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Comprehensive Global Bibliometric Analysis of Negative-Pressure Wound Therapy Research (1997–2025)

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ABSTRACT

Objective: Negative Pressure Wound Therapy (NPWT) is a wound care technology widely used to treat complex wounds, including diabetic foot infections and pressure ulcers. The aim of this study is to examine global research trends in the field of NPWT from January 1, 1997, to March 1, 2025, using bibliometric methods, including productivity, institutional contributions, and emerging research topics.

Methods: This study is bibliometric research using Web of Science database data. The R Biblioshiny program was used for the analysis.

Results: A total of 2,386 publications were analyzed. The USA led with the most research output (n=1,660) and total citations (n=21,068), followed by China (n=668) and Germany (n=395). The most productive institution was Lund University (n=77). International Wound Journal published the most articles (n=168), while Plastic and Reconstructive Surgery had the highest h-index (30). The annual growth rate is 11.39%. The evolution of keywords had moved from technical words like “vacuum-assisted closure” (n=828) to clinical information such as “risk factors” and “surgical complications” in the recent time span.

Conclusions: The analysis of research productivity shows a high concentration of leading institutions in Sweden and the USA. However, we need to establish more extensive global collaborations.

Keywords: Negative-pressure wound therapy, bibliometric analysis, wound care, vacuum assisted closure, research trends

Introduction

Negative pressure wound therapy (NPWT) is a widely used and recommended wound care technology for the treatment of diabetic foot infections, pressure ulcers and similar complex wounds [1-3]. NPWT accelerates healing by removing harmful and corrosive substances that negatively affect healing in chronic wounds. In wounds closed using skin grafts or dermal implants, NPWT promotes granulation tissue formation, controls exudate and reduces the bacterial load in the wound [4].

In the 20th century, Russians revolutionized negative pressure treatments, particularly in surgical techniques and wound care, with Dr. Nail Bagaoutdinov using a negative pressure unit with foam dressings in 1985 [5]. NPWT involves the application of a wound dressing through which a negative pressure (or vacuum) is applied, with wound and tissue fluid being collected into a canister [6]. Dr. Louis Argenta and Michael Morykwas from Wake Forest University School of Medicine invented the mechanical vacuum and polyurethane foam that were used in the 1990s to create the current NPWT systems [7]. When it was first introduced, NPWT devices were supplied by a single manufacturer (KCI's V.A.C. system). However, as the NPWT market grew, a variety of commercial NPWT systems were developed, including smaller and portable devices. Even disposable NPWT products have recently been introduced. In resource-limited settings, simple, homemade NPWT devices using hospital vacuum pumps are also used. NPWT can be prescribed and administered by different healthcare professionals and its use outside the hospital has become widespread, especially with the development of mobile systems. Although NPWT systems differ in the type of pressure, the material in contact with the wound surface

and the dressing used, the basic principle is the same [6].

The place of NPWT in the treatment process and the rationale for its use vary according to wound type and local protocols. The National Institute for Health and Care Excellence (NICE) recommends that NPWT should be considered as a temporary dressing option prior to surgical intervention in open wounds that have been debrided but are awaiting soft tissue repair. In this situation, NPWT is used for a short period of time to reduce the risk of infection [8].

There have been many advances in NPWT technology, such as NPWT with instillation and retention (NPWTi-d). NPWTi-d promotes wound healing through wound cleansing, irrigation and non-excisional debridement. Comparative clinical studies have shown that NPWTi-d reduces the time to definitive wound healing and hospitalization. NPWTi-d, especially when using reticulated open-cell foam dressing with "through" holes (ROCF-CC), is suggested to facilitate the solubilization, decomposition and elimination of infectious materials such as necrotic tissue and dense exudate before or after surgical debridement or when surgical debridement is not possible [9].

Since the emergence of this therapy, numerous studies on NPWT have been published. But these studies have not been systematically collected and reviewed. There are continued controversies over NPWT indications, potential side effects (e.g., infection, trauma), and ethical dilemmas that make it difficult for physicians to choose the right treatment method. Based on a systematic review of the literature, clinicians and scientists can gain more knowledge about the effective use of NPWT in wound healing, including its possible future directions.

Bibliometric analysis is a methodological approach used to map the structural and dynamic aspects of a scientific field through the quantitative evaluation of publication data within that field. This method enables the identification of global research trends, institutional collaborations, and thematic evolutions over a specific time period [10, 11]. However, to our knowledge, bibliometric methods have not been used to analyze studies related to NPWT in wound healing. Therefore, this analysis aims to examine the published literature using bibliometric techniques and information visualization methods to summarize NPWT research. Additionally, this article aims to contribute to the existing body of knowledge and propose new directions for future research.

Methods

Study model

We conducted a systematic literature search using the Web of Science electronic database to identify studies evaluating NPWT. To perform the bibliometric analysis, we organized our work into three parts, following the guidelines of Donthu et al. [12]. The first part involved the systematic identification and selection of relevant data.

Data source

A bibliometric analysis using Boolean searches on the Web of Science (WoS, Clarivate Analytics, Philadelphia, PA, USA) was carried out to evaluate the main trends of publications about NPWT.

All data download procedures were completed on March 26, 2025. The process was verified through double-checking by two independent researchers. The literature search encompassed all studies published prior to March 1, 2025.

The time frame was selected to include the studies published between January 1, 1997, and March 1, 2025.

We limited the search to the 'Title (TI)' field only because, in many cases, NPWT is not the main focus but is mentioned as a secondary method (e.g., case reports or large surgical series). This allowed us to filter out thousands of irrelevant publications and focus on the core literature. We scanned all indexes (Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (AHCI), Emerging Sources Citation Index (ESCI), Conference Proceedings Citation Index- Science (CPCI-S), Conference Proceedings Citation Index- Social Sciences & Humanities (CPCI-SSH), Book Citation Index– Science (BKCI-S), Book Citation Index– Social Sciences & Humanities (BKCI-SSH)) within the Web of Science Core Collection.

We have included "Research Articles" as a document type, including those written in English.

The following were excluded from the sample: studies not published within the specified time frame; letters to the editor; reviews; case reports and case series (those without "NPWT" in the title); conference abstracts; book chapters; and studies published in languages other than English.

The search terms were as belows: TI=(Negative-Pressure Wound Therapy OR Negative-Pressure Wound Therapies OR Negative Pressure Wound Therapy OR Negative-Pressure Wound OR Wound Therapies, Negative-Pressure OR Wound Therapy, Negative-Pressure OR Topical Negative-Pressure Therapy OR Negative-Pressure Therapies, Topical OR Negative-Pressure Therapy, Topical OR Therapies, Topical Negative-Pressure OR Therapy, Topical Negative-Pressure OR Topical Negative-Pressure Therapies OR Topical Negative Pressure Therapy OR Vacuum-Assisted Closure OR Closures, Vacuum-Assisted OR Closure, Vacuum-Assisted OR Vacuum Assisted Closure OR Vacuum-Assisted Closures OR Negative-Pressure Dressings OR Dressing, Negative-Pressure OR Dressings, Negative-Pressure OR Negative-Pressure Dressing OR Negative Pressure Dressings)

Research methodology and exclusion criteria presented in the flowchart

The initial search conducted in the WoS Core Collection using keywords yielded 3,881 results. When the document type was refined to research articles, the number of publications was reduced to 2,541. By selecting English as the language of publication, the number of relevant papers further decreased to 2,386. These publications constitute the sample for the bibliometric analysis. Subsequent analyses were performed on this subset of publications

These studies were downloaded to the computer in plaintext format. They were transferred to the Biblioshiny program [13] for analysis.

Bibliometric analysis

In this study, Biblioshiny software was used to analyze, evaluate, and visualize selected articles. Developed by M. Aria and C. Cuccurullo [13] using the R statistical programming

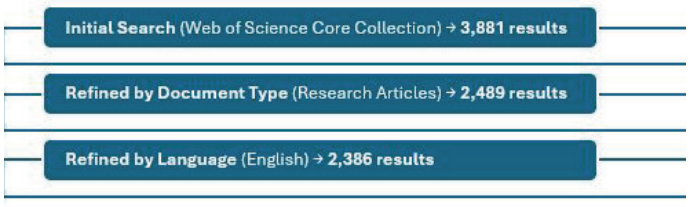

Figure 1 – **Flowchart**

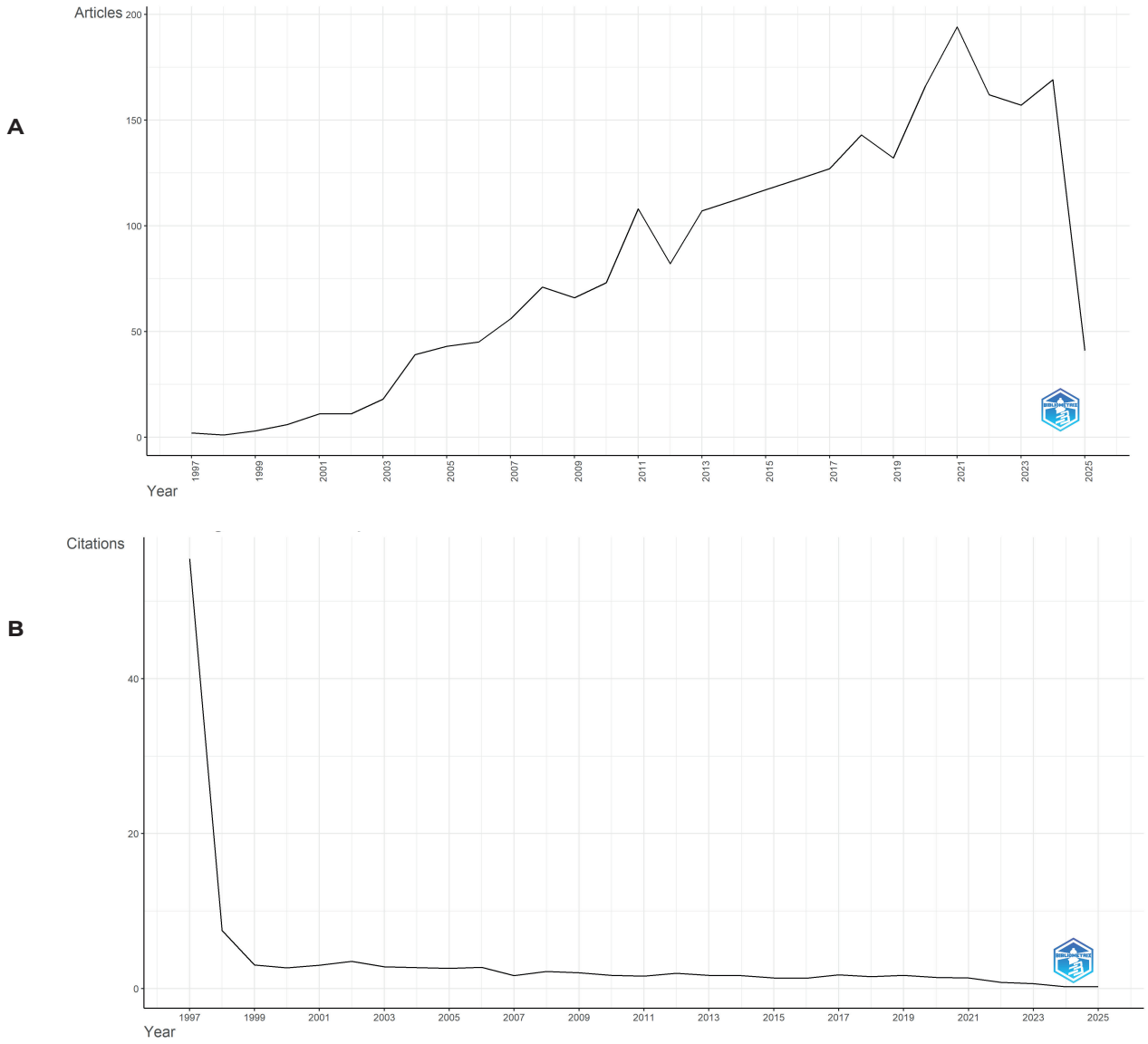

Figure 2 – Scientific Publications and Citations Statistics: A) Annual Scientific Production; B) Average Citations Per Year

language, Biblioshiny offers the possibility to import and edit data and create interactive visualizations. It offers various visualization options such as bar charts, line graphs, and maps and can be integrated with other data mining tools such as R and Excel. All analyses in our study were conducted through this software. We chose this software because it combines the capacity to process complex metadata with powerful statistical routines that provide a high level of reproducibility in the mapping process.

To assess NPWT research performance, and scientific trends and development, two main analyses were conducted using bibliometric methods such as citation analysis, trend analysis, and network analysis: (1) performance analysis was used to identify important institutions and countries in the field, and (2) science mapping was used to identify the historical development of the research field, gaps in the literature, and new/declining trends.

Results

Publication trend

The total number of publications is 2,386, spanning from 1997 to 2025. The publications were published in 591 different journals and had an annual growth rate of 11.39%. The average age of the publications was 8.75 years. In total, there were 26,135 references in these publications and 2,018 Keywords Plus (ID) and 3,280 Keywords (DE) were used. According to the data on authors, there were 9,943 authors, and 87 articles were single-authored. The average number of authors in each publication was 5.37. Furthermore, 10.23% of publications were published in international collaborations.

The first publication was released in 1997. There is a general upward trend in the number of articles published over the years. Originally, only 2 articles were published in 1997; however, the amount has since increased over the years. There has been a notable rise in the number of publications, particularly since the early 2000s. The number of articles began to grow in 2004, experiencing large increases such as 56 in 2007 and 71 in 2008. Since 2015, approximately 120 articles have been published annually. In 2020, 166 articles were published. There was an increase to 194 articles in 2021, followed by a slight decline in 2022 and 2023. The number of articles has increased again since 2024 (Figure 2a). Although the number of published articles continues to rise over time, the average number of citations and the annual number of citations have continued to decline (Figure 2b). The annual publication and citation counts are presented in Figures 2a and 2b.

Table 1 Top cited 10 articles

No	Title	Authors	Source Title	Publication Year	DOI	Total Citations	Average per Year
1	Vacuum-assisted closure: A new method for wound control and treatment: Animal studies and basic foundation	Morykwas, MJ et al.	Annals of plastic surgery	1997	10.1097/00000637-199706000-00001	1613	55.62
2	Vacuum-assisted closure: A new method for wound control and treatment: Clinical experience	Argenta, LC et al.	Annals of plastic surgery	1997	10.1097/00000637-199706000-00002	1603	55.28
3	Negative pressure wound therapy after partial diabetic foot amputation: a multicentre, randomised controlled trial	Armstrong, DG et al.	Lancet	2005	10.1016/S0140-6736(05)67695-7	647	30.81
4	Vacuum-assisted closure: Micro deformations of wounds and cell proliferation	Saxena, V et al.	Plastic and reconstructive surgery	2004	10.1097/01.prs.0000135330.51408.97	526	23.91
5	Comparison of negative pressure wound therapy using vacuum-assisted closure with advanced moist wound therapy in the treatment of diabetic foot ulcers: A multicenter randomized controlled trial	Blume, PA et al.	Diabetes care	2008	10.2337/dc07-2196	418	23.22
6	Bacterial load in relation to vacuum-assisted closure wound therapy: A prospective randomized trial	Mouës, CM et al.	Wound repair and regeneration	2004	10.1111/j.1067-1927.2004.12105.x	398	18.09
7	The use of vacuum-assisted closure therapy for the treatment of lower-extremity wounds with exposed bone	DeFranzo, AJ et al.	Plastic and reconstructive surgery	2001	10.1097/00006534-200110000-00013	327	13.08
8	Vacuum-assisted closure: State of basic research and physiologic foundation	Morykwas, MJ et al.	Plastic and reconstructive surgery	2006	10.1097/01.prs.0000225450.12593.12	304	15.20
9	Incisional Negative Pressure Wound Therapy After High-Risk Lower Extremity Fractures	Stannard, JP et al.	Journal of orthopaedic trauma	2012	10.1097/BOT.0b013e318216b1e5	278	19.86
10	State-of-the-art treatment of chronic leg ulcers: a randomized controlled trial comparing vacuum-assisted closure (VAC) with modern wound dressings	Vuerstaek, JDD et al.	Journal of vascular surgery	2006	10.1016/j.jvs.2006.07.030	259	12.95

Most cited articles and citations by years

Table 1 (see the next page) summarizes the top 10 most-cited articles on NPWT. The findings highlight three key studies that have made the most significant contributions to the NPWT literature. The study titled "Vacuum-assisted closure: A new method for wound control and treatment: Clinical experience," which has received 1,613 citations and is the most cited article, examines the fundamental biological effects of NPWT using animal models [14]. The second most-cited article, "Negative Pressure Wound Therapy: A New Method for Wound Control and Treatment: Clinical Experience" [15], with 1,603 citations, reviews the clinical experience demonstrating the efficacy of NPWT in the treatment of large wounds. The third most-cited article, "Negative pressure wound therapy after partial diabetic foot amputation: a multicenter, randomized controlled trial" [16], with 647 citations, addresses the mechanisms of action of NPWT in the healing of diabetic foot amputations.

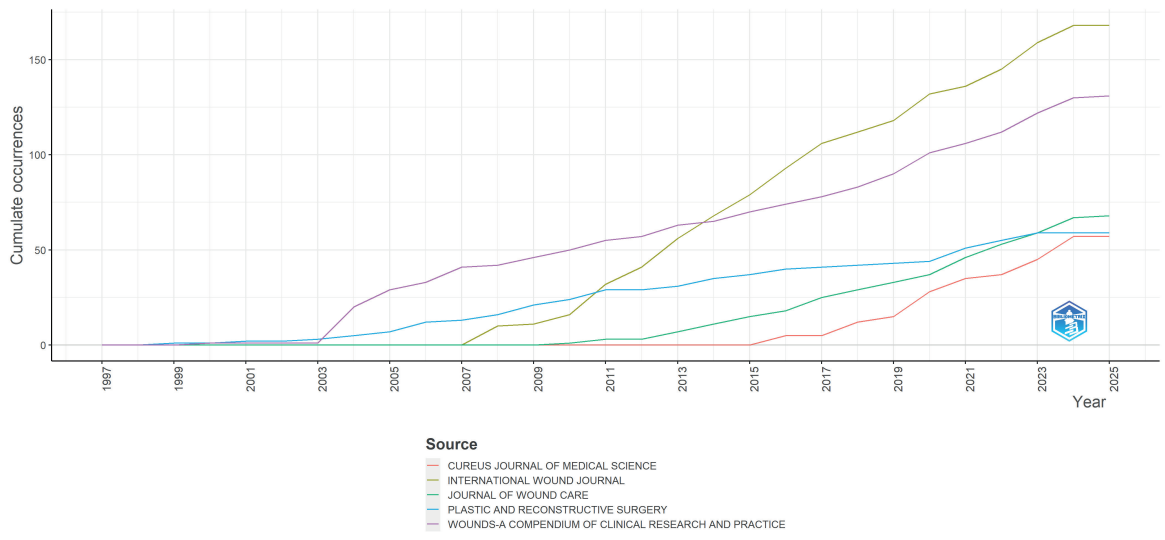

Figure 3 – Top Sources' Production over Time

Table 2 Average Citations per Article, Number of Articles, Total Citations per Year, and Citable Years (1997-2025)

Year	Mean Total Citations per Article	Number of Articles	Mean Total Citations per Year	Citable Years
1997	1608	2	55.45	29
1998	210	1	7.50	28
1999	83	3	3.07	27
2000	70	6	2.69	26
2001	75.27	11	3.01	25
2002	84.45	11	3.52	24
2003	65.06	18	2.83	23
2004	59.67	39	2.71	22
2005	55.16	43	2.63	21
2006	55.16	45	2.76	20
2007	32.11	56	1.69	19
2008	40.17	71	2.23	18
2009	34.89	66	2.05	17
2010	27.33	73	1.71	16
2011	24.36	108	1.62	15
2012	27.98	82	2.00	14
2013	22.17	107	1.71	13
2014	20.27	112	1.69	12
2015	15.32	117	1.39	11
2016	13.56	122	1.36	10
2017	16.17	127	1.80	9
2018	12.35	143	1.54	8
2019	11.94	132	1.71	7
2020	8.64	166	1.44	6
2021	6.89	194	1.38	5
2022	3.24	162	0.81	4
2023	1.94	157	0.65	3
2024	0.5	169	0.25	2
2025	0.24	41	0.24	1

Table 2 summarizes the average number of citations per article, the total number of articles, and the total annual number of citations. According to the data, whilst the average number of citations per article was quite high in 1997, this figure had fallen to 0.24 by 2025; similarly, the annual average citation rate, which stood at 55.45 in 1997, had dropped to 1.44 by 2020.

Publication distribution of journals

The International Wound Journal is the most prolific journal in this field, with 168 articles, 28.2% more than the second-ranked journal. "Wounds: A Compendium of Clinical Research and Practice" journal ranks second with 131 articles. The Journal of Wound Care ranks third with 68 publications, and Plastic and Reconstructive Surgery, the leading journal in plastic surgery, ranks fourth with 59 articles. The distribution of publications in the field is concentrated in certain journals, with open access journals like Cureus Journal of Medical Science and Plastic and Reconstructive Surgery-Global Open ranking in the top 10. Specialty journals like Annals of Plastic Surgery and Wound Repair and Regeneration also hold significant importance in the list.

Figure 3 shows the cumulative publication growth and scientific output trends of the five leading journals in NPWT between 1997 and 2025.

The distribution of publications in the field is concentrated in certain journals, with open access journals like Cureus Journal of Medical Science and Plastic and Reconstructive Surgery-

Table 3 Top Journals' Local Impact

Journal	Category quartile	h-index	g-index	m-index	Total Citations	Number of publications	Publication year threshold
PLASTIC AND RECONSTRUCTIVE SURGERY	Q1	30	59	1,111	4101	59	1999
INTERNATIONAL WOUND JOURNAL	Q1	28	44	1,556	2944	168	2008
ANNALS OF PLASTIC SURGERY	Q3	25	49	0,862	5295	49	1997
WOUND REPAIR AND REGENERATION	Q1	20	41	0,909	1737	46	2004
JOURNAL OF ORTHOPAEDIC TRAUMA	Q3	17	33	0,739	1448	33	2003
ANNALS OF THORACIC SURGERY	Q1	16	20	0,593	1241	20	1999
JOURNAL OF PLASTIC RECONSTRUCTIVE AND AESTHETIC SURGERY	Q2	15	28	0,789	787	28	2007
WOUNDS-A COMPENDIUM OF CLINICAL RESEARCH AND PRACTICE	Q3	14	27	0,538	1110	131	2000
ANNALS OF SURGERY	Q1	13	13	0,591	913	13	2004
JOURNAL OF VASCULAR SURGERY	Q1	13	17	0,619	743	17	2005
OSTOMY WOUND MANAGEMENT	Q2	13	20	0,619	468	30	2005
INTERACTIVE CARDIOVASCULAR AND THORACIC SURGERY	Q2	12	19	0,75	397	20	2010
JOURNAL OF WOUND CARE	Q3	12	18	0,75	479	68	2010
AMERICAN JOURNAL OF SURGERY	Q1	11	14	0,44	682	14	2001
WORLD JOURNAL OF SURGERY	Q2	11	15	0,579	571	15	2007
EUROPEAN JOURNAL OF CARDIOTHORACIC SURGERY	Q2	10	10	0,385	452	10	2000

Table 4 Comparative Analysis of Scientific Productivity and Citation Impact by Country

Country	Total Publications	Total Citations	Avarage Citations/ Article	Category*
United States	1660	21068	30.80	A
Germany	395	4047	24.50	A
Sweden	255	2626	32.80	A
United Kingdom	336	238	19.80	B
China	668	2113	8.20	C
Italy	256	1368	13.80	B
Netherlands	144	1261	34.10	A
Canada	111	1025	26.30	A
Switzerland	84	851	23.00	B
Australia	233	783	14.20	B
Japan	298	722	5.40	C
South Korea	109	698	12.00	B
Turkey	153	671	8.80	C
Belgium	51	509	21.20	B
France	111	500	14.30	B
South Africa	-	479	39.90	-
India	137	417	6.10	C
Ireland	38	409	21.50	B
Austria	49	337	17.70	B
Singapore	51	305	12.70	B
Brazil	54	277	15.40	B
Poland	72	231	9.20	C
Spain	74	212	9.60	C
Denmark	79	190	8.60	C
Greece	-	183	15.20	-

**Performance Categories:*
A: High publication volume with strong citation impact
B: Moderate publication volume with good citation impact
C: High publication volume but low citation impact

Global Open ranking in the top 10. Specialty journals like Annals of Plastic Surgery and Wound Repair and Regeneration also hold significant importance in the list.

Plastic and Reconstructive Surgery demonstrates early dominance with consistent publications since 1999, reaching its apparent saturation point (n=59) by 2023. In contrast, Wounds-A Compendium of Clinical Research and Practice exhibited exponential growth between 2004-2008 (1 to 42 publications), later stabilizing with marginal annual increases. The International Wound Journal shows the steepest trajectory, with 158 publications added since its 2008 inception (10 publications) to 2024 (168 publications), reflecting a compound annual growth rate of 18.2%. Notably, the Journal of Wound Care and Cureus Journal of Medical Science represent more recent contributors, with 88% and 100% of their respective outputs (68 and 57 publications) occurring post-2015. The longitudinal bibliometric analysis of five leading wound care journals (1997-2025) reveals distinct evolutionary phases: an initial incubation period (1997-2007) characterized by minimal output (dominated solely by Plastic and Reconstructive Surgery), followed by an exponential growth phase (2008-2019) marked by the emergence of specialty journals like International Wound Journal.

The comprehensive measurements on featured journals List of featured journals in the field are shown in Table 3. The data includes five key metrics: h-index, g-index, m-index, total citations, and number of publications. Plastic and Reconstructive Surgery (Q1) has the highest h-index (30) with 4101 citations and 59 publications, indicating its leading position. International Wound Journal (Q1) has the highest annual citation performance with its m-index value (1.556) and highest productivity with 168 publications. Despite having the highest total number of citations, Annals of Plastic Surgery (Q3) remains weak in terms of annual impact due to its low m-index value (0.862). Wounds-A Compendium of Clinical Research and Practice (Q3) shows high productivity with 131 publications but has low h-index and m-index values, indicating limited citation activity. Table 3 shows that Q1 journals generally have higher number of citations, but there is no linear relationship between publication number and citation performance. Newer journals like International Wound Journal show better annual performance, reflecting the dynamic changes in this field.

Top countries contributing to NPWT research and international collabrations

Table 4 presents a comparative analysis of scientific productivity and number of citations by country, based on all

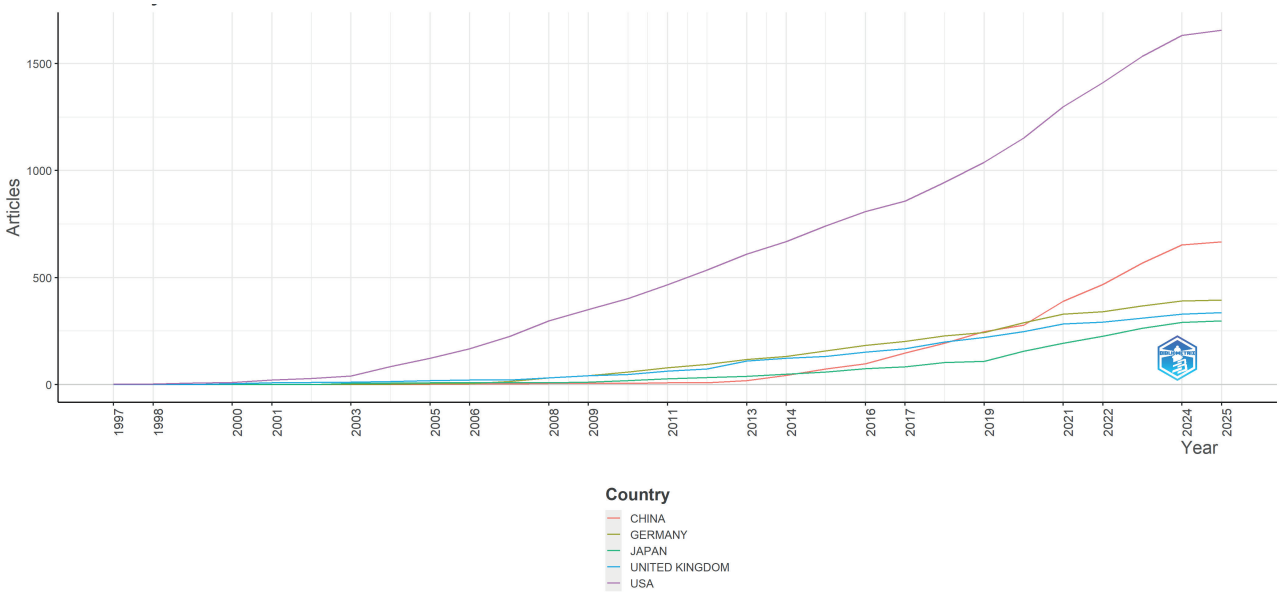

Figure 4 – Top published Countries' Production over Time

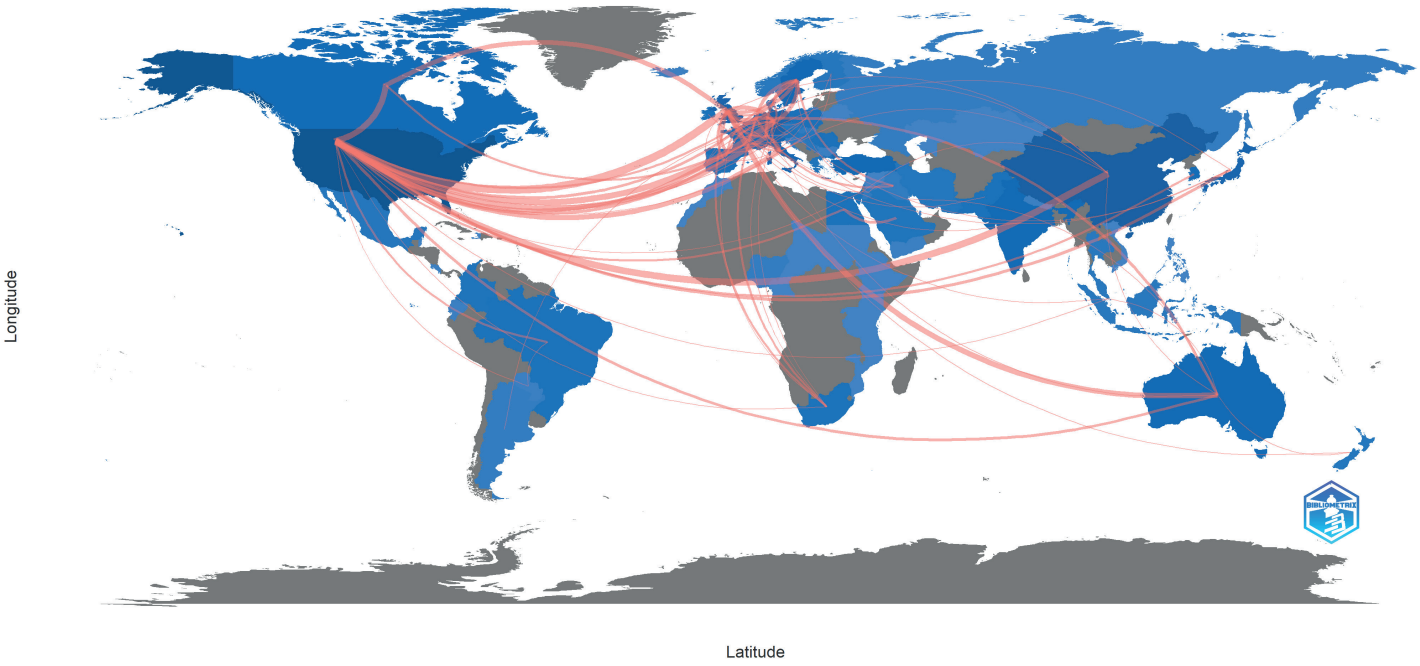

Figure 5 – Countries' Collaboration World Map

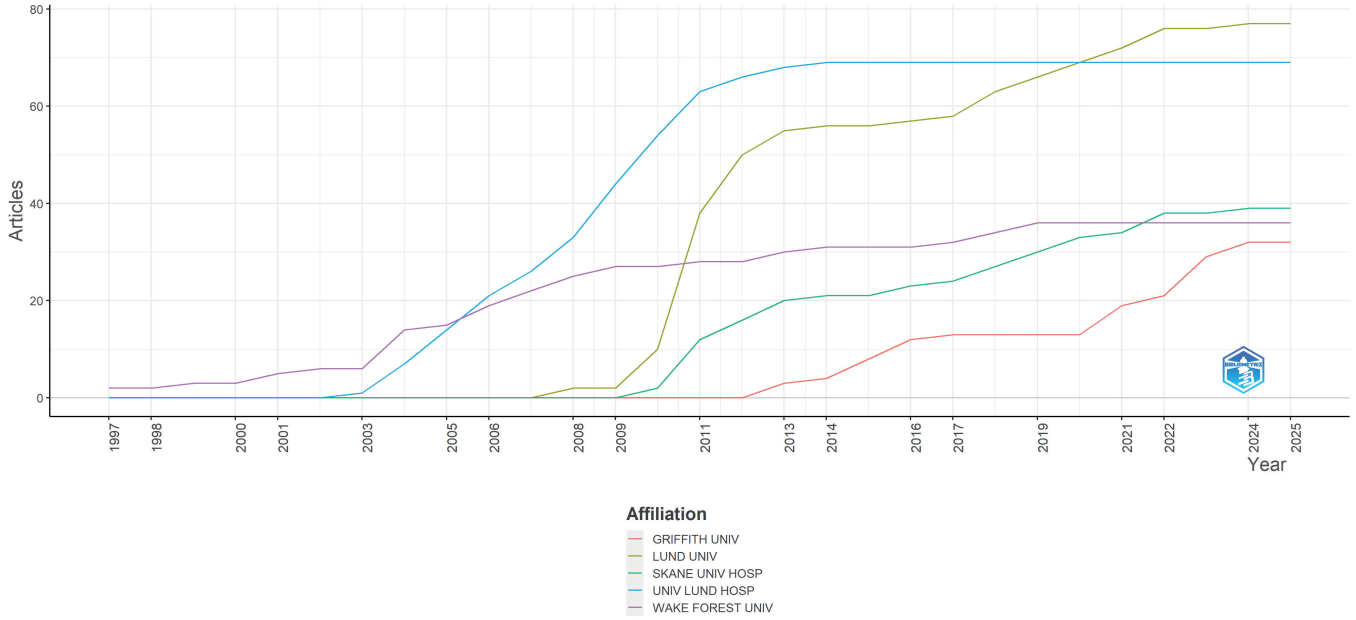

Figure 6 – Affiliations' Production over Time

authors. The USA leads globally in both total of publications (n=1,660) and citations (n=21,068), with a strong citation rate of 30.80 per article. Germany (395 publications, 24.50 average citations), Sweden (255 publications, 32.80 average citations), and the Netherlands (144 publications, 34.10 average citations) are among the high-performing European countries. The United Kingdom, with 336 articles, exhibits a moderate influence (19.80 average citations). In contrast, China exhibits a notable quantity-quality gap, ranking second in total publications (n=668), but with a low number of citations (8.20 average citations). With 153 publications and 671 total citations (8.8 average citations), Turkey maintains to hold a middle-of-the-road position, while more focused, high-impact research helps smaller but more productive producers like Switzerland (23.00 average citations) and Belgium (21.20 average citations). The remarkable number of citationss of the Netherlands (34.1%) and South Africa (39.90 average citations) are especially noteworthy, indicating focused expertise in particular research fields.

The analysis of the number of publications by country is shown in Figure 4. The United States recorded significant growth, rising from two publications in 1997 to a total of 1,656 in 2025, and has been the country with the highest annual output every year. In the United Kingdom, an increase in the number of publications was observed after 2010. Japan's publication count remained at a low level until 2003, then peaked between 2020 and 2023. Germany's first publication activities began in 2004, and an increase in the number of publications was observed in subsequent years. No publications were released from China until 2005, but there has been an exponential increase over the past decade.

Figure 5 shows the frequency of international links among the countries with the highest publishing volumes. The USA maintains the most intensive relationships with the UK (24), China (18), Canada and Germany (15 each), while the UK

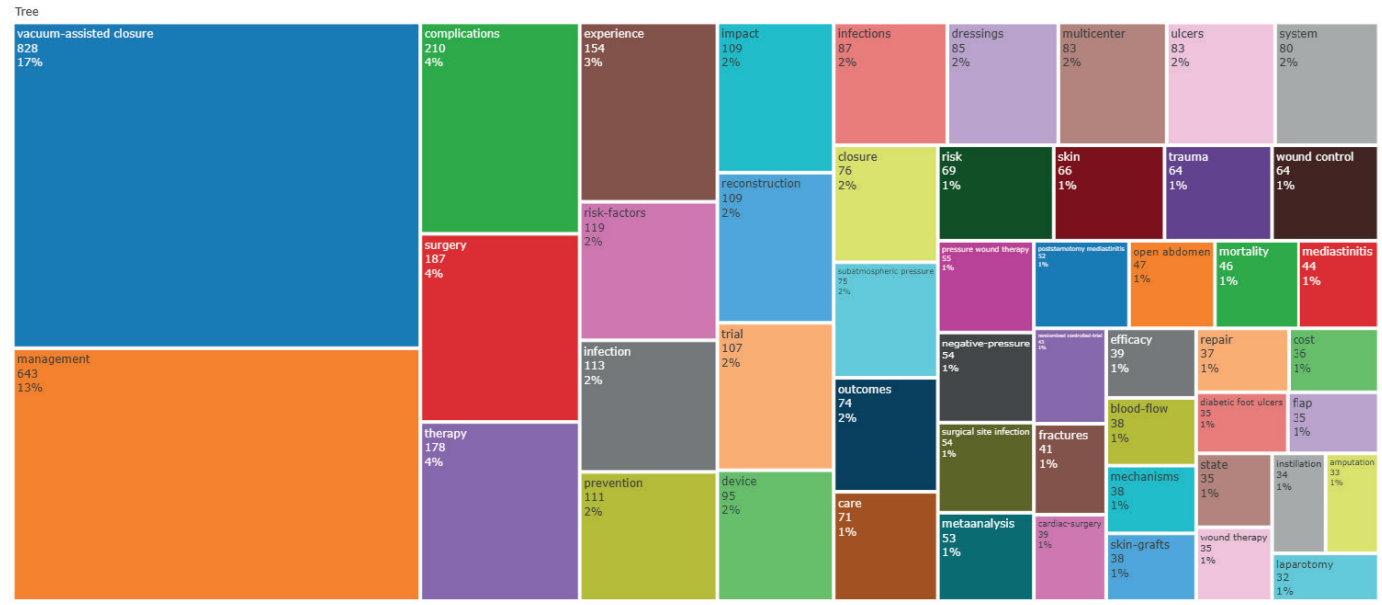

Figure 7a – TreeMap

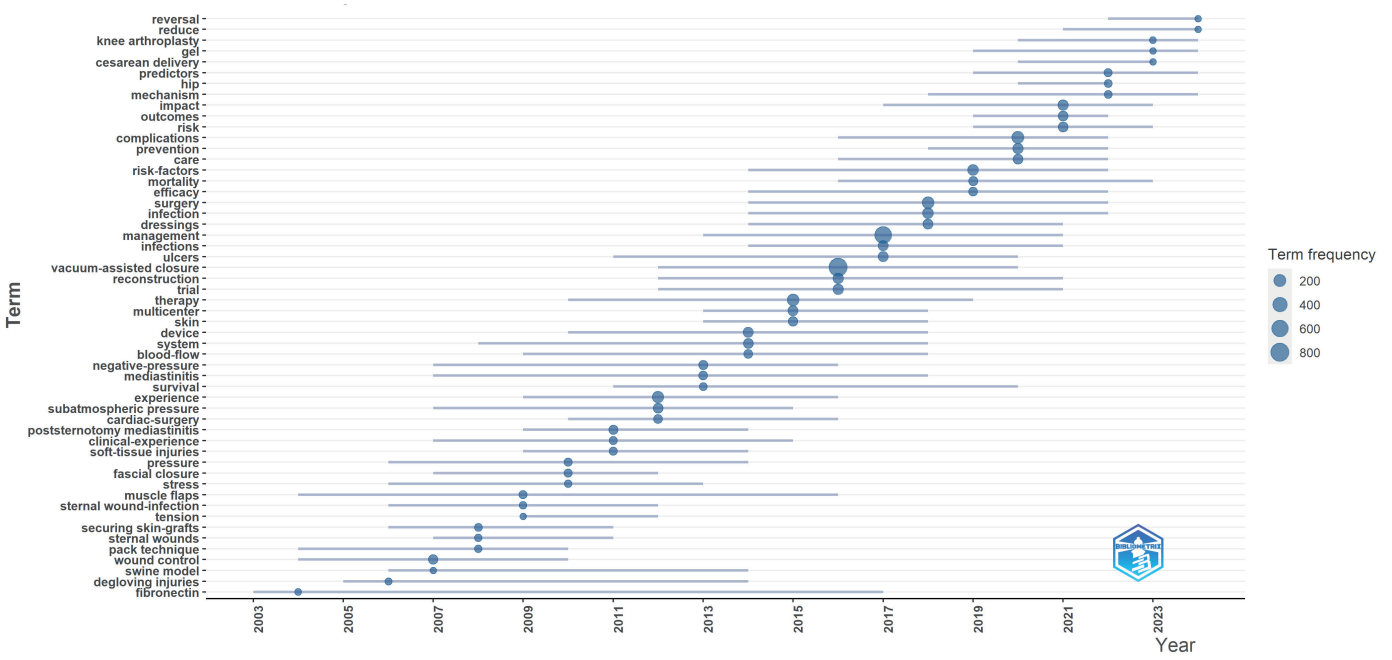

Figure 7b – Trend Topics

interacts most with Australia (11) and Canada (9). Germany has strong ties with Sweden, Switzerland and the United Kingdom (8 each). European countries (France, Italy, the Netherlands, Switzerland) maintain close ties with each other, while Asian and Middle Eastern countries are less frequent. Overall, the USA and Western countries are predominantly in the center.

Most Relevant Affiliations

When examining the cumulative number of publications by institution, certain regional clusters and academic networks stand out. Sweden demonstrates a high research output through the Lund academic network, which primarily consists of Lund University (n = 77 publications), Lund University Hospital (n = 69), and Skåne University Hospital (n = 39). While the bibliometric tool used in this study records these institutions as separate units, it does not allow for manual corrections. Additionally, the United States has made significant publication contributions through Wake Forest University (n = 36), Harvard University (n = 24), and the Mayo Clinic (n = 18). Other major contributing institutions are, in order: from China, Wuhan University (n = 30) and Shanghai Jiao Tong University (n = 24); from Germany, Hannover Medical School (n = 22) and the University of Erlangen-Nuremberg (n = 21); from the United Kingdom: the University of Oxford (n = 23) and the University of Warwick (n = 18); from Australia: Griffith University (n = 22) and the University of Queensland (n = 19); from Brazil: the University of São Paulo (n = 9); and from Canada: the University of Toronto (n = 18). Although automated software analyses present institutional rankings separately based on name variations in metadata, this assessment has identified institutions affiliated with Lund, along with Wake Forest University—recognized as a pioneer of modern NPWT—as the most productive institutions.

Figure 6 shows the distribution of annual publication numbers for the most productive institutions in the field of NPWT over the years. The data indicates that Wake Forest

Table 5 Keyword analysis

Words	Occurrences
vacuum-assisted closure	828
management	643
complications	210
surgery	187
therapy	178
experience	154
risk-factors	119
infection	113
prevention	111
impact	109
reconstruction	109
trial	107
device	95
infections	87
dressings	85
multicenter	83
ulcers	83
system	80
closure	76
subatmospheric pressure	75
outcomes	74
care	71
risk	69
skin	66
trauma	64
wound control	64
pressure wound therapy	55
negative-pressure	54
surgical site infection	54
metaanalysis	53
poststernotomy mediastinitis	52
open abdomen	47
mortality	46
mediastinitis	44
randomized controlled-trial	43
fractures	41
cardiac-surgery	39
efficacy	39
blood-flow	38
mechanisms	38
skin-grafts	38
repair	37
cost	36
diabetic foot ulcers	35
flap	35
state	35
wound therapy	35
instillation	34
amputation	33
laparotomy	32

University, based in the USA has maintained its leadership in the field with a steady increase, while Swedish institutions such as Lund University and its affiliated hospitals, as well as Skåne University Hospital, have made a significant surge, particularly after 2010. Additionally, there has been a rapid rise in the number of publications from Griffith University in Australia in recent years.

Keyword analysis and trend topics

Figure 7a and Table 5 summarize the keyword analysis data, while Figure 7b summarizes the trend topic analysis. The term “vacuum-assisted closure,” which appeared 828 times, is the most frequently used word. Terms such as “therapy” (n = 178), “pressure wound therapy” (n = 55), “negative pressure” (n = 54), and “wound therapy” (n = 35) were also used very frequently. These synonymous or closely related technical terms were not manually merged due to the software’s design, which preserves the repeatability of the raw metadata.

Following these keywords, the term “management” (n = 643) stands out, highlighting the field’s emphasis on developing systematic approaches, particularly for patient care. The prominence of the terms “complications” (n = 210) and “infection” (n = 113) underscores the persistent challenges clinicians face in postoperative care and wound healing. Related terms such as “surgical site infection” (n = 54) and “mediastinitis” (n = 44) reveal the scope of their application in this context. The surgical dimension is strongly represented through multiple keywords, including "surgery" (187), "reconstruction" (109), "closure" (76), and "flap" (35), demonstrating the interdisciplinary nature of wound management that bridges general surgery, plastic surgery, and specialized interventions. Therapeutic approaches constitute another major theme, with "therapy" (178) serving as an umbrella term complemented by more specific modalities like "pressure wound therapy" (55), "negative-pressure" (54), and "wound therapy" (35). The technical aspects of treatment are further emphasized by terms such as "device" (95), "system" (80), and "dressings" (85), reflecting the continuous innovation in wound care technologies. Research methodology emerges as a significant focus area, evidenced by the frequent appearance of "trial" (107), "randomized controlled-trial" (43), and "metaanalysis" (53). These are complemented by "multicenter" (83) and "experience" (154), suggesting a field that values both rigorous evidence-based approaches and collective clinical expertise. Outcome measurement is prominently represented through "outcomes" (74), "efficacy" (39), and "mortality" (46), indicating the growing emphasis on result-oriented care. Specialized wound types receive considerable attention, particularly "ulcers" (83) with its subtype "diabetic foot ulcers" (35), as well as "open abdomen" (47) and "poststernotomy mediastinitis" (52). The anatomical focus extends to "skin" (66), "muscle flaps" (20), and "skin-grafts" (38), demonstrating the multifaceted approach to tissue repair. Emerging trends in the field are visible through terms like "risk-factors" (119), "prevention" (111), and "impact" (109), reflecting a paradigm shift toward proactive care and holistic assessment of treatment effects. The inclusion of "cost" (36) and "care" (71) suggests growing recognition of healthcare economics and patient-centered approaches in wound management (Table 5).

The most frequently used keywords in the articles include "vacuum-assisted closure" (828 occurrences), followed by "management" (643), "complications" (210), "surgery" (187), and "therapy" (178). Other commonly appearing terms are "experience" (154), "risk factors" (119), "infection" (113), "prevention" (111), "impact" (109), "reconstruction" (109), and "trial" (107). Additional notable keywords consist of "device" (95), "infections" (87), "dressings" (85), "multicenter" (83), "ulcers" (83), "system" (80), "closure" (76), "subatmospheric pressure" (75), "outcomes" (74), "care" (71), "risk" (69), "skin" (66), and "trauma" (64) (Figure 7a).

The trend analysis of keywords (Figure 7b) reveals the evolution of research focus over time. Early terms like "fibronectin" (2003–2017, peak 2004) and "degloving injuries" (2005–2014, peak 2006) were gradually replaced by broader concepts such as "wound control" (2004–2010, peak 2007) and

"muscle flaps" (2004–2016, peak 2009). Between 2009–2014, clinical conditions like "poststernotomy mediastinitis" (peak 2011) and techniques like "subatmospheric pressure" (peak 2012) gained prominence. The period 2012–2016 saw dominant keywords like "vacuum-assisted closure" (peak 2016), "therapy" (peak 2015), and "negative-pressure" (peak 2013), reflecting advancements in wound care technology. From 2016 onward, research shifted toward "management" (peak 2017), "surgery" (peak 2018), "complications" (peak 2020), and outcome-focused terms like "risk factors" (peak 2019) and "mortality" (peak 2019). Recent trends (2020–2024) highlight emerging topics such as "predictors", "hip", "knee arthroplasty", and "cesarean delivery", alongside methodological terms like "mechanism" and "gel", indicating a diversification into specialized surgical and mechanistic studies. Notably, "vacuum-assisted closure" remained highly cited until 2020, while "reconstruction" and "trial" persisted through 2021, underscoring sustained interest in evidence-based surgical solutions.

Discussion

NPWT is a widely recognized method for managing chronic wounds, but a comprehensive analysis of research trends is lacking. Despite similar studies on chronic wounds [17-20], no study specifically focusing on NPWT has been found. This gap highlights the need for a systematic evaluation of global research output, collaboration patterns, and emerging trends in NPWT to guide future scientific studies. A bibliometric analysis could provide insights into the most productive countries, leading institutions, key authors, and international collaborations shaping the field. It could identify research disparities, track temporal trends, and foster stronger global partnerships. Addressing this gap would consolidate existing knowledge and direct future research towards understudied areas [17-19,21]. Based on the bibliometric analysis conducted in this study between 1997 and 2025, we can make the following observations: (i) There has been a steady increase in the number of NPWT studies and this topic has attracted attention with close cooperation among various countries. (ii) Some scholars and journals have focused on NPWT research and achieved significant results and impact, but their impact is not fully consistent with the total number of articles published. Research on surgical procedures has evolved over time, with early focus on biomaterials and injuries, middle periods on clinical conditions and technological innovations, and near-term trends focusing on management, complications, and outcome analysis. Current trends (2020-2024) see a diversified focus on specialized surgical fields (“knee arthroplasty”, “cesarean delivery”), mechanistic studies, and intervention optimization, with evidence-based surgical solutions such as vacuum-assisted closure and reconstruction. This demonstrates a continued interest in NPWT studies.

Research topic that has received attention from numerous scholars and journals. These scholars and journals cover a wide range of specialties. For example, the most publications were in the plastic surgery specialty, and the others were in the wound and anesthesia specialties respectively. The bibliometric analysis of NPWT research publication trends shows a dynamic evolution, with the International Wound Journal dominating the field with 168 articles and an 18.2% compound annual growth rate since 2008. The data shows three phases: early (1997-2007) dominance by Plastic and Reconstructive Surgery, exponential growth of specialty journals from 2008-2019, and a maturation phase (2020-2025) with the stabilization of traditional journals and the explosive growth of open-access platforms like Cureus. Although Plastic and Reconstructive Surgery still leads in terms of h-index and total citations, newer Q1 journals, such as the International Wound Journal, appear to have better annual citation performance, indicating a change in spread of research. The rise of open-access publishing and the predominance of wound care in specialized journals over general surgical journals illustrate the increasing maturity and specialisation of the field, with its own classical and digital habits, influenced by recent advances in the technology of wound care and shifts in publishing trends.

The landscape of NPWT research shows specific trends in relation to scientific activity and cooperation. More than half (n = 13 articles) originated from the United States, representing the United States’ established research infrastructure and national presence, compared with other nations based on its publication volume (1,660 articles) and number of citations (21,068 total citations) in the field. European countries including Germany, Sweden, and the Netherlands produced fewer papers, but have relatively high average citation rates (24.50–34.10 per article). In contrast, while China ranks second in terms of output (668 articles), its citation count is lower (an average of 8.20).

Collaboration networks further illustrate the dynamics of NPWT research, with the USA maintaining the strongest ties, particularly with the U.K., China, and Germany. European countries exhibit dense intraregional partnerships, while Asian and Middle Eastern nations remain relatively isolated. Leading institutions such as Sweden’s Lund University and the USA’s Wake Forest University dominate production, with Sweden emerging as a hub post-2010. Wake Forest, a pioneer in NPWT, has sustained steady output, whereas Australian institutions like Griffith University show rapid recent growth, signaling geographic diversification in research. These trends highlight the critical role of international collaboration in driving innovation, with Western nations remaining central to global networks while newer players gradually expand their influence. The rise in the number of publications by institutions in Australia and China points to a changing landscape.

Among the latest innovations in NPWT is application and waiting time (NPWTi-d), which enhances wound healing through debridement that does not require irrigation and excision. Clinical evidence shows that NPWTi-d reduces hospital stay and healing time, especially when using 'passage' perforated mesh open-cell foam (ROCF-CC) to facilitate the removal of necrotic tissue and infected material [9]. Our keyword analysis confirms that applications requiring specialized expertise are increasingly coming to the fore, with “instillation” emerging as a significant keyword (n = 34). These data reflect the growing academic interest in NPWTi-d, highlighting this topic as a new area of focus in the literature.

Limitations

To the best of our knowledge, there has been no bibliometric study about NPWT research-associated literature investigating WoS database globally. Our research, analysis of NPWT research trends has several limitations. It contained only the studies that were indexed in the Web of Science database, which may have been excluded some studies on different databases or published with languages other than English. When evaluating the findings of this study, certain methodological limitations should be taken into account: a title-only search strategy, a lack of affiliation disambiguation, and limited keyword harmonization. We made this choice to ensure direct access to the core NPWT literature. Another limitation of the study concerns the use of

the terms “citable years” or “citability length.” This concept does not represent an independent metric. It reflects the age of the publication or the defined citation window. To avoid any misunderstanding, readers are advised to interpret this concept as an indicator of the time elapsed since the publication date.

Citation metrics may highlight articles published in the past and, as a result, underestimate the contribution of more recently published high-quality research. It should be noted that the decline in the average number of citations observed in recent publications stems from a shorter citation accumulation period rather than a decline in the research’s impact or quality; therefore, readers should evaluate the article from this perspective. This study focuses solely on numerical data related to research productivity; no content analysis was conducted. Differences in institutional names and changes in the institutions to which authors are affiliated may reduce the reliability of institutional productivity rankings. Based on keyword and trending topic analyses, synonyms such as ‘NPWT,’ 'VAC,‘ and 'vacuum-assisted closure’ were treated as separate nodes to preserve the raw repeatability generated by the software; it is acknowledged that this approach leads to a certain degree of thematic fragmentation in semantic mapping. However, the bibliometric method used does not allow for manual revision. Scientific literature is dynamic, and since indexing may be delayed, the most recent reports have not been included. Future studies could be made more efficient by incorporating alternative metrics and utilizing multiple databases.

Conclusion

In our study, we examined only the core NPWT literature with high specificity; that is, we created a dataset by conducting a “title-only” search. According to our findings, the number of publications on NPWT has increased globally, and research focuses have diversified. The United States and Sweden are the countries with the highest share of publications; institutions based in the USA and Sweden have emerged as the most productive and influential centers. According to our data, the current research focus has shifted from technical developments to clinical outcome reports. Additionally, the data indicates that evidence gaps still exist in areas such as local protocols and cost-effectiveness, and that academic interest in instillation therapy is increasing.

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