



## A Bibliometric Vision on Triage in the Emergency Department

### Acil Serviste Triyaj Konusunda Bibliyometrik Bir Vizyon

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#### ABSTRACT

**Aim:** Triage is an indispensable process in the emergency department. Bibliometrics and visual analysis were performed in this study to look at the hotspots and future prospects in triage research, with the aim of giving researchers some useful recommendations.

**Material and Method:** This study was based on bibliometric methods, which have two main uses: scientific analysis and mapping. The data retrieved on a single day, 15 June 2022. The search keywords, in the title, entered into the database were triage and emergency room or emergency department, and document type was article. From 1970 through 2021, the data were gathered from the Web of Science (WOS) Core Collection database. The retrieved data transferred to Excel 2010 and VOSviewer programs for further analyses.

**Results:** By searching for the title words in WOS database, firstly a total of 1538 publications were retrieved between 1970–2021. Of these documents, only articles were evaluated due to their high scientific value (n=999; 64.95%). The first article was published in 1970. There was a peak in the number of publications since 2000s. The highest number of publications published in the year 2021. The most prolific countries were the United States of America (USA) (n=317; 31.73%), Canada (n=87; 8.71%) and Australia (n=79; 7.91%). The most prolific institutions were the League of European Research Universities (LERU) (n=82; 8.21%), Harvard University (n=45; 4.51%) and the University of California system (n=34, 3.40%). Although Canadian publications had the most citations per article, the United States had the most publications and the highest H-Index.

**Conclusions:** This is the first bibliometric study to give comprehensive description on the published emergency triage literature. The number of papers on emergency triage has grown over time, however there have been few research in this area.

**Keywords:** Bibliometric methods, triage, emergency department

#### ÖZ

**Giriş:** Triyaj, acil servislerde vazgeçilmez bir süreçtir. Bu çalışmada, araştırmacılara bazı yararlı tavsiyelerde bulunmak amacıyla, triyaj araştırmalarındaki sıcak noktaları ve gelecekteki beklentileri incelemek için bibliyometri ve görsel analiz yapılmıştır.

**Gereç ve Yöntem:** Bu çalışma, bilimsel analiz ve haritalama olmak üzere iki ana kullanıma sahip olan bibliyometrik yöntemlere dayanmaktadır. Veriler tek bir günde, 15 Haziran 2022 tarihinde elde edilmiştir. Veritabanına girilen başlıktaki arama anahtar kelimeleri triyaj ve acil servis veya acil servis, belge türü ise makale idi. 1970-2021 yılları arasındaki veriler Web of Science (WOS) Core Collection veri tabanından toplanmıştır. Elde edilen veriler daha ileri analizler için Excel 2010 ve VOSviewer programlarına aktarılmıştır.

**Sonuçlar:** WOS veri tabanında başlık kelimeleri aranarak, ilk olarak 1970-2021 yılları arasında toplam 1538 yayına ulaşıldı. Bu dokümanlardan sadece makaleler yüksek bilimsel değerleri nedeniyle değerlendirmeye alındı (n=999; %64,95). İlk makale 1970 yılında yayınlanmıştır. Yayın sayısında 2000'li yıllardan itibaren bir zirve yaşanmıştır. En fazla yayın 2021 yılında yayımlanmıştır. En üretken ülkeler Amerika Birleşik Devletleri (ABD) (n=317; %31,73), Kanada (n=87; %8,71) ve Avustralya (n=79; %7,91) olmuştur. En üretken kurumlar Avrupa Araştırma Üniversiteleri Ligi (LERU) (n=82; %8,21), Harvard Üniversitesi (n=45; %4,51) ve Kaliforniya Üniversitesi sistemi (n=34, %3,40) olmuştur. Kanada yayınları makale başına en fazla atıf alan yayınlar olmasına rağmen, Amerika Birleşik Devletleri en fazla yayına ve en yüksek H-İndeksine sahipti.

**Sonuçlar:** Bu çalışma, yayınlanmış acil triyaj literatürü hakkında kapsamlı bilgi veren ilk bibliyometrik çalışmadır. Acil triyaj konusundaki makalelerin sayısı zaman içinde artmıştır, ancak bu alanda çok az araştırma yapılmıştır.

**Anahtar Kelimeler:** Bibliyometrik yöntemler; triyaj; acil servis

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## INTRODUCTION

The practice of classifying or prioritizing patients depending on their level of acuity is referred to as “triage” in medicine (1,2). The term “triage” is typically linked with the emergency department (ED). Patients’ visits to the ED are unplanned and unpredictable, which means that patients with varied treatment needs may show up at the same time or within a short period of time. This necessitates making patient care a top priority (3). Triage is a critical phase that affects not just the patient experience but also ED operations, such as patient flow through the department and resource use (4,5). Failure to properly triage patients could result in their health deteriorating while they wait (4).

This procedure is essential for the efficient operation of the ED. Triage systems are intended to serve as a tool for departmental organization, monitoring, and evaluation as well as to assure clinical justice for patients. Triage systems have been established in a number of nations over the last 30 years, with efforts taken to ensure consistency of application (6). In many industrialized nations, such as Australia, the United Kingdom, Sweden, the United States, and Canada, there is a vast and expanding body of literature that informs the present state and development of ED triage (2,4,5).

We performed bibliometrics and visualizations to investigate the hotspots and frontier prospects of triage studies in the aim of offering researchers some useful recommendations.

## MATERIAL AND METHOD

This study was based on bibliometric methods, which have two main uses: scientific analysis and mapping. The data search was conducted on 15 June 2022. To avoid any potential variance due to the database’s daily update, the obtained data was collected within one day. The search keywords, in the title, entered into the database were as follows: TS = (triage\* and emergency room\* or emergency department) and document type: article. Furthermore, there were no restrictions on the countries, journals, or language of publishing.

The Web of Science (WOS)™ is the world’s most trusted worldwide citation database that is publisher-independent. Web of Science Core Collection is at the heart of the WOS platform, spanning all subjects and regions. The WOS Core Collection includes only publications that demonstrate high levels of editorial rigor and best practice, as selected by an expert team of in-house editors (7).

The data for the study was retrieved from the WOS database between 1970 and 2021. Because the year 2022 has yet to be completed, publications from this time period were excluded from the analysis.

## Analysis Tool

The retrieved data transferred to Microsoft Excel 2010 and VOSviewer programs for further analyses. The data in the tables were converted to absolute values (frequency and percentage). There were no advanced statistical analysis tests employed.

The maps were generated by the VOSviewer program (The VOSviewer 1.6.18 for Microsoft Windows) consisting of citation tree rings and lines. The triage literature maps were created using bibliometric techniques like as co-citation, bibliographic coupling, and keyword co-occurrence. The frequency with which two units are referenced together, demonstrating similarity between them, is known as co-citation analysis (8). The number of references shared by two publications is used as a measure of similarity between them in bibliographic coupling; that is, the more their bibliographies overlap, the stronger their link (9). Co-occurrence, on the other hand, finds word connections when they co-occur, allowing researchers to analyze the conceptual structure of a research field by using the most essential terms or keywords in the texts (10). We analysed the keyword co-occurrence, bibliographic coupling and co-citations of the published documents.

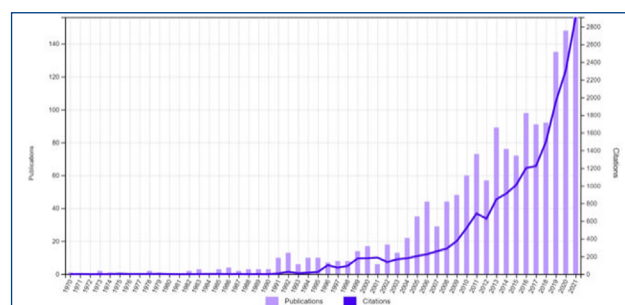
The Hirsch Index (H-Index) has been proposed as a measure of individual research success. Its application has become widespread in the scientific community around the world. Those with a large number of low-impact publications or only a few high-impact articles have little effect on the H-Index (11,12).

## RESULTS

### Annual Publications

By searching for the title words in WOS database, firstly a total of 1538 publications were retrieved between 1970 and 2021. Of these documents, only articles were evaluated due to their high scientific value (n=999; 64.95%). The first article was published in 1970.13 This article had 12 citations.

There was a peak in the number of publications since 2000s. The highest number of publications published in the year 2021 (**Figure 1**).



**Figure 1.** The annual number of publications on triage between 1970 and 2021.

### General Features of the Articles

The majority of the articles (92.39%) were written in English language. Spanish (3.10%) and German (1.80%) languages were the other most preferred languages. 79.28% of them published in Science Citation Index Expanded (SCI-E), 22.62% of them published in Social Sciences Citation Index (SSCI) and 17.52% of them published in Emerging Sources Citation Index (ESCI) indexed journals. 448 (44.84%) of the articles had funding sponsors. The leading funding sponsor was United States Department of Health Human Services (5.01%).

### Distribution of Countries and Institutions

A total 78 countries contributed the triage literature. The most prolific countries were the United States of America (USA) (n=317; 31.73%), Canada (n=87; 8.71%) and Australia (n=79; 7.91%) (**Table 1**).

Countries/Regions	n	%
USA	317	31.73
Canada	87	8.71
Australia	79	7.91
England	59	5.91
Italy	46	4.61
France	44	4.40
Switzerland	43	4.30
Netherlands	35	3.50
Sweden	35	3.50
Peoples R China	34	3.40
Spain	32	3.20
Iran	30	3.00
Germany	29	2.90
Turkey	27	2.70
South Africa	26	2.60
South Korea	23	2.30
Taiwan	20	2.00
Brazil	18	1.80
Denmark	17	1.70
Belgium	14	1.40

Note: Showing 20 out of 78 countries; Total number of articles: 999

A total 1548 institutions contributed the triage literature. The most prolific institutions were the League of European Research Universities (LERU) (n=82; 8.29%), Harvard University (n=45; 4.51%) and the University of California system (n=34; 3.40%) (**Table 2**).

### Publishing Journals

The most of the articles on triage was published in the Emergency Medicine Journal (n=48; 4.81%), Academic Emergency Medicine (n= 36; 3.60%) and the Journal of Emergency Nursing (n=34; 3.40%) (**Table 3**).

**Table 2. The list of most prolific institutions on triage articles.**

Institutions	n	%
League of European Research Universities (LERU)	82	8.21
Harvard University	45	4.51
University of California System	34	3.40
Udice French Research Universities	23	2.30
University of Toronto	20	2.00
Assistance Publique Hopitaux Paris Aphp	19	1.90
University of Basel	19	1.90
Massachusetts General Hospital	18	1.80
Brigham Women S Hospital	17	1.70
Karolinska Institutet	17	1.70

Note: Showing 10 out of 1548 institutions; Total number of articles: 999.

**Table 3. The list of the mostly publishing journals on triage.**

Publishing journals	n	%
Emergency Medicine Journal	48	4.81
Academic Emergency Medicine	36	3.60
Journal of Emergency Nursing	34	3.40
Annals of Emergency Medicine	31	3.10
International Emergency Nursing	26	2.60
American Journal of Emergency Medicine	25	2.50
Pediatric Emergency Care	20	2.00
European Journal of Emergency Medicine	19	1.90
Journal of Emergency Medicine	18	1.80
BMC Emergency Medicine	17	1.70
Emergency Medicine Australasia	17	1.70
Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine	17	1.70
Emergencias	15	1.50
Canadian Journal of Emergency Medicine	14	1.40
PLOS One	14	1.40

Note: Showing 15 out of 403 journals; Total number of articles: 999.

### Mapping

The keywords analysis was given in **Figure 2**.

The citation analysis between countries was given in **Figure 3**.

The density visualization of bibliographic coupling between countries was given in **Figure 4** with network visualisation.

### Citing Analysis

The articles were cited 16880 times (16.9/ per article) and the mean of H-Index was 63. The number of citations had increased over the years, especially after 2013. The highest cited article was published in 1997 (14). This article was cited 817 times. The summary of highly cited articles were given in **Table 4**.

The number of the published articles and citations has increased over the years (**Figure 1** and **Table 5**).

The publications from Canada had the highest number of citations per article, but the USA had the highest number of publications and H-Index (**Table 6**).

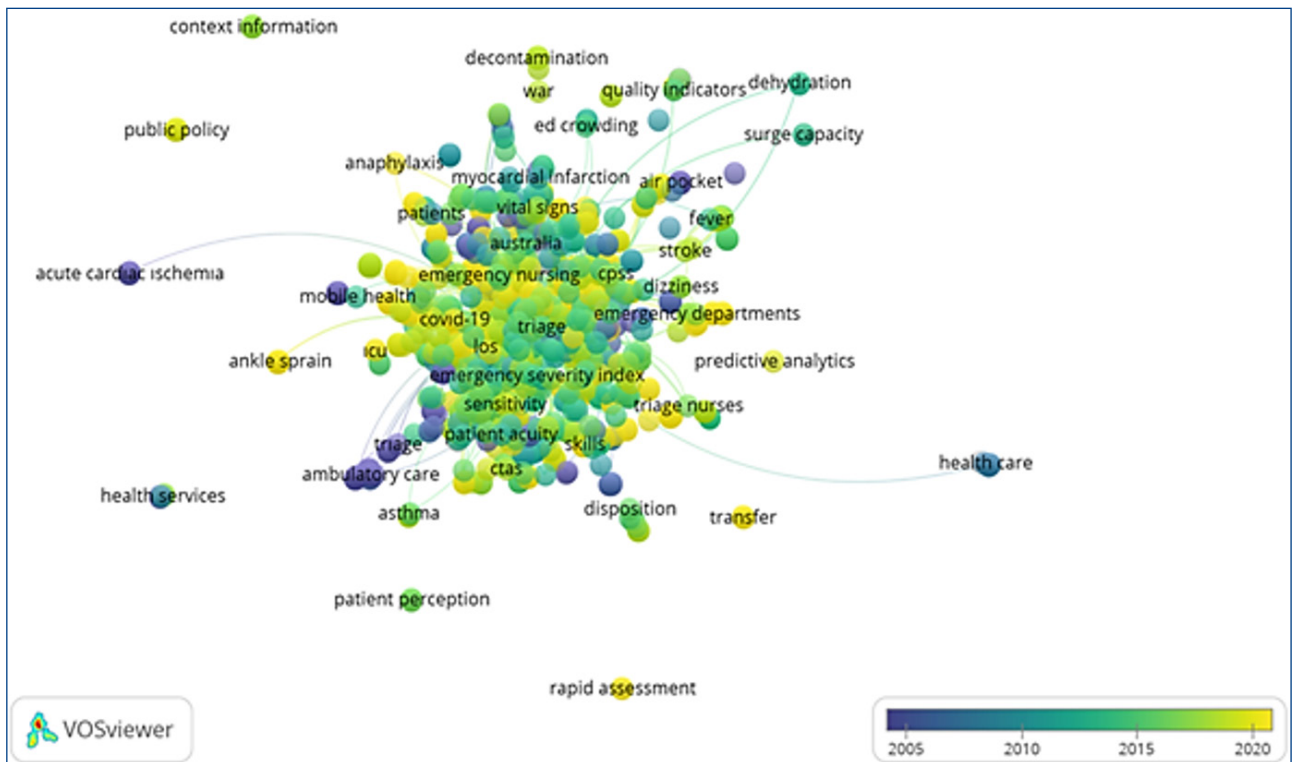


Figure 2. The keywords analysis of the triage articles.

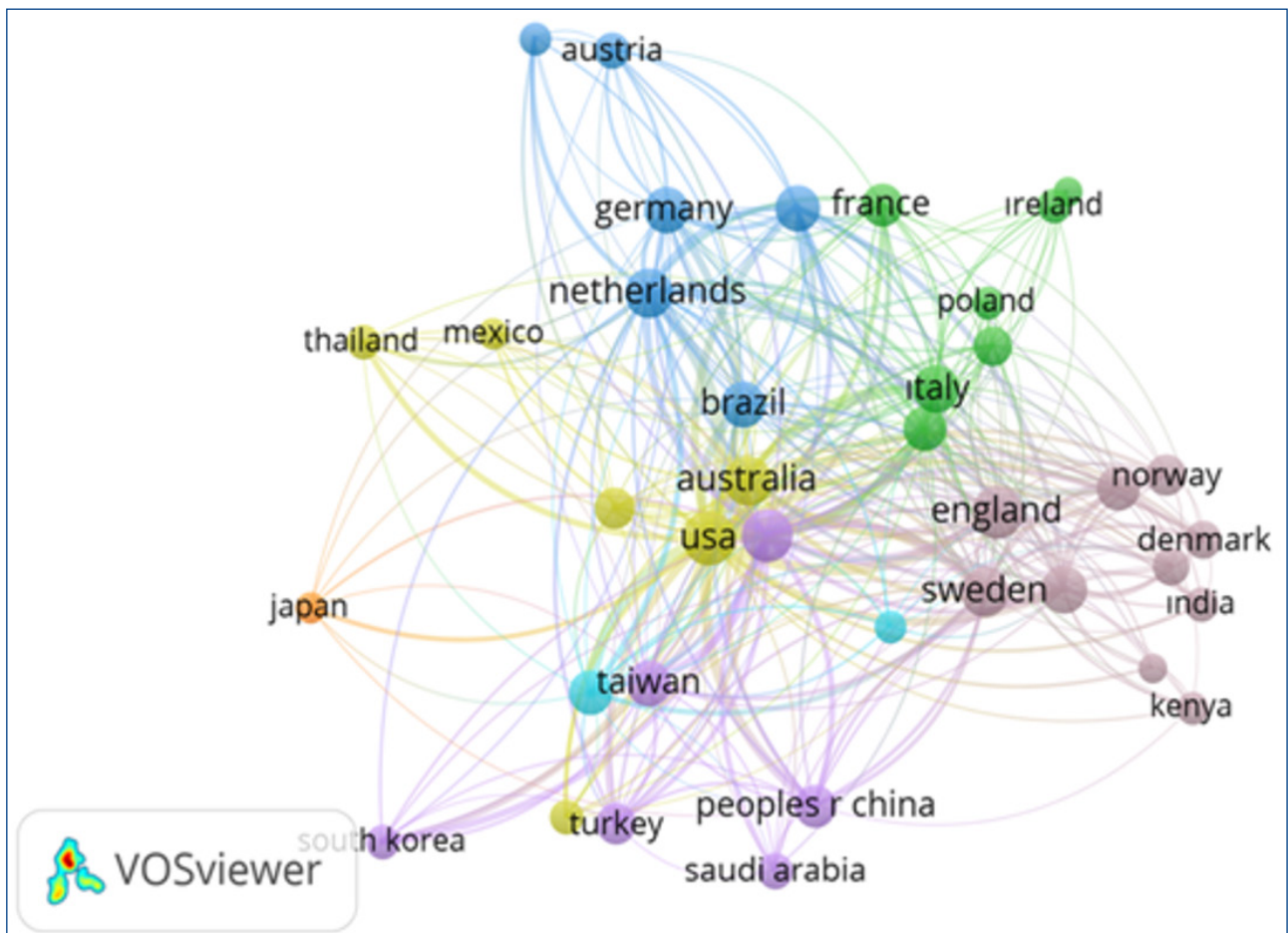


Figure 3. The citation analysis between countries in the context of triage articles.



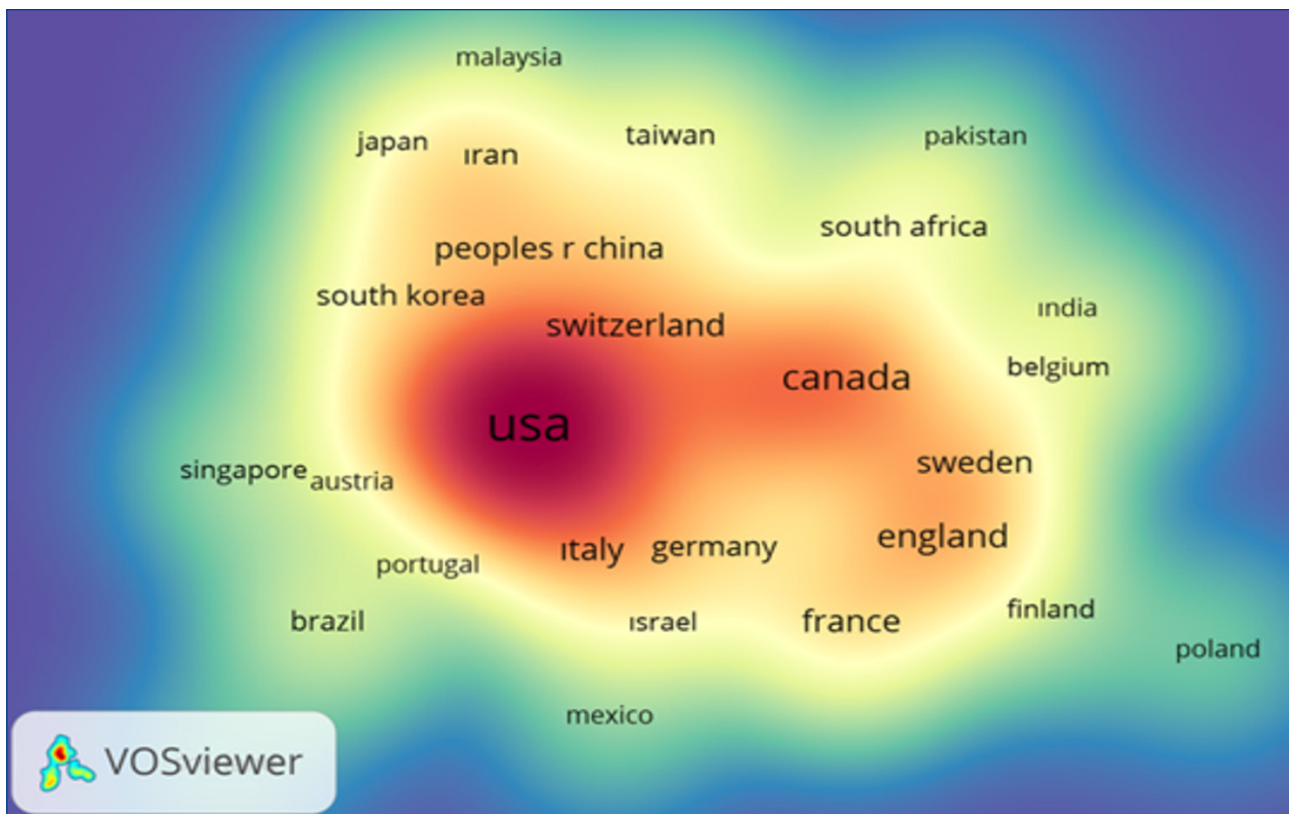


Figure 4. The density visualization of bibliographic coupling between countries in the context of triage literature.

**Table 4. The summary of the most cited articles.**

Reference	Journal	Article name	Citations
Hamm et al. 1997 (14)	New England Journal of Medicine	Emergency room triage of patients with acute chest pain by means of rapid testing for cardiac troponin T or troponin I	817
Eitel et al. 2003 (15)	Academic Emergency Medicine	The emergency severity index triage algorithm version 2 is reliable and valid	206
Molyneux et al. 2006 (16)	Bulletin of the World Health Organization	Improved triage and emergency care for children reduces inpatient mortality in a resource-constrained setting	178
Beveridge et al. 1999 (17)	Annals of Emergency Medicine	Reliability of the Canadian emergency department triage and acuity scale: Interrater agreement	174
Han et al. 2013 (18)	Annals of Emergency Medicine	Diagnosing Delirium in Older Emergency Department Patients: Validity and Reliability of the Delirium Triage Screen and the Brief Confusion Assessment Method	161
Lima et al. 2016 (19)	Stroke	Field Assessment Stroke Triage for Emergency Destination A Simple and Accurate Prehospital Scale to Detect Large Vessel Occlusion Strokes	148
Larsen et al. 2011 (20)	Pediatrics	An Emergency Department Septic Shock Protocol and Care Guideline for Children Initiated at Triage	142
Widgren et al. 2011 (21)	Journal of Emergency Medicine	Medical Emergency Triage and Treatment System (METTS): a new protocol in primary triage and secondary priority decision in emergency medicine	142
Pearson et al. 1995 (22)	Journal of General Internal Medicine	Triage decisions for emergency department patients with chest pain: do physicians' risk attitudes make the difference	141
Hornig et al. 2017 (23)	PLOS One	Creating an automated trigger for sepsis clinical decision support at emergency department triage using machine learning	123

**Table 5. The number of articles and citations over the years.**

Time span	Number of publications	Times cited in WOS	Times cited in all databases
1970-1989	18	122	123
1990-2009	209	7729	7908
2010-2021	772	9029	9305

**Table 6. H-Indexes, number of publications, and number of citations of the**

Country	H-Index	Number of publications	Number of citations	Number of citations per article
USA	45*	317*	6819*	21.51
Canada	26	87	2078	23.89*
Australia	19	79	1206	15.27
England	20	59	1134	19.22
Italy	12	46	602	13.09



## DISCUSSION

The main purpose of the ED is to give prompt assistance to those who have urgent or critical needs. Triage is the initial meeting between healthcare personnel and patients after registering for emergency services (24). In a hospital, the goal of triage is to identify and prioritize individuals with the most urgent requirements so that emergency services can be used first. A proper arrangement of patients to receive emergency care at the most appropriate time for their condition is referred to as an effective triage decision (25). Several researches has looked into the usefulness of triage methods (26-28). But no available bibliometric study on triage research.

A bibliometric study can be used to investigate research hotspots and frontiers in specific subjects by calculating the productivity of institutions, authors, countries and the frequency of keywords (29). Researchers can use bibliometric analysis to describe the present state of research domains or specific diseases, as well as propose recommendations and ideas for future study. In recent years many bibliometric studies conducted on various topics in medicine (30-35). But, the current study is the first bibliometric study of emergency triage research, and it may give useful references for investigators looking to delve deeper into current topics in the field.

We performed a preliminary search in the WOS database using terms linked to ED triage. For the extraction, we used the WOS database because it is a scientific database in the biomedical field with a precise and specific search engine. Also we chose articles as they had high scientific impact. A total of 999 papers on emergency triage were evaluated for this study. Although the number of published articles has risen exponentially since 2000, it can be said that there has not been enough valuable work in this field in total. In addition, the number of articles in the emergency medicine literature has increased a lot in recent years, but it seems like there has been less shooting in the field of triage (36,37). According to the findings of a Pubmed Medline search, the first publication on emergency triage was published in the year 1947. However, the WOS database only goes back to 1970.

Furthermore, an ED network may be developed to debate and give recommendations on how to use the triage system across the country. The network clears up any ambiguities regarding the triage process, and a standardized triage training program for all EDs across the country might be developed. A triage training instructor's qualification can be generated through network communication. Furthermore, the network can provide recommendations to the research team of the triage system in order to improve the system's future development. The network can establish an acceptable triage rate for the nation to improve overall

triage performance (25). Our results showed that a total of 78 countries contributed to the triage literature. The most prolific countries were the USA (31.73%), Canada (8.71%), and Australia (7.91%). The first prolific countries were American, European and Asian countries. This demonstrated the priority focused on scientific research and the fact that the USA has numerous scientific institutions. No countries other than South Africa were listed in the top 25 country rankings, among African countries.

The bibliometric visualization programs CiteSpace and VOSviewer are widely used for data processing and visualization (26,28,33-35). In this study we used VOSviewer for visualization. We analyzed keywords, citation analysis between countries and bibliographic coupling between countries. The co-occurrences of author keywords show that these concepts have been examined extensively by the researchers (32,36-38). We also studied this parameter in our study.

### Limitations

The study only examined at documents from the WOS database. So the period prior to 1970 cannot be analyzed using the current database. We also expect that exploring multiple databases will turn up further works.

## CONCLUSION

This is the first bibliometric study to give comprehensive description on the published emergency triage literature. Throughout time, the number of papers on the emergency triage has increased but there were limited studies. As there are few studies concentrating on triage, further research is needed to discover and assess its usefulness in improving triage accuracy. In conclusion, this study gives potential collaborators and institutions, as well as hot topics, so providing a perspective on the growing trend of triage on the ED, which may assist academics explore new research routes in this field.

## ETHICAL DECLARATIONS

**Ethics Committee Approval:** There were no human or animal subjects in this retrospective bibliometric analysis study. The data for this study was taken directly from the WOS database. Therefore, there was no need for ethical approval.

**Informed Consent:** Because the study was designed retrospectively, no written informed consent form was obtained from patients.

**Referee Evaluation Process:** Externally peer-reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

**Financial Disclosure:** The authors declared that this study has received no financial support.

**Author Contributions:** All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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