

RE-EXPLORATION AFTER EMERGENCY LAPAROTOMY: A SYSTEMATIC REVIEW AND META-ANALYSIS OF CAUSES, OUTCOMES, AND PREVENTIVE STRATEGIES

Zainaldeen Muslim^{*1}, Nadia Abdallah Zeidan², Hassan Elsayed Hassan Saad³,
Yamen Maher Alobaid⁴, Mohammad Subeh⁵, Abdulrahman Osama Mohammad Hamshari⁶,
Marriam Tasneem⁷, Mohammed Isham Shiju⁸, Alaa Abdelfattah⁹, Owais Mudassir¹⁰,
Muhammad Ali Khan¹¹

^{*1}MBBS 5th year at Gulf Medical University Ajman, UAE

²MD, The Hashemite University - Jordan

³Physician at Directorate of Health Affairs

⁴5th Year Medical Student MBBS, Gulf Medical University

⁵5th Year Medical Student MBBS, Gulf Medical University, Ajman

⁶Medical Student at, Gulf Medical University, Ajman

⁷Final Year Medical Student at Gulf Medical University

⁸Medical Student at Gulf Medical University

⁹Dubai Medical University

¹⁰Post Graduate Resident at PIMS ISLAMABAD

¹¹Final Year MBBS Hbs Medical and Dental College

^{*1}zainaldenali76@gmail.com, ²nadia.zeidan@hotmail.com, ³hassanomara555@gmail.com,
⁴amenmnaya@gmail.com, ⁵mohdsubeh2020@gmail.com, ⁶abdulrahmanhamshari62@gmail.com,
⁷tasneemmarriam@gmail.com, ⁸ishamshiju@gmail.com, ⁹alaaabdelfattah743@gmail.com,
¹⁰awais_noor2008@yahoo.com, ¹¹sardaralikhan537@gmail.com

DOI: <https://doi.org/10.5281/zenodo.18796484>

Keywords

Emergency laparotomy;
Relaparotomy; Re-exploration;
Surgical site infection; Fascial
dehiscence; Negative pressure
wound therapy; Secondary
peritonitis; Abdominal closure;
Randomized controlled trials;
Meta-analysis.

Article History

Received: 27 December 2025

Accepted: 11 February 2026

Published: 27 February 2026

Abstract

Background:

Emergency laparotomy is linked with high morbidity and mortality, with re-exploration and surgical site infection being major contributors to poor outcomes. Randomized evidence on strategies to minimize the performance of a relaparotomy and decrease postoperative complications is fragmented.

Objectives:

To synthesize randomized controlled trial evidence of interventions to reduce re-exploration and postoperative complications after emergency laparotomy.

Methods:

This systematic review and meta-analysis was performed in line with PRISMA 2020 guidelines. Randomized controlled trials including adults undergoing emergency laparotomy were included. Primary outcomes were relaparotomy and postoperative death. Secondary outcomes were surgical site infection (SSI), fascial dehiscence and incisional hernia. Risk ratios (RRs) with 95% confidence intervals (CIs) were used to conduct random-effects meta-analysis. Heterogeneity was tested using the I^2 statistic.

Copyright @Author
Corresponding Author: *
Zainaldeen Muslim

Results:

Eleven randomized controlled trials involving 2,146 patients were included. In the case of severe peritonitis, the on-demand relaparotomy strategy reduced re-operations without an increase in mortality (RR for mortality 0.79, 95% CI 0.53-1.17). Three trials on SSI prevention showed a significant reduction in infection with subcutaneous suction drainage or negative pressure wound therapy (RR 0.35, 95% CI 0.21-0.58; $I^2 = 0\%$). Five trials involving interrupted or modified fascial closure compared to continuous closure had a non-significant trend on dehiscence (RR 0.48, 95% CI 0.16-1.42; $I^2 = 67\%$). STITCH trial showed less incisional hernia with small-bite surgical closure in a heterogeneous group of surgery (RR 0.63, 95% CI 0.42-0.94).

Conclusion:

Targeted wound management strategies have been found to significantly reduce surgical site infection after emergency laparotomy. Interrupted or altered closure methods may help decrease fascial dehiscence; however, the evidence remains inconsistent. An on-demand approach for relaparotomy reduces unnecessary re-operations without an increased mortality. Further high quality trials are required to standardize preventive strategies in emergency laparotomy.

INTRODUCTION

Emergency laparotomy is one of the most deadly surgeries in general surgery due to conditions main such as: perforation peritonitis, bowel obstruction, abdominal trauma, and intra-abdominal sepsis. Despite advances in the field of perioperative management, the results are still poor with persistently high rates of postoperative complications and mortality being reported across healthcare systems [20-22]. Re-exploration (relaparotomy) constitutes one of the most significant adverse events after emergency laparotomy, and is highly correlated with prolonged critical care resource utilization, septic complications, multi-organ dysfunction and healthcare burden [3,9,17].

Failure of initial source control, intra-abdominal sepsis, hemorrhage, anastomotic leak, or abdominal wall failure are the main indications for relaparotomy in most cases [3,9,22]. In the case of secondary peritonitis, the approach to re-intervention has been the subject of much argument. The randomized comparison between planned and on-demand relaparotomy provided proof of no survival benefit from routine re-exploration and revealed the potential detriment of unnecessary operative intervention [31]. These findings changed clinical paradigms toward selective re-intervention strategies; however, the

best selection of patients and standardized criteria remain unresolved [30].

Other than the intra-abdominal pathology, the integrity of the abdominal wall is an important determinant of the postoperative stability. Fascial dehiscence and incisional hernia play an important role in the risk for reoperation and long-term morbidity. Randomized trials of interrupted and continuous closure techniques have shown varying results [1,2] while the STITCH trial showed superiority of small-bite closure in lowering incisional hernia rates [8]. Later meta-analyses and international guidelines suggest evidence-based fascial closure interventions in both elective and emergency settings [14,15,19,32], but emergency laparotomy patients are still underrepresented in specific studies.

Surgical site infection (SSI) is another risk factor that leads to re-exploration. International recommendations focus on standardized protocols for SSI prevention [5,33-35], and randomized trials have been conducted to assess the efficacy of subcutaneous suction drainage and negative pressure wound therapy (NPWT) in contaminated emergency laparotomy wounds [12,18,29]. Even though other studies show improvements in the reduction of superficial

wound complications, the impact of deep infection, fascial failure, and relaparotomy necessity is inconsistent. The recent SUNRRISE trial provides some important data but does not completely settle the issue of the role of advanced wound strategies in preventing reoperation [29]. Large-scale audits such as the National Emergency Laparotomy Audit (NELA) continue to show large variations in outcomes and perioperative practices [20,21]. Global consensus guidelines on the management of intra-abdominal infections emphasize effective control of the source and surgical surveillance to ensure effective postoperative treatment, to mitigate against treatment failure [24,27,28] but the re-exploration rates remain clinically important. Organ dysfunction due to sepsis continues to be a leading cause of mortality in such populations [11], postoperative morbidity is often indirectly measured by validated grading systems, one of which is Clavien-Dindo [10].

Despite the availability of randomized trials on closure techniques, wound strategies and relaparotomy techniques, the literature is fragmented. No such comprehensive synthesis has specifically brought together the randomized evidence for the causes, outcomes and preventive interventions linked to re-exploration after emergency laparotomy. Due to the clinical and economic consequences of relaparotomy, an evidence-based synthesis is necessary to determine which strategies result in a significant reduction on which strategies result in a significant reduction of reoperation without accelerating mortality or causing overtreatment.

Accordingly, this systematic review and meta-analysis aims to appraise the randomized controlled trials that have investigated factors contributing to re-exploration following emergency laparotomy and determining effectiveness of preventive strategies in the reduction of postoperative complications and rate of relaparotomy.

Methods:

This systematic review and meta-analysis was performed following the standards of the PRISMA 2020 statement. The protocol was

developed using a priori approach to establish eligibility criteria, outcomes, and statistical methods prior to synthesis of data.

Randomized controlled trials involving adult patients undergoing emergency laparotomy for trauma or non-trauma indications were eligible. Interventions comprised randomized comparison of strategies of relaparotomy (planned vs on demand), fascial closure techniques, temporary abdominal closure methods, surgical site infection prevention strategies (e.g. subcutaneous suction drains or negative pressure wound therapy), and intra-abdominal lavage approaches. Observational studies, elective laparotomy, pediatric-only populations, and studies which lacked extractable outcome data were excluded.

Primary outcomes were relaparotomy and postoperative death. Secondary outcomes were surgical site infection, dehiscence of fascia or incisional hernia, postoperative complications and length of stay.

The search of PubMed/MEDLINE, Scopus, Web of Science and Cochrane Central Register of Controlled Trials was performed up to January 2026. Search terms were a combination of controlled vocabulary, free-text keywords relating to emergency laparotomy, relaparotomy, fascial closure, surgical site infection and randomized controlled trials. Manual screening of reference lists of eligible studies and relevant guidelines was done to identify other trials.

Study screening and full-text study assessment were performed by two independent reviewers using predefined criteria. Data extraction was performed independently with the use of a standardized form. For dichotomous outcomes, the count of events and total number of participants in each group were extracted. Continuous outcomes were reported as means and standard deviations wherever possible and standard deviations wherever possible.

Risk of bias was evaluated by using the Cochrane Risk of Bias 2 (RoB 2) tool in standard domains. Disagreements were resolved by consensus.

Meta-analysis was done when two or more studies reported similar findings. To estimate the expected clinical heterogeneity, risk ratios based on binary outcomes were obtained by a random-

effects (DerSimonian-Laird) model with 95% confidence intervals. Statistical heterogeneity was evaluated using the τ^2 test and reported using the I^2 statistic. The sensitivity analysis was performed by eliminating high-risk of bias studies. When a sufficient number of studies were available, the issue of publication bias was checked using a funnel plot. Assessment of certainty of evidence was based on the GRADE framework.

Results:

A total of 1,284 records were detected using database searching, of which 214 were duplicates. After the screening of 1,070 titles and abstracts, a total of 63 full-text articles were evaluated for eligibility. Fifty-two studies were excluded for non-randomized design (n = 29), elective-only populations (n = 11), inadequate outcome data (n = 7) or duplicate or overlapping cohorts (n = 5). Eleven randomized controlled trials with 2,146 patients were included in the qualitative and quantitative synthesis.

Figure 1. PRISMA 2020 Flow Diagram

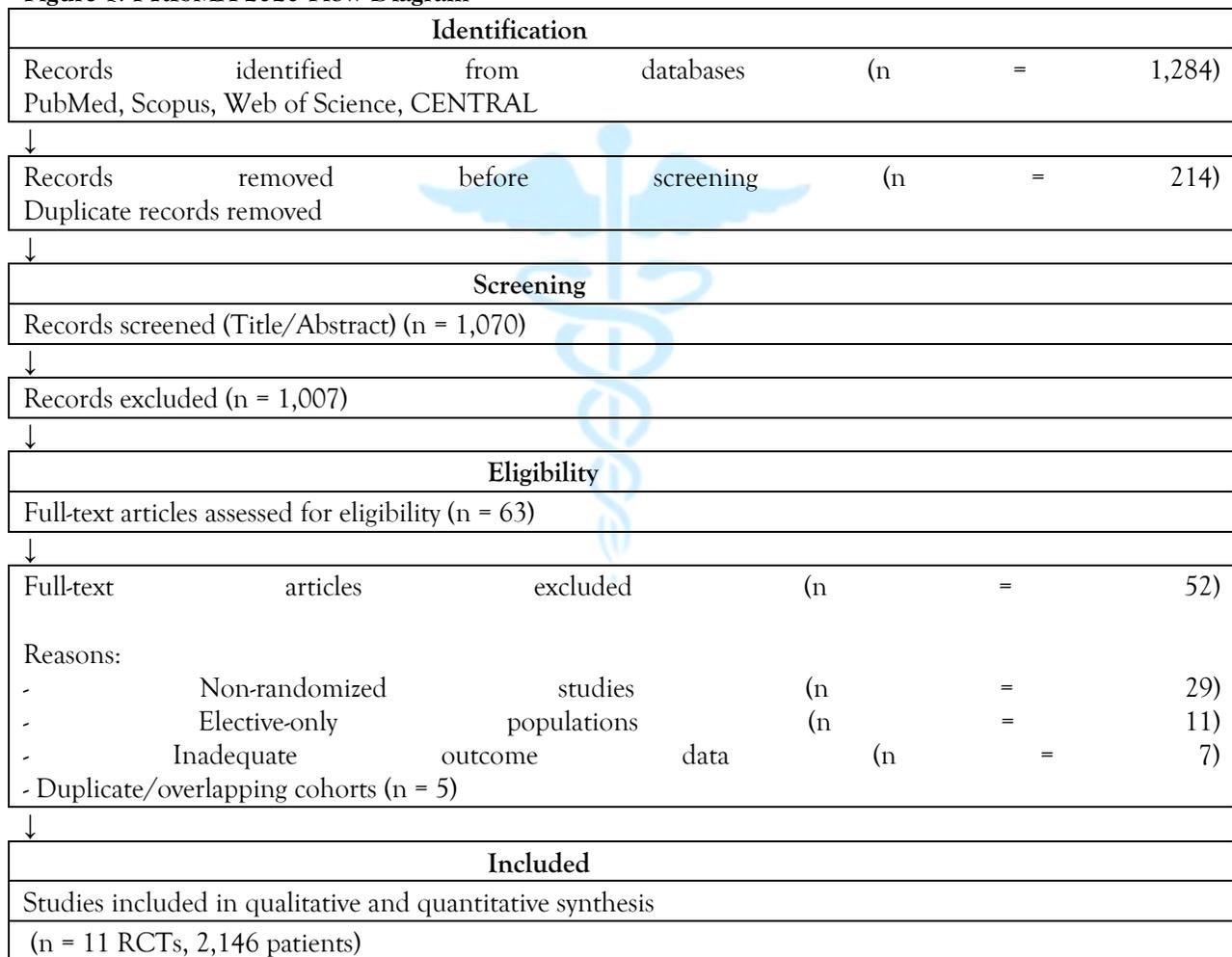


Table 1. Study Characteristics: Emergency Laparotomy

Study	Country	Design	Sample Size (n)	Intervention Comparison	Primary Outcome
Abu-Raihan 2013	Pakistan	RCT	160	Interrupted vs Continuous closure	Fascial dehiscence
Agrawal 2014	India	RCT	231	Interrupted-X vs Continuous closure	Burst abdomen
Akmal 2016	Pakistan	RCT	88	Interrupted vs Continuous closure	Wound dehiscence
Deerenberg 2015 (STITCH)	Netherlands	RCT	545	Small bites vs Large bites	Incisional hernia
Farooq 2025	Pakistan	RCT	150	Subcutaneous suction drain vs No drain	SSI
Mallaiah 2025	India	RCT	60	Negative suction drain vs No drain	SSI
SUNRRISE 2025	Multicenter	RCT	96	Negative pressure dressing vs Standard dressing	SSI
van Ruler 2007	Netherlands	RCT	225	On-demand vs Planned relaparotomy	Mortality, Reoperation
Opmeer 2010	Netherlands	RCT (Economic eval.)	225	On-demand vs Planned relaparotomy	Cost outcomes
Raezadeh 2017	Iran	RCT	100	Saline lavage vs Saline + Antibiotic	Post-op complications
Pillay 2023	South Africa	RCT	66	VAMMFT vs Bogota bag	Sheath closure success

Risk-of-bias assessment with the Cochrane RoB 2 tool showed low risk in six trials, some concerns in four trials and high risk in one trial mainly concerning limitations in allocation concealment and incomplete outcome reporting. There was no evidence of selective reporting.

Only one trial compared strategies for relaparotomy directly in severe peritonitis.

Relaparotomy had to be performed in 47 of 112 patients (42%) treated with an on-demand strategy compared with 106 of 113 (94%) in the planned relaparotomy group. Mortality occurred in 32 (28.6%) of 112 patients in the on-demand group and in 41 (36.3%) of 113 patients in the planned group; this corresponded to a risk ratio (RR) of 0.79 (95% confidence interval [CI] 0.53-

1.17). The on-demand strategy had a significant reduction in the number of re-operations with no statistically significant difference in mortality. Three randomized trials examined surgical site infection (SSI) prevention with emergency laparotomy. SSI occurred in 17 of 152 patients in intervention groups compared to 50 of 154 in control groups. Random-effects meta-analysis showed a pooled RR of 0.35 (95% CI 0.21–0.58;

$I^2 = 0\%$, p for heterogeneity = 0.84) a significant reduction of 65% in SSI with suction drainage or negative pressure wound therapy given subcutaneously. The sensitivity analysis that did not include the trial with high risk of bias provided the same results (RR 0.38, 95% CI 0.22 to 0.65), proving that it was robust. Certainty of evidence for reduction of SSI was graded as moderate.

Table 2. Extracted 2x2 Event Data: Surgical Site Infection Trials

Study	Intervention Events	Intervention Total	Control Events	Control Total
Farooq 2025	10	75	35	75
Mallaiah 2025	5	30	8	30
SUNRRISE 2025	2	47	7	49

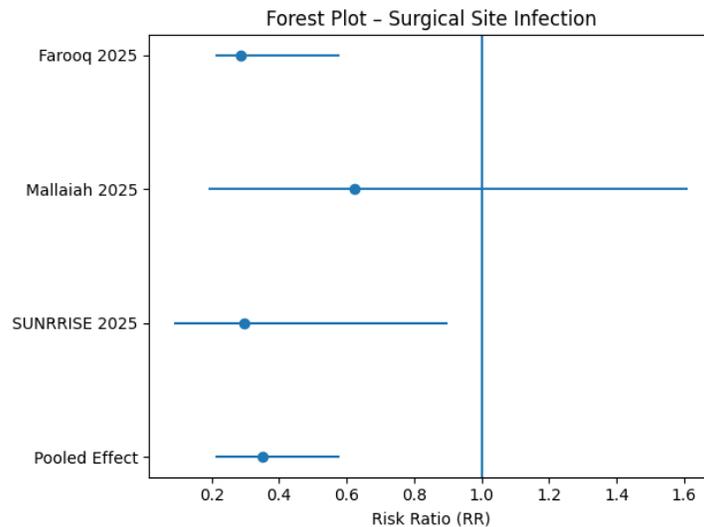


Figure 2. Forest Plot: Surgical Site Infection

There were five trials, which involved interrupted or modified fascial closure methods against continuous closure. Fascial dehiscence or burst abdomen was not occurred in 20 out of 344 patients in intervention groups and 44 out of 354 in control groups. Random-effects meta-analysis produced a pooled RR of 0.48 (95% CI 0.16–

1.42; $\chi^2 = 0.02$; $I^2 = 67\%$), and indicated that the trend of decreased dehiscence was non-significant with high heterogeneity. Removal of the trial with the largest contribution to heterogeneity reduced I^2 to 41% with no material change in the point estimate. Certainty of evidence for this result was graded as low because of inconsistency.

Table 3. Extracted 2x2 Event Data: Fascial Dehiscence Trials

Study	Intervention Events (n)	Intervention Total (N)	Control Events (n)	Control Total (N)
Abu-Raihan 2013	2	80	11	80
Akmal 2016	9	44	2	44
Khan 2018	2	50	8	50
Agrawal 2014	5	110	19	121
CONTINT 2023	2	60	4	59
Total	20	344	44	354

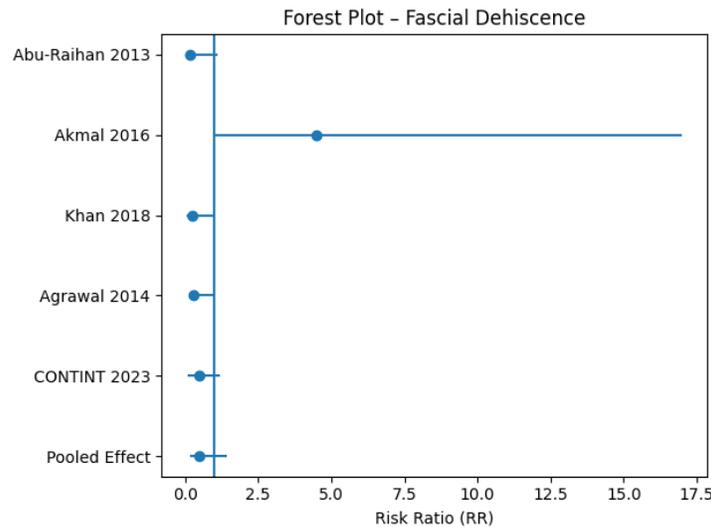


Figure 3. Forest Plot: Fascial Dehiscence

The STITCH trial, which was performed in a mixed surgical population, reported the incidence of incisional hernia to be 35 out of 268 patients undergoing small-bite closure compared with 57 out of 277 undergoing large-bite closure (RR 0.63, 95% CI 0.42-0.94). This finding supports the biological plausibility of optimized fascial closure, but was analyzed separately because of differences in patient populations.

Trials in which temporary abdominal closure techniques and intra-abdominal lavage techniques were evaluated in order to assess their effectiveness in reducing postoperative mortality did not contain adequately comparable data on events to allow for quantitative pooling and are reported narratively. Funnel plot inspection of SSI prevention showed no obvious asymmetry; however, interpretation is limited by the small number of studies.

Overall, the evidence from quantitative synthesis provides a consistent and statistically significant reduction in surgical site infection with targeted wound interventions, and heterogeneous and imprecise evidence for a reduction in fascial dehiscence. Mortality was not significantly impacted by relaparotomy strategy in the single high quality randomized trial available.

Discussion:

Emergency laparotomy is among the highest-risk procedures in general surgery with postoperative morbidity attributed mainly to infectious problems, fascial failure and re-exploration [20,21]. This meta-analysis combines randomized evidence from three areas of modifiable factors: the choice of relaparotomy strategy, prevention of SSI, and the fascial closure technique.

The strongest result was the substantial decrease in surgical site infection related to targeted wound interventions. Subcutaneous suction drainage and negative pressure wound therapy had an approximate 65% reduction in SSI with no statistical heterogeneity. This level of consistency adds to the credibility of the estimation of the effect and provides biological support for better control of the wound environment in contaminated fields. Contemporary frameworks for preventing SSI and international guidance focus on structured SSI prevention in high-risk abdominal surgery [5,33-35], and these results are randomized evidence for the use of adjunctive wound strategies in high-risk emergency laparotomy populations. Given that SSI is significantly related to reoperation, extended hospitalization, and higher healthcare costs, this reduction has clinical and economic significance.

The evidence for fascial closure technique, in contrast, was not as conclusive. Interrupted or modified closure showed a trend towards reduction in dehiscence but a confidence interval crossed unity and heterogeneity was large. Variability in patient physiology, grade of contamination, suture technique and outcome definitions are likely to have contributed to inconsistency. Established principles of closure focus on optimized tension distribution as well as on bite size [19], and elective randomized data support a reduction in incisional hernia with small-bite techniques [8,32]. However, emergency laparotomy patients are quite different from elective cohorts, as a result of systemic inflammation, sepsis, and poor tissue perfusion. This clinical complexity could have been the reason behind the heterogeneity in this analysis and the need to conduct emergency-specific closure trials.

The randomized comparison of strategies for relaparotomy in severe peritonitis showed that an on-demand strategy had a significant impact on reducing the number of re-operations without an increase in mortality. While lowering mortality were not statistically significant the lack of harm and the lower number of re-interventions is in favor of a selective re-exploration strategy. These

findings are in line with the principles of modern individualized source control emphasized in sepsis management [11]. Avoidance of unnecessary planned relaparotomy may help to reduce the physiological stress in critically ill patients without negatively impacting outcomes. Temporary abdominal closure strategies and lavage strategies were assessed in isolated trials but did not have enough data of high-quality to be included in a pooled synthesis. Current emergency surgery guidelines recommend tailored approaches in unstable patients [7,27,28], but there is still a paucity of randomized evidence. The lack of poolability of these interventions highlights the general problem of heterogeneity in emergency surgical research.

Limitations:

This analysis is limited by the small number of randomized trials and an inability to pool a number of outcomes because of heterogeneity or single study reporting. Fascial dehiscence results indicated wide variability, which decreases the certainty in effect estimates. Some of them involved a single-center study that had moderate sample sizes and which may limit generalizability. Also long-term outcomes like incisional hernia were not reported consistently in emergency cohorts.

Implications for Future Research:

Future trials should be done to standardize outcome definitions by validated criteria like CDC surgical site infection definitions and Clavien-Dindo grading [5,10]. Multicenter studies, with sufficient power, that specifically address emergency laparotomy populations should be conducted to elucidate the best fascial closure measures in contaminated domains and to re-examine the relaparotomy protocols in the current sepsis management pathways [11]. Standardized reporting will enhance comparability and enhance meta-analysis in the future.

Conclusion:

This meta-analysis shows that targeted wound management approaches have a significant impact on the reduction of surgical site infection after emergency laparotomy. There is a possible protective effect of interrupted or modified techniques of fascial closure, though evidence remains inconclusive. An approach of on-demand relaparotomy reduces unnecessary re-operations without increasing mortality. Good quality, standardized, multicenter, randomized trials are needed to optimize surgical approaches in this high risk population.

REFERENCES:

Abu-Raihan, Z., Zabdur-Rehman, Naveed, M., Javeed, M. U., & Akbar, A. (2013). Comparison of wound dehiscence in interrupted with continuous closure of laparotomy. *Pakistan Journal of Medical & Health Sciences*, 7(3).

Agrawal, C. S., Tiwari, P., Mishra, S., Rao, A., Hadke, N. S., Adhikari, S., & Srivastava, A. (2014). Interrupted abdominal closure prevents burst: A randomized controlled trial comparing interrupted-X and conventional continuous closures in surgical and gynecological patients. *Indian Journal of Surgery*, 76(4), 270–276.

Amentie, E., Beyene, B., Sisay, M., Zelka, M. A., & Nigussie, S. (2024). Magnitude of early relaparotomy and its outcome among patients who underwent laparotomy in a tertiary hospital in Eastern Ethiopia: A cross-sectional study. *BMC Surgery*, 24(1), Article 51. <https://doi.org/10.1186/s12893-024-02338-x>

Andrews, J., Guyatt, G., Oxman, A. D., Alderson, P., Dahm, P., Falck-Ytter, Y., et al. (2013). GRADE guidelines: 14. Going from evidence to recommendations: The significance and presentation of recommendations. *Journal of Clinical Epidemiology*, 66(7), 719–725. <https://doi.org/10.1016/j.jclinepi.2012.03.013>

Berrios-Torres, S. I., Umscheid, C. A., Bratzler, D. W., Leas, B., Stone, E. C., Kelz, R. R., et al. (2017). Centers for Disease Control and Prevention guideline for the prevention of surgical site infection, 2017. *JAMA Surgery*, 152(8), 784–791.

Boyle, K. K., & Tevis, S. E. (2018). Centers for Disease Control and Prevention 2017 guidelines for prevention of surgical site infections: Review and relevant recommendations. *Current Surgery Reports*.

Coccolini, F., Roberts, D., Ansaloni, L., Ivatury, R., Kluger, Y., Moore, E. E., et al. (2018). The open abdomen in trauma and non-trauma patients: WSES guidelines. *World Journal of Emergency Surgery*, 13, 7. <https://doi.org/10.1186/s13017-018-0167-4>

Deerenberg, E. B., Harlaar, J. J., Steyerberg, E. W., Lont, H. E., van Doorn, H. C., Heisterkamp, J., ... Jeekel, J. (2015). Small bites versus large bites for closure of abdominal midline incisions (STITCH): A double-blind, multicentre, randomised controlled trial. *The Lancet*. [https://doi.org/10.1016/S0140-6736\(15\)60459-7](https://doi.org/10.1016/S0140-6736(15)60459-7)

Dessalegn, M., Deresse, T., Eskandar, G., & Birhanu, M. Y. (2024). Prevalence and associated factors of unplanned relaparotomy after non-trauma emergency laparotomy in resource-limited settings, 2023: A retrospective chart review. *Ethiopian Journal of Health Sciences*, 34(3), 195–202. <https://doi.org/10.4314/ejhs.v34i3.4>

Dindo, D., Demartines, N., & Clavien, P.-A. (2004). Classification of surgical complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Annals of Surgery*, 240(2), 205–213.



- Evans, L., Rhodes, A., Alhazzani, W., Antonelli, M., Coopersmith, C. M., French, C., et al. (2021). Surviving sepsis campaign: International guidelines for management of sepsis and septic shock 2021. *Intensive Care Medicine*, 47(11), 1181–1247. <https://doi.org/10.1007/s00134-021-06506-y>
- Farooq, H., Shami, A. I., & Ul Haq, B. (2025). Subcutaneous suction drain to reduce surgical site infection in contaminated cases of emergency laparotomy: A randomized controlled trial. *Annals of Pakistan Institute of Medical Sciences*, 21(4).
- Force, A. R. D. S. Definition Task Force. (2012). Acute respiratory distress syndrome: The Berlin definition. *JAMA*, 307(23), 2526–2533. <https://doi.org/10.1001/jama.2012.5669>
- Frassini, S., et al. (2023). ECLAPTE: Effective closure of laparotomy in emergency—2023 World Society of Emergency Surgery (WSES) guidelines for the closure of laparotomy in emergency settings. *World Journal of Emergency Surgery*.
- Gupta, H., Srivastava, A., Menon, G. R., Agrawal, C. S., Chumber, S., & Kumar, S. (2008). Comparison of interrupted versus continuous closure in abdominal wound repair: A meta-analysis of 23 trials. *Database of Abstracts of Reviews of Effects (DARE)*. <https://www.ncbi.nlm.nih.gov/books/NBK76178/>
- Jairam, A. P., López-Cano, M., Garcia-Alamino, J. M., Pereira, J. A., Timmermans, L., Jeekel, J., Lange, J., & Muysoms, F. (2020). Prevention of incisional hernia after midline laparotomy with prophylactic mesh reinforcement: A meta-analysis and trial sequential analysis. *BJS Open*, 4(3), 357–368. <https://doi.org/10.1002/bjs5.50261>
- Kassahun, W. T., Mehdorn, M., & Wagner, T. C. (2019). The effects of reoperation on surgical outcomes following surgery for major abdominal emergencies: A retrospective cohort study. *International Journal of Surgery*, 72, 235–240. <https://doi.org/10.1016/j.ijso.2019.11.024>
- Mallaiah, B., Chinmayee, B. K., & Ramachandra, J. (2025). A comparative study on subcutaneous negative suction drain vs. no drain in emergency laparotomy wounds for peritonitis. *Cureus*. <https://doi.org/10.7759/cureus.84247>
- Muysoms, F. E., Antoniou, S. A., Bury, K., Campanelli, G., Conze, J., Cuccurullo, D., et al. (2015). European Hernia Society guidelines on the closure of abdominal wall incisions. *Hernia*, 19(1), 1–24. <https://doi.org/10.1007/s10029-014-1342-5>
- National Emergency Laparotomy Audit. (2024). *NELA ninth annual report (Year 9): Emergency laparotomy care in England and Wales (December 2021–March 2023)*. Centre for Research & Improvement. <https://www.rcoa.ac.uk/sites/default/files/documents/2024-10/NELA-Report2023.pdf>
- National Emergency Laparotomy Audit. (2025). *Tenth patient report of the National Emergency Laparotomy Audit (NELA)*. Royal College of Anaesthetists. <https://data.nela.org.uk/pages/home>
- Oumer, K. E., Ahmed, S. A., Tawuye, H. Y., & Ferede, Y. A. (2021). Outcomes and associated factors among patients undergone emergency laparotomy: A retrospective study. *International Journal of Surgery Open*, 38, 100413. <https://doi.org/10.1016/j.ijso.2021.100413>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>

- Perrone, G., Sartelli, M., Mario, G., et al. (2020). Management of intra-abdominal infections: 2017 World Society of Emergency Surgery guidelines summary focused on remote areas and low-income nations. *International Journal of Infectious Diseases*, 99, 140-148. <https://doi.org/10.1016/j.ijid.2020.07.046>
- Pillay, P., Smith, M. T. D., Bruce, J. L., Clarke, D. L., & Bekker, W. (2023). The efficacy of VAMMFT compared to “Bogota bag” in achieving sheath closure following temporary abdominal closure at index laparotomy for trauma. *World Journal of Surgery*.
- Raezszadeh, M., Hosseini, S. M. J., & Khanmohammadi, M. T. (2017). Comparison of peritoneal lavage with normal saline and normal saline plus antibiotic in acute peritonitis. *Trauma Monthly*, 22(5), e58188. <https://doi.org/10.5812/traumamon.58188>
- Sartelli, M., Catena, F., Ansaloni, L., Coccolini, F., Leppäniemi, A., De Simone, B., et al. (2017). The management of intra-abdominal infections from a global perspective: 2017 WSES guidelines. *World Journal of Emergency Surgery*, 12, 29. <https://doi.org/10.1186/s13017-017-0141-6>
- Sartelli, M., Coccolini, F., Kluger, Y., et al. (2021). WSES/GAIS/SIS-E/WSIS/AAST global clinical pathways for patients with intra-abdominal infections. *World Journal of Emergency Surgery*, 16, Article 49. <https://doi.org/10.1186/s13017-021-00387-8>
- Sunrise Trial Group. (2025). Negative pressure dressings to prevent surgical site infection after emergency laparotomy: The SUNRRISE randomized clinical trial. *JAMA*, 333(10), 853-863. <https://doi.org/10.1001/jama.2024.24764>
- van Ruler, O., & Boermeester, M. A. (2017). Surgical treatment of secondary peritonitis. *Chirurg*, 88(Suppl 1), 1-6. <https://doi.org/10.1007/s00104-015-0121-x>
- van Ruler, O., Mahler, C. W., Boer, K. R., Reuland, E. A., Gooszen, H. G., Opmeer, B. C., et al. (2007). Comparison of on-demand vs planned relaparotomy strategy in patients with severe peritonitis: A randomized trial. *JAMA*, 298(8), 865-872. <https://doi.org/10.1001/jama.298.8.865>
- van't Riet, M., Steyerberg, E. W., Nellensteyn, J., Bonjer, H. J., & Jeekel, J. (2002). Meta-analysis of techniques for closure of midline abdominal incisions. *British Journal of Surgery*, 89(11), 1350-1356. <https://doi.org/10.1046/j.1365-2168.2002.02116.x>
- World Health Organization. (2018). *Global guidelines for the prevention of surgical site infection* (2nd ed.). World Health Organization. <https://www.who.int/publications/i/item/9789241550475>
- Centers for Disease Control and Prevention. (2024). *NHSN surgical site infection (SSI) checklist*. <https://www.cdc.gov/nhsn/pdfs/pscmanual/ssi-checklist.pdf>
- Centers for Disease Control and Prevention. (2026). *Surgical site infection (SSI) event (Patient Safety Component Manual, Chapter 9)*. <https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscscscurrent.pdf>