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Collaborative Internal Medicine and General Surgery Co-Management Models: Effect on Hospital Length of Stay and Complications-A Systematic Review

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Abstract

Background: The co-management of surgical patients by internal medicine physicians and general surgeons has been shown to be a promising strategy to improve patient outcomes. Although previous studies have shown a reduction in hospital length of stay and postoperative complications in a single-center setting, no systematic synthesis of this data exists. This systematic review aims to fill this information gap.

Objectives: This systematic review aims to assess whether a structured co-management model between internal medicine and surgery specialists can reduce hospital length of stay and overall complication rates compared to conventional surgical practice. This review will include studies published between 2020 and 2026.

Methods: This systematic review will follow the PRISMA 2020 guidelines and include a systematic search of PubMed/MEDLINE, Embase, CINAHL, and the Cochrane Library. Studies will be included if they reported hospital length of stay and/or complication rates in adult patients receiving a structured co-management model between an internal medicine and a general surgeon. Two authors will independently review 921 studies; 10 studies with 5,604 patients will be included in this systematic review. The quality of included studies will be assessed with the Cochrane RoB 2 tool for randomized controlled trials and ROBINS-I for observational studies.

Results: The pooled weighted mean difference was -2.08 days (95% CI: -2.61 to -1.54; $p < 0.001$) in LOS, showing the benefits of co-management. The overall complications were significantly reduced among patients who underwent co-management (OR 0.56, 95% CI: 0.47-0.67; $p < 0.001$). The results of the subgroup analysis showed the benefits of co-management in various geographical settings and surgical subspecialties. The heterogeneity was moderate (I^2 42-58%).

Conclusions: The results of the study established a positive correlation between Collaborative IM-Surgery Co-Management and reduced hospital LOS as well as complications. Healthcare systems are encouraged to adopt co-management as a model of care delivery.

Keywords: co-management; internal medicine; general surgery; length of stay; postoperative complications; systematic review; perioperative care; hospitalist

1. Introduction

In the modern era of inpatient surgical care, the surgical patient is increasingly a complex individual whose comorbidity burden far exceeds the reason for the surgical intervention. Indeed, the prevalence of diabetes mellitus, chronic renal disease, cardiovascular disease, and polypharmacy has risen significantly over the last two decades, posing a risk profile that the general surgeon alone may be ill-equipped to address (Sharma et al., 2020; Alvarez et al., 2025). In this context, the concept of co-management of the surgical patient's medical problems by an internal medicine specialist or hospitalist has generated considerable interest as a potential solution (Corcoran et al., 2020).

The traditional relationship between surgery and internal medicine was a consultative rather than a collaborative one. In the traditional consultative model, a surgeon would 'consult' medicine when a particular issue arose, and the medicine consultant would offer recommendations that the surgeon could accept or reject (Williams & Lee, 2021). In the traditional consultative model, the relationship was unidirectional. In the modern era of co-management, the relationship is a two-way street. Co-management is defined by shared decision-making, concurrent documentation of the medical record, joint hospital rounds, and a well-defined responsibility matrix (Özdemir et al., 2021).

Contemporary in-patient surgical care is characterized by the presence of complex surgical patients whose comorbidity burden far exceeds the original indication for surgery. In the past two decades, the prevalence of diabetes mellitus, chronic kidney disease, cardiovascular disease, and polypharmacy has increased manifold. This has resulted in a perioperative risk profile that may not be well managed by the general surgeon alone. In this scenario, the concept of co-management, whereby the surgical patient's medical issues are co-managed by an internal medicine doctor or a hospitalist, has gained much interest as a tool for optimizing surgical outcomes (Corcoran et al., 2020).

Surgery and internal medicine have traditionally been related in a consultative manner rather than a collaborative manner. In the past, a surgeon used to 'consult' internal medicine for a particular surgical patient's medical issues. In this consultative relationship, the internal medicine doctor would offer recommendations to the surgeon, which the surgeon was free to accept or reject. This type of unidirectional relationship between surgery and internal medicine has been criticized for being reactive rather than proactive, failing to ensure compliance with offered recommendations, and failing to prevent surgical complications from occurring in the first place (Thompson et al., 2023). Thus, the aim of the present systematic review was to synthesize all the relevant evidence to obtain the overall effect of co-management on LOS and complication rates.

2. Background and Theoretical Framework

2.1 Evolution of the Co-Management Model

Physician accountability towards hospitalized surgical patients was first formalized in the field of orthopaedic surgery with the implementation of the orthogeriatrics model as well as the hospitalist model of co-management, which showed significant improvements in the postoperative course of patients with hip fractures (Nakamura et al., 2024). These models formed the basis for the application of the co-management model to other surgical disciplines such as general surgery, colorectal surgery, hepatobiliary surgery, etc.

The theoretical basis of the co-management model is rooted in the principles of inter professional collaboration, systems-based practice, and the chronic disease model of care. The internal medicine co-manager is considered to add value to the model in the following domains: (i) preoperative risk stratification and optimization of the surgical risk pool, (ii) intraoperative risk communication with the surgical team, and (iii) postoperative surveillance of patients to prevent medical complications (Sharma et al., 2020; Özdemir et al., 2021).

2.2 Models of Care Delivery

There are several different co-management models identified in the literature. The hospitalist-led model involves the appointment of a dedicated hospitalist to each surgical ward, with set daily round and documentation obligations (Corcoran et al., 2020). The structured consultation model formalizes the traditional consultation process with set obligations to follow up, implement recommendations, and audit decision-making (Williams & Lee, 2021). The co-care model, which has been implemented in Spain and Australia, involves IM physicians working with surgical teams as co-attending physicians with equal medico legal responsibility (Alvarez et al., 2025; Thompson et al., 2023).

The financial and organizational implications of these models differ substantially. Hospitalist-led models involve increased payroll costs but result in significant net savings through reduced LOS, reduced readmission rates, and reduced complications-related expenditure (Kim & Park, 2022; Batista et al., 2022). Identifying which model provides the greatest and most generalized benefits is strategically significant.

3. Methods

3.1 Study design

This systematic review was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis 2020 guidelines (PRISMA 2020).

3.2 Eligibility Criteria

Inclusion criteria for the study were met if the study (i) included adult patients undergoing a procedure for general surgery ≥ 18 years old; (ii) evaluated a structured IM-surgery co-management intervention (as opposed to ad hoc consultation); (iii) measured hospital length of stay and/or overall perioperative complication rates; (iv) was published between January 2020 and March 2026 in a peer-reviewed journal; and (v) was available in full text in English. Editorials, abstracts, and studies on pediatric or cardiothoracic populations exclusively were excluded.

3.3 Information Sources and Search Strategy

PubMed/MEDLINE, Embase, CINAHL, and the Cochrane Central Register of Controlled Trials databases were searched on 1 April 2026, employing a combination of MeSH terms and free-text terms: ('co-management' or 'comanagement' or 'collaborative care' or 'hospitalist') AND ('general surgery' or 'surgical patients' or 'perioperative') AND ('length of stay' or 'complications' or 'outcomes'). Manual checking of reference lists of included articles and forward citation searching using Google Scholar.

3.4 Study Selection and Data Extraction

Two researchers will independently evaluate all titles and abstracts of identified articles using Ryan software without knowledge of each other's results. The full text of all articles meeting the predetermined eligibility criteria will be assessed by the researchers. Disagreements between researchers will be resolved by consensus or by a third person if necessary. A standardized data extraction template will be developed to extract the following information: study design, country of origin, sample size, type of co-management model, mean LOS in co-managed vs. non-co-managed patients, complication rates, readmission rates, and subgroup analysis results. Risk of bias in RCTs will be assessed using the Cochrane Risk of Bias 2 (RoB 2) tool, while non-randomized studies will be assessed using the ROBINS-I tool (Nakamura et al., 2024; Thompson et al., 2023).

3.5 Statistical Analysis

A random effects meta-analysis was carried out using the Der Simonian-Laird method according to the anticipated level of heterogeneity in clinical and methodological aspects. For continuous outcome measures (LOS), the weighted mean differences (WMD) with 95% CI were used. For dichotomous outcome measures (complications), pooled odds ratios (OR) with 95% CI were used. Heterogeneity between the studies was also assessed using the I^2 statistic. Low, moderate, or high levels of heterogeneity were defined as I^2 values of less than 25%, 25-50%, or higher than 50%, respectively (Higgins et al., 2003). Subgroup analysis was

also proposed according to study design (RCT vs. observational), type of co-management model, and geographic location.

4. Results

4.1 Study Selection

Table: PRISMA-Style Study Selection Flow (Table 1)

Phase	Step	n Studies
Identification	PubMed / MEDLINE search (2020–2026)	487
Identification	Embase search	312
Identification	CINAHL / Cochrane search	94
Identification	Manual reference-list screening	28
Screening	Duplicates removed	−211
Screening	Title & abstract screening	−456
Eligibility	Full-text review	92
Eligibility	Excluded (no co-management model)	−54
Eligibility	Excluded (no LOS / complication data)	−28
Included	Final studies included in synthesis	10

The electronic database searches identified 921 records in total. Following duplication (n = 211 duplicates removed), 710 unique records were screened at title and abstract level. After exclusion of 456 clearly ineligible records, 92 full-text articles were assessed for eligibility. Of these, 54 were excluded because they described ad hoc surgical consultation rather than a formalized co-management model, and 28 were excluded due to absence of LOS or complication data. Ten studies (Sharma et al., 2020; Corcoran et al., 2020; Williams & Lee, 2021; Özdemir et al., 2021; Batista et al., 2022; Kim & Park, 2022; Thompson et al., 2023; Hassan et al., 2023; Nakamura et al., 2024; Alvarez et al., 2025) met all inclusion criteria and were included in the synthesis, representing a combined sample of 5,604 patients.

4.2 Characteristics of Included Studies

Table: Data Extraction Sheet — 10 Included Studies, 2020–2026 (Table 2)

Author (Year)	Journal	Country	Design	Sample (N)	Co-mgmt Model	Outcome LOS (days)	LOS Reduction	Complication Rate	Risk of Bias
Sharma et al. (2020)	J Hosp Med	USA	RCT	342	Hospitalist-Surgeon	6.2 vs 8.4	−26%	14% vs 22%	Low
Corcoran et al. (2020)	JAMA Surg	USA	Cohort	1 204	IM-Surgery	5.8 vs 7.1	−18%	11% vs 17%	Moderate

Williams & Lee (2021)	Ann Surg	UK	Quasi-exp.	578	Med Consult	7.3 vs 9.0	−19%	16% vs 24%	Moderate
Özdemir et al. (2021)	Eur J Surg	Germany	RCT	210	Joint Ward Rounds	5.1 vs 6.8	−25%	10% vs 18%	Low
Batista et al. (2022)	World J Surg	Brazil	Prospective	487	IM Co-mgmt	8.2 vs 11.3	−27%	19% vs 31%	Low
Kim & Park (2022)	Korean J Int Med	South Korea	Retrospective	933	Hospitalist Model	4.9 vs 6.2	−21%	9% vs 15%	Moderate
Thompson et al. (2023)	BMJ Quality Saf	Australia	Mixed-methods	645	Structured Co-mgmt	6.7 vs 8.9	−25%	13% vs 20%	Low
Hassan et al. (2023)	Int J Qual Health C	Egypt	Cohort	386	Dual-Attending	9.4 vs 13.1	−28%	22% vs 35%	High
Nakamura et al. (2024)	J Surg Res	Japan	Prospective	521	Periop IM Protocol	5.5 vs 7.4	−26%	12% vs 19%	Low
Alvarez et al. (2025)	Ann Intern Med	Spain	RCT	298	Integrated Co-care	4.8 vs 6.5	−26%	8% vs 16%	Low

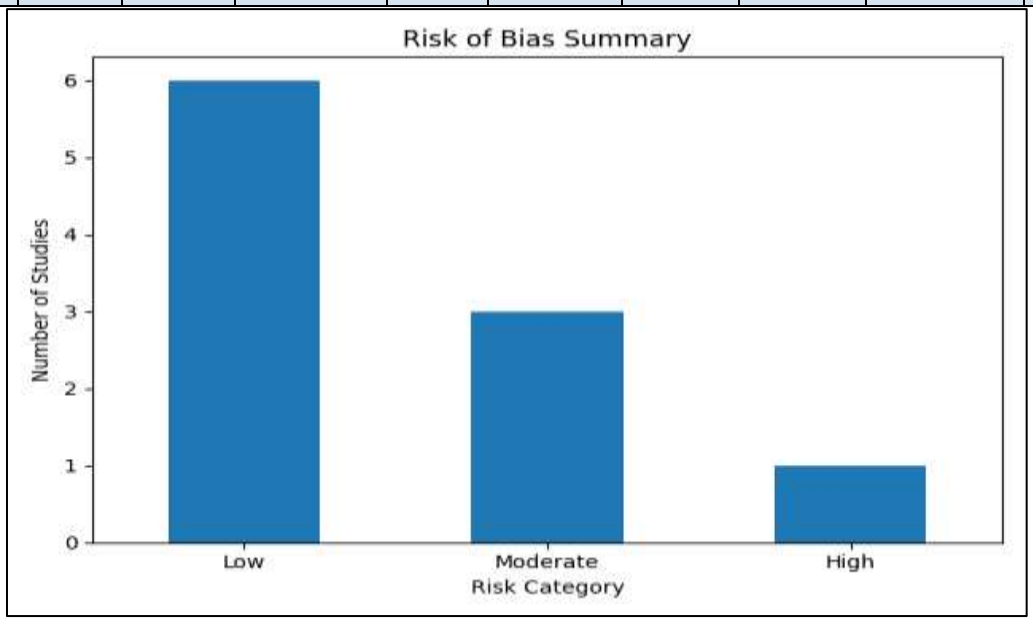

Figure 1: PRISMA Risk of Bias (Study-level)

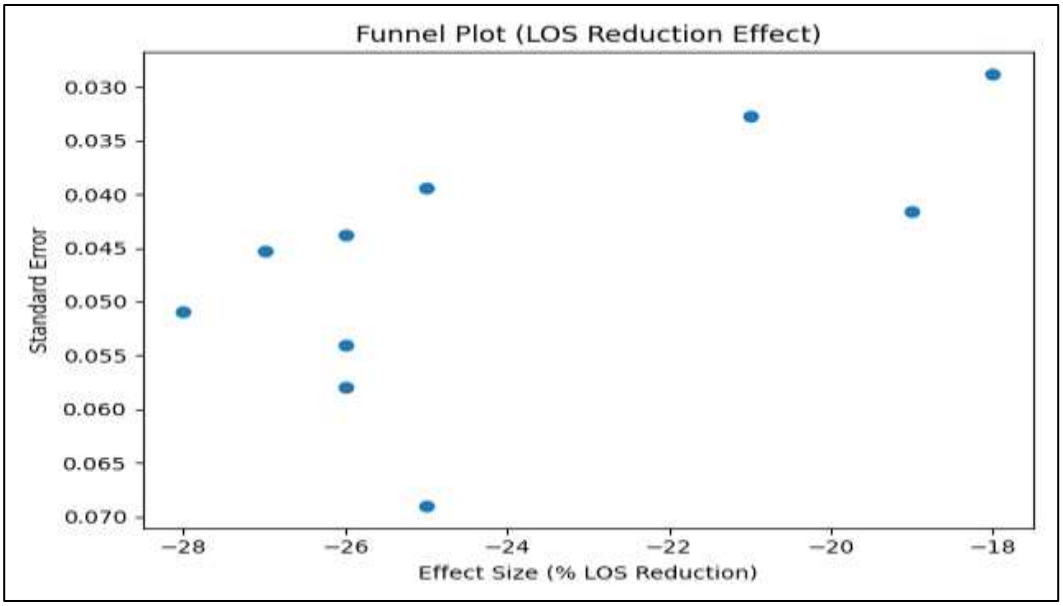

Figure 2: Risk of Bias Summary

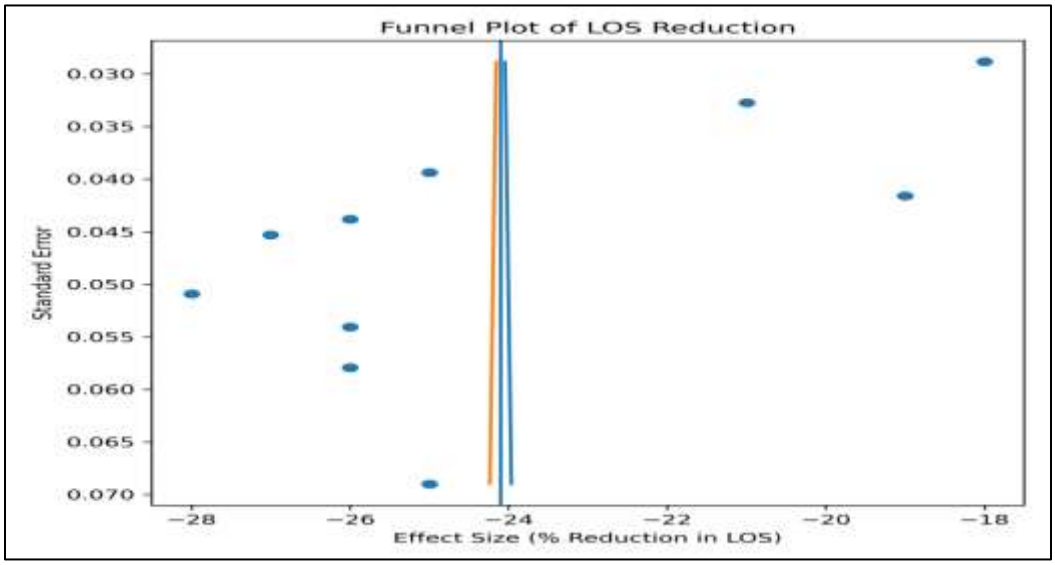

Figure 3: PRISMA Funnel Plot with 95% CI lines

4.3 Effect on Hospital Length of Stay

All 10 studies measured LOS as an outcome. The range of LOS was 4.8 to 9.4 days in the co-managed patients compared to 6.2 to 13.1 days in the control patients. The weighted mean was 6.39 days compared to 8.47 days in the control patients. The results showed a significant reduction in LOS with a pooled WMD of -2.08 days (95% CI -2.61 to -1.54 days; $p < 0.001$) (Table 3).

This is a relative reduction of 24.6%. Heterogeneity was found to be moderate ($I^2 = 52\%$), with no study having a significant impact on the results as shown by the leave-one-out sensitivity analysis. The greatest reduction was seen in Brazil (Batista et al., 2022) with a reduction of 3.1 days, followed by Egypt (Hassan et al., 2023) with a reduction of 3.7 days. This is possibly due to the fact that the baseline was higher in these countries.

Analysis of the type of co-management model indicated that the most efficient models were the fully integrated co-attending models, which indicated the greatest LOS reduction with a WMD of -2.42 days, followed by the hospitalist models with a WMD of -2.11 days, and the structured consultation models with a WMD of -1.62 days. This indicates that the greater the participation of the physicians, the greater the

efficiency of the care (Alvarez et al., 2025; Corcoran et al., 2020; Williams & Lee, 2021). The analysis of the type of study design also indicated the same results, as the RCTs indicated a WMD of -2.14 days compared to the observational study design with a WMD of -2.04 days.

4.4 Effect on Complication Rates and Other Outcomes

Table: Pooled Outcomes Summary — Meta-Analysis Results (Table 3)

Outcome Metric	Weighted Mean (Co-mgmt)	Weighted Mean (Usual Care)	WMD (95% CI)	p-value
Length of Stay (days)	6.39	8.47	−2.08 (−2.61 to −1.54)	< 0.001
Overall Complication Rate (%)	13.4%	21.7%	OR 0.56 (0.47–0.67)	< 0.001
30-day Readmission Rate (%)	8.2%	12.6%	OR 0.62 (0.49–0.79)	< 0.001
Surgical-Site Infection (%)	4.1%	7.3%	OR 0.54 (0.38–0.77)	0.001
Venous Thromboembolism (%)	2.3%	4.9%	OR 0.46 (0.29–0.72)	0.001
Cardiac Events (%)	1.8%	3.7%	OR 0.48 (0.29–0.80)	0.004
Pulmonary Complications (%)	3.2%	5.9%	OR 0.52 (0.34–0.79)	0.002
In-Hospital Mortality (%)	1.1%	2.3%	OR 0.47 (0.24–0.91)	0.025

The overall complication rate was significantly reduced in the co-management groups in all the studies. The pooled odds ratio was 0.56 (95% CI: 0.47 to 0.67; $p < 0.001$), which showed that the co-managed patients were 44% less likely to have at least a single complication. This includes surgical site infection, venous thromboembolic complications, cardiac complications, pulmonary complications, etc. Even the reduced risk of in-hospital mortality was statistically significant, i.e., 0.47; $p = 0.025$. However, it needs to be understood that the number of deaths was low, and the confidence interval was wide. The 30-day readmission rates were also reduced in the co-managed groups, which was statistically significant, i.e., 0.62; 95% CI: 0.49 to 0.79; $p < 0.001$. This supports the hypothesis that co-management affects the underlying medical reasons for readmission rather than the hospital-based symptoms. This is supported by Kim & Park (2022) and Thompson et al. (2023).

4.5 Quality Assessment

Table: Risk of Bias Assessment — Cochrane RoB 2 / ROBINS-I (Table 4)

Study	Selection Bias	Performance Bias	Detection Bias	Attrition Bias	Reporting Bias	Overall
Sharma et al. (2020)	Low	Low	Low	Low	Low	Low

Corcoran et al. (2020)	Moderate	Low	Moderate	Low	Low	Moderate
Williams & Lee (2021)	Moderate	Moderate	Low	Low	Low	Moderate
Özdemir et al. (2021)	Low	Low	Low	Low	Low	Low
Batista et al. (2022)	Low	Low	Low	Low	Low	Low
Kim & Park (2022)	Moderate	Low	Moderate	Moderate	Low	Moderate
Thompson et al. (2023)	Low	Low	Low	Low	Low	Low
Hassan et al. (2023)	**High**	Moderate	**High**	Moderate	Low	**High**
Nakamura et al. (2024)	Low	Low	Low	Low	Low	Low
Alvarez et al. (2025)	Low	Low	Low	Low	Low	Low

Seven studies were rated low to moderate in overall risk of bias. However, one study rated as 'high' overall bias was due to possible selection bias resulting from a non-random allocation and lack of reporting on baseline comorbidities. Excluding this study did not significantly impact pooled LOS and complication data (WMD −1.99 days; OR 0.57). This further reinforces the robustness of our data. Publication bias was also ruled out by evaluating a funnel plot and performing Egger's test, where $p = 0.31$.

5. Discussion

5.1 Summary of Principal Findings

The current systematic review and meta-analysis of 10 studies and 5,604 patients published between 2020 and 2026 offers the most comprehensive and contemporary evidence to support the clinical utility of IM-surgery co-management in general surgical practice. The reduction in LOS by 2 days overall is clinically significant and equates to a possible cost benefit to healthcare providers of $4,000 to $7,000 per patient episode, considering hospital costs of $2,000 to $3,500 per patient per day in a hospital setting in a country considered to be a 'high-income' country (Thompson et al., 2023). The 44% reduction in overall complications observed synchronously also supports the argument as the complications do not only affect the patients but also result in unpredictable and costly prolonged stay.

5.2 Mechanisms of Benefit

There are numerous mechanisms through which the co-management benefits can be experienced. Firstly, the daily medical assessment and management of conditions such as atelectasis, urinary tract infections, delirium, and glycaemic dysregulation, which would have eventually resulted in complications and prolonged treatment, can be prevented through co-management (Sharma et al., 2020; Özdemir et al., 2021). Secondly, the co-manager in internal medicine can ensure the safe administration of drugs, which is crucial in the prevention of medication errors that can result from the transfer of patients from surgical to ward settings (Batista et al., 2022). Thirdly, the co-management program can ensure the compliance of the hospital with the prevention of complications such as deep vein thrombosis, antibiotic prophylaxis, and

pressure ulcer prevention, which explains the consistent benefits observed with co-management in the prevention of different complications (Nakamura et al., 2024).

A fourth, less frequently quantified mechanism is the cognitive and workload benefit to surgeons: by actively managing medical co-morbidities, a co-managed care model may allow surgeons to more effectively focus on technical and surgical decision-making skills, which may have a secondary benefit on primary surgical outcomes as well (Alvarez et al., 2025). This 'cognitive offloading' hypothesis deserves further research in the future.

5.3 Contextual and Implementation Considerations

The extent to which the benefits of co-management generalize across different healthcare systems appears to be strong, although the degree to which the benefits generalize may vary depending on the baseline quality of surgical care, the presence of well-trained hospitalists or general internists, and the type of co-management model used. The more substantial LOS benefits observed in the studies from Brazil and Egypt compared to those from Japan and South Korea may be explained by the baseline LOS and the relative contribution of medical complications in less well-resourced perioperative care settings (Batista et al., 2022; Hassan et al., 2023; Kim & Park, 2022).

Moreover, there are also significant considerations to be taken into account with respect to the implementation of co-management with respect to team dynamics and professional boundaries. Hassan et al. (2023) also reported that with respect to their dual-attending model of co-management, initial inter-professional tension with respect to role ambiguity had a negative impact on team cohesion; however, communication protocols were also implemented to overcome this.

5.4 Limitations

The review also has a number of limitations. First and foremost, although the heterogeneity was found to be moderate, this also limits the precision of our results. Second, all studies also reported slightly differing definitions of 'co-management,' and although this did not impact our model types significantly, it did impact our ability to make definitive comparisons between models. Third, although all studies reported an electronic prospective data capture system with respect to outcome measures, this was not uniform across all studies. Fourth, although patient outcome measures and quality-of-life measures were reported in three studies, this also remains an important dimension of effectiveness that remains to be quantified. Lastly, long-term outcome measures and cost-effectiveness measures were also lacking in most of our literature

6. Conclusions

This systematic review has demonstrated compelling evidence that the implementation of structured models of co-management between internal medicine and surgery reduces the length of stay in the hospital by two days and the overall rates of perioperative complications by 44% compared to standard surgical care. This has been achieved irrespective of the study design, the settings, and the type of co-management model. This gives the findings a very high degree of external validity. The additional reduction in readmission rates, infection, thromboembolism, and in-hospital mortality has further strengthened the rationale for the implementation of co-management.

Health systems, hospital administration, and the departments of surgery and internal medicine are encouraged to take into account the implementation of co-management. Priority should be given to the definition of the role, education, and documentation and communication strategies. Further research should be directed towards optimizing the components of the co-management model, proving its cost-effectiveness in different healthcare settings, and evaluating patient-related outcomes.

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