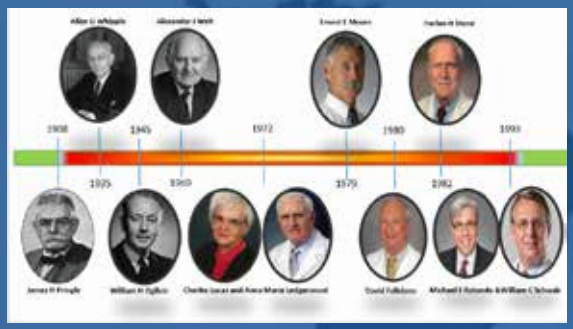
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State of the Art Interventions in Geriatric Trauma

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Abstract

Geriatric patients (≥ age 65) present unique challenges in trauma care. They are predisposed to lower-energy injury mechanisms, especially falls, and may have baseline comorbidities which limit comprehensive examination or blunt the physiologic response to trauma. These factors contribute to undertriage and have led to exploring whether the geriatric population should have unique and specific triage criteria. Frailty is also a major age-related contributor to poor clinical outcomes following trauma.

This review focuses on novel clinical management strategies that have shown to improve geriatric trauma outcomes. Frailty screening and interdisciplinary interventions can lower rates of readmission and delirium. Environmentally focused treatment bundles can reduce the duration and severity of delirium. Formal medication reconciliation is associated with reductions in hospital readmissions and prescribing errors. Early establishment of goals of care may improve process-related outcomes and should be a target for institutional quality improvement.

The field of geriatric trauma care is rapidly evolving to meet the needs of an aging global population. Emerging evidence is enabling more effective systems-based care. Triage practices remain an area of ongoing refinement. Accurate estimation of frailty will be central to future research.

Keywords: Trauma; geriatrics; elderly; trauma centers; state-of-the-art review

Background

Geriatric trauma (GT) is defined as that which affects patients aged 65 years or older.[1-3] Since the early 1990's, the incidence of GT has more than doubled, and GT

patients now represent over half of trauma-related admissions at many institutions.[4-6] Aging weakens the physiologic response to stress across all organ systems, and this complicates recovery from injury.[7] Old age is a risk factor for mortality, morbidity, and undertriage in trauma care. Due to an aging global population, there remains great need for novel clinical strategies that improve geriatric trauma care.

Objectives

This article presents the best available evidence on epidemiology, outcomes, and clinical management strategies associated with the GT population. We performed a state-of-the-art review in a six-stage process.[8] The primary research question was: Which modern evidence-based practices facilitate high-quality care in the GT population? We limited our review to articles published in 2013 or later, except for when contextualizing the current state of the field. PubMed and Google Scholar databases were searched for recent evidence in key concentrations including frailty, delirium, overtriage, polypharmacy, palliative care, and fracture risk reduction. Citation lists of relevant articles were also searched to discover more literature.

Findings

Epidemiology and Outcomes

Popular consensus is that the age cutoff defining geriatric trauma is 65 years old. The use of a discrete age helps facilitate research and inform policy, but practicing clinicians understand that patients can be physiologically younger or older than they appear. The age 65 threshold is based on historical data showing sharp increases in trauma-related mortality starting around that age. Recent data has suggested that age-related mortality from trauma starts to increase greatly around age 55 rather than 65.[9,10,11,12] The ideal age and methods for defining a "geriatric" patient remains a topic of ongoing discussion.[11]

The proportion of trauma affecting geriatric patients has more than doubled since the 1990's and is recently estimated at 33% to 54%.[4,5,13-15] Falls account for over 60% of GT injuries.[20,21] The second most common mechanism is motor vehicle accidents. The hospital mortality rate for geriatric trauma patients is around 10%, and trauma patients older than 65 years have a 300–400% higher risk for trauma mortality as compared to those younger.[14,16-18] The elderly are also around twice as likely to experience postoperative complications and unplanned readmission.[19]

Frailty

Frailty is a general inability to tolerate stress. Frailty worsens the effects of trauma and prolongs recovery from injury.[20] For a long time, frailty assessment was a clinical gestalt influenced by obvious factors such as muscle mass and mobility. Over the years, objective measures of frailty have emerged. In the GT population, use of the Trauma-Specific Frailty Index (TSFI) is recommended.[1] It has been prospectively validated for the prediction of mortality, morbidity, discharge disposition, and readmission in GT patients.[21-23] Importantly, it also identifies pre-frail patients at high risk for progression to frailty. The TSFI c-statistic ranges from 0.75 to 0.83 for composite outcomes, which is superior to comparable alternatives.[24] Very few publications have directly compared multiple frailty indices simultaneously in the GT population.[25] Because the TSFI is best-applied to an awake, participative patient, is important to develop robust, simple alternatives to the TSFI that do not require direct participation. Frailty screening is important because multiple studies have reported over 70% reductions in readmissions after implementing multidisciplinary protocols to diagnose and support frail patients.[26,27] In-hospital frailty identification has also shown to reduce delirium rates by over 50%.[27] Examples of frailty-triggered interventions include medication reconciliation, early physical therapy, bowel regimens, adequate pain control, and judicious fluid resuscitation.

Undertriage

Undertriage is well-documented in the GT population and is multifactorial. Key drivers include low energy mechanisms, misleading vital signs, and limited patient participation for cognitive reasons. These factors can result in misestimation of illness acuity and inadequate or delayed care. Institutional geriatric trauma volumes correlate with mortality benefits, and high-volume GT centers tend to achieve better outcomes than low-volume centers.[28,29] The challenge lies in correctly identifying high risk GT patients who would most benefit from specialized care. Trauma triage guidelines evolved around a focus on preventable mortality from hemorrhagic shock, and the phenotype of the GT patient with traumatic brain injury can be vastly different than that of the young exsanguinating patient.

A 2019 multi-institutional prospective study showed that current American guidelines have low sensitivity for identifying seriously injured GT patients.[30] The study

tested geriatric-specific triage criteria which incorporated adjusted vital sign thresholds and presence of multiple comorbidities. The modified criteria had dramatically increased sensitivity (90% vs. 37%) but significantly reduced specificity (17% vs. 90%). Generally, a tool with low sensitivity lends itself to undertriage while a tool with low specificity leads to overtriage. Although ideal risk thresholds are unclear, current cultural consensus is that GT-specific triage tools would benefit from increased sensitivity. Recent trauma activation guidelines include age-based hemodynamic thresholds for major trauma activation–a systolic blood pressure below 110 mmHg generally triggers activation for patients above age 65, compared to a cutoff of less than 90 mmHg for younger patients. Additionally, the ground-level fall on antithrombotic agents is now considered major trauma criteria at several institutions, but this strategy can predispose to overtriage.[30]

There is currently no prehospital triage tool that accurately identifies severely injured GT population.[31] A recent review identified 14 studies since the year 2000 that have assessed major trauma prehospital triage tools in the GT population.[31] There was great heterogeneity in outcomes reported, no studies assessed more than 2 tools simultaneously, and risk of bias was high in most reports. Moving forward, geriatric triage will remain an area of high research priority.

Osteoporosis

Several institutions utilize vitamin D screening, as deficiency has been linked to worse functional outcomes.[32] In the general adult population, calcium-vitamin D (Ca/D) supplementation lowers risk for future hip fractures (RR 0.61–0.84).[33] However, only two RCTs have specifically enrolled geriatric patients with traumatic fractures, and no conclusive evidence exists for the GT population.[34,35] Given the risk-reductive benefit of Ca/D therapy observed in the general population, it is reasonable to screen GT patients for deficiency and to provide supplementation for deficient patients, however this is based on incomplete evidence.

Delirium

The incidence of hospital delirium in the overall GT population ranges from 3% to 17%.[36,37] In the intensive care unit, rates can range from 14% to 61%.[38-40] Delirium prolongs hospital length of stay by at least 4 days on average.[36,41] Modifiable risk factors include polypharmacy and use of restraints.[36] Confirmation of a delirium diagnosis can be difficult due to the phenomenon's characteristic fluctuating course of consciousness. The Confusion Assessment Method (CAM) has been validated several times in the GT population and is the gold standard delirium diagnostic tool for both clinical and research use; context-specific variants have been validated for use in emergency and critical care settings.[42,43,44,45]

In 2022, Stanford University published a geriatric trauma care pathway associated with 50% reductions in delirium.[46] The design focused on the 4M framework of values proposed by the Institute of Healthcare Improvement: medication, mentation, mobility, and what matters.[47] Order sets were implemented in clinical software with nonpharmacological interventions and age-corrected medication dosages. Key process measures included adequate pain control, mobilization within 24 hours, and early advanced care planning if not already completed. A similar pre-post study from 2017 showed a significant 3.7-day reduction in delirium duration after implementation of a treatment protocol involving antipsychotic medications and nonpharmacologic interventions.[48] Emphasis was placed on promoting restfulness through appropriate light exposure, extended quiet hours, reduced lab draws, and orienting auditory and visual aids. Finally, from a financial perspective, implementation of updated delirium and sedation guidelines has been associated with savings of $4.3 million over a 5-year period.[49]

Several pharmacologic interventions have been explored for delirium prophylaxis, and most are relatively understudied in the trauma population. A 2020 meta-analysis found that for surgical ICU patients–a department that usually also manages critical traumas–only dexmedetomidine and risperidone were associated with significant reductions in delirium risk.[50] Across all types of ICU, quetiapine was associated with the best response rate to treatment of delirium of any tested medicine (OR 8.00, 1.41–45.41).[50]

Polypharmacy

Around 10% of geriatric admissions are related to adverse drug events.[51,52] Medication reconciliation, or the auditing of prescribed substances, can mitigate the use of potentially hazardous medications in older adults.[53] The Beers Criteria, first published in 1991, have historically been central to successful medication reconciliation. More recently, the STOPP/START criteria were developed to support not only deprescribing of risky

medications but also introduction of helpful medications.[54] Guidelines support using these criteria in formal medication reconciliation, which can be partially automated through software.[1,54] There is evidence that structured medication reconciliation programs can reduce prescribing errors at time of discharge, especially when a pharmacist is involved.[55] A 2024 meta-analysis of prospective studies found that formal medication reconciliation programs significantly reduced hospital readmission rates (HR 0.92, CI: 0.85–0.99).[56] However, no effect on mortality was observed.

Palliative care

Establishing goals of patient care is best done long before critical decisions are needed. Current guidelines state that a positive frailty screen should trigger palliative care processes, starting with a conversation with patients, family, or friends to establish goals of care. This provides most value when done within the first 3 days of hospitalization.[57] However, data suggests that fewer than 20% of critically ill trauma patients establish goals of care within the first 3 hospital days.[58] Early goals of care conversations are associated with significant reductions in ICU length of stay, duration of mechanical ventilation, and tracheostomy.[59] The literature lacks prospective evidence to support these results, and this is an area of ongoing study.

Conclusions

Geriatric trauma care has greatly evolved over the past decade. Accurate estimation of frailty is the central concept in the field. Modern best practice data supports interdisciplinary pathways for the diagnosis and treatment of frailty and delirium, as well as for guiding end-of-life decision making. The TSFI and CAM are recommended for the diagnosis of frailty and delirium, respectively. Formal medication reconciliation may reduce polypharmacy, prescribing errors, and readmission rates. Evidence-based guidance is still wanted for key topics of overtriage and fracture risk reduction.

References:

1. ACS TQIP Geriatric Trauma Management Guidelines. Accessed 16 August, 2025. Available at: https://www.facs.org/media/ubyj2ubl/best-practices-guidelines-geriatric-trauma.pdf

2. Calland JF, Ingraham AM, Martin N, et al. Evaluation and management of geriatric trauma: an Eastern Association for the Surgery of Trauma practice management guideline. *J Trauma Acute Care Surg*. 2012;73(5 Suppl 4):S345-S350. doi:10.1097/TA.0b013e318270191f

3. American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Blunt Trauma, Gerardo CJ, Blanda M, et al. Clinical Policy: Critical Issues in the Evaluation of Adult Patients Presenting to the Emergency Department With Acute Blunt Trauma. *Ann Emerg Med*. 2024;84(4):e25-e55. doi:10.1016/j.annemergmed.2024.05.027

4. Benhamed A, Batomen B, Boucher V, et al. Epidemiology, injury pattern and outcome of older trauma patients: A 15-year study of level-I trauma centers. *PLoS One*. 2023;18(1):e0280345. Published 2023 Jan 30. doi:10.1371/journal.pone.0280345

5. Farrow L, Diffley T, Gordon MWG, et al. Epidemiology of major trauma in older adults within Scotland: A national perspective from the Scottish Trauma Audit Group (STAG). *Injury*. 2023;54(12):111065. doi:10.1016/j.injury.2023.111065

6. Jiang L, Zheng Z, Zhang M. The incidence of geriatric trauma is increasing and comparison of different scoring tools for the prediction of in-hospital mortality in geriatric trauma patients. *World J Emerg Surg*. 2020;15(1):59. Published 2020 Oct 19. doi:10.1186/s13017-020-00340-1

7. Khan SS, Singer BD, Vaughan DE. Molecular and physiological manifestations and measurement of aging in humans. *Aging Cell*. 2017;16(4):624-633. doi:10.1111/acel.12601

8. Barry ES, Merkebu J, Varpio L. State-of-the-art literature review methodology: A six-step approach for knowledge synthesis. *Perspect Med Educ*. 2022;11(5):281-288. doi:10.1007/s40037-022-00725-9

9. Fakhry SM, Morse JL, Garland JM, et al. Redefining geriatric trauma: 55 is the new 65. *J Trauma Acute Care Surg*. 2021;90(4):738-743. doi:10.1097/TA.0000000000003062

10. Campbell-Furtick M, Moore BJ, Overton TL, et al. Post-trauma mortality increase at age 60: a cutoff for defining elderly?. *Am J Surg*. 2016;212(4):781-785. doi:10.1016/j.amjsurg.2015.12.018

11. Noureldin A, Matecki M, Li R, Atahar J, Lee SM, Kartiko S. Should we redefine the age of geriatric trauma? An insight from American College of Surgeons Trauma Quality Improvement Program database 30-day mortality risk. *J Trauma Acute Care Surg*. 2025;99(1):128-134. doi:10.1097/TA.0000000000004611

12. Ciesla DJ, Pracht EE, Tepas JJ 3rd, Cha JY, Langland-Orban B, Flint LM. The injured elderly: a rising tide. *Surgery*. 2013;154(2):291-298. doi:10.1016/j.surg.2013.04.025

13. Miyoshi Y, Kondo Y, Hirano Y, et al. Characteristics, injuries, and clinical outcomes of geriatric trauma patients in Japan: an analysis of the nationwide trauma registry database. *Sci Rep*. 2020;10(1):19148. Published 2020 Nov 5. doi:10.1038/s41598-020-76149-4

14. Cuevas-Østrem M, Røise O, Wisborg T, Jeppesen E.

Epidemiology of geriatric trauma patients in Norway: A nationwide analysis of Norwegian Trauma Registry data, 2015-2018. A retrospective cohort study. *Injury*. 2021;52(3):450-459. doi:10.1016/j.injury.2020.11.007

15. Tomas C, Kallies K, Cronn S, Kostelac C, deRoon-Cassini T, Cassidy L. Mechanisms of traumatic injury by demographic characteristics: an 8-year review of temporal trends from the National Trauma Data Bank. *Inj Prev*. 2023;29(4):347-354. doi:10.1136/ip-2022-044817

16. Lu R, Chotirosniramit N, Chandacham K, et al. Association between clinical factors and mortality in older adult trauma patients: A systematic review and meta-analysis. *Am J Surg*. 2024;236:115890. doi:10.1016/j.amjsurg.2024.115890

17. Lin PC, Wu NC, Su HC, Hsu CC, Chen KT. Comprehensive comparison between geriatric and nongeriatric patients with trauma. *Medicine (Baltimore)*. 2022;101(7):e28913. doi:10.1097/MD.0000000000028913

18. Pagin M, Mabire C, Cotton M, Zingg T, Carron PN. Retrospective Analysis of Geriatric Major Trauma Patients Admitted in the Shock Room of a Swiss Academic Hospital: Characteristics and Prognosis. *J Clin Med*. 2020;9(5):1343. Published 2020 May 4. doi:10.3390/jcm9051343

19. Zhao F, Tang B, Hu C, Wang B, Wang Y, Zhang L. The impact of frailty on posttraumatic outcomes in older trauma patients: A systematic review and meta-analysis. *J Trauma Acute Care Surg*. 2020;88(4):546-554. doi:10.1097/TA.0000000000002583

20. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet*. 2013;381(9868):752-762.

21. Joseph B, Saljuqi AT, Amos JD, et al. Prospective validation and application of the Trauma-Specific Frailty Index: Results of an American Association for the Surgery of Trauma multi-institutional observational trial. *J Trauma Acute Care Surg*. 2023;94(1):36-44. doi:10.1097/TA.0000000000003817

22. Alizai Q, Colosimo C, Hosseinpour H, et al. It is not all black and white: The effect of increasing severity of frailty on outcomes of geriatric trauma patients. *J Trauma Acute Care Surg*. 2024;96(3):434-442. doi:10.1097/TA.0000000000004217

23. Joseph B, Pandit V, Zangbar B, et al. Validating trauma-specific frailty index for geriatric trauma patients: a prospective analysis. *J Am Coll Surg*. 2014;219(1):10-17.e1. doi:10.1016/j.jamcollsurg.2014.03.020

24. Hamidi M, Haddadin Z, Zeeshan M, et al. Prospective evaluation and comparison of the predictive ability of different frailty scores to predict outcomes in geriatric trauma patients. *J Trauma Acute Care Surg*. 2019;87(5):1172-1180. doi:10.1097/TA.0000000000002458

25. Alqarni AG, Gladman JRF, Obasi AA, Ollivere B. Does frailty status predict outcome in major trauma in older people? A systematic review and meta-analysis. *Age Ageing*. 2023;52(5):afad073. doi:10.1093/ageing/afad073

26. Engelhardt KE, Reuter Q, Liu J, et al. Frailty screening and a frailty pathway decrease length of stay, loss of independence, and 30-day readmission rates in frail geriatric trauma and emergency general surgery patients. *J Trauma Acute Care Surg*. 2018;85(1):167-173. doi:10.1097/TA.0000000000001931

27. Bryant EA, Tulebaev S, Castillo-Angeles M, et al. Frailty Identification and Care Pathway: An Interdisciplinary Approach to Care for Older Trauma Patients. *J Am Coll Surg*. 2019;228(6):852-859.e1. doi:10.1016/j.jamcollsurg.2019.02.052

28. Zafar SN, Obirieze A, Schneider EB, et al. Outcomes of trauma care at centers treating a higher proportion of older patients: the case for geriatric trauma centers. *J Trauma Acute Care Surg*. 2015;78(4):852-859. doi:10.1097/TA.0000000000000557

29. Kojima M, Endo A, Zakhary B, Shoko T, Firek M, Coimbra R. Case volume and rate are associated with outcomes in geriatric trauma: A case for geriatric trauma centers?. *J Trauma Acute Care Surg*. 2023;94(2):241-247. doi:10.1097/TA.0000000000003838

30. Newgard CD, Lin A, Eckstrom E, et al. Comorbidities, anticoagulants, and geriatric-specific physiology for the field triage of injured older adults. *J Trauma Acute Care Surg*. 2019;86(5):829-837. doi:10.1097/TA.0000000000002195

31. Fuller G, Pandor A, Essat M, et al. Diagnostic accuracy of prehospital triage tools for identifying major trauma in elderly injured patients: A systematic review. *J Trauma Acute Care Surg*. 2021;90(2):403-412. doi:10.1097/TA.0000000000003039

32. Llombart R, Mariscal G, Barrios C, de la Rubia Ortí JE, Llombart-Ais R. Does vitamin D deficiency affect functional outcomes in hip fracture patients? A meta-analysis of cohort studies. *J Endocrinol Invest*. 2024;47(6):1323-1334. doi:10.1007/s40618-023-02266-2

33. Chakhtoura M, Bacha DS, Gharios C, et al. Vitamin D Supplementation and Fractures in Adults: A Systematic Umbrella Review of Meta-Analyses of Controlled Trials. *J Clin Endocrinol Metab*. 2022;107(3):882-898. doi:10.1210/clinem/dgab742

34. Harwood RH, Sahota O, Gaynor K, Masud T, Hosking DJ; Nottingham Neck of Femur (NONOF) Study. A randomised, controlled comparison of different calcium and vitamin D supplementation regimens in elderly women after hip fracture: The Nottingham Neck of Femur (NONOF) Study. *Age Ageing*. 2004;33(1):45-51. doi:10.1093/ageing/afh002

35. Grant AM, Avenell A, Campbell MK, et al. Oral vitamin D3 and calcium for secondary prevention of low-trauma fractures in elderly people (Randomised Evaluation of Calcium Or vitamin D, RECORD): a randomised placebo-controlled trial. *Lancet*. 2005;365(9471):1621-1628. doi:10.1016/S0140-6736(05)63013-9

36. Toure A, Tadi R, Meagher M, et al. There's No Place Like

Home: Delirium as a Barrier in Geriatric Trauma. *J Surg Res*. 2024;293:89-94. doi:10.1016/j.jss.2023.08.014

37. An Z, Xiao L, Chen C, et al. Analysis of risk factors for postoperative delirium in middle-aged and elderly fracture patients in the perioperative period. *Sci Rep*. 2023;13(1):13019. Published 2023 Aug 10. doi:10.1038/s41598-023-40090-z

38. 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(6):944-951. doi:10.1097/TA.0000000000000427

39. Ulderich Williams SC, Qaddoumi AI, Meghreblian JT, et al. Incidence and Risk Factors for ICU-Associated Delirium in the Alert Geriatric Trauma Population. *Am Surg*. 2024;90(7):1866-1871. doi:10.1177/00031348241241707

40. Williams EC, Estime S, Kuza CM. Delirium in trauma ICUs: a review of incidence, risk factors, outcomes, and management. *Curr Opin Anaesthesiol*. 2023;36(2):137-146. doi:10.1097/ACO.0000000000001233

41. Émond M, Boucher V, Carmichael PH, et al. Incidence of delirium in the Canadian emergency department and its consequences on hospital length of stay: a prospective observational multicentre cohort study. *BMJ Open*. 2018;8(3):e018190. Published 2018 Mar 8. doi:10.1136/bmjopen-2017-018190

42. Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med*. 1990;113(12):941-948. doi:10.7326/0003-4819-113-12-941

43. Lin CJ, Su IC, Huang SW, et al. Delirium assessment tools among hospitalized older adults: A systematic review and meta-analysis of diagnostic accuracy. *Ageing Res Rev*. 2023;90:102025. doi:10.1016/j.arr.2023.102025

44. Miranda F, Gonzalez F, Plana MN, Zamora J, Quinn TJ, Seron P. Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) for the diagnosis of delirium in adults in critical care settings. *Cochrane Database Syst Rev*. 2023;11(11):CD013126. Published 2023 Nov 21. doi:10.1002/14651858.CD013126.pub2

45. Han JH, Wilson A, Vasilevskis EE, et al. Diagnosing delirium in older emergency department patients: validity and reliability of the delirium triage screen and the brief confusion assessment method. *Ann Emerg Med*. 2013;62(5):457-465. doi:10.1016/j.annemergmed.2013.05.003

46. Park C, Bharija A, Mesias M, et al. Association Between Implementation of a Geriatric Trauma Clinical Pathway and Changes in Rates of Delirium in Older Adults With Traumatic Injury. *JAMA Surg*. 2022;157(8):676-683. doi:10.1001/jamasurg.2022.1556

47. Fulmer T, Mate KS, Berman A. The Age-Friendly Health System Imperative. *J Am Geriatr Soc*. 2018;66(1):22-24. doi:10.1111/jgs.15076

48. Sullinger D, Gilmer A, Jurado L, et al. Development, Implementation, and Outcomes of a Delirium Protocol in the Surgical Trauma Intensive Care Unit. *Ann Pharmacother*. 2017;51(1):5-12. doi:10.1177/1060028016668627

49. Fish JT, Baxa JT, Draheim RR, et al. Five-Year Outcomes After Implementing a Pain, Agitation, and Delirium Protocol in a Mixed Intensive Care Unit. *J Intensive Care Med*. 2022;37(8):1060-1066. doi:10.1177/08850666211063404

50. Kim MS, Rhim HC, Park A, et al. Comparative efficacy and acceptability of pharmacological interventions for the treatment and prevention of delirium: A systematic review and network meta-analysis. *J Psychiatr Res*. 2020;125:164-176. doi:10.1016/j.jpsychires.2020.03.012

51. Cahir C, Curran C, Walsh C, et al. Adverse drug reactions in an ageing PopulaTion (ADAPT) study: Prevalence and risk factors associated with adverse drug reaction-related hospital admissions in older patients. *Front Pharmacol*. 2023;13:1029067. Published 2023 Jan 13. doi:10.3389/fphar.2022.1029067

52. Oscanoa TJ, Lizaraso F, Carvajal A. Hospital admissions due to adverse drug reactions in the elderly. A meta-analysis. *Eur J Clin Pharmacol*. 2017;73(6):759-770. doi:10.1007/s00228-017-2225-3

53. By the 2023 American Geriatrics Society Beers Criteria® Update Expert Panel. American Geriatrics Society 2023 updated AGS Beers Criteria® for potentially inappropriate medication use in older adults. *J Am Geriatr Soc*. 2023;71(7):2052-2081. doi:10.1111/jgs.18372

54. O'Mahony D, Cherubini A, Guiteras AR, et al. STOPP/START criteria for potentially inappropriate prescribing in older people: version 3. *Eur Geriatr Med*. 2023;14(4):625-632. doi:10.1007/s41999-023-00777-y

55. Parro Martín MLÁ, Muñoz García M, Delgado Silveira E, Martín-Aragón Álvarez S, Bermejo Vicedo T. Intervention study for the reduction of medication errors in elderly trauma patients. *J Eval Clin Pract*. 2021;27(1):160-166. doi:10.1111/jep.13407

56. Carollo M, Crisafulli S, Vitturi G, et al. Clinical impact of medication review and deprescribing in older inpatients: A systematic review and meta-analysis. *J Am Geriatr Soc*. 2024;72(10):3219-3238. doi:10.1111/jgs.19035

57. American College of Surgeons Trauma Quality Improvement Program (TQIP). ACS TQIP palliative care best practices guidelines. October 2017. Accessed August 23, 2025. Available at: https://www.facs.org/media/g3rfegcn/palliative_guidelines.pdf

58. Pierce JG, Ricon R, Rukmangadhan S, et al. Adherence to the TQIP Palliative Care Guidelines Among Patients With Serious Illness at a Level I Trauma Center in the US. *JAMA Surg*. 2022;157(12):1125-1132. doi:10.1001/jamasurg.2022.4718

59. Masterson M, Hunter K, Egodage T. Clinical Outcomes After Early Palliative Care Evaluations in Geriatric Trauma Intensive Care. *J Surg Res*. 2024;302:359-363. doi:10.1016/j.jss.2024.07.062