

Review Article

Enhanced Recovery After Surgery Protocols in Total Joint Arthroplasty: Length of Stay and Readmission

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Received: 24 March 2026; **Accepted:** 6 June 2026; **Published:** 22 August 2026; **DOI:** 10.5281/zenodo.22328086**Citation of this article:** Tamme R, Juric A, Marchand A (2026) Enhanced Recovery After Surgery Protocols in Total Joint Arthroplasty: Length of Stay and Readmission. Int J Orthop, 7(1): 01-06.**Copyright:** © 2026 Rasmus Tamme, et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.**Abstract****Background:** Enhanced Recovery After Surgery (ERAS) pathways bundle preoperative optimisation, multimodal analgesia, blood management, and early mobilisation to accelerate recovery after total hip and knee arthroplasty (THA/TKA).**Objective:** To synthesise evidence on ERAS protocol components and their effect on length of stay (LOS), readmission, complications, satisfaction, and cost in total joint arthroplasty (TJA).**Methods:** Narrative review of systematic reviews, meta-analyses, randomised trials, and national registry studies.**Findings:** ERAS pathways reduce LOS by roughly one to three days across meta-analyses and registries, without increasing 30- or 90-day readmission; several studies show fewer complications and lower transfusion and mortality rates. Economic analyses consistently report cost savings, driven mainly by shortened hospitalisation, while satisfaction is equal or improved.**Conclusions:** ERAS protocols are a validated, cost-effective standard of care for TJA, though preoperative optimisation components remain the least standardised element of current pathways.**Keywords:** Enhanced recovery after surgery; Total joint arthroplasty; Length of stay; Hospital readmission; Multimodal analgesia

Abstract

Background: Enhanced Recovery After Surgery (ERAS) pathways bundle preoperative optimisation, multimodal analgesia, blood management, and early mobilisation to accelerate recovery after total hip and knee arthroplasty (THA/TKA). **Objective:** To synthesise evidence on ERAS protocol components and their effect on length of stay (LOS), readmission, complications, satisfaction, and cost in total joint arthroplasty (TJA). **Methods:** Narrative review of systematic reviews, meta-analyses, randomised trials, and national registry studies. **Findings:** ERAS pathways reduce LOS by roughly one to three days across meta-analyses and registries, without increasing 30- or 90-day readmission; several studies show fewer complications and lower transfusion and mortality rates. Economic analyses consistently report cost savings, driven mainly by shortened hospitalisation, while satisfaction is equal or improved. **Conclusions:** ERAS protocols are a validated, cost-effective standard of care for TJA, though preoperative optimisation components remain the least standardised element of current pathways.

Keywords: enhanced recovery after surgery; total joint arthroplasty; length of stay; hospital readmission; multimodal analgesia

Introduction

Total hip and knee arthroplasty are among the highest-volume elective procedures in orthopaedic surgery, and health systems worldwide face pressure to shorten hospitalisation while preserving safety and, increasingly, delivering care within fixed bundled-payment episodes. Enhanced Recovery After Surgery (ERAS), originally developed for colorectal surgery by Kehlet and colleagues, was adapted to total joint arthroplasty (TJA) as "fast-track" perioperative care combining evidence-based preoperative, intraoperative, and postoperative interventions designed to attenuate the

surgical stress response and accelerate functional recovery [1,2]. The rationale is physiological rather than purely administrative: reducing the neuroendocrine and inflammatory stress response to surgery, minimising opioid-related sedation and ileus, and correcting modifiable risk factors before admission are each hypothesised to shorten the interval to safe, independent mobility, which in turn is the principal determinant of discharge readiness after TJA. The Enhanced Recovery After Surgery (ERAS®) Society published a consensus statement formalising 20 specific perioperative care items for total hip and total knee replacement, spanning preadmission counselling, anaemia correction, multimodal analgesia, tranexamic acid use, and early mobilisation, graded by the strength of supporting evidence available at the time [3].

An earlier narrative review of the evidence base for hip and knee ERAS identified preoperative education, intraoperative anaesthetic technique, multimodal analgesia, and early mobilisation as the components with the strongest supporting evidence at that time, while flagging a paucity of dedicated randomised trials in arthroplasty specifically, as opposed to extrapolation from general-surgery ERAS literature [4]. Subsequent multicentre randomised trials, including an eight-hospital Chinese protocol comparing a structured ERAS pathway against conventional perioperative care in both hip and knee arthroplasty, have since tested this evidence base directly against LOS, complications, cost, and readmission as prespecified outcomes [5]. This review synthesises that accumulated evidence, organised around the core protocol components, their effect on LOS, their effect on readmission and complications, and their effect on satisfaction and cost.

ERAS Protocol Components: Preoperative Optimisation, Analgesia, and Blood Management

ERAS pathways for TJA are typically organised into

preadmission, intraoperative, and postoperative bundles (Table 1). Preoperative optimisation includes patient education, smoking cessation, and correction of anaemia, but a 2025 systematic review of 38 ERAS programmes found that most protocols relied on low-evidence education and physiotherapy components, with over 60% providing no structured medical optimisation of comorbidities and only one study setting a specific glycaemic target [6]. This matters because preoperative anaemia, present in roughly 15-18% of primary and up to 38% of revision TJA candidates, is independently associated with transfusion, infection, prolonged stay, and readmission [7]. Intraoperative components emphasise neuraxial (spinal) rather than general anaesthesia, normothermia, goal-directed fluid management, and tranexamic acid for blood conservation; a national registry analysis found spinal anaesthesia associated with modestly shorter LOS, fewer 30-day complications, and higher rates of home discharge compared with general anaesthesia [8], while network meta-analysis of tranexamic acid regimens found combined intravenous-and-topical administration reduced transfusion rates by 98% relative to placebo [9]. Multimodal analgesia combining periarticular local infiltration, acetaminophen, and NSAIDs, with regional nerve blocks favoured for total knee arthroplasty, is intended to minimise opioid use while preserving quadriceps strength for early mobilisation; periarticular multimodal injection has been shown in randomised and pooled data to reduce narcotic consumption and, in some series, shorten hospital stay, without increasing wound complications or venous thromboembolism [10,11]. For analgesic technique, adductor canal block preserves early ambulation better than femoral nerve block, with comparable pain control and no significant difference in LOS [12]. Postoperative elements include same-day or day-one mobilisation, early oral nutrition, restrictive urinary catheterisation, and criteria-based discharge

planning [13]. Taken together, these components are designed to act cumulatively rather than in isolation: a patient who mobilises on the day of surgery but still requires an indwelling catheter, remains fasted into the following morning, or has uncorrected anaemia is unlikely to realise the full LOS benefit attributed to ERAS as a bundle, which is why adherence auditing and fidelity to the full pathway, rather than adoption of any single element, has emerged as a recurring theme across the implementation literature summarised in Table 1.

Table 1: Core components of ERAS pathways for total joint arthroplasty, organised by perioperative phase, with representative supporting evidence [3,6,8,9,10,12,13].		
Phase	Key components	Representative evidence
Preadmission / preoperative	Patient education, smoking cessation, anaemia screening and correction, expectation-setting	38-study review found most protocols relied on low-evidence education with minimal medical optimisation [6]
Intraoperative	Spinal/neuraxial anaesthesia, normothermia, goal-directed fluids, tranexamic acid, minimal drains/catheters	Spinal anaesthesia associated with shorter LOS and fewer complications [8]; combined IV/topical TXA cut transfusion by 98% vs placebo [9]
Postoperative analgesia	Periarticular multimodal injection, acetaminophen/NSAIDs, adductor canal block over femoral nerve block	Periarticular injection reduced opioid use without increasing complications [10]; adductor canal block preserved early mobilisation vs femoral nerve block [12]
Postoperative recovery	Same-day/day-one mobilisation, early oral nutrition, restrictive catheterisation, criteria-based discharge	Reduced postoperative complications, LOS, and cost with improved satisfaction [13]
Society consensus	20 perioperative care items spanning all phases above	ERAS® Society consensus statement for THA/TKA [3]

Effect on Length of Stay

The effect of ERAS on LOS is the most consistently reproduced finding in this literature (Figure 1). A randomised controlled trial of a multicentre ERAS pathway for primary TKA found total LOS fell from 8.17 ± 1.76 days with conventional care to 5.92 ± 1.16 days with ERAS ($p < 0.001$) [14]. At the national level, an interrupted time-series analysis of the National Joint Registry for England, Wales, Northern Ireland, and the Isle of Man, spanning almost 500,000 primary knee replacements, found LOS fell from 5.8 to 3.7 days after implementation of a national ERAS programme, with complications falling from 4.1% to 1.7% [15]. A separate population-based study of 1,455,842 primary hip, knee, and unicompartmental knee procedures in England found median LOS declined from 4.26 to 2.75 days for THR and from 4.35 to 2.91 days for TKR between 2010 and 2022, occurring independently of rising comorbidity burden [16]. Danish multicentre fast-track data spanning 36,935 procedures similarly showed median LOS falling from three days in 2010 to one day by 2017 [17]. Pooled meta-analytic estimates corroborate these single-source findings: a synthesis of seven studies and 8,346 patients found a standardised mean difference of -0.85 days favouring ERAS [18], while a larger and more recent meta-analysis of 47 studies and 76,971 patients (29,702 ERAS, 47,269 conventional) found a weighted mean LOS reduction of 2.65 days [19]. Systematic review of dedicated preoperative pain-control adjuncts and randomised controlled early-mobilisation protocols corroborate a discrete contribution from earlier ambulation, with pooled analysis of five trials finding early mobilisation alone reduced LOS by 1.8 days, with most patients sitting out of bed within 24 hours and walking within 48 hours [20]. A dedicated randomised trial of ERAS in patients over 65 undergoing TKA reported a similarly significant LOS reduction alongside reduced intraoperative and total blood loss, reinforcing that the LOS benefit persists in

older, higher-risk surgical populations rather than being confined to younger trial cohorts [21]. Direct periarticular multimodal drug injection has also been linked to a shorter stay in a dedicated single-centre comparison, from 6.2 ± 1.3 to 5.4 ± 1.0 days, alongside markedly higher rates of independent ambulation within 24 hours [11].

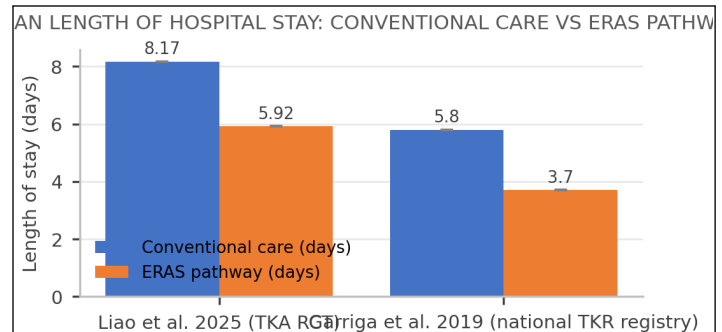
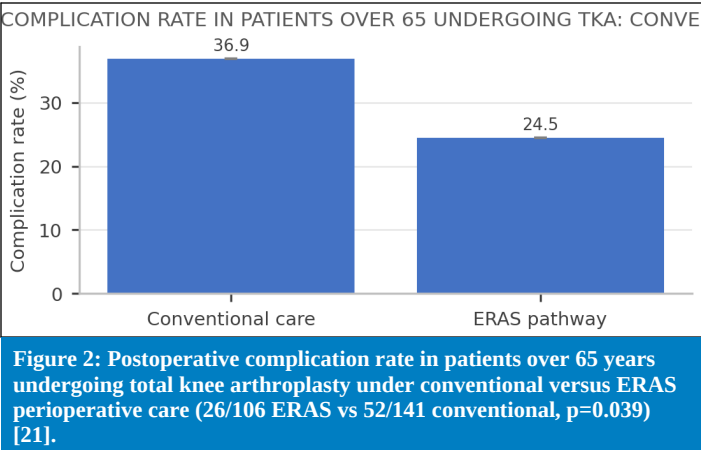


Figure 1: Mean length of hospital stay under conventional versus ERAS pathway care in a multicentre randomised controlled trial of primary total knee arthroplasty [14] and a national interrupted time-series registry study of primary total knee replacement [15].

Readmission and Postoperative Complications

A central safety concern is whether shortened stays displace morbidity into unplanned readmission. Reassuringly, most large syntheses find no significant increase. The Zhu meta-analysis found no significant difference in 30-day readmission between ERAS and conventional care (odds ratio 0.84, 95% CI 0.65-1.08) while complications were significantly reduced (odds ratio 0.77) [18]. The Zhang meta-analysis similarly found ERAS did not increase readmission, while reporting significantly lower 30-day mortality (odds ratio 0.46) and lower transfusion requirement (odds ratio 0.40) [19]. The English national LOS study found no increase in crude 30-day readmission despite a nearly two-day reduction in median stay [16], and Danish fast-track data showed 90-day readmission falling slightly, from 8.6% to 7.7%, over the same period that LOS fell most sharply [17]. At the individual-study level, a randomised comparison of ERAS versus traditional perioperative care in patients over 65 undergoing TKA found significantly fewer total

complications with ERAS (26/106 versus 52/141 patients, $p=0.039$; Figure 2), alongside lower blood loss and transfusion rates [21]. Outpatient and ambulatory TJA pathways, an extension of ERAS principles, show a comparable safety profile: a meta-analysis of 41 studies found no significant difference in readmission between outpatient and inpatient hip/knee arthroplasty, with 92% of outpatient patients achieving same-day discharge [22]. Discharge destination itself carries readmission-relevant risk independent of LOS: national inpatient sample data show 18.3% of primary THA patients are discharged to a skilled nursing facility, with systemic complications such as pneumonia (odds ratio 3.2) and venous thromboembolism (odds ratio 2.58) most strongly associated with non-home discharge [23].



Patient Satisfaction and Cost-Effectiveness

Beyond LOS and readmission, ERAS pathways are consistently associated with improved patient-reported experience and lower episode cost (Table 2). A randomised nursing-led ERAS strategy for THA in older adults found higher satisfaction (only one dissatisfied patient versus three under conventional care) alongside faster functional recovery on Harris hip and Barthel index scores [24]. The Zhang meta-analysis reported ERAS improved SF-36 bodily pain and physical function subscales relative to conventional care [19]. Economic

analyses are similarly favourable: a systematic review of seven cost studies found fast-track THA/TKA reduced total treatment cost in every included study, primarily through shortened hospitalisation [25], and the national ERAS-linked TKA registry programme in England reported bed-day costs falling from £7,607 to £5,276 per case as LOS fell [15]. Outpatient ERAS pathways extend these savings further, with one meta-analysis reporting an average cost reduction of approximately \$6,800 per case relative to inpatient care [22]. A 2025 narrative synthesis situates these gains within the broader POWER2 enhanced-recovery cohort, which found no difference in overall complication rate but significantly fewer moderate-to-severe complications under ERAS (4.6% versus 6.1%, odds ratio 0.74) [26].

Table 2: Selected comparative studies of length of stay, complications, satisfaction, and cost for ERAS versus conventional care in total joint arthroplasty reviewed here [18,19,17,16,25,24,22].			
Study	Design	Population	Key outcome
Zhu 2017	Meta-analysis (7-8 studies)	8,346 THA/TKA patients	LOS SMD -0.85; readmission OR 0.84 (ns); complications OR 0.77
Zhang 2024	Meta-analysis (47 studies)	76,971 THA/TKA patients	LOS WMD -2.65 days; mortality OR 0.46; no increase in readmission
Petersen 2020	Prospective multicentre cohort	36,935 procedures, Denmark	Median LOS 3 to 1 day (2010-2017); 90-day readmission 8.6% to 7.7%
French 2025	Population-based registry	1,455,842 THR/TKR/UKR, England	Median LOS fell ~1.4-1.5 days (2010-2022); no rise in 30-day readmission
Buttner 2020	Systematic review (7 studies)	Fast-track THA/TKA	Total treatment cost reduced in every included study

Study	Design	Population	Key outcome
He 2025	Randomised controlled trial	90 THA patients, older adults	Higher satisfaction (1 vs 3 dissatisfied); faster functional recovery
Bemelmans 2022	Meta-analysis (41 studies)	Outpatient vs inpatient THA/TKA	No readmission difference; ~\$6,800 average cost reduction

Conclusion

Across randomised trials, national registries, and pooled meta-analyses, ERAS protocols for total hip and knee arthroplasty reliably shorten length of stay by one to three days, without increasing 30- or 90-day readmission, and with several studies reporting fewer complications, lower transfusion and mortality rates, higher satisfaction, and materially lower episode cost. The principal gap in the evidence base is not whether ERAS works but which components drive the benefit: preoperative optimisation remains the least standardised element of current pathways, with most programmes providing brief, low-intensity education rather than structured medical optimisation of anaemia, glycaemic control, or weight. Future trials isolating individual preoperative, analgesic, and mobilisation components, alongside continued registry surveillance of readmission after further LOS compression, should refine which elements of the ERAS bundle are indispensable for TJA.

References

1. Kehlet, H. (2013) Fast-track hip and knee arthroplasty. *The Lancet*, 381(9878): 1600-1602.

2. Di Martino, A., Brunello, M., Pederiva, D., Schilardi, F., Rossomando, V., Cataldi, P., D'Agostino, C., Genco, R., Faldini, C. (2023) Fast track protocols and early rehabilitation after surgery in total hip arthroplasty: a narrative review. *Clinics and Practice*, 13(3): 569-582.

3. Wainwright, T.W., Gill, M., McDonald, D.A., Middleton, R.G., Reed, M., Sahota, O., Yates, P., Ljungqvist, O. (2020) Consensus statement for perioperative care in total hip replacement and total knee replacement surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations. *Acta Orthopaedica*, 91(1): 3-19.

4. Soffin, E.M., YaDeau, J.T. (2016) Enhanced recovery after surgery for primary hip and knee arthroplasty: a review of the evidence. *British Journal of Anaesthesia*, 117(suppl_3): iii62-iii72.

5. Li, J., Zhu, H., Liao, R. (2019) Enhanced recovery after surgery (ERAS) pathway for primary hip and knee arthroplasty: study protocol for a randomized controlled trial. *Trials*, 20: 599.

6. Liu, V., Lin, J.Y., Chang, W.J., Naylor, J., Jenkin, D., Adie, S. (2025) Preoperative optimisation in enhanced recovery after surgery (ERAS) programs for total hip and knee arthroplasty: a systematic review. *Annals of Musculoskeletal Disorders*, 6(1): 1-12.

7. Guo, H.Z., Zhang, F.Q., Yang, Y.Z., Li, P.F., Ma, G.R., Zhang, A.R., Zhang, H. (2024) Impact of preoperative anemia on patients undergoing total joint replacement of lower extremity: a systematic review and meta-analysis. *Journal of Orthopaedic Surgery and Research*, 19: 249.

8. Ferreira, A.C., Hung, C.W., Ghanta, R.B., Harrington, M.A., Halawi, M.J. (2023) Spinal anesthesia is a grossly underutilized gold standard in primary total joint arthroplasty: propensity-matched analysis of a national surgical quality database. *Arthroplasty*, 5: 7.

9. Yoon, B.H., Kim, T.Y., Ko, Y.S., Lee, Y.K., Ha, Y.C., Koo, K.H. (2018) Optimal use of tranexamic acid for total hip arthroplasty: a network meta-analysis. *PLOS ONE*, 13(10): e0206480.

10. Teng, Y., Jiang, J., Chen, S., Zhao, L., Cui, Z., Khan, M.S., Du, W., Gao, X., Wang, J., Xia, Y. (2014) Periarticular multimodal

- drug injection in total knee arthroplasty. *Knee Surgery, Sports Traumatology, Arthroscopy*, 22(8): 1949-1957.
11. Chen, J.J., Wu, Y.C., Hung, C.Y., Lee, C.H., Wang, J.S. (2024) Effects of periarticular multimodal drug injection on pain control, early mobilization, and length of hospital stay in patients undergoing total knee arthroplasty. *Life*, 14(8): 1018.
 12. Wang, D., et al. (2017) Adductor canal block versus femoral nerve block for total knee arthroplasty: a meta-analysis of randomized controlled trials. *Scientific Reports*, 7: 40721.
 13. Chang, C.B., Choi, Y.S., Kim, T.W., Chang, M.J., Kang, S.B. (2022) Enhanced recovery after surgery for major orthopedic surgery: a narrative review. *Knee Surgery & Related Research*, 34(1): 8.
 14. Liao, C., Lai, X., Zhong, J., et al. (2025) Reducing the length of hospital stay for patients undergoing primary total knee arthroplasty by application of enhanced recovery after surgery (ERAS) pathway: a multicenter, prospective, randomized controlled trial. *European Journal of Medical Research*, 30: 385.
 15. Garriga, C., Sanchez-Santos, M.T., Judge, A., Perry, D., Arden, N.K., et al. (2019) Impact of a national enhanced recovery after surgery programme on patient outcomes of primary total knee replacement: an interrupted time series analysis from the National Joint Registry of England, Wales, Northern Ireland and the Isle of Man. *Osteoarthritis and Cartilage*, 27(9): 1280-1293.
 16. French, J.M.R., Deere, K., Sayers, A., Whitehouse, M.R. (2025) Trends in hip and knee replacement length of stay and patient demographics in England: a population-based study of 1,455,842 primary procedures. *BMC Medicine*, 23: 561.
 17. Petersen, P.B., Kehlet, H., Jørgensen, C.C., et al. (2020) Improvement in fast-track hip and knee arthroplasty: a prospective multicentre study of 36,935 procedures from 2010 to 2017. *Scientific Reports*, 10: 21233.
 18. Zhu, S., Qian, W., Jiang, C., Ye, C., Chen, X. (2017) Enhanced recovery after surgery for hip and knee arthroplasty: a systematic review and meta-analysis. *Postgraduate Medical Journal*, 93(1106): 736-742.
 19. Zhang, Q., Chen, Y., Li, Y., Liu, R., Rai, S., Li, J., Hong, P. (2024) Enhanced recovery after surgery in patients after hip and knee arthroplasty: a systematic review and meta-analysis. *Postgraduate Medical Journal*, 100(1181): 159-173.
 20. Guerra, M.L., Singh, P.J., Taylor, N.F. (2015) Early mobilization of patients who have had a hip or knee joint replacement reduces length of stay in hospital: a systematic review. *Clinical Rehabilitation*, 29(9): 844-854.
 21. Jiang, H., Jian, X., Shangguan, Y., Qing, J., Chen, L. (2019) Effects of enhanced recovery after surgery in total knee arthroplasty for patients older than 65 years. *Orthopaedic Surgery*, 11(2): 229-235.
 22. Bemelmans, Y.F.L., Keulen, M.H.F., Heymans, M., et al. (2022) Safety and efficacy of outpatient hip and knee arthroplasty: a systematic review with meta-analysis. *Archives of Orthopaedic and Trauma Surgery*, 142(8): 1775-1791.
 23. Viswanathan, V.K., Subramanian, S., Jones, H., Mounasamy, V., Sambandam, S. (2024) Patient disposition after discharge following primary total hip arthroplasty: home versus skilled nursing facility - a study based on national inpatient sample database. *Archives of Orthopaedic and Trauma Surgery*, 144(2): 937-945.
 24. He, R., Liu, G., Li, L., Deng, J., Cai, L., et al. (2025) Enhanced recovery after surgery: nursing strategy for total hip arthroplasty in older adult patients. *BMC Geriatrics*, 25: 282.
 25. Büttner, M., Mayer, A.M., Büchler, B., Betz, U., Drees, P., Susanne, S. (2020) Economic analyses of fast-track total hip and knee arthroplasty: a systematic review. *European Journal of Orthopaedic Surgery & Traumatology*, 30(1): 67-74.
 26. Ishaku, Z., Koshy, D.I., Adamu Bala, M. (2025) Enhanced

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recovery after surgery (ERAS) pathways in elective total joint arthroplasty. Cureus, 17(9): e91481.

