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Beyond compliance: examining the completeness and determinants of WHO surgical safety checklist - a systematic review and meta-analysis

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Abstract

The aim of this systematic review and meta-analysis was to assess the compliance, completeness, and key barriers to the successful initiation and implementation of checklists in surgical theaters.

Methods This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure the accuracy and reliability of the included studies. The protocol was registered in PROSPERO (CRD42024589344).

Results The review included 13 observational studies conducted globally, encompassing a total of 17,867 participants. The overall compliance rate with the World Health Organization Surgical Safety Checklist was 73% (95% CI: 62–85%). Compliance rates for individual components were 76% for "Sign In," 61% for "Time Out," and 62% for "Sign Out." The overall completeness of checklist implementation was 51%. Factors that improve compliance rate include prior Surgical Safety Checklist exposure, training, a positive work environment, management support, and regular monitoring with feedback. Conversely, barriers such as insufficient staffing, high workloads, lack of checklist ownership, resistance to change, weak audit systems, and rapid staff turnover hinder effective implementation and compliance.

Conclusion Despite the importance of Surgical Safety Checklist in improving healthcare outcomes, its overall compliance rate across healthcare settings remains suboptimal, with a notably low completeness rate. This highlights the frequent omission or inconsistent application of critical checklist components. Maximizing the checklist's full potential requires continuous efforts, including sustained support, regular audit, and strong commitment from all stakeholders.

Recommendation Policymakers, healthcare administrators, and surgical teams must work together to integrate the checklist into routine workflows, ensure continuous monitoring and support, and foster a culture of safety to improve patient outcomes.

Keywords World health organization surgical safety checklist, Compliance, Completeness, Barrier, Systematic review

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Introduction

Each year, over 312 million surgeries are performed worldwide [1]. General surgical procedures are the most commonly performed, particularly in high- and middle-income countries [2]. As a result, millions of individuals are at risk of surgical complications if proper actions and preventive strategies are not implemented at the right time [3]. A systematic review revealed that hospitals are not always safe for patients, with 9.2% experiencing adverse events. While approximately 43.5% of these events were preventable, 1 in 150 patients' dies due to complications related to medical care. Most incidents were associated with surgical procedures, with 39.6% involving surgeries and 15.1% related to medications [4].

During surgery and anesthesia, various complications can arise, including wrong-site surgeries, extended hospital stays, mortality, and surgical site infections (SSIs). Implementing strategies to prevent or mitigate these complications is crucial [5, 6]. One of the key objectives of healthcare organizations is to measure and enhance the quality of care with minimizing adverse events [7]. To support this, the World Health Organization (WHO) introduced a surgical safety checklist in 2008, to address key safety concerns in surgical care, with the aim of to improve team communication and consistency of care [8]. It provides a structured framework for preoperative, intraoperative, and postoperative safety measures, ensuring that essential steps are followed before, during, and after surgery [8–10].

After checklist implementation, postoperative crude mortality decreased from 1.2 to 0.92% and length of admission decreased from 5.2 to 4.7 days [11]. Based on these findings, the WHO estimated that implementing surgical safety checklist could save 500,000 lives globally each year [12]. After WHO launches the initiative called Safe Surgery Saves Lives over 3,000 hospitals or healthcare facilities in many countries have adopted the checklist, with many other nations planning to implement it soon [13].

The checklist also fosters better communication and teamwork among the surgical team, which is vital for anticipating and responding to potential complications during procedures. By promoting accountability and collaboration, it ensures that every team member is aware of their role and the patient's condition at each stage of the surgery [14]. Despite its proven benefits, the success of the WHO checklist depends on consistent and thorough implementation. Health professionals understand that adherence to the checklist is not just a formality but a critical step in reducing adverse events and improving overall patient outcomes. As a result, there is growing awareness within healthcare teams that the checklist must be diligently applied in every surgical procedure to maximize its impact on patient safety [15].

The overall effectiveness of WHO SSC was strongly related to its compliance [16]. The checklist targets three critical phases: prior to anesthesia induction (Sign In), after induction but before the surgical incision (Time Out), and during or just after wound closure (Sign Out) [17]. The sign-in process, conducted by the anesthesiologist, the anesthesia nurse, and the patient, involves verifying the patient's identity, confirming the procedure and its designated side, and reviewing key anesthesia-related points. During the time-out, the patient's identity is re-confirmed, team members introduce themselves and their roles, and critical aspects of the operation, such as estimated duration and anticipated blood loss, are discussed. Lastly, the sign-out ensures final checks, including verification of the sponge count and completion of postoperative orders [18].

Despite the potential benefits of using the checklist, the initiation and implementation of the WHO SSC are influenced by several organizational and logistical factors, such as rapid staff turnover, and poor organizational support [9]. To our knowledge, there is a lack of pooled, up-to-date global data on its compliance and completeness.

The aim of this systematic review and meta-analysis is to assess the compliance, completeness, and key barriers to the successful initiation and implementation of checklists or protocols in surgical theaters. Specifically, it seeks to answer: (a) what is the global compliance with surgical checklists? (b) Is checklist completeness consistent across all phases (Sign In, Time Out, and Sign Out)? (c) What factors influence the compliance and completeness of checklists or protocols?

Methods

Data sources and searches

This study employs meta-analysis, a statistical approach that synthesizes findings from multiple studies to provide a more precise estimate of effect size. Rigorous guidelines were followed to ensure the accuracy and reliability of the included studies [6]. A comprehensive PROSPERO database search confirmed no existing reviews on the topic. The study protocol was then registered with PROSPERO RD42024589344. A comprehensive systematic search of the literature was performed for articles published in reputable journal with English language between January 2014 and October 2024, to ensure a broad and updated inclusion of literature across multiple electronic databases, including PubMed, Google Scholar, Cochrane Central Register of Controlled Trials and Web of Science.

The entire review process strictly followed the 2020 PRISMA checklist, ensuring a rigorous, transparent, and unbiased synthesis of the evidence. A meticulously created search strategy was employed, combined with carefully selected keywords with Medical Subject Headings (MeSH) terms. Boolean operators ("AND" and "OR") were strategically applied to refine the search query: ((((Surgical Safety Checklist) OR (Surgical Safety Protocol)) AND (Compliance)) OR (Checklist Adherence)) AND ("Associated Factors" OR "Determinants"). To enhance the comprehensiveness of the search, a snowballing technique was also utilized, screening the reference lists of retrieved articles to identify additional relevant studies.

Study selection

Two independent investigators (TE and SF) systematically screened articles from electronic databases, focusing on WHO Surgical Safety Checklist (SSC) compliance, completeness, factors or all. The screening process began with a rigorous assessment of titles and abstracts to identify studies for potential inclusion. When further clarification was needed to determine a study's eligibility, the investigators contacted corresponding authors. Any disagreements during the screening process were resolved through detailed discussions, ensuring consensus on study inclusion or exclusion.

Eligibility criteria

The retrieved studies were exported to EndNote version 7.0 to remove duplicates. Eligible primary articles focused on surgical safety checklist compliance, completeness, or critical factors for initiation and implementation were included, While studies with undefined or unclear outcomes, non–English articles, publications in non-reputable or predatory journals, low-quality studies (JBI score ≤ 3 applicable for cross-sectional or survey studies), and articles lacking sufficient data for analysis were excluded. The methodological quality of the included studies was then assessed by two independent reviewers using the JBI Critical Appraisal Tool [19], demonstrating substantial agreement ($\kappa = 0.672$; $P < 0.01$). Most studies scored ≥ 5, reflecting a quality score above 62%, with an average of 6.15 out of 8 criteria met. Detailed analyses for each study are available upon request (Table 1).

Data extraction

To describe the included studies, the following data were extracted and documented in a spreadsheet: study design and methodology, sample size, sampling methods, response rates or proportion, and study quality. Information on compliance and both overall and individual completeness in the Sign In, Sign Out, and Time Out stages was also tabulated. Additionally, critical determinants were extracted if their relationship with compliance and completeness had been empirically studied.

Statistical analysis

Using STATA 17.0, we performed a random-effects meta-analysis employing the Restricted Maximum Likelihood (REML) method for outcomes reported in two or more studies. Findings were summarized both narratively and quantitatively. For outcomes with multiple estimates, we calculated pooled estimates. When multiple estimates for the same outcome were available, we presented their range and calculated a pooled estimate. The standard error for each study was computed using the binomial distribution formula [20].

Proportion of WHO SSC compliance, including "Sign-in," "Time-out," and "Sign-out and associated factors were pooled with a 95% confidence interval (CI) through forest plots. Heterogeneity was assessed using I^2, p-values, and

Table 1 Baseline characteristics of included studies regarding to WHO SSC compliance

Author	Year	Country	Study Design	Sampling technique	Sample Size	Proportion of SSC compliance	Quality of included studies(JBI)
Tiruneh and Yetneberk [31]	2020	Ethiopia	Cross-sectional	Not stated	3460	82.1%	6
Mersh et al. [30]	2021	Ethiopia	Cross-sectional	Not stated	100	100%	6
Igaga et al. [21]	2018	Uganda	Prospective Cohort	Purposive	859	41.7%	7
Sibhatu et al. [25]	2022	Ethiopia	Retrospective CS	Stratified random sampling	1603	67.6%	8
Melekie and Getahun [23]	2015	Ethiopia	Prospective observational	Not stated	282	39.7%	8
Girma et al. [26]	2022	Ethiopia	Prospective CS	Convenient	384	93.5%	8
Bajracharya et al. [27]	2021	Nepal	Prospective CS	Convenient	267	64%	6
Ribeiro et al. [28]	2019	Brazil	Retrospective CS	Simple random	423	95%	6
Fridrich et al. [32]	2022	Swiss	Not stated	systematic	8622	91%	4
Ambulkar et al. [24]	2018	India	Prospective Observational	Convenient	600	84.8%	5
Allene [22]	2020	Ethiopia	Prospective Cohort	Convenient	255	100%	6
Cullati et al. [14]	2014	Swiss	Cross sectional	Not stated	152	65%	5
Tan et al. [33]	2021	China	Prospective CS	Not stated	860	79.8%	5
Mean score							**6.15**

Cochrane's Q test, while sensitivity analysis evaluated the impact of individual studies on the overall estimate. Publication bias was assessed visually with a funnel plot and statistically using Egger's and Begg's tests.

Result

A total of 3,466 primary studies were identified for possible inclusion through the initial electronic database search. After an in-depth review, 13 articles met the inclusion criteria and were included in the review (Table 1). Among these, 2 were prospective cohort studies [21, 22] 11 were prospective observational and prospective or retrospective cross-sectional studies [14, 23–31] and the study design of 1 was unspecified [32]. The majority of studies were prospective observational. All studies utilized the WHO surgical safety checklist (Fig. 1).

Compliance with checklists

Thirteen studies evaluated the compliance with WHO surgical safety checklists. The mean quality score of these studies that investigated compliance with the checklist was 6.15/8. Three studies [21, 22, 24] collected data about compliance in real time or in the assessment and 1 study [30] by surveying or interviewing surgical staff members and patients. While all the studies [14, 21–28, 30–33] assessed the overall compliance, only 8 studies [23, 25–28, 30–32] assessed completeness and one missed the three components of Sign in, Time Out and sign out [25].

Of the studies that collected data in real time or in the assessment, all reported the overall compliance with arrange between 39.7% and 100% in Ethiopian studies. In the 1 study which surveyed or interviewed surgical staff members about their overall compliance with the checklist, the fraction of responders that reported being "always or mostly" compliant with the checklist or specific required procedures is 100% a study by Mersh et al. [30] in Ethiopia.

The compliance rates for the Sign in, Time Out and Sign Out were identified in 12 articles. For Sign in: compliance ranged from 30.5% in one of the studies in Ethiopia by Melekie and Getahun [23] and 100% in a study in India by Ambulkar et al. [24]. Time Out' compliance rates varied, with 25% in the other Ethiopian study by Girma et al. [26] and 96% in a Swiss study by Cullati et al. [14] and Compliance for 'Time Out' ranged between 33.3% in a Ugandan study by Igaga et al. [21] and 86% in a separate Swiss study by Fridrich et al. [32] (Table 1).

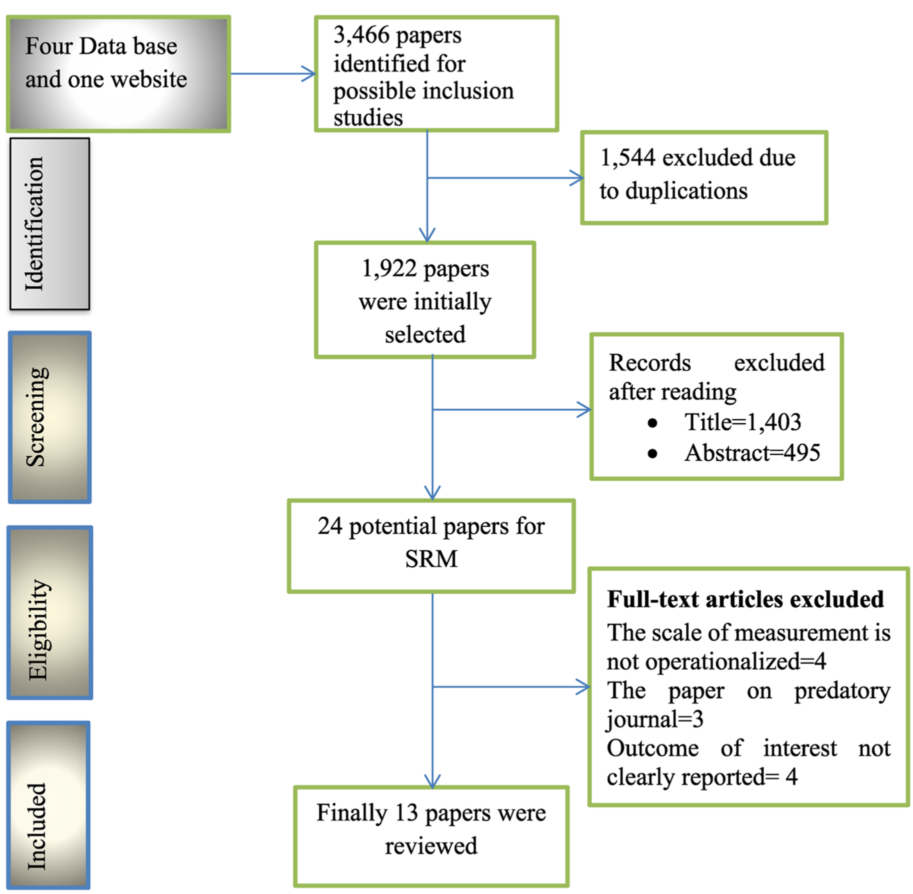

Fig. 1 PRISMA flow diagram to illustrate search strategy

Factors influencing WHO SSC compliance and completeness

The initiation and implementation of the WHO SSC are influenced by organizational and logistical factors. Insufficient staff, high workload, and limited resources make it difficult to incorporate the checklist, as staff often prioritize immediate patient care over SSC procedures, leading to inconsistent implementation [34]. Resistance to change, inconsistent audit system, rapid staff turnover, and poor organizational support further hinder integration into routine practice [35]. However, prior exposure to SSC use and training improves familiarity, reduces resistance, and promotes consistent application [36]. This familiarity can reduce hesitation and resistance, allowing for smoother adoption and consistent application of the checklist. A positive working environment, where resources are available, teamwork is encouraged, and management supports safety protocols, regular monitoring and feedback, also promotes SSC implementation. In such settings, healthcare providers are likely to feel empowered and motivated to follow safety practices, fostering an atmosphere where SSC usage is seen as integral to patient care [35].

Assessment of publication bias and heterogeneity

We assessed heterogeneity among the included studies using Cochrane's Q test and the I^2 statistic. Due to the presence of substantial heterogeneity (I^2 = 99.72%; $p < 0.001$, $Q(9) = 1695.76$, $p < 0.001$), we applied a random-effects model to account for between-study variability (Fig. 2). This model assumes that the true effect size varies across studies due to differences in study populations, methodologies, and other contextual factors.

The funnel plot showed an asymmetrical distribution of the included studies, suggesting potential publication bias (Fig. 1S). Additionally, Egger's regression test yielded a p-value of 0.0207, providing strong statistical evidence for publication bias in line with the asymmetrical appearance of the funnel plot. To further investigate the presence of publication bias, a trim-and-fill analysis was conducted using a random effects model, but no imputed studies were added. Additionally, a leave-one-out sensitivity analysis was performed to assess the impact of individual studies on the pooled estimate of WHO SSC compliance. The sensitivity analysis revealed that the pooled findings were significantly affected by the studies of Igaga et al. [21] and Melekie and Getahun [23] (Fig. 2S).

Pooled proportion of global compliance of the WHO SSC

The overall global compliance of the WHO SSC was found to be 73% (95% CI: 62–85%, $p = 0.001$) (Fig. 2).

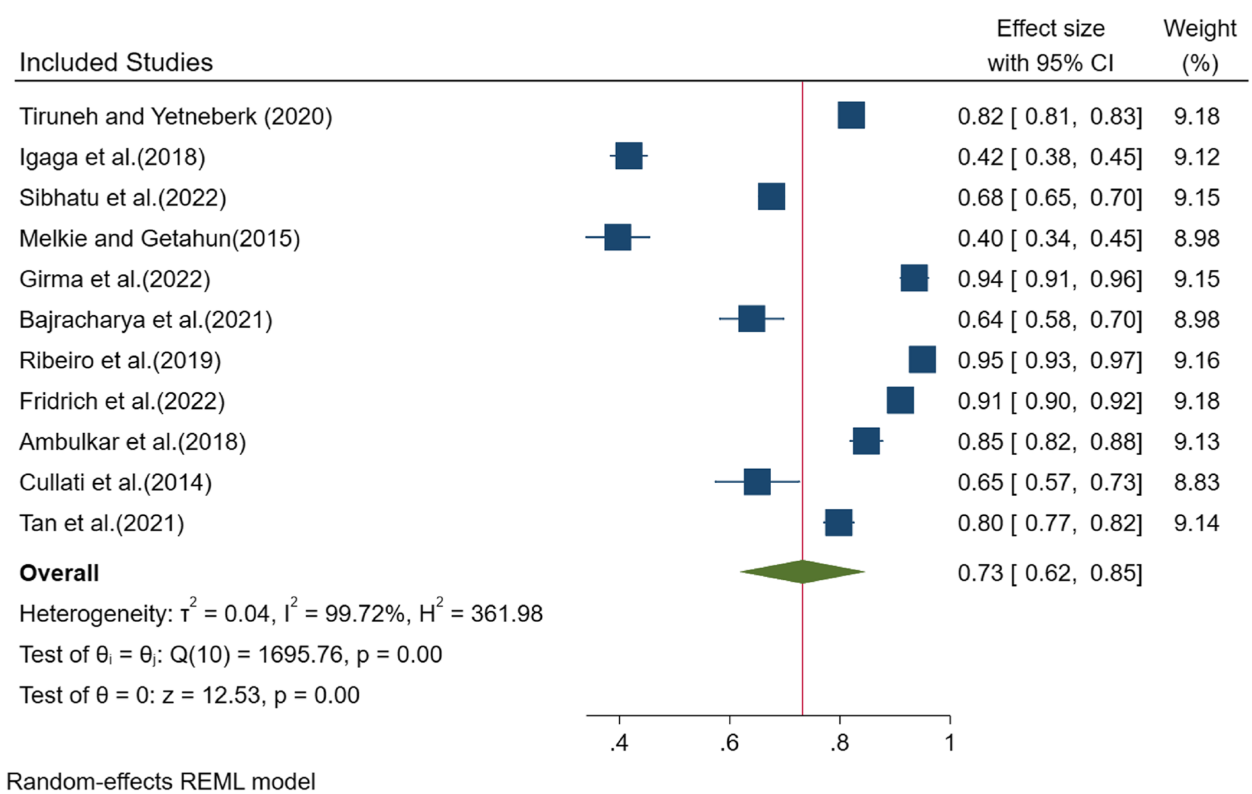

Fig. 2 Forest plot of the global compliance of WHO SSC

Assessment of publication bias and heterogeneity

We assessed heterogeneity among the included studies using Cochrane's Q test and the I^2 statistic. The random-effects model indicated substantial heterogeneity with the value of (I^2 = 99.80%; $p < 0.001$) and ($Q(9) = 826.13$, $p < 0.001$) (Fig. 3).

The funnel plot showed an asymmetrical distribution of the included studies, suggesting potential publication bias (Fig. 3S). Additionally, Egger's regression test yielded a p-value of 0.0015, providing strong statistical evidence for publication bias in line with the asymmetrical appearance of the funnel plot. To further investigate the presence of publication bias, a trim-and-fill analysis was conducted using a random-effects model; however, no imputed studies were added. Additionally, a leave-one-out sensitivity analysis was performed to assess the impact of individual studies on the pooled estimate of WHO SSC Sign in portion. The sensitivity analysis revealed that the pooled findings were significantly affected by the studies of Igaga et al. [21] and Melekie and Getahun [23] (Fig. 4S).

Pooled proportion in global compliance of "sign in" portion of WHO SSC

This review estimates the pooled global compliance with the 'Sign In' component of the WHO Surgical Safety Checklist at 76% (95% CI: 62–89%, $p = 0.00$) (Fig. 3).

Assessment of publication bias and heterogeneity

We assessed heterogeneity among the included studies using Cochrane's Q test and the I^2 statistic. The random-effects model indicated substantial heterogeneity with the value of (I^2 = 99.57%; $p < 0.001$) and ($Q(9) = 2546.25$, $p < 0.001$) (Fig. 4).

The funnel plot showed an asymmetrical distribution of the included studies, suggesting potential publication bias (Fig. 5S). Additionally, Egger's regression test yielded a p-value of 0.0034, providing strong statistical evidence for publication bias in line with the asymmetrical appearance of the funnel plot. To further investigate the presence of publication bias, a trim-and-fill analysis was conducted using a random-effects model; however, no imputed studies were added. Additionally, a leave-one-out sensitivity analysis was performed to assess the impact of individual studies on the pooled estimate of WHO SSC Sign in portion. The sensitivity analysis revealed that the pooled findings were significantly affected with a Girma et al. [26] (Fig. 6S).

Pooled proportion in global compliance of "time out" portion of WHO SSC

The pooled global compliance with the WHO SSC "Time Out" component is estimated by this study to be 61% (95% CI: 47–76%, $p = 0.001$) (Fig. 4).

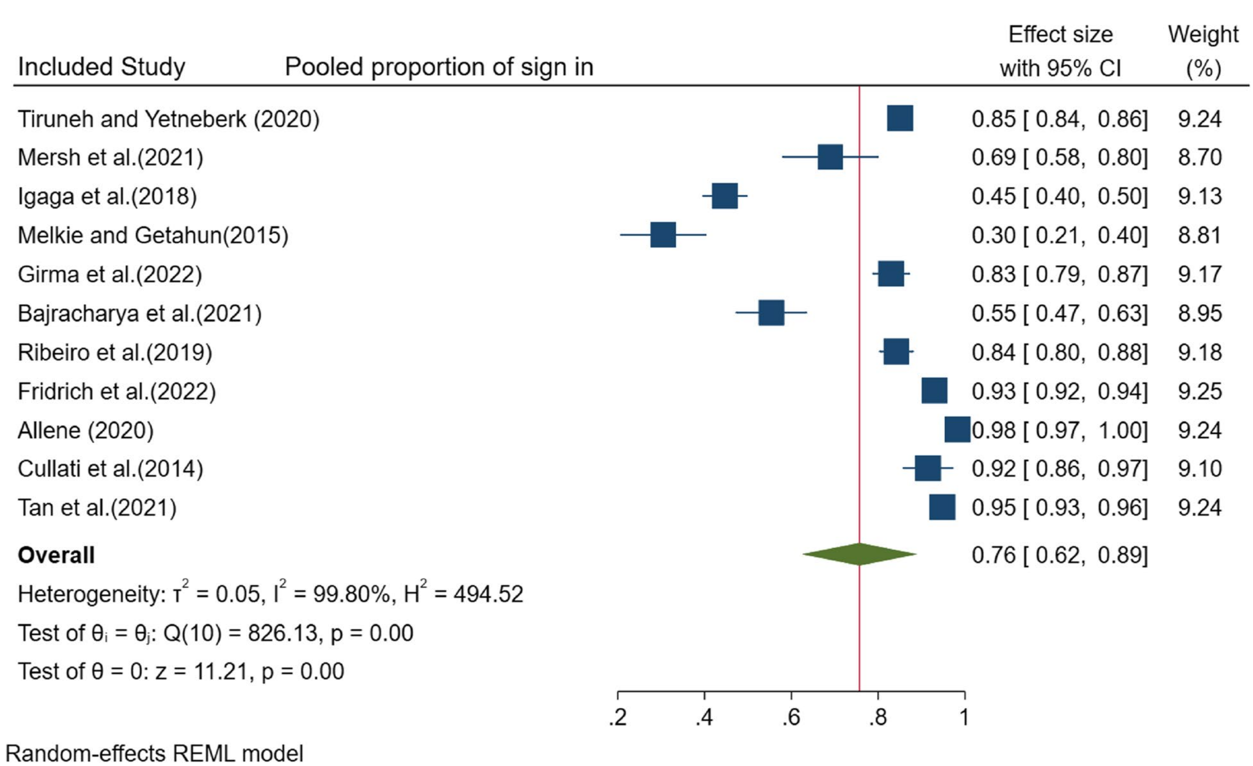

Fig. 3 Forest plot of global compliance with the 'Sign In' component of WHO SSC

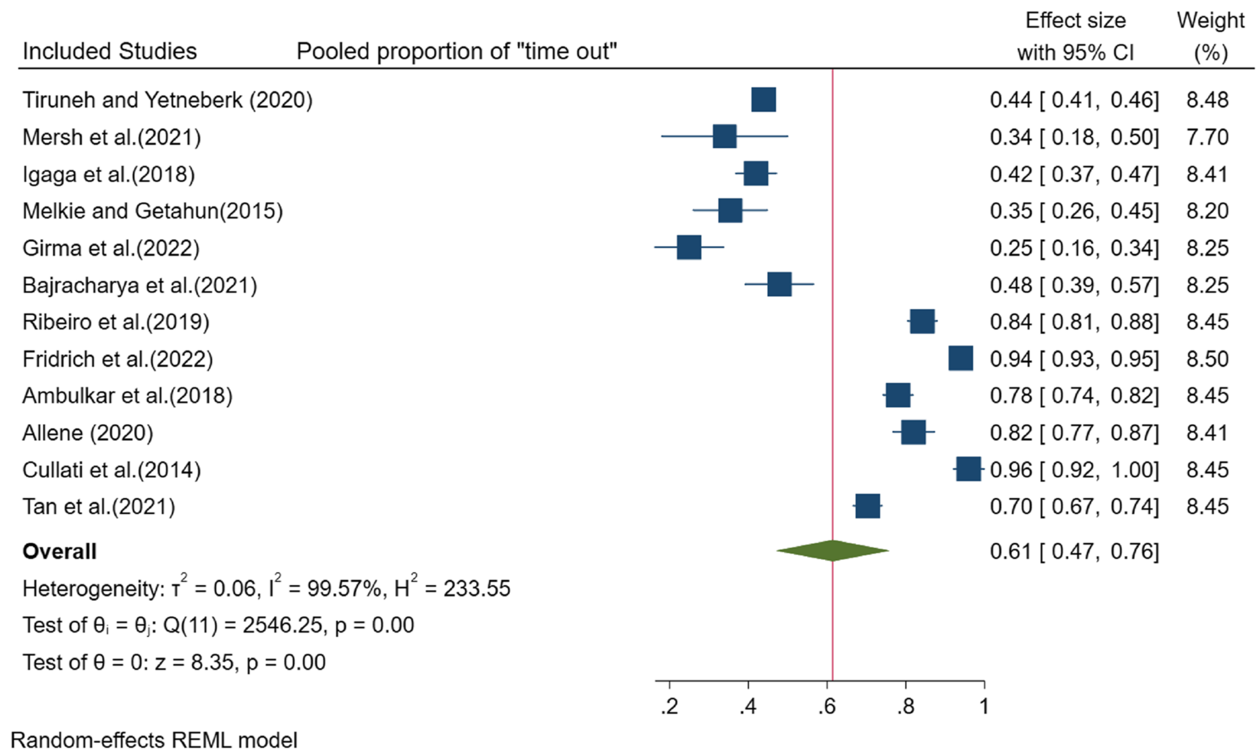

Fig. 4 Forest plot of global compliance with the 'Time Out' component of WHO SSC

Assessment of publication bias and heterogeneity

We had assessed heterogeneity among the included studies using Cochrane's Q test and the I^2 statistic. The random-effects model indicated substantial heterogeneity with the value of (I^2 = 99.15%; $p<0.001$) and ($Q(9)=1178.69$, $p<0.001$) (Fig. 5).

The funnel plot showed an asymmetrical distribution of the included studies, suggesting potential publication bias (Fig. 7S). Additionally, Egger's regression test yielded a p-value of 0.0255, providing strong statistical evidence for publication bias in line with the asymmetrical appearance of the funnel plot. To further investigate the presence or absence of publication bias, a trim-and-fill analysis was conducted using a random-effects model; however, no imputed studies were added. Additionally, a leave-one-out sensitivity analysis was performed to assess the impact of individual studies on the pooled estimate of WHO SSC Sign out portion. The sensitivity analysis revealed that the pooled findings were significantly affected with Girma et al. [26] (Fig. 8S).

Pooled proportion in global compliance of "sign out" portion of WHO SSC

This systematic review and meta-analysis estimates the pooled global compliance with the 'Sign Out' component of the WHO SSC at 62% (95% CI: 51–72%, $p=0.00$) (Fig. 5).

Assessment of publication bias and heterogeneity

We had assessed heterogeneity among the included studies using Cochrane's Q test and the I^2 statistic. The random-effects model indicated substantial heterogeneity with an I^2 value of 99.65%, suggesting considerable variability in the effect sizes across studies (Fig. 6).

The funnel plot showed an asymmetrical distribution of the included studies, suggesting potential publication bias (Fig. 9S). However, Egger's and Begg's regression test yielded a *p*-value of 0.8543, 1.000 respectively indicate that the statistical evidence for publication bias is not strong despite the asymmetrical appearance of the funnel plot this may be due to high heterogeneity. To further investigate the presence or absence of publication bias, a trim-and-fill analysis was conducted using a random-effects model; however, no imputed studies were added. Additionally, a leave-one-out sensitivity analysis was performed to assess the impact of individual studies on the pooled estimate of WHO SSC Sign out portion. The sensitivity analysis revealed that the pooled findings were significantly affected with Girma et al. (Fig. 10S).

Pooled proportion of global WHO SSC completeness

The pooled global completeness of the WHO SSC was estimated at 51% (95% CI: 37–66%; $p<0.001$) in this

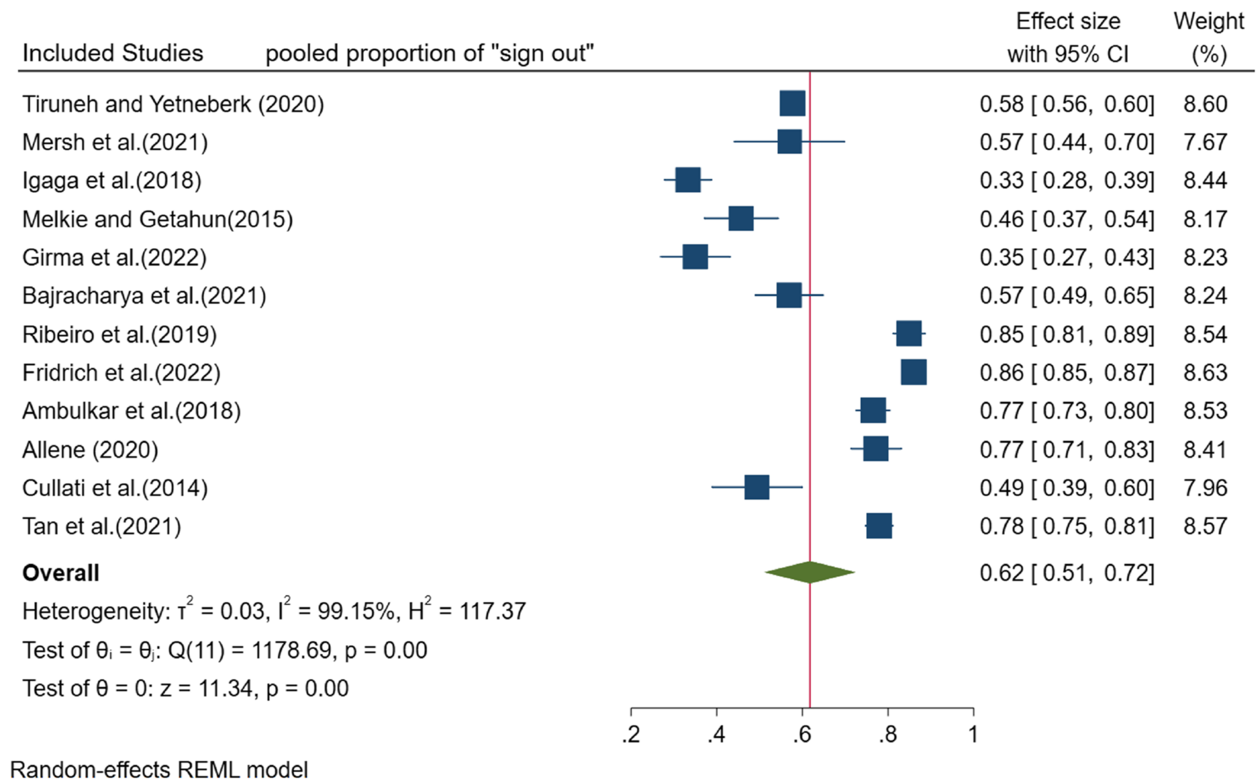

Fig. 5 Forest plot of global compliance with the 'Sign Out' component of WHO SSC

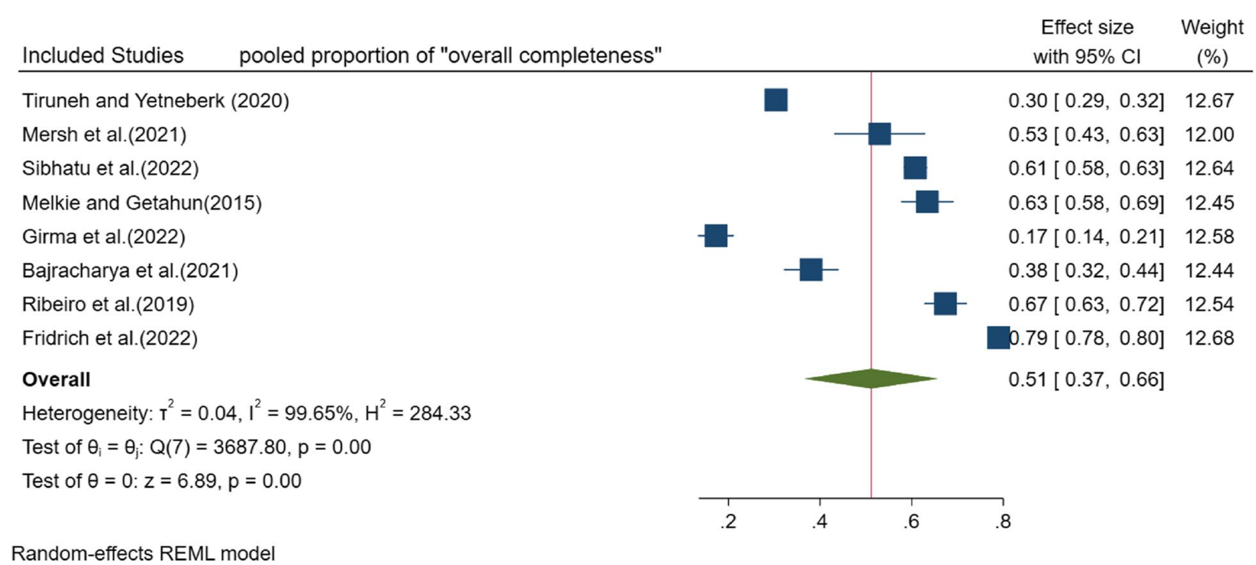

Fig. 6 Forest plot showing the pooled global proportion of overall completeness of the WHO SSC

review. This finding indicates that fewer than half of surgical procedures worldwide fully adhere to the checklist, underscoring significant gaps in its implementation. The wide confidence interval reflects substantial variability across regions and healthcare settings, highlighting disparities in the adoption and application of the WHO SSC (Fig. 6).

Discussion

Ensuring quality improvement in healthcare delivery, including adherence to the WHO Surgical Safety Checklist (SSC), is a core mission of every health system to promote patient recovery, reduce adverse reaction and increase satisfaction. Numerous studies have emphasized the critical role of the SSC in reducing perioperative complications among surgical patients although the definition of SSC compliance varies. It has been shown to improve team communication and significantly reduce morbidity and mortality rates [37]. However, these benefits can only be realized when the checklist is implemented effectively and compliance is high.

Achieving effective implementation and adherence to the WHO Surgical Safety Checklist (SSC) require ongoing monitoring, evaluation, and support. A systematic review by Liang Qin Liu in 2021 highlighted the need for global research to address SSC compliance measures [38]. In response, this systematic review and meta-analysis aim to determine the pooled proportion of compliance with the SSC, including its individual components (Sign In, Time Out, and Sign Out) and its overall completeness. By providing an updated and comprehensive aggregated estimate, this analysis addresses the limitations of outdated pooled data and smaller, isolated studies. By synthesizing global evidence, it offers a vital understanding of the overall compliance levels, highlights existing gaps, and identifies key contributing factors to guide improvement efforts worldwide.

Overall the finding reveal that the overall compliance rate with the WHO Surgical Safety Checklist is suboptimal, at 73% (95% CI: 62–85%), significantly below the WHO's recommended target of 100%. While the studies included in this meta-analysis are predominantly observational, the study provides an updated and comprehensive understanding of SSC compliance. The results highlight that, although the checklist is widely adopted globally, substantial gaps in adherence remains below the expected level. These findings emphasize the urgent need for targeted interventions to improve compliance and strengthen surgical safety practices worldwide.

The overall compliance rates for the individual components of the WHO Surgical Safety Checklist (SSC) reveal variations in adherence: 76% for Sign In, 61% for Time Out, and 62% for Sign Out. These findings suggest that compliance is highest during the initial phase of the surgical process (Sign In), where patient identity, procedure details, and safety checks are verified before anesthesia induction. This might be due to earlier surgical safety protocols being more limited in scope, excluding comprehensive input from the entire surgical team, or prioritizing harm prevention by reducing active failures [39]. However, adherence decreases during the intraoperative phase (Time Out), which focuses on confirming critical details such as the surgical site, instruments, and team roles. The finding is in line with a cohort study by Poon et al. in 2013 [40]. The pooled adherence remains low during the postoperative phase (Sign Out), where final checks on counts, specimens, and patient status are performed. Many studies attribute this low adherence to certain team members, particularly surgeons, leaving the work area prematurely, highlighting the need for greater accountability and engagement throughout all phases of the surgical process.

This disparity in compliance across the checklist components highlights the need for targeted interventions to address the weaker areas, particularly during the Time Out and Sign Out phases. Strengthening team communication, increasing awareness of the importance of these phases, and integrating compliance monitoring into routine practice are essential to improving overall adherence and enhancing patient safety outcomes. Evidence from a systematic review on interventions aimed at implementing, and improving compliance with the SSC highlights the positive impact of strategies such as tailoring the SSC to local contexts or existing practices, modifying its delivery methods, promoting clinician awareness and engagement, and implementing supportive policies [38]. Educational interventions play a significant role in improving SSC compliance, as indicated by Gul et al. [41].

Although some of the included studies do not directly evaluate the overall completeness of the World Health Organization Surgical Safety Checklist (WHO SSC), the pooled completeness rate is approximately 51% (95% CI: 37–66%). This highlights a concerning gap in the consistent application of the checklist, emphasizing the need for stronger efforts to ensure its comprehensive implementation and maximize its potential to enhance surgical safety. Despite the widespread adoption of the WHO Surgical Safety Checklist (WHO SSC) in various healthcare settings worldwide, and the implementation of targeted initiatives such as Ethiopia's 'Saving Lives through Safe Surgery,' the overall completeness rate of the checklist remains alarmingly low. This indicates that while efforts have been made to promote the checklist and integrate it into surgical workflows, significant barriers such as inadequate training, lack of resources, limited adherence to protocols, or resistance to change may be hindering its full implementation. Addressing these challenges is crucial to ensure the checklist achieves its intended impact on reducing surgical errors and improving patient safety.

Individuals who have prior exposure to SSC use and those having SSC training are more likely to understand its benefits, feel comfortable with the process, and recognize its role in enhancing patient safety [36]. This familiarity can reduce hesitation and resistance, allowing for smoother adoption and consistent application of the checklist. A positive working environment, where resources are available, teamwork is encouraged, and management supports safety protocols, regular monitoring and feedback, also promotes SSC implementation. In such settings, healthcare providers are likely to feel empowered and motivated to follow safety practices, fostering an atmosphere where SSC usage is seen as integral to patient care [35].

In contrast, the initiation and implementation of the World Health Organization Surgical Safety Checklist (WHO SSC) are influenced by various organizational and logistical factors. Challenges such as insufficient staffing, high workloads, and limited resources can hinder the integration of the WHO SSC, as staff often prioritize immediate patient care tasks over checklist procedures, resulting in inconsistent application [34]. Additionally, lack of understanding of the purpose and ownership of the SSC, lack of clarity on the roles and responsibilities of team members [42], resistance to change, a weak or inconsistent audit system, rapid staff turnover, and poor organizational support further complicate efforts to embed checklist use into the organizational culture [35].

Recommendation for the concerned bodies

Numerous studies have demonstrated the invaluable positive effects of the WHO SSC on team communication, reducing preventable errors, and decreasing morbidity and mortality among surgical patients. These benefits are maximized when compliance rates are high. Achieving this requires consistent monitoring, support, and evaluation by relevant stakeholders. Evidence supports this claim: a study on SSC compliance and effectiveness reported an increase in compliance rates from 20.4% in year 1 to 89.9% in year 4 under close monitoring and support [43]. Similarly, a quality improvement project in Ethiopia highlighted the irreplaceable impact of regular monitoring and evaluation on SSC compliance [44]. Overall, ensuring SSC compliance is not a one-time activity but a continuous process requiring sustained support and audits by all responsible bodies.

In conclusion, there is substantial variation in compliance with the WHO SSC across different settings, driven by contextual, organizational, and logistical factors. This systematic review and meta-analysis identified a suboptimal overall compliance rate of 73%, highlighting that the SSC's full potential in improving surgical safety remains unrealized. Additionally, the overall completeness rate of checklist implementation is notably low at 51%, indicating that critical components of the SSC are frequently omitted or inconsistently applied.

This underscores the urgent need for targeted interventions to address barriers to compliance, such as insufficient staff training, high workloads, and lack of monitoring systems. Strengthening the integration of the SSC into routine surgical workflows, ensuring consistent support and evaluation, and fostering a culture of safety are paramount. Policymakers, healthcare administrators, and surgical teams must collaborate to develop and implement strategies that improve SSC adherence and ultimately enhance patient safety outcomes.

Limitation

We acknowledge the potential for publication bias and language restrictions, which may have influenced the comprehensiveness of our findings. Due to methodological differences across studies, only 13 were included, which may limit the generalizability of our results. Despite these challenges, we employed a rigorous search strategy to ensure a comprehensive review. Importantly, this study provides updated estimates of WHO SSC compliance and completeness rates, along with actionable recommendations for stakeholders.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-025-12569-0.

Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Supplementary Material 4.

Supplementary Material 5.

Supplementary Material 6.

Supplementary Material 7.

Supplementary Material 8.

Supplementary Material 9.

Supplementary Material 10.

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Authors' contributions

TEH and SFF conceptualized and designed the study. TEH, SFF, and MAA conducted the data analysis. TEH, SFF, and ABT prepared the initial manuscript draft, while TEH and SFF performed critical revisions and final editing. All authors contributed substantially to the study's conception, design, data acquisition, analysis, and interpretation. They were actively involved in drafting or critically revising the manuscript for important intellectual content, approved the final version for publication, and take collective responsibility for the integrity and accuracy of the work.

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Data availability

All relevant data are included in the manuscript and its supporting files.

Declarations

Ethics approval and consent to participate

Not applicable. This is a systematic review and meta-analysis using previously published data. No individual patient data were collected.

Consent for publication

Not applicable. This study does not involve identifiable individual data.

Competing interests

The authors declare no competing interests.

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