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EFFICACY OF NEGATIVE PRESSURE WOUND THERAPY IN LAPAROTOMY WOUNDS: PROTOCOL FOR A SYSTEMATIC REVIEW AND META-ANALYSIS

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Study protocol

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ABSTRACT

Introduction: A laparotomy is a surgical procedure involving an abdominal incision to access the peritoneal cavity, commonly performed for diagnostic and therapeutic purposes, including trauma management and the treatment of gynecological, pelvic, and abdominal conditions. In this context, negative pressure wound therapy (NPWT) serves as an effective adjunct to wound management by applying subatmospheric pressure to the wound bed, thereby promoting granulation tissue formation and reducing local inflammation.

Objective: This systematic review will aim to evaluate the efficacy of NPWT compared to standard wound care in adult patients undergoing laparotomy, with specific attention to key clinical outcomes such as wound healing time, surgical site infection rates, wound dehiscence, and overall complication rates.

Materials and methods: The systematic review follows the PRISMA guidelines and uses the PICO framework for search terms. The studies will be identified through important databases (PubMed, Scopus, CINAHL and Web of Science). Methodological quality and risk of bias will be assessed with JBI critical assessment tools. This protocol for a systematic review has been registered on PROSPERO (N. CRD420251058825).

Results: The results of the systematic search and selection process will be reported using a PRISMA flowchart. The extracted data will include wound healing time, granulation tissue development, infection rates, and adverse events. The quantitative synthesis will be conducted if the homogeneity of the data allows it.

Conclusions: This systematic review will synthesize the available evidence on the efficacy of NPWT in the management of laparotomy wounds. The findings will have implications for clinical practice in surgical wound care and may contribute to the development of standardized wound management protocols.

Keywords: Laparotomy, negative pressure wound therapy, bandages, wound healing, granulation tissue, systematic review.

INTRODUCTION:

A laparotomy involves a surgical incision through the abdominal wall to access the peritoneal cavity during a laparotomy procedure [1-5]. This incision is typically a large vertical cut that allows surgeons to examine and treat conditions within the abdominal organs. The term "laparotomy" itself denotes this surgical approach, which is often employed in both emergency and planned surgical settings [6]. Laparotomy remains a common surgical procedure worldwide, particularly in the treatment of abdominal trauma, intestinal obstruction, perforated bowel, and malignancies [3]. Despite its widespread use, laparotomy is associated with a high incidence of postoperative wound complications. Recent data indicate that surgical site infections (SSIs) occur in approximately 20–30% of laparotomy cases, especially in high-risk settings such as emergency surgeries or in patients with comorbidities. According to a multicenter cohort study published in 2022, SSI rates after emergency abdominal surgery reached up to 33%, with wound dehiscence observed in 4–6% of cases [7,8]. Wound dehiscence, defined as the partial or complete separation of a surgically closed wound, is strongly associated with increased morbidity, delayed recovery, and higher mortality. In a recent analysis conducted in the United States, SSIs following laparotomy were found to contribute to an average extended hospital stay of 9.7 days and increased treatment costs by over $20,000 per patient [9]. Surgical wound dehiscence (SWD) occurs in approximately 1% of patients within 30 days following laparotomy, with a prevalence of up to 3% in hepatobiliary surgery [8]. Among older patients, the incidence may reach 10%, with an associated mortality rate of up to 45% [9]. A study involving 674 patients undergoing emergency laparotomy documented a 31.9% rate of surgical complications, including 16.3% SSIs and 5% wound dehiscence. Furthermore, 19.1% of patients required surgical reintervention, while 53.6% experienced additional medical complications such as

respiratory failure or sepsis [10].

These complications place a significant burden on healthcare systems. For example, a 2023 analysis estimated that surgical site infections alone contribute to over USD 3.3 billion in annual costs in the United States, primarily due to extended hospital stays, additional interventions, and increased resource utilization [6,7]. In addition, wound complications often require additional interventions, such as reoperations, prolonged antibiotic therapy, or advanced wound care support, thus placing a considerable burden on both healthcare systems and patients. Effective postoperative wound management is therefore essential to reduce these risks and promote optimal recovery. Conventional dressing techniques may be insufficient in high-risk patients or in complex surgical settings. In recent years, NPWT has emerged as an innovative approach to improving surgical wound healing. By applying controlled subatmospheric pressure through a sealed dressing system, NPWT improves tissue perfusion, reduces local edema, and facilitates the removal of exudates and contaminants [11,12]. It also promotes the formation of granulation tissue and can promote faster and longer-lasting wound closure.

Although NPWT is increasingly utilized across various surgical disciplines, no systematic review focused exclusively on its effectiveness in laparotomy wounds exists to date, there is still limited consensus regarding its efficacy specifically in laparotomy wounds. Available studies show heterogeneous results, often influenced by variability in patient populations, the type of procedure (elective vs. emergency laparotomy), surgical techniques, and NPWT protocols (e.g., pressure settings, duration, frequency of dressing changes). Furthermore, many investigations suffer from methodological limitations, small sample sizes, or a lack of attention to patient-reported outcomes such as pain, quality of life, and satisfaction with care. While some reviews in other surgical contexts have reported potential benefits of NPWT, there is currently no systematic synthesis specifically focused on laparotomy wounds. In light of these gaps, the present protocol for a systematic review aims to guide a rigorous systematic review designed to comprehensively assess

the clinical efficacy of NPWT in this specific surgical population.

The use of negative pressure wound therapy (NPWT) in laparotomy wounds may offer substantial clinical advantages over conventional wound care approaches. By promoting faster wound healing, reducing the incidence of surgical site infections, and decreasing the risk of wound dehiscence, NPWT has the potential to improve surgical outcomes, particularly in high-risk patients. Its application may also reduce the need for reoperations and prolonged antibiotic therapy, thereby shortening hospital stays and facilitating earlier discharge. From a patient-centered perspective, NPWT may lead to improved pain control, better quality of life, and enhanced satisfaction with care. Integrating NPWT into postoperative care pathways could thus contribute to more efficient resource use and support the development of evidence-based protocols aimed at optimizing recovery following major abdominal surgery.

This systematic review aims to evaluate the efficacy of NPWT in laparotomy wounds by analyzing key clinical outcomes, including wound healing time, incidence of surgical site infection, wound dehiscence, and complication rates. The systematic review will also plan to consider patient-centered outcomes such as pain, quality of life, and satisfaction with care, supporting evidence-based decision-making in postoperative wound treatment.

OUTCOMES:

Primary Outcomes

- Incidence of surgical site infection (SSI)
- Wound healing time (days from surgery to complete epithelialization or closure)
- Rate of wound dehiscence (partial or complete separation of the wound)

Secondary Outcomes:

- Postoperative pain scores (as measured by validated pain scales, e.g., VAS or NRS)

- Quality of life (measured by validated tools such as EQ-5D, SF-36)
- Patient satisfaction with wound care
- Length of hospital stay
- Rate of reoperation related to wound complications
- Incidence of wound-related hospital readmissions

This systematic review will focus exclusively on adult patients (≥18 years) undergoing laparotomy procedures in either elective or emergency surgical settings.

Where sufficient data homogeneity is identified across studies in terms of populations, interventions, and outcome measures, a meta-analysis will be conducted. Statistical heterogeneity will be assessed using the I^2 statistic, with a threshold of $I^2 > 50\%$ indicating substantial heterogeneity. In such cases, a random-effects model will be applied. If heterogeneity is too high or data are insufficiently comparable, results will be synthesized using a narrative approach, supported by structured tables and descriptive analysis. Subgroup analyses (e.g., by type of laparotomy or patient risk profile) will be considered where appropriate and data permit.

MATERIALS AND METHODS

Study Protocol

This preliminary protocol for a systematic review is designed to ensure methodological consistency and alignment of the selected studies with the overall objectives of the systematic review. The final synthesis will aim to provide a clear and evidence-based contribution to the scientific discourse on the topic.

The protocol for a systematic review will be conducted in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines. In particular, the PRISMA-P (Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols) checklist [13,14]

was used to structure this protocol for a systematic review [refer to supplemental files for the complete checklist], while the full PRISMA 2020 guidelines will be used in the reporting of the final manuscript of the systematic review.

Eligibility criteria

The systematic research was developed following the PICO framework described in Table 1.

Popolation	Patients undergoing laparotomy and with laparotomy surgical wound
Intervention	Negative pressure wound therapy
Confront	Standard Care
Outcome	Granulation Tissue / Wound Healing

Table 1. *PICO Framework*

Eligibility criteria will include peer-reviewed primary research studies investigating the efficacy of negative pressure wound therapy in the management of laparotomy wounds. Eligible study designs will include observational studies (cohort, cross-sectional), quasi-experimental studies, randomized controlled trials (RCTs), non-randomized controlled trials, and interventional studies. The exclusion criteria will outline parameters to maintain the focus and integrity of the systematic review. Studies investigating non-laparotomies wounds, the use of other devices such as Prevena or PICO or conventional dressings, secondary studies, outcomes not related to healing will also be excluded. Similarly, editorials and opinion articles lacking primary data, animal studies, and experimental or laboratory models will be excluded from the scope of this systematic review. In addition, studies focused exclusively on pediatric populations (<18 years) will not be considered. Unpublished studies and academic theses typically lack the rigorous peer review process necessary to ensure methodological soundness, thus raising questions about their reliability and scientific validity. Similarly, while conference abstracts can offer preliminary insights into ongoing research, they are often concise and not sufficiently detailed, lacking the comprehensive data and analytical depth

needed to support solid conclusions. The experimental protocols, although valuable for the understanding of the proposed methodologies, do not present empirical results and therefore offer limited utility in evidence-based evaluations. No language restrictions will be applied during the literature search to ensure comprehensive coverage of the available evidence. To mitigate the risk of excluding relevant non-English studies, the systematic review team will use professional translation tools and, when necessary, involve collaborators or native speakers for accurate interpretation of full texts. Articles in languages unfamiliar to the systematic review team will be assessed for eligibility through translated abstracts or consulted with multilingual experts when available.

Sources of information

This systematic review will include primary research studies that directly address the research question, including randomized controlled trials (RCTs), cohort studies, cross-sectional studies, case-control studies, and qualitative investigations.

The protocol for a systematic review was developed using the PICO (Population–Intervention–Comparison–Outcome) framework to ensure a methodologically sound and targeted approach to the synthesis of evidence. To ensure the completeness of the review, a structured and systematic research strategy will be employed. Carefully selected search terms will be applied to multiple electronic databases, including MEDLINE (via PubMed), CINAHL (via EBSCO), Web of Science (WOS), and SCOPUS. All eligible studies published up to the date of data extraction will be considered. Given the specific objective of the research question, the PICO framework will facilitate the precise delineation of the scope of the systematic review (Table 1).

Two independent reviewers will conduct the first screening of the titles and abstracts. In the event of disagreement, a fourth reviewer will be consulted to reach consensus. Full-text articles will be evaluated to determine final eligibility for inclusion in the systematic review.

Research strategy

We used keywords and search terms as shown in the Table 2 Duplicate records will be identified and removed using Rayyan software (Rayyan Enterprise, Cambridge, MA, USA, https://www.rayyan.ai/, accessed on 29.4.2025 [15].

#1 Laparotomy"[MeSH Terms]
#2 Negative Pressure Wound Therapy"[MeSH Terms]
#3 negative pressure wound therapy"[MeSH Terms] OR ("negative pressure"[All fields] AND "wound"[All fields] AND "therapy"[All fields]) OR "negative pressure wound therapy"[All fields] OR ("empty"[All fields] AND "assisted"[All fields] AND "closure"[All fields]) OR "void-assisted closure"[All fields]
#4 Bandages"[MeSH Terms] Or "Bandages, Hydrocolloids"[MeSH Terms] Or "Occlusive Dressings"[MeSH Terms]
#5 Wound healing"[MeSH terms] OR "Granulation tissue"[MeSH terms]

Table 2. *Key terms and search strategy.*

The defined keywords adhere to the Mesh term for health research. The keywords being used are varied because they are tailored to the search engine. The keywords are combined with Boolean operators such as “OR” and “AND” (Table 3)

Database	Research	Results	Date
PubMed	("Laparotomy"[MeSH Terms] AND "Negative Pressure Wound Therapy"[MeSH Terms]) OR ("Negative Pressure Wound Therapy"[MeSH Terms] OR ("Negative Pressure"[All Fields] AND "Wound"[All Fields] AND "Therapy"[All Fields]) OR "Negative Pressure Wound Therapy"[All Fields] OR ("Blank"[All Fields] AND "Assisted"[All Fields] AND "Closure"[All Fields]) OR "Vacuum Assisted Closure"[All Fields])) AND ("Bandages"[MeSH Terms] OR "Bandages, hydrocolloids"[MeSH terms] or "occlusive dressings"[MeSH terms]) and ("Wound healing"[MeSH terms] or "granulation tissue"[MeSH terms])	703	29/04/2025
Scopus	(INDEXTERMS(Laparotomy) AND INDEXTERMS("Negative Pressure Wound Therapy")) OR (INDEXTERMS("Negative Pressure Wound Therapy") OR (ALL("negative pressure") AND ALL(wound) AND ALL(therapy)) OR ALL("Negative Pressure Wound Therapy") OR (ALL(vacuum) AND ALL(assisted) AND ALL(closure)) OR ALL("vacuum-assisted closure"))AND (INDEXTERMS(BANDAGES) OR INDEXTERMS("Bandages, Hydrocolloid") OR INDEXTERMS("Occlusive Dressings")) AND (INDEXTERMS("Wound Healing") OR	1176	29/04/2025

	INDEXTERMS("Granulation Tissue"))		
CINAHL	((HD Laparotomy+) AND (HD "Negative Pressure Wound Therapy+")) OR ((MH "Negative Pressure Wound Therapy+") OR ("Negative Pressure" AND Wound And Therapy) OR "Negative Pressure Wound Therapy" OR (Vacuum AND Assisted Closure AND) OR "Vacuum Assisted Closure")AND ((MH Bandages+) OR (MH "Bandages, Hydrocolloid+") OR (MH "Occlusive Dressings+")) AND ((MH "Wound Healing+") OR (MH "Granulation Tissue+"))	921	29/04/2025
WOS	(ALL=Laparotomy AND ALL="Negative Pressure Wound Therapy") OR (ALL="Negative Pressure Wound Therapy" OR (ALL="negative pressure" AND ALL=wound AND ALL=therapy) OR ALL="Negative Pressure Wound Therapy" OR (ALL=vacuum AND ALL=assisted AND ALL=closure) OR ALL="Vacuum-Assisted Closure")AND (ALL=Bandages OR ALL="Bandages, Hydrocolloid" OR ALL="Occlusive Dressings") AND (ALL="Wound Healing" OR ALL="Granulation Tissue")	230	01/05/2025

Table 3. *The search string*

Selection process

The methodological quality of the included studies will be assessed using the Joanna Briggs Institute (JBI) critical evaluation tools, selecting the appropriate checklist based on the study design (e.g., case-control studies, case reports, cohort studies, case series, quasi-experimental studies, and randomized controlled trials) [16]. Each tool includes multiple elements, with response options limited to: *Yes*, *No*, *ambiguous not applicable*. This systematic review protocol will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) guidelines [14,17]. The process of selecting and extracting data will take place in two distinct phases. Initially, two reviewers will independently review the titles and abstracts of all records retrieved using Rayyan software [15] to identify potentially suitable studies. Any disagreements will be resolved by consensus; If necessary, a third reviewer will be consulted to reach the resolution. In the second phase, three reviewers will independently evaluate the full texts of the selected studies and proceed with data extraction. To ensure methodological rigor and consistency throughout the review process, each included study will be critically evaluated for both internal validity and relevance.

The following data will be extracted independently by two reviewers:

- Author(s)
- Year and country of publication
- Study design
- Study population
- Clinical or care context
- Speech(s)
- Primary and secondary outcomes
- Main Findings/Achievements

Data collection process

A PRISMA flowchart will be included to provide a visual representation of the study selection process, detailing the number of records identified, reviewed, evaluated for eligibility, and excluded, along with justifications for exclusion. This revision will follow a systematic and standardized data collection procedure, using a predefined data extraction module to ensure consistency and reproducibility. Key data elements to be extracted from each included study will include: study design, participant characteristics, intervention details, outcome measures, and key outcomes. Quantitative data will be synthesized through narrative synthesis, allowing for a descriptive comparison between studies. Instead, qualitative results will be analyzed using thematic synthesis, aimed at identifying themes, insights, and patterns through the evidence base. Each study will be ranked according to its level of evidence, thus allowing for a comparative assessment of the robustness and reliability of the results. This integrative synthesis of mixed methods will combine

qualitative and quantitative evidence to develop a comprehensive understanding of the efficacy of NPWT in laparotomy wound management.

Scan risk assessment study

The risk of bias in included studies will be systematically assessed by two or more independent reviewers using the ROBINS-E (Risk Of Bias In Non-Randomized Studies of Exposures) tool, which is specifically designed to assess bias in observational studies [14].

In the event of disagreement, discrepancies will first be discussed between two reviewers. If consensus cannot be reached, a third reviewer will be consulted to resolve the issue. To evaluate inter-rater reliability during the selection process, the level of agreement between reviewers will be quantitatively assessed using Cohen's Kappa coefficient.

The ROBINS-E tool assesses the risk of bias in seven areas:

1. Confusion bias
2. Bias in the selection of participants
3. Bias in exposure classification
4. Bias due to deviations from planned interventions (post-exposure)
5. Bias due to missing data
6. Bias on the measurement of results
7. Bias on the selection of the reported results.

Each domain will be assessed individually, and domain-level judgments will inform the overall assessment of bias risk for each study. Overall judgment will be classified as low risk, some concerns, high risk or critical risk of bias, in accordance with the ROBINS-E guidelines.

To assess the methodological quality of non-randomised studies, the ROBINS-E tool will be used. This tool was selected because it is specifically designed to evaluate bias in studies assessing the

effects of exposures, which is appropriate given the observational nature of many studies expected in this systematic review (e.g., cohort studies comparing NPWT with conventional wound care). ROBINS-E includes domains such as confounding, selection of participants, measurement of exposure and outcomes, and selection of reported results—providing a comprehensive framework for appraising the internal validity of non-randomised designs. Compared to ROBINS-I, which is tailored more closely to interventions and clinical trials, ROBINS-E better aligns with the anticipated heterogeneity in clinical exposure settings observed in surgical wound management research.

Synthesis methods

In accordance with the Joanna Briggs Institute (JBI) data extraction framework, two or more independent reviewers will perform data extraction from full-text articles included in the systematic review to ensure completeness and accuracy. The information collected will include the key characteristics of the study, such as the author and year of publication, country of origin, study objectives, sample demographics, methodology and design, type of intervention, reported outcomes, and key findings. All data will be entered into a Microsoft Excel® spreadsheet to facilitate the construction of structured summary tables and comparative analysis. The synthesis of the results will be mainly narrative in nature, with the aim of identifying and describing recurring patterns and thematic elements in studies. This approach will allow reviewers to highlight conceptual consistencies, methodological trends, and gaps in the literature that could inform future research. Quantitative data, when available, will be presented descriptively, while qualitative data will be analyzed thematically to derive common insights and meaningful interpretations. The synthesis will be guided by a structured framework that explores relationships both within individual studies and across the broader evidence base, in order to map key themes and areas of convergence. In case the included studies demonstrate sufficient methodological and statistical homogeneity, a meta-analysis

will be conducted using RevMan 5.3 software. A randomized effects model will be applied to account for variability expected in study design, intervention types, and population characteristics. Where appropriate, data from included studies will be pooled in a meta-analysis. Heterogeneity will be assessed using the I^2 statistic and Chi-square test. If substantial heterogeneity is detected ($I^2 > 50\%$), a random-effects model will be used; otherwise, a fixed-effect model will be applied. To explore sources of heterogeneity, subgroup analyses will be conducted based on predefined variables such as type of laparotomy (elective vs. emergency), NPWT protocol (duration, pressure setting), and patient risk profile (e.g., age, comorbidities). Sensitivity analyses will also be performed by excluding studies at high risk of bias or with small sample sizes to test the robustness of the findings.

Meta-Analysis Criteria

Where appropriate, data from included studies will be pooled in a meta-analysis. Heterogeneity will be assessed using the I^2 statistic and Chi-square test. If substantial heterogeneity is detected ($I^2 > 50\%$), a random-effects model will be used; otherwise, a fixed-effect model will be applied. To explore sources of heterogeneity, subgroup analyses will be conducted based on predefined variables such as type of laparotomy (elective vs. emergency), NPWT protocol (duration, pressure setting), and patient risk profile (e.g., age, comorbidities). Sensitivity analyses will also be performed by excluding studies at high risk of bias or with small sample sizes to test the robustness of the findings.

Measurements and results

To ensure a comprehensive evaluation of the efficacy of NPWT in the management of laparotomy wounds, this systematic review will focus on both clinical and patient-centered outcomes. Primary outcomes of interest will include wound healing indicators such as time to complete wound closure,

wound infection rates, incidence of wound dehiscence, and length of hospital stay. These measures are considered essential for evaluating the clinical efficacy and safety of NPWT compared to conventional wound care methods. Secondary outcomes will encompass broader dimensions of efficacy, including patient-reported outcomes such as pain reduction, quality of life, and satisfaction with care, when available. Additional findings may include the need for resurgery or revision, antibiotic use, and healthcare resource utilization, providing a more holistic understanding of the impact of NPWT in both acute and post-operative phases. Data related to these outcomes will be extracted and analyzed in relation to study design, population characteristics, intervention protocols, and duration of follow-up. The heterogeneity of result definitions and measurement tools will be taken into account in the summary to ensure the validity and applicability of the results. Through this multidimensional outcome framework, the systematic review aims to generate robust evidence on the clinical efficacy, patient benefit, and potential health system implications of NPWT in the context of laparotomy wound management.

Impact of the review

This systematic review will synthesize original research studies evaluating the efficacy of NPWT in adult patients (≥18 years old) undergoing laparotomy. By systematically analyzing outcomes such as wound healing time, infection rates, and surgical site complications, the systematic review aims to clarify the clinical value of NPWT in laparotomy wound management compared to standard wound care approaches. The systematic review will adopt a structured and transparent methodology to ensure the robustness and reproducibility of the results. Emphasis will be placed on identifying which patient populations and clinical conditions benefit most from NPWT, as well as examining intervention protocols, duration, and care settings. This evidence-based approach will facilitate the integration of best practices into perioperative wound management and postoperative care pathways. If NPWT has been shown to significantly improve clinical outcomes, it can offer a cost-

effective and scalable intervention to improve surgical recovery, reduce complications, and optimize hospital resource utilization. In addition, the findings of this systematic review can help healthcare professionals develop targeted postoperative protocols and inform clinical decision-making, ultimately helping to improve patient safety and the quality of surgical care.

DISCUSSION

This systematic review protocol aims to evaluate the efficacy of negative pressure wound therapy (NPWT) in the management of laparotomy wounds, with a primary focus on clinical outcomes such as wound healing time, surgical site infection (SSI) rates, wound dehiscence, and postoperative complications. These outcomes are critical indicators of recovery quality and patient safety following major abdominal surgery [18,19]. NPWT has been shown to promote wound healing through mechanisms such as edema reduction, enhanced local perfusion, and stimulation of granulation tissue formation [11]. Furthermore, it may contribute to a lower incidence of SSIs, particularly in high-risk patients or contaminated surgical fields [12]. Evaluating its clinical efficacy relative to conventional wound care is therefore essential to inform evidence-based surgical practice.

Secondary outcomes will include patient-reported pain scores, quality of life measures, length of hospital stay, readmission rates, and healthcare resource utilization. These broader metrics are fundamental for understanding not only the clinical effectiveness of NPWT, but also its impact on patient experience and economic sustainability [20]. Improved wound outcomes may facilitate earlier discharge, reduce the need for reoperation or prolonged antibiotic therapy, and ultimately lower the overall burden on healthcare systems. Given the significant clinical and financial consequences associated with postoperative complications, the systematic use of NPWT may yield substantial cost savings by decreasing resource consumption and improving care efficiency, particularly in high-risk surgical populations.

This systematic review aims to assess whether the clinical benefits of NPWT are accompanied by tangible economic advantages, thereby providing a robust evidence base to support more informed clinical decision-making and health policy development. By synthesizing current evidence, the systematic review will offer guidance for surgeons, wound care specialists, and nursing professionals, particularly in identifying patient populations and surgical contexts in which NPWT provides the greatest benefit—such as obese individuals, contaminated wounds, or high-tension closures [21]. Ultimately, the findings may contribute to the development of standardized, cost-effective postoperative wound management protocols and promote the integration of advanced wound care technologies into routine surgical practice [22].

Implications for clinical practice

The findings generated by this systematic review may provide a foundation for informing future clinical guidelines on postoperative wound care in laparotomy patients. Should NPWT demonstrate significant clinical benefits, such evidence could support its broader adoption in both public and private healthcare settings. In public systems, this may contribute to more efficient resource allocation by reducing complication rates and hospital stay durations. In private care contexts, it could offer cost-effective strategies that enhance patient satisfaction and surgical outcomes. By synthesising available data across various healthcare environments, the systematic review aims to produce insights that are broadly applicable and relevant to multidisciplinary clinical decision-making. Overall, this systematic review aims to generate evidence that is generalisable across diverse healthcare systems, promoting evidence-based, patient-centered surgical care.. Integrating NPWT as a standard wound care strategy could significantly contribute to improving surgical outcomes by accelerating wound healing, reducing the incidence of surgical site infections, and minimizing wound-related complications. These benefits are particularly relevant in high-risk surgical populations, such as those with obesity, diabetes, or immunosuppression, where wound

healing is often impaired. Educating healthcare professionals, especially nurses and surgical staff, on the appropriate indications, application techniques, and monitoring of NPWT is essential to ensure its effective implementation. A structured training approach can help improve adherence to evidence-based wound care protocols and promote consistency in clinical practice. In addition, standardized NPWT protocols can support early mobilization, reduce the need for reoperation, and help reduce hospital stays, ultimately decreasing the burden on healthcare systems. From a patient-centered perspective, the use of NPWT can also improve postoperative experience by reducing pain, improving comfort, and promoting a faster return to daily activities. Effective laparotomy wound management through advanced wound care technologies such as NPWT not only promotes physical recovery but can also positively impact psychological well-being and patient satisfaction. Integrating NPWT into routine postoperative care pathways has the potential to optimize resource utilization, improve clinical efficiency, and align surgical wound management with modern quality and safety standards in healthcare delivery. Therefore, this systematic review aims to support evidence-based decision-making and inform the development of targeted guidelines for the management of laparotomy wounds using NPWT. From an economic point of view, NPWT implementation can offer significant cost savings potential despite the initial expense of the device and consumables. Studies have shown that the use of NPWT can lead to a reduction in overall treatment costs by decreasing the incidence of postoperative wound complications, shortening the length of hospital stay, and minimizing the need for additional surgery or prolonged antibiotic therapy. These factors collectively contribute to lower resource utilization, particularly in high-risk surgical populations where complications are more frequent and costly to manage. In addition, by accelerating wound healing and facilitating early discharge, NPWT can help increase bed turnover and improve hospital efficiency, which is especially relevant in resource-constrained healthcare facilities. While the upfront costs of NPWT systems may seem prohibitive, health economics has shown that these are often offset by downstream savings associated with avoided complications and

reduced readmission rates. Therefore, integrating NPWT into standard postoperative care protocols can not only improve patient outcomes, but also represent a cost-effective strategy for surgical services that aims to optimize quality while maintaining financial sustainability.

Limitations

This systematic review may encounter several methodological limitations. While no language restrictions are applied during the selection process, allowing for the inclusion of studies published in any language, a potential risk of bias in selection remains if relevant non-English studies are lost due to translation constraints or limited access to full texts. To mitigate this, translation tools and, when necessary, native speakers will be used to ensure accurate interpretation and data extraction. Another limitation concerns the heterogeneity of the studies included. Differences in surgical indications, patient populations, wound classifications, NPWT protocols (e.g., pressure levels, frequency of dressing changes), and control interventions may call into question the feasibility of conducting a meta-analysis and may limit the comparability of results between studies. In addition, variations in reporting and outcome measurement, such as wound healing time, infection rates, or quality of life indicators, could affect the consistency of outcomes. These discrepancies can introduce a degree of variability that complicates the interpretation of the aggregated results. The risk of bias in primary studies is also a potential limitation. While validated critical evaluation tools will be used to assess methodological quality, the inclusion of observational studies, in particular, may lead to evidence that is more susceptible to confusion and bias due to lack of randomization and blinding. Finally, while the systematic review focuses on adult patients undergoing laparotomy, the diversity of surgical and clinical settings may limit the generalizability of findings to other surgical populations or wound types. However, this systematic review aims to provide a rigorous and comprehensive summary of the available evidence on the efficacy of NPWT in the management of laparotomy wounds.

Meta-bias

Potential meta-biases, including publication bias and selective reporting, will be assessed using funnel charts and the Egger test when at least 10 studies are available for a given outcome. To detect selective reporting of results, study protocols or study registries will be compared with published reports, where accessible.

All studies will be evaluated using the ROBINS-E tool, which includes domains that assess deviations from intended interventions and selective reporting, allowing for a structured assessment of reporting bias and its potential impact on systematic review conclusions.

In addition to assessing publication bias through funnel plots and Egger's test (where applicable), this protocol for a systematic review acknowledges the inherent limitations associated with relying on published literature. Studies with statistically significant or positive findings are more likely to be published, potentially leading to overestimation of effect sizes. To mitigate this, the search strategy includes grey literature sources and trial registries when available. Furthermore, the systematic review team will consider the impact of language and database indexing bias and transparently report any imbalances in study availability across outcomes or settings. These considerations will help contextualize the findings and strengthen the interpretation of the synthesized evidence.

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Conflict of interest

The authors report no conflict of interest.

Authors' contribution

AM, DFM and CR were the major contributors in writing the manuscript. DCA, VV and AFG performed the data collection and interpreted the patient data. All authors read and approved the final manuscript.

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