

Study on myocardial infarction based on nationwide inpatient sample database: a bibliometric analysis from 2000 to 2022

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Abstract

Background: Studies on myocardial infarction (MI) based on large medical databases have become popular in recent years. The influence of the National Inpatient Sample (NIS), the largest collection of administrative healthcare data across the United States, on the field of MI has not been well investigated. This study aimed to quantify the contribution of NIS to MI research using bibliometric methods.

Methods: We searched the Web of Science Core Collection database to identify publications on MI using NIS from 2000 to 2022. Bibliometric indicators, such as the number of publications, citations, and Hirsch index (H-index), were summarized by years, authors, organizations, and journals. VOSviewer and CiteSpace software were used to analyze the keywords and trends of the hot spots.

Results: A total of 342 articles on MI based on NIS were included. A significant growth in outputs related to MI using the NIS from 2000 to 2020 was observed. The publications were mainly from the United States. The Mayo Clinic was the most prolific institution and had the most citations and the highest H-index. The *American Journal of Cardiology* ranked first among journals with the highest number of publications, citations, and H-index. Mortality and healthcare management are the main focuses of this field. Personalized risks and care are receiving increased attention.

Conclusion: This study suggests that NIS significantly contributes to high-quality output in MI research. More efforts are needed to improve the impact of knowledge gained from the NIS on MI.

Keywords: Administrative healthcare database, Bibliometrics, Big data, Myocardial infarction, National Inpatient Sample

Introduction

The total deaths and years of loss (YLLs) from cardiovascular diseases have increased greatly in the last decade, accounting for the largest proportion of deaths from noncommunicable diseases.^[1] Cardiovascular diseases have produced immense health and economic burdens worldwide and are expanding threats to global health.^[2] Myocardial infarction (MI), the leading cause of morbidity and

mortality from cardiovascular disease, has caused a significant increase in the rate of hospitalization in recent years and usually leads to a high in-hospital mortality.^[3,4] The outcomes of patients hospitalized with MI may be affected by the process of healthcare, as in-hospital mortality varies substantially across hospitals.^[5] Thus, it is critical to study and assess the characteristics and healthcare needs of patients with MI based on hospitalization data.

With the rapid accumulation of data in hospitals, large administrative databases have been built and developed that provide researchers with access and a platform to estimate healthcare effectiveness, quality, and outcomes. The National Inpatient Sample (NIS) is part of the Healthcare Cost and Utilization Project, which represents the largest collection of administrative healthcare data across the United States.^[6] The NIS contains data on all hospital stays, such as resource use information, from 1988. The large sample size makes it especially useful for analyzing rare conditions and uncommon treatments. In recent years, there have been a growing number of studies on MI based on the NIS.^[7–9] A bibliometric study will be helpful in revealing the laws of publication, summarizing the hotspots of the research field, and predicting the future direction of the discipline.^[10,11] However, no bibliometric analysis has been reported. Therefore, in this study, we carried out a bibliometric analysis to study the characteristics of MI research based on the NIS and to provide a specific reference for future analysis using a large healthcare database.

Methods

Publications on MI-based NIS between January 1, 2000, and December 31, 2022, were retrieved from the Web of Science Core Collection (WoSCC) database. The retrieval strategy was based on a combination of themes [TS] and titles [TI]. The keywords “National Inpatient Sample” or “Nationwide Inpatient Sample” were used under the TS category. The term “myocardial infarction”

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The data sets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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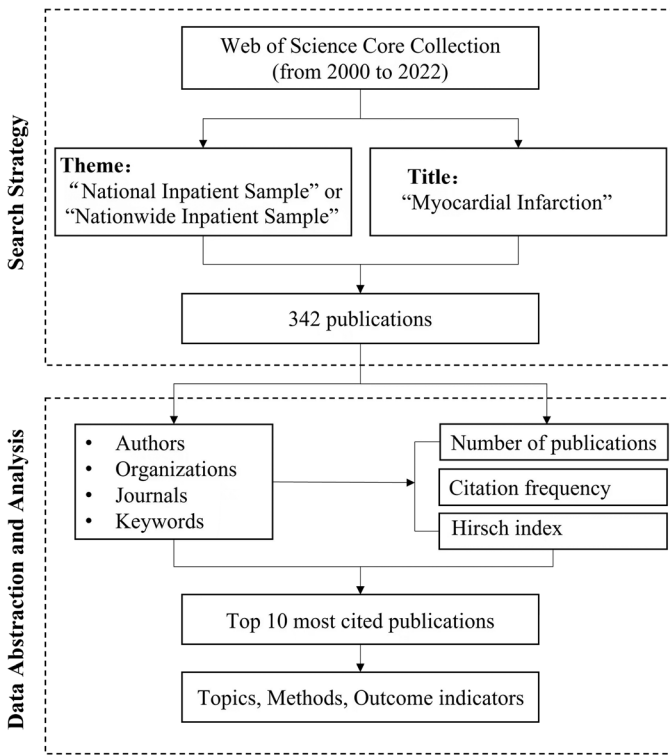


Figure 1. The flow chart of this study.

was used when the category of TI was limited to ensure that the literature included was highly correlated with MI. No restrictions on language or publication type were imposed.

Information on the number of publications, citation frequency, and Hirsch index (H-index) according to authors, organizations, and journals was extracted based on the Web of Science database literature analysis report. The H-index was used to simultaneously assess the productivity and impact of authors, organizations, and journals, which was defined as the number of publications with cita-

tion frequency above H.^[12] To evaluate the scientific value of the research, the impact factor (IF), quartile by category, was obtained from the 2021 Journal Citation Reports (JCR). For the top 10 most cited publications, the following data were further extracted: title, authors, year of publication, journal, IF, subject included, primary outcome for study, methods of statistical analysis, and conclusions arrived at.

Descriptive statistical analyses were performed in this study. Trends in the quantity and quality of publications were plotted and analyzed by year. The software of VOSviewer (version 1.6.16; Leiden University, the Netherlands)^[13] was used to visualize the co-occurrence networks of keywords provided by the authors, with a minimum occurrence of 3. To explore the trend of hot spots, we used Citespace to develop the keywords timeline map.^[14] The study flow diagram is shown in Fig. 1.

Results

A total of 342 publications on MI based on the NIS between 2000 and 2022 were identified from the WoSCC database and included in this study. By the end of 2022, the 342 articles have been cited 5375 times, with an average of 244.32 times per year and 15.72 times per article. As shown in Fig. 2, there was a significant increase in the number of publications and citations between 2000 and 2020. However, there is a slight drop in numbers in 2021 and 2022.

A total of 342 articles originated from 458 organizations. As shown in Table 1, Mayo Clinic had the highest output, with 74 publications accounting for 21.64% of the total publications. Harvard University was the second most productive institution (43), followed by the University of California system (34). The top 3 institutions with the most citations were also the 3 organizations mentioned previously, with 1222, 1213, and 1078 citations, respectively. After removing the self-citations, a minor drop in citations could be observed, except for the Mayo Clinic, whose citations dropped by 41.98%. As for the rankings regarding H-index, Mayo Clinic had the highest H-index (22), followed by Harvard University (20), University of California system (16), and New York Medical College (16).

A total of 1318 authors contributed 342 articles. Vallabhajosyula S published 52 articles and was the most prolific author, followed by Barsness GW (31) and Cheungpasitporn W (29). Vallabhajosyula S tops the ranking of citations (1043), followed by Aronow WS (1010), Khera S (937), and Kolte D (937). After removing self-citations, there was a significant decrease in the number of citations received by

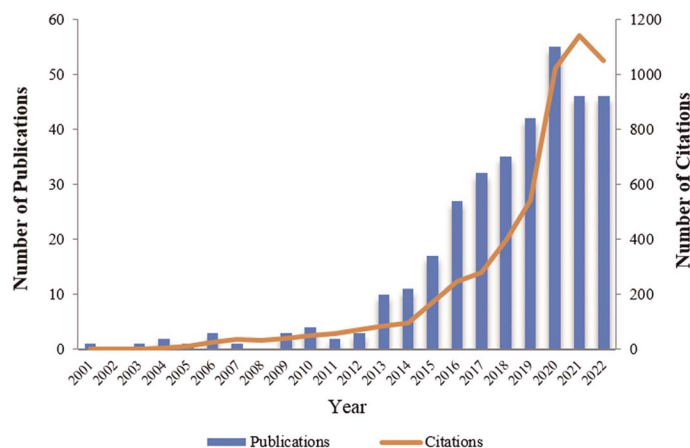


Figure 2. Annual publications and citations of studies on myocardial infarction based on Nationwide Inpatient Sample.

Table 1**The Top 12 Organizations That Published the Most Articles on Myocardial Infarction Based on Nationwide Inpatient Sample**

Rank	Organization	Publication Numbers	Citation Times	Citations After Removing Self-Citations	H-Index
1	Mayo Clinic	74	1222	709	22
2	Harvard University	43	1213	1189	20
3	University of California System	34	1078	1047	16
4	New York Medical College	25	1013	981	16
5	Mount Sinai St. Luke's	24	280	276	9
5	Emory University	24	159	147	8
7	University of Kentucky	21	258	254	8
8	University of Texas System	18	407	404	8
8	Keele University	18	141	133	6
10	West Virginia University	16	260	248	8
10	University of Mississippi	16	145	133	9
10	Yeshiva University	16	130	129	8

Vallabhajosyula S, Barsness GW, Cheungpasitporn W, Sundaragiri PR, Holmes DR, Jaffe AS, and Patlolla SH, whose citations dropped by 20% or above. Among the top 10 productive authors, all authors had an H-index ranging from 10 to 21, except for Cheungpasitporn W and Patlolla SH, who had H-indices of 9 and 7, respectively (Supplemental Table 1, <http://links.lww.com/ECCM/A67>).

A total of 45 journals were associated with the retrieved publications. The top 10 most active journals are listed in Table 2. A total of 197 articles were published, accounting for 57.60% of the articles included in this study. The *American Journal of Cardiology* (58), *Journal of the American College of Cardiology* (40), and *Circulation* (26) were the top journals in terms of number of publications. The *Journal of the American Heart Association* (756), *American Journal of Cardiology* (753), and the *Journal of the American College of Cardiology* (687) received the most citations. The highest H-index was 16, which belonged to the *American Journal of Cardiology*. *Circulation* had the highest IF with a value of 39.922. Among the top 10 journals, *Journal of the American College of Cardiology*, *Circulation*, *Journal of the American College of Cardiology*, *Circulation*, *American Journal of Medicine*, and *Arthritis Rheumatology* were classified as Q1 according to JCR (2021).

According to the keyword co-occurrence network map, 51 keywords occurred more than 3 times. The top 5 keywords were acute MI (n = 67), MI (n = 42), cardiogenic shock (n = 31), mortality (n = 29), and outcome research (n = 26) (Fig. 3). The keywords timeline view constructed by Citespace showed that the research mainly focused on the mortality of the myocardial infarction at the beginning of the 21st century. Based on the NIS, researchers paid more attention to the treatment, management, complications, and safety of

myocardial infarctions over time (Supplemental Fig. 1, <http://links.lww.com/ECCM/A68>).

The top 10 cited articles^[15–24] on MI based on NIS are listed in Table 3. The article with the most citations was “Trends in Incidence, Management, and Outcomes of Cardiogenic Shock Complicating ST-Elevation Myocardial Infarction in the United States,” published in *Journal of the American Heart Association* in 2014. After reviewing the full text of the top 10 articles, we summarized the general characteristics of the studies in Supplemental Table 2, <http://links.lww.com/ECCM/A69>. Seven studies^[15,17–21,23] evaluated the temporal trends of hospital outcomes (such as in-hospital mortality and length of stay), use of procedures, and resources related to MI, among which 2 also assessed the sex differences. One study determined the incidence, mortality, and risk factors of pregnancy-related AML.^[16] Other studies have estimated the impact of public reporting, socioeconomic status, and insurance on hospital outcomes in patients with MI.^[22,24] For the outcome indicator evaluated in these influential clinical studies, “in-hospital mortality” is the most widely used indicator, which was reported by 9 studies, followed by “length of stay” and “management strategy” (such as the use of percutaneous coronary intervention [PCI] and coronary artery bypass grafting) (Fig. 4). Multivariable logistic regression was the most commonly used statistical method in these studies.

Discussion

To the best of our knowledge, this is the first analysis to quantify the scientific usage and contribution of NIS to the study of MI. During the last 2 decades, research on MI stemming from

Table 2**The Top 10 Most Active Journals That Published Articles on Myocardial Infarction Based on Nationwide Inpatient Sample**

Rank	Journal	Publication Numbers	Citation Times	Citations After Removing Self-Citations	H-Index	Impact Factor	JCR Category
1	<i>American Journal of Cardiology</i>	58	753	738	16	3.133	3
2	<i>Journal of The American College of Cardiology</i>	40	687	685	5	27.206	1
3	<i>Circulation</i>	26	353	353	2	39.922	1
4	<i>International Journal of Cardiology</i>	15	257	254	8	4.039	2
4	<i>Journal of The American Heart Association</i>	15	756	751	10	6.107	2
6	<i>American Journal of Medicine</i>	11	219	217	10	5.928	1
6	<i>Clinical Cardiology</i>	11	118	117	6	3.287	3
8	<i>American Heart Journal</i>	7	147	146	5	5.099	2
8	<i>Journal of Clinical Medicine</i>	7	63	62	4	4.964	2
8	<i>Arthritis Rheumatology</i>	7	0	0	0	15.483	1

Table 3
The Basic Information on the Top 10 Highly Cited Publications of Myocardial Infarction Based on Nationwide Inpatient Sample

Rank	Title	Authors	Journal	Impact Factor	Year	No. Citations
1	Trends in incidence, management, and outcomes of cardiogenic shock complicating ST-elevation myocardial infarction in the United States	Dhaval Kolte, Sahil Khera, Wilbert S Aronow, Marjan Mujib, Chandrasekar Palaniswamy, Sachin Sule, Diwakar Jain, William Gotsis, Ali Ahmed, William H Frishman, Gregg C Fonarow	<i>Journal of the American Heart Association</i>	6.107	2014	368
2	Acute myocardial infarction in pregnancy—a United States population-based study	Andra H James, Margaret G Jamison, Mimi S Biswas, Leo R Brancazio, Geeta K Swamy, Evan R Myers	<i>Circulation</i>	39.922	2006	331
3	Trends in acute myocardial infarction in young patients and differences by sex and race, 2001 to 2010	Aakriti Gupta, Yongfei Wang, John A Spertus, Mary Geda, Nancy Lorenze, Chileshe Nkonde-Price, Gail D'Onofrio, Judith H Lichtman, Harlan M Krumholz	<i>Journal of the American College of Cardiology</i>	27.206	2014	280
4	Temporal trends and sex differences in revascularization and outcomes of ST-segment elevation myocardial infarction in younger adults in the United States	Sahil Khera, Dhaval Kolte, Tanush Gupta, Kathir Selvan Subramanian, Neel Khanna, Wilbert S Aronow, Chul Ahn, Robert J Timmermans, Howard A Cooper, Gregg C Fonarow, William H Frishman, Julio A Panza, Deepak L Bhatt	<i>Journal of the American College of Cardiology</i>	27.206	2015	153
5	Trends in mechanical circulatory support use and hospital mortality among patients with acute myocardial infarction and non-infarction related cardiogenic shock in the United States	Mahek Shah, Soumya Patnaik, Brijesh Patel, Pradhum Ram, Lohit Garg, Manyoo Agarwal, Sahil Agrawal, Shilpkumar Arora, Nilay Patel, Joyce Wald, Ulrich P Jorde	<i>Clinical Research in Cardiology</i>	6.138	2018	138
6	Acute noncardiac organ failure in acute myocardial infarction with cardiogenic shock	Saraschandra Vallabhajosyula, Shannon M Dunlay, Abhiram Prasad, Kianoush Kashani, Ankit Sakhuja, Bernard J Gersh, Allan S Jaffe, David R Holmes Jr, Gregory W Barsness	<i>Journal of the American College of Cardiology</i>	27.206	2019	118
7	Temporal trends and outcomes of mechanical complications in patients with acute myocardial infarction	Ayman Elbadawi, Islam Y Elgendy, Karim Mahmoud, Amr F Barakat, Amgad Mentias, Ahmed H Mohamed, Gbolahan O Ogunbayo, Michael Megaly, Marwan Saad, Mohamed A Omer, David Paniagua, J Dawn Abbott, Hani Jneid	<i>JACC-Cardiovascular Interventions</i>	11.075	2019	113
8	Association between public reporting of outcomes with procedural management and mortality for patients with acute myocardial infarction	Stephen W Waldo, James M McCabe, Cashel O'Brien, Kevin F Kennedy, Karen E Joynt, Robert W Yeh	<i>Journal of the American College of Cardiology</i>	27.206	2015	83
9	Perioperative acute myocardial infarction associated with non-cardiac surgery	Nathaniel R Smilowitz, Navdeep Gupta, Yu Guo, Jeffrey S Berger, Sripal Bangalore	<i>European Heart Journal</i>	35.855	2017	77
10	An exploration of the complex relationship of socioecologic factors in the treatment and outcomes of acute myocardial infarction in disadvantaged populations	JJ Shen, TT Wan, JB Perlin	<i>Health Services Research</i>	3.734	2001	76

only articles with “myocardial infarction” were included, which could omit articles on MI if the term “myocardial infarction” appeared only in the text. Finally, using citation counts to assess research impact without accounting for context may not reflect the quality of the study directly and completely, as citation counts can include both positive and negative citations.

Conclusion

The annual number of publications on MI based on NIS has significantly increased over the last 2 decades. The large database has provided a platform to evaluate patient care, resource utilization, and in-hospital outcomes in patients with MI, especially in those with relatively rare conditions. Combining NIS with other registry databases that contain detailed clinical information and long-term outcomes should be suggested to promote the quality of future studies and expand the contribution of NIS in clinical practice. International collaboration is encouraged to facilitate the use of NIS and improve scientific outputs in the future.

Conflict of interest statement

The authors declare no conflict of interest.

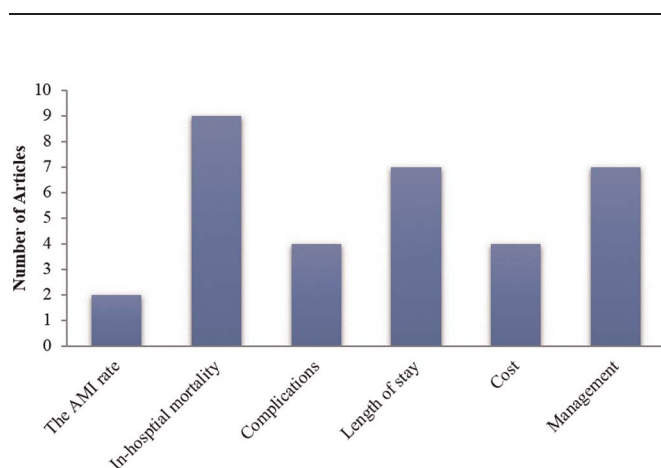


Figure 4. The primary outcome indicators reported in the top 10 cited studies. *Note: management means the use of intra-aortic balloon pump, coronary angiography, PCI, and CABG. CABG, coronary artery bypass grafting; PCI, percutaneous coronary intervention.

Author contributions

Zhang T, Yang X, Zhuang Q, Liu Y and Bai H participated in the performance of the research. Zhang T, Ye Z and Yang X wrote the paper. Zhang T and Liu J analyzed the data. Zhang T and Liu Y collected the data. Liu J and Ye Z participated in research design.

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Ethical approval of studies and informed consent

All studies included in this study followed the principles of the Declaration of Helsinki as revised in 2013.

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