

## General

# Enhanced recovery after orthopaedic surgery: global research trends, collaboration, and emerging themes

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### Purpose

Enhanced recovery after surgery (ERAS) pathways are increasingly used in arthroplasty and spine surgery, but the structure of the orthopaedic literature remains incompletely characterized. This study mapped publication growth, contributors, collaboration, citation influence, and research themes.

### Methods

Web of Science Core Collection records were retrieved with a title-based search and exported on June 15, 2026. Reproducibility screening of 655 exported records excluded 347 stemming-related false positives in which “ERAS” matched the word “era” and 13 enhanced-recovery records that were trauma-related but not orthopaedic, leaving 295 eligible publications. Publication patterns, co-authorship, keyword co-occurrence, and reference co-citation were analyzed.

### Results

The 295 publications spanned 2012–2026; 242 (82.0%) were published from 2020 onward, and annual output peaked at 53 in 2025. China contributed to 129 records (43.7%), the United States to 59 (20.0%), and England to 16 (5.4%). Sichuan University was the leading standardized organization (12 publications). Major themes centered on total knee and hip arthroplasty, length of stay, complications, perioperative care, pain, and spine surgery.

### Conclusion

Orthopaedic ERAS research has grown rapidly and continued to increase through 2025, but output remains geographically concentrated. The literature is mature around clinical efficacy and perioperative outcomes; implementation, dissemination, and broader international representation are important priorities.

## INTRODUCTION

Enhanced recovery after surgery (ERAS) is an evidence-based, multimodal model of perioperative care designed to reduce the physiologic stress of surgery, limit avoidable variation in care, accelerate functional recovery, and shorten hospitalization without compromising safety.<sup>1,2</sup> Although the modern ERAS concept arose outside orthopaedics, its principles have been incorporated into procedure-specific pathways across musculoskeletal surgery.

Formal ERAS Society recommendations now address total hip and total knee replacement and lumbar spinal fusion, reflecting the increasing adoption of enhanced-recovery principles in high-volume orthopaedic procedures.<sup>3,4</sup> Clinical studies in joint replacement have associated structured enhanced-recovery pathways with shorter length of stay and lower complication burden.<sup>5,6</sup>

The clinical relevance of this work is likely to increase as demand for major orthopaedic procedures rises. Contemporary projections anticipate substantial growth in total hip and knee arthroplasty volumes through 2050, while the global burden of hip fracture continues to increase.<sup>7,8</sup>

Despite the clinical maturity of ERAS, the structure of the orthopaedic ERAS evidence base is less clear. Bibliometric analysis can identify not only publication volume but also the countries, institutions, journals, collaborative relationships, influential articles, and recurring concepts that shape a field.<sup>9,10</sup> The objective of this study was therefore to characterize the growth, geographic and institutional distribution, collaboration patterns, citation structure, and thematic evolution of enhanced-recovery research in orthopaedic surgery.

## MATERIALS AND METHODS

### STUDY DESIGN AND DATA SOURCE

A bibliometric study was performed using records exported from the Web of Science Core Collection. Reporting and analytic decisions were informed by published guidance for conducting and reporting bibliometric analyses.<sup>9,10</sup> The exported Web of Science files supplied for this analysis were dated June 15, 2026. Citation counts therefore represent the database status at that time and should be interpreted as time-dependent measures.

### SEARCH STRATEGY AND ELIGIBILITY

The original search was limited to the title field and used the following strategy: TI=((“enhanced recovery after surgery” OR “ERAS” OR “enhanced recovery program\*” OR “enhanced recovery protocol\*” OR “enhanced recovery pathway\*” OR “fast track surgery” OR “fast-track surgery” OR “rapid recovery”) AND (orthop\* OR “orthopedic surgery” OR “orthopaedic surgery” OR arthroplast\* OR “joint replacement” OR “total knee arthroplasty” OR “TKA” OR “total hip arthroplasty” OR “THA” OR “spine” OR “spinal surgery” OR trauma OR “fracture\*”). No language restriction was applied.

The original export contained 655 records. During reproducibility review, Web of Science stemming was found to have treated the acronym term “ERAS” as matching the common word “era,” creating extensive off-topic retrieval. A deterministic two-stage screen was therefore applied before analysis. First, 347 titles lacking a true enhanced-recovery signal (enhanced recovery, standalone ERAS, fast-track/fast track, or rapid recovery) were excluded as stemming-related false positives. Second, the remaining titles were reviewed for orthopaedic relevance; 13 true enhanced-recovery records retrieved solely through the broad trauma term but concerning non-orthopaedic trauma care were excluded. The final analytic dataset contained 295 publications (Fig. 1).

### BIBLIOMETRIC VARIABLES AND DESCRIPTIVE ANALYSIS

For each eligible record, publication year, source journal, author affiliations, standardized organization names, total citation count, author keywords, Keywords Plus terms, and cited references were extracted from the Web of Science export. Annual publication counts and journal rankings were summarized descriptively. A country was credited to a publication when at least one author affiliation was located in that country; consequently, multinational publications could contribute to more than one country count. Institutional rankings used the standardized organization field supplied in the export rather than post hoc aggregation of distinct institutions or health-system affiliates.

### NETWORK ANALYSIS

Country co-authorship networks were constructed from publications listing affiliations in two or more countries.

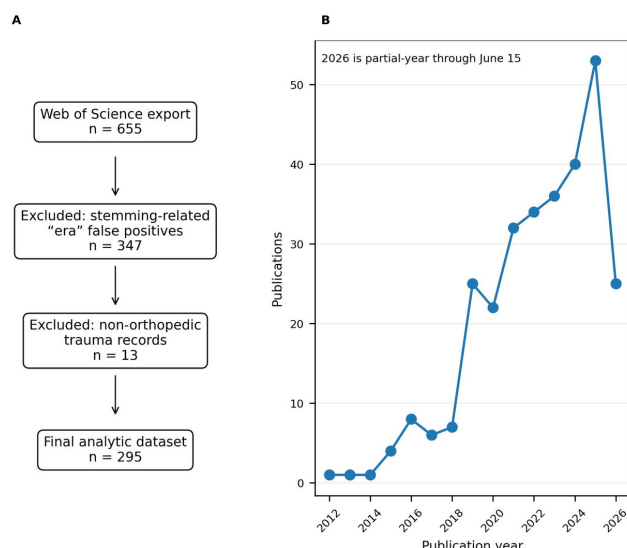


**Fig. 1 Study screening and annual publication output. A Exclusion of 347 stemming-related false-positive records and 13 non-orthopaedic trauma records from the 655-record export, yielding 295 eligible publications. B Annual publication output; 2026 is a partial year through June 15**

Countries with at least 5 eligible publications were retained for visualization; node size represented publication output, and edge width represented the number of shared publications. Keyword analysis combined author keywords and Keywords Plus terms after normalization of obvious spelling and hyphenation variants and common ERAS synonyms. The most frequent terms were mapped using within-record co-occurrence relationships. Reference co-citation analysis identified cited works that appeared together within reference lists; references cited by at least 20 records were retained for the displayed network.

## RESULTS

### STUDY SELECTION AND PUBLICATION GROWTH

After screening 655 exported records, 360 were excluded and 295 were retained for analysis (Fig. 1A). The eligible literature began in 2012 and remained limited through 2018, with annual counts ranging from 1 to 8 publications. Output then increased to 25 publications in 2019, 22 in 2020, 32 in 2021, 34 in 2022, 36 in 2023, 40 in 2024, and 53 in 2025. The 2026 count was 25 through the June 15 export date and therefore represents only a partial year (Fig. 1B). Overall, 242 of 295 publications (82.0%) appeared from 2020 through June 2026.

### JOURNALS AND GEOGRAPHIC DISTRIBUTION

The literature was dispersed across orthopaedic, spine, anesthesia, rehabilitation, and general clinical journals. The Journal of Orthopaedic Surgery and Research published the most eligible records (n=13), followed by Medicine

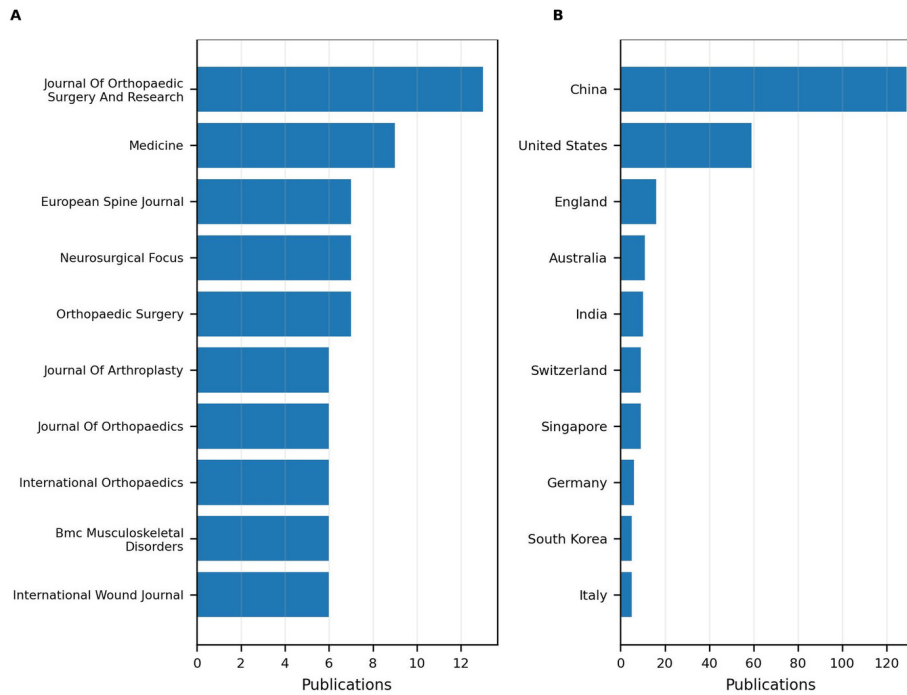


**Fig. 2 Publication outlets and geographic contribution. A Ten journals with the most eligible publications. B Ten countries most frequently represented in author affiliations. Multinational papers contribute once to each represented country**

( $n=9$ ). European Spine Journal, Neurosurgical Focus, and Orthopaedic Surgery each published 7 records, while Journal of Arthroplasty, Journal of Orthopaedics, International Orthopaedics, BMC Musculoskeletal Disorders, and International Wound Journal each published 6 (Fig. 2A).

China was represented in 129 publications (43.7%), followed by the United States in 59 (20.0%) and England in 16 (5.4%). Australia contributed to 11 records, India to 10, Switzerland and Singapore to 9 each, Germany to 6, and South Korea and Italy to 5 each (Fig. 2B). Because a multinational paper was counted once for each represented country, country counts are not mutually exclusive.

#### INSTITUTIONS AND INTERNATIONAL COLLABORATION

Using standardized Web of Science organization names, Sichuan University was the most frequently represented institution ( $n=12$ ), followed by the University of Pennsylvania ( $n=8$ ). Singapore General Hospital, Cornell University, Weill Cornell Medicine, and Soochow University - China each appeared in 6 publications, and Fudan University appeared in 5. The remaining institutions in the top 10 contributed 4 publications each (Fig. 3A). No single standardized organization accounted for more than 4.1% of the 295-record corpus, indicating broad institutional dispersion despite country-level concentration.

The international co-authorship network was relatively sparse compared with the volume of nationally produced research. China and the United States were the largest nodes, with cross-country links involving England, Australia, India, Switzerland, Singapore, Germany, South Korea, Italy, Canada, and Denmark among countries meeting

the 5-publication threshold (Fig. 3B). The network suggests that a substantial portion of the literature remains organized within national or regional research systems rather than a densely integrated global collaboration network.

#### RESEARCH THEMES AND CITATION INFLUENCE

Keyword analysis showed that “enhanced recovery after surgery” was the dominant normalized term (171 records). Other frequent terms included total knee arthroplasty (56), replacement (50), length of stay (45), care (39), complications (35), total hip arthroplasty (33), pain (30), management (30), perioperative care (27), meta-analysis (26), outcomes (24), arthroplasty (23), and spine surgery (21). The co-occurrence network linked procedure-focused terms to outcome and care-process concepts, with length of stay, complications, pain, and perioperative care occupying central positions (Fig. 4A).

Reference co-citation analysis identified several foundational works repeatedly cited together. Kehlet’s 1997 framework for multimodal postoperative rehabilitation was the most frequently cited reference within eligible reference lists, appearing in 75 records, while the ERAS Society hip and knee consensus statement, Zhu et al.’s arthroplasty meta-analysis, and Ljungqvist et al.’s ERAS review each appeared in 48 records. Procedure-specific spine and arthroplasty publications formed strongly connected parts of the same co-citation network (Fig. 4B).<sup>1-3,11</sup>

The most highly cited eligible article by Web of Science total citation count was the 2019 systematic review of ERAS for spine surgery by Dietz et al. (238 citations).<sup>12</sup> It was followed by Soffin and YaDeau’s review of primary hip and

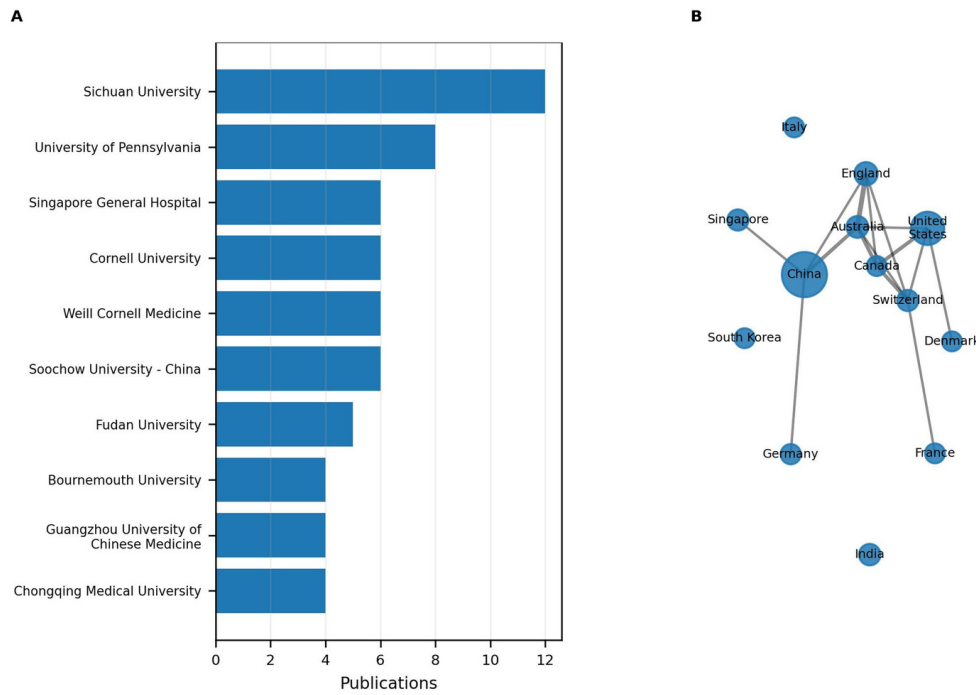


**Fig. 3 Institutional productivity and international co-authorship. A** Ten most frequently represented standardized Web of Science organizations. **B** Countries with at least 5 publications; node size reflects eligible publication output and edge width reflects the number of shared publications

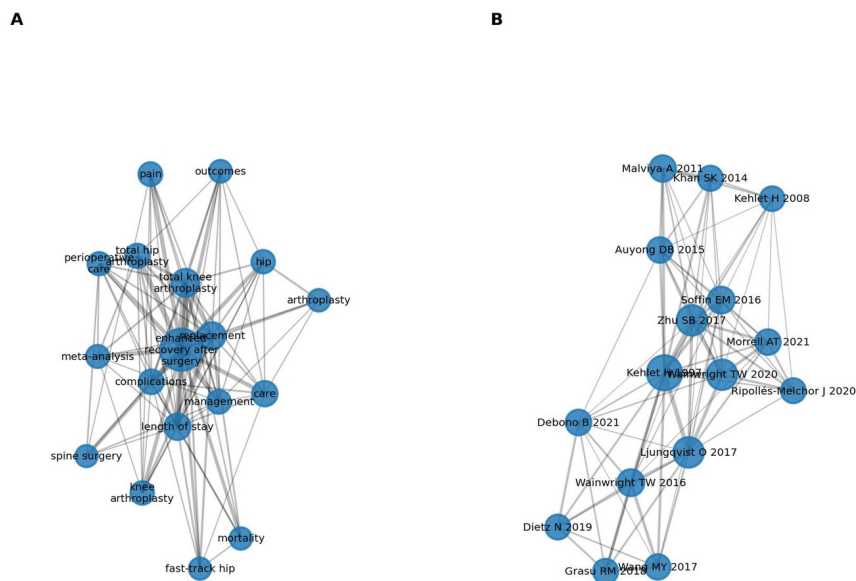


**Fig. 4 Keyword co-occurrence and reference co-citation networks. A** Frequent normalized author keywords and Keywords Plus terms; links represent within-record co-occurrence. **B** References cited by at least 20 eligible records; links represent co-citation within the same publication. Node size reflects frequency.

knee arthroplasty (237 citations)<sup>13</sup> and Zhu et al.'s systematic review and meta-analysis of hip and knee arthroplasty (233 citations).<sup>11</sup> Other highly cited studies addressed ERAS applicability to major spine surgery, reduced hospitalization after total knee arthroplasty, orthopaedic en-

hanced-recovery pathways, elective hip and knee arthroplasty outcomes, and spine-specific implementation ([Table 1](#)).<sup>14-21</sup>

**Table 1. Top 10 cited publications on enhanced recovery in orthopaedic surgery**

| First author           | Year | Title                                                                                                                                             | Journal                                           | Citations |
|------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-----------|
| Dietz et al            | 2019 | Enhanced Recovery After Surgery (ERAS) for Spine Surgery: A Systematic Review                                                                     | World Neurosurgery                                | 238       |
| Soffin and YaDeau      | 2016 | Enhanced recovery after surgery for primary hip and knee arthroplasty: a review of the evidence                                                   | British Journal of Anaesthesia                    | 237       |
| Zhu et al              | 2017 | Enhanced recovery after surgery for hip and knee arthroplasty: a systematic review and meta-analysis                                              | Postgraduate Medical Journal                      | 233       |
| Wainwright et al       | 2016 | Enhanced recovery after surgery (ERAS) and its applicability for major spine surgery                                                              | Best Practice & Research Clinical Anaesthesiology | 164       |
| Auyong et al           | 2015 | Reduced Length of Hospitalization in Primary Total Knee Arthroplasty Patients Using an Updated Enhanced Recovery After Orthopedic Surgery Pathway | Journal of Arthroplasty                           | 151       |
| Kaye et al             | 2019 | Enhanced recovery pathways in orthopedic surgery                                                                                                  | Journal of Anaesthesiology Clinical Pharmacology  | 141       |
| Ripolles-Melchor et al | 2020 | Association Between Use of Enhanced Recovery After Surgery Protocol and Postoperative Complications in Total Hip and Knee Arthroplasty            | JAMA Surgery                                      | 131       |
| Stowers et al          | 2016 | Enhanced Recovery After Surgery in elective hip and knee arthroplasty reduces length of hospital stay                                             | ANZ Journal of Surgery                            | 108       |
| Debono et al           | 2019 | Benefits of Enhanced Recovery After Surgery for fusion in degenerative spine surgery                                                              | Neurosurgical Focus                               | 107       |
| Soffin et al           | 2019 | Opioid-free anesthesia within an enhanced recovery after surgery pathway for minimally invasive lumbar spine surgery                              | Neurosurgical Focus                               | 105       |

Note: Citation counts are Web of Science total citation counts as of the June 15, 2026 export and therefore will change over time.

## DISCUSSION

### PRINCIPAL FINDINGS

This reanalysis identifies a rapidly expanding but unevenly distributed literature on enhanced recovery in orthopaedic surgery. After removal of stemming-related and non-orthopaedic false-positive records, 295 publications remained, more than four-fifths of which were published from 2020 onward. Contrary to the apparent plateau produced by the uncleaned 655-record dataset, the eligible literature continued to grow from 2022 through 2025, reaching its highest annual output in 2025. Arthroplasty, length of stay, complications, pain, perioperative care, and spine surgery dominated the thematic landscape, while the most-cited works were reviews, consensus-oriented publications, and pathway studies that helped establish the clinical case for ERAS.

### GROWTH AND CLINICAL MATURATION OF ORTHOPAEDIC ENHANCED RECOVERY

The sustained increase in publication volume is clinically plausible. ERAS has moved from a broad perioperative philosophy to increasingly standardized pathways for joint replacement and spine surgery, and the high co-citation prominence of the hip/knee consensus recommendations reflects that transition.<sup>3,4</sup> The citation leaders likewise trace the field's progression: early arthroplasty pathway

studies demonstrated reduced hospitalization and favorable outcomes, later reviews synthesized the evidence, and spine-specific programs extended the model into another high-volume orthopaedic domain.<sup>11-21</sup>

This trajectory is particularly relevant given expected growth in arthroplasty demand.<sup>7</sup> The 2026 publication count should not be interpreted as a decline because the underlying export ended on June 15. Similarly, short-term fluctuations around 2020 should be interpreted cautiously in light of the major disruption to elective orthopaedic surgical volume during the COVID-19 pandemic.<sup>22</sup>

### GEOGRAPHIC AND INSTITUTIONAL CONCENTRATION

The geographic distribution also changed materially after data cleaning. China, rather than the United States, was the most frequently represented country in the eligible corpus. This distinction matters because bibliometric rankings are sensitive to search specificity: when hundreds of generic "era" records remain in the dataset, apparent institutional and national leaders can be driven by off-topic literature rather than enhanced-recovery research. Using the cleaned dataset, country-level output was concentrated in China and the United States, but institutional productivity was much more diffuse, with no standardized organization contributing more than 12 records.

The broader issue of geographic concentration is not unique to ERAS. Orthopaedic research output and authorship remain disproportionately centered in high-income

settings, while lower-resource countries bear substantial musculoskeletal disease burden and often face greater barriers to protocol implementation, rehabilitation resources, and perioperative infrastructure.<sup>23,24</sup> For ERAS, this creates a specific translational challenge: a pathway can be strongly supported in well-resourced centers yet remain difficult to implement in settings with different staffing, anesthesia capacity, rehabilitation access, discharge pathways, or follow-up systems.

#### FROM EFFICACY TO IMPLEMENTATION

The keyword and citation structures suggest that the orthopaedic ERAS literature is mature around efficacy and near-term perioperative outcomes. Length of stay, complications, pain, arthroplasty, and postoperative care were among the most frequently connected concepts, while many of the citation leaders focused on whether ERAS pathways reduce hospitalization or improve recovery.<sup>5,6,11-13,15,17,18</sup> This is an important foundation, but it leaves a some questions unanswered such as: which components are consistently implemented, which are most difficult to sustain, how adherence varies across institutions, and how pathways should be adapted to different health systems and patient populations.

Implementation research outside orthopaedic-specific bibliometrics has documented persistent barriers even when clinicians recognize the benefits of ERAS.<sup>25</sup> For orthopaedic surgery, the next phase of scholarship may therefore benefit from multicenter implementation studies, pragmatic comparisons of pathway components, standardized reporting of protocol adherence, economic analyses, and collaborations that include institutions beyond the countries currently dominating publication output.

#### LIMITATIONS

This study has several limitations. First, Web of Science was the only bibliographic database used, so eligible studies indexed only in Scopus, PubMed/MEDLINE, Embase, or regional databases may have been missed. Second, the search was restricted to titles to maximize specificity; relevant orthopaedic ERAS publications that discussed enhanced recovery without using an eligible term in the title may there-

fore have been omitted. Third, the original use of the acronym “ERAS” produced substantial stemming-related false positives. Although the reproducibility screen corrected this problem in the supplied export, a future update should rerun the search with syntax that disables or otherwise avoids stemming of the acronym and should prospectively validate the retrieval set. Fourth, country and institution counts depend on affiliation metadata and normalization within Web of Science; multicountry publications contribute to more than one country count, and closely related institutions can remain separate standardized entities. Fifth, citation counts favor older publications because they have had more time to accumulate citations, and the 2026 publication count represents only records available through June 15. Finally, keyword and co-citation networks depend on normalization choices and display thresholds and should be interpreted as maps of the indexed literature rather than direct measures of clinical importance.

#### CONCLUSION

Enhanced-recovery research in orthopaedic surgery has expanded markedly, with 82.0% of the cleaned 295-publication corpus appearing from 2020 onward and annual output continuing to rise through 2025. China and the United States accounted for the largest shares of publications, whereas institutional output was comparatively dispersed. Arthroplasty, length of stay, complications, perioperative care, pain, and spine surgery formed the central research themes, and highly cited reviews and pathway studies established a strong evidence base for clinical efficacy. The field is now positioned to move beyond demonstrating that enhanced recovery can work toward determining how reliably it is implemented, which pathway components matter most in routine practice, and how the evidence can be generalized across a broader range of institutions and health systems.

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## REFERENCES

1. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. *Br J Anaesth*. 1997;78:606-617. doi:[10.1093/bja/78.5.606](https://doi.org/10.1093/bja/78.5.606)
2. Ljungqvist O, Scott M, Fearon KC. Enhanced Recovery After Surgery: a review. *JAMA Surg*. 2017;152:292-298. doi:[10.1001/jamasurg.2016.4952](https://doi.org/10.1001/jamasurg.2016.4952)
3. Wainwright TW, Gill M, McDonald DA, et al. Consensus statement for perioperative care in total hip replacement and total knee replacement surgery: Enhanced Recovery After Surgery (ERAS) Society recommendations. *Acta Orthop*. 2020;91:3-19. doi:[10.1080/17453674.2019.1683790](https://doi.org/10.1080/17453674.2019.1683790)
4. Debono B, Wainwright TW, Wang MY, et al. Consensus statement for perioperative care in lumbar spinal fusion: Enhanced Recovery After Surgery (ERAS) Society recommendations. *Spine J*. 2021;21:729-752. doi:[10.1016/j.spinee.2021.01.001](https://doi.org/10.1016/j.spinee.2021.01.001)
5. Ripolles-Melchor J, Abad-Motos A, Diez-Remesal Y, et al. Association between use of Enhanced Recovery After Surgery protocol and postoperative complications in total hip and knee arthroplasty in the POWER2 study. *JAMA Surg*. 2020;155:e196024. doi:[10.1001/jamasurg.2019.6024](https://doi.org/10.1001/jamasurg.2019.6024)
6. Malviya A, Martin K, Harper I, et al. Enhanced recovery programme for hip and knee replacement reduces death rate. *Acta Orthop*. 2011;82:577-581. doi:[10.3109/17453674.2011.618911](https://doi.org/10.3109/17453674.2011.618911)
7. Stubnya BG, Schulz M, Vancsa S, Szilagyi GS, Szatmari A, Bejek Z. Global trends in joint arthroplasty: a systematic review and future projections. *J Clin Med*. 2025;14:8214. doi:[10.3390/jcm14228214](https://doi.org/10.3390/jcm14228214)
8. Feng JN, Zhang CG, Li BH, Zhan SY, Wang SF, Song CL. Global burden of hip fracture: the Global Burden of Disease Study. *Osteoporos Int*. 2024;35:41-52. doi:[10.1007/s00198-023-06907-3](https://doi.org/10.1007/s00198-023-06907-3)
9. Montazeri A, Mohammadi S, Hesari MP, Ghaemi M, Riazi H, Sheikhi-Mobarakeh Z. Preliminary guideline for reporting bibliometric reviews of the biomedical literature (BIBLIO): minimum requirements. *Syst Rev*. 2023;12:239. doi:[10.1186/s13643-023-02410-2](https://doi.org/10.1186/s13643-023-02410-2)
10. Ninkov A, Frank JR, Maggio LA. Bibliometrics: methods for studying academic publishing. *Perspect Med Educ*. 2022;11:173-176. doi:[10.1007/s40037-021-00695-4](https://doi.org/10.1007/s40037-021-00695-4)
11. Zhu S, Qian W, Jiang C, Ye C, Chen X. Enhanced recovery after surgery for hip and knee arthroplasty: a systematic review and meta-analysis. *Postgrad Med J*. 2017;93:736-742. doi:[10.1136/postgradmedj-2017-134991](https://doi.org/10.1136/postgradmedj-2017-134991)
12. Dietz N, Sharma M, Adams S, et al. Enhanced Recovery After Surgery (ERAS) for spine surgery: a systematic review. *World Neurosurg*. 2019;130:415-426. doi:[10.1016/j.wneu.2019.06.181](https://doi.org/10.1016/j.wneu.2019.06.181)
13. Soffin EM, YaDeau JT. Enhanced recovery after surgery for primary hip and knee arthroplasty: a review of the evidence. *Br J Anaesth*. 2016;117:iii62-iii72. doi:[10.1093/bja/aew362](https://doi.org/10.1093/bja/aew362)
14. Wainwright TW, Immins T, Middleton RG. Enhanced recovery after surgery (ERAS) and its applicability for major spine surgery. *Best Pract Res Clin Anaesthesiol*. 2016;30:91-102. doi:[10.1016/j.bpa.2015.11.001](https://doi.org/10.1016/j.bpa.2015.11.001)
15. Auyong DB, Allen CJ, Pahang JA, Clabeaux JJ, MacDonald KM, Hanson NA. Reduced length of hospitalization in primary total knee arthroplasty patients using an updated Enhanced Recovery After Orthopedic Surgery pathway. *J Arthroplasty*. 2015;30:1705-1709. doi:[10.1016/j.arth.2015.05.007](https://doi.org/10.1016/j.arth.2015.05.007)
16. Kaye AD, Urman RD, Cornett EM, et al. Enhanced recovery pathways in orthopedic surgery. *J Anaesthesiol Clin Pharmacol*. 2019;35:S35-S39. doi:[10.4103/joacp.JOACP\\_35\\_18](https://doi.org/10.4103/joacp.JOACP_35_18)
17. Stowers MDJ, Manuopangai L, Hill AG, Gray JR, Coleman B, Munro JT. Enhanced Recovery After Surgery in elective hip and knee arthroplasty reduces length of hospital stay. *ANZ J Surg*. 2016;86:475-479. doi:[10.1111/ans.13538](https://doi.org/10.1111/ans.13538)
18. Debono B, Corniola MV, Pietton R, Sabatier P, Hamel O, Tessitore E. Benefits of Enhanced Recovery After Surgery for fusion in degenerative spine surgery: impact on outcome, length of stay, and patient satisfaction. *Neurosurg Focus*. 2019;46:E6. doi:[10.3171/2019.1.FOCUS18669](https://doi.org/10.3171/2019.1.FOCUS18669)
19. Soffin EM, Wetmore DS, Beckman JD, et al. Opioid-free anesthesia within an enhanced recovery after surgery pathway for minimally invasive lumbar spine surgery: a retrospective matched cohort study. *Neurosurg Focus*. 2019;46:E8. doi:[10.3171/2019.1.FOCUS18645](https://doi.org/10.3171/2019.1.FOCUS18645)

20. Soffin EM, Vaishnav AS, Wetmore DS, et al. Design and implementation of an Enhanced Recovery After Surgery program for minimally invasive lumbar decompression spine surgery: initial experience. *Spine (Phila Pa 1976)*. 2019;44:E561-E570. doi:[10.1097/BRS.0000000000002905](https://doi.org/10.1097/BRS.0000000000002905)
21. Smith J, Probst S, Calandra C, et al. Enhanced recovery after surgery program for lumbar spine fusion. *Perioper Med (Lond)*. 2019;8:4. doi:[10.1186/s13741-019-0114-2](https://doi.org/10.1186/s13741-019-0114-2)
22. Ghoshal S, Stovall N, King AH, Miller AS, Harris MB, Succi MD. Orthopedic surgery volume trends during the COVID-19 pandemic and postvaccination era: implications for healthcare planning. *J Arthroplasty*. 2024;39:1959-1966.e1. doi:[10.1016/j.arth.2024.03.028](https://doi.org/10.1016/j.arth.2024.03.028)
23. DeMaio EL, Marra G, Suleiman LI, Tjong VK. Global health inequities in orthopaedic care: perspectives beyond the US. *Curr Rev Musculoskelet Med*. 2024;17:439-448. doi:[10.1007/s12178-024-09917-8](https://doi.org/10.1007/s12178-024-09917-8)
24. Graham SM, Brennan C, Laubscher M, et al. Orthopaedic research in low-income countries: a bibliometric analysis of the current literature. *SICOT J*. 2019;5:41. doi:[10.1051/sicotj/2019038](https://doi.org/10.1051/sicotj/2019038)
25. Clet A, Guy M, Muir JF, Cuvelier A, Gravier FE, Bonnevie T. Enhanced Recovery after Surgery implementation and barriers among healthcare providers in France: a cross-sectional study. *Healthcare (Basel)*. 2024;12:436. doi:[10.3390/healthcare12040436](https://doi.org/10.3390/healthcare12040436)