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Older trauma patients are at high risk of delirium, especially those with underlying dementia or baseline frailty

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ABSTRACT

Background Given the increasing numbers of older patients presenting with trauma, and the potential influence of delirium on outcomes, we sought to investigate the proportion of such patients who were diagnosed with delirium during their stay—and patient factors associated therewith—and the potential associations between delirium and hospital length of stay (LOS). We hypothesized that delirium would be common, associated with certain patient characteristics, and associated with long hospital LOS (highest quartile).

Methods We conducted a retrospective observational cohort study of all trauma patients aged ≥65 years presenting in September to October 2019, interrogating medical records and the institutional trauma database. The primary outcome measure was occurrence of delirium.

Results Among 99 eligible patients, delirium was common, documented in 23% (23 of 99). On multivariable analysis, adjusting for age, frailty and history of dementia, frailty (OR 4.09, 95% CI 1.08 to 15.53, p=0.04) and dementia (OR 5.23, 95% CI 1.38 to 19.90, p=0.02) were independently associated with likelihood of delirium. Standardized assessment tools were underused, with only 34% (34 of 99) screened within 4 hours of arrival. On univariate logistic regression analysis, having an episode of delirium was associated with long LOS (highest quartile), OR of 5.29 (95% CI 1.92 to 14.56, p<0.001). In the final multivariable model, adjusting for any (non-delirium) in-hospital complication, delirium was independently associated with long LOS (≥16 days; OR 4.81, p=0.005).

Discussion In this study, delirium was common. History of dementia and baseline frailty were associated with increased risk. Delirium was independently associated with long LOS. However, many patients did not undergo standardized screening at admission. Early identification and targeted management of older patients at risk of delirium may reduce incidence and improve care of this vulnerable cohort. These data are hypothesis generating, but support the need for initiatives which improve delirium care, acknowledging the complex interplay between frailty and other geriatric syndromes in the older trauma patients.

Level of evidence III.

INTRODUCTION

By the year 2050, it is estimated that 21% of the US population will be aged ≥65 years, a decided increase from the current 13%.[1] Likewise, in Australia, we have over 4 million residents aged ≥65 years (16%), a number expected to increase to 8.8 million (approximately 22% of the predicted population) by 2057.[2] It is unsurprising then that the number of older people presenting with traumatic injury—and who are particularly vulnerable to adverse outcomes—is set to rise.[3–6]

Delirium is an acute and fluctuating disorder of consciousness, attention and cognition.[7 8] A systematic review indicated that up to one in two hospital-admitted adults will experience delirium,[4] with higher rates demonstrated in older adults, the postoperative period and intensive care unit (ICU).[7 9–12] Delirium is associated with worse outcomes, including death, poor function, increased length of stay (LOS) and institutionalization.[4 5 7] Once delirium has set in, management options focus on minimization of ongoing risk factors and supportive care.[7] Despite its status as a potential marker of medical emergencies and downstream burdens associated with its presence, delirium is often under-recognized.[11 13] Hence, the importance of prevention, as emphasized in guidelines.[14–16]

Older trauma patients have poorer outcomes than younger trauma patients. While the reasons for this are multifactorial,[3 17] delirium may contribute. Elucidation of factors associated with increased risk of delirium in older trauma patients, and the association between delirium and adverse outcomes in such patients, will better inform the management of older trauma patients. In this context, we sought to establish the proportion of older patients presenting with trauma who were diagnosed with delirium during their stay—and patient factors associated therewith—and to investigate the potential associations between delirium and hospital LOS. We hypothesized that delirium would be common, and associated with certain patient characteristics, and that delirium would be associated with long hospital LOS (highest quartile).

METHODS

Patients and setting

Liverpool Hospital is a large tertiary hospital in south-west Sydney metropolitan area, Australia. It is the only verified level 1 (major) trauma center in New South Wales (NSW), receiving >1900 trauma activations a year. We performed a retrospective observational cohort study of a convenience sample of all consecutive patients who were admitted after acute trauma team activation with suspected injury,

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during a 2-month period (September/October 2019). In addition to data captured within the comprehensive trauma registry, electronic medical notes were reviewed by three members of the research team (YDK, SN, PW), with input from DNC, NF and SDA as required.

Definitions and diagnoses

Injury Severity Score (ISS) was calculated and Abbreviated Injury Scale data were sourced directly from patient records by specific trained trauma nurses and entered into the trauma registry.

Delirium was defined as an acute and fluctuating change in cognition, as evidenced by a 'positive' outcome using the Confusion Assessment Method (CAM) and/or physician diagnosis of delirium (using Diagnostic and Statistical Manual of Mental Disorders, 5th Edition criteria).[8] All episodes of delirium were included—both prevalent (at arrival) and incident (during hospital stay). NSW Health standards, like others, recommend that all adult patients being admitted to hospital should have a delirium screen, using a validated and standardized assessment tool, and ideally this should be completed within 4 hours of admission[18] (online supplemental appendix 1). All patients were reviewed by the treating medical team at least daily; this traditionally includes some assessment of cognitive status, with or without the use of a standardized assessment tool such as CAM. As this was an observational study, patients were seen by additional members of the allied health team and/or other medical specialties as needed. Delirium etiology was recorded as per the medical team's notes.

Frailty was measured using the 9-point Clinical Frailty Score (CFS), designating those with CFS ≥5 'frail'.[19 20] This was calculated retrospectively for a baseline 1 month prior to presentation, an approach previously adopted in the literature.[21 22] Selected in-hospital complications were chosen for inclusion in consultation with trauma and geriatric colleagues, agreed with consensus of the multidisciplinary investigating team (table 1).

Hospital LOS was described as a continuous measure, and long LOS (primary outcome measure) defined as LOS in the highest quartile.

In terms of in-hospital delirium management for delirium beyond supportive care by the treating team, we also assessed referral to the specialist geriatric medicine team, and arrangements for geriatric clinic follow-up. (Please see also online supplemental methods: *Definitions of clinical conditions*.)

Statistical analyses

Distributions of variables were compared using t-tests, rank-sum tests, χ^2 and Fisher's exact tests as appropriate. Associations between key variables and binomial outcomes of interest (including long LOS) were investigated initially using logistic regression analysis, and continuous variable outcome measures (eg, absolute LOS) using linear regression. Those associated with the outcome of interest on univariable analysis ($p \leq 0.05$) were included in multivariable models. Additional factors were trialed within the multivariable model if a statistical trend ($p \leq 0.10$) was observed on univariate analysis and the association was considered biologically plausible, but excluded from the final model if it did not thereafter meet statistical significance. Where two measures were highly correlated (Spearman rho, Pearson correlation coefficient or phi coefficient $> \pm 0.5$), only one was preserved. Statistical analyses were performed using Stata V.13.0 (StataCorp, College Station, Texas).

Table 1 Patient characteristics (n=99)

Patient characteristics	Whole group (n=99)	Patients without diagnosis of delirium (n=76)	Patients with delirium (n=23)	P value
Age (years), mean (SD)	79.2 (7.9)	77.7 (0.8)	84.0 (1.7)	<0.001
Female sex, n (%)	50 (51.5)	40 (52.6)	10 (43.5)	0.48
ISS, median (IQR)	9 (4–14)	9 (4–14)	9 (4.5–10)	0.93
Primary injury, n (%)				
Rib fracture	29 (29)	22 (29)	7 (30)	0.68
Other fracture	22 (22)	16 (21)	6 (26)	
Head injury	21 (21)	16 (21)	5 (22)	
Other traumatic injury	18 (18)	16 (21)	2 (9)	
No injury*	9 (9)	6 (8)	3 (13)	
From RACF (nursing home), n (%)	14 (14)	9 (12)	5 (22)	0.30
Baseline frailty				
CFS, median (IQR)	4 (3–6)	3 (3–5)	6 (5–6)	<0.001
Proportion frail†, n (%)	44 (45)	25 (33)	19 (83)	<0.001
History of dementia‡	16 (16)	5 (7)	11 (48)	<0.001
Outcomes				
LOS				
Median (IQR)	6 (2–16)	4 (1–10.5)	17 (6–27)	<0.001
Long LOS§, n (%)	25 (25.25)	13 (17.1)	12 (52.2)	0.001
Selected complications, n (%)				
Any complication	29 (29)	19 (25)	10 (44)	0.09
Cardiovascular	16 (16)	10 (13)	6 (26)	0.14
Respiratory	9 (9)	5 (7)	4 (17)	0.11
Venous thromboembolism	0 (0)	0 (0)	0 (0)	1.0
Pressure injury	0 (0)	0 (0)	0 (0)	1.0
Deconditioning	5 (5)	2 (3)	3 (13)	0.08
In-hospital death	9 (9)	6 (8)	3 (13)	0.43

*These patients presented with suspected traumatic injury, for example, due to the mechanism of (potential) injury, or fall with loss of consciousness or similar, but were subsequently determined to have an ISS score of 0.
†Frail defined as CFS ≥5.
‡Among the 16 patients identified as having a history of dementia, the subtype was unspecified in 9/16, Alzheimer's in 2/16, vascular in 3/16 and one patient had mixed dementia.
§Long LOS defined as highest quartile, ≥16 days.
CFS, Clinical Frailty Score; ISS, Injury Severity Score; LOS, loss of consciousness; RACF, residential aged care facility.

RESULTS

Among 350 trauma patients admitted during the 2-month period, 99 (28.3%) were aged ≥65 years and included in the analyses. Other than early CAM results (see below), all data were available. No patients were lost to follow-up during their hospitalization. Patient characteristics are detailed in table 1. Baseline (premorbid) frailty was common, with CFS ≥5 for almost one in two patients.

Delirium diagnosis and factors associated with increased risk

Delirium was common, with a documented diagnosis of delirium in 23% (23 of 99) of patients during their admission. Delirium was noted to be present at arrival in the emergency department (prevalent delirium) in 2 of 23 patients.

Patients with delirium were older, with high rates of baseline frailty (83% vs. 33%, $p<0.001$), and more likely to have an underlying history of dementia ($p<0.001$; table 1). In terms of etiology, the (presumed) cause of delirium was documented in 21 of 23 patients with delirium. Among these, 57% (12 of

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21) of cases were noted to be multifactorial. Major documented contributors included pain (48%; 10 of 21), medications (29%; 6 of 21) and head injury/intracranial pathology (38%, 8 of 21). Other documented contributory factors included infection (4 of 21), ICU stay (3 of 21), constipation (2), alcohol withdrawal (1), seizures (1), hepatic encephalopathy (1), electrolyte derangement (1; due to dehydration), and diarrheal illness (1).

On univariable logistic regression analysis, age (OR per year increase 1.12, 95% CI 1.04 to 1.20, p=0.001), frailty (OR 9.5, 95% CI 2.92 to 30.92, p<0.001) and history of dementia (OR 13.02, 95% CI 3.84 to 44.15, p<0.001) were associated with increased likelihood of delirium. We did not observe any association between sex, ISS, primary injury, or residential aged care facility (RACF) residence, and odds of delirium. On multivariable analysis, adjusting for age, frailty and history of dementia, frailty (OR 4.09, 95% CI 1.08 to 15.53, p=0.04) and history of dementia (OR 5.23, 95% CI 1.38 to 19.90, p=0.02) were independently associated with likelihood of delirium. Findings were similar when baseline CFS was included instead of frailty as a binomial variable.

Assessment and diagnosis of delirium

Standardized assessment tools were underused, especially at the time of admission, with only 34% (34 of 99) of patients having a CAM recorded within 4 hours of arrival. Among the delirious patients (n=23), a positive CAM was noted in 83% (19 of 23), with the remainder (n=4) diagnosed by the medical team without a CAM. Delirium was documented by various members of the multidisciplinary team, with nursing staff documenting delirium in 78% (18 of 23) of delirious patients, whereas the trauma/surgical team documented delirium in 48% (11 of 23) of patients.

Length of stay

Median LOS for the group was 6 days (IQR 2–16 days). Those with a diagnosis of delirium were more likely to have a long LOS (highest quartile, ≥16 days; p=0.001; table 1).

On univariate logistic regression analysis, having an episode of delirium was associated with long LOS (highest quartile), with an OR of 5.29 (95% CI 1.92 to 14.56, p<0.001). Having any (non-delirium) complication was also associated with long LOS (OR 6.43, 95% CI 2.39 to 17.29, p<0.001), and observed a statistical trend towards an association with frail status (OR 2.27, 95% CI 0.91 to 5.75, p=0.08). In the final multivariable model, adjusting for any (non-delirium) in-hospital complication, having delirium maintained an independent association with long LOS (≥16 days; OR 4.81, p=0.005) (table 2). Likewise, when LOS was analyzed as a continuous variable, both delirium and having any complication were independently associated with LOS (both p<0.001).

Table 2 Multivariable logistic regression analysis of factors associated with long LOS (highest quartile, ≥16 days)

Variable	OR for long LOS	95% CI	P value
Delirium	4.81	1.59 to 14.47	0.005
Any (non-delirium) complication*	5.96	2.09 to 16.97	0.001

Frailty was included in an earlier multivariable analysis (as was not strongly associated with delirium (correlation coefficient 0.44), as per the a priori statistical plan, but excluded from the final model as it did not meet statistical significance.
*From selected in-hospital complications (see text).
LOS, length of stay.

Other outcomes

In total, 29% (29 of 99) had at least one complication, and 16% (16 of 99) of patients had multiple (≥2) complications (table 1). There was no difference in complication rates between those with or without delirium (table 1). We did not specifically investigate the temporal relationship between complications and occurrence of delirium.

Almost 1 in 10 patients died. Delirium was not associated with risk of death (p=0.46).

Geriatric medicine team input for trauma patients with delirium

Overall, 24 patients (24%) were seen by the geriatric consultation service at a median 1.5 days (IQR 1–2.5) after admission. More patients with delirium were referred to the geriatric team compared with those without delirium (59% (13 of 23) vs. 14% (11 of 76) (p<0.001).

In terms of addressing the need for follow-up after an episode of inpatient delirium, geriatric clinic review was organized at discharge for only six (6%) patients—three with delirium, three without (p=0.14).

DISCUSSION

In this study of consecutive older patients presenting with trauma, delirium was common, with advancing age, frailty and a history of dementia associated with increased risk. Delirium was associated with long LOS, but not with in-hospital death. Furthermore, delirium was independently associated with higher likelihood of prolonged hospitalization, consistent with literature pertaining to other cohorts of older patients.[4 5 7] However, early screening for delirium was suboptimal, despite evidence-based recommendations that this be implemented early in the hospital stay. Holistic delirium care includes a combination of assessment, prevention and appropriate management. Few patients were diagnosed with delirium on arrival, highlighting the opportunity for potential prevention during the hospital stay.

In this cohort, both frailty and history of dementia were independent risk factors for delirium. Almost half of the group were frail prior to admission, and one in six had a history of dementia. The overall numbers of individuals with dementia are climbing, and this will likely be reflected in increasing trauma presentations. Dementia is a risk factor for presentation with traumatic injury due to increased risk of falls,[23] car crashes (although rates may fall in latter stages due to limited driving),[24] pedestrian injuries,[25] and elder abuse.[26] Frailty and delirium are intricately linked,[12] with common risk factors such as age and dementia. In our cohort, delirium was independently associated with LOS, whereas frailty was not. This contrasts with Cheung *et al*'s[27] study, in which preadmission frailty was associated with adverse discharge outcomes. Differences from our study, which may contribute to the discrepancy, include their lack of delirium as a variable, older 7-point CFS, higher frailty cut-off, and lower rates of frailty in their study, and that we may have been underpowered to detect a relationship.

Contrasting with the plethora of studies describing delirium in 'medical' patients—and even other surgical cohorts—data pertaining to delirium in older trauma patients are more limited. A number of North American studies have included delirium as an outcome measure, usually in the context of assessing geriatric and/or multicomponent interventions for frail older patients.[28–31] Some authors have explored delirium in particular trauma subgroups, with delirium observed in 25% of patients with rib

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fracture in a Danish study,[32] and two-thirds of trauma patients requiring ICU and mechanical ventilation for >24 hours.[10]

The causes of delirium are myriad, and typically the syndrome is multifactorial. Over a third of cases are thought to be preventable.[7] In keeping with this, the strongest evidence for prevention hails from multifaceted strategies.[33] Traumatic injury can be associated with significant pain, and both pain and opioid analgesics are risk factors for delirium. In this setting, interventions focusing on pain control, sensible opiate prescribing, and regional anesthesia have proven promising.[34 35]

Despite the vulnerability of our cohort, delirium screening was suboptimal. Exploring the reasons for poor adherence was beyond the scope of this study, and the subject of ongoing quality improvement efforts. To improve pick-up of delirium in this study, we did not rely solely on CAM screening, but also included delirium diagnosis recorded in the medical notes.

In terms of treating delirium, the mainstay of delirium treatment is treatment of the underlying cause, complimented by prevention of complications (such as falls, pressure injuries).[7] Other interventions, for example, non-pharmacological multicomponent strategies,[7 33] or dexmedetomidine in the ICU setting,[36] have shown limited benefit in terms of reducing the duration or severity of delirium.[7 33 36]

There is some evidence that specialist aged care teams may have benefit in the care of older surgical patients, including those presenting with trauma. In the present study, three-quarters of patients were not seen by the geriatric medical team, and despite known poor long-term sequelae after delirium, and vulnerability to further episodes of delirium, few patients had follow-up arranged with a specialist geriatrician after discharge, examples of potential 'missed' opportunities for optimal delirium management in both acute and later settings. While orthogeriatric care for the subset of patients with hip fractures is relatively embedded in healthcare settings, the role of aged care specialists in trauma is rather embryonic, with some exceptions.[29–31 37–39] The potential benefits of early geriatric team involvement in trauma care are manifold, with studies describing improvements in diagnosis of medical morbidity, anticipatory care planning, functional outcomes, ICU and total hospital LOS, and death.[28–30 37] Eagles *et al*'s systematic review and meta-analysis of trauma patients noted a reduction in LOS associated with geriatric team input, but noted heterogeneity among studies including delirium as an outcome measure.[38] The relationship between geriatric specialist review and delirium in trauma patients is complex. Marcantonio *et al* noted a reduction in both delirium incidence and severity with proactive geriatrician input in patients with hip fracture.[9] However, geriatric physicians may improve detection of delirium, leading to an apparent 'increase' in incidence and/or prevalence,[17 30] or there may be a selection bias whereby trauma teams are more likely to seek consultation where delirium is already evident.[29] On the other hand, early involvement of aged care specialists may lead to improved prevention and reduced incidence.[9 28 31]

Our study's limitations include data drawn from a single-center study in a level 1 trauma center. As such, our findings may not necessarily be extrapolated to all scenarios. However, the rates of delirium we observed are not dissimilar to those observed in other settings.[4–7 17 28–32] Our numbers were not large, which may mean we were underpowered to detect other potential associations, for example, with mortality (type II error), and the confidence for our observed associations was wider (less precise) than may have been observed with a larger sample size. Although Leratowicz[31] investigated the use of a geriatric consultation in a before-and-after study of 486 older trauma patients—reporting a decrease in delirium incidence with same—few authors have focused on delirium in cohorts of more than a couple of hundred older trauma patients.[10 17 28–30 32 34] The lack of large-scale studies highlights the need for more robust evidence to guide management of this vulnerable group. As this was a retrospective study, we relied on available documentation. A notable proportion of patients did not undergo early delirium screening, which may have led to missed or delayed diagnosis. The rationale for early routine screening is that validated standardized assessment tools improve pick-up,[40] and early recognition can facilitate rapid instigation of a management plan.[7 16] Real-life practice deficits highlight the need for ongoing education and training of healthcare professionals in the assessment and management of delirium.[15] Likewise, in terms of etiology, we were reliant on available documentation and the assessment of the treating clinical team. We did not assess delirium severity, duration or later cognitive outcomes, all of which would be of interest, and will be areas for future research. We chose to focus on older patients, defined as ≥65 years, but also acknowledge that younger trauma patients may also be at risk of delirium. In a study of 115 trauma patients admitted to surgical ICU, Bryczkowski *et al* noted that the risk of delirium increased by 10% per year after age 50.[41]

Strengths of this study include the use of consecutive sampling—probably the best of all non-probability sampling,[42] inclusion of patients presenting with diverse injuries and severity, and our ability to adjust for factors such as frailty and non-delirium complications in our outcome analyses. Our findings also highlight that delirium risk screening in real-world practice is suboptimal, despite the vulnerability of older trauma patients.

CONCLUSIONS

In combination with the existing literature, this study highlights that older trauma patients are a vulnerable group, in whom delirium is common, and associated with poor outcomes. Frailty and dementia may increase risk, and the relationship between these syndromes in trauma patients warrants further investigation. Ideally, delirium prevention should be incorporated into a comprehensive plan for patient-centered care of the older patients, acknowledging the complex interplay between frailty and other geriatric syndromes in the older trauma patients.

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Data availability statement Data are available upon reasonable request. The data herein comprise deidentified individual patient data held in a local database. These data would only be made available if the ethics committee were to approve their distribution/use beyond the current study.

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REFERENCES

1 Australian Bureau of Statistics (ABS). Population Projections - A tool for Examining Population Ageing. 2008. https://www.abs.gov.au/AUSSTATS/abs@.nsf/bb8db737e2af84b8ca2571780015701e/0046DAF21CAA349BCA2573D20010FE65?opendocument (2 Oct 2020).
2 Australian Institute of Health and Welfare (AIWHW). Older Australia at a glance. 2018. https://www.aihw.gov.au/reports/older-people/older-australia-at-a-glance/contents/diverse-groups-of-older-australians/culturally-and-linguistically-diverse-people (2 Oct 2020).
3 Kozar RA, Arbabi S, Stein DM, Shackford SR, Barraco RD, Biffl WL, Brasel KJ, Cooper Z, Fakhry SM, Livingston D, *et al*. Injury in the aged: geriatric trauma care at the crossroads. *J Trauma Acute Care Surg* 2015;78:1197–209.
4 Siddiqi N, House AO, Holmes JD. Occurrence and outcome of delirium in medical in-patients: a systematic literature review. *Age Ageing* 2006;35:350–64.
5 Harari D, Hopper A, Dhesi J, Babic-Illman G, Lockwood L, Martin F. Proactive care of older people undergoing surgery ('POPS'): designing, embedding, evaluating and funding a comprehensive geriatric assessment service for older elective surgical patients. *Age Ageing* 2007;36:190–6.
6 Mudge AM, McRae P, Hubbard RE, Peel NM, Lim WK, Barnett AG, Inouye SK. Hospital-Associated complications of older people: a proposed multicomponent outcome for acute care. *J Am Geriatr Soc* 2019;67:352–6.
7 Inouye SK, Westendorp RGJ, Saczynski JS, Kimchi EY, Cleinman AA. Delirium in elderly people. *Lancet* 2014;383:911–22.
8 American Psychiatric Association. *Diagnostic and statistical manual of mental disorders*. 5th edn. Washington, DC, 2013.
9 Marcantonio ER, Flacker JM, Wright RJ, Resnick NM. Reducing delirium after hip fracture: a randomized trial. *J Am Geriatr Soc* 2001;49:516–22.
10 Pandharipande P, Cotton BA, Shintani A, Thompson J, Pun BT, Morris JA, Dittus R, Ely EW. Prevalence and risk factors for development of delirium in surgical and trauma intensive care unit patients. *J Trauma* 2008;65:34–41.
11 Ryan DJ, O'Regan NA, Caoimh Ronán Ó, Clare J, O'Connor M, Leonard M, McFarland J, Tighe S, O'Sullivan K, Trzepacz PT, *et al*. Delirium in an adult acute hospital population: predictors, prevalence and detection. *BMJ Open* 2013;3:e001772.
12 Sanchez D, Brennan K, Al Sayfe M, Shunker S-A, Bogdanoski T, Hedges S, Hou YC, Lynch J, Hunt L, Alexandrou E, *et al*. Frailty, delirium and hospital mortality of older adults admitted to intensive care: the delirium (Deli) in ICU study. *Crit Care* 2020;24:609.
13 Inouye SK, Foreman MD, Mion LC, Katz KH, Cooney LM. Nurses' recognition of delirium and its symptoms: comparison of nurse and researcher ratings. *Arch Intern Med* 2001;161:2467–73.
14 Barr J, Fraser GL, Puntillo K, Ely EW, Gélinas C, Dasta JF, Davidson JE, Devlin JW, Kress JP, Joffe AM, *et al*. Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit. *Crit Care Med* 2013;41:263–306.
15 American Geriatrics Society Expert Panel on Postoperative Delirium in Older Adults. American geriatrics Society abstracted clinical practice guideline for postoperative delirium in older adults. *J Am Geriatr Soc* 2015;63:142–50.
16 *Australian Commission on safety and quality in healthcare*: Delirium Clinical Care Standard. Australian Commission on Safety and Quality in Healthcare. AAahws, 2006.
17 Southerland LT, Gure TR, Ruter DI, Li MM, Evans DC. Early geriatric consultation increases adherence to TQIP geriatric trauma management guidelines. *J Surg Res* 2017;216:56–64.
18 South Western Sydney Local Health District (SWSLHD). Care of Confused Hospitalized Older Persons (CHOPS) - Screening patients. 2015. https://www.aci.health.nsw.gov.au/chops/chops-key-principles/undertake-cognitive-screening/screening-patients (21 Jul 2020).
19 Rockwood K, Song X, MacKnight C, Bergman H, Hogan DB, McDowell I, Mitnitski A. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005;173:489–95.
20 Geriatric Medicine Research (GMR), Centre for Health Care of the Elderly. Nova Scotia Health Authority (NSHA), Division of Geriatric Medicine, Dalhousie University. https://www.dal.ca/sites/gmr/our-tools/clinical-frailty-scale.html (11 Aug 2020).
21 Ní Chróinín D, Basic D, Conforti D, Shanley C. Functional deterioration in the month before hospitalisation is associated with in-hospital functional decline: an observational study. *Eur Geriatr Med* 2018;9:321–7.
22 Carlson JE, Zocchi KA, Bettencourt DM, Gambrel ML, Freeman JL, Zhang D, Goodwin JS. Measuring frailty in the hospitalized elderly: concept of functional homeostasis. *Am J Phys Med Rehabil* 1998;77:252–7.
23 Amboni M, Barone P, Hausdorff JM. Cognitive contributions to gait and falls: evidence and implications. *Mov Disord* 2013;28:1520–33.
24 Meuleners LB, Ng J, Chow K, Stevenson M, Crashes MV. And dementia: a population-based study. *J Am Geriatr Soc* 2016;64:1039–45.
25 Oxley JCJ, Fildes B. *The effect of cognitive impairment on older pedestrian behaviour and crash risk report 244*. Victoria, Australia: Monash Accident research Centre, 2005.
26 Dong X, Chen R, Simon MA. Elder abuse and dementia: a review of the research and health policy. *Health Aff* 2014;33:642–9.
27 Cheung A, Haas B, Ringer TJ, McFarlan A, Wong CL. Canadian study of health and aging clinical frailty scale: does it predict adverse outcomes among geriatric trauma patients? *J Am Coll Surg* 2017;225:658–65.
28 Bryant EA, Tulebaev S, Castillo-Angeles M, Moberg E, Senglaub SS, O'Mara L, McDonald M, Salim A, Cooper Z, Identification F. Frailty identification and care pathway: an interdisciplinary approach to care for older trauma patients. *J Am Coll Surg* 2019;228:852–9.
29 Sharma J, Parulekar M, Stewart P, Blatt M, Zielonka T, Nyirenda T, Rogers C, Tank L. Geriatric consultation reduces high-risk medication usage at discharge in elderly trauma patients. *Cureus* 2018;10:e3649.
30 Fallon WF, Rader E, Zyzanski S, Mancuso C, Martin B, Breedlove L, DeGolia P, Allen K, Campbell J. Geriatric outcomes are improved by a geriatric trauma consultation service. *J Trauma* 2006;61:1040–6.
31 Lenartowicz M, Parkovnick M, McFarlan A, Haas B, Straus SE, Nathens AB, Wong CL. An evaluation of a proactive geriatric trauma consultation service. *Ann Surg* 2012;256:1098–101.
32 Janssen TL, Hosseinzoi E, Vos DI, Veen EJ, Mulder PGH, van der Holst AM, van der Laan L. The importance of increased awareness for delirium in elderly patients with rib fractures after blunt chest wall trauma: a retrospective cohort study on risk factors and outcomes. *BMC Emerg Med* 2019;19:34.
33 Inouye SK, Bogardus ST, Charpentier PA, Leo-Summers L, Acampora D, Holford TR, Cooney LM. A multicomponent intervention to prevent delirium in hospitalized older patients. *N Engl J Med* 1999;340:669–76.
34 O'Connell KM, Quistberg DA, Tessler R, Robinson BRH, Cuschieri J, Maier RV, Rivara FP, Vavilala MS, Bhalla PI, Arbabi S. Decreased risk of delirium with use of regional analgesia in geriatric trauma patients with multiple rib fractures. *Ann Surg* 2018;268:534–40.
35 Chuan A, Zhao L, Tillekeratne N, Alani S, Middleton PM, Harris IA, McEvoy L, Ní Chróinín D. The effect of a multidisciplinary care bundle on the incidence of delirium after hip fracture surgery: a quality improvement study. *Anaesthesia* 2020;75:63–71.
36 Liu X, Xiong J, Tang Y, Gong C-C, Wang D-F. Role of dexmedetomidine in the treatment of delirium in critically ill patients: a systematic review and meta-analysis. *Minerva Anestesiol* 2021;87:65–76.
37 Mangram AJ, Mitchell CD, Shifflette VK, Lorenzo M, Truitt MS, Goel A, Lyons MA, Nichols DJ, Dunn EL. Geriatric trauma service: a one-year experience. *J Trauma Acute Care Surg* 2012;72:119–22.
38 Eagles D, Godwin B, Cheng W, Moors J, Figueira S, Khoury L, Fournier K, Lampron J. A systematic review and meta-analysis evaluating geriatric consultation on older trauma patients. *J Trauma Acute Care Surg* 2020;88:446–53.
39 Bradburn E, Rogers FB, Krasne M, Rogers A, Horst MA, Beelen MJ, Belan MJ, Miller JA. High-Risk geriatric protocol: improving mortality in the elderly. *J Trauma Acute Care Surg* 2012;73:435–40.
40 Kean J, Ryan K. Delirium detection in clinical practice and research: critique of current tools and suggestions for future development. *J Psychosom Res* 2008;65:255–9.
41 Bryczkowski SB, Lopreiato MC, Yonclas PP, Sacca JJ, Mosenthal AC. Risk factors for delirium in older trauma patients admitted to the surgical intensive care unit. *J Trauma Acute Care Surg* 2014;77:944–51.
42 Basic D, Shanley C, Gonzales R. The impact of being a migrant from a non-English-speaking country on healthcare outcomes in frail older inpatients: an Australian study. *J Cross Cult Gerontol* 2017;32:447–60.

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