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Systematic Review

Evaluating the effectiveness of enhanced recovery after surgery protocols on outcomes in general surgery: a systematic review

Salman A. Aljubouri[1], Emad A. Alsaedi[2]*, Meaad A. Alrehaili[3], Hussam K. Aloufi[3], Reham M. Alsubhi[3], Mohammed W. Aljayyar[3], Abdurrahman S. Seraj[3], Hasan M. Samman[3], Amal N. Alharbi[3], Waleed K. Kaki[3], Heba A. Mohammad[3], Nawaf H. Alharbi[3], Mohammed N. Almarwani[4]

[1]Department of General Surgery, King Salman Bin Abdulaziz Medical City, Al-Madinah, Saudi Arabia
[2]Department of Internal Medicine, King Salman Bin Abdulaziz Medical City, Al-Madinah, Saudi Arabia
[3]Medical Intern, Taibah University, Al-Madinah, Saudi Arabia
[4]Pharmaceutical Care Services, Prince Muhammad Bin Abdulaziz Hospital, Ministry of National Guard Health Affairs, Madinah, Saudi Arabia

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***Correspondence:**
Dr. Emad A. Alsaedi,
E-mail: emadd862@gmail.com

ABSTRACT

Multimodal treatment pathways called enhanced recovery after surgery (ERAS) programs are intended to lessen surgery's physical and emotional impacts. In many surgeries, patient outcomes are linked to better compliance with ERAS protocols. To investigate the effectiveness of ERAS protocols on outcomes in general surgery. The systematic review used PubMed, Scopus, Google Scholar, and Clinicaltrial.gov as data sources. Randomised clinical trials comparing any traditional protocol with ERAS. Protocols for general surgical procedures, published from January 2015 to January 2025, were included based on preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. A total of 1860 study titles were identified. Only randomised control trials were included, so 230 titles were produced as randomized controlled trial (RCT). Researchers chose 145 abstracts for screening after removing the papers that did not fit the original search criteria; only 13 qualified for final review. Three reviewers independently identified the relevant trials and extracted data on study details, outcomes, and efficacy from included studies. The overall hospital stay, pain score, medical cost, post-operative complications, morbidity, and inflammation were significantly reduced in the ERAS group ($p<0.05$), and improved quality of life, comfort level, and immunity. The study concluded that ERAS protocol helps to improve patient well-being after surgery and should be implemented in general surgery. Further longitudinal studies should also be conducted.

Keywords: ERAS, Surgery, Enhanced recovery, General surgery, Hospitalization

INTRODUCTION

Enhanced recovery after surgery (ERAS) protocols represent a change of paradigm in the management of patients in the period after surgery. Piloted initially at the end of the 1990s by Professor Henrik Kehlet, ERAS programs began with colorectal surgery. Later, it was applied to other specialities, such as general and abdominal surgery, owing to the marked improvement in patients' outcomes in terms of postoperative complication rate, length of stay in the hospital, and global costs.[1] These protocols established across disciplines enhance patient care plans and preoperative, intraoperative, and postoperative spectrum to promote recovery and minimize the physiological impact of surgical procedures.[2]

General surgery means any procedure, from minimal access laparoscopic procedures to large complex operations, such as open surgeries. These procedures may differ in terms of difficulty and the patients being treated. Some of the problems that patients experience are postoperative complications, prolonged hospitalization, and slow recovery. Previous approaches to perioperative care management were characterized by a uniform broad system that could not capture the patient's details to enhance the recovery process. The gap between acute care surgery and critical care commonly stems from the ERAS protocols that endeavoured to fill this gap with preoperative education, carbohydrate loading, multimodal analgesia, early mobilization, and nutrition optimisation.[3]

An analysis of the scientific publications reveals that general surgical patients who are managed according to ERAS standardized perioperative care pathways derive better, more effective, and less expensive benefits. Such protocols have been demonstrated to reduce operation stress and early recovery, as well as postoperative complications like infections, postoperative ileus, and venous thromboembolism.[4] Also, those seeking to adopt ERAS programs would benefit from a value-based healthcare agenda to raise the quality of the services offered and lower prices. A systematic review of the general surgery ERAS programme published in 2019 showed that, on average, ERAS reduced 30 hours of hospital stay without incrementing morbidity mortality or dissatisfaction rates.[5]

The other important advantage of ERAS is that it creates and implements to different operations and distinct categories of individuals. Many patients who require general surgery have other health-related conditions like obesity, diabetes, or cardiovascular disease, hence exposure to complications. Strategies unique to ERAS include broadband interventions like perioperative glycemic control and individual fluid therapy.[6] These protocols also focus on patient self-education and decision-making, promoting patients' engagement in the recovery process and following a doctor's recommendations after the operation.

ERAS protocols are characteristic due to the following features: the protocols are developed based on evidence from the literature; it is a multidisciplinary approach; the interventions are performed focused within the entire time perioperative period. Before surgery, this protocol involves patient preparations through cessation of smoking and optimization of anemia, amongst many others.

According to Nygren and colleagues, pre-operative carbohydrate loading, for instance, can help lower insulin resistance and enhance post-operative energy stores.[7] Further, organized patient education sessions give some of the most important details about the surgical process, eradicating patients' fear.

During the surgery, components of ERAS include avoiding tissue trauma and tissue handling, and inadequate and appropriate perioperative fluid therapy besides the use of morphine sparing analgesia. Research has shown that minimally invasive techniques benefit such procedures as they have less pain, ileus, and shorter hospital stays compared to open surgery where possible.[8] Prolonged inpatient stays and the administration of opioids enhance postoperative complications, including nausea, sedation, and dependency; thus, the use of acetaminophen in combination with regional anaesthesia, called multimodal analgesia, decreases postoperative opioid effects.[9]

The ERAS path following the operation means early recovery from basic movements, return to oral intake, and avoidance of complications. Lack of food and inactivity have been substituted by constant feeding and mobilization soon after the surgery. Getting the patient out of bed earlier has been seen to reduce the incidence of venous thromboembolism and shorten gastrointestinal recovery time.[10] Likewise, the practice of early oral intake aids in reducing new tissue formation and risks of infection, defeating the traditional practice of postponing feeding to allow bowel recovery to take place.

Nonetheless, the current review provided substantial evidence of the impact and benefits of ERAS protocols in general surgical patients; the implementation of these protocols in the general surgical population varies across countries and even institutions. Some challenges include stakeholder and organizational culture in healthcare sectors regarding receiving and implementing change, the absence of a code of shared best practices, and financial and human resources limitations, especially in LAMI countries. Moreover, it deserves the organized cooperation of the surgeon, anaesthetist, nurse, dietitian, physical therapist, and many more professionals, so it is crucial to have an institutional commitment to the condition of interdisciplinary collaboration.

Other issues relate to cultural aspects and patients' beliefs that also contribute to the implementation of ERAS. For example, some patients may not engage in early mobilization or oral feeding due to misconceptions about traditional post-surgery recovery. Addressing these challenges with simple educational and engagement techniques becomes crucial in optimizing the value of utilizing the guidelines of ERAS protocols.

Objectives

The following systematic review is intended to comprehensively compare the effects of ERAS protocols for patient recovery factors after general surgery in terms of clinical, economic, and patient-reported outcomes: enabling the comparison to estimate the role of ERAS in postoperative complications, the postoperative period length, and the readmission rate; and assessing global quality and access to care satisfaction concerning ERAS.

METHODS

Search strategy

First the protocol for this systematic review was registered on PROSPERO (ID: 6374467). We developed search strategies from three electronic databases: Pubmed, Scopus, and Google Scholar. The researcher searched from January 2015 to January 2025, including the articles published in English only. Three reviewers conducted an initial screening of the publications. Each reviewer's categorisation of the studies followed an independent approach regarding the eligibility assessment. The final list of included studies was made after a consensus. The references of the relevant articles were also scanned. In addition, researcher exploited the ClinicalTrials.gov site (last searched on 10 January 2025). The search string used for PubMed was: (enhanced[All Fields] AND recovery[All Fields] AND ("general surgery"[MeSH Terms] OR "general surgery"[All Fields] OR "surgeries"[All Fields]) AND ("protocol"[Subheading] OR "surgery"[All Fields] OR "surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "surgery"[All Fields] OR "general surgery"[MeSH Terms] OR ("general"[All Fields] AND "surgery"[All Fields]) OR "general surgery"[All Fields])) AND ("2015/01/01"[PDat]: "2025/01/01" AND "humans"[MeSH Terms]).

Inclusion criteria

Randomised control trials focusing on ERAS published from January 2015 till 2025 in English language were included in this study.

Dealing with duplicate publications

In the case where more than two articles drew their results from a single trial (i.e. where written by the same authors, in the exact geographical location, using the same study subjects and on pre-selected days, ranging from recruitment dates), we only included the article reporting the main outcome for the trial.

Data extraction

We employed a predefined form to extract data that all junior authors signed. In each study, researchers noted the year it was published, study population, state, treatment, results, sample size, number of participants, events, mean and range standard deviation for condition results, and severe adverse. These steps and their connection with the events in the case were also analyzed.

To reduce the possibility of mistakes, the three review authors conducted data extraction individually, reviewed the entries, reconciled the entries, and corroborated. A single set of data.

Risk of bias assessment

Three authors also independently determined the risk of a particular bias by using the review criteria. The risk of bias tool criteria for identifying bias in the included studies was determined as per the Cochrane guidelines (McGuinness & Higgins, 2020).

The risk assessment plot is represented in Figure 1.

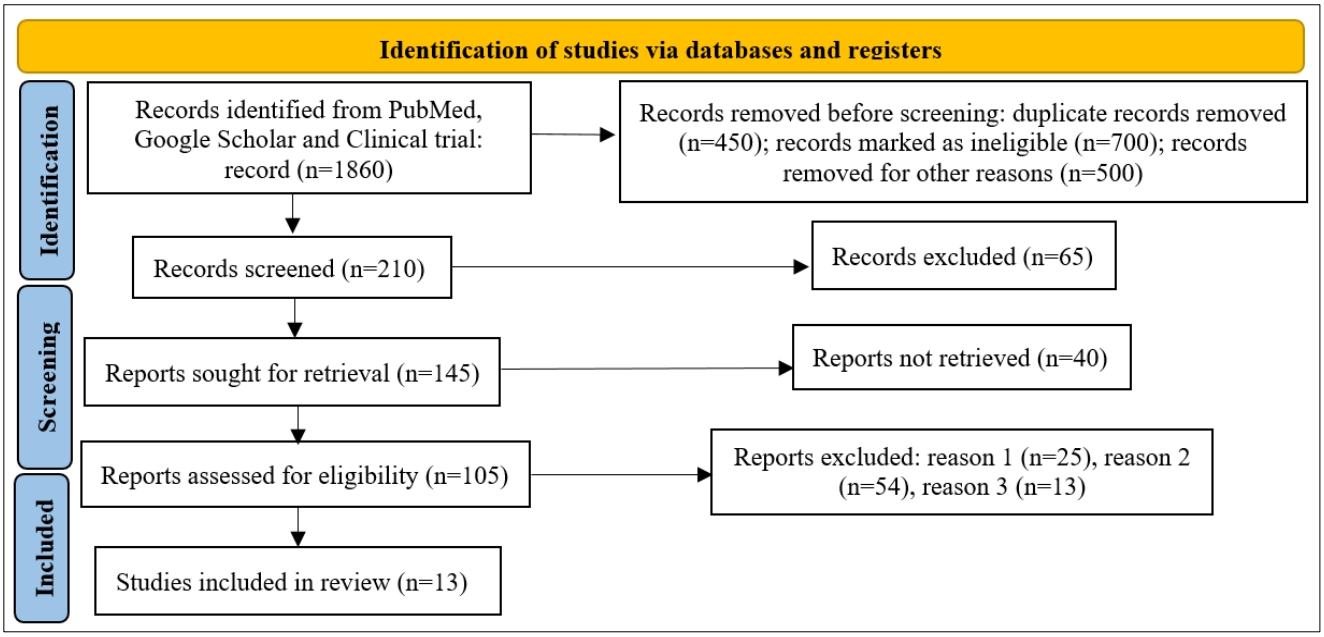

Figure 1: PRISMA flowchart of the included studies.

Data synthesis

Thus, researchers evaluated the impact of ERAS protocols on the surgical procedure.

RESULTS

A total of 1860 study titles were identified. As the current review only included randomised control trials, only 230 titles were produced as RCT. Researchers chose 145 abstracts for screening after removing the papers that did not fit the original search criteria; only 13 qualified for final review. Prisma flowchart represents the detail in Figure 2.

This analysis included 13 studies that satisfied the inclusion criteria. All studies have quite different patient populations. All the studies that used the ERAS procedure reported shorter lengths of stay. Studies comparing ERAS and non-ERAS patients reveal lower postoperative complications and better pain scores. Three ERAS methods resulted in a significant decrease in visual analogue scale pain scores. Using ERAS protocols also reduced direct, indirect, and overall hospital costs. The study characteristics are summarised in Table 1.

Pain levels

The visual analogue scale (VAS) scoring was used to measure the pain score after 12, 24, 36 and 48 hours of operation. Out of the 13 studies, 6 studies found significantly lower levels of VAS score in the ERAS group than the other control groups ($p<0.05$).

Time to mobilization

In the current review, 3 RCTs reported quicker mobilisation in patients enrolled in the ERAS group than the control group ($p<0.05$).

Hospital stay

Compared to the controls, ERAS patients recovered more quickly and spent less time in the hospital after surgery ($p<0.05$), as reported in 8 RCTs included in this review.

Post-operative complications

7 RCTs discussed the impact of ERAS on postoperative complications; five studies found a significantly lower incidence of complications than the control group ($p<0.05$), whereas 2 studies reported that there was no significant difference.

Cost effectiveness

The overall medical cost of the operation and hospital stay charges were reduced significantly in ERAS group according to three RCTS ($p<0.05$).

Table 1: Characteristics of the studies included in this review.

Reference	Study type	Condition	Intervention	N	Primary outcome	Significant
Lin et al, 2024	RCT	Acute appendicitis	ERAS	120	Improved pain score	Yes
Wei et al, 2024	RCT	Endoscopic sinus surgery	ERAS	80	Improved comfort level	Yes
Huang et al, 2024	RCT	Thoracoscopic radical resection	ERAS	85	Reduced complications	Yes
Akbar et al, 2024	RCT	Abdominal surgery	ERAS	650	Lesser postoperative complications	Yes
Wang et al, 2023	RCT	Ureteral calculi	ERAS	105	Improved post-operative recovery	Yes
Shen et al, 2022	RCT	Esophagectomy	ERAS	118	Lower pulmonary complications	Yes
Quin et al, 2020	RCT	Mastoidectomy	ERAS	84	Improved general comfort	Yes
Wang et al, 2019	RCT	Gastric carcinoma	ERAS	60	Lesser inflammation and improved immunity	Yes
Wang et al, 2018	RCT	Elective craniotomy	ERAS	140	Less hospital stay	Yes
Takagi et al, 2018	RCT	Pancreaticoduodenec-tomy	ERAS	74	Accelerated recovery and better quality of life	Yes
Kang et al, 2018	RCT	Totally laparoscopic distal gastrectomy	ERAS	97	Less pain and faster recovery	Yes
Tanaka et al, 2017	RCT	Gastric cancer		148	Short hospital stay and	Yes
Forsmo, et al, 2016	RCT	Colorectal surgery	ERAS	307	Shorter hospital stayt	Yes

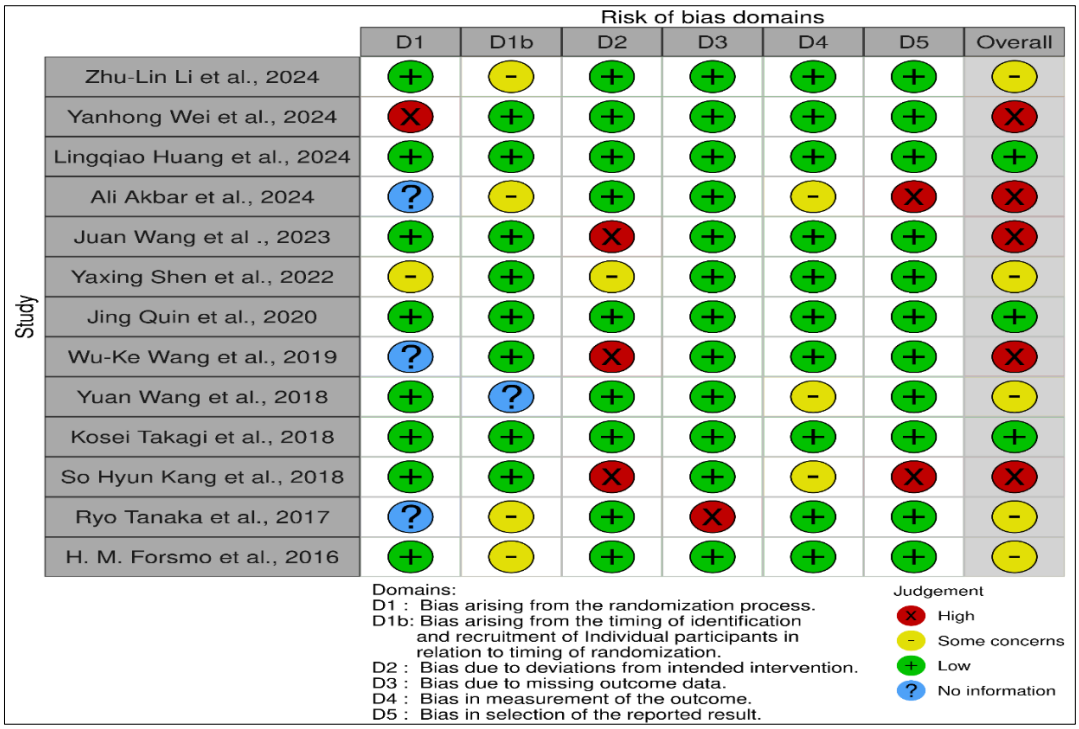

Figure 2: Risk assessment plot (Cochrane).

Quality of life

In five studies, the general quality of life and comfort was assessed using the GQOLI-74 score, GCQ and QLQ-C30 questionnaire, and the data revealed higher scores in the ERAS group than the control group.

Inflammation and immunity

Based on the serum albumin, C reactive protein, and IgM levels, two RCTs reported improved immunity and lesser inflammation in the ERAS group).

DISCUSSION

This study focused on to the outcomes of ERAS protocol implementation after general surgery. It was found that ERAS protocol is effective and beneficial in many ways for the patient recovery and well-being. ERAS is a trend in implementing care management after surgeries. It refers to a specific bundle of implemented care processes on the basis of scientific evidence designed to enhance postoperative results, especially in the sector of general surgery. According to the current review pain levels, cost and duration of hospital stay, post-operative complications and inflammation were significantly reduced in surgery patients who followed ERAS protocol and the quality of life was improved postoperatively.

One of the key ideas behind the ERAS protocols is to reduce pain after the surgery. A study revealed concurrent results that that the use of multimodal analgesics in ERAS protocol helps to reduce the pain as well as the complications, such as nausea, sedation and dependency.[9] Another prospective randomized multicenter trial aimed at comparing conventional postoperative management and ERAS in patients undergoing colorectal surgery. Comparing the ERAS group and the control group, the authors noted that patients in the ERAS group had, on average, 35% less all types of pain, as estimated by VAS, in the first 48 hours after the surgery.[11] Another study highlighted the importance of multimodal analgesia within ERAS and reported reduced postoperative pain and fast recovery time.[5] These results highlight the importance of maximizing preoperative pain management and offering nurses and patients some level of comfort regarding the efficacy of ERAS. Current study also summarized that that following the ERAS protocol either in the form of diet, medication or physical activity reduces the severity of pain.

Early hospital discharge is the second significant benefit of ERAS protocols since the cost of healthcare will also be under control. A thorough preoperative management, including smokers' cessation, optimization of nutrient status and psychological optimization, in the preoperative period improves early postoperative recovery and minimizes early postoperative morbidities.[2] Another meta-analysis demonstrated that ERAS, in general surgery, shortened the length of stay by an average of 2.5 days.[12] All these reductions go straight to the costs without impacting patient welfare too much. Another study also concluded that the mean direct hospital costs of the patients treated under ERAS protocols are reduced by 20 % relative to conventional practice.[13] These enlightenments align with the value-based strategy to offer service value at cost. The results from the current study also coincide with the

literature as the ERAS protocol was found compelling, and a significant reduction in hospital stay was found in this study.

Postoperative compliance is the hardest to attain but most closely linked to the best recovery. Research demonstrated the significant benefit of ERAS on patients undergoing open surgery. Even in the case of laparoscopic procedures, the outcome of the ERAS protocol was better, and fewer complications were reported than in conventional procedures.[14] Current studies also support that post-operative complications are less common in patients who follow the ERAS protocol.

Postoperative surgical stress can alter the surgical outcomes and healing times. The stress can lead to inflammation, and the immunity of the patient can be compromised in some instances. A study examined the levels of immunological and nutritional serum investigators in patients having elective colorectal laparoscopic surgery under conventional care guidelines or as part of an ERAS procedure. It concluded that the ERAS protocol impacts the surgical stress response after colorectal laparoscopic surgery by lowering postoperative IL-6 and CRP levels and enhancing postoperative prealbumin synthesis.[15] These factors are linked with inflammation, so the results of this study are similar to the findings of the current review, which states that ERAS protocol improves immunity and reduces inflammation in post-surgical patients.

However, the standard of care before, during, and after surgeries is mainly characterized by forced fasting, delayed mobilization, undue use of drains and tubes, extra days in the hospital, and increased costs. ERAS challenges these traditions by permitting early oral intake and mobilization, which are believed to shorten the time needed to recover gastrointestinal function and reduce the incidence of venous thromboembolism.[16]

A longitudinal study was conducted to determine the QoL of patients undergoing elective liver surgery. These studies showed that even in the follow-up evaluations of the ERAS protocols, the patients reported better physical and mental health Composite scores than the control group three months after surgery.[17] It was also noted that ERAS enhanced long-term functional recovery and allowed early return to baseline physical activities. Earlier comparative studies also proved that implementing ERAS in general surgery is compatible with the patient-reported outcomes (PRO) perspective indicated that ERAS group patients gave higher satisfaction since they had less postoperative pain, a fast recovery time, and less readmission.[8] These outcomes indicate that the impact of ERAS is significant not only in terms of traditional metrics but also in terms of patient-reported outcomes, which have long been the focus of considering whether a technique is effective or not. Patient satisfaction rate was not studied in the current review, but it can be another effective outcome of the ERAS protocol that should be studied.

A study canvassed multicenter data on the effectiveness of ERAS protocols in major abdominal surgery and observed a lower % construct of complications of 40%, compared to standard care.[2] Similar to the findings of another study that noted one of the significant advantages of ERAS is to offer patients tailored needs for, for instance, glycemic control in diabetic patients, decreases complications, infections, and delayed wound healing. Improved wound healing and fewer complications are also highlighted in this study.[18]

Another important factor in the effectiveness of ERAS is the time and speed of its implementation. A study concluded that implementing the ERSAS protocol is a progressive process that takes at least 30 patients and roughly six months to achieve 80% or above compliance rates. Continuous training of staff members across all specialisations and ongoing outcomes assessment should get specific attention in the early stages. Staff attitudes can be influenced, and change adoption can be accelerated by presenting findings and observations from one's own study and those from other studies at frequent multidisciplinary meetings.[18]

The current study has not focused on the path of ERAS implementation or the staff training in the process, so further study is needed.

Literature from resource-limited countries has established some of these barriers, including lack of training, lack of interdisciplinary teamwork, and restricted availability of resources. Overcoming these issues through effective implementation, including public health and practice development and document standardization, remains essential for translating the success of ERAS protocols worldwide, and a systematic review should be planned to evaluate the shortcomings of ERAS protocol implementation.

CONCLUSION

ERAS protocols are a radical change from traditional preoperative and postoperative care opportunities, providing better results in the postoperative period, such as less pain, shorter hospitalization, lower costs, and increased quality of life. Consequently, comparative research repeatedly showcases the benefit of ERAS over conventional treatment, including its flexibility, irrespective of the type of surgery. These studies, albeit with implementation issues, show the possibility of ERAS in general surgery. Future studies and focused initiatives will thus be critical in identifying and reducing continued limitations and enhancing the delivery of ERAS protocols across the patient spectrum and for all patient needs.

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