

Cost Analysis Application of Enhanced Recovery After Surgery (ERAS), is it Beneficial?: a Literature Review

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Abstract

Background Enhanced Recovery After Surgery (ERAS) is a surgery protocol that focused on the patient. This protocol designed to reduce stress responses and promoting faster recovery to patient. ERAS protocols have been widely used and demonstrating better result in patient outcomes. There is limited information about its economic impact and cost analysis of ERAS. This review aims to analyze the existing literature on the application of ERAS protocol by comparing the cost of patient care with or without ERAS protocol.

Methods This study conducted a literature search using electronic research databases over the past ten years. Data was taken from Scopus, analyzed 99 articles using various analysis techniques and supported by the VOS viewer application. The analysis includes observations of research developments, evaluating authors and research subject areas and than analyzed with descriptive statistics to describe the results.

Results This study identified ninety nine potential studies published between 2014 and 2024, resulting ten studies for inclusion in the review. The studies identified from various types of surgeries. Nine from ten articles in this review show that application of ERAS protocol resulted in advantage in financial. The advantage of application ERAS protocol to reduce cost of hospitalization due to shorter Length of Stay (LOS), lower mortality and complication rate in patient.

Conclusions Application of ERAS protocol provide benefits and efficiency across various types of surgical specialities. Hospitalization costs in ERAS group consistently lower compared to non-ERAS group.

Introduction

Enhanced Recovery After Surgery (ERAS) protocol was introduced in early 1990s. This protocol was developed based on understanding of perioperative care that refers to the period surrounding a surgical procedure, encompassing before surgery (preoperative), during surgery (intraoperative), and after surgery (postoperative). Perioperative care focuses on patient safety to minimizing complication and promoting recovery. ERAS also known as fast track surgery, effectively minimizes complication and surgical stress and accelerate postoperative recovery (Qing Li et al., 2020).

Many researchs have demonstrated the safety and effectiveness of ERAS in reducing length of stay and complication rates. Therefore, ERAS has been extensively adopted in various specialties, such as urology surgery, colorectal surgey, gastrointestinal surgey, orthopedic, and obstetric gynecology surgery (Yihan Dong et al., 2021). ERAS is a comprehensive, holistic, and multidisciplinary approach that integrates various evidence-based interventions to enhance recovery, shorten length of stay (LOS), and improve clinical outcome (Lyrics Noba et al., 2023).

The benefit from implementation of ERAS protocol is not only to improve clinical outcomes, but also to reduction in cost per patient and savings (Tshering Tamang et al., 2021). This study aim to analyze the cost of hospitalization of established ERAS protocol in various surgery.

Method

This review analyzed 99 articles using various analysis techniques. Data was taken from Scopus and supported by the VOS viewer application. The analysis includes observations of research developments over the last 10 years, evaluating authors and research subject areas.

Table 1. Number of article per year

Year	Documents number
2024	16
2023	16
2022	13
2021	19
2020	12
2019	6
2018	8
2017	3

Results and Discussion

The database search initially identified 99 studies. Following the removal of duplicates, title and abstract screening, citation search, and review the full text, a total ten studies were included in the analysis. These ten articles evaluated and analyzed the implementation of ERAS protocol across various surgical specialties.

Table 2. Ten Journals That Are At The Highest Level Of Relevance.

No.	Author	Surgical Specialties	ERAS	Non ERAS
1	(Qing Li et al., 2020)	Urology surgery; PCNL for kidney stone	Stone clearance; 93,2% Operation time; 54 ±12 minutes VAS score : 0.79 ± 0,76 Complication; 15 cases Cost; 21,348 ± 2404 RMB	Stone clearance; 89,8% Operation time; 58± 11 minutes VAS Score; 2.79 ±0.98 Complication; 22 cases Cost; 21,597 ±2293 RMB (P= 0.529)
2	(Yihan Dong et al., 2021)	Digestive surgery; Hepatectomy	Cost; \$5958.67	Cost; \$6725.80
3	(Pietro Bisagni et al., 2024)	Digestive surgery; emergency abdominal surgery	Cost saving 1022,78€ per patient Average LOS 9 days	Average LOS 12 days
4	(Tshering Tamang et al., 2021)	Obstetric surgery; caesarean surgery	81% patient discharge on day 2	2.3% patient discharge on day 2
5	(Basile Pache et al., 2019)	Gynecologic surgery	Cost per patient \$13,327	Cost perpatient \$17,710
6	(Lyrics Noba et al., 2023)	Digestive surgery; pancreaticoduodenectomy	Cost significantly reduced ; P< 0.0001	
7	(Johannes Petersen et al., 2021)	Cardiac surgery; minimally invasive cardiac	LOS; 6.1 ± 2.6 days Cost saving € 1087.2 per patient (P=0.003)	LOS; 7.7 ± 3.8 days P = 0.0008
8	(Simon Moosburner et al., 2023)	Digestive surgery; Liver surgery	Complication ; 18 %	Complication ; 32 %
9	(Frédéric Bizard et al., 2021)	All surgery	Average LOS; 1.45 days Cost reduction; €1060 per patient.	
10	(Wei-Ling Hsiao et al., 2024)	Plastic surgery; Free fibula flap surgery	LOS; 8.66 ± 3.90 days Ventilator use; 1.08 ± 0.28 days	LOS; 11.64 ± 5.42 days (P= 0.003) Ventilator use; 2.03 ± 1.05 days (P< 0.001)

In this review, nine from ten articles demonstrate that implementating of ERAS protocol in surgical lead to financial benefits by decrease hospitalization costs. However, one study in urology surgery found no significant difference in costs (21,348 ± 2404 RMB in ERAS group vs. 21,597 ± 2293 RMB in non ERAS group, P= 0.529). Although

there were no cost difference in both group, in ERAS group show reduction in hospitalization time and complication rate. There were 15 complications in ERAS group, and 22 complication in non ERAS group (Qing Li et al., 2020).

Johanes Petersen et la., 2021 reported in cardiac surgery, the cost in ERAS protocol group were € 11,200 ± 3029 per patient, compared to € 13,1098 ± 4527 in non ERAS group. This is resulting in a significant cost saving of € 1909.8 per patient (P = 0.006). This findings highlight the financial advantages of ERAS protocol, saving up cost per patient and will pivotal role in future cardiac surgery. Basile Pache et al., 2019 reported in gynecologic surgery, found that average cost in ERAS- specific protocol were \$ 687 per patient, with total mean cost per patient were \$13,329, compared \$17,710 in non ERAS group.

Implementation of ERAS has been associated with improved clinical outcome, including decrease in hospital length of stay. ERAS average reduce average 1.45 days per patient, resulting in cost saving € 1060 per patient. This result translates to a total financial benefit of € 65 million for hospital per year (Frederic Bizard et al., 2021).

The study by Simon Moosburner et al., 2023, show total 537 patient underwent liver surgery, with 46 % undergoing laparoscopic procedure, 28 % open surgery, and 26 % robotic surgery. Among them, 487 patients were managed using ERAS protocol. The Implementation of ERAS significantly reduced post operative complication compared to Non ERAS group (18% vs 32%, P= 0.048). Another study in plastic surgery also showed that ERAS group has a shorter postoperative ventilator use (1.08 ± 0.28 days ,vs 2.03 ± 10.5 days, P < 0.001) and shorter stay in intensive care unit (8.66 ± 3.90 days vs 11.64 ± 5.42 days, P = 0.003) compared to the non ERAS group (Wei-Ling Hsiiao et al., 2024).

Implementation of ERAS should transition from being a guiding principles to becoming a formally established standard of care in surgery. Research about effectiveness of ERAS should identify it's applicability across various surgical specialities. Sustained commitment to these efforts will ensure the continuous improvement of ERAS protocol.

Conclusions

The ERAS protocol has demonstrated significant potential in enhancing patient outcomes and optimizing healthcare resource utilization across various surgical specialities. Implementation of ERAS protocol supports a patient-centered approach to surgical care, making the perioperative process more efficient and effective by reducing hospitalization cost, reducing complication, and shortening length of stay (LOS).

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References

- Qing Li, Li Wan, Shucheng Liu, Mingyong Li, Libo Chen, Zhengwu Hou, Wang Zhang (2020). Clinical efficacy of enhanced recovery after surgery in percutaneous nephrolithotripsy: a randomized controlled trial. *BMC Urol.*; 20;162
- Yihan Dong, Yan Zhang, Chengcheng Jin (2021). Comprehensive economic evaluation of enhanced recovery after surgery in hepatectomy. *International Journal for Equity in Health.*; 20;245.
- Pietro Bisagni, Vera D'Abrosca, Vincenzo Tripodi, Francesca Teodora Armao, Marco Longhi, Gianluca Russo, Michele Ballabio (2024). Cost saving in implementing ERAS protocol in emergency abdominal surgery. *BMC Surgery.*; 24:70.
- Basile Pache, Gaëtan-Romain Joliat, Martin Hübner, Fabian Grass, Nicolas Demartines, Patrice Mathevet, Chahin Achartaria (2019). Cost-analysis of Enhanced Recovery After Surgery (ERAS) program in gynecologic surgery. *Gynecologic Oncology.*; 154 (2019) 388-393.
- Pietro Bisagni, Vera D'Abrosca, Vincenzo Tripodi, Francesca Teodora Armao, Marco Longhi, Gianluca Russo, Michele Ballabio (2024). Cost saving in implementing ERAS protocol in emergency abdominal surgery. *BMC Surgery.*; 24:70.
- Lyrics Noba, Sheila Rodgers, Lawrence Doi, Colin Chandler, Deepak Hariharan, Vincent Yip (2023). Costsvand clinical benefits of enhanced recovery after surgery (ERAS) in pancreaticoduodenectomy: an updated systematic review and meta-analysis. *Journal of Cancer Research and Clinical Oncology* (2023) 149:6639-6660.

- Johannes Petersen, Benjamin Kloth, Johanna Konertz, Jens Kubitz, Leonie Schulte-Uentrop, Gesche Ketels, Hermann Reichenspurner, Evaldas Girduškas (2021). Economic impact of enhanced recovery after surgery protocol in minimally invasive cardiac surgery. *BMC Health Services Research.*; 21:254.
- Simon Moosburner, Paul M. Dahlke, Jens Neudecker, Karl H. Hillebrandt, Pia F. Koch, Sebastian Knitter, Kristina Ludwig (2024). From morbidity reduction to cost-effectiveness: Enhanced recovery after surgery (ERAS) society recommendations in minimal invasive liver surgery. *Langenbeck's Archives of Surgery.*; 409:137.
- Frédéric Bizard, Thierry Boudemaghe, Laurent Delaunay, Lucas Léger, Karem Slim (2021). Medico-economic impact of enhanced rehabilitation after surgery: an exhaustive, nation-wide claims study. *BMC Health Services Research.*; 21:1341.
- Wei-Ling Hsiao, Yao-Cheng Wu, Hao-Chih Tai (2024). Cost saving in implementing ERAS protocol in emergency abdominal surgery. *Scientific Reports.*; (2024) 14:302
- Tshering Tamang, Tashi Wangchuk, Choning Zangmo, Tshering Wangmo, Karma Tshomo (2021). The successful implementation of the Enhanced Recovery After Surgery (ERAS) program among caesarean deliveries in Bhutan to reduce the postoperative length of hospital stay. *BMC Pregnancy and Childbirth.*; 21:637.