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Comprehensive Geriatric Management Reduces Postoperative Delirium After Hip Fracture: An Updated Meta-Analysis

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ADMINISTRATIVE INFORMATION

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Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 2 June 2026 and was last updated on 2 June 2026.

INTRODUCTION

Review question / Objective Using the PICOS framework — P: adults ≥60 years with fragility hip fracture managed surgically; I: systematic comprehensive geriatric management with ≥1 component (CGA/OGM/MDT/delirium prevention bundle/medication review/fast-track pathway); C: usual orthopaedic care; O: postoperative delirium incidence (CAM/DSM criteria); S: RCTs and controlled observational studies with contemporaneous controls — to update and refine the meta-analytic estimate reported by Van Heghe et al. (2021).

Rationale Postoperative delirium is the most common complication of hip fracture surgery (incidence 20%–50%) and is independently associated with mortality, functional decline, and incident dementia. Although Van Heghe et al. (2021) reported a 19% delirium risk reduction with orthogeriatric care (RR 0.81), their analysis included single-drug and single-modality interventions, omitted three landmark RCTs (Lundström 2007, Vidán 2005, Deschodt 2012), and did not search psychology or nursing databases (PsycINFO, CINAHL). Furthermore, the global burden of postoperative cognitive dysfunction is rising with
population ageing, generating increasing economic and psychological costs. An updated estimate with stricter exclusion criteria, augmented database coverage, and newly incorporated evidence is warranted.

Condition being studied Hip fracture is the most common and consequential osteoporotic fracture in older adults, with 1.6 million cases annually worldwide, projected to reach 6.3 million by 2050. Although surgical fixation achieves >90% union rates, postoperative delirium—the most frequent complication (incidence 20%–50%)—drives a "cognitive-functional cascade" (delirium → reduced rehabilitation → prolonged immobility → unctional loss → institutionalisation) that leaves >50% of patients below their pre-fracture functional level. Delirium is independently associated with prolonged hospitalisation, 2–3-fold

increased mortality, and 2–5-fold elevated long-term dementia risk. Comprehensive geriatric management (CGA/OGM/MDT/delirium prevention bundles) may protect cognition through multi-component synergistic mechanisms.

METHODS

Search strategy Keywords: hip fracture; postoperative delirium; comprehensive geriatric assessment; orthogeriatric co-management; multidisciplinary team; systematic review; meta-analysis
Electronic Databases: PubMed (MEDLINE), Embase (Elsevier), Cochrane CENTRAL, Web of Science Core Collection, CINAHL (EBSCO), PsycINFO (APA), ClinicalTrials.gov, WHO ICTRP.

Participant or population Adults aged ≥60 years with radiologically confirmed low-energy (fragility) hip fracture (femoral neck, intertrochanteric, or subtrochanteric; ICD-10 S72.0–S72.2), managed surgically (internal fixation or arthroplasty). Excludes pathological fractures, high-energy trauma, non-operative management, and patients with pre-existing severe dementia precluding cognitive assessment.

Intervention Comprehensive Geriatric Management, defined as a systematic protocol incorporating ≥1 of the following components:
(a) Comprehensive Geriatric Assessment (CGA) / Orthogeriatric Co-Management (OGM)
(b) Delirium prevention multi-component bundle
(c) Peri-operative cognitive screening and targeted intervention
(d) Multidisciplinary team (MDT) routine involvement
(e) Standardised fast-track surgical pathway
(f) Medication review / anticholinergic burden management
The protocol must be explicitly described in the study report. The comparator is usual orthopaedic care without the above systematic components (specialist consultation on referral permitted). Single-drug interventions (e.g., dexmedetomidine, haloperidol, melatonin) and single non-pharmacological interventions (e.g., music therapy alone, bright light therapy alone) are excluded.

Comparator Usual orthopaedic care without systematic geriatric management components, provided on a standard orthopaedic ward led by an orthopaedic surgeon.Geriatric consultation is permitted on referral only, without routine geriatrician involvement in daily ward rounds, treatment decisions, or proactive complication screening.

Study designs to be included Randomised controlled trials (RCTs), quasi-RCTs, prospective controlled studies, and retrospective cohort studies with contemporaneous control groups. Single-arm studies, before-after studies without concurrent controls, case series (n < 10), case reports, narrative reviews, editorials, and conference abstracts without full data are excluded.

Eligibility criteria Additional inclusion criteria:
- Language: English or Chinese
- Publication status: Peer-reviewed journal articles with accessible full text; completed trials from grey literature (ClinicalTrials.gov, WHO ICTRP) with results available
- Delirium must be reported as a discrete outcome using a standardised diagnostic instrument (CAM, CAM-ICU, DSM-IV, DSM-5, or validated clinical diagnosis), with extractable events/total (n/N) for both intervention and control groups
Additional exclusion criteria:
- Studies where the delirium assessment tool was not specified or relied solely on non-validated clinical impression
- Studies reporting only continuous cognitive scores (e.g., MMSE change) without binary delirium incidence data
- Studies where the intervention group received additional non-standard treatments (e.g., experimental drugs) not available to the control group, unless the effect of geriatric management can be isolated
- Overlapping study populations: where multiple publications derive from the same cohort, only the report with the most complete delirium data is retained.

Information sources Electronic databases (searched from inception to May 2026):
- PubMed (MEDLINE) via NCBI Entrez
- Embase (Elsevier) via institutional access
- Cochrane CENTRAL (Wiley)
- Web of Science Core Collection (Clarivate)
- CINAHL (EBSCO) — nursing and allied health literature
- PsycINFO (APA) — cognitive psychology and geriatric psychiatry literature
Grey literature sources:
- ClinicalTrials.gov (https://clinicaltrials.gov)
- WHO International Clinical Trials Registry Platform (ICTRP;https://trialsearch.who.int)
Supplementary search methods:
- Hand-searching of reference lists of all included studies
- Citation tracking (forward and backward) of three key prior systematic reviews: Van Heghe et al. (2021, Calcif Tissue Int, PMID 34668035), Shields

et al. (2017, J Am Geriatr Soc, PMID 28407199), and Grigoryan et al. (2014, J Orthop Trauma, PMID23222099) - Contact with study authors was planned for cases where full text was unavailable or where binary delirium outcome data could not be extracted from the publishedreport.

Main outcome(s) Primary outcome: Postoperative delirium incidence during indexhospitalisation
Seven studies (5 RCTs, 2 observational; N = 1,555) were included. Delirium occurred in 37.4% (295/789) of the geriatric management group versus 47.4% (363/766) of the control group.
- Fixed-effect: RR = 0.80 (95% CI: 0.72–0.90)
- Random-effects (DerSimonian-Laird + Hartung-Knapp-Sidik-Jonkman): RR = 0.80 (95% CI: 0.70–0.93, P = 0.021)
- Heterogeneity: I^2 = 2.8% (very low), τ^2 = 0.0007, Q = 6.17 (df = 6), P = 0.40
- 95% prediction interval: 0.68–0.94
- Absolute risk reduction: 10 percentage points; NNT = 10
Sensitivity analyses: RCT-only subgroup (k = 5): RR = 0.79 (95% CI: 0.70–0.89, I^2 = 4%). Excluding one confounded observational study (k = 6): RR = 0.79 (95% CI: 0.70–0.88, I^2 = 0%). Leave-one-out range: RR 0.76–0.83.
Pooled incidence by group: Comprehensive geriatric management: 38.4% (95% CI: 30.1%–47.4%). Usual care: 48.5% (95% CI: 38.0%–59.1%).

Additional outcome(s) Secondary outcomes (pre-specified):
- Severe delirium incidence (CAM-S or MDAS-defined), where reported
- Delirium duration (days, continuous)
- In-hospital mortality
- Length of hospital stay (days)
Planned but not meta-analysed (insufficient data):
- Postoperative cognitive dysfunction (POCD/NCD) at 3 months
- Cognitive score change from baseline (MMSE/MoCA, SMD)
- New-onset dementia diagnosis at 1 year
- Discharge to pre-fracture residence
Insufficient studies reported these outcomes in extractable format for quantitative synthesis; they are addressed narratively in the Discussion and identified as future research priorities.

Data management Two reviewers (XL and XD) independently screened titles/abstracts against eligibility criteria using a standardised screening form implemented in CSV format with pre-defined decision codes (INCLUDE, EXCLUDE, CHECK, LOW). Full-text assessment decisions were independently recorded and cross-checked.format with pre-defined decision codes (INCLUDE, EXCLUDE, CHECK, LOW). Full-text assessment decisions were independently recorded and cross-checked.
Discrepancies at any stage were resolved through discussion; a third reviewer (JZG) served as arbitrator where consensus could not be reached. All records, screening decisions, extraction sheets, and analysis scripts are archived in the project repository and available from the corresponding authorupon request.

Quality assessment / Risk of bias analysis Risk of biasassessment:
- Randomised controlled trials: Cochrane RoB 2 tool (Sterne et al., BMJ 2019), assessing five domains — randomisation process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Each domain rated as low risk, some concerns, or high risk.
- Non-randomised studies: ROBINS-I tool (Sterne et al., BMJ 2016), assessing seven domains — confounding, selection of participants, classification of interventions, deviations from intended interventions, missing data, measurement of outcomes, and selection of the reported result. Each domain rated as low, moderate, serious, or critical risk.
- Cognitive outcome-specific considerations: Particular attention was paid to detection bias (whether delirium assessors were blinded to group allocation) and attrition bias (whether patients who developed delirium were differentially lost to follow-up).
- Two reviewers (XL, XD) independently assessed risk of bias; disagreements were resolved by discussion.
- Results were incorporated into GRADE evidence certainty ratings.

Strategy of data synthesis Effect measure: Risk ratio (RR) with 95% confidence interval (CI) for binary outcomes (delirium incidence), calculated using the Mantel-Haenszelmethod.For planned secondary outcomes, mean difference (MD) for same-scale continuous variables and standardised mean difference (Hedges' g) for different-scale continuous variables.
Meta-analysis model: Primary analysis used the DerSimonian-Laird random-effects model (REML estimator for τ^2) with Hartung-Knapp-Sidik-Jonkman (HKSJ) adjustment to account for between-study heterogeneity. Fixed-effect results were reported for comparison. The 95% prediction interval was computed to quantify the range of expected treatment effects in future settings.

Heterogeneity: Assessed using Cochrane's Q test and the I^2 statistic. I^2 thresholds: 75% considerable.Meta-analysis was performed when ≥3 studies were available for a given outcome.
Subgroup analysis: Pre-specified by study design (RCT vs observational studies). Planned but underpowered: by number of intervention components (1 vs ≥2) and geographical region.
Sensitivity analyses: (1) Exclusion of observational studies with evidence of confounding by indication; (2) leave-one-out (influence) analysis; (3)exclusion of studies not using CAM/DSM-IV criteria for delirium ascertainment.
Publication bias: Quantitative testing (Egger's regression, funnel plot) was planned for outcomes with ≥10 studies. Given k = 7, potential selective reporting is addressed narratively.
Meta-analysis of proportions: Pooled delirium incidence for intervention and control groups separately was estimated using random-effects meta-analysis with logit transformation.
Software: Python 3.11 (NumPy, SciPy) with manual implementation of DL+HKSJ and metaprop algorithms; analysis script archived and available from the corresponding author.

Subgroup analysis Pre-specified subgroup analysis:
1. Study design: RCTs versus observational studies (quasi-RCTs grouped with RCTs). Rationale: observational studies are susceptible to confounding by indication—frailer patients may be selectively directed to geriatric management pathways—potentially biasing the effect estimate toward the null.
2. Number of intervention components: 1 component versus ≥2 components. Rationale: to explore a potential dose-response relationship between intervention intensity and delirium reduction. Hypothesis: multi-component interventions (≥2) will show a larger effect.
3. Geographical region: Europe versus North America versus other regions. Rationale: healthcare system organisation, baseline delirium management standards, and orthogeriatric care model maturity differ across regions.
Subgroup analyses 2 and 3 were pre-specified but remained underpowered at the present sample size (k = 7; strata contained 1–5 studies each) and are identified as priorities for future updates when the evidence base has expanded.

Sensitivity analysis 1. Exclusion of confounded observational studies. Observational studies rated as ROBINS-I "serious" or "critical" risk of confounding were excluded, retaining only RCTs and quasi-RCTs with low or moderate risk of bias. Sensitivity analysis was also performed excluding all observational studies, regardless of risk rating.
2. Leave-one-out (influence) analysis. The pooled estimate was recalculated after sequentially removing each individual study to assess whether any single study exerted disproportionate influence on the overall result. A study was considered influential if its removal shifted the pooled RR by ≥10% or altered the statistical significance of the estimate.
3. Exclusion of studies using non-structured delirium ascertainment. Studies that identified delirium through retrospective chart review or non-validated clinical diagnosis (rather than prospective CAM or DSM assessment by trained, blinded assessors) were excluded to evaluate the impact of outcome measurement quality.
4. Exclusion of studies retaining patients with prevalent baseline delirium. The Lundström 2007 trial did not exclude patients already delirious preoperatively; sensitivity analysis excluded this study to determine whether its inclusion of prevalent cases affected the pooled estimate.
5. Effect-model switching. The primary random-effects estimate (DL + HKSJ) was compared with the fixed-effect estimate (Mantel-Haenszel) and with alternative τ^2 estimators (Paule-Mandel, Sidik-Jonkman) to ensure model choice did not drive the conclusion.
6. Post hoc sensitivity: exclusion of ward-level randomised trials. Deschodt 2012 used ward-level allocation rather than individual randomisation; sensitivity analysis excluded this study to assess whether quasi-random allocation biased results.
All sensitivity analyses were planned to be reported in a supplementary table with the recalculated pooled RR, 95% CI, I^2, and interpretation for each scenario.

Language restriction English and Chinese.

Country(ies) involved China.

Keywords hip fracture; postoperative delirium; comprehensive geriatric assessment; orthogeriatric co-management; multidisciplinary team; geriatric consultation; systematic review; meta-analysis.

Contributions of each author
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