Cognitive screening</li> <li>• Cognitive stimulation, rehabilitation and training interventions graded and advanced according to patient ability</li> <li>• Stress management information and practice</li> <li>• Orientation</li> </ul>
<b>+2/+3/+4</b>	<ul style="list-style-type: none"> <li>• Discussion and education with patient and family</li> <li>• Cognitive screening</li> <li>• Cognitive stimulation, rehabilitation and training interventions graded according to patient ability</li> <li>• Stress management information and practice</li> <li>• Orientation</li> </ul>
<b>Four components of cognitive intervention protocol with tasks</b>	
<b>Family or loved one directed intervention</b>	<ul style="list-style-type: none"> <li>• Patient and family education about ICU delirium, ICU delirium sequelae and cognitive interventions</li> <li>• Specific family interventions: orientation, therapeutic touch, bringing in pictures, promoting day/night routines, providing reassurance if patient is experiencing delirium</li> <li>• OT initial interview with family and patient to establish baseline patient cognitive status</li> <li>• Family starting a memory journal for patient</li> <li>• Stress management information for family.</li> </ul>
<b>Cognitive Stimulation</b>	<ul style="list-style-type: none"> <li>• Orientation</li> <li>• Reading to patient</li> <li>• Sensory stimulation with light, orientation, music, television, radio, touch, smell</li> <li>• Stress Management information and practice with patient (i.e. deep breathing, imagery, progressive relaxation and meditation).</li> <li>• Communication board visible to patient</li> <li>• Sleep routine</li> <li>• Discussion about motivation, beliefs and values, self-efficacy, fears, stressors, weaknesses and strengths.</li> </ul>
<b>Cognitive Training</b>	<ul style="list-style-type: none"> <li>• Card games (e.g. memory match, aligning colors, suites, numbers, face cards, over and under, go fish, war.)</li> <li>• Pencil and paper tasks (e.g. word search, scanning tasks, crosswords, number puzzles such as Sudoku).</li> <li>• Sequencing tasks (e.g. steps to driving a car)</li> <li>• Picture interpretation</li> <li>• Reading comprehension</li> <li>• Use of blocks and shapes (e.g. sorting shapes and patterns)</li> <li>• Functional mobility</li> </ul>
<b>Cognitive Rehabilitation</b>	<ul style="list-style-type: none"> <li>• Self-care and ADLs: Dressing upper and lower body, mouth care, washing face, hands and body, brushing hair, shaving, toileting</li> <li>• IADLs: Wayfinding, money tasks (e.g. identifying coins, counting, making change)</li> <li>• IADLs: Medication management such as counting and identifying pills, and time of day to take medication</li> </ul>

**Fig. 1** OT-guided cognitive intervention protocol. ADL = activities of daily living; IADL = instrumental activities of daily living; ICU = intensive care unit; OT = occupational therapist; RASS = Richmond Agitation and Sedation Scale<sup>20</sup>

provincially to ensure that delirium is measured consistently among RNs. Patients were considered as having delirium if they had an ICDSC score  $\geq 4$  at least once during their ICU stay (i.e., ever delirium). Delirium duration was measured by determining the total number of days with delirium from ICU admission to ICU discharge for each patient. Additional outcomes included cognitive function measured using the Johns Hopkins' Adapted Cognitive Exam,<sup>25</sup> physical function measured using the Functional Status Score for ICU,<sup>26</sup> QOL measured using the Euro-Qual 5 Dimensions,<sup>27</sup> ICU length of stay, days of mechanical ventilation, and hospital length of stay (see ESM eAppendix 6 for additional instruments).<sup>28–31</sup>

#### Statistical analysis

A previous systematic review of nonpharmacological interventions reported an average reduction of delirium

prevalence of 24.7%.<sup>32</sup> To detect this difference in delirium prevalence (assuming 49% without the intervention based on local data) at 80% power and a two-sided  $\alpha = 0.05$ , we determined that 56 participants would need to be enrolled per arm ( $N = 112$  total). Patient characteristics and clinical outcome data are summarized using frequency with percent for categorical data and mean with standard deviation (SD) or median with interquartile range [IQR] for continuous data.

#### Results

Enrolment began on 13 June 2019, but was paused on 19 March 2020 and resumed on 28 July 2020 because of the COVID-19 pandemic. Lack of capacity of the OT and investigators (who are front line providers) to provide critical care and conduct study activities resulted in

termination of the study on 30 November 2020, before the original goal enrolment number ( $N = 112$ ) was reached (ESM eAppendix 1).

After screening 408 patients for eligibility, 70 patients were enrolled with 37 randomized to the control group and 33 to the intervention group (Fig. 2). Forty-seven patients were enrolled before the pandemic and 23 patients were enrolled during the pandemic. One patient withdrew from the study after randomization, and 69 patients were included in the final analysis. Three patients were lost to follow up and 27 patients received the study intervention (at least one treatment). Five patients (16%) admitted on a holiday or weekend did not receive cognitive interventions because an OT was not available and were excluded from feasibility analysis. The most common reason for study exclusion was expected ICU stay less than 48 hr ( $n = 143/408$ ; 35%). An average of six patients (69/11.6 months) included in final analysis were enrolled per month and an average of 35 patients were screened per study month.

Differences between the control and intervention group were owing to an incomplete sample size. Baseline characteristics of study participants are shown in Table 1. The median [IQR] acute physiology and chronic health evaluation (APACHE)-II score was 22 [15–31] in the intervention group and 19 (14–24) in the control group. Patients in the intervention group were older (median [IQR] age, 63 [56–71] yr) than those in the control group (median [IQR] age, 53 [43–64] yr). The results of the study are summarized according to methodological issues reported in feasibility studies as discussed in Sosnowski *et al.*<sup>33</sup> and Shanyinde *et al.*<sup>34</sup> (Table 2).

Proportion of eligible cognitive interventions delivered

The majority (110/137, 80%) of eligible cognitive intervention sessions were delivered. The mean (SD) number of sessions per patient was 4.1 (3.8). The most common reason for omitted interventions was patient test(s) or procedure(s) (19/137 sessions, 14%), patient refusal (5/137 sessions, 4%), family member refusal (2/137

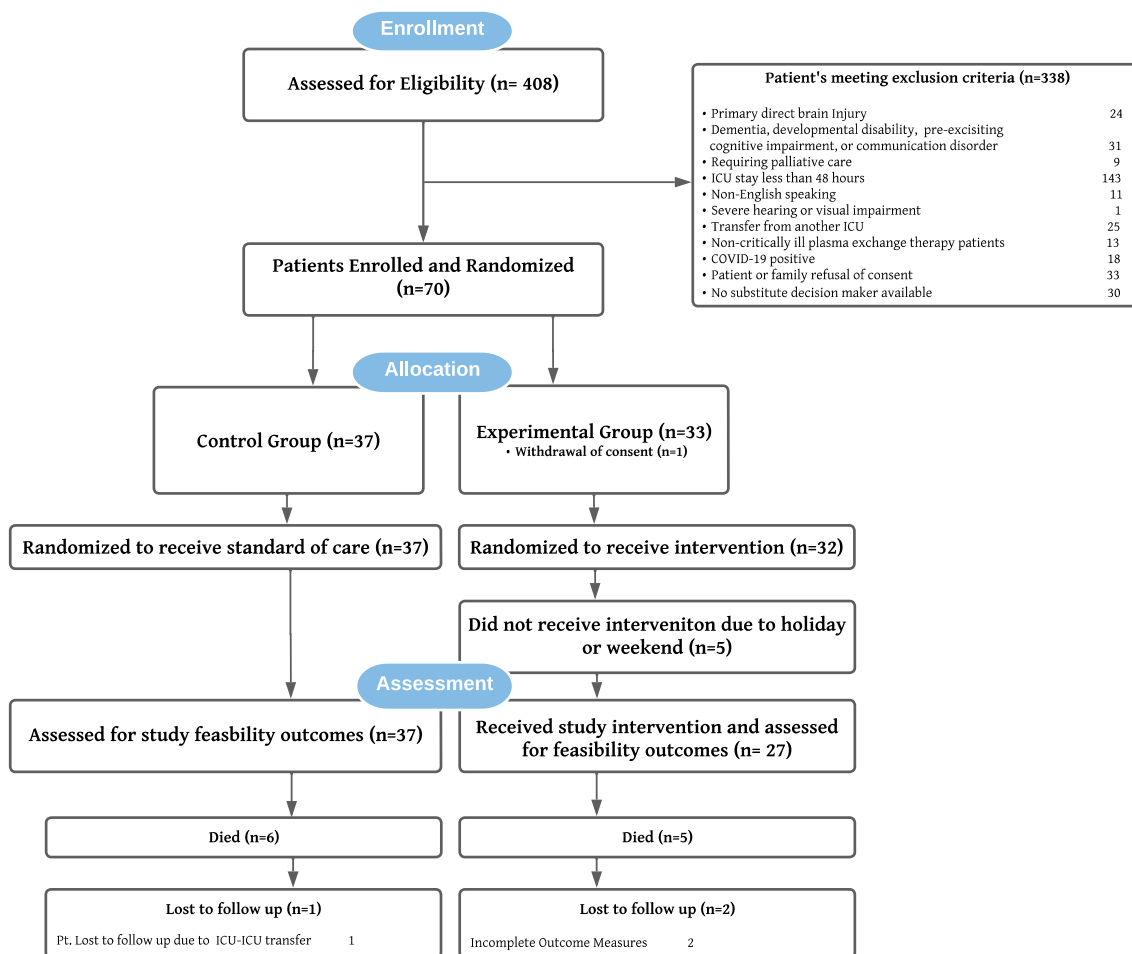


Fig. 2 CONSORT enrolment flow chart

**Table 1** Summary of baseline patient characteristics

Patient characteristic	Intervention group <i>N</i> = 32	Control group <i>N</i> = 37
Age, median [IQR]	63 [56–71]	53 [43–64]
Male, <i>n</i> /total <i>N</i> (%)	20/32 (63%)	23/37 (62%)
Diagnosis group, <i>n</i> /total <i>N</i> (%)		
Medical	26/32 (81%)	32/37 (87%)
Surgical	4/32 (13%)	4/37 (11%)
Neurology	2/32 (6%)	1/37 (3%)
Urgent admission, <i>n</i> /total <i>N</i> (%)	30/32 (94)	36/37 (97%)
Coma first 24 hr, <i>n</i> /total <i>N</i> (%)		
No	24/32 (75%)	23/37 (62%)
Drug-induced	5/32 (16%)	12/37 (32%)
Miscellaneous coma	1/32 (3%)	1/37 (3%)
Combination coma	2/32 (6%)	1/37 (3%)
Infection, <i>n</i> /total <i>N</i> (%)	28/32 (88%)	28/37 (76%)
Metabolic acidosis, <i>n</i> /total <i>N</i> (%)	22/32 (69%)	13/37 (35%)
Morphine in first 24 hr		
No	28/32 (88%)	29/37 (78%)
0.01–7.1 mg·24 hr <sup>-1</sup>	4/32 (13%)	7/37 (19%)
7.2–18.6 mg·24 hr <sup>-1</sup>	0/32 (0%)	1/37 (3%)
> 18.6 mg·24 hr <sup>-1</sup>	0/32 (0%)	0/37 (0%)
Sedative use (propofol or benzodiazepines), <i>n</i> /total <i>N</i> (%)	27/32 (84%)	28/37 (76%)
APACHE II score, median [IQR] <sup>29</sup>	22 [15–31]	19 [14–24]
SOFA score, median [IQR] <sup>28</sup>	7 [5–12]	7 [4–10]
CFS, median [IQR] <sup>27</sup>	4 [3–5]	4 [3–5]
Probability of ICU delirium based on predeliric score, median [IQR] <sup>30</sup>	41 [30–48]%	30 [22–40]%

APACHE II = acute physiology and chronic health evaluation; CFS = clinical frailty score; ICU = intensive care unit; IQR = interquartile range; SOFA = sequential organ failure assessment

sessions, 2%), healthcare provider refusal (1/137 sessions, < 1%) and one medical emergency (< 1%). Additionally, five patients (16%) enrolled in the intervention arm were discharged from ICU after a short length of stay (median ICU days, 2.7; range, 2.4–2.7) and prior to receiving any OT interventions on a weekend or holiday. There were no adverse events associated with the protocol.

#### Individual session length

The mean (SD) session length was 19.8 (3.1) min. The median [IQR] time to initiation of first OT intervention from the time the patient was admitted to ICU was 46 [36–60] hr. Thirteen sessions of 110 (12%) were terminated early because of patient request or fatigue (8/110, 7%), healthcare provider request (4/110, 4%); and a medical emergency (1/110, < 1%).

#### Description of interventions conducted

Interventions were titrated according to RASS with the majority of interventions conducted at a RASS of 0 (*n* = 41, 37%), followed by a RASS of -5 (*n* = 18, 16%).<sup>20</sup> The OT did not observe RASS scores of +2 to +4 in patients during study intervention periods, so no interventions were conducted at those levels of agitation.

Of the 110 OT-guided sessions, the most frequent cognitive interventions conducted were cognitive stimulation exercises (91/110, 83%), family-based intervention (78/110, 71%), cognitive training (27/110, 25%), and cognitive rehabilitation (12/110, 11%) (ESM eTable). We identified eight major cognitive domains targeted during each cognitive intervention session: sensation, perception, motor skills, attention and concentration, memory, executive functioning, processing speed, and language skills.<sup>15</sup> The most frequently targeted cognitive domains were sensation (99/110 sessions, 90%), attention and concentration (62/110, 56%), and memory (53/110, 48%).

**Table 2** Summary of findings of methodological issues for feasibility research<sup>33, 34</sup>

Methodological issues	Findings	Evidence	Solution
Recruitment and consent	An average of 5.9 patients (69/11.6 months) included in final analysis were enrolled per month and an average of 35.2 patients were screened per study month	<ul style="list-style-type: none"> <li>• 8% of eligible patients or their SDM refused consent (<math>n = 33</math>)</li> <li>• Trial paused and then terminated early because of COVID-19 pandemic</li> </ul>	<ul style="list-style-type: none"> <li>• Provide more information on the goals and benefits of the study to patients and SDMs</li> <li>• Consider extending timeline of consent to 72 hr ensure inclusion of patients admitted on a weekend or holiday</li> <li>• Ensure adequate budget to allow for RA support so that no enrolment opportunities are missed</li> </ul>
Randomization	A failure to complete goal enrolment number because of early termination resulted in imbalances between groups	Size variation between intervention and control group may occur with small sample sizes	A larger randomized controlled trial with a complete sample size
Blinding procedures	Research assistants and investigators remained blinded throughout trial	OTs and primary RN unable to be blinded because of the nature of the intervention	No change
Was intervention conducted?	Yes	<p>110 cognitive intervention sessions among 27 patients were conducted. The mean (SD) number of sessions per patient was 4.1 (3.8)</p> <p>5 patients (16%) in the intervention arm did not receive any cognitive interventions because it was a weekend or holiday</p>	Obtain more OT coverage to conduct interventions during a weekend or holiday. Alternatively, therapy assistants can be indirectly supervised by the OT
Did participants adhere to intervention?	Yes	<p>The majority of eligible cognitive interventions (80%) took place (110/137 intended sessions). Reasons the OT was not able to conduct the intervention were:</p> <ul style="list-style-type: none"> <li>• Patient off unit for test or procedure: 19 (14%)</li> <li>• Patient refusal: 5 (4%)</li> <li>• Family member refusal: 2 (2%)</li> <li>• Healthcare provider refusal: 1 (&lt; 1%)</li> <li>• Medical emergency: 1 (&lt; 1%)</li> </ul>	<ul style="list-style-type: none"> <li>• Educate families and patients regarding potential benefits of cognitive interventions during critical illness</li> <li>• Discuss alternate times of day with patient when interventions may be most appropriate</li> <li>• Multiple tests and procedures are necessary in critically ill patients and the OT can use discretion on feasibility of conducting intervention</li> <li>• Resource-limited institutions would benefit from analysis of once daily interventions</li> </ul>
Were cognitive interventions titrated according to RASS?	Yes	Cognitive interventions occurred in RASS scores -5 to +1. No RASS scores +2 to +4 were observed in the small sample size	A larger sample size will likely yield the opportunity to conduct interventions for all levels of agitation and sedation
Was the intervention acceptable?	Yes. Acceptability can be defined as patient participation in therapy	5 instances of patient refusal to participate in intervention (4%)	Work with patient to define goals, best timing of intervention, and provide education on potential benefits

**Table 2** continued

Methodological issues	Findings	Evidence	Solution
Duration of the interventions	Goal OT-guided session duration was reached	<ul style="list-style-type: none"> <li>• The mean (SD) session length was 19.8 (3.1) min</li> <li>• Length of sessions were deemed acceptable as only 8 (7%) sessions were terminated early because of patient request or fatigue</li> <li>• Four sessions (4%) were terminated early at healthcare provider request</li> <li>• One session was stopped early because of medical emergency (&lt; 1%)</li> </ul>	Healthcare provider education surrounding cognitive intervention protocol may maximize OT time with patient and avoid early termination
Were outcome measures completed?	Some outcome measures were not possible to complete due to severity of patient illness, death, transfer to another ICU or altered level of consciousness	<ul style="list-style-type: none"> <li>• A large number of patients (<math>n = 43</math>) could not complete the <i>admission</i> cognitive exam or FSS-ICU (<math>n = 44</math>) because of deep sedation, medical emergencies or communication barriers</li> <li>• 16 patients (23%) did not complete ACE scores prior to <i>discharge</i> due to death (<math>n = 11</math>; 16%), altered LOC (<math>n = 2</math>; 3%), patient refusal (<math>n = 1</math>), loss to follow up (<math>n = 1</math>), and communication barriers (<math>n = 1</math>)</li> <li>• 16 patients (23%) did not complete FSS-ICU scores prior to <i>discharge</i> due to death (<math>n = 11</math>; 16%), loss to follow up (<math>n = 3</math>, 4%) and altered LOC (<math>n = 2</math>; 3%)</li> <li>• Many patients (<math>n = 18</math>; 26%) did not complete the QOL score on <i>discharge</i> because of death (<math>n = 11</math>; 16%), altered level of consciousness (<math>n = 4</math>; 6%), communication barriers (<math>n = 1</math>), loss to follow up (<math>n = 1</math>), and patient refusal (<math>n = 1</math>). Three patients did not rate their overall health status</li> <li>• 1 patient was transferred to another ICU, so no outcome measures were completed</li> </ul>	<ul style="list-style-type: none"> <li>• A larger research team may help to avoid lost to follow up</li> <li>• Due to the nature of critical illness, a significant portion of patients will not be able to complete functional status scores or cognitive exams upon ICU admission and therefore, it is reasonable to omit these scores in future RCTs</li> <li>• Avoid transfer of patients enrolled in trials that are conducted at a single site</li> </ul>
Selection of most appropriate outcomes	All outcomes were deemed appropriate.	See <b>ESM eAppendix 6</b> for summary of instruments and data collection	Future RCTs may consider having trained study team members conduct delirium outcome measures (i.e., ICDSC)
Retention of participants	Study retention was deemed acceptable.	<ul style="list-style-type: none"> <li>• 11 patients (16%) died during ICU admission</li> <li>• 1 patient was transferred to another ICU prior to outcome measures being completed</li> <li>• 1 patient withdrew from the study after randomization</li> </ul>	Participant death may be expected in ICU trials due to critical illness



**Table 2** continued

Methodological issues	Findings	Evidence	Solution
Did all components of the protocol work together?	Overall, both the intervention and the study design were deemed acceptable	There was a high portion of uncompleted admission cognitive exams and functional status scores	Omit admission cognitive exams and FSS-ICU in future trials

ACE = adapted cognitive exam; ESM = electronic supplementary material; ICU = intensive care unit; FSS-ICU = functional status score for the ICU; LOC = level of consciousness; OT = occupational therapist; QOL = quality of life; RA = research assistant; RASS = Richmond Agitation and Sedation Scale; RCT = randomized controlled trial; SD = standard deviation; SDM = substitute decision maker

## Clinical outcomes

Overall, 36/67 (54%) of patients enrolled experienced delirium. A description of delirium outcomes, cognitive function, functional status, QOL, and length of stay is presented in Table 3.

## Discussion

In this feasibility RCT, we have shown that OT-guided cognitive interventions in critically ill patients are feasible. Despite the severity of illness experienced by ICU patients, the length of the interventions was also deemed feasible. Additionally, we were able to measure clinical outcomes relevant to future RCTs including delirium prevalence and duration, cognitive status, functional status, QOL, and ICU length of stay. We also identified several methodological challenges with recruitment, refusal of consent, OT weekend support, and ICU admission outcome measures. The results of this study will provide much-needed data to help plan for future large RCTs of OT-guided cognitive interventions.

The majority of eligible cognitive interventions were delivered and only 4% of sessions were refused by patients, which shows feasibility of the intervention. We found that the goal session length of 20 min was frequently achieved with a low rate of early termination due to patient fatigue. Similarly, in a feasibility trial of combined cognitive and physical therapy in critically ill patients, Brummel *et al.* found that cognitive interventions conducted by physicians or nurses for 20 min twice daily was feasible and safe.<sup>35</sup> In another pilot study of non-mechanically ventilated patients, OTs conducted a longer duration of intervention (40 min twice daily for five days) and found a positive impact on delirium incidence and duration.<sup>36</sup>

## Methodological challenges and proposed solutions

### Participant consent

We identified several methodological challenges outlined in Table 2. Many patients or their SDM refused consent, which could be attributed to early study enrolment during periods of high stress or the belief that cognitive interventions may be burdensome during critical illness. However, similar to the concept of early mobility in ICU patients, our protocol aims were for early cognitive engagement, so we view early study enrolment as beneficial. Nevertheless, consent timing could be extended to 72 hr in future trials to ensure inclusion of patients admitted on a weekend or holiday. Finally, highlighting family participation in delirium management as part of the study design may provide family members with a sense of purpose and autonomy.

### Randomization

A failure to complete goal study enrolment due to early termination resulted in imbalances between groups. The intervention group had a higher proportion of delirium, which may be attributed to the group's higher median age and higher severity of illness. Both age and higher APACHE-II scores have been independently associated with delirium in critical illness and thus, future RCTs may stratify randomization and include a subgroup analysis.<sup>5, 37, 38</sup> It should be noted that Brummel *et al.* trialled their cognitive plus physical therapy intervention protocol on patients with higher APACHE-II scores (median score, 25) than our sample intervention population (median score, 22) and yet the intervention was still deemed feasible.<sup>35</sup> It is worth investigating the demands, time constraints, and level of coma in sicker patients (i.e., those with higher APACHE-II scores) and the potential impact on the number or duration of interventions. These variables (along with other factors) and treatment effect modification should be considered in a larger hypothesis-testing RCT.

**Table 3** Clinical outcomes stratified by group assignment

Outcome*	Intervention group N = 32	Control group N = 37
Delirium ever experienced, <i>n</i> /total <i>N</i> (%) <sup>†</sup>	17/32 (57%)	19 (51%)
Duration of delirium (calendar days with at least 1 ICDSC score $\geq$ 4), median [IQR]	1 [0–2]	1 [0–3]
ACE admission assessment, mean (SD) <sup>‡</sup>	64 (39)	71 (34)
ACE discharge assessment, mean (SD) <sup>§</sup>	82 (20)	83 (27)
FSS-ICU admission assessment, mean (SD) <sup>**</sup>	13.0 (12.4)	13.1 (12.6)
FSS-ICU discharge assessment, mean (SD) <sup>††</sup>	22.0 (10.4)	23.0 (11.1)
QOL, mean (SD) <sup>‡‡</sup>		
Mobility	3.2 (1.1)	2.9 (1.3)
Self-care	2.9 (1.5)	2.5 (1.2)
Usual activities	3.3 (1.2)	3.3 (1.8)
Pain/discomfort	2.6 (1.2)	2.5 (1.1)
Anxiety/depression	2.6 (1.4)	2.5 (1.0)
Reported health status on scale of 0 (worst health you can imagine) to 100 (best health you can imagine)	42 (26)	51 (29)
Days of mechanical ventilation, median [IQR]	2.8 [1.2–4.4]	3.0 [1.2–6.1]
ICU LOS, median [IQR]	4.4 [3.3–5.9]	5.0 [3.0–8.2]
Hospital LOS, median [IQR]	14.2 [7.2–27.9]	12.4 [7.5–24.1]
Death, <i>n</i> /total <i>N</i> (%)	6/32 (19%)	5 (14%)

\* See Electronic Supplementary Material for full description of instruments

<sup>†</sup> ICDSC is not calculated for patients with RASS -4/-5

<sup>‡</sup> Unable to complete admission ACE <sup>24</sup> for 43 participants because of altered level of consciousness (*n* = 41), medical emergency (*n* = 1), or communication barriers (*n* = 1).

<sup>§</sup> Unable to complete discharge ACE <sup>24</sup> for 16 participants because of death (*n* = 11); altered level of consciousness (*n* = 2); patient refusal (*n* = 1); communication barriers (*n* = 1); and transfer to another ICU (*n* = 1).

<sup>\*\*</sup> Unable to complete admission FSS-ICU <sup>25</sup> for 44 participants because of altered level of consciousness (*n* = 43) and medical emergency (*n* = 1)

<sup>††</sup> Unable to complete discharge FSS-ICU <sup>25</sup> for 16 participants because of death (*n* = 11); loss to follow-up (*n* = 3); altered level of consciousness (*n* = 2)

<sup>‡‡</sup> Unable to complete QOL scores <sup>26</sup> for 18 patients because of death (*n* = 11), communication barriers (*n* = 1), altered level of consciousness (*n* = 4), loss to follow up (*n* = 1), and patient refusal (*n* = 1). 21 patients did not complete the Health Status Score portion of the QOL

ACE = adapted cognitive exam; FSS-ICU = Functional Status Score for ICU; ICDSC<sup>10</sup> = intensive care delirium screening checklist; ICU = intensive care unit; IQR = interquartile range; LOS = length of stay; QOL = quality of life; SD = standard deviation

### Occupational therapist guided cognitive interventions

A mean of four sessions per patient were delivered. Nevertheless, the optimal “dose” or number of OT interventions should be investigated in future trials. The analysis of delirium outcomes, with a cost effectiveness analysis using just once daily interventions would be important for resource-limited institutions. Furthermore, the indirect supervision of other providers, such as therapy assistants, by OTs may be acceptable to maximize the number of interventions. Occupational therapist or assistant delivery of delirium prevention practices may help to ameliorate nursing workloads by allowing this specifically focused therapy to be conducted by a separate provider; therefore, future trials may measure nursing satisfaction

with the protocol. Finally, determining the effects of interventions at each level of sedation on outcomes such as delirium, cognitive scores, hospital length of stay, outpatient cognitive function, or memory formation at various levels of sedation would delineate the most efficacious portions of the protocol and assist with further refinement.<sup>39</sup>

### Limitations

There are several limitations to our study. This study was underpowered to determine effects of the intervention on delirium prevalence and duration, and a failure to complete target study enrolment because of early termination resulted in imbalances between the groups. A well-

powered trial is needed to equally distribute confounding variables and address the protocol's effect on delirium prevalence and duration.

The COVID-19 pandemic greatly impacted the target recruitment number and may have impacted our cognitive intervention protocol because of family visitation restrictions and continuous masking, which interfered with communication and facial recognition. Although the study was terminated before a major pandemic surge, the standard of care delirium prevention practices may have been affected by higher staff workloads. This may have included missing delirium scores in the electronic medical record. Future studies should consider using trained study team members to conduct delirium assessments to ensure complete data collection. Additionally, the use of sealed opaque envelopes to conceal randomization, while cost effective and practical, may have increased the risk of bias; therefore, future trial designs may include the use of a web-based allocation concealment method.<sup>40</sup> Finally, this protocol was not designed for neurocritical care patients, and enrolment at a single site limits generalizability of feasibility findings to other ICUs and to patients with COVID-19.

## Conclusion

Intensive care unit delirium remains a frequent and severe consequence of critical illness with the potential for long term cognitive impairments. Using a novel approach, this OT-guided cognitive intervention protocol is feasible in critically ill medical/surgical patients and can be titrated according to the deepest levels of sedation while incorporating family members. A larger RCT is required to determine the impact of such a protocol on delirium prevalence or duration.

**Author contributions** Kirsten Deemer, Brittany Myhre, Michelle Parsons, Stephanie Oviatt, and Juan Posadas-Calleja contributed to all aspects of this manuscript, including study conception and design; acquisition, analysis, and interpretation of data; and drafting the article. Kirsten Fiest contributed to study design; acquisition, analysis and interpretation of data; and drafting of the article. Andrea Soo contributed to statistical analysis, interpretation of data, and drafting the article. Mallory Watson contributed to study conception and design. Karolina Zjadewicz contributed to study conception and drafting the article.

**Acknowledgements** We would like to thank the Department of Critical Care Medicine at University of Calgary including Dr. Karla Krewulak, Senior Research Associate. We also would like to show our gratitude to the Alberta Health Services Research Challenge, SHC ICU Manager Rachel Taylor, RN, the SHC Department of Allied Health, and SHC ICU staff.

**Disclosures** The authors report no conflicts of interest.

**Funding statement** This work was supported by the Transitions in Care Seed Grant (Canadian Institutes of Health Research), the Alberta Health Services Research Challenge, and the Department of Critical Care Medicine, Calgary, Alberta.

**Editorial responsibility** This submission was handled by Dr. Patricia S. Fontela, Associate Editor, *Canadian Journal of Anesthesia/Journal canadien d'anesthésie*.

## References

1. Deemer K, Zjadewicz K, Fiest K, et al. Effect of early cognitive interventions on delirium in critically ill patients: a systematic review. *Can J Anesth* 2020; 67: 1016–34. <https://doi.org/10.1007/s12630-020-01670-z>
2. Pandharipande P, Ba C, Shintani A, et al. Prevalence and risk factors for development of delirium in surgical and trauma intensive care unit patients. *J Trauma* 2008; 65: 34–41. <https://doi.org/10.1097/ta.0b013e31814b2c4d>
3. Barnes-Daly MA, Phillips G, Ely EW. Improving hospital survival and reducing brain dysfunction at Seven California Community Hospitals: implementing PAD guidelines via the ABCDEF bundle in 6,064 patients. *Crit Care Med* 2017; 45: 171–8. <https://doi.org/10.1097/ccm.0000000000002149>
4. Hughes CG, Hayhurst CJ, Pandharipande PP, et al. Association of delirium during critical illness with mortality: multicenter prospective cohort study. *Anesth Analg* 2021; 133: 1152–61. <https://doi.org/10.1213/ane.0000000000005544>
5. Salluh JI, Wang H, Schneider EB, et al. Outcome of delirium in critically ill patients: systematic review and meta-analysis. *BMJ* 2015; 350: h2538. <https://doi.org/10.1136/bmj.h2538>
6. Brummel NE, Jackson JC, Pandharipande PP, et al. Delirium in the ICU and subsequent long-term disability among survivors of mechanical ventilation. *Crit Care Med* 2014; 42: 369–77. <https://doi.org/10.1097/ccm.0b013e3182a645bd>
7. Ely EW, Shintani A, Truman B, et al. Delirium as a predictor of mortality in mechanically ventilated patients in the intensive care unit. *JAMA* 2004; 291: 1753–62. <https://doi.org/10.1001/jama.291.14.1753>
8. Dziegielewski C, Skead C, Canturk T, et al. Delirium and associated length of stay and costs in critically ill patients. *Crit Care Res Pract* 2021; 2021: 6612187. <https://doi.org/10.1155/2021/6612187>
9. Devlin JW, Skrobik Y, Gélinas C, et al. Clinical practice guidelines for the prevention and management of pain, agitation/sedation, delirium, immobility, and sleep disruption in adult patients in the ICU. *Crit Care Med* 2018; 46: e825–73. <https://doi.org/10.1097/ccm.0000000000003299>
10. Bergeron N, Dubois MJ, Dumont M, Dial S, Skrobik Y. Intensive care delirium screening checklist: evaluation of a new screening tool. *Intensive Care Med* 2001; 27: 859–64. <https://doi.org/10.1007/s001340100909>
11. Al-Qadheeb N, Fraser G, Balk E, et al. A meta-analysis and meta-regression of randomized, controlled ICU trials with interventions hypothesized to reduce delirium: the relationship between duration of delirium and hospital mortality. *Crit Care Med* 2012; 1: 93–4.
12. Schweickert WD, Pohlman MC, Pohlman AS, et al. Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial. *Lancet* 2009; 373: 1874–82. [https://doi.org/10.1016/s0140-6736\(09\)60658-9](https://doi.org/10.1016/s0140-6736(09)60658-9)

13. Kolanowski AM, Hill N, Clare L, Marx P. Practical protocol for implementing cognitive stimulation in persons with delirium superimposed on dementia. *Nonpharmacol Ther Dement* 2012; 2: 101–10.
14. Clare L, Woods R. Cognitive training and cognitive rehabilitation for people with early-stage Alzheimer's disease: a review. *Neuropsychol Rehabil* 2004; 14: 385–401. <https://doi.org/10.1080/09602010443000074>
15. Harvey PD. Domains of cognition and their assessment. *Dialogues Clin Neurosci* 2019; 21: 227–37. <https://doi.org/10.31887/dens.2019.21.3/pharvey>
16. Bahar-Fuchs A, Clare L, Woods B. Cognitive training and cognitive rehabilitation for persons with mild to moderate dementia of the Alzheimer's or vascular type: a review. *Alzheimers Res Ther* 2013; 5: 35. <https://doi.org/10.1186/alzrt189>
17. Germain S, Wojtasik V, Lekeu F, et al. Efficacy of cognitive rehabilitation in alzheimer disease: a 1-year follow-up study. *J Geriatr Psychiatry Neurol* 2019; 32: 16–23. <https://doi.org/10.1177/0891988718813724>
18. Costigan FA, Duffett M, Harris JE, Baptiste S, Kho ME. Occupational therapy in the ICU: a scoping review of 221 documents. *Crit Care Med* 2019; 47: e1014–21. <https://doi.org/10.1097/ccm.0000000000003999>
19. American Occupational Therapy Association. Cognition, cognitive rehabilitation, and occupational performance. *Am J Occup Ther* 2019; 73: <https://doi.org/10.5014/ajot.2019.73s201>
20. Sessler CN, Gosnell MS, Grap MJ, et al. The Richmond Agitation-Sedation Scale: validity and reliability in adult intensive care unit patients. *Am J Respir Crit Care Med* 2002; 166: 1338–44. <https://doi.org/10.1164/rccm.2107138>
21. Eldridge SM, Chan CL, Campbell MJ, et al. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. *Pilot Feasibility Stud* 2016; 2: 64. <https://doi.org/10.1186/s40814-016-0105-8>
22. Orkin AM, Gill PJ, Ghersi D, et al. Guidelines for reporting trial protocols and completed trials modified due to the COVID-19 Pandemic and other extenuating circumstances: the CONSERVE 2021 Statement. *JAMA* 2021; 326: 257–65. <https://doi.org/10.1001/jama.2021.9941>
23. Brundin-Mather R, Soo A, Zuege DJ, et al. Secondary EMR data for quality improvement and research: a comparison of manual and electronic data collection from an integrated critical care electronic medical record system. *J Crit Care* 2018; 47: 295–301. <https://doi.org/10.1016/j.jcrc.2018.07.021>
24. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009; 42: 377–81. <https://doi.org/10.1016/j.jbi.2008.08.010>
25. Lewin JJ 3rd, LeDroux SN, Shermock KM, et al. Validity and reliability of The Johns Hopkins Adapted Cognitive Exam for critically ill patients. *Crit Care Med* 2012; 40: 139–44. <https://doi.org/10.1097/ccm.0b013e31822ef9fc>
26. Huang M, Chan KS, Zanni JM, et al. Functional status score for the ICU: an international clinimetric analysis of validity, responsiveness, and minimal important difference. *Crit Care Med* 2016; 44: e1155–64. <https://doi.org/10.1097/ccm.0000000000001949>
27. Herdman M, Gudex C, Lloyd A, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Qual Life Res* 2011; 20: 1727–36. <https://doi.org/10.1007/s11136-011-9903-x>
28. Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005; 173: 489–95. <https://doi.org/10.1503/cmaj.050051>
29. Raith EP, Udy AA, Bailey M, et al. Prognostic accuracy of the SOFA Score, SIRS Criteria, and qSOFA Score for in-hospital mortality among adults with suspected infection admitted to the intensive care unit. *JAMA* 2017; 317: 290–300. <https://doi.org/10.1001/jama.2016.20328>
30. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. *Crit Care Med* 1985; 13: 818–29.
31. van den Boogaard M, Schoonhoven L, Maseda E, et al. Recalibration of the delirium prediction model for ICU patients (PRE-DELIRIC): a multinational observational study. *Intensive Care Med* 2014; 40: 361–9. <https://doi.org/10.1007/s00134-013-3202-7>
32. Rivosecchi RM, Smithburger PL, Svec S, Campbell S, Kane-Gill SL. Nonpharmacological interventions to prevent delirium: an evidence-based systematic review. *Crit Care Nurse* 2015; 35: 39–50. <https://doi.org/10.4037/ccn2015423>
33. Sosnowski K, Mitchell ML, White H, et al. A feasibility study of a randomised controlled trial to examine the impact of the ABCDE bundle on quality of life in ICU survivors. *Pilot Feasibility Stud* 2018; 4: 32. <https://doi.org/10.1186/s40814-017-0224-x>
34. Shanyinde M, Pickering RM, Weatherall M. Questions asked and answered in pilot and feasibility randomized controlled trials. *BMC Med Res Methodol* 2011; 11: 117. <https://doi.org/10.1186/1471-2288-11-117>
35. Brummel NE, Girard TD, Ely EW, 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: 370–9. <https://doi.org/10.1007/s00134-013-3136-0>
36. Álvarez EA, Garrido MA, Tobar EA, et al. Occupational therapy for delirium management in elderly patients without mechanical ventilation in an intensive care unit: a pilot randomized clinical trial. *J Crit Care* 2017; 37: 85–90. <https://doi.org/10.1016/j.jcrc.2016.09.002>
37. Gravante F, Giannarelli D, Pucci A, et al. Prevalence and risk factors of delirium in the intensive care unit: an observational study. *Nurs Crit Care* 2021; 26: 156–65. <https://doi.org/10.1111/nicc.12526>
38. Zaal IJ, Devlin JW, Peelan LM, Slooter AJ. A systematic review of risk factors for delirium in the intensive care unit. *Crit Care Med* 2013; 1: 40–7. <https://doi.org/10.1097/ccm.0000000000000625>
39. Kredentser MS, Blouw M, Marten N, et al. Preventing posttraumatic stress in ICU survivors: a single-center pilot randomized controlled trial of ICU diaries and psychoeducation. *Crit Care Med* 2018; 46: 1914–22. <https://doi.org/10.1097/ccm.0000000000000367>
40. Clark L, Dean A, Mitchell A, Torgerson D. Envelope use and reporting in randomized controlled trials: a guide for researchers. *Res Methods Med Health Sci* 2020; 2: 2–11. <https://doi.org/10.1177/2F2632084320957204>

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