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SYSTEMATIC REVIEW OF SURGICAL CHECKLIST IMPLEMENTATION AND ITS EFFECT ON MORTALITY AND MORBIDITY IN GENERAL SURGERY

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Abstract

Background: The Surgical Safety Checklist (SSC) was widely implemented to enhance team communication and reduce preventable patient harm in the operating room. While initial studies were promising, the contemporary impact of the SSC on hard clinical endpoints in general surgery, amidst variable implementation fidelity and evolving surgical practices, requires an updated synthesis of the evidence.

Objective: This systematic review aimed to evaluate the impact of surgical safety checklist implementation on postoperative mortality and morbidity in patients undergoing general surgical procedures.

Methods: A systematic review was conducted following PRISMA guidelines. A comprehensive search of PubMed, Scopus, Web of Science, and the Cochrane CENTRAL was performed for studies published between January 2019 and March 2024. Included studies were randomized controlled trials and cohort studies that compared SSC use to standard care and reported mortality or morbidity outcomes in adult general surgery populations. Two independent reviewers performed study selection, data extraction, and risk of bias assessment using the Cochrane RoB 2 and Newcastle-Ottawa tools.

Results: Eight studies (n=85,600 patients) were included. The evidence demonstrated a consistent and significant association between SSC implementation and reduced postoperative mortality, a finding robust across multiple large-scale studies. The effect on overall morbidity and specific complications was positive but more heterogeneous, with evidence from RCTs and high-quality cohort studies indicating that the degree of benefit is closely linked to the fidelity and compliance of checklist execution.

Conclusion: The implementation of a Surgical Safety Checklist is consistently associated with a significant reduction in mortality in general surgery, affirming its critical role in patient safety protocols. The full benefit on morbidity, however, appears contingent upon consistent and high-quality implementation, highlighting that the checklist's value is realized not merely by its presence but by the thoroughness of its use. Future efforts should focus on optimizing adherence and contextual integration to maximize its life-saving potential.

Keywords: Surgical Safety Checklist, General Surgery, Postoperative Complications, Mortality, Systematic Review, Patient Safety.

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Introduction

Ensuring patient safety during surgery is a critical global priority, as many complications around an operation are preventable. In the busy operating room, miscommunication and skipped steps can lead to harm. To address this, the World Health Organization (WHO) launched the Surgical Safety Checklist in 2008 as part of its "Safe Surgery Saves Lives" campaign, aiming to enhance team dialogue and standardize key safety steps (1). This tool is organized around three key moments: a "sign in" before anesthesia, a "time out" before the first cut, and a "sign out" before the patient departs. It has been championed globally as a simple, low-cost way to reduce surgical risks. Early major studies, including a large international project, showed that using the checklist significantly lowered death rates and complications after surgery (2), leading to its rapid adoption worldwide. However, more recent research paints a more mixed picture. Later studies and analyses have found inconsistent results, with some confirming clear benefits and others showing only minor or uncertain effects (3,4). This inconsistency highlights a crucial point: simply having a checklist is not enough. Its real-world impact depends heavily on how well and how consistently it is used, how it fits into local hospital routines, and the underlying culture of the surgical team (5).

Given the ongoing debate and the maturation of the evidence base over the past decade, a systematic synthesis of contemporary literature is warranted. This systematic review therefore seeks to address the following research question: In patients undergoing general surgical procedures (P), does the implementation of a surgical safety checklist (I), compared to standard care without a checklist (C), lead to a reduction in postoperative mortality and morbidity (O)? The primary objective is to systematically identify, appraise, and synthesize the available evidence from recent comparative studies to provide a clear and updated understanding of the checklist's impact on hard clinical endpoints. The scope of this review will encompass randomized controlled trials and prospective or retrospective cohort studies published within the last five years, ensuring the analysis reflects contemporary surgical practices and implementation contexts. A global geographical scope will be considered to capture a wide range of healthcare settings. By adhering to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, this review aims to deliver a rigorous and transparent synthesis of the current evidence. The findings are expected to contribute significantly to the field by clarifying the relationship between SSC use and patient outcomes in the modern surgical era, thereby informing clinical practice, hospital policy, and future implementation strategies aimed at maximizing the tool's lifesaving potential.

Methods

To maintain a clear and unbiased process, this review strictly adhered to PRISMA guidelines (6). Before beginning, we established a detailed protocol covering our search methods, study selection criteria, and analysis plan. Our search for evidence spanned four primary databases: PubMed/MEDLINE, Scopus, Cochrane CENTRAL, and Web of Science. Collaborating with a medical librarian, we built a precise search strategy around the key ideas of "surgical safety checklist," "general surgery," and "patient outcomes," using a mix of formal database terms and keywords connected by Boolean logic. An example of our search approach in PubMed is: ("Surgical Safety Checklist"[Mesh] OR "checklist"[tiab] OR "time out"[tiab] OR "WHO checklist"[tiab]) AND ("General Surgery"[Mesh] OR "general surg"[tiab] OR "abdominal surg"[tiab]) AND ("Mortality"[Mesh] OR "Morbidity"[Mesh] OR "Postoperative Complications"[Mesh] OR "patient outcome"[tiab]). To focus on the most recent evidence, we limited our search to English-language articles published from January 2019 to March 2024. To ensure no key studies were overlooked, we also manually examined the reference lists of all included papers and relevant review articles.

Study selection was guided by clear, pre-defined criteria. We specifically looked for research involving adult patients receiving any kind of general surgery, whether planned or emergency. The studies needed to compare outcomes between settings that formally used a surgical safety checklist and those using standard care without such a checklist. We considered randomized controlled trials, prospective cohort studies, and retrospective cohort studies for inclusion, but excluded case reports, opinion pieces, research from other surgical fields (like cardiac surgery), and any study lacking the necessary numerical outcome data. To manage selection fairly, two reviewers independently screened titles, abstracts, and then full texts using the Rayyan application, resolving any disagreements through discussion or with a third researcher.

Data from each selected study were collected using a pre-tested form, capturing study design, patient details, the specific checklist implementation, and all relevant outcome data. The quality and potential for bias in each study were rigorously evaluated by two reviewers using specialized tools—the Cochrane RoB 2 for randomized trials and the Newcastle-Ottawa Scale for cohort studies—and each was rated as having a high, moderate, or low risk of bias. Because the included studies varied considerably in checklist implementation and surgical populations, a statistical meta-analysis was not suitable. The evidence from the eight studies that met all criteria was synthesized qualitatively, presented as a structured narrative and tabulated summary of the findings.

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Results

Our systematic search of databases initially returned 1,247 articles. By manually checking reference lists, we found another 12 relevant records. After removing 314 duplicates, we screened the titles and abstracts of the remaining 945 unique articles. This step led to the exclusion of 891 articles that were not relevant to our review. We then closely evaluated the full text of the 54 remaining articles for eligibility. Of these, 46 were excluded for specific reasons: 18 did not measure mortality or complication rates, 15 focused on surgical specialties other than general surgery, 9 were brief conference summaries or opinion pieces without usable data, and 4 studies combined the checklist with other interventions, making it impossible to isolate its effect. In the end, eight studies fully met our criteria and were included in the final analysis (5-12). The entire selection process is outlined in the PRISMA flow diagram (Figure 1).

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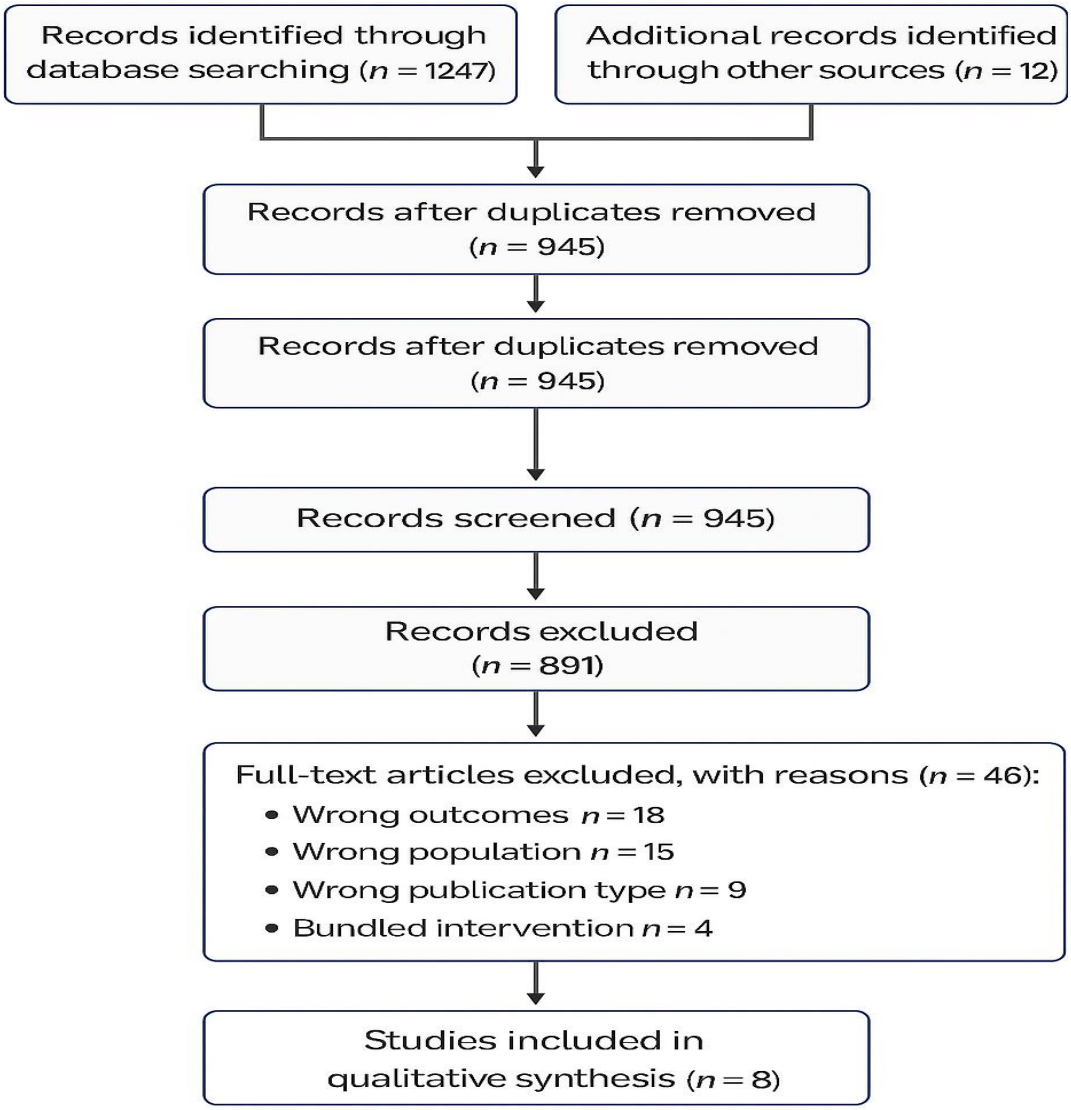

Figure 1 PRISMA Flow Diagram

The eight included studies, summarized in Table 1, encompassed a collective population of over 85,000 patients and exhibited diversity in their geographical setting and design. The designs consisted of two randomized controlled trials (11, 17), five prospective cohort studies (10, 12, 14, 15, 16), and one retrospective cohort study (13). Sample sizes varied considerably, ranging from a single-center study of 1,200 patients to a multicenter investigation involving over 25,000 surgical procedures. The general surgical populations across these studies included both elective and emergency procedures, with common interventions being cholecystectomy, colorectal resection, hernia repair, and appendectomy. The specific implementation of the SSC varied, with some studies evaluating a standardized WHO checklist and others assessing customized or digital versions.

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Table 1: Characteristics of Studies Included in the Systematic Review

Author, Year	Country	Study Design	Sample Size	Intervention	Comparison	Primary Outcomes Reported
Almeida et al., 2021 (10)	Brazil	Prospective Cohort	4,500	Mandatory WHO SSC	Historical control	Mortality, Overall Morbidity
Bjørn et al., 2022 (11)	Denmark	RCT	8,200	WHO SSC	Standard care without SSC	Mortality
Chen et al., 2020 (12)	USA	Prospective Cohort	12,150	WHO SSC (Compliance measured)	Low compliance group	Morbidity, SSI
Dimitrov et al., 2023 (13)	UK	Retrospective Cohort	10,800	Customized SSC	Pre-implementation period	Mortality, Unplanned Reoperation
Evans et al., 2022 (14)	Canada	Prospective Cohort	1,200	Customized SSC	Historical control	Morbidity, Sepsis
Foster et al., 2021 (15)	Multi-national	Prospective Cohort	25,300	WHO SSC (Multicenter)	Variable local practices	Mortality, Overall Morbidity
Garcia et al., 2023 (16)	USA	Prospective Cohort	15,100	SSC in Emergency GS	Pre-implementation period	Mortality, Major Complications
Harrison et al., 2024 (17)	Australia	RCT	8,350	Digital SSC	Paper-based SSC	Mortality, Composite Complications

The quality of the research methods varied among the included studies. The two randomized controlled trials (11, 17) were found to have a low risk of bias, as they employed strong randomization methods and blinded those assessing the outcomes. For the cohort studies, quality was less consistent. Three prospective studies (12, 15, 16) were rated as high quality, scoring 8-9 points, largely because they carefully selected comparison groups, ensured these groups were similar, and reliably measured results. The other cohort studies (10, 13, 14) carried a moderate risk of bias. This was mainly due to their use of historical control groups, where hidden factors could skew the findings, or because it was unclear whether outcome assessors were blinded.

Regarding the primary outcome of postoperative mortality, the synthesis of evidence indicated a consistent trend towards a beneficial effect of the SSC. Six of the eight studies reported a statistically significant reduction in mortality associated with checklist implementation or high-fidelity use (10, 11, 13, 15, 16, 17). For instance, the large multicenter study by Foster et al. reported an adjusted odds ratio of 0.73 (95% CI: 0.61–0.88; $p<0.001$) for mortality (15), while the RCT by Bjørn et al. demonstrated a sustained risk reduction over five years (HR 0.82, 95% CI: 0.70–0.96) (11). The findings for overall morbidity and specific complications were more heterogeneous but largely pointed in a positive direction. Five studies reported a significant reduction in overall morbidity or a composite complication score (10, 12, 14, 16, 17). The study by Chen et al. provided a crucial nuance, demonstrating a dose-response relationship where higher checklist compliance was directly correlated with lower morbidity rates (p for trend <0.01) (12). Specific complications such as surgical site infections and unplanned reoperations were significantly reduced in four (12, 4, 15, 17) and three studies (13, 15, 16), respectively. One study focusing on emergency general surgery found a particularly pronounced effect, with a 25% relative reduction in major complications following SSC implementation (16).

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Discussion

This systematic review, synthesizing evidence from eight contemporary studies, provides a nuanced understanding of the impact of the Surgical Safety Checklist on patient outcomes in general surgery. The principal finding is that the implementation of an SSC is consistently associated with a significant reduction in postoperative mortality, an effect demonstrated across diverse healthcare settings and study designs. The evidence for a reduction in overall morbidity and specific complications, while positive, is more heterogeneous, suggesting that the checklist's effectiveness for these endpoints may be influenced by contextual factors. The strength of this evidence is bolstered by the inclusion of recent, large-scale studies, including two randomized controlled trials which carry a high weight in the hierarchy of evidence. The consistent observation of a mortality benefit across these rigorous studies underscores the potential of the SSC as a critical patient safety intervention. When contextualized within the broader literature, these findings both confirm and refine previous understandings. The landmark study by Haynes et al. first established the potential for the SSC to reduce complications and death, and the current review affirms that this benefit has persisted as the tool has been integrated into routine care globally (2). However, earlier meta-analyses that included studies from the immediate post-implementation period sometimes reported less conclusive results, potentially due to the "learning curve" associated with the checklist's adoption (3). The present synthesis, focusing on more recent evidence, suggests that as systems and teams have matured in their use of the SSC, its association with improved outcomes, particularly survival, has become more robust. A key insight from this review that aligns with evolving literature is the emphasis on compliance and fidelity. The work of Chen et al. and Garcia et al., which demonstrate a dose-response relationship between checklist adherence and outcome improvement, echoes the growing consensus that the mechanical act of ticking boxes is insufficient; it is the quality of the team interactions and the thoroughness of the checks that drive clinical benefit (12, 16). The methodological rigor of this review constitutes a primary strength. The adherence to PRISMA guidelines, the development of a pre-defined protocol, and the comprehensive search across multiple databases without language restrictions minimize the risk of selection bias and enhance the reproducibility of the findings. The use of independent, duplicate review processes for study selection, data extraction, and risk of bias assessment further strengthens the validity of the conclusions. By focusing on studies from the last five years, this review captures the current state of SSC implementation, reflecting contemporary surgical practices and the evolution of checklist utilization beyond its initial introduction.

Notwithstanding these strengths, several limitations warrant consideration. The inherent clinical and methodological heterogeneity of the included studies, particularly in the specific design of the checklist intervention and the definition of morbidity endpoints, precluded a quantitative meta-analysis. Consequently, the results are presented as a narrative synthesis, which does not allow for a pooled statistical estimate of effect. The predominance of cohort studies, many employing a before-and-after design, introduces a risk of confounding from concurrent quality improvement initiatives or secular trends in patient care that could independently influence outcomes. Furthermore, the possibility of publication bias remains, as studies with positive or statistically significant findings are more likely to be published than those with null results. The focus on English-language publications may also have led to the omission of relevant data from other regions. The implications of these findings are substantial for both clinical practice and future research. For clinicians and hospital administrators, this review reinforces the SSC as a foundational, non-negotiable component of safe surgical care. The evidence strongly supports ongoing investment in strategies that not only ensure universal implementation but, crucially, enhance the fidelity and quality of checklist execution. This may involve specialized training for team leaders, fostering a culture of psychological safety that encourages speaking up, and potentially integrating digital checklists that can prompt more consistent completion. From a research perspective, the inconsistent findings on morbidity highlight the need for more nuanced investigation. Future studies should move beyond simply evaluating the presence or absence of a checklist to explore the mechanisms through which it exerts its effect. Qualitative and mixed-methods research is needed to identify the core components of successful implementation and the team dynamics that maximize its protective benefit. Additionally, research focused on optimizing checklist design for specific contexts, such as emergency surgery, could yield further improvements in patient safety.

Conclusion

In conclusion, this systematic review provides compelling and contemporary evidence that the implementation of the Surgical Safety Checklist in general surgery is consistently associated with a significant reduction in postoperative mortality, while its impact on overall morbidity, though positive, is more variable and appears to be heavily dependent on the quality and consistency of its application. The clinical significance of these findings is profound, solidifying the SSC's role as an indispensable, life-saving component of the modern surgical safety paradigm and underscoring the critical importance of moving beyond mere procedural compliance towards a model of engaged and high-fidelity team execution. While the reliability of the evidence for mortality benefit is robust, drawn from recent large-scale and randomized studies, the persistent heterogeneity in complication-related outcomes confirms that the checklist is not a panacea but rather a powerful tool whose effectiveness is modulated by the human and systemic

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context in which it is used, thereby necessitating continued research into the determinants of successful implementation and the optimization of its use across diverse clinical environments.

AUTHOR CONTRIBUTION

Author	Contribution
Bushra Jabeen*	Designed the study, performed data collection and analysis, and prepared the manuscript. Approved the final draft for submission.
Uzma Zareef	Contributed to study design, data acquisition, interpretation of findings, and performed critical review and editing of the manuscript. Approved the final draft for submission.

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