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The application of project management theory in hospital management: Bibliometric analysis based on web of science database

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Abstract: This investigation analyzes the incorporation of theoretical frameworks in project management within the context of hospital administration through a bibliometric evaluation of publications in the Web of Science from 2014 to 2024 using CiteSpace. An analysis of contributions by 7,020 researchers in 96 countries across 426 publications identified Jeffrey Braithwaite as one of the notable contributors, while the top institutions in this field included Harvard University and the University of London. Findings reflect an evolution in methods in project management from conventional waterfall methods to agile and mixed methods. Keyword analysis emphasized an increased focus on improving quality, implementation, and evidence-based practice, indicating a greater emphasis on leadership and evidence-based practice between 2020 and 2024 compared to systems and management themes from 2014 to 2018. Highly cited publications included JAMA and BMC Health Services Research. Conclusion: Project management in hospital contexts has immense potential for optimizing resources, improving service provision, and enhancing patient outcomes while reducing organizational costs in complex healthcare systems. Practical Implications: Findings reflect an emerging interdisciplinary framework that integrates aspects of nursing, public policy in healthcare, nursing management, and patient safety with value-based healthcare programs focusing on improving quality, efficiency, and outcomes as core objectives.

Keywords: *Bibliometric, CiteSpace, Hospitals, Project management.*

1. Introduction

In the rapidly evolving healthcare landscape of today, hospital management faces increasingly intricate challenges, the limitation of public resources and the growing complexity, diversity, and plurality of the health status of populations, and ever-changing policies and regulations [1]. Consequently, effectively managing hospitals to enhance service quality and operational efficiency has emerged as a pivotal topic in both research and practice [2]. Project management theory, as a systematic approach to management, has gradually garnered attention from hospital administrators. Although derived from engineering and manufacturing fields, project management theory can be seamlessly applied to hospital management by transferring its principles and methods [3]. The functioning of a hospital can be perceived as an independent project involving various aspects such as the implementation of new technologies, renovation of hospital facilities, or optimization of medical service processes. By employing project management theory in these endeavors, hospitals can better strategize, coordinate, and oversee projects to ensure timely delivery within budgetary constraints while adhering to expected quality standards [4].

Bibliometrics is a quantitative analysis method used to examine the literature output and its impact, providing a robust foundation for the application of project management in hospital

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administration [5]. By systematically analyzing relevant literature, we can identify the current status, trends, and influencing factors of project management theory in hospital administration.

This research not only reveals the effectiveness of project management theory but also offers practical guidance for hospital managers to enhance their implementation of project management methods. Although there have been some studies on the application of project management in hospital administration, certain deficiencies still exist. For instance, most existing studies primarily focus on individual case analyses while lacking systematic literature reviews and empirical investigations. Therefore, this study aims to comprehensively analyze the application of project management theory in hospital administration using bibliometric methods and bridge the gaps present in current research.

This study utilizes the Web of Science Core Collection database to retrieve literature data pertaining to hospital project management (PM) and employs CiteSpace software to generate a visual knowledge map. The study focuses on the following four key themes: (a) Investigating the characteristics of collaboration in hospital project management research; (b) Identifying highly cited authors and frequently used keywords in this field; (c) Analyzing the primary research categories in this field over the past decade and their evolution; (d) Evaluating current hotspots and future trends in hospital project management research.

2. Data Acquisition and Methods

2.1. Data Collection

The data utilised in this study were gathered from the WoS Core Collection database which contains more than 12,000 primary and high-impact scholarly journals spanning natural sciences, engineering technology, biomedicine, social sciences, arts, and humanities, among others since 1900 [6]. The two steps are: In step one, the Web of Science Core Collection (WosCC), which is one of the primary sources of scientific information where all cited references for all publications are fully indexed and searchable, was searched and claimed [7]. The search text "Project management" "Hospitals" was applied for searching the published literature data within the date range of 2014/01/01-2024/10/27. Out of 1257 literatures, 1257 were selected.

2.2. Bibliometric Analysis and Tools

CiteSpace is a type of software used to visualise bibliometric information such as references, authors, and journals within specific parameters [8]. It generates co-occurrence network maps for authors, keywords, regions, institutions, and even countries for different subjects [9]. For this study, CiteSpace was set to have a time span between 2014 and 2024 with a slice interval of one year.

Regardless of the type of analysis applied, this paper illustrates an analysis of literature data on hospital PM taken from the WoSCC databases, using different perspectives like analysis of keywords, citation burst analysis, geographical location analysis, institutional analysis as well as analysis by subject category.

3. Results and Discussion

This paper provides a two-stage examination of the literature on hospital project management: (1) This descriptive stage aims to map the literature by identifying its geographical and institutional sources such as countries/regions, institutions and authors, and co-cited authors and journals; (2) A detailed investigation of theme shifts within the literature emphasising features of hospital project management research evolution through bibliometric and visual analysis methods.

3.1. Descriptive Analysis

3.1.1. The Distribution of Literature on Project Management In Hospitals For Publication

The number of literature reflects, to some extent, the research level and development speed of related fields. As depicted in Figure 1, the research outcomes on hospital project management exhibit

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certain fluctuations across different years, with an overall trend that can be categorized into the following stages: Initial stage (2014-2016): During this period, there was a limited quantity of literature available, and the average annual volume remained relatively stable. This indicates the preliminary exploration phase in project management research. Accumulation stage (2017-2018): Since early 2017, there has been a rapid increase in articles from 119 to 125, signifying a period of accumulation and consolidation within this field. Rapid growth stage (2019-2021): Post-2019 witnessed a significant surge in literature count from 140 to 161, indicating heightened interest within the academic community towards project management research and substantial advancements made therein. As of October 27th, 2024, a total of 81 literatures have been included for that year; although lower than the total amount recorded for 2023, it still falls within normal fluctuation range. It is anticipated that future numbers will match or even surpass those seen in 2023. This continuous growth trend underscores increasing attention from academia towards hospital project management research—particularly over the past decade—as it enters into a phase characterized by rapid expansion and positive developmental prospects.

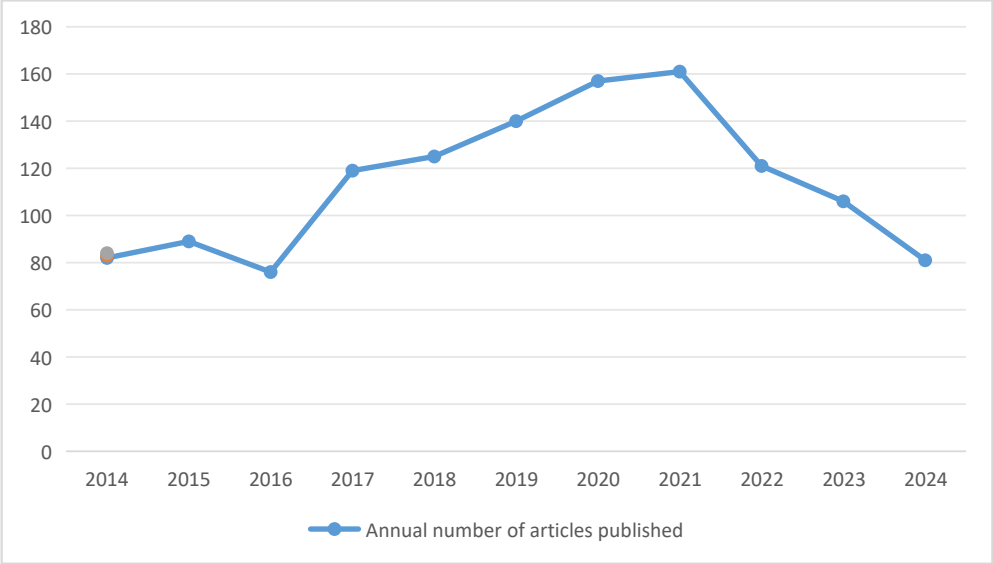

Figure 1.
Annual distribution of literature related to hospital project management from 2014 to 2024

In the research field, a total of 1257 articles were collected for analysis, revealing extensive involvement of hospitals in project management research across various domains. Specifically, 353 articles (28.1%) were from Nursing, 324 articles (25.7%) were from Health Care Sciences Services, 203 articles (16.1%) were from Public Environmental Occupational Health, and 117 articles (9.3%) were from General Internal Medicine; while other subjects accounted for 20.8%.

3.1.2. Distribution of Countries/Regions and Institutions Involved in Hospital PM Research

Figures 2 and 3 and Table 1 present volume of publications, number of papers, and centrality scores in top 10 countries/regions (out of 96) and institutions (out of 330) that have been most influential in the area of hospital performance management (PM).

Figures 2 and 3 present the institutional and geographical distributions of publications related to hospital performance measurements in the Web of Science. We can clearly see that these countries, institutions, and regions have an extensive network of associations among each other, which reflects an appreciable amount of cooperation among these institutions. Centrality refers to an entity's importance

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in an underlying system [10]. As a result, an entity with greater centrality in a system is related to an appreciably greater number of collaborative publications with other entities [11].

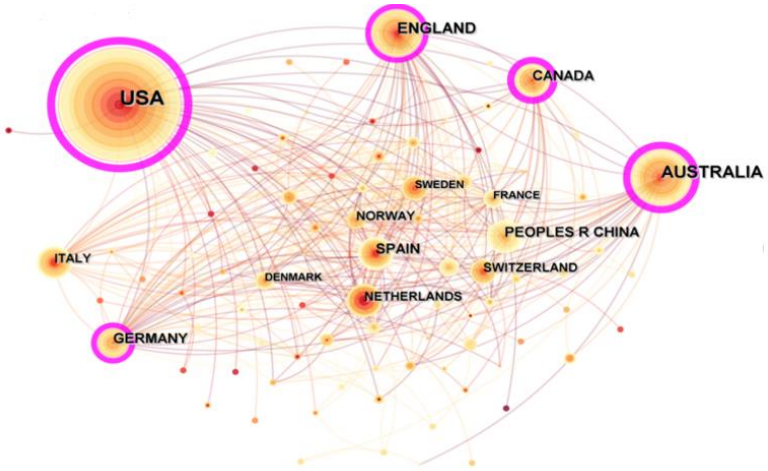

Figure 2.
Collaboration network map of countries/regions.

The circle represents the frequency while the radius of the circle has proportional correspondence to the number of frequencies. All nodes have interconnectedness in that these nodes co-occur in the same work.

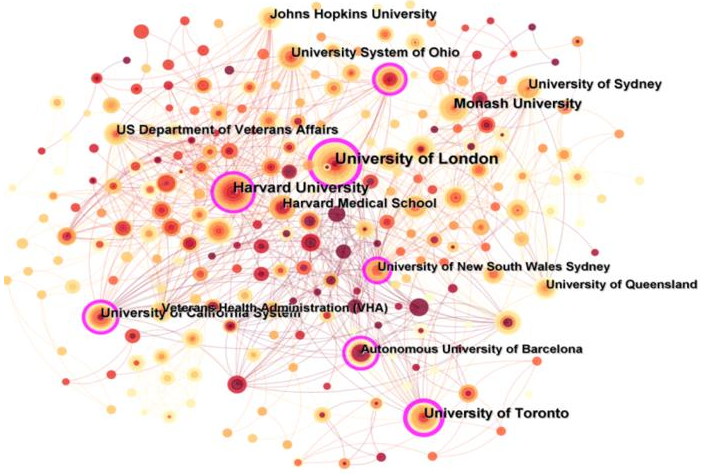

Figure 3.
Collaboration network map of institutions.

The circle is used to indicate quantity in terms of frequencies where magnitude is directly proportional to their corresponding number. Arrows between nodes indicate that these nodes have co-occurred in the same document.

Between 2014 and 2024, a total of 1,257 research papers on hospital project management were collected. Following the application of the "Remove duplicative" function in CiteSpace, a country distribution map illustrating the study of hospital project management (based on the Pathfinder/pruning network) was generated using visual pruning parameters. Upon running the software, an analytical network comprising 96 nodes and 460 links emerged, with a network density of

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0.1009 (Figure 2). Table 1 presents the top 10 countries with the highest output in hospital project management research. The United States ranked first both in terms of study count (491) and centrality (0.75) , show casing its remarkable contribution to this field. Australia followed closely behind with 170 articles, while the United Kingdom contributed significantly with 132 articles. Canada produced 84 articles and China published 71 articles respectively. It is note worthy that although ranking third in publication count, the United Kingdom ranks fifth in centrality (0.19), indicating room for improvement regarding its influence despite having published more literature on hospital project management research.

The Institution module in CiteSpace was utilized to conduct an analysis on the publishing institutions of the literature. As depicted in Figure 3, there are a total of 330 nodes and 980 connections, resulting in a density value of 0.0181 (Figure 3). The size of the nodes represents the number of publishing institutions, while centrality measures their significance and reflects their importance [12].

Based on the visual analysis of 1257 articles, the main research institutions in editing and publishing can be identified, and their cooperation can be observed through node connections [13]. Regarding publishing institutions, representative research institutions with University of London, Harvard University, University of Toronto and Monash University as core members have been established (Table 1). Among them, the University of London ranked first with 48 articles; its most cited literature was cited 63 times and mainly focused on delays and cost overruns in hospital construction and infrastructure projects. The study found that scope changes, risk management issues, and optimism bias were major contributors to poor project performance. It highlighted the importance of project governance and management approaches to ensure healthcare projects meet quality standards within budgetary constraints while adhering to time targets.

Table 1.
The top 10 countries and institutions contributing to publications on Hospital PM

Rank	Count	Centrality	Country	Count	Centrality	Institution
1	491	0.75	USA	48	0.26	University of London
2	170	0.21	AUSTRALIA	41	0.17	Harvard University
3	132	0.19	ENGLAND	28	0.21	University of Toronto
4	84	0.22	CANADA	26	0.07	Monash University
5	71	0.06	PEOPLES R CHINA	24	0.05	University System of Ohio
6	69	0.2	GERMANY	24	0.11	University of California System
7	58	0.1	SPAIN	21	0.04	Harvard Medical School
8	54	0.04	NETHERLANDS	21	0.07	University of Sydney
9	53	0.03	ITALY	21	0.05	US Department of Veterans Affairs
10	37	0.01	NORWAY	21	0.08	Johns Hopkins University

3.1.3. Distribution of Authors and Co-Cited Authors on Hospital PM Studies

By utilizing the Pathfinder/pruning slicing networks method to apply pruning parameters, a diagram of the author network is generated, which comprises 374 nodes and 407 links with a network density of 0.0058 (Figure 4). In the study on hospital project management, a total of 7020 authors participated (Table 2). Based on the number of studies and network centrality, Ellis, et al. [14]; Lui, et al. [15]; Goirand, et al. [16] and Groene, et al. [17] are among the most productive authors.

Meanwhile, using pruning parameters to construct a cited author network map for hospital project management research results in a network that consists of 525 nodes and 1658 links with a density of 0.0121 (Figure 5). Figure 5 illustrates the co-cited network of authors in this field where there are altogether 525 cited authors contributing to relevant literature on hospital project management research(Table 2). The data presented in Table 2 indicate that [ANONYMOUS] is cited most frequently(675) followed by Tunstall-Pedoe, et al. [18] however, the latter has significantly higher centrality than the former. Overall, this study concludes that [ANONYMOUS]is currently the most influential active authoring this field.

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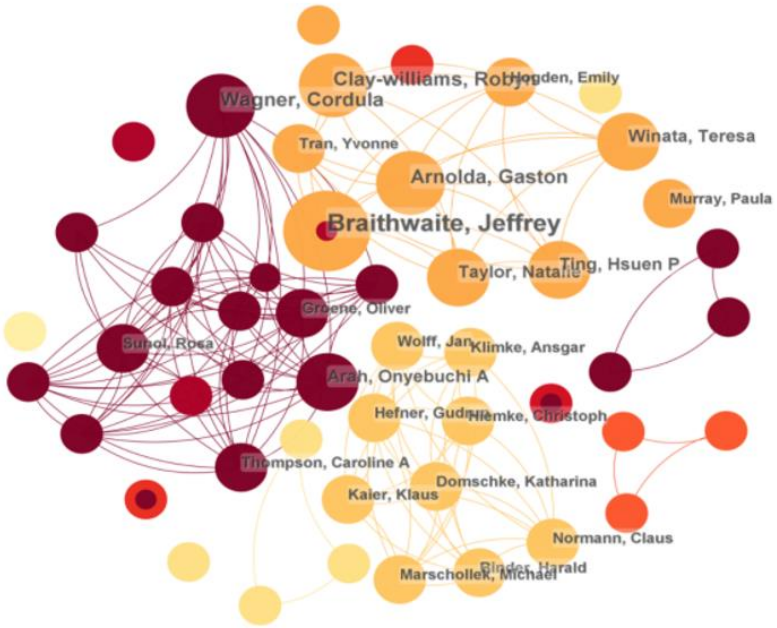

Figure 4.
Collaboration network map of authors.

The circle is used to indicate frequency while radius is used to indicate the number of these frequencies. Associations between nodes indicate these nodes co-occur in the same context.

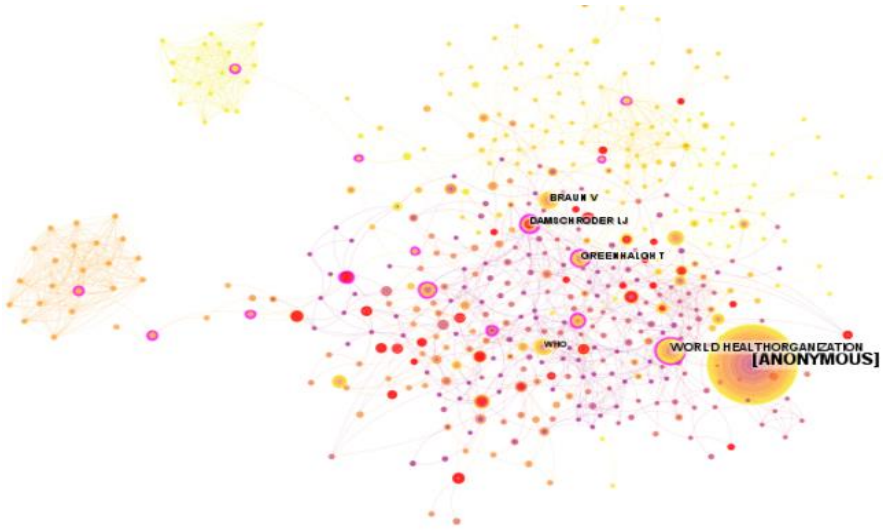

Figure 5.
Co-citation network map of cited authors.

The circle represents the frequency, and the circle size is positively correlated with the frequency count. The lines bet.

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Table 2.
The top 10 authors and cited authors contributing to publications on Hospital PM

Rank	Count	Centrality	Author	Count	Centrality	Co-Cited Author
1	8	0	Braithwaite, Jeffrey	675	0.01	[ANONYMOUS]
2	5	0	Arnolda, Gaston	89	0.1	WORLD HEALTHORGANIZATION
3	5	0	Clay-williams, Robyn	45	0.04	BRAUN V
4	5	0	Wagner, Cordula	38	0.13	GREENHALGH T
5	4	0	Winata, Teresa	38	0.48	DAMSCHRODER LJ
6	4	0	Ting, Hsuen P	33	0.04	WHO
7	4	0	Taylor, Natalie	29	0.09	CRESWELL JW
8	4	0	Arah, Onyebuchi A	28	0.04	BERWICK DM
9	3	0	Klimke, Ansgar	25	0.19	DONABEDIAN A
10	3	0	Domschke, Katharina	25	0.03	YIN RK

Source: Miles [19]; Harris, et al. [20]; Wagner [21]; Secanell [22]; Barnett, et al. [23]; Taylor [24]; Groene, et al. [17]; Makary and Daniel [25]; Aiken, et al. [26]; Tricco [27]; Holden, et al. [28]; Harvey [29]; Shaw [30] and Maldonado [31].

3.1.4. Distribution of Co-Cited Journals for on Hospital PM Studies

The cited journal map for Hospital PM research, obtained by applying pruning parameters in the Hospital PM research area, exhibits a distinct structural characteristic: it comprises 90 nodes and 280 links with a density of 0.009 (Figure 6). Table 3 presents the top 15 cited journals and their centrality values among a total of 462 literature sources on hospital project management. The most influential journal is JAMA-J AM MED ASSOC with a remarkable count of citations (302), followed closely by Hammett, et al. [32]; Ledges [33] and Sedda, et al. [34]. These findings demonstrate that journals with higher impact factors are more likely to receive greater citation frequencies within this field.

Regarding network centrality measures outlined in Table 3, BMC HEALTH SERV RES secures the first position with a centrality value of 1.23, trailed by JAMA-J AM MED ASSOC at 0.67 and INT J QUAL HEALTH C at 0.63. Notably, BMC HEALTH SERV RES attains the highest centrality value within this field (1.23), signifying its pivotal role in hospital project management research as the "core journal" in this domain.

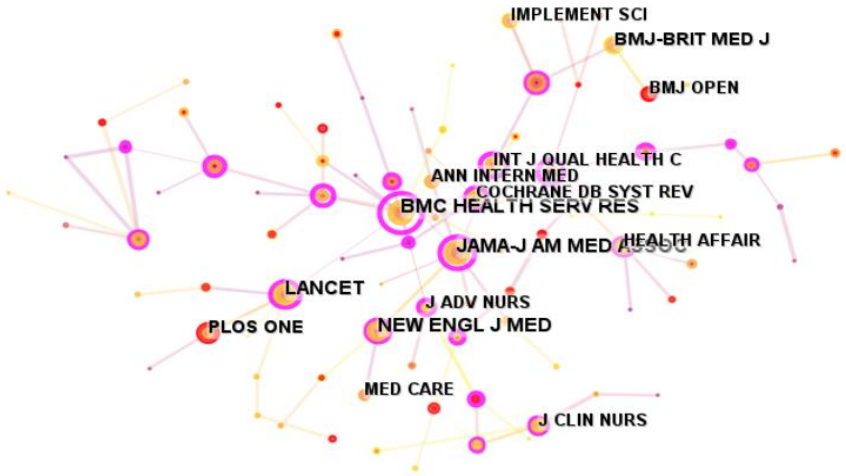

Figure 6.
Network map of co-occurring journals.

The circle represents the frequency, with radius representing the number of frequencies. The links between nodes reflect that these nodes in each cluster coexist in the same body of work.

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Table 3.
The top 15 cited journal and the importance index (centrality value) of the Hospital PM literature

Rank	Count	Centrality	Co-Cited Journals	Publishing Country/Region	IF
1	302	0.67	JAMA-J AM MED ASSOC	United States	63.1
2	267	1.23	BMC HEALTH SERV RES	United Kingdom	2.98
3	261	0.34	LANCET	United Kingdom	202.7
4	247	0.13	NEW ENGL J MED	United States	158.5
5	237	0.09	BMJ-BRIT MED J	United Kingdom	105.7
6	224	0.04	PLOS ONE	United States	3.752
7	170	0.38	J ADV NURS	United Kingdom	2.36
8	169	0	IMPLEMENT SCI	United Kingdom	5.8
9	168	0.13	HEALTH AFFAIR	United States	6.56
10	163	0.63	INT J QUAL HEALTH C	United Kingdom	2.3
11	154	0.04	BMJ OPEN	United Kingdom	3.58
12	141	0.26	COCHRANE DB SYST REV	United Kingdom	12.4
13	134	0.04	ANN INTERN MED	United States	51.3
14	132	0.13	J CLIN NURS	United Kingdom	3.4
15	129	0	MED CARE	United States	3.912

3.2. In-Depth Analysis

3.2.1. Distribution of Category Analysis in Hospital PM Studies

The articles in Web of Science (WoS) are typically categorized into one or more subject categories [35]. This study covered a total of 115 categories (refer to Table 4). Table 4 displays the top 10 research categories associated with hospital project management. Among all the categories, "NURSING" (353 articles) and "HEALTH CARE SCIENCES & SERVICES" (262 articles) emerged as the two most prolific ones. They were followed by "HEALTH POLICY & SERVICES" (223 articles) and "PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH" (203 articles). Although "GERIATRICS & GERONTOLOGY" (38 articles) and "ENVIRONMENTAL SCIENCES" (43 articles) had relatively fewer publications, these categories offer researchers novel perspectives for further exploration. In CiteSpace's category network, nodes with high centrality play a crucial role in connecting different categories, and their presence can significantly influence the advancement of specific research fields. As depicted in Table 4, the category of "NURSING" exhibits the highest score in terms of production centrality index, thereby reinforcing nursing research's pivotal position within the realm of hospital project management.

Table 4.
Top 10 categories of Hospital PM research.

Rank	count	Centrality	Year	categories
1	353	0.45	2014	NURSING
2	262	0.26	2014	HEALTH CARE SCIENCES & SERVICES
3	223	0.18	2014	HEALTH POLICY & SERVICES
4	203	0.26	2014	PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH
5	87	0.03	2014	MEDICINE, GENERAL & INTERNAL
6	79	0.26	2014	MANAGEMENT
7	55	0.08	2014	MEDICAL INFORMATICS
8	52	0.15	2014	PSYCHIATRY
9	43	0.05	2017	ENVIRONMENTAL SCIENCES
10	38	0.04	2014	GERIATRICS & GERONTOLOGY

The analysis of the burst intensity of discipline categories related to hospital project management reveals a significant shift in research interest between 2014 and 2024. From the Figure 7 we can found that the earliest and most enduring outbreak categories were Milbank Quarterly (MILBANK Q) and Annals of Emergency Medicine (ANN EMERG MED), which peaked between 2014 and 2017 (burst intensity 11.52) and 2014 and 2016 (burst intensity 8.48), respectively, indicating strong early attention

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towards these categories. Since 2015, Journal of the American Medical Informatics Association (JAM MED INFORM ASSN) and International Journal of Medical Sciences such as INT J MED INFORM have reached an outbreak intensity of 10.91 and 11, respectively, suggesting that medical informatics has become a prominent research topic during this period. Over time, there has been a gradual change in research focus across different areas, with subsequent outbreak categories like Health Policy (10.58, 2016-2018) and Circulation (7.87, 2017-2018) reflecting emerging research concerns. Overall, the breakout period analysis reveals dynamic trends and emerging areas of interest in hospital project management research over the past decade, providing valuable insights into the evolution and future direction of research in this field.

Subject Categories	Year	Strength	Begin	End	2014 - 2024
MILBANK Q	2014	11.52	2014	2017	
ANN EMERG MED	2014	8.48	2014	2016	
ARCH INTERN MED	2014	8.08	2014	2017	
BRIT MED J	2014	5.89	2014	2016	
INT J MED INFORM	2015	11	2015	2019	
J AM MED INFORM ASSN	2015	10.91	2015	2018	
JT COMM J QUAL PATIE	2015	5.53	2015	2016	
J NURS ADMIN	2015	5.13	2015	2016	
HARVARD BUS REV	2015	4.57	2015	2016	
HEALTH POLICY	2016	10.58	2016	2018	
J PAIN SYMPTOM MANAG	2016	6.84	2016	2018	
HEALTH SERV RES	2014	3.41	2016	2017	
CIRCULATION	2017	7.87	2017	2018	
PEDIATRICS	2014	6.16	2018	2019	
J CLIN EPIDEMIOL	2015	4.34	2018	2019	

Figure 7.
Category burst detection based on WoS data.

The blue lines indicate where each category is in both starting point and end point over the time frame between 2014 to 2024 while red lines indicate each category reaching each point of dominance.

3.2.2. Distribution of Co-Cited References in Hospital PM Studies

Co-cited literature analysis is a crucial bibliometric index, as demonstrated by the top 15 co-cited works from 2014 to 2024 listed in Table 5 [36].The co-cited reference map for Hospital PM research was obtained via the pruning parameter (pruning: none): 473 nodes and 726 links were included in the network, and the density was 0.0065 (Figure 8).In bibliometric analysis, co-cited literature analysis serves as a crucial approach to identify the core knowledge of project management [37].

Figure 9 shows the top 15 (of 473) strongest citations in the total cited literature. Among the most frequently cited literature from 2014 to 2024, Miles [19] from the Journal of Environmental Psychology discussed the role of hospital environmental design in enhancing work efficiency and employees' mental well-being, thereby suggesting the value of environmental optimization in project management. Harris, et al. [20] from the Journal of Biomedical Informatics examined the significance of information systems in healthcare project management, particularly in relation to electronic health record (EHR) deployment and data management [20]. This study demonstrates that integrating information technology can enhance project management efficiency. Barnett, et al. [23] from The

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Lancet explored the importance of healthcare quality management in efficient nursing practice and proposed effective strategies for project management developmentBarnett, et al. [23]. Makary and Daniel [25]Makary M.A. (2016) from BMJ revealed potential safety hazards within medical projects and emphasized improving patient safety through project management measures[25].

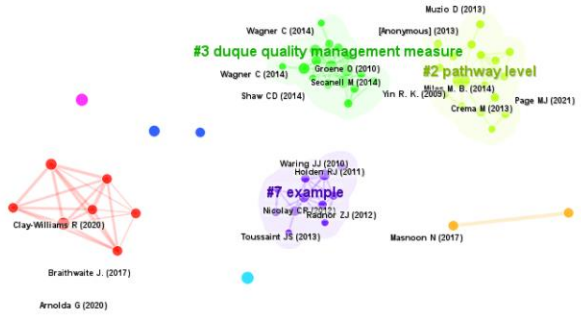

Figure 8.
Co-citation network map of cited references.

The circular shape represents quantity with radius equal to number of frequencies. Links between nodes indicate that these nodes coexisted in the same body work in co-presence.

Collectively, these documents establish a fundamental framework for hospital project management theory by highlighting key dimensions such as environmental design, information system integration, quality and safety management among others within healthcare settings. They provide both theoretical foundations and methodological guidance for practical implementation of effective project management strategies.

Subject Categories	Year	Strength	Begin	End	2014 – 2024
MILBANK Q	2014	11.52	2014	2017	
ANN EMERG MED	2014	8.48	2014	2016	
ARCH INTERN MED	2014	8.08	2014	2017	
BRIT MED J	2014	5.89	2014	2016	
INT J MED INFORM	2015	11	2015	2019	
J AM MED INFORM ASSN	2015	10.91	2015	2018	
JT COMM J QUAL PATIE	2015	5.53	2015	2016	
J NURS ADMIN	2015	5.13	2015	2016	
HARVARD BUS REV	2015	4.57	2015	2016	
HEALTH POLICY	2016	10.58	2016	2018	
J PAIN SYMPTOM MANAG	2016	6.84	2016	2018	
HEALTH SERV RES	2014	3.41	2016	2017	
CIRCULATION	2017	7.87	2017	2018	
PEDIATRICS	2014	6.16	2018	2019	
J CLIN EPIDEMIOL	2015	4.34	2018	2019	

Figure 9.
The top 15 co-cited references with the strongest citation burst. The lines (blue and red lines) represent the start and end times (from 2014 to 2024), and the red lines represent the duration of the burst.

Table 5.
Top 15 most-cited references from 2014 to 2024.

Rank	Count	Centrality	Year	References
1	12	0.01	2014	Miles M. B., 2014, JOURNAL OF ENVIRONMENTAL PSYCHOLOGY, V3rd, P0
2	7	0	2019	Harris PA, 2019, J BIOMED INFORM, V95, P0, DOI 10.1016/j.jbi.2019.103208
3	5	0	2014	Wagner C, 2014, INT J QUAL HEALTH C, V26, P27, DOI 10.1093/intqhc/mzu026
4	5	0	2014	Secanell M, 2014, INT J QUAL HEALTH C, V26, P5, DOI 10.1093/intqhc/mzu025
5	5	0	2012	Barnett K, 2012, LANCET, V380, P37, DOI 10.1016/S0140-6736(12)60240-2
6	5	0	2016	Ogrinc Greg, 2016, BMJ QUAL SAF, V25, P986, DOI 10.1136/bmjqs-2015-004411
7	5	0	2015	Taylor N, 2015, BMJ OPEN, V5, P0, DOI 10.1136/bmjopen-2015-010349
8	5	0	2010	Groene O, 2010, BMC HEALTH SERV RES, V10, P0, DOI 10.1186/1472-6963-10-281
9	5	0	2016	Makary MA, 2016, BMJ-BRIT MED J, V353, P0, DOI 10.1136/bmj.i2139 [19]
10	5	0	2014	Aiken LH, 2014, LANCET, V383, P1824, DOI 10.1016/S0140-6736(13)62631-8 [20]
11	5	0	2018	Tricco AC, 2018, ANN INTERN MED, V169, P467, DOI 10.7326/M18-0850
12	4	0.01	2011	Holden RJ, 2011, ANN EMERG MED, V57, P265, DOI 10.1016/j.annemergmed.2010.08.001 [21]
13	4	0	2016	Harvey G, 2016, IMPLEMENT SCI, V11, P0, DOI 10.1186/s13012-016-0398-2
14	4	0	2014	Shaw CD, 2014, INT J QUAL HEALTH C, V26, P100, DOI 10.1093/intqhc/mzu023
15	4	0	2017	Maldonado JR, 2017, CRIT CARE CLIN, V33, P461, DOI 10.1016/j.ccc.2017.03.013 [22]

Source: Miles [19]; Harris, et al. [20]; Wagner [21]; Secanell [22]; Barnett, et al. [23]; Taylor [24]; Groene, et al. [17]; Makary and Daniel [25]; Aiken, et al. [26]; Tricco [27]; Holden, et al. [28]; Harvey [29]; Shaw [30] and Maldonado [31].

3.2.3. Analysis of Keywords

3.2.3.1. Keyword Co-Occurrence Knowledge Map

Keywords, as the terms that signify the distinctive features of a paper's content, often embody its core and principal substance, representing words of substantial significance in expressing the central theme [38]. Consequently, conducting word frequency statistical analysis on keywords can effectively reflect the research focal points within this field [39]. By utilizing CiteSpace's keyword co-occurrence analysis template to visualize and analyze the keywords from research literature on project management of Traditional Chinese Medicine hospitals in 2014 - 2024 obtained from Web of Science, a statistical compilation of high-frequency words was generated (Table 6), where in frequency denotes the number of occurrences for retrieved paper keywords. Intermediate centrality refers to a paper keyword's weight index within the network, serving as an evaluation metric for literature importance [40]. The higher the centrality value, indicating greater likelihoods for keyword co-occurrences with other terms Hsieh and Li [41] nodes exceeding a data threshold of 0.1 are considered key nodes [42]. Keywords exhibiting both high frequency and centrality generally represent prominent research frontiers within this field [43].

According to Table 6, the most frequently occurring keywords are "management" (count = 292), "care" (count = 185), and "impact" (count = 101), followed by "outcome" (count = 98) and "health care" (count = 94). Keywords such as "implementation" and "health" also appeared with relatively high counts, indicating the significant emphasis on these aspects within the hospital project management domain. Centrality values, which denote the importance of a keyword in connecting different research

themes, show that "implementation" and "mortality" had the highest centrality (0.13 each), followed by "validation" (0.08) and "performance" (0.09). These keywords reflect the diverse topics covered in hospital project management literature, ranging from health care implementation to risk assessment and performance measurement.

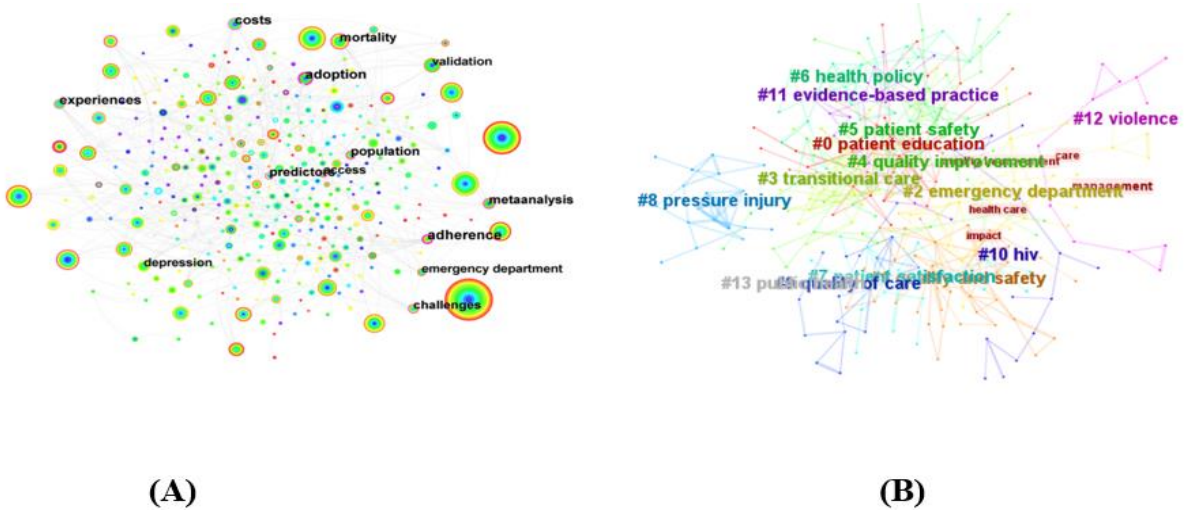

Figure 10.
(A): Keyword co-occurrence visualization map of publications on Hospital PM from 2014 to 2024.

The circle is used as an eye-catching device to indicate frequency where area is used to indicate a continuously positive value representing a number of occurrences in frequencies. Associations between nodes indicate that nodes tend to co-occur in the context in which they co-occur.

The results show that the keywords with both high frequency and centrality tend to form the core of the research network. The presence of keywords like "quality," "model," "performance," and "strategy" suggests that hospital project management literature often explores the relationships between health outcomes and various strategic interventions. The keyword "nurses," which emerged in 2015, signifies a growing recognition of the crucial role that nursing professionals play in achieving improved health outcomes.

Table 6.
Top 15 keywords in terms of citation counts and centrality for Hospital PM research.

No.	Count	Centrality	Year	Keyword
1	292	0	2014	Management
2	185	0	2014	Care
3	101	0	2014	Impact
4	98	0.01	2014	Outcm
5	94	0.06	2014	Health Care
6	74	0.13	2014	Implementation
7	73	0.07	2014	Health
8	72	0.03	2014	Quality
9	56	0.04	2014	Model
10	51	0.09	2014	Performance
11	50	0.04	2014	Program
12	47	0.02	2014	Risk
13	45	0.05	2014	Intervention
14	43	0.13	2014	Mortality
15	41	0.03	2015	Nurses

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3.2.3.2. Keyword Burst Analysis

The occurrence of keyword bursts serves as a crucial indicator for identifying emerging trends and shifts in research priorities over time [44]. In this study, we employed

CiteSpace to conduct an analysis on keyword clustering and identify significant emergences within the literature pertaining to hospital project management. Figure 10 presents the results obtained from keyword burst detection, where the intensity and duration of each burst signify periods of heightened research interest [45]. As depicted in the figure, there are several noteworthy keywords that experienced substantial outbursts between 2014 and 2024. Notably, "systems" emerged as the most prominent keyword burst (intensity = 4.83) between 2014 and 2018, underscoring the central role played by a systems approach in hospital project management during that period. Similarly, "Quality management" (strength = 4.77; 2014-2017) and "quality of care" (strength =3 .79; 2014-2017) witnessed significant bursts, indicating a strong emphasis on enhancing care quality and outcomes. This trend aligns with a broader shift towards a value-based healthcare model that prioritizes patient-centered care and quality assurance efforts. The growing interest observed in keywords such as "time" between 2018 and 2021 (intensity =3 .72;2020-2021) reflects an increasing focus on efficiency improvement and time management within healthcare settings. Furthermore, "Leadership"(strength=3 .48;2020-2022) also experienced notable growth, highlighting an escalating recognition of leadership's pivotal role in navigating complex healthcare environments while implementing effective project management strategies.

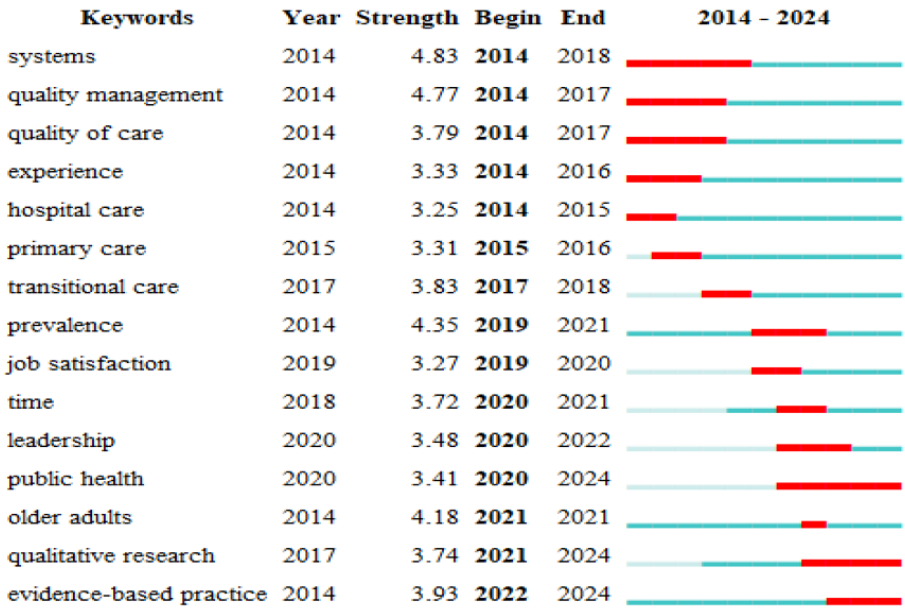

Figure 11.
The top 15 burst-detection keywords based on WoS data. The lines (blue and red lines) represent the start and end times. (from 2014 to 2024), and the red lines represent the duration of the burst.

Other keywords, such as "transitional care" (strength = 3.83, 2017-2018) and "evidence-based practice" (strength = 3.93, 2022-2024), have exhibited relatively brief yet impactful bursts, indicating a research focus on specific care processes and decision-making frameworks. Notably, the surges in the usage of "prevalence" (intensity = 4.35, 2019-2021) and "older adults" (intensity = 4.18, 2021) signify an increased attention towards the epidemiological aspects of managing aging populations and healthcare provision. The analysis of keyword outbreaks reveals a clear trend in hotspots for hospital project management research. Earlier studies (2014-2018) primarily concentrated on systems and

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quality management methods, reflecting efforts to optimize medical processes and ensure high standards of care. In contrast, recent research (2020-2024) has shifted its focus towards leadership, public health, and evidence-based practice—indicating a growing awareness of the strategic and policy-driven dimensions within healthcare management. In summary, burst analysis highlights the dynamic nature of hospital project management research with evolving priorities and thematic areas over the past decade. The findings suggest that future research may continue expanding into topics such as public health, leadership development, and evidence-based practice—areas that have demonstrated sustained bursts in interest while gaining increasing importance.

4. Conclusions

In summary, this study not only helps us to identify research hotspots and trends in the field of hospital project management, but also reveals the network of collaboration between key researchers and institutions, providing valuable insight into the application of hospital project management. Applying project management theory to hospitals can help us gain insight into how to optimize the quality of care, improve productivity, promote patient safety, and effectively implement change management in complex healthcare environments. In addition, the application of project management theory enables us to improve health care outcomes through systematic methods and data-driven decision making, and enhance the effectiveness of team collaboration, thus driving innovation and improvement of health care services.

Based on bibliometrics, this paper comprehensively discusses the research on hospital project management from 2014 to 2024, and uses CiteSpace to conduct in-depth analysis on keyword clustering, co-citation of authors, institutional cooperation and national networks. The research reveals the main research directions, important researchers and emerging research trends in the field, and identifies potential research hotspots. Keyword co-occurrence and cluster analysis show that "quality of care", "leadership", "transitional care" and "evidence-based practice" are the main research topics in hospital project management, reflecting the core concerns of improving health care quality, efficiency and evidence-based decision-making. At the same time, the presence of keywords such as "emergency department", "public health" and "patient safety" indicates the importance researchers attach to improving the flow of acute care and safety management.

In the author co-citation network, scholars such as Braithwaite, Jeffrey, Sunol and Rosa, as core nodes, show their important influence in shaping the research direction in this field. The Institutional Collaboration Network shows that well-known institutions such as Harvard University, Johns Hopkins University and the University of London have played an important role in promoting academic cooperation and the development of the field. In terms of country collaboration, the United States, the United Kingdom and Australia lead in research output, demonstrating the global influence of hospital project management research.

In-depth analysis shows that interdisciplinary research has become a key trend in the field of hospital project management over the past decade, especially in the integration of public health, nursing and management. The research shows that the field is moving toward a more integrated and interdisciplinary approach, integrating multiple aspects of public health policy, nursing, quality management, and patient safety, which aligns with the broader value-oriented healthcare movement where improvements in quality, efficiency, and outcomes remain the primary goals. However, challenges such as promoting international collaboration, especially beyond traditional partners, and effectively applying research findings to practical problems in different healthcare Settings still need to be addressed in the future.

The comprehensive visualization and analysis of this bibliometric study provides a clear roadmap for future researchers, policymakers, and practitioners to inspire them to further explore emerging trends such as digital health transformation, crisis management leadership, and patient-centered care models. By identifying existing research gaps and collaboration patterns, future research can build on

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them to develop more effective strategies and frameworks to better manage healthcare programs and improve patient outcomes.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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