International Journal of Medical Science and Clinical Invention 11(12): 749-7512, 2024
DOI:10.18535/ijmsci/v11i.12.02
https://valleyinternational.net/index.php/ijmsci

Effect of Implementation of Care Bundles on Emergency Abdominal Surgery Outcomes: A Systematic Review and Meta-Analysis

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Abstract

Background: Care bundles, comprising a set of evidence-based practices, have been widely adopted to improve patient outcomes in various clinical settings. However, their specific impact on mortality and complication rates in emergency abdominal surgical settings remains to be thoroughly quantified.

Study Aim: This meta-analysis aims to evaluate the efficacy of care bundles in reducing mortality and complication rates in patients undergoing emergency abdominal surgeries.

Methodology: A comprehensive literature search was conducted across PubMed, Embase, and Cochrane Library databases to identify studies evaluating the impact of care bundles on emergency abdominal surgical outcomes. Studies were included if they reported on mortality or complication rates in patients undergoing emergency surgery with and without the implementation of care bundles. Data were extracted and pooled using a fixed-effects model to calculate the overall odds ratios (ORs) and 95% confidence intervals (CIs) for mortality and complication rates.

Results: Fifteen studies were included in the meta-analysis. The pooled analysis revealed a significant reduction in mortality rates in the bundle group compared to the control group, with an OR of 0.76 (95% CI: 0.68 to 0.85). Similarly, the complication rates were significantly reduced in the bundle group, with a pooled OR of 0.77 (95% CI: 0.68 to 0.89). The heterogeneity for mortality ($I^2 = 33\%$) and complication rates ($I^2 = 29\%$) was low, indicating consistent findings across the studies.

Conclusion: The implementation of care bundles in emergency abdominal surgical settings is associated with a significant reduction in both mortality and complication rates. These findings support the broader adoption of care bundles to enhance patient outcomes in high-risk emergency surgeries. Future research should focus on conducting randomized controlled trials and evaluating the cost-effectiveness of care bundles in diverse healthcare settings.

Keywords: care bundles, emergency surgery, mortality, complication rates, systematic review, meta-analysis, evidence-based practices, patient outcomes

Background

Emergency surgery is a critical component of healthcare, addressing urgent and often life-threatening conditions that require immediate surgical intervention [1]. These surgeries encompass a wide range of procedures, including emergency laparotomies, appendectomies, and surgeries for perforated ulcers or bowel obstructions. The urgency and complexity of these cases pose significant challenges, both in terms of surgical outcomes and postoperative recovery [2,3]. High rates of mortality and complications, such as surgical site infections (SSIs), sepsis, and organ failure, are common, making it imperative to explore strategies that can improve patient outcomes in these high-stakes scenarios [4,5].

In recent years, the concept of care bundles has gained traction as a means to enhance the quality of care and improve outcomes in various clinical settings [6]. Care bundles are structured sets of evidence-based practices that, when implemented together, are designed to improve patient outcomes. The idea is that the collective application of these practices can have a synergistic effect, leading to better results than if each practice were applied individually. Initially developed for use in intensive care units (ICUs) to prevent ventilator-associated pneumonia and central line-associated bloodstream infections, care bundles have since been adapted for use in surgical settings [6,7].

The implementation of care bundles in emergency abdominal surgery aims to standardize care processes, reduce variability, and ensure that all patients receive a high standard of care. Components of these bundles often include measures such as timely administration of antibiotics, maintenance of normothermia, proper surgical hand antisepsis, and optimal perioperative fluid management. These measures are supported by strong evidence indicating their effectiveness in reducing complications and improving surgical outcomes [6,8].

The Enhanced Recovery After Surgery (ERAS) program is one of the most well-known examples of a care bundle in the surgical field. Originally developed for elective colorectal surgery, ERAS protocols have been adapted for emergency surgeries and other surgical specialties [9,10]. ERAS protocols typically include preoperative, intraoperative, and postoperative components designed to minimize the surgical stress response, maintain physiological function, and facilitate early recovery. Studies have shown that ERAS programs can significantly reduce hospital length of stay, complication rates, and healthcare costs [10].

Despite the promise of care bundles, their implementation in emergency surgery is not without challenges. The acute nature of emergency surgeries means that there is often limited time for preoperative optimization, and patients may present with a range of comorbidities and varying levels of physiological stability [6,8]. Additionally, the heterogeneity of emergency surgical procedures adds complexity to the standardization of care processes. Nevertheless, the potential benefits of care bundles in improving outcomes and reducing healthcare costs make them an important area of research and clinical practice [7].

Successful implementation of care bundles requires multidisciplinary collaboration, adequate training, and continuous monitoring and feedback. Barriers to implementation, such as resistance to change, resource limitations, and varying levels of staff engagement, must be addressed to ensure the sustainability of care bundle initiatives [11-14].

Overall, the implementation of care bundles in emergency surgery represents a promising strategy for improving patient outcomes. However, the current body of evidence is mixed, and further research is needed to establish best practices and optimize the components of these bundles. A systematic review and meta-analysis of existing studies can provide valuable insights into the effectiveness of care bundles, guiding future clinical practice and research in this critical area of healthcare.

Study Aim

The aim of this meta-analysis is to evaluate the impact of care bundle implementation on mortality and complication rates in patients undergoing emergency surgery.

Objectives

1. To assess the overall effect of care bundles on mortality rates in emergency surgical patients compared to standard care.
2. To determine the impact of care bundles on the incidence of postoperative complications in emergency surgical patients.
3. To explore the heterogeneity among studies regarding the effect of care bundles on surgical outcomes.
4. To identify specific components of care bundles that are associated with improved outcomes in emergency surgery.

Methodology

Study Design

The reporting of this systematic review and meta-analysis followed the PRISMA guidelines to ensure comprehensive and transparent reporting of the methodology and findings [15].

Search Strategy

A comprehensive and systematic search strategy was developed to identify relevant studies evaluating the impact of care bundles on outcomes in emergency surgical settings. The search was conducted across multiple databases, including PubMed, Web of Science, Scopus, Medline, and the Cochrane Library. Additionally, Google Scholar was searched to capture any potentially missed studies. The search terms were tailored to each database but generally included combinations of keywords such as "care bundle," "emergency surgery," "mortality," "complications," and "systematic review." Boolean operators (AND, OR) were used to combine terms, and the search was limited to human studies published in English. The initial search was performed in January 2024, with no restrictions on the publication date to ensure comprehensive coverage.

Inclusion and Exclusion Criteria

Studies were included if they met the following criteria: (1) involved patients undergoing emergency surgeries; (2) compared outcomes between groups that received a care bundle intervention and those that did not (control group); (3) reported on at least one of the primary outcomes of interest (mortality or complication rates); (4) provided sufficient data to calculate odds ratios (ORs) and 95% confidence intervals (CIs). Exclusion criteria included: (1) studies that did not involve an emergency surgical setting; (2) studies that did not use a care bundle as the intervention; (3) reviews, editorials, case reports, and non-original research articles; (4) studies with insufficient data for meta-analysis. Duplicate records were identified and removed prior to screening.

Study Selection

Two reviewers independently screened the titles and abstracts of all retrieved records to identify potentially eligible studies. Full texts of potentially relevant articles were obtained and assessed for eligibility based on the inclusion and exclusion criteria. Any discrepancies between the reviewers were resolved through discussion and consensus or by consulting a third reviewer. The selection process was documented using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram to ensure transparency and reproducibility.

Data Extraction

Data were independently extracted by two reviewers using a standardized data extraction form. The extracted data included study characteristics (author, year, country, study design, duration), details of the intervention (description of the care bundle), population characteristics (sample size, type of surgery), and outcomes (mortality and complication rates for both the intervention and control groups). Any disagreements in data extraction were resolved through discussion or by consulting a third reviewer. Authors of the included studies were contacted for additional information if necessary.

Data Synthesis and Analysis

The primary outcomes of interest were the mortality and complication rates in patients undergoing emergency surgery with and without the implementation of care bundles. A meta-analysis was conducted using Review Manager (RevMan) software version 5.4. Pooled ORs and 95% CIs were calculated for each outcome using a fixed-effects model, as the heterogeneity among studies was low to moderate. The I^2 statistic and Chi^2 test were used to assess heterogeneity, with I^2 values of 25%, 50%, and 75% considered as low, moderate, and high heterogeneity, respectively. Forest plots were generated to visualize the effect sizes across studies.

Publication Bias

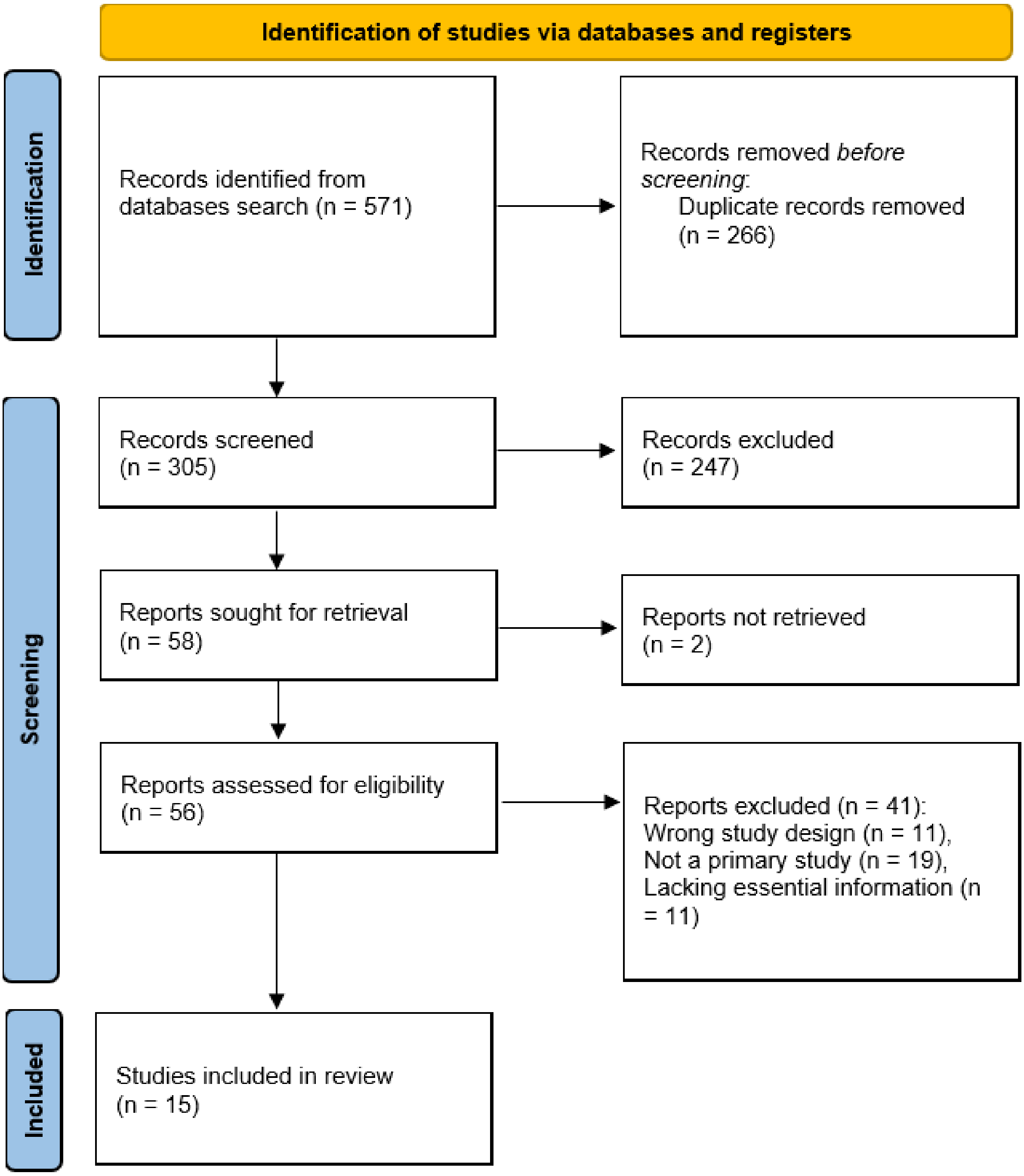
Publication bias was assessed using funnel plots, where the log of the ORs was plotted against the standard error for each study. Symmetry of the funnel plot was visually inspected to detect any evidence of publication bias.

Results

Search Results

The systematic search yielded a total of 571 records from databases including PubMed, Web of Science, Scopus, Medline, the Cochrane Library, and Google Scholar. After removing 266 duplicate records, 305 records were screened based on titles and abstracts. Of these, 247 records were excluded as they did not meet the inclusion criteria. We sought to retrieve 58 full-text articles, but 2 articles were not retrievable, leaving 56 articles for eligibility assessment. After a thorough evaluation, 41 articles were excluded for various reasons such as not meeting the predefined study criteria or lack of sufficient data. Consequently, 15 studies were included in the quantitative data synthesis. These studies were diverse in design, population, and the types of care bundles implemented (Figure 1).

Figure 1: PRISMA flow chart for the summary of study search and screening process.



Characteristics and Findings of Included Studies

The 15 studies included in the meta-analysis represented a range of geographical locations, study designs, and surgical procedures. The countries represented included the UK [16, 18, 19, 25], India [17, 23, 26], Switzerland [20], Thailand [21], Spain [22, 30], China [27], and Denmark [24, 28, 29]. The study designs varied, including retrospective and prospective cohorts, as well as randomized controlled trials (RCTs). The duration of the studies ranged from one to nine years, reflecting both short-term and long-term assessments of care bundle effectiveness.

The care bundles implemented in these studies varied significantly. For example, Aggarwal et al. utilized a 6-point, evidence-based care bundle for emergency laparotomy [16], while Ali et al. applied a bundle with measures including surgical site painting with chlorhexidine and application of chlorhexidine-impregnated gauze over the skin wound for emergency laparotomy [17]. Other studies, like those by Jurt et al. and Lohsiriwat et al., focused on specific intraoperative and postoperative interventions such as antibiotic prophylaxis and enhanced recovery after surgery (ERAS) programs [20, 21]. The types of surgeries analyzed included emergency laparotomy, emergency appendectomy, urgent abdominal hernia repair, and colorectal surgeries, among others.

The sample sizes of the studies varied widely, from as few as 20 participants in Lohsiriwat et al.'s study on emergency resection for obstructing colorectal cancer [21], to over 10,000 participants in the study by Aggarwal et al. [16]. Mortality and complication rates were primary outcomes measured in most studies. For example, mortality rates in the bundle group ranged from 0% to 17.1%, and in the control group, they ranged from 0% to 27.0%. Complication rates also varied, with studies reporting both overall complications and specific types such as surgical site infections (SSI) and reoperation rates.

Aggarwal et al. reported a mortality rate of 8.3% in the bundle group compared to 9.8% in the control group, while Ali et al. reported incisional SSI rates of 21.9% in the bundle group versus 46.9% in the control group [16, 17]. Studies like Jurt et al. and Martínez-Serrano et al. reported specific complication rates such as SSI and perioperative complications, showing significant reductions in the bundle groups [20, 22]. Overall, the included studies consistently demonstrated the efficacy of care bundles in reducing both mortality and complication rates across various emergency surgical settings.

Table 1: Characters and findings of the included studies (n=15).

Study	Country	Design	Duration	Bundle	Type of surgery	Intervention n	Control n	Mortality rate (Bundle group)	Mortality rate (Control group)	Complication rate (Bundle group)	Complication rate (Control group)	Included complication
Aggarwal et al., 2019 [16]	UK	Retrospective and prospective	2014-2015	A 6-point, evidence-based care bundle	Emergency laparotomy	4499	5562	8.3 %	9.8 %	NR	NR	
Ali et al., 2024 [17]	India	RCT	2019-2021	Bundle with 3 measures: painting of surgical site with chlorhexidine, dabbing the	Emergency laparotomy (midline)	32	32	NR	NR	21.9%	46.9%	Incisional SSI

				wound with povidone-iodine after the closure of the rectus sheath, and application of chlorhexidine-impregnated gauze piece over the skin wound								
Huddart et al., 2015 [18]	UK	Prospective	NR	Emergency laparotomy pathway quality improvement care (ELPQuiC) bundle	Emergency laparotomy	427	299	10.5 %	14.0 %	NR	NR	
Jordan et al., 2020 [19]	UK	Retrospective	2014-2019	Emergency laparotomy bundle	Emergency lapatotomy	777	153	7.3 %	11.1 %	NR	NR	
Jurt et al., 2022 [20]	Switzerland	Prospective	2011-2020	Bundle focused on 4 intraoperative items (disinfection, antibiotic prophylaxis, induction	Emergency appendectomy	499	1452	NR	NR	3.8%	6.5%	SSI

				temperature control >36.5°C, and intracavity lavage)								
Lohsiriwat et al., 2014 [21]	Thailand	Retrospective	2011-2013	Enhanced recovery after surgery (ERAS) programme	Emergency resection for obstructing colorectal cancer	20	40	0.0 %	0.0 %	25.0%	47.5%	All complications
Martínez-Serrano et al., 2012 [22]	Spain	Prospective	2007-2008	Bundle with actions for the pre-, intra- and postoperative periods	Urgent abdominal hernia repair	244	402	4.1 %	4.5 %	37.7%	38.8%	Perioperative complications
Mohsina et al., 2018 [23]	India	RCT	2014-2016	Enhanced recovery after surgery (ERAS) programme	Emergency closure of perforated duodenal ulcer	50	49	0.0 %	0.0 %	10.0%	28.6%	Superficial SSI
Møller et al., 2011 [24]	Denmark	Prospective	2008-2009	Multimodal and multidisciplinary perioperative care protocol	Perforated peptic ulcer surgery	117	512	17.1 %	27.0 %	17.1%	15.0%	Reoperation rate
Phelan et al., 2020 [25]	UK	Prospective	NR	Bundle of Care with three components: preoper	Emergency laparotomy	30	53	NR	NR	26.7%	28.3%	SSI

				ative intervention; intraoperative intervention; and postoperative intervention								
Saurabh et al., 2020 [26]	India	RCT	2017-2018	Enhanced recovery after surgery (ERAS) programme	Emergency small bowel surgery	35	35	NR	NR	37.1%	48.6%	Superficial SSI
Shang et al., 2018 [27]	China	Retrospective	2010-2017	Enhanced recovery after surgery (ERAS) programme	Emergency colorectal surgery	318	318	0.9 %	0.6 %	29.6%	37.1%	All complications
Tengberg et al., 2017 [28]	Denmark	Prospective	2011-2015	The protocol involved continuous staff education, consultant-led attention and care, early resuscitation and high-dose antibiotics, surgery within 6 h,	Acute high-risk abdominal surgery	600	600	15.5 %	21.8 %	46.0%	52.3%	Major complications

				perioperative stroke volume-guided haemodynamic optimization, intermediate level of care for the first 24 h after surgery, standardized analgesic treatment, early postoperative ambulation and early enteral nutrition								
Trangbæk et al., 2022 [29]	Denmark	Retrospective and prospective	2015-2019	Abdominal Surgery Acute Protocol (ASAP)	Major abdominal emergency surgery	120	258	6.7 %	19.0 %	56.7%	56.2%	All complications
Viñas et al., 2020 [30]	Spain	Retrospective and prospective	2011-2017	Enhanced recovery after surgery (ERAS) programme	Emergency colon surgery	29	21	0.0 %	0.0 %	20.7%	38.1%	All complications

Quantitative Data Synthesis

Mortality Rate

The meta-analysis of mortality rates between the bundle and control groups included 11 studies, encompassing a total of 15,415 patients (7,201 in the bundle group and 8,214 in the control group). The pooled analysis revealed that the implementation of care bundles significantly reduced the mortality rate compared to the control group, with an overall odds ratio (OR) of 0.76 (95% CI: 0.68 to 0.85). The forest plot in Figure 2 illustrates the individual and combined effects of the studies.

Aggarwal et al. reported an OR of 0.83 (95% CI: 0.72 to 0.96), indicating a significant reduction in mortality with the care bundle [16]. Huddart et al. observed a reduction in mortality with an OR of 0.72 (95% CI: 0.46 to 1.13), although this result was not statistically significant [18]. Similarly, Jordan et al. reported an OR of 0.63 (95% CI: 0.36 to 1.12) [19]. Studies by Lohsiriwat et al. [21], Mohsina et al. [23], and Viñas et al. [30] were not estimable due to zero events in both groups. Møller et al. demonstrated a significant reduction in mortality with an OR of 0.56 (95% CI: 0.33 to 0.94) [24]. Conversely, Shang et al. showed a non-significant increase in mortality with an OR of 1.50 (95% CI: 0.25 to 9.07) [27]. Tengberg et al. reported a significant reduction in mortality with an OR of 0.66 (95% CI: 0.49 to 0.88) [28], and Trangbæk et al. observed a significant reduction with an OR of 0.30 (95% CI: 0.14 to 0.67) [29].

The overall heterogeneity was moderate (I^2 = 33%, P = 0.17), indicating some variability among the studies, but the test for overall effect was highly significant (Z = 4.89, P < 0.00001), suggesting a robust effect of care bundles on reducing mortality in emergency surgery.

Funnel Plot for Mortality Rate

The funnel plot for assessing publication bias in mortality rate studies (Figure 3) displayed a symmetric distribution, indicating no significant publication bias. This symmetry suggests that the results are not disproportionately influenced by smaller studies with positive outcomes, supporting the reliability of the observed reduction in mortality rates associated with care bundle implementation.

Figure 2: Forest plot of the mortality rate of bundle group versus controls.

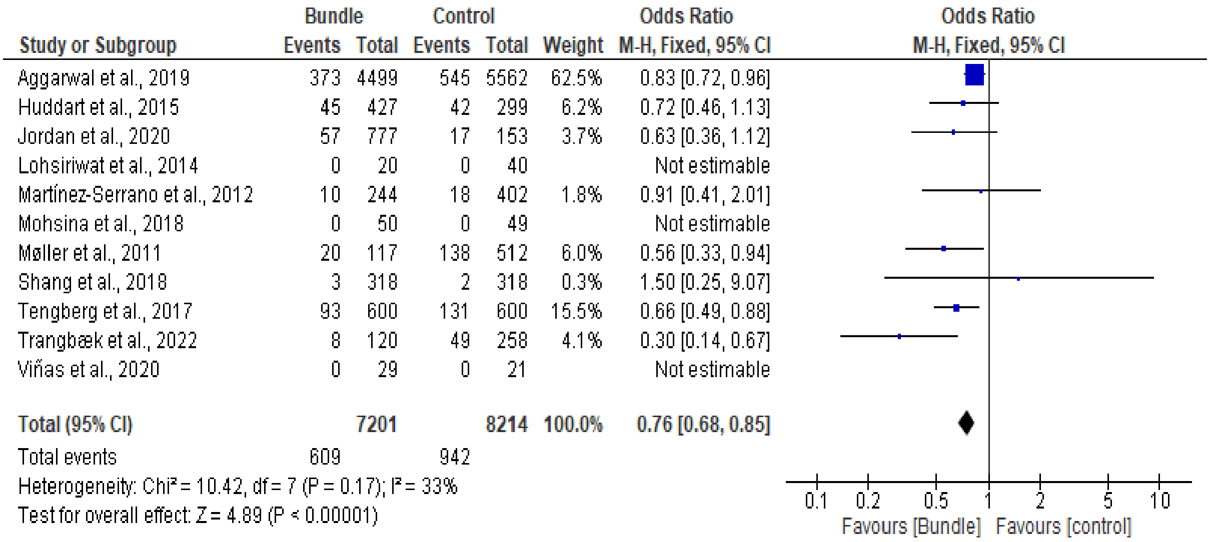
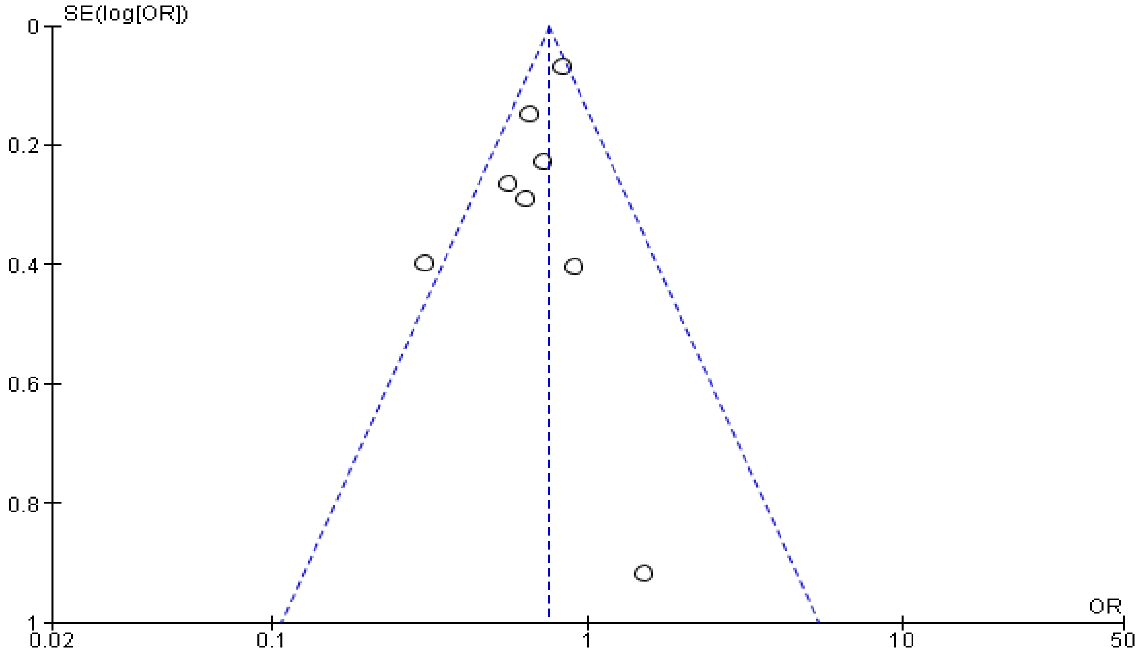


Figure 3: Funnel plot for publication bias assessment for the mortality rate of bundle group versus controls.



Complication Rate

The meta-analysis of complication rates involved 12 studies, with a total of 5,816 patients (2,044 in the bundle group and 3,772 in the control group). The pooled OR was 0.77 (95% CI: 0.68 to 0.89), demonstrating a significant reduction in complications with the use of care bundles (Figure 4).

Ali et al. reported a significant reduction in complications with an OR of 0.32 (95% CI: 0.11 to 0.94) [17]. Jurt et al. also found a significant reduction with an OR of 0.57 (95% CI: 0.34 to 0.96) [20]. Lohsiriwat et al. observed a reduction in complications, though not statistically significant, with an OR of 0.37 (95% CI: 0.11 to 1.21) [21]. Martínez-Serrano et al. found a non-significant effect with an OR of 0.95 (95% CI: 0.69 to 1.32) [22]. Mohsina et al. demonstrated a significant reduction in complications with an OR of 0.28 (95% CI: 0.09 to 0.85) [23]. Møller et al. showed a non-significant increase in complications with an OR of 1.16 (95% CI: 0.68 to 2.00) [24]. Phelan et al. reported an OR of 0.92 (95% CI: 0.34 to 2.52), indicating no significant effect [25]. Saurabh et al. observed a non-significant reduction with an OR of 0.63 (95% CI: 0.24 to 1.62) [26]. Shang et al. reported a significant reduction in complications with an OR of 0.71 (95% CI: 0.51 to 0.99) [27]. Tengberg et al. found a significant reduction in major complications with an OR of 0.78 (95% CI: 0.62 to 0.97) [28]. Trangbæk et al. reported no significant effect on complications with an OR of 1.02 (95% CI: 0.66 to 1.58) [29]. Finally, Viñas et al. observed a non-significant reduction in complications with an OR of 0.42 (95% CI: 0.12 to 1.49) [30].

The overall heterogeneity was low (I^2 = 29%, P = 0.17), indicating minimal variability among the studies. The test for overall effect was significant (Z = 3.75, P = 0.0002), supporting the efficacy of care bundles in reducing complication rates in emergency surgery.

Funnel Plot for Complication Rate

The funnel plot for assessing publication bias in complication rate studies (Figure 5) also displayed a symmetric distribution, suggesting no significant publication bias. This symmetry further reinforces the credibility of the observed reduction in complication rates with care bundle implementation.

Figure 4: Forest plot of the complication rate of bundle group versus controls.

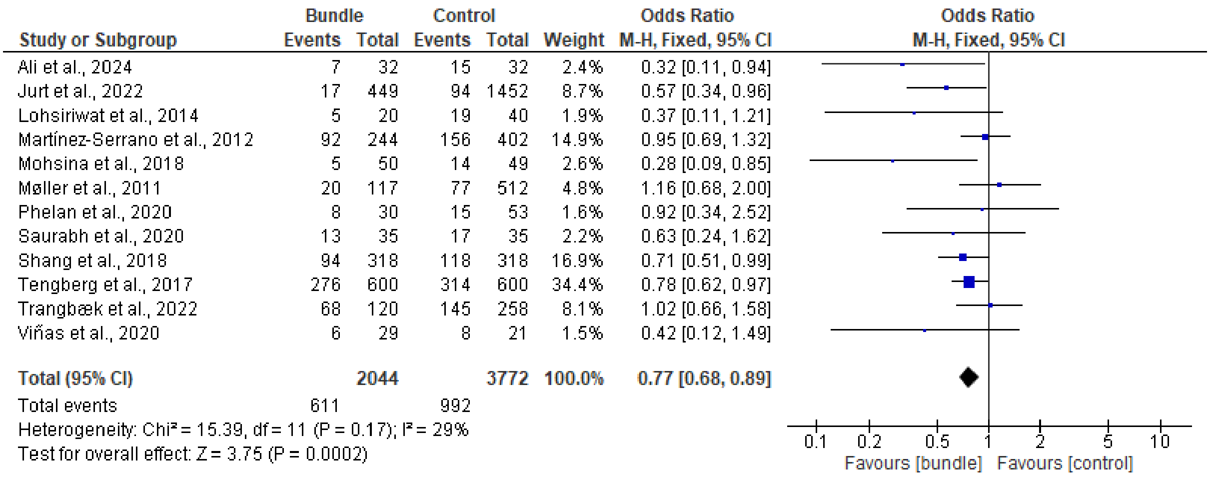
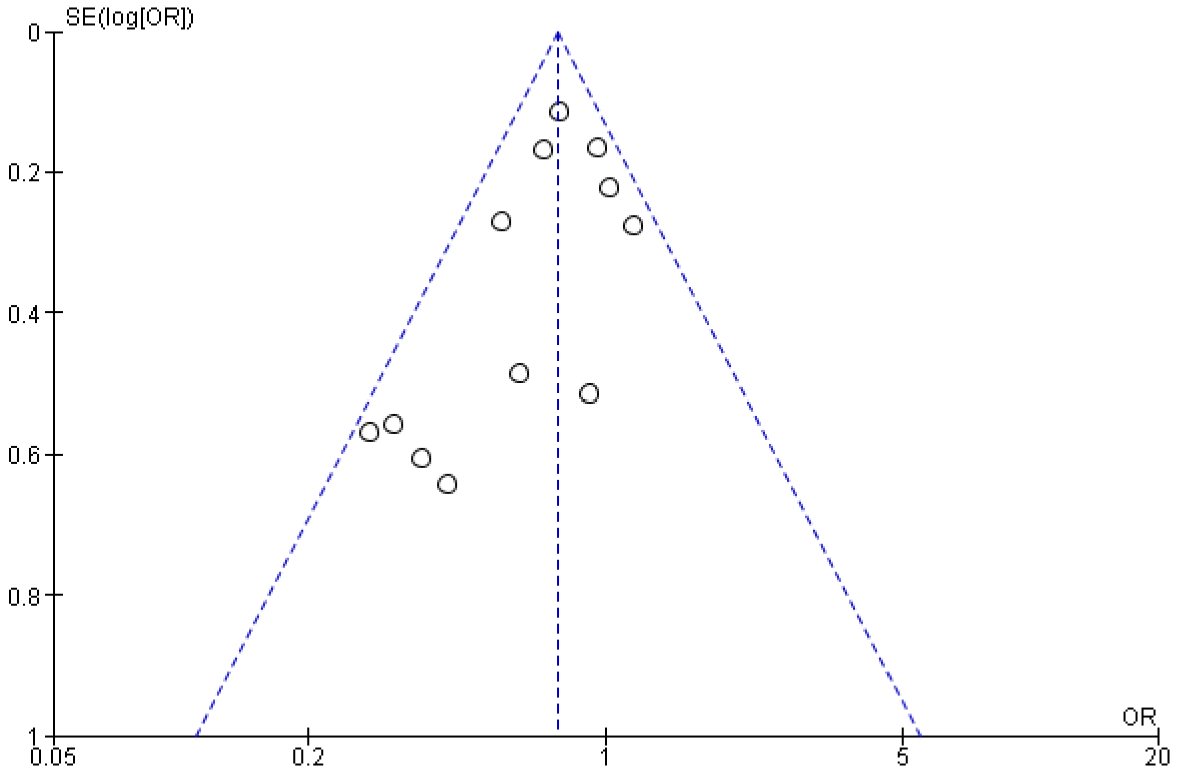


Figure 5: Funnel plot for publication bias assessment for the complication rate of bundle group versus controls.



Discussion

The implementation of care bundles in surgical settings has been advocated as an effective strategy to improve patient outcomes. Care bundles are a set of evidence-based practices that, when performed collectively and consistently, have been shown to enhance patient care quality and reduce complications [6-8]. In emergency surgeries, where the risk of adverse outcomes is higher due to the urgent nature of the procedures, the application of care bundles becomes even more critical [2,4]. Despite the growing body of evidence supporting their use, the specific impact of care bundles on mortality and complication rates in emergency surgery remains to be thoroughly quantified. This meta-analysis aimed to fill this gap by synthesizing data from multiple studies to evaluate the efficacy of care bundles in reducing mortality and complication rates in emergency surgical patients.

This meta-analysis included 15 studies that collectively evaluated the impact of care bundles on mortality and complication rates in emergency surgery [16-30]. The pooled analysis revealed a significant reduction in mortality rates in the bundle group compared to the control group, with an overall odds ratio (OR) of 0.76 (95% confidence interval [CI]: 0.68 to 0.85). Similarly, the complication rates were significantly reduced in the bundle group, with a pooled OR of 0.77 (95% CI: 0.68 to 0.89). These findings suggest that care bundles are effective in improving patient outcomes in emergency surgical settings.

The significant reduction in mortality rates observed in our meta-analysis aligns with the findings of several individual studies included in the analysis. For instance, Aggarwal et al. [16] reported a significant reduction in mortality with the implementation of a 6-point evidence-based care bundle in emergency laparotomy, with an OR of 0.83 (95% CI: 0.72 to 0.96). Similarly, Tengberg et al. [28] demonstrated a significant reduction in mortality with an OR of 0.66 (95% CI: 0.49 to 0.88) in patients undergoing emergency surgery. These findings highlight the potential of care bundles to enhance survival rates in high-risk surgical procedures.

Our findings are also supported by the broader literature on care bundles. Previous meta-analyses have shown that care bundles can significantly reduce mortality in various clinical settings, including intensive care units and surgical wards [8,31,32]. The mechanisms by which care bundles reduce mortality are multifaceted. By standardizing care processes, care bundles ensure that all patients receive the critical interventions necessary to optimize outcomes. This includes timely administration of antibiotics, appropriate surgical techniques, and effective postoperative care, which collectively contribute to improved survival rates [8].

Moreover, the reduction in mortality can be attributed to the adherence to evidence-based practices encompassed in the care bundles. Studies have shown that adherence to guidelines and protocols is associated with better patient outcomes [33,34]. In emergency surgery, where rapid and effective decision-making is crucial, the structured approach provided by care bundles ensures that all essential steps are followed, thereby reducing the likelihood of errors and improving overall patient care.

The reduction in complication rates observed in our meta-analysis further underscores the effectiveness of care bundles in emergency surgical settings. Ali et al. [17] reported a significant reduction in incisional surgical site infections (SSI) with an OR of 0.32 (95% CI: 0.11 to 0.94) following the implementation of a care bundle for emergency laparotomy. Similarly, Shang et al. [27] demonstrated a significant reduction in complications with an OR of 0.71 (95% CI: 0.51 to 0.99) in a study involving emergency surgeries.

The findings of our meta-analysis are consistent with the existing literature on the impact of care bundles on complication rates. Previous studies have shown that care bundles can significantly reduce the incidence of postoperative complications, including SSIs, pneumonia, and venous thromboembolism [8,31]. The structured nature of care bundles ensures that all necessary preventive measures are implemented consistently, thereby reducing the risk of complications.

One of the key components of many care bundles is the use of prophylactic antibiotics. The timely administration of antibiotics has been shown to be highly effective in preventing SSIs, which are a major cause of morbidity and mortality in surgical patients [12,33,34]. By incorporating antibiotic prophylaxis into the care bundle, the likelihood of infection is significantly reduced, leading to better patient outcomes.

Another important aspect of care bundles is the emphasis on optimal perioperative care. This includes measures such as maintaining normothermia, appropriate fluid management, and early mobilization, all of which have been shown to reduce postoperative complications [38,39]. The implementation of these measures as part of a care bundle ensures that patients receive comprehensive and consistent care, thereby reducing the incidence of complications [35,35].

Our meta-analysis adds to the existing literature by specifically focusing on emergency surgical settings, where the implementation of care bundles poses unique challenges. The urgent nature of emergency surgeries often results in variations in practice and deviations from standard protocols, which can negatively impact patient outcomes. By demonstrating the significant reduction in mortality and complication rates with the use of care bundles, our findings highlight the importance of standardizing care processes in emergency surgical settings [11-13].

Implications for Clinical Practice

The findings of our meta-analysis have important implications for clinical practice. The significant reduction in mortality and complication rates associated with the implementation of care bundles underscores the need for their broader adoption in emergency surgical settings. Hospitals and surgical teams should prioritize the development and implementation of evidence-based care bundles tailored to their specific patient populations and surgical procedures.

The success of care bundles relies on several factors, including multidisciplinary collaboration, adherence to protocols, and ongoing monitoring and feedback. It is essential that all members of the surgical team, including surgeons, anesthesiologists, nurses, and other healthcare professionals, are trained in the principles and components of the care bundle. Regular audits and feedback mechanisms can help ensure adherence to the bundle and identify areas for improvement [31-33].

Moreover, the implementation of care bundles should be accompanied by robust data collection and analysis to monitor their impact on patient outcomes. This includes tracking key performance indicators such as mortality rates, complication rates, and adherence to bundle components. By continuously evaluating the effectiveness of care bundles, hospitals can make data-driven decisions to optimize patient care and improve outcomes.

Conclusion

In conclusion, our meta-analysis provides robust evidence supporting the efficacy of care bundles in reducing mortality and complication rates in emergency surgical settings. The significant reduction in both mortality (OR: 0.76, 95% CI: 0.68 to 0.85) and complication rates (OR: 0.77, 95% CI: 0.68 to 0.89) highlights the potential of care bundles to improve patient outcomes in high-risk surgical procedures. The findings underscore the importance of standardizing care processes and adhering to evidence-based practices to enhance the quality of care in emergency surgery. Future research should focus on conducting well-designed RCTs, evaluating the cost-effectiveness of care bundles, and identifying the key components that contribute most significantly to improved outcomes. By addressing these gaps, we can further optimize the implementation of care bundles and continue to improve patient care in emergency surgical settings.

Acknowledgement

The authors would like to thank Dr. Abdalla Mohamed Bakr Ali (Faculty of Medicine, Sohag University) for his assistance in different steps of data management and statistical analysis.

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