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A Bibliometric Analysis and Review of Literature on Casualty Evacuation (2000-2021)

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Abstract

Catastrophic disasters often result in a considerable number of casualties in a short period of time. These casualties need to be timely transported to medical facilities for treatment. Thus, effective casualty response planning is crucial for reducing the mortality of casualties. To explore the research situation of casualty evacuation in the disaster scene, the Web of Science databases published by Science Citation Index (SCI) and Social Science Citation Index (SSCI) is searched by using the keywords "casualty" and "optimization". Then, the VOSviewer is utilized to provide a bibliometric analysis of the literature published from 2000 to 2021. Analytical methods including citation analysis, cluster analysis, and co-occurrence analysis are also applied. The final analysis results are presented by knowledge graphs to show the leading scholars, highly cited papers, highly cited journals, and research hotspots.

Keywords

Casualty Evacuation; Bibliometric Analysis; VOSviewer; Knowledge Graph.

1. Introduction

Historical data indicate that the number and severity of disasters around the world have been increasing in recent decades. These disasters often cause great loss of life and property, which seriously affects the stability of society[1,2]. According to the Centre for Research on the Epidemiology of Disasters, such natural disasters killed about 1.3 million people and affected 4.4 billion people from 1998 to 2017. As recorded by the Global Natural Disaster Assessment Report, there are 313 large-scale natural disasters in the world, 99 million people are affected and threatened by natural disasters. These facts motivate us to determine the efficient plannings for transporting casualties, which can improve the survival rate of casualties[3,4].

The optimization problem of casualty evacuation has attracted the attention of many scholars. The related studies can be roughly divided into two categories: single problem research and integrated problem research. Some scholars have studied the optimization problem of casualty evacuation separately to decide the best transportation routes[5,6]. However, there is an inextricable relationship between facility location and casualty evacuation. The former determines the mode and structure of the whole emergency logistics system, and the latter decides the distribution route of casualties. Thus, a few scholars studied both facility location and casualty evacuation[7,8,9,10]. Since a large number of relief supplies are needed for casualties in post-disaster, some scholars simultaneously optimized the decisions of casualty evacuation and relief supply allocation[11,12,13,14]. Besides, some researchers studied the integration problem of facility location, casualty evacuation and relief supply allocation [15, 16, 17]. There already exist some review papers related to casualty evacuation [18,19,20]. However, few studies apply the bibliometric method to analyze the literature on casualty evacuation.

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Using mathematical and statistical principles as well as computer analysis tools for data mining, quantitative analysis and citation analysis of basic attributes of the literature, bibliometric methods can help scholars assess the current research situation, clarify current research hotspots, and forecast future trends[21]. Besides, the bibliometric methods have been applied to topical issues in many fields, and have yielded excellent results[22,23]. Therefore, this paper utilizes the bibliometric approach to explore the research situation of casualty evacuation. The data are from Web of Science databases, and the search term is "casualty" and "optimization". Applying analytical methods such as citation analysis, cluster analysis, and co-occurrence analysis, the leading scholars, highly cited papers, highly cited journals, and research hotspots are presented by knowledge graphs.

2. Bibliometric Analysis of Literature on Casualty Evacuation

The data used in this study are all obtained from the Web of Science database. The articles are searched using "casualty" and "optimization". Only English literature published in international journals from 2000-2021 is taken into account. A total of 280 articles matching the requirements are retrieved. The VOSviewer is utilized to provide a bibliometric analysis of these papers.

2.1. Analysis of Co-authorship Authors

Analysis of Co-authorship authors can reveal the cooperation status among scholars who study the optimization problem of casualty evacuation, and the leading scholars in the field can be easily found. The cooperation relationship among scholars is visualized in Figure 1. Each node represents an author who has contributed to casualty evacuation. And the larger node means that the corresponding scholar has greater contributions in this field[24]. The connecting lines between nodes imply a collaborative relationship between scholars. As shown in Figure 1, the node named Cap has the largest size. It indicates that Cap has made the greatest contributions to the scientific research on casualty evacuation. And Cap has collaborated with many scholars We can also find that there is a relatively close collaboration among authors. However, the collaboration among scholars from different organizations is not strong.

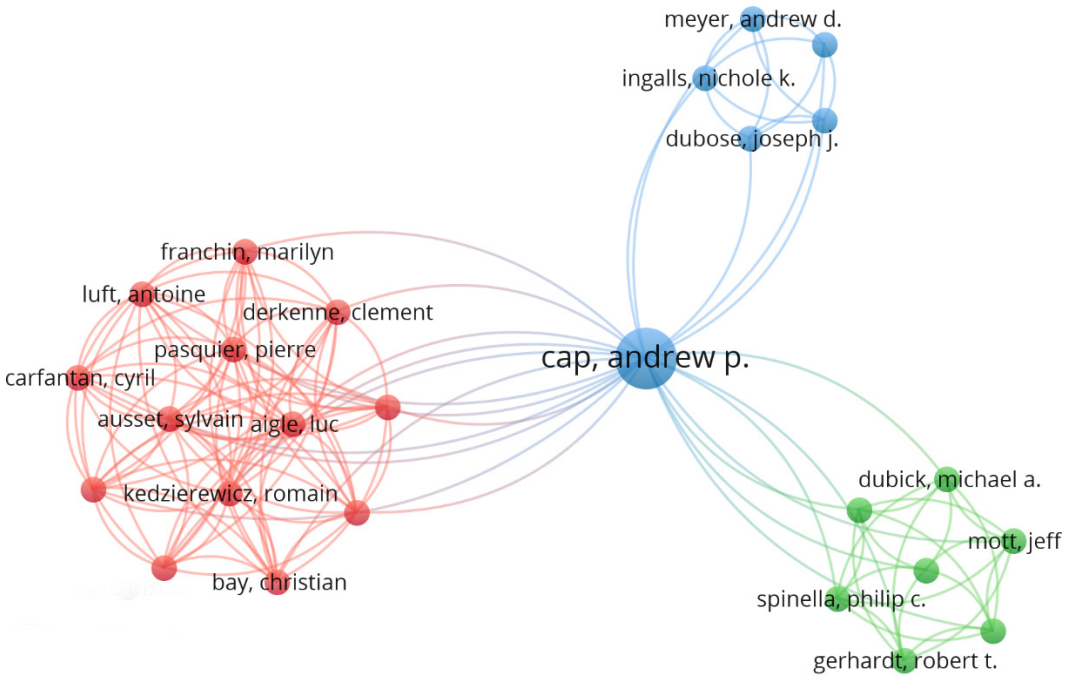

Figure 1. Cooperation network of authors

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2.2. Analysis of Co-authorship Countries

The 280 papers come from 57 different countries. The top 10 productive countries are listed in Table 1. It can be found that the People's Republic of China has 100 documents on casualty evacuation, which is the most productive country. The number of documents produced by the USA ranks second, and Iran ranks third. From the perspective of citation, the papers from the USA are the most cited. In addition, the USA also has the largest total link strength.

Table 1. The top 10 productive countries

Rank	Journals	Documents	Citations	Total link strength
1	People's Republic of China	101	672	18
2	USA	72	2176	50
3	Iran	27	266	6
4	England	20	260	28
5	Spain	9	30	13
6	Turkey	9	118	13
7	Italy	8	80	22
8	Canada	8	80	20
9	Germany	8	153	16
10	India	8	67	12

The cooperation network of countries is presented in Figure 2. The minimum number of articles is set at 3, and a total of 27 countries meet the requirement. Each node represents a country, and the larger the node, the greater the number of documents from the responding country. As shown in the figure, the People's Republic of China cooperates most closely with other countries. In addition, there are a total of six clusters. The People's Republic of China, the USA, Israel and Japan are within a cluster, which means that these four countries are studying relatively similar topics.

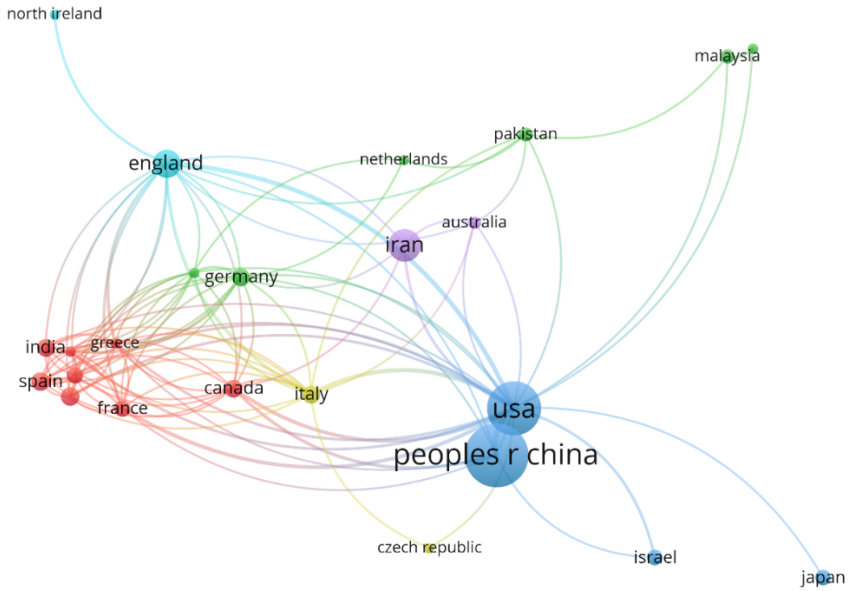

Figure 2. Cooperation network of countries

2.3. Analysis of Co-authorship Institutions

Table 2 gives the top 10 most productive institutions. Obviously, the University of Tehran and Tongji University have the most documents. As for citations, Islamic Azad University is the most

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cited institution. In addition, most of the productive institutions are from the People's Republic of China and Iran. It indicates that the institutions from the two countries play an important role in the field of casualty evacuation optimization research.

Table 2. The top 10 productive institutions

Rank	Journals	Documents	Citations	Total link strength
1	University of Tehran	7	49	4
2	Tongji University	7	55	1
3	Dalian University	6	42	2
4	Chinese Acad Sci	6	55	1
5	Minist Educ	5	15	2
6	Northeastern University	5	24	2
7	Islamic Azad University	5	24	1
8	Jilin University	5	21	1
9	Sichuan University	4	17	5
10	Islamic Azad University	4	57	2

There are collaboration, information sharing and scientific cooperation among institutions to conduct some research. To find the organizations that have made outstanding contributions to the casualty evacuation optimization research, the collaborative relationships among scientific institutions are analyzed in Figure 3. The institutions shown in Figure 3 are all important in the study of casualty evacuation. However, the cooperation among institutions is rather separated. Thus, we should focus on cooperation among schools to improve international influence.

Figure 3. Cooperation network of institutions

2.4. Analysis of High-impact Journals

Finding the core journals in a particular field can assist scholars in searching for articles and selecting the appropriate journals to publish papers. Table 3 summarizes the top 10 productive journals on casualty evacuation. We can see that IEEE Access is the most productive journal with 8 papers. followed by the European Journal of Operational Research and International Journal of Environmental Research and Public Health with 7 papers. In terms of citations, the Journal of Trauma and Acute Care Surgery is the most cited of all published sources with 197 citations. As for total link strength, the European Journal of Operational Research is in the first place.

The total citation frequency of a journal is an indicator for evaluating the influence of a journal, which refers to the total number of citations of all papers published in the journal during the statistical year. Co-citation mapping of journals is displayed in Figure 4. Each node represents a journal, and the size of the node indicates the importance of the journal. As can be seen in Figure 4, the top three journals, ranked according to total citation frequency, are “European Journal of Operational Research”, “Natural Hazards”, and “Computers & Operations Research”. These journals play an important role in the field of casualty evacuation.

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Table 3. The top 10 productive journals

Rank	Journals	Documents	Citations	Total link strength
1	IEEE Access	8	31	1
2	European Journal of Operational Research	7	188	26
3	International Journal of Environmental Research and Public Health	7	20	1
4	International Journal of Disaster Risk Reduction	6	44	9
5	Journal of Trauma and Acute Care Surgery	6	964	2
6	Sustainability	6	74	2
7	Natural Hazards	6	163	1
8	Computers Industrial & Engineering	5	66	13
9	PLoS One	5	31	1
10	Transportation Research Part E	4	80	15

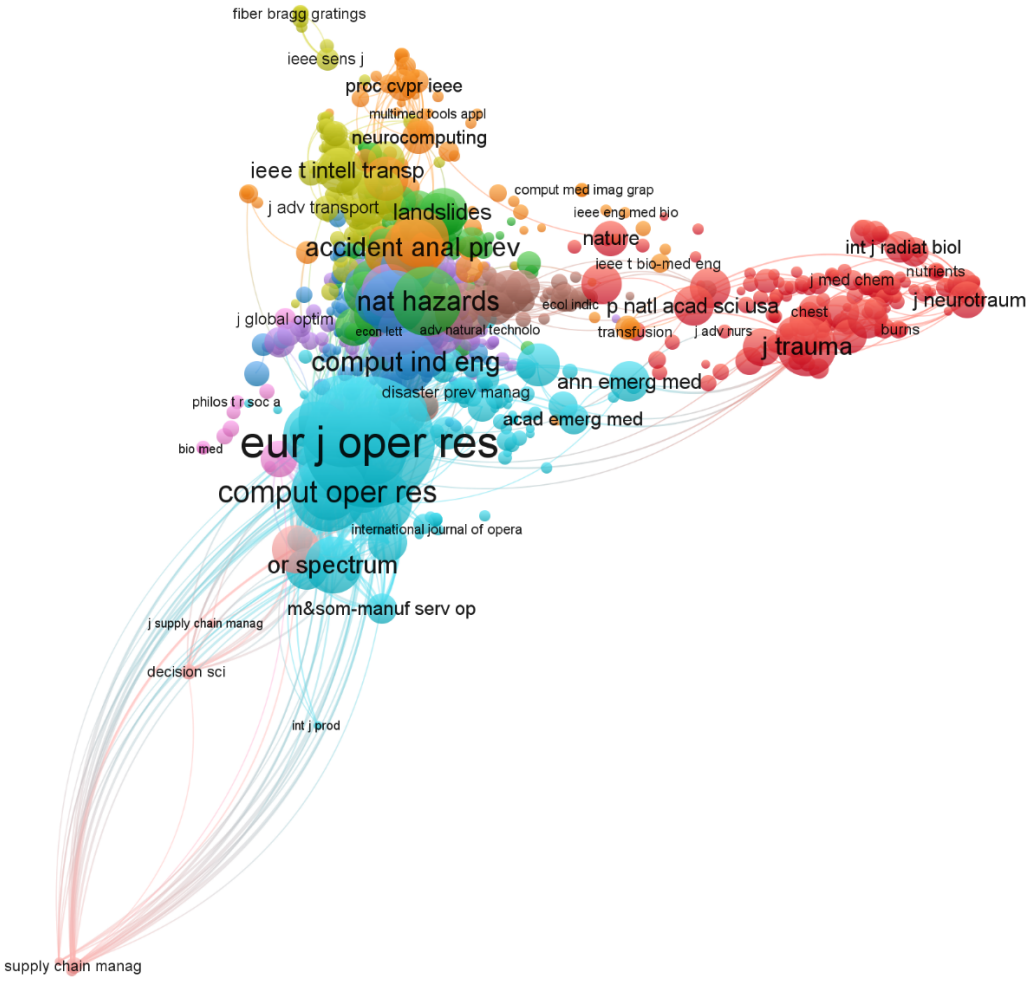

Figure 4. Co-citation network of journals

2.5. Analysis of Research Hotspots

Research hotspots can be indicated by the frequency of keywords related to a certain topic. To explore the research hotspots on casualty evacuation, Figure 5 shows the keyword co-occurrence network analysis of the related literature. As can be seen from Figure 5, the most popular keywords are "optimization", "design", “management”, “system”, “risk”, “behavior”, and “evacuation”. These keywords can be roughly classified into two categories. One is related to optimization problems, where the evacuation routes of casualties are studied by

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mathematical models. The other is theoretical research, where the behavior and management methods of casualties are studied.

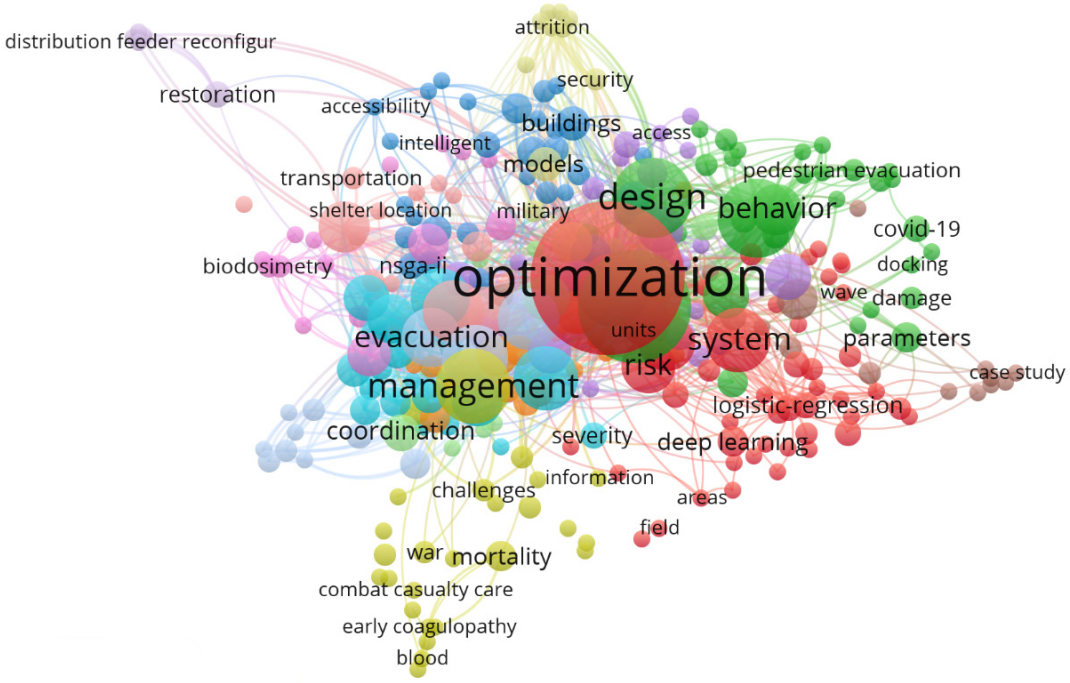

Figure 5. Co-occurrence analysis of keywords

3. Conclusion

In this paper, bibliometric analysis and review of casualty evacuation research articles published from 2000 to 2021. The final analysis results can be concluded as follows:

(1) Cap plays a pivotal role in this area and facilitates the development of research. However, the collaboration of scholars between different institutions is not close.

(2) The cooperation among countries is active, and the People's Republic of China has great influences.

(3) University of Tehran and Tongji University are the most productive originations. Islamic Azad University attracts the most attention around the world since it has the most citations.

(4) According to the co-citation analysis, the European Journal of Operational Research is the greatest influential journal.

(5) The most frequently used keywords are "optimization", "design", “management”, “system”, “risk” and “behavior” in the literature on casualty evacuation.

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