Systematic Literature Review: Effectiveness of Laparoscopic Cholecystectomy on Service Efficiency and Length of Hospitalization

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Gallstone disease is one of the most common gastrointestinal conditions requiring surgical intervention worldwide. Over the past few decades, laparoscopic cholecystectomy (LC) has replaced open cholecystectomy (OC) as the gold standard in gallbladder surgical management. Although its clinical advantages have been widely recognized, a systematic evaluation of its impact on hospital operational efficiency and resource optimization through length of stay is still needed. This study aims to evaluate the effectiveness of laparoscopic cholecystectomy in improving healthcare efficiency and shortening patient length of stay compared with open surgical procedures. This study used a Systematic Literature Review (SLR) method through a literature search in various scientific databases, such as PubMed, Scopus, and Google Scholar. The literature analyzed included meta-analyses, randomized clinical trials, and cohort studies comparing the outcomes of laparoscopic cholecystectomy and open cholecystectomy. A total of eight key journals were selected for further analysis, focusing on mortality, postoperative complications, length of stay, and healthcare cost-efficiency. The study showed that laparoscopic cholecystectomy significantly reduced mortality by 84% (RR 0.16) and reduced the risk of postoperative complications by 54% compared to open surgical procedures. In terms of service efficiency, this procedure was also shown to shorten the average length of stay by 4.08 days compared to open cholecystectomy. In several healthcare centers, the average length of stay for patients undergoing laparoscopic cholecystectomy was only around 2.1 days, compared to 5.6 days for open procedures. Furthermore, the implementation of ambulatory laparoscopic cholecystectomy has been proven safe, provides significant hospital cost savings, and improves patient satisfaction through a faster recovery process. Based on the study results, it can be concluded that laparoscopic cholecystectomy is more effective than open cholecystectomy in improving healthcare efficiency. The significant reduction in length of stay and the potential for outpatient procedures make this method an important strategy in optimizing hospital bed utilization and reducing healthcare system costs. Therefore, investment in infrastructure and development of laparoscopic services is highly recommended to increase accessibility of more efficient, safe, and high-quality surgical services.

Keywords: Laparoscopic Cholecystectomy, Open Cholecystectomy, Service Efficiency, Length of Hospitalization, Healthcare Costs.

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1. Introduction

Gallstone disease, or cholelithiasis, is one of the most common gastrointestinal health problems worldwide, with a prevalence of approximately 10–15% in the adult population in Western countries [1]. This condition occurs due to impaired bile metabolism that leads to crystallization and stone formation in the gallbladder, which can be cholesterol stones or pigment stones. In the early stages, this disease is often asymptomatic so that patients are not aware of it, but over time it can cause symptoms such as right upper abdominal pain, nausea, vomiting, bloating, and digestive disorders that can reduce quality of life. In some cases, gallstones can move and block the bile duct, leading to further complications.

Cholelithiasis can progress to cholecystitis, an inflammation of the gallbladder that often requires surgical intervention as definitive therapy [2]. Cholecystitis generally occurs due to obstruction of the cystic duct by gallstones, which causes increased intraluminal pressure, gallbladder distension, and inflammation that progresses to secondary bacterial infection. If not treated promptly and appropriately, this condition can develop into serious complications such as gallbladder perforation, pericholecystic abscess, sepsis, and even life-threatening peritonitis. Therefore, appropriate treatment is essential to prevent worsening of the clinical condition.

The occurrence of cholelithiasis is influenced by various risk factors such as age, female gender, obesity, a high-fat diet, low physical activity, and genetic factors [3]. These factors contribute to changes in bile composition, increased cholesterol levels, and decreased gallbladder motility, which can trigger stone formation. Furthermore, metabolic conditions such as diabetes mellitus, hyperlipidemia, and metabolic syndrome are also known to increase the risk of cholelithiasis. This combination of factors makes this disease more common in groups with certain lifestyles and metabolic conditions.

The classic risk factors known as the four "Fs"—female, fat, forty, and fertile—show that this disease is more common in middle-aged women [4]. This is due to the influence of the hormone estrogen, which can increase cholesterol saturation in bile, and progesterone, which can decrease gallbladder motility. The combination of these two mechanisms puts women, especially those of reproductive age to middle age, at higher risk than men. Pregnancy also contributes to an increased risk due to hormonal and metabolic changes.

In Indonesia, the majority of cholelithiasis patients are also reported to be women over 40 years of age [5]. This pattern aligns with global epidemiological data, which places age and gender as the primary determinants of cholelithiasis. Increasing age is associated with changes in body metabolism, decreased gallbladder function, and increased comorbidities such as obesity and diabetes, which also increase the risk of gallstone formation.

Historically, open cholecystectomy (OC) has been the standard surgical procedure for gallbladder removal for a long time [6]. This procedure is performed through a large abdominal incision to directly access the gallbladder, providing the surgeon with ample visibility. While effective in removing gallstones, this method has several limitations, such as more severe postoperative pain, a higher risk of wound infection, a longer hospital stay, and a slower recovery time. This has led to the development of minimally invasive surgical techniques as a more effective and efficient alternative.

2. Literature Review and Problem Statement

Basic Concept of Laparoscopic Cholecystectomy

Laparoscopic cholecystectomy is a minimally invasive surgical technique used to remove the gallbladder in patients with symptomatic cholelithiasis or gallstone-related complications. This procedure is performed using a camera and specialized instruments through several small incisions in the abdomen, thereby reducing tissue trauma compared to open cholecystectomy. The development of this technique is a significant milestone in modern surgery because it offers a safer, more effective approach and provides greater comfort for patients during the post-operative recovery process. With the advancement of medical technology, laparoscopic cholecystectomy has become the gold standard for gallstone treatment in various healthcare facilities because it provides better clinical outcomes and a lower risk of complications than conventional methods [7].

Clinical Effectiveness and Service Efficiency

Laparoscopic cholecystectomy has been shown to be highly clinically effective in the management of gallstones, particularly in reducing postoperative complications and pain, and accelerating patient recovery. Compared with open cholecystectomy, the laparoscopic method offers significant advantages in terms of shorter hospital stays, faster patient mobilization, and a reduced risk of surgical site infections. This has a direct impact on improving healthcare efficiency, as hospitals can optimize bed utilization and increase the number of patients they can serve. Furthermore, various studies have shown that this minimally invasive approach contributes to an overall improvement in postoperative patients' quality of life [8].

Systemic Impacts and Implications for Health Services

From a healthcare system perspective, the implementation of laparoscopic cholecystectomy has a broad impact not only on clinical aspects, but also on cost efficiency and overall hospital management. Significantly reducing the length of hospital stay helps reduce the economic burden on hospitals while increasing the availability of services for other patients. Furthermore, this procedure also supports the concept of value-based healthcare because it is able to provide better therapeutic outcomes with more efficient resources. Thus, laparoscopic cholecystectomy is not only a surgical treatment option, but also an important strategy in improving the effectiveness of modern healthcare systems [9].

3. Method

This study used the Systematic Literature Review (SLR) method to comprehensively examine the effectiveness of laparoscopic cholecystectomy on healthcare efficiency and length of stay. Data sources were obtained from various scientific databases such as PubMed, Scopus, ScienceDirect, and Google Scholar using the keywords "laparoscopic cholecystectomy", "hospital efficiency", "length of stay", "minimally invasive surgery", and "patient recovery" which were systematically combined. Inclusion criteria included national and international journal articles published between 2015 and 2025, available in full text, and relevant to the research focus. While exclusion criteria included articles that were not peer-reviewed, irrelevant to the topic, and duplicate articles that did not meet selection standards.

The article selection process was conducted through identification, screening, and eligibility stages, resulting in approximately 1,800 articles in the initial stage. After screening based on title and abstract, the number of articles was reduced to 250, followed by a full-text evaluation, leaving 40 articles worthy of further analysis. From the final selection process, 8 articles were selected as the most relevant for in-depth analysis. Data analysis was conducted using a thematic approach by grouping research results based on main themes, namely the effectiveness of laparoscopic cholecystectomy, efficiency of hospital services, length of patient stay, postoperative complications, and patient satisfaction [7].

4. Results and Discussion

The results of the literature search and selection showed that of the 1,800 articles identified, only 8 met the inclusion criteria and were worthy of further analysis. The findings from these studies consistently demonstrate that laparoscopic cholecystectomy is more effective than open cholecystectomy, particularly in reducing hospital stays, accelerating patient recovery, and improving hospital service efficiency. Furthermore, this procedure is also associated with reduced postoperative complications and increased patient satisfaction, thus overall supporting the adoption of laparoscopic cholecystectomy as the gold standard in the management of cholelithiasis.

Table 1 Analysis of Studies Related to Laparoscopic Cholecystectomy

No	Author (Year)	Article Title	Objective	Research methods	Results
1	Delpino et al. (2026)	Comparison between open, laparoscopic, and robotic cholecystectomy: a systematic review and meta-analysis	Comparing postoperative outcomes between open, laparoscopic, and robotic cholecystectomy and the influence of country income level	Systematic review and meta-analysis of 85 studies (>7.5 million patients)	LC significantly reduced mortality (RR 0.16), complications, and length of hospital stay compared to OC; robotic surgery showed no clear advantage.
2	Manzia et al. (2020)	Feasibility and cost effectiveness of ambulatory laparoscopic cholecystectomy	Evaluating the cost-effectiveness and safety of outpatient LC compared with inpatient care	Retrospective cohort of 288 patients	Outpatient LC is safe, effective, and cost-saving >300% with significant financial benefits.
3	Nam et al. (2024)	Evolution of minimally invasive cholecystectomy: a narrative review	Reviewing the development of minimally invasive cholecystectomy techniques	Narrative review from PubMed, Embase, Cochrane	New techniques (SILC, NOTES, RALC) are not yet superior to conventional LC and have technical limitations.
4	Mannam et al. (2023)	Laparoscopic Cholecystectomy Versus Open Cholecystectomy in Acute Cholecystitis	Comparing LC and OC in acute cholecystitis	Literature review	LC is becoming the gold standard due to lower pain, shorter hospital stays, and faster recovery.
5	Sankar S et al. (2026)	Impact of 3D Laparoscopy on Surgical Efficiency and Ergonomics in Elective Cholecystectomy	Assessing the effect of 3D laparoscopy on surgical efficiency	Randomized prospective study (100 patients)	3D laparoscopy improves surgical efficiency and depth perception, but increases operator eye strain.
6	Prakash et al. (2025)	Comparative Outcomes of Laparoscopic Versus Open Cholecystectomy in an Indian Tertiary Center	Comparing LC and OC results	Prospective cohort of 260 patients	LC was superior in pain, bleeding, complications, and length of hospital stay (2.1 vs 5.6 days)
7	Rizal Syafiie (2025)	Comparison of laparoscopic and open	Assessing the differences between	Cross-sectional 85 patients	LC results in less pain and shorter hospital stays.

No	Author (Year)	Article Title	Objective	Research methods	Results
		cholecystectomy with respect to pain, length of hospital stay, and mobilization	LC and OC in cholelithiasis patients		
8	Roy & Sheikh (2024)	A Systematic Review and Meta-Analysis of Outcomes of Laparoscopic Cholecystectomy	Examining the comparison of LC and OC outcomes	Systematic review & meta-analysis of 24 studies	LC reduces mortality, complications, wound infections, length of hospital stay, and recovery time.

The first is titled “Comparison between open, laparoscopic, and robotic cholecystectomy: a systematic review and meta-analysis” (Delpino et al., 2026). This study is a large-scale systematic review and meta-analysis that included 85 studies with over 7.5 million patients to compare the outcomes of open, laparoscopic, and robotic cholecystectomy. The results showed that laparoscopic cholecystectomy significantly reduced mortality by 84%, reduced the risk of complications by 54%, and shortened the average length of hospital stay by 4.08 days compared to open surgery. Meanwhile, robotic surgical techniques did not show significant clinical advantages over conventional laparoscopy, but they did have higher costs.

The second title is "Feasibility and cost-effectiveness of ambulatory laparoscopic cholecystectomy. A retrospective cohort study" (Manzia et al., 2020). This study evaluated the feasibility and cost-effectiveness of outpatient laparoscopic cholecystectomy at a tertiary healthcare center in Italy by comparing 120 outpatient cases with 120 inpatient cases. The study results showed that the outpatient procedure was safe, with a readmission rate of only 0.8% and a complication rate comparable to that of inpatients. From an economic perspective, this approach was able to save hospital costs by over 300% and provide significant financial benefits to the national healthcare system.

The third title is "Evolution of Minimally Invasive Cholecystectomy: A Narrative Review" (Nam et al., 2024). This article discusses the development of minimally invasive cholecystectomy techniques, from conventional laparoscopy to newer techniques such as SILC, MLC, NOTES, and RALC. The review results show that although newer techniques such as SILC offer cosmetic advantages with minimal scarring, they still have limitations in the form of technical challenges and an increased risk of complications such as incisional hernia. To date, conventional laparoscopic cholecystectomy with four ports remains the gold standard in clinical practice.

The fourth title is "Laparoscopic Cholecystectomy Versus Open Cholecystectomy in Acute Cholecystitis: A Literature Review" (Mannam et al., 2023). This study compared the effectiveness of laparoscopic cholecystectomy and open surgery in cases of acute cholecystitis. The review results showed that laparoscopic cholecystectomy has become the primary choice due to its ability to reduce postoperative pain, accelerate recovery, and shorten hospital stay. Open surgery is now more often performed only in cases of conversion due to severe inflammation or difficulty identifying intraoperative anatomy.

The fifth title is "Impact of 3D Laparoscopy on Surgical Efficiency and Ergonomics in Elective Cholecystectomy: A Prospective Randomized Comparative Study" (Sankar et al., 2026). This study

evaluated the effect of using a 3D laparoscopy system on surgical efficiency and surgeon ergonomics compared to a 2D system. The results of the study on 100 patients showed that 3D technology can speed up surgical time and improve visual depth perception. However, the use of this system also increased complaints of eye strain and dizziness in operators despite reducing hand strain.

The sixth title is “Comparative Outcomes of Laparoscopic Versus Open Cholecystectomy in an Indian Tertiary Center” (Prakash et al., 2025). This prospective cohort study compared the outcomes of laparoscopic and open cholecystectomy in 260 patients at a tertiary hospital in India. The results showed that although laparoscopic surgery took slightly longer, this procedure significantly reduced intraoperative bleeding, decreased postoperative pain, and shortened hospital stay (2.1 days vs. 5.6 days). These findings underscore the importance of strengthening laparoscopic infrastructure, especially in resource-limited areas.

The seventh title is "Comparison of laparoscopic cholecystectomy and open cholecystectomy on postoperative pain, length of hospital stay, and speed of mobilization in cholelithiasis patients at Raden Mattaher Regional Hospital, Jambi, 2023–2024" (Ramadhan, 2024). This retrospective study involved 85 patients to compare the clinical outcomes of the two methods. The results showed that the laparoscopic group experienced less postoperative pain and a shorter length of hospitalization than the open group, although there was no significant difference in the speed of patient mobilization.

The eighth title is "A Systematic Review and Meta-Analysis of the Outcomes of Laparoscopic Cholecystectomy Compared to the Open Procedure in Patients with Gallbladder Disease" (Roy & Sheikh, 2024). This meta-analysis combined 24 studies to evaluate the comparative outcomes of laparoscopic and open cholecystectomy. The analysis results showed that laparoscopy was consistently superior in reducing mortality, surgical site infections, length of hospital stay, and patient recovery time. Therefore, the researchers recommend laparoscopic cholecystectomy as the primary procedure to replace open surgery when clinically feasible.

Laparoscopic cholecystectomy (LC) has become the gold standard in the management of gallstone disease due to its minimally invasive nature, which significantly shifted surgical practice from the open approach to a more efficient and safe technique. A systematic review and meta-analysis by Delpino et al. showed that LC can reduce mortality by up to 84%, reduce complications by 54%, and shorten the average length of stay by 4.08 days compared to open surgery [1]. These findings are in line with Roy & Sheikh who reported that LC consistently provides better clinical outcomes, including reduced risk of infection, increased patient safety, and accelerated postoperative recovery [2]. These advantages are related to minimal tissue trauma and a lower inflammatory response, allowing patients to recover more quickly.

Healthcare efficiency has also been significantly improved through the implementation of ambulatory laparoscopic cholecystectomy. Manzia et al. found that this procedure is safe, effective, and can save hospital costs by over 300%, while also increasing the efficiency of hospital bed utilization [3]. In addition to providing financial benefits to the healthcare system, the outpatient approach also speeds up patient rotation and reduces the burden on inpatient services. This makes laparoscopic cholecystectomy a procedure that is not only clinically superior but also economically valuable.

In terms of length of stay, laparoscopic cholecystectomy consistently demonstrates superiority over open surgery. Prakash et al. reported that the average length of stay for laparoscopic patients was only 2.1 days, compared to 5.6 days for open surgery [4]. Similar findings were also reported in an Indonesian study by Ramadhan, which showed that laparoscopic patients had a shorter length of stay and less postoperative pain than the open surgery group [5]. This reduced length of stay directly contributes to a faster return to activity for patients and increased economic productivity.

In addition to clinical benefits and service efficiency, technological developments also support the optimization of laparoscopic procedures. The use of 3D laparoscopic systems has been shown to improve visual depth perception and surgical time efficiency compared to conventional 2D systems, as reported by Sankar et al. [6]. However, this technology still has limitations in the form of increased eye strain and operator discomfort. On the other hand, although techniques such as robotic surgery and SILC offer cosmetic advantages, conventional laparoscopic cholecystectomy remains the primary choice due to its best balance between effectiveness, safety, and cost.

Furthermore, laparoscopic cholecystectomy also positively impacts patient quality of life. Minimal tissue trauma results in less postoperative pain, faster mobilization, and optimal recovery of physical function. This contributes to increased patient satisfaction and a faster return to daily activities. However, implementing this technique still faces challenges, particularly in healthcare facilities with limited resources, such as limited equipment, high costs, and the need for intensive operator training. Furthermore, this procedure has a relatively steep learning curve due to the limitations of tactile sensation and two-dimensional visualization.

In the context of modern healthcare, laparoscopic cholecystectomy represents the concept of value-based healthcare, prioritizing optimal clinical outcomes with resource efficiency. The combination of reduced length of hospital stay, fewer complications, and accelerated recovery make LC a surgical intervention that not only benefits patients but also improves the efficiency of the overall healthcare system. Therefore, despite requiring a higher initial investment, the long-term benefits of laparoscopic cholecystectomy far outweigh those of conventional open surgical approaches.

5. Conclusion

Based on the results of a Systematic Literature Review of various clinical studies and meta-analyses involving large patient populations, laparoscopic cholecystectomy (LC) has been shown to offer significant clinical advantages over open surgery. LC is consistently able to reduce mortality rates by up to 84% and reduce postoperative complications by 54%, thus confirming its position as the gold standard in the management of gallstone disease. Furthermore, in terms of service efficiency, LC also has a significant impact on length of stay (LOS), with an average reduction of approximately 4.08 days compared to the open method. In some healthcare centers, laparoscopic patients can even be discharged in approximately 2.1 days, significantly faster than open surgery, which reaches an average of 5.6 days. These advantages are further strengthened by the implementation of outpatient laparoscopic cholecystectomy, which is proven to be safe, effective, and able to reduce costs by more than 300%, while optimizing the use of hospital beds.

In addition to clinical benefits and service efficiency, technological advances have also strengthened the effectiveness of laparoscopic cholecystectomy in modern practice. Innovations such as 3D laparoscopy have been shown to improve surgical efficiency by shortening procedure times and improving visual accuracy, although they can still cause discomfort in the form of operator eye fatigue. Furthermore, the benefits of LC are even greater in low- and middle-income countries, where reductions in complication and mortality rates are more significant, making investment in infrastructure, training of medical personnel, and development of laparoscopic facilities crucial. Overall, laparoscopic cholecystectomy is not only clinically superior but also serves as a key strategy for improving healthcare system efficiency by shortening hospital stays, increasing service capacity, and reducing costs for both patients and the healthcare system at large.

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