



Current status of research on emergency surgery score in trauma patients: a bibliometric analysis

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Background: The use of a relevant emergency score can provide an accurate assessment of the patient's condition and prognosis. However, the status of related studies remains unclear. The current study analyzed the research status of emergency surgery score (ESS) of trauma patients by using bibliometric methods.

Methods: The Science Citation Index Expanded (SCI-E) database in the Web of Science Core Collection (WOSCC) was searched using keywords “trauma” and “emergency surgery score”. All records from the search results and cited references were exported to Excel, duplicate literature records were removed, information for the same author and organization in different signature forms were merged. The resulting literatures were analyzed by year of publication, citation, discipline, countries and research institutions, journals, authors, and use of keywords. The cooperation among countries, institutions, and authors was also examined.

Results: A total of 2,175 document were retrieved. The number of published literature and the number of citations per year increased annually. The number of published documents (n=1,029) and research cooperation (centrality score, 0.44) in the United States were significantly ahead of those in other countries. The ten research institutions with the largest number of published documents were all from the United States, with much cooperation between research institutions and authors. There were many publications from China (n=108), but with few cooperations (centrality score, 0.22). The journals with the largest number of published articles were professional in the fields of trauma, emergency, and critical care. Keyword analysis showed that infection and shock were important issues besides surgery in the research related to ESS of trauma patients.

Conclusions: Research related to ESS of trauma patients has been mainly conducted in the United States, and Chinese researchers should increase their level of cooperation.

Keywords: Trauma; emergency surgery score (ESS); bibliometrics analysis

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Introduction

Trauma, resulting from human factors or natural disasters, is a major cause of morbidity and mortality worldwide (1-3). Trauma often requires urgent surgical treatment, and this can depend on the quality of the assessment and triage process (4-6). Increasingly, researchers have introduced various disease scores after analyzing a large number of injury related data (4-8). While some of the scores were designed for trauma patients, score that was designed for other patients have also become applicable for trauma patients (7). Among them, the emergency surgery score (ESS) for trauma patients remains a major focus of clinical research. ESS comprise several factors related to patient's condition to help clinician to evaluate the severity of disease or trauma. This tool may also helpful in clinical practice for doctors to provide palliative care to patients with trauma and emergency surgery (9). A previous study demonstrated that the ESS accurately predicts mortality across patients undergoing emergency surgery in multiple surgical specialties, especially general, gynecologic, and urologic surgery. The ESS can prove useful for perioperative patient counseling and for benchmarking the quality of surgical care (10). However, the general situation of studies on ESS remains unclear. Bibliometrics provides statistics and analysis of the relevant literature on a certain topic, showing the information on nations, institutions, researchers, journals, and the use of keywords in the relevant literature

on the topic, and cooperation status (11-14). This current study used bibliometric methods to analyze the research status of the ESS of trauma patients.

Methods

Literature search

Since it is the leading scientific database with daily updating, the Science Citation Index Expanded (SCI-E) database (online version) in the Web of Science Core Collection (WOSCC) was searched for related articles published from the inception of the database to October 22, 2022. A topic term search was performed using the search words "trauma" and "emergency surgery score" by two authors (Z.H. and Z.C.).

Data analysis

All records of the search results and references cited in were exported into Excel. Duplicate literature records were removed manually according to title sorting, and information for the same author and organization in different signature forms were combined. The documents were analyzed by year of publication, citation, discipline, countries and research institutions, journals, authors, and keywords used. The cooperation among countries, institutions, and authors was also examined.

Statistical analysis

Data are expressed in terms of quantity and percentage (n, %). All data were analyzed using the bibliometric software package of R software.

Results

General information

A total of 2,863 literature records were searched, and were screened by Z.H. and Z.C. After 688 duplicate records were removed, a total of 2,175 publications were included in final analysis. The number of published literatures showed an annual upwards trend (*Figure 1*). A total of 38,212 articles were cited, and 963 of which were self-cited. The 2,175 literatures were cited 53,808 times, and the number of citations per year also showed an obvious annual upward trend (*Figure 1*). The H-index of these documents

Highlight box

Key findings

- Research related to emergency surgery score (ESS) of trauma patients has been mainly conducted in the United States. There were many publications from China, but with few cooperations.

What is known and what is new?

- Trauma patients often require efficient and accurate assess their condition in the emergency department, so that surgical treatments can be implemented in a timely manner. The use of a relevant emergency score can provide an accurate assessment of the patient's condition and prognosis.
- This research provided an overview of the status of related research on ESS. And this study found that cooperation in research on ESS in China was less than countries like the United States, UK and Germany.

What is the implication, and what should change now?

- Chinese researchers should increase their level of cooperation.

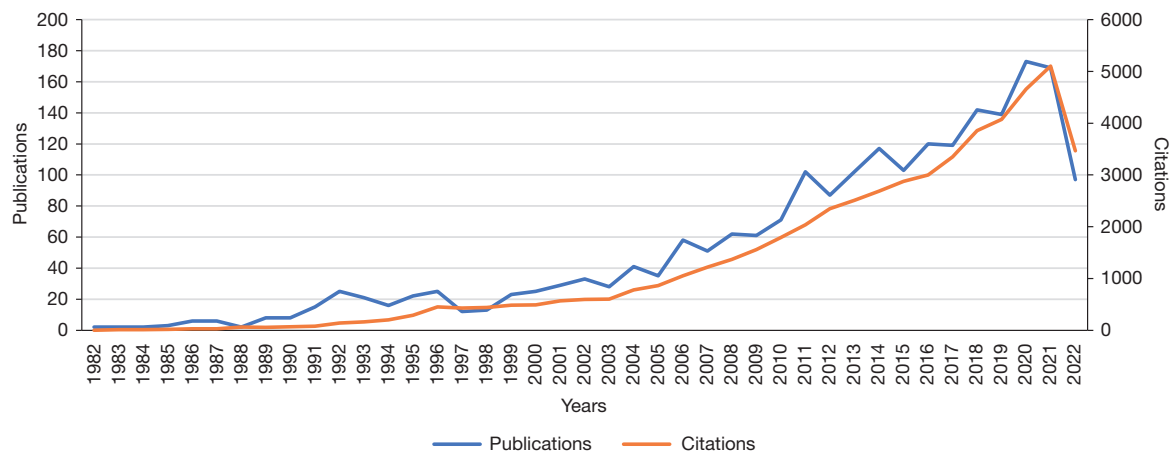


Figure 1 Annual trend of publications and citations related to emergency surgery score in trauma patients.

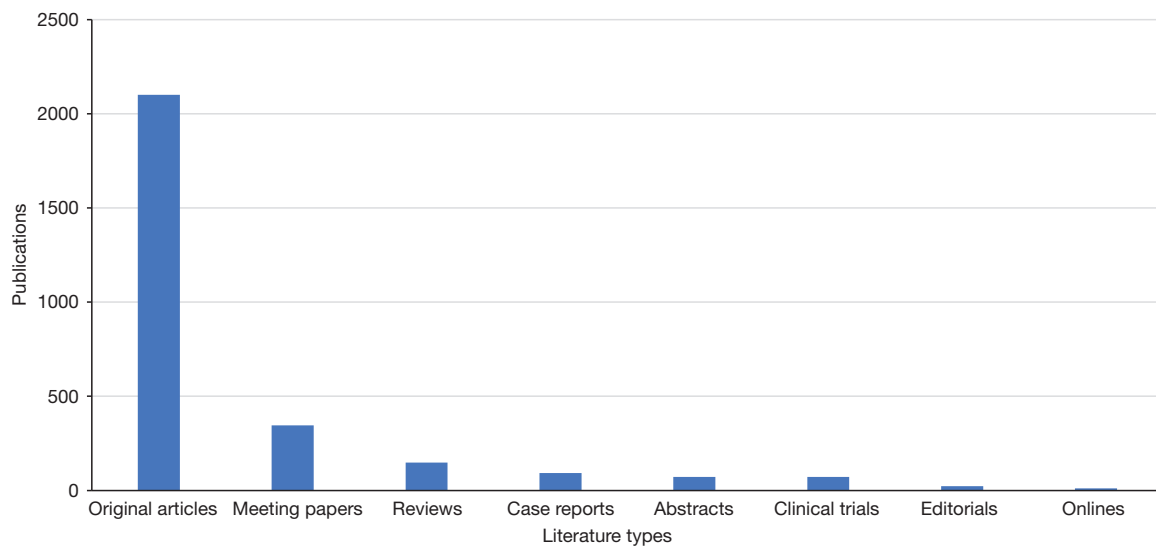


Figure 2 Type of literatures related to emergency surgery score in trauma patients.

as a whole was 102. Among these documents, there are 2,100 original articles, showing that relevant research was very active. Other types of documents included 345 conference papers, 148 reviews, 92 case reports, 72 conference abstracts, 72 clinical trials, 23 editorial materials, and 11 online publications (Figure 2). In the research on ESS for trauma patients, the main research directions included surgery, pathology, and emergency medicine (Figure 3). However, if the Medical Subject Headings (MeSH) subject words used in these documents were classified (Figure 4), the most commonly used subject words were “humans”, “male”, “female”, and “adult”.

Countries and institutions

The number of literatures published in the United States is much higher than that in other countries, accounting for 47.31% of all 2,175 articles (Table 1). Germany, the United Kingdom, and China also published more than 100 related articles, while Canada, Turkey, Japan, Italy, France, and Australia published more than 50 articles. The centrality score of the United States was higher than that of other countries. Although the number of published papers in China ranked fourth among all countries, the centrality score only ranked ninth (Table 2). The top ten research

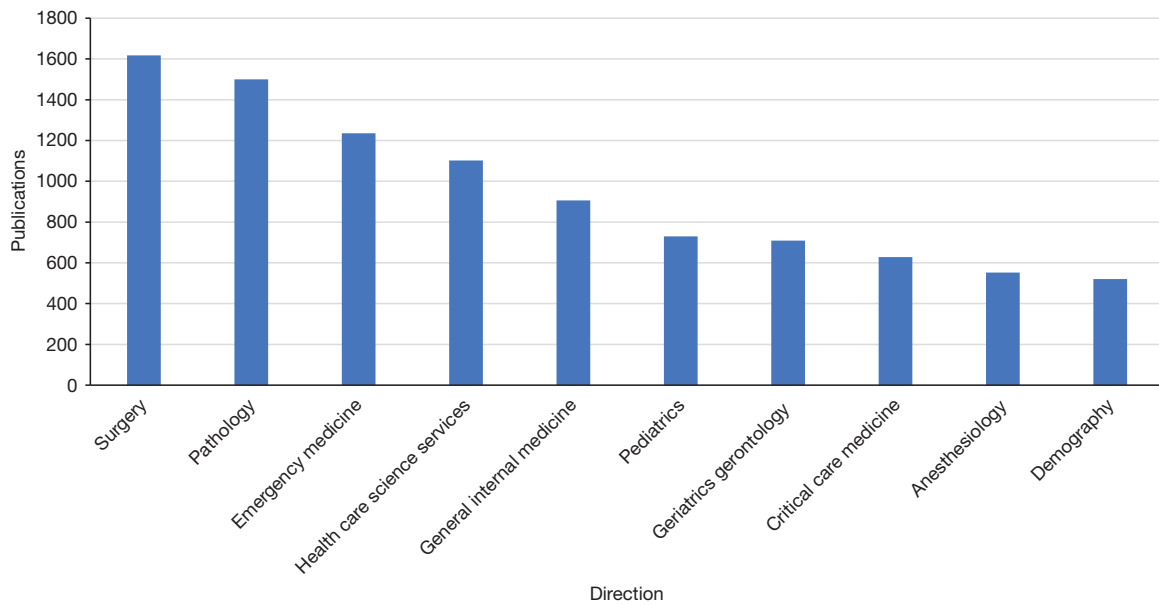


Figure 3 Direction of studies related to emergency surgery score in trauma patients.

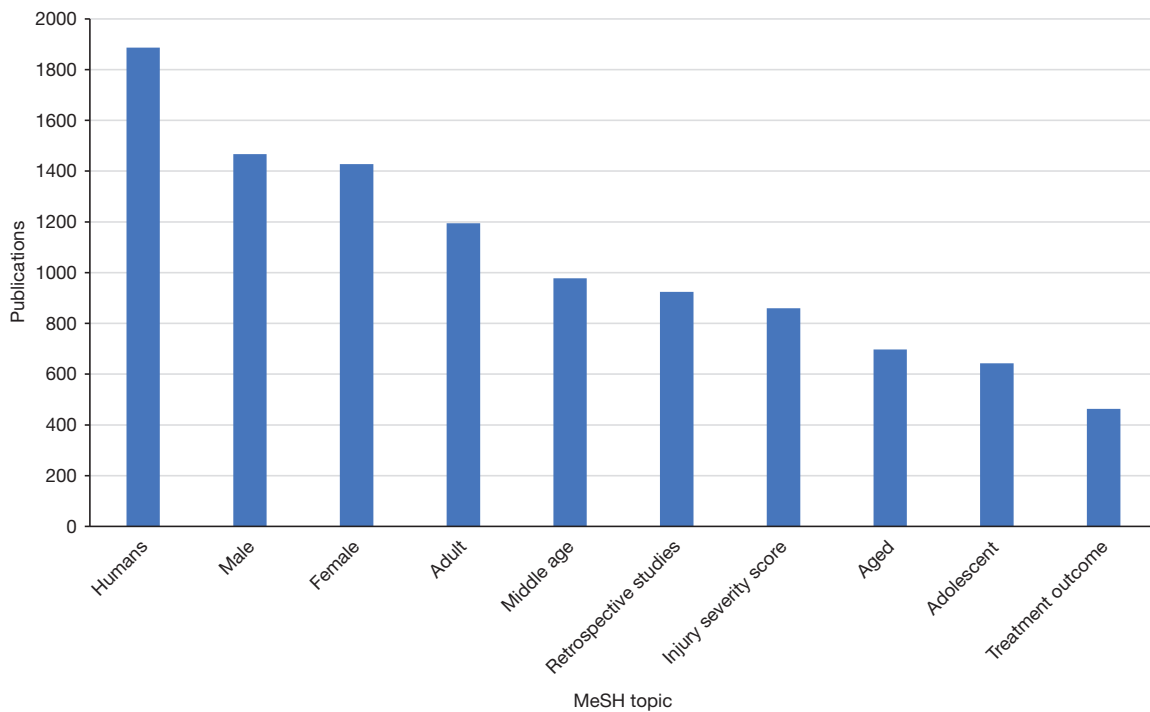


Figure 4 MeSH topic words for literatures related to emergency surgery score in traumatic patients. MeSH, Medical Subject Headings.

Table 1 Top ten countries by publications

Rank	Countries	Records, n (%)
1	USA	1,029 (47.31)
2	Germany	174 (8.00)
3	UK	131 (6.02)
4	China	108 (4.97)
5	Canada	83 (3.82)
6	Turkey	82 (3.77)
7	Japan	67 (3.08)
8	Italy	65 (2.99)
9	France	62 (2.85)
10	Australia	60 (2.76)

Table 2 Top ten countries by centrality

Rank	Countries	Centrality
1	USA	0.44
2	UK	0.38
3	Germany	0.36
4	Canada	0.31
5	France	0.27
6	Italy	0.25
7	Japan	0.24
8	Australia	0.23
9	China	0.22
10	The Netherlands	0.20

Table 3 Top ten institutions by publications

Rank	Institutions	Records, n (%)
1	University of Maryland	97 (4.46)
2	University of Pennsylvania	93 (4.28)
3	University of Washington	91 (4.18)
4	University of Colorado	88 (4.05)
5	Harvard University	85 (3.91)
6	University of California San Francisco	85 (3.91)
7	University of Texas	78 (3.59)
8	University of Southern California	74 (3.40)
9	Denver Health Medical Center	49 (2.25)
10	University of Washington Seattle	48 (2.21)

Table 4 Top ten institutions by centrality

Rank	Institutions	Centrality
1	University of Washington	0.37
2	University of Pennsylvania	0.35
3	University of Maryland	0.34
4	University of Colorado	0.30
5	Harvard University	0.29
6	University of California San Francisco	0.25
7	University of Texas	0.22
8	University of Southern California	0.17
9	Massachusetts General Hospital	0.15
10	Mayo Clinic	0.14

Table 5 Top ten authors by publications

Rank	Authors	Records, n (%)
1	Inaba Kenji	90 (4.14)
2	Moore Ernest E	72 (3.31)
3	Demetriades Demetrios	69 (3.17)
4	Lefering Rolf	64 (2.94)
5	Holcomb John B	43 (1.98)
6	Joseph Bella	39 (1.79)
7	Matsushima Kazuhide	37 (1.70)
8	Asensio JA	34 (1.56)
9	Velmahos George C	30 (1.38)
10	Zielinski Martin D	30 (1.38)

institutions with the largest number of published papers were all from the United States, and the top ten institutions in terms of centrality scores were also from the United States (*Tables 3,4*).

Authors

Analysis of the author statistics (*Table 5*) revealed that Inaba Kenji *et al.* from the University of Southern California in the United States published the most articles, Moore Ernest E *et al.* from Denver Medical Center ranked second, and Demetriades Demetrios *et al.*, also from the University of Southern California, ranked third. Further analysis showed that researchers with a large number of published articles often appeared in the same article at the same time, that

Table 6 Top ten authors by centrality

Rank	Authors	Centrality
1	Inaba Kenji	0.42
2	Lefering Rolf	0.38
3	Demetriades Demetrios	0.32
4	Moore Ernest E	0.31
5	Joseph Bella	0.27
6	Holcomb John B	0.22
7	Matsushima Kazuhide	0.20
8	Asensio JA	0.18
9	Zielinski Martin D	0.15
10	Velmahos George C	0.15

Table 7 Top ten journals by publications

Rank	Journals	Records, n (%)
1	<i>Journal of Trauma and Acute Care Surgery</i>	375 (17.24)
2	<i>The Journal of Trauma</i>	247 (11.36)
3	<i>Journal of Trauma Injury Infection and Critical Care</i>	198 (9.10)
4	<i>Injury</i>	174 (8.00)
5	<i>American Surgeon</i>	128 (5.89)
6	<i>European Journal of Trauma and Emergency Surgery</i>	95 (4.37)
7	<i>Journal of Surgical Research</i>	92 (4.23)
8	<i>Turkish Journal of Trauma Emergency Surgery</i>	74 (3.40)
9	<i>World Journal of Emergency Surgery</i>	50 (2.30)
10	<i>Figshare</i>	49 (2.25)

is, there was a large degree of cooperation between these researchers (*Table 6*).

Journals

To date, the journals that have published more than 100 related articles in this field included *Journal of Trauma and Acute Care Survey*, *The Journal of Trauma*, *Journal of Trauma Injury Infection and Critical Care*, *Injury*, and *American Surgeon* (*Table 7*). Among them, *Journal of Trauma and Acute Care Surgery*, which is a professional journal of

Table 8 Top ten used keywords in literatures on emergency surgery score in trauma patients

Rank	Keywords	Frequency, n (%)
1	Trauma	1,392 (64.00)
2	Surgery	1,176 (54.07)
3	Emergency	905 (41.61)
4	Infection	784 (36.05)
5	Male	658 (30.25)
6	Female	512 (23.54)
7	Outcome	471 (21.66)
8	Sepsis	449 (20.64)
9	Shock	317 (14.57)
10	Risk	283 (13.01)

trauma and emergency surgery, published the most relevant literatures.

Keywords

The most commonly used keywords were “trauma” and “surgery”, while “emergency” and “infection” were also commonly used keywords. The distribution of keywords demonstrated that infection and shock are important issues besides surgery in the relevant research related to the score of emergency surgery for trauma patients (*Table 8*).

Discussion

This study is a bibliometric analysis of the literature related to ESS for traumatic patients. It summarized the number of publications, the country and research institutions, the authors, the journals, and the use of topic words and keywords. The number of literatures related to ESS of traumatic patients began to grow rapidly after the year 2005. The research direction in this field mainly focused on surgery and pathological examination, as well as emergency medicine. There was also a certain number of research related to children’s trauma and elderly trauma. The United States was the leader in terms of the number of publications, and American researchers have conducted the largest number of international and domestic cooperations. In particular, the top ten research institutions with the largest number of published documents were all from the United States, and these institutions had extensive

cooperation with other institutions. Although China also published a significant number of papers, there has been less cooperative research. The top three authors were all from research institutions in the United States, and these authors were heavily involved in cooperative research with other institutions. In the field of ESS for traumatic patients, the journals with the most published literatures were those related to trauma, emergency, and critical medicine. Keyword analysis showed that “trauma” and “surgery” were the most frequently used keywords.

This current report presents the general status of research related to the ESS of trauma patients. From the annual distribution of the number of literatures, countries and research institutions, it can be seen that research in this field is closely related to a country’s medical facilities, first aid system, and security level. Although in some countries and regions of the world, perennial war and traffic chaos have led to a large number of trauma patients, the weak emergency system, the low level of medical services, and the lack of equipment hinder the advancement of research in this area. At present, the United States is the country with the most advanced medical system and equipment in the world, and its first aid system is also the most developed. However, because the control of guns in this country is obviously different from other developed countries, gunshot injuries can occur from time to time (15,16). Moreover, the use of private cars in the United States is also the largest in the world, resulting in a great number of traffic injuries (17,18). Therefore, research on trauma treatment in the United States is far ahead of other countries due to various factors (19,20). The number of published documents is about 1–2 orders of magnitude higher than that of other countries. The United States not only has the largest number of research, but also the largest number of cooperative research, which is probably due to the private healthcare setting in which American researchers are asked to clarify better the severity of a traumatic event. This is related to evidence-based medicine, which has received more attention in recent decades. One of the leading advantages in the United States is the prevalence of multicenter research (21). Multicenter research tends to be more representative than single center studies, and can overcome the shortcomings of small sample size and various biases (such as patient’s condition, medical service level, etc.). Furthermore, multicenter research often involves multiple research institutions and a large number of researchers, forming more mature cooperative research. The United States has performed a large number

of multicenter research in this field, which is reflected in the number of documents, the centrality of research institutions, and the centrality of authors. Indeed, according to our analysis of the country, research institutions, and authors, the United States is an absolute leader in this field of research.

Most of the research literatures in this field were published in the journals related to trauma and emergency, and critical medicine. The quantitative analysis of the literature suggested that we should focus on journals such as *Journal of Trauma and Acute Care Surgery*, *Injury*, and *American Surgeon* since these journals published the most article related to ESS. As this field is just a branch of emergency medicine, the impact factors of journals were generally not high, but they are all authoritative journals in this field. In the literature on the application of ESS in trauma patients, the use of keywords reflected that the main concerns were not only related to basic trauma and surgery, but also related to infection, shock, and outcomes.

A variety of scoring systems can be used for trauma patients in the emergency department. Different scores are applicable to different situations. The rational use of scores can accurately determine the risk of patients and provide a basis for treatment decisions. The LEMON (Look-Evaluate-Mallampati-Obstruction-Neck mobility) evaluation method can comprehensively evaluate the injured person’s airway and effectively predict difficult airways with an accuracy of 86.3–89.7% (22). The evaluation indicators include the patient’s external characteristics [look externally (L)], airway measurement [evaluate (E)], Mallampati classification (M), airway obstruction (O), and neck mobility (N). However, some patients who are in a critical condition may not be able to cooperate with the Mallampati grading assessment (22). The modified early warning score (MEWS), which combines the patient’s heart rate, systolic pressure, respiratory rate, body temperature, and consciousness into a score, can assess the patient’s condition and potential risks, and can improve the ability of the medical staff to assess the patient’s condition (23). CRAMS (circulation, response, abdomens, motor, and speech) is a commonly used pre-hospital quantitative scoring method to evaluate and classify trauma, and guide cardiopulmonary resuscitation (24). The POSSUM (Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity) scoring system is used to evaluate 12 preoperative factors and six surgical factors, and to comprehensively evaluate the preoperative physiological conditions and intraoperative surgical trauma of patients. However, the calculation is

complex and is not convenient for use in an emergency environment. The Acute Physiology and Chronic Health Evaluation II (APACHE II) is an important score for evaluating the prognosis of critical patients with disease progression and vital sign changes, and can also be used to predict the prognosis of trauma patients. Therefore, the application of various scores to different patients, and the predictive value of various scores to different patients warrants further in-depth research so as to provide a basic reference for clinical practice (25).

According to the present study, the research hotspots of ESS focused on prognosis prediction, especially short-term prognosis including 28-day mortality. We suggest that long-term prognosis can also be studied in the future. We also suggest multicenter, large sample clinical study be carried out to further validate the predictive value of ESS. This investigation had some limitations. First, this study analyzed the research overview related to the score of emergency surgery for trauma patients from a bird's view perspective, without in-depth analysis of the included literatures, such as the research focus and main achievements in this field for each country, institution, and researcher. Second, there was no in-depth analysis of the cooperation between various research institutions and researchers, and it remains unclear which issues were the focus for the cooperative research. Future studies should focus on a specific problem and conduct in-depth analysis of the relevant research.

Conclusions

By bibliometrics analysis, we found that research on ESS of trauma patients has been widely conducted, especially in the United States. Though Chinese researchers have published some related papers, they should increase their level of cooperation. Also, our study suggests that multicenter study on ESS in clinical practice is needed.

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Footnote

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The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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