As populations age worldwide, and medical advances enable a high quality of life into the eighth, ninth and even tenth decades of life, there have been increased admissions to intensive care units (ICUs) among adults aged 65 years and older (older adults). Older adults now account for more than 50% of patients in ICUs in Canada.\(^1\) To date, during the COVID-19 pandemic, 59.3% of patients with COVID-19 admitted to ICUs in Canada were older than 60 years.\(^2\) People requiring ICU admission are deemed “critically ill.” Critically ill older adults are a unique population with distinct care requirements owing to physiologic and pathologic changes associated with aging. We review best practice in the care of critically ill older adults, drawing on available evidence (see Box 1). We discuss integration of evidence-based geriatric principles into ICU care, the importance of identifying pre-existing frailty in older adults, measures to prevent and treat delirium, and optimization of post-ICU care.

### Why and how should evidence-based geriatric principles be integrated into routine ICU care?

Because older adults are more likely to have complex medical and social needs, it is important to use a holistic and comprehensive approach to their care in all health care settings. The increasing numbers of older adults requiring ICU care has led to the development of the nascent field of geriatric critical care. Practitioners of geriatric medicine have expertise in caring for frail older adults, and there is growing interest within the critical care community in adopting evidence-based geriatric principles in the ICU.\(^3\)–\(^11\) Geriatricians are already involved in successful collaborative models with clinicians who have expertise in orthopedics, cardiology, vascular surgery, trauma and oncology, with evidence for improved patient outcomes.\(^10\)–\(^12\),\(^15\) However, an important barrier to collaborative care models in Canada is the relative scarcity of geriatricians, with fewer than 400 specialists nationally. It is thus most practical for principles used in comprehensive geriatric assessment to be incorporated in other ways into routine ICU care.

Integration of geriatric principles into routine care has been well studied in specialized acute care of the elderly (ACE) units for older adults in hospital who are acutely unwell but do not require ICU admission. In a systematic review and meta-analysis of 13 trials and 6839 patients with a mean age of 81 years, the use of geriatric principles in ACE units was shown to reduce hospital-acquired functional decline, falls, delirium, hospital length of stay, cost and discharge to long-term care.\(^16\) Table 1 summarizes the multicomponent interventions typically used in ACE units. Capacity-building collaborative care models to increase geriatric competencies among ICU staff, as well as innovative strategies such as abbreviated geriatric assessments using electronic health records,\(^25\) are promising areas for future research.

Comprehensive care is incomplete without consideration of patients’ social contexts. Geriatricians use a biopsychosocial approach to care planning. Although current evidence is of very low to moderate quality, guidelines support increasing family presence, support and communication in the ICU.\(^26\) Resources to increase family-centred care are available online (https://www.sccm.org/Research/Guidelines/Guidelines/Family-Centered-Care-in-the-ICU).
What is the relevance of pre-existing frailty for critically ill older adults?

The prevalence of frailty in older patients admitted to the ICU is about 30%, according to pooled results across 6 prospective observational studies. Frailty is a state of decreased physiologic, functional and cognitive reserve that results in increased vulnerability to new health stressors. It is believed to result from the interplay of comorbid diseases, genetics and environmental factors, and may be partially reversible in the intermediate stages. Frailty is not an inherent part of aging, although age is a risk factor for frailty and an independent risk factor for adverse outcomes.

Ascertaining frailty is relevant in the ICU as part of a global assessment to better understand a patient’s risk of adverse outcomes and to inform goals-of-care discussions. In a prospective multicentre cohort study of 610 patients older than 80 years in Canada, frailty was found to be a more significant independent predictor of long-term ICU outcomes than age, illness severity or comorbidity. A 2017 meta-analysis of 10 prospective cohort studies of moderate quality (mean Newcastle-Ottawa Scale score 6.5) found that pre-hospital frailty was associated with increased hospital mortality (relative risk [RR] 1.71, 95% confidence interval [CI] 1.43–2.05) and long-term mortality (RR 1.53, 95% CI 1.40–1.68), independent of age or illness severity. Several studies have reported an incremental increase in mortality for each additional point on the Clinical Frailty Scale (CFS), particularly in those with severe or very severe frailty (CFS ≥ 7). Understanding the impact of frailty on ICU prognosis shifts the concern from a patient’s age toward their overall clinical status and trajectory before ICU admission.

With respect to post-ICU morbidity, patients who are frail and survive their incident critical illness face worsened physical function and higher admission rates to long-term care homes compared with older adults who are not frail. A 15-year-long prospective longitudinal study of 754 community-dwelling adults

| Table 1: Comprehensive multicomponent checklist for routine ICU care* |
|-----------------------------------------------|
| Principle                                      | Routine practice suggestion                                              |
| Prevention of delirium                        | • Provide patients with hearing aids and glasses                           |
| Sleep                                         | • Earplugs, minimization of noise                                           |
| Cognition                                     | • Cognitive-stimulation activities such as music, family-voice reorientation and family involvement   |
| Mood                                          | • Conversion to daytime bolus feeds to decrease night-time interruptions† |
| Mobility and early rehabilitation             | • Early physiotherapy or occupational therapy assessment for advancing mobility and function toward maintenance of activities of daily living |
| Nutrition                                     | • Dietitian consult                                                        |
| Continen ce                                   | • Removal of indwelling catheters to avoid catheter-associated bladder infections and promote mobility |
| Skin integrity                                | • Frequent turning to avoid pressure injuries                              |
| Minimization of polypharmacy                 | • Daily medication review by pharmacist using STOPP/START criteria or American Geriatrics Society Beers criteria of potentially inappropriate medications |
| Environmental modifications to facilitate physical and cognitive function | • Large clocks and calendars                                             |
| Early discharge planning                      | • Early involvement of social worker and family                           |
|                                               | • Multidisciplinary team rounding with early ongoing emphasis on the goal of returning home (or to pre-hospital living environment) |

Note: ACE = acute care of the elderly, ICU = intensive care unit, START = Screening Tool to Alert to Right Treatment, STOPP = Screening Tool of Older Persons’ Prescriptions. Based on evidence-based principles of ACE unit care. Not included in traditional ACE unit protocols. ABCDEF bundle is a multicomponent strategy for delirium prevention and treatment, and includes pain management, trials of spontaneous awakening, choice of analgesia and sedation, monitoring and management of delirium, early mobilization, and family engagement.
older than 70 years found that patients who were pre-frail (1 or 2 Fried frailty criteria present, using the Fried phenotypic model of frailty) or frail (3 or more criteria) did not return to their baseline physical function by 6 months. They did, however, improve compared with their functional status 1 month after ICU discharge, when disability was at its greatest. In comparison, older adults who were not frail at ICU admission returned close to their baseline level of physical function by 6 months. Patients who were frail had a 58.8% admission rate to long-term care at 6 months, a finding consistent with a 2017 meta-analysis in which these patients were less likely to be discharged home (RR 0.59, 95% CI 0.49–0.71). When counselling patients and families on post-ICU expectations, explicit consideration of frailty helps prevent overestimation of functional impairment in those who are not frail, and underestimation in those who are frail (Figure 1). Nevertheless, it is not clear whether the post-ICU outcomes observed are inevitable for patients who are frail, as no studies have examined how changes to management during or after ICU admission could mitigate the incidence or worsening of frailty-associated outcomes. This is an important area for future research.

The 2 main conceptual frameworks of frailty are a physical, or phenotypic, model and a deficit accumulation, or index, model. Several tools based on these frameworks may be used to assess frailty. For older adults admitted to the ICU, we favour the Clinical Frailty Scale presented in Figure 2. The CFS is highly correlated with the Frailty Index and has been validated with good inter-rater reliability (κ 0.74) between assessors in the ICU setting. Its use is more feasible in critically ill patients than other commonly used tools that require grip strength or mobility assessments, for example. To avoid overscoring the CFS based on the state of critical illness of a patient in the ICU, the assessment should be based on clinical status at least 2 weeks before admission. If there is limited history available from the patient or family members to make this assessment, collateral information can be sought through community care providers, including personal support workers, pharmacists, family physicians and local community care coordinators. Clinicians unfamiliar with the CFS are encouraged to review resources on proper use to ensure reliability.

Why is recognizing delirium important?

Delirium in the ICU is common, although underdiagnosed, with prevalence of 20%–84% depending on the severity of illness and method of diagnosis. It is defined by a change from baseline in attention and awareness that is acute, fluctuating and accompanied by disturbed cognition (memory deficit, disorientation, or abnormal language, visuospatial ability or perception). Functional abilities

Figure 1: Potential impact of pre-existing frailty on outcomes after minor and major illness. The green line represents the medical course of an individual who is not frail (Clinical Frailty Score [CFS] 1–3, independent with basic and instrumental activities of daily living [BADLs and IADLs]): a minor illness may cause a transient reduction in physical or cognitive function, but the individual recovers to baseline. A major illness requiring admission to intensive care may cause substantial reduction in function and impairment in ADLs, but a patient who is not frail may improve close to baseline by 6 months. The yellow line represents the medical course of an individual with mild frailty (CFS 4–5): a minor illness may cause a disproportionate reduction in function, and the individual may not return to baseline. A major illness requiring admission to intensive care may cause further substantial reduction in function, from which the individual recovers only partially by 6 months. The orange line represents the medical course of an individual with moderate to severe frailty (CFS 6–8): a minor illness is likely to cause further disproportionate reduction in already limited function without return to baseline, and a major illness is likely to result in substantial reduction in function that does not improve by 6 months, assuming the individual is able to survive the index critical illness (in-hospital mortality for CFS 8 is reported at 48%, and 12-month survival for CFS 6–7 is 35%). Note: ICU = intensive care unit.
### CLINICAL FRAILTY SCALE

| Number | State | Description |
|--------|-------|-------------|
| 1      | VERY FIT | People who are robust, active, energetic and motivated. They tend to exercise regularly and are among the fittest for their age. |
| 2      | FIT | People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g., seasonally. |
| 3      | MANAGING WELL | People whose medical problems are well controlled, even if occasionally symptomatic, but often are not regularly active beyond routine walking. |
| 4      | LIVING WITH VERY MILD FRAILTY | Previously “vulnerable,” this category marks early transition from complete independence. While not dependent on others for daily help, often symptoms limit activities. A common complaint is being “slowed up” and/or being tired during the day. |
| 5      | LIVING WITH MILD FRAILTY | People who often have more evident slowing, and need help with high order instrumental activities of daily living (finances, transportation, heavy housework). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation, medications and begins to restrict light housework. |
| 6      | LIVING WITH MODERATE FRAILTY | People who need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing. |
| 7      | LIVING WITH SEVERE FRAILTY | Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~6 months). |
| 8      | LIVING WITH VERY SEVERE FRAILTY | Completely dependent for personal care and approaching end of life. Typically, they could not recover even from a minor illness. |
| 9      | TERMINALLY ILL | Approaching the end of life. This category applies to people with a life expectancy <6 months, who are not otherwise living with severe frailty. (Many terminally ill people can still exercise until very close to death.) |

### SCORING FRAILTY IN PEOPLE WITH DEMENTIA

The degree of frailty generally corresponds to the degree of dementia. Common symptoms in mild dementia include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal. In moderate dementia, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting. In severe dementia, they cannot do personal care without help. In very severe dementia they are often bedfast. Many are virtually mute.

Clinical Frailty Scale ©2005–2020 Rockwood, Version 2.0 (EN). All rights reserved. For permission: www.geriatricmedicine.rockwood.ca
Rockwood K et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173:489–495.

Figure 2: The Clinical Frailty Score (CFS) can be used to summarize the overall clinical status of a patient based on comorbidities, activity level and functional impairment. Through conversations with the patient, family or other reliable informant, clinical judgment is used to determine which category best fits the patient. It is recommended that the score be based on the patient’s status 2 weeks before admission to an intensive care unit (ICU) (reproduced with permission: Rockwood et al.25).
A 2015 meta-analysis found that delirium in the ICU was associated with increased mortality (RR 2.19, 95% CI 1.78–2.70), a finding that persisted even after the metaregression to account for age, proportion of female participants and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores; longer duration of mechanical ventilation (mean difference [MD] 1.79 days longer), longer ICU admission (MD 33 hours longer), longer hospital stay (MD 23.3 hours longer) and postdischarge cognitive impairment at 3 and 12 months, compared with those who do not develop delirium.51

Risk factors for delirium in the ICU include benzodiazepine use, blood transfusions, increasing age, a history of dementia, previous coma, higher APACHE II and American Society of Anesthesiology scores, and pre-ICU emergency surgery or trauma.57 Of these, benzodiazepine use is potentially modifiable;48,59 this class of medication should be avoided unless clearly indicated for a specific medical condition, such as acute alcohol withdrawal.

How can delirium be prevented and managed?

Because delirium often goes undiagnosed, it is important to optimize recognition of the condition. The 2018 Clinical Practice Guidelines for ICU Pain, Agitation/Sedation, Delirium, Immobility and Sleep Disruption (PADIS) recommend screening for delirium with a valid tool,57 such as the Confusion Assessment method for the ICU (CAM-ICU)60 or Intensive Care Delirium Screening Checklist (ICDSC).53 The ICDSC has a sensitivity of 99% and specificity of 64%,61 and the CAM-ICU has a sensitivity of 75.5% and specificity of 95.8%.60

Nonpharmacologic interventions are the mainstay of preventing delirium in the ICU. A meta-analysis of 9 studies found that earplugs reduce the incidence of delirium (RR 0.59, 95% CI 0.44–0.78),53 suggesting their use is reasonable as a low-harm, low-cost intervention. Several small randomized controlled trials (RCTs) of limited generalizability have investigated other single-component interventions with negative results, including cognitive therapy,63 family-voice reorientation64 and light therapy.65

Evidence is stronger for multicomponent interventions,46,66–68 likely reflecting that the development of delirium is multifactorial. The PADIS guideline found an odds ratio (OR) of 0.59 (95% CI 0.39–0.88) for reduced incidence of delirium with use of multicomponent bundles.57 The ABCDEF bundle is an operationalized framework of these guidelines; its components include pain management, trials of spontaneous awakening, choice of analgesia and sedation, monitoring and management of delirium, early mobilization, and family engagement.46 Principles of the ABCDEF bundle overlap with the demedicalization and patient-centred principles of the multicomponent interventions typically used in ACE units (outlined in Table 1). In a large, prospective, multicentre cohort study of more than 15,000 patients, use of the bundle resulted in a dose-dependent reduction in delirium incidence (OR 0.60, 95% CI 0.49–0.72), coma, use of physical restraint, ICU readmission, and ICU and hospital mortality.46 Future studies should focus on implementation and knowledge translation strategies; implementation resources are available online (www.icudelirium.org/medical-professionals/overview).

Antipsychotic use for the prevention of delirium is not recommended,57 given a Cochrane meta-analysis59 and large subsequent RCT of more than 1700 patients that showed no benefit over placebo.60 Dexmedetomidine may be preferentially considered for sedation in patients at high risk for delirium who require sedation for other indications. Although the PADIS guideline recommends against the use of dexmedetomidine for the prevention of delirium,57 2 more recent systematic reviews and meta-analyses suggest it is associated with reduced incidence of delirium.70,71

Most evidence supporting the use of multicomponent bundles is related to prevention of delirium, but they are also recommended for its treatment, as their potential benefits outweigh the risks.46,57 Antipsychotics are not effective, with the Modifying the Impact of ICU-Associated Neurological Dysfunction-USA (MIND USA) multicentre RCT of 1789 patients finding no difference in effect between haloperidol, ziprasidone and placebo when measuring duration of delirium.84 The PADIS guideline supports use of dexmedetomidine when delirium-associated agitation precludes weaning or extubation,57 based on a single, low-quality RCT.72 The effectiveness of dexmedetomidine in delirium without agitation remains unclear, and dose reduction is suggested in those older than 65 years, owing to higher rates of bradycardia and hypotension.73

When symptoms of delirium such as hallucinations, anxiety or agitation cause psychological or physical harm to patients or pose risks to health care workers, antipsychotic treatment may be required. If so, it is best to follow the geriatric principle of “start low and go slow,” and prescribe on a short-term and as-needed basis to avoid unintentional use after discharge from the ICU or hospital. A prospective observational cohort study found that 24% of patients treated for delirium with an atypical antipsychotic medication were discharged from hospital on these medications.74 Such discharge prescriptions are likely unintentional, but prescribing inertia may lead to their continued use.

What post-ICU complications should physicians anticipate in older adults who survive critical illness?

As medical and technological capabilities have improved, ICU-associated mortality has declined and most older adults survive critical illness; among ICU survivors older than 80 years, long-term mortality rates at 1, 2 and 3 years after hospital discharge are comparable with age- and sex-matched general population mortality rates.75 One prospective study of 3920 patients with a mean age of 84 years from 22 countries found an ICU survival rate of 72.5%, with a 30-day survival rate of 61.2%.34 However, surviving critical illness may lead to long-term ICU-associated morbidity and functional decline, which are important outcomes to anticipate and manage proactively in the post-ICU period.

The prevalence of post-intensive care syndrome (PICS) in adults is unclear, but is believed to affect between 25% and 55% or
more of ICU survivors. The syndrome encompasses a heterogeneous group of new or worsening cognitive, physical or mental health impairments (Figure 3), which can include posttraumatic stress disorder (PTSD) (44% at 6 mo), impairment in instrumental activities of daily living, depression (34% at 6 mo), and cognitive impairment (34% at 12 mo). Given the scope of impairments, patients with PICS may need higher levels of care or informal caregiver support after hospital discharge. Post–intensive care syndrome—Family (PICS-F) is a similar grouping of outcomes in family members of ICU survivors, and includes new or worsening PTSD, depression, complicated grief or anxiety.

Management of PICS after ICU discharge is an area of evolving knowledge. Most patients discharged from the hospital experience inadequate specialist follow-up and rehabilitation, polypharmacy, and fragmented care. Several systematic reviews have examined various post-ICU follow-up interventions; however, the results are difficult to interpret, given low-certainty evidence and heterogeneity in the populations, interventions, settings (inpatient v. outpatient) and outcome measures. We identified 5 controlled studies in which the intervention group had a mean age of more than 65 years. No studies provided subgroup analysis by degree of frailty, a major limitation given the evidence that pre-existing frailty substantially affects outcomes. Further studies on the management of older ICU survivors in the post-ICU period are needed, with a priori subgroup stratification by degree of frailty. Despite these limitations, some findings can be applied to older ICU survivors.

A large, population-based cohort study in Taiwan of more than 15,000 sepsis survivors with a mean age of 69.4 years found that physical rehabilitation in the 90 days after ICU discharge resulted in 8% decreased 1-year mortality (hazard ratio [HR] 0.92, 95% CI 0.88–0.96) and 5.6% decreased 10-year mortality (HR 0.94, 95% CI 0.92–0.97). Mortality reduced in a dose-dependent fashion based on the number of rehabilitation sessions that participants received.

**Figure 3:** Components of post-intensive care syndrome (PICS). Survivors of the intensive care unit (ICU) may experience cognitive, physical and mental health impairments. Family members may also experience mental health impairments after the care of a loved one in the ICU.
The benefit of physical therapy after critical illness was also shown in a recent systematic review of 16 RCTs and 10 observational studies of adult ICU survivors, which found that interventions for physical function improved depression and mental health–related quality of life. Importantly, it appears benefits may be lost if the correct population is not targeted, which could partially explain why some rehabilitation studies have not shown the same benefit in other populations. For example, the study in Taiwan found that there was no survival benefit in patients with a duration of ICU stay or mechanical ventilation less than 7 days, or in those with few comorbidities (measured by a Charlson Comorbidity Index ≤ 2), suggesting that patients most likely to benefit from physical rehabilitation are those who are less well at baseline or experience a prolonged critical illness and are thus at greater risk of muscle wasting and deconditioning. Determining what interventions work, for whom, and in what circumstances will help health teams avoid both under- and overuse of resources in patient-centred post-ICU care. A realist review (which uses a systematic approach to understand the mechanisms behind intervention outcomes) on post-ICU interventions is currently under way and will hopefully provide guidance for future post-ICU care pathways.

Other potentially effective interventions in older adults include the use of an ICU diary and incorporation of ACE unit principles into post-ICU care. An ICU diary is a record kept by family and health care providers during a patient’s ICU stay to fill in memory gaps, and in the general ICU population has been associated with reduced risk of depression and better quality of life in 2 systematic reviews. The ACE unit principles showed promise in 1 small RCT in France that, although underpowered, found a trend toward improved functional autonomy when older adults were admitted after ICU discharge to a geriatric ward using ACE unit principles, compared with routine care on a medical ward. Many hospital policies already support incorporation of geriatric principles into routine care for all older patients in the form of age-friendly care initiatives. The integration of ACE principles outlined in Table 1 may be considered for older ICU survivors admitted to medical or surgical wards, to prevent further hospital-acquired disability. Several studies using system and technological innovations to implement ACE principles are available.

During a hospital stay or soon after hospital discharge, referral to geriatric medicine for cognitive impairment, geriatric psychiatry for mental health concerns, and physiatry for optimization of physical function may be helpful to address specific components of PICS, although referral strategies have not been directly studied. Other postdischarge management strategies, such as nurse-led ICU follow-up services, are not effective, according to current evidence.

Conclusion

Guidance on how best to care for critically ill older adults is limited by a lack of RCTs that specifically focus on older adults and lack of studies that stratify results by the degree of frailty. Despite these limitations, we have identified steps to improve care, including understanding pre-existing frailty as a prognostic tool in the ICU, the importance of nonpharmacologic multicomponent interventions in delirium prevention and treatment, applying principles of geriatric medicine in routine ICU care, and an appreciation for the high prevalence of cognitive, physical and mental impairments after ICU admission. The involvement of geriatricians, who are experts in frailty, cognitive impairment and the care of older adults, may help intensivists and hospitalists focus on the acute nature of ICU and post-ICU care while the unique needs of older adults are addressed. Future research directions include geriatric collaborative care models in the ICU, implementation of geriatric principles in the post-ICU period, and the use of peri-ICU frailty assessments to create and monitor individualized treatment plans that address patients’ overall health trajectories (see Box 2).

References

1. Care in Canadian ICUs: data tables. Ottawa: Canadian Institute for Health Information. Available: https://www.cihi.ca/en/care-in-canadian-icu-data-tables (accessed 2021 Aug. 18).
2. COVID 19 daily epidemiology update. Ottawa: Public Health Agency of Canada; updated 2021 Sept. 3. Available: https://health-infobase.canada.ca/src/data/covidlive/Epidemiological-summary-of-COVID-19-cases-in-Canada-Canada.pdf (accessed 2021 Sept. 15).
3. Joyce MF, Reich JA. Critical care issues of the geriatric patient. Anesthesiol Clin 2015;33:551-61.
4. Flaatten H, de Lange DW, Artigas A, et al. The status of intensive care medicine research and a future agenda for very old patients in the ICU. Intensive Care Med 2017;43:1319-28.
5. Michels G, Sieber CC, Gernot M, et al. Geriatric intensive care: Consensus paper of DGfIN, DIVI, DAGI, DGGG, OGIAIN, DGP, DGEM, DGD, DGNI, DGIM, DGKiiPhi and DGG [article in German]. Z Gerontal Geriatr 2019;52:440-56.
6. Conroy S, Parker S. Acute care for frail older people: time to get back to basics? Age Ageing 2014;43:448-9.
7. Brummel NE, Ferrante LE. Integrating geriatric principles into critical care medicine: the time is now. Ann Am Thorac Soc 2018;15:518-22.
8. Hao J-F, Cui H-M, Han J-M, et al. Tele-ICU: The way forward in geriatric care? Aging Clin Exp Res 2014;26:575-82.
9. Guidet B, Vallet H, Boddart J, et al. Tele-ICU: The way forward in geriatric care? Aging Clin Exp Res 2014;26:575-82.
10. Damluji AA, Forman DE, van Diepen S, et al.; American Heart Association Council on Clinical Cardiology and Council on Cardiovascular and Stroke Nursing. Older adults in the cardiac intensive care unit: factoring geriatric syndromes in the management, prognosis, and process of care: a scientific statement from the American Heart Association. Circulation 2020;141:6-32.
11. Tardini F, Pinciroli R, Berra L. The intensive care unit: how to make this unfriendly environment more geriatric-friendly. Eur J Surg Oncol 2020;46:379-82.
12. Grigoryan KV, Javedan H, Rudolph JL. Orthogeriatric care models and outcomes in hip fracture patients: a systematic review and meta-analysis. J Orthop Trauma 2014;28:e49-55.
13. Partridge JSL, Harari D, Martin FC, et al. Randomized clinical trial of comprehensive geriatric assessment and optimization in vascular surgery. Br J Surg 2017;104:679-87.

Box 2: Unanswered questions

- What other interventions during or after admission to the intensive care unit (ICU) can prevent the incidence or worsening of frailty?
- How does frailty affect the success of interventions used to manage post–intensive care syndrome?
- Are collaborative care models using geriatric principles effective for the management of critically ill older adults during or after ICU admission, and what components are necessary for success?
14. Eagles D, Godwin B, Cheng W, et al. A systematic review and meta-analysis evaluating geriatric consultation on older trauma patients. *J Trauma Acute Care Surg* 2020;88:446-53.

15. Kalsi T, Babic-Iliman G, Ross PJ, et al. The impact of comprehensive geriatric assessment interventions on tolerance to chemotherapy in older people. *Br J Cancer* 2015;112:1343-44.

16. Fox MT, Persaud M, Maimets I, et al. Effectiveness of acute geriatric unit care using acute care for elders components: a systematic review and meta-analysis. *J Am Geriatr Soc* 2012;60:2237-45.

17. O'Mahony D, Holder CM, Liebenauer LL, et al. Effects of a multicomponent intervention on functional outcomes and process of care in hospitalized older patients: a randomized controlled trial of Acute Care for Elders (ACE) in a community hospital. *J Am Geriatr Soc* 2000;48:1572-81.

18. Palmer RM. The acute care for elders unit model of care. *Geriatrics (Basel)* 2018;3:59.

19. Landefeld CS, Palmer RM, Kresevic DM, et al. A randomized trial of care in a hospital medical unit especially designed to improve the functional outcomes of acutely ill older patients. *N Engl J Med* 1999;340:1338-44.

20. Barnes DE, Palmer RM, Kresevic DM, et al. Acute care for elders units produced shorter hospital lengths of stays at lower costs while maintaining patients' functional status. *Health Aff (Millwood)* 2012;31:1227-36.

21. Flood KL, Booth K, Vickers J. Acute Care for Elders (ACE) team model of care: a clinical overview. *Geriatrics (Basel)* 2018;3:50.

22. Pun BT, Balas MC, Barnes-Dalay MA, et al. Caring for critically ill patients with the ABCDEF Bundle: results of the ICU liberation collaborative in over 15,000 adults. *Crit Care Med* 2019;47:3-14.

23. Katic MR, Coleman J, Khan K, et al. Sinai abbreviated geriatric evaluation: development and validation of a practical test. *Ann Surg* 2019;269:177-83.

24. Davidson JE, Aslakson RA, Long AC, et al. Guidelines for family-centered care in the neonatal, pediatric, and adult ICU. *Crit Care Med* 2017;45:103-28.

25. Muscedere J, Waters B, Varambally A, et al. The impact of frailty on intensive care unit outcomes: a systematic review and meta-analysis. *Intensive Care Med* 2017;43:1105-22.

26. Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005;173:489-95.

27. Rockwood R, Stelfox HT, Bagshaw SM. Frailty in the critically ill: a novel concept. *Crit Care Med* 2019;47:1301-13.

28. Negm AM, Kennedy CC, Thabane L, et al. Management of frailty: a systematic review and meta-analysis of randomized controlled trials. *J Am Med Dir Assoc* 2019;20:1190-8.

29. Darvall JN, Bellomo R, Bailey M, et al. Frailty and outcomes from pneumonia in critical illness: a population-based cohort study. *Br J Anaesth* 2020;125:730-8.

30. Flaatten H, De Lange DW, Morandi A, et al.; VIP1 study group. The impact of frailty on ICU and 30-day mortality and the level of care in very elderly patients (> 80 years). *Intensive Care Med* 2017;43:1820-8.

31. De Geer L, Fredriksson M, Tibblin AO. Frailty predicts 30-day mortality in intensive care patients: a prospective prediction study. *Eur J Anaesthesiol* 2020;37:1058-65.

32. Guidet B, de Lange DW, Boumendil A, et al.; VIP1 study group. He contribution of frailty, cognition, activity of daily life and comorbidities on outcome in acutely admitted patients over 80 years in European ICUs; the VIP1 study. *Intensive Care Med* 2020;46:57-69.

33. De Blasio JC, Mittel AM, Mueller AL, et al. Frailty in critical care medicine: a review. *Anesthesiol Analg* 2020;130:1462-73.

34. Heyland DK, Garland A, Bagshaw S, et al. Recovery after critical illness in patients aged 80 years or older: a multi-center prospective observational cohort study. *Intensive Care Med* 2015;41:1911-20.

35. Brummel NE, Bell SP, Girard TD, et al. Frailty and subsequent disability and mortality among patients with critical illness. *Am J Respir Crit Care Med* 2017;196:64-72.

36. Hendin A, Tanuseputro P, McIsaac D, et al. Frailty is associated with decreased time spent at home after critical illness: a population-based study. *J Intensive Care Med* 2021;36:937-44.

37. Ferrante LE, Pisani MA, Murphy T, et al. The association of frailty with post-ICU disability, nursing home admission, and mortality. *Chest* 2018;153:1378-86.

40. Bagshaw SM, Stelfox HT, McDermid RC, et al. Association between frailty and short- and long-term outcomes among critically ill patients: a multicentre prospective cohort study. *CMJ* 2014;186:E95-102.

41. Fried LP, Tangen CM, Walston J, et al.; Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001;56:M146-56.

42. Buta BJ, Walston JD, Godino JG, et al. Frailty assessment instruments: systematic characterization of the uses and contexts of highly-cited instruments. *Ageing Res Rev* 2016;26:53-61.

44. Pugh RJ, Battle CE, Thorpe C, et al. Reliability of frailty assessment in the critically ill: a multicenter prospective observational study. *Anaesthesia* 2019;74:758-64.

45. Shears M, Takaoka A, Rochweg B, et al.; Canadian Critical Care Trials Group. Assessing frailty in the intensive care unit: a reliability and validity study. *J Crit Care* 2018;45:197-203.

46. Falvey JR, Ferrante LE. Frailty assessment in the ICU: translation to "real-world" clinical practice. *Anaesthesia* 2019;74:700-3.
67. Moon K-J, Lee S-M. The effects of a tailored intensive care unit delirium prevention protocol: a randomized controlled trial. Int J Nurs Stud 2015;52:1423-32.

68. Rivosecchi RM, Kane-Gill SL, Svec S, et al. The implementation of a nonpharmacologic protocol to prevent intensive care delirium. J Crit Care 2016;31: 206-11.

69. van den Boogaard M, Slooter AJC, Bruggemann RJM, et al. Effect of haloperidol on survival among critically ill adults with a high risk of delirium: the REDUCE randomized clinical trial. JAMA 2018;319:680-90.

70. Ng KT, Shuabah CJ, Chong JS. The effect of dexmedetomidine on delirium and agitation in patients in intensive care: systematic review and meta-analysis with trial sequential analysis. Anesthesia 2019;74:380-92.

71. Pereira JV, Sanjanwala RM, Mohammed MK, et al. Dexmedetomidine versus propofol sedation in reducing delirium among older adults in the ICU: a systematic review and meta-analysis. Eur J Anesthesiol 2020;37:121-31.

72. Reade MC, Eastwood GM, Bellomo R, et al. Effect of Dexmedetomidine added to standard care on ventilator-free time in patients with agitated delirium: a randomized clinical trial. JAMA 2016;315:1460-8.

73. Product monograph: Pr dexmede TO Mini dine Hydrochloride for injection. Boucherville QC: Sandoz Canada Inc.; revised 2020 Mar. 24. Available: https://pdf.hres.ca/rdpdm_pmn/00056114.PDF (accessed 2020 Oct. 17).

74. Tomichek JE, Stollings JL, Pandharipande PP, et al. Antipsychotic prescribing patterns during and after critical illness: a prospective cohort study. Crit Care 2016;20:378.

75. Atramont A, Lindecker-Cournil V, Rudant J, et al. Association of age with short-term mortality among older adults with sepsis: a systematic review. Crit Care Med 2018;46:1392-1401.

76. Needham DM, Davidson J, Cohen H, et al. Improving long-term outcomes after discharge from intensive care unit: report from a stakeholders’ conference. Crit Care Med 2012;40:502-9.

77. Parker AM, Srirachaonchit T, Raparla S, et al. Posttraumatic stress disorder in intensive care syndrome: a systematic review based on the World Health Organization’s international classification of functioning, disability and health framework. Phys Ther 2018;98:631-45.

78. Marra A, Pandharipande P, Girard T, et al. Co-occurrence of Post-Intensive Care Syndrome problems among 406 survivors of critical illness. Crit Care Med 2018;46:1392-1401.

79. Connolly B, Thompson A, Douiri A, et al. Exercise-based rehabilitation after critical illness: a systematic review and meta-analysis. Int J Sports Phys Ther 2015;10:1121-9.

80. Hopkins RO, Suchyta MR, Kamdar BB, et al. Instrumental activities of daily living with trial sequential analysis. Anaesthesia 2019;74:380-92.

81. Ohtake PJ, Lee AC, Scott JC, et al. Physical impairments associated with post-intensive care syndrome: systematic review based on the World Health Organization’s international classification of functioning, disability and health framework. Phys Ther 2018;98:631-45.

82. Howard AF, Currie L, Bungay V, et al. Health solutions to improve post-intensive care outcomes: a realist review protocol. Syst Rev 2019;8:11.

83. Brown SM, Bose S, Banner-Goodspeed V, et al.; Addressing Post Intensive Care Syndrome problems among 406 survivors of critical illness. Crit Care Med 2012;40:2033-40.

84. Hopkins RO, Suchyta MR, Kamdar BB, et al. Instrumental activities of daily living with trial sequential analysis. Anaesthesia 2019;74:380-92.

85. Moon K-J, Lee S-M. The effects of a tailored intensive care unit delirium prevention protocol: a randomized controlled trial. Int J Nurs Stud 2015;52:1423-32.

86. Rosenberg RM, Kane-Gill SL, Svec S, et al. The implementation of a nonpharmacologic protocol to prevent intensive care delirium. J Crit Care 2016;31: 206-11.

87. van den Boogaard M, Slooter AJC, Bruggemann RJM, et al. Effect of haloperidol on survival among critically ill adults with a high risk of delirium: the REDUCE randomized clinical trial. JAMA 2018;319:680-90.

88. Ng KT, Shuabah CJ, Chong JS. The effect of dexmedetomidine on delirium and agitation in patients in intensive care: systematic review and meta-analysis with trial sequential analysis. Anesthesia 2019;74:380-92.

89. Pereira JV, Sanjanwala RM, Mohammed MK, et al. Dexmedetomidine versus propofol sedation in reducing delirium among older adults in the ICU: a systematic review and meta-analysis. Eur J Anesthesiol 2020;37:121-31.

90. Reade MC, Eastwood GM, Bellomo R, et al. Effect of Dexmedetomidine added to standard care on ventilator-free time in patients with agitated delirium: a randomized clinical trial. JAMA 2016;315:1460-8.

91. Rivosecchi RM, Kane-Gill SL, Svec S, et al. The implementation of a nonpharmacologic protocol to prevent intensive care delirium. J Crit Care 2016;31: 206-11.

92. van den Boogaard M, Slooter AJC, Bruggemann RJM, et al. Effect of haloperidol on survival among critically ill adults with a high risk of delirium: the REDUCE randomized clinical trial. JAMA 2018;319:680-90.

93. Ng KT, Shuabah CJ, Chong JS. The effect of dexmedetomidine on delirium and agitation in patients in intensive care: systematic review and meta-analysis with trial sequential analysis. Anesthesia 2019;74:380-92.

94. Pereira JV, Sanjanwala RM, Mohammed MK, et al. Dexmedetomidine versus propofol sedation in reducing delirium among older adults in the ICU: a systematic review and meta-analysis. Eur J Anesthesiol 2020;37:121-31.

95. Reade MC, Eastwood GM, Bellomo R, et al. Effect of Dexmedetomidine added to standard care on ventilator-free time in patients with agitated delirium: a randomized clinical trial. JAMA 2016;315:1460-8.

96. Parker AM, Srirachaonchit T, Raparla S, et al. Posttraumatic stress disorder in intensive care syndrome: a systematic review based on the World Health Organization’s international classification of functioning, disability and health framework. Phys Ther 2018;98:631-45.

97. Marra A, Pandharipande P, Girard T, et al. Co-occurrence of Post-Intensive Care Syndrome problems among 406 survivors of critical illness. Crit Care Med 2018;46:1392-1401.

98. Needham DM, Davidson J, Cohen H, et al. Improving long-term outcomes after discharge from intensive care unit: report from a stakeholders’ conference. Crit Care Med 2012;40:502-9.

99. Parker AM, Srirachaonchit T, Raparla S, et al. Posttraumatic stress disorder in critical illness survivors: a meta-analysis. Crit Care Med 2015;43:1221-9.

100. Hopkins RO, Suchyta MR, Kamdar BB, et al. Instrumental activities of daily living after critical illness: a systematic review. Ann Am Thorac Soc 2017;14:1332-43.

101. Rabbie A, Nikayin S, Hashem MD, et al. Depressive symptoms after critical illness: a systematic review and meta-analysis. Crit Care Med 2016;44:1744-53.

102. Pandharipande PP, Girard TD, Jackson JC, et al. Long-term cognitive impairment following critical illness. N Engl J Med 2013;369:1306-16.

103. Cameron JI, Chu LM, Matte A, et al. One-year outcomes in caregivers of critically ill patients. N Engl J Med 2016;374:1381-41.

104. Malone ML, Volbrecht M, Stephenson J, et al. Acute Care for Elders (ACE) tracker and e-Geriatrician: methods to disseminate ACE concepts to hospitals with no geriatricians on staff. J Am Geriatr Soc 2010;58:161-7.

105. Booth KA, Simmons EE, Viles AF, et al. Improving geriatric care processes on two medical-surgical acute care units: a pilot study. J Healthc Qual 2019;41:23-31.

106. Hung WW, Ross JS, Farber J, et al. Evaluation of the Mobile Acute Care of the Elderly (MACE) service. JAMA Intern Med 2013;173:990-6.

107. Farber JI, Korc-Grodzicki B, Du Q, et al. Operational and quality outcomes of a mobile acute care for the elderly service. J Hosp Med 2011;6:358-63.

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Affiliations: Divisions of Geriatric Medicine (Geen, Wang) and Critical Care Medicine (Rochwerg), Department of Medicine, and Department of Health Research Methods, Impact and Evidence (Rochwerg), McMaster University, Hamilton, Ont.

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Correspondence to: Olivia Geen, olivia.geen@medportal.ca