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Identification of Critical Waste in Lean Hospital Administration Through Bibliometric Study

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Background: Lean principles, originating from the manufacturing sector, have gained traction in healthcare as hospitals aim to enhance operational efficiency and service quality. **Specific background:** Despite growing interest, the application of Lean in hospital settings remains fragmented, particularly concerning waste identification and management. **Knowledge gap:** Few studies provide a comprehensive mapping of research trends and critical issues in Lean Hospital literature related to waste. **Aim:** This study aims to bridge that gap by conducting a bibliometric analysis to identify and classify critical research streams addressing waste in Lean Hospital administration. **Results:** Analyzing 97 peer-reviewed articles using R Studio and VOSviewer, we identified five key research streams: (1) Lean Hospital and Waste Reduction, (2) Healthcare Quality Improvement, (3) Digital Transformation, (4) Policy Implementation, and (5) Sustainability. **Novelty:** This study offers a systematic synthesis of two decades of scholarly work, presenting a structured overview of evolving themes and proposing future research questions within each stream. **Implications:** The findings advance academic understanding by categorizing existing literature and guiding future research on Lean healthcare, particularly in waste reduction, ultimately supporting evidence-based administrative improvements in hospital management.

Highlights:

- Identifies five core research streams in Lean Hospital literature.
- Uses bibliometric analysis over a 20-year span.
- Proposes future research directions for each stream.

Keywords: Lean Hospital, Waste Reduction, Healthcare Quality, Digital Transformation, Sustainability

Introduction

Healthcare systems in various countries face challenges in meeting public expectations for quality services, such as efficiency and timeliness [1]. Challenges such as increasing patient needs, limited resources, and the complexity of the service process often cause inefficiencies, including waste of time, energy, and costs [2]. As one of the important components of the hospital, the pharmacy service unit is not free from these problems [3].

This phenomenon indicates the need to apply innovative approaches, such as lean hospitals, to

identify and reduce critical wastes to improve operational efficiency and quality of health services sustainably [4] 5].

This is in line with the increasing number of hospitals, competition between hospitals to provide the best service is also increasing. Public expectations of quality health services are also getting higher. Health services can be of high quality if they can satisfy all service users with a high level of satisfaction according to the average population, and their implementation is in line with the code of ethics and professional standards established [6].

Therefore, hospitals must ensure that all health service activities are quality-assured, safe, and timely by applying patient safety principles based on relevant scientific evidence, experience, and/or applicable guidelines or regulations. One of the hospital's objectives is to provide business facilities for health services. Health services in hospitals include outpatient, inpatient, and emergency services and medical and medical support services. Pharmaceutical installation is one of the important units in hospital services.

In many countries, long waiting times are one of the contributing factors to patient dissatisfaction with hospital services. Hospital organizations are complex entities, have large capital, and operate as businesses and social service institutions. Therefore, hospital management must pay attention to and improve the balance between service quality and patient satisfaction. In addition, hospitals are also expected to be able to consider the values brought by customers, not just provide customer satisfaction alone [7].

Hospitals need a lean approach to optimally meet patient service needs and improve health services' quality while reducing waste that can provide added value to the hospital [8]. Therefore, the success of this approach has prompted many studies to explore how lean hospitals can be effectively applied in improving hospital operational performance.

Several previous studies examined the application of lean hospitals in improving hospital operational efficiency. They examined how lean hospital methods can improve workflow efficiency, reduce (non-value-added) activities, and improve patient safety and staff satisfaction. The research showed that this approach effectively creates better services in hospitals. In line with that, [9] lean healthcare implementation can reduce patient waiting time by 30% and improve operational efficiency, especially in pharmaceutical services. In addition to the benefits, other studies [10] highlighted the challenges in implementing lean hospitals, namely the complexity of the hospital system and ineffective coordination between units, [11] adding that staff resistance is also a major obstacle to implementing this method, often caused by a significant change in work culture.

Management support is an important factor in ensuring the success of lean hospital implementation [8] a systematic study shows that lean hospitals provide significant economic benefits and improve efficiency, provided they are fully supported by hospital management. In addition, [12] it shows that tools such as value stream mapping can effectively map value-added activities and identify wastage. However, its effectiveness depends on the staff's active involvement and adequate data availability. [13] It also shows that lean hospitals can improve patient and staff satisfaction and reduce clinical errors. However, sustainable implementation requires intensive training as well as organizational culture change.

Previous studies have predominantly examined the application of lean hospitals to improve general operational efficiency, such as reduced waiting time, improved patient satisfaction, and workflow effectiveness. However, studies that specifically highlight the application of lean hospitals to identify critical waste through bibliometric analysis are still limited. Therefore, this study contributes to filling the gap in previous studies and provides a practical contribution to improving hospital pharmacy services. Thus, this article will ask several main questions.

RQ1. How is the development of Lean Hospital and Waste?

RQ2. What themes/topics were debated during those two decades?

Literature Review

A. The Theoretical Multidimensionality of Lean in The Hospital Sector

The concept is based on the Lean Philosophy in Healthcare, which aims to eliminate waste, add value to services, and provide better healthcare. Research conducted in the context of public hospitals shows that implementing lean management aims to improve the patient experience by reducing waiting times, speeding up care processes, and optimizing the use of resources. Hospitals can create a more organized and calm working environment through this approach, increasing patient and staff satisfaction. Lean also emphasizes the importance of employee engagement, where all levels of staff are encouraged to contribute to problem identification and solving. Overall, the application of lean philosophy in public hospitals focuses not only on reducing costs but also on improving service quality, which is crucial in achieving the goal of better healthcare.

The main assumptions of the lean concept focus on improving healthcare delivery, reducing costs, and increasing operational efficiency. In line with the research [14], Lean implementation in public hospitals can help reduce waiting times, improve patient access, and optimize the use of space and workforce. Hospitals can be more responsive to patient's needs and enhance their service experience through this approach. In addition, Lean also encourages a culture of continuous improvement, where every team member is invited to contribute to finding solutions to existing problems. Thus, Lean improves efficiency and the quality of services provided to the community. [15] This philosophy encourages collaboration and employee engagement by involving the entire staff, from upper management to healthcare workers, improving patient satisfaction and care outcomes. Through a systematic and continuous approach, Lean serves not only as a tool for cost efficiency but also as a strategy to build a culture of constant improvement in public hospitals. Further [16], in a public health system that often faces challenges such as budget constraints and high demand for services, the Lean philosophy offers an effective strategy to create a better, faster, and more affordable service system, thus significantly benefiting the wider community.

Lean aims to improve efficiency, quality, and safety in service procedures. It is a structured strategy to recognize and eliminate waste or non-value-adding activities through continuous improvement. The goal is to improve service processes’ efficiency, quality, and safety. [17].

According to [6], the definition of lean can be divided into two parts. Firstly, continuous improvement is needed to improve hospital services. Continuous improvement, in this case, focuses on reducing waste. In a hospital, many activities do not contribute to the patient's recovery and are considered waste. The lean approach aims to eliminate or minimize these wastes to reduce hospital costs, increase patient satisfaction, and improve patient and staff safety [6]. There are seven types of waste in hospitals: overproduction, waste of time, waste in transport, waste in the production process, waste in inventory, waste in movement, and waste as a result of failed products [7]. Second, Respect for People in the lean approach means many ways to motivate employees and improve the performance of employees. Employees and all elements of the hospital are involved in problem-solving and reducing or eliminating waste. In hospitals, respect for people can be interpreted as respect for patients, doctors, employees, the community, and all parties involved in the hospital, including the environment. In this case, bad actions against any of them are considered unacceptable [6].

Methods

This research uses a qualitative method with a bibliometric study approach. In bibliometric analysis, we aim to show patterns, categorization, and linkages among articles and research topics by analyzing how often an article is cited and cited by other articles. The article is the basic unit of analysis. The basic assumption in bibliometric citation analysis is that articles published in

scientific journals build their research based on similar articles already published [18]. The chosen bibliometric analysis tools, R Studio and VOSviwer are powerful methods that improve upon conventional literature reviews. R Studio provides information on important articles, authors, institutions, countries, and journal publishers, resulting in a deeper and more reliable research flow map of lean hospitals and waste management compared to previous studies. We used the Web of Science (WOS) publication data to form the database for articles from 1 January 2001 to 30 December 2024. As for the author's consideration of Using the last 20 years of reference, first, we will assess developments over time or issues being discussed to enable the mapping of lean hospitals and waste.

Furthermore, the consideration of using article data sources taken from WOS, which is used as the main database, is based on the fact that first, WOS has high quality and credibility, and it only indexes quality journals that have undergone a rigorous selection process. Second, its multidisciplinary coverage makes it an invaluable resource for researchers, providing diverse references from different fields and perspectives.

We use two approaches to select articles using the keywords “Lean Hospital” AND Waste.” Firstly, we selected articles based on the same keywords. For search limitations, we only selected articles written in English. We selected articles in:

Main Topic	Subtopic
Lean Hospital AND " Waste "	1. Lean Hospital Administration
	2. Administrative Waste in Healthcare
	3. Efficiency in Hospital Management
	4. Digital Transformation in Hospital Administration
	5. Process Waste in Healthcare Administration
	6. Lean Policy Implementation in Hospitals
	7. Automation and Waste Reduction in Hospital Administration

Table 1. *General Information on Lean Hospital and Waste Publication Data (2001-2024)*

Furthermore, the author's main point is choosing articles from reputable publishers based on publication by years, document types, web of science categories, citation topics, meso and micro, languages, and research areas. The resulting database of 97 articles was carefully read and analyzed for content.

In addition to R Studio bibliometric analysis, we also used bibliometric cartographic analysis. This is a tool designed to analyze keywords. Keyword analysis was used to identify the growth of each stream of lean hospital and waste research through the number of publications in the last 20 years. Bibliometric cartography allows us to determine which research streams have received less attention by identifying the areas with the fewest articles. In the bibliometric cartography analysis, we identified all publications from ISI that used lean hospital and waste as keywords (in the abstract or abstract keyword data fields) from 2001 to 2024 and found 97 articles. Using VOSviewer, we could select the 67 most frequently occurring keywords with five or more occurrences. VOSviewer can classify those keywords into different clusters: keywords located close to each other illustrate a high frequency of co-occurrence in articles, and those further apart indicate a low frequency of co-occurrence. Each keyword cluster represents a stream of lean hospital and waste research.

Result And Discussion

A. Main Information

This section presents the results of the main analyses related to the research data covering 2001 to 2024.

Description	Results	Authors	361
MAIN INFORMATION ABOUT DATA		Authors of single-authored docs	8
Timespan	2001:2024	AUTHORS COLLABORATION	
Sources (Journals, Books, etc)	52	Single-authored docs	8
Documents	97	Co-Authors per Doc	3.94
Annual Growth Rate %	2.93	International co-authorships %	27.55
Document Average Age	6.88	DOCUMENT TYPES	
Average citations per doc	22.03	article	80
References	3881	article; book chapter	3
DOCUMENT CONTENTS		article; early access	4
Keywords Plus (ID)	231	article: proceedings paper	1
Author's Keywords (DE)	334	review	9
AUTHORS		review; book chapter	1

Table 2. *Scientific Production of Leading Authors in Lean Hospital and Waste Studies*

The table above provides a comprehensive overview of various aspects of publication metadata on Lean Hospital and Waste, including the number of sources used (52 journals, books, and others) and the total documents analyzed (97). In terms of growth, the average annual growth rate was recorded at 2.93%, with the average age of the papers reaching 6.88 years. In addition, each document received an average of 22.03 citations, totaling 3,881 references. Author collaboration was also analyzed, showing 361 authors involved in this publication. Among them, eight authors produced documents individually, with an average of 3.94 authors per document. The proportion of international collaboration reached 27.55%. In terms of document type, articles became the most dominant category with 80 publications, followed by various other combinations such as articles in early access form (4 documents), articles in proceedings (1 document), and literature reviews (9 papers). The keywords used also varied, with 231 keywords from the ‘Keywords Plus’ category and 334 from the ‘Author's Keywords’ category.

B. Authors' Production Over Time in the Lean Hospital and Waste Study

This section analyses the authors' scientific production development in Lean Hospital and Waste studies. This analysis aims to identify publication trends, including author contributions, publication frequency, and research growth patterns in this field. By understanding the dynamics of scientific production, insights can be gained into developing the Lean Hospital concept and waste management in the healthcare context.

Rank	Author(s)/Year/Title	Journal	TC	TCpY
1	[19]. SuccessFactors For The AdoptionOf Green Lean Six Sigma In HealthcareFacility: An Ism-Micmac Study	International Journal of Lean Six Sigma	35	11.667
2	[20]. ReleasingOperating Room NursingTime To CareThrough The ReductionOfSurgicalCasePreparationTime: A Lean Six Sigma Pilot Study	International Journal of Environmental Research And Public Health	12	2.4
3	[21]. Lean Six Sigma	International Journal of	7	1.4

	RedesignOf A Process For HealthcareMandatoryEducation In Basic Life Support-A Pilot Study	Environmental Research And Public Health		
4	[22]. Lean Six Sigma For The HealthcareSector: A MultipleCase Study AnalysisFrom The Indian Context	International Journal of Quality \& Reliability Management	56	8
5	[23]. ReducingRiskOf Development Or ExacerbationOfNutritionalDeficits By OptimizingPatient Access To MealtimeAssistance	International Journal For Quality In Health Care	10	1.429
6	[24]. SustainableOrganizational Performance: A Study OfHealth-CareOrganizations In The United Arab Emirates	International Journal of Organizational Analysis	33	4.714
7	[25]. Prioritizing Lean ManagementPractices In PublicAndPrivate Hospitals	Journal of Health Organization And Management	45	4.5
8	[26]. AhpFramework To Assist Lean Deployment In Abu Dhabi PublicHealthcareDelivery System	Business Process Management Journal	41	4.1
9	[27]. ApplicationsOf Lean Six Sigma In An Irish Hospital	Leadership In Health Services	83	6.385

Table 3. *Most Relevant Keywords in the Study of Lean Hospital and Waste*

Table 1 lists scientific publications addressing Lean and other management practices in the healthcare sector. The article with the highest number of citations (total citations, TC) is the study of [27] that discusses the implementation of Lean Six Sigma in Irish hospitals. The study found that although the projects were carried out by relatively new users of Lean Six Sigma techniques, they quickly delivered practical benefits to the hospitals. These projects also demonstrated the importance of top management support and good communication with stakeholders as key success factors study by [22] The study on the application of Lean Six Sigma in the context of healthcare in India also had a high citation count of 56 citations with a TCpY of 8, finding that long waiting times can harm patient health. In addition, the study emphasized the importance of effective leadership, good communication, team engagement, significant improvements in cycle time and patient satisfaction, and operational cost savings.

Furthermore, recent research by [19]. Regarding the success factors of Green Lean Six Sigma implementation in healthcare facilities occupying a significant position with 35 citations and a TCpY of 11.667, this study found that the success factors ‘management commitment’ and ‘financial availability’ are the most important for the successful implementation of GLSS, as they support the development of all other success factors. Meanwhile, ‘embedding continuous measures at every stage of service,’ ‘real-time data collection capability and effectiveness,’ and ‘feedback and corrective action’ most directly supported the implementation of GLSS in healthcare facilities and served as the final indicators of implementation progress suggesting that this topic is of increasing relevance and interest in recent studies. Several other studies have also focused on specific service efficiency aspects, such as optimizing treatment times in operating theatres [20] and redesigning

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the health services' basic life support education process [21]. Overall, it shows that lean-based approaches and quality management are increasingly being applied in various aspects of healthcare, such as operational efficiency, service quality improvement, and sustainable organizational performance.

C. Analysis of the Most Relevant Keywords in Lean Hospital and Waste Study

This section analyzes the most relevant keywords in Lean Hospital and Waste studies. The graph below shows the frequency of occurrence of key terms frequently used in related studies.

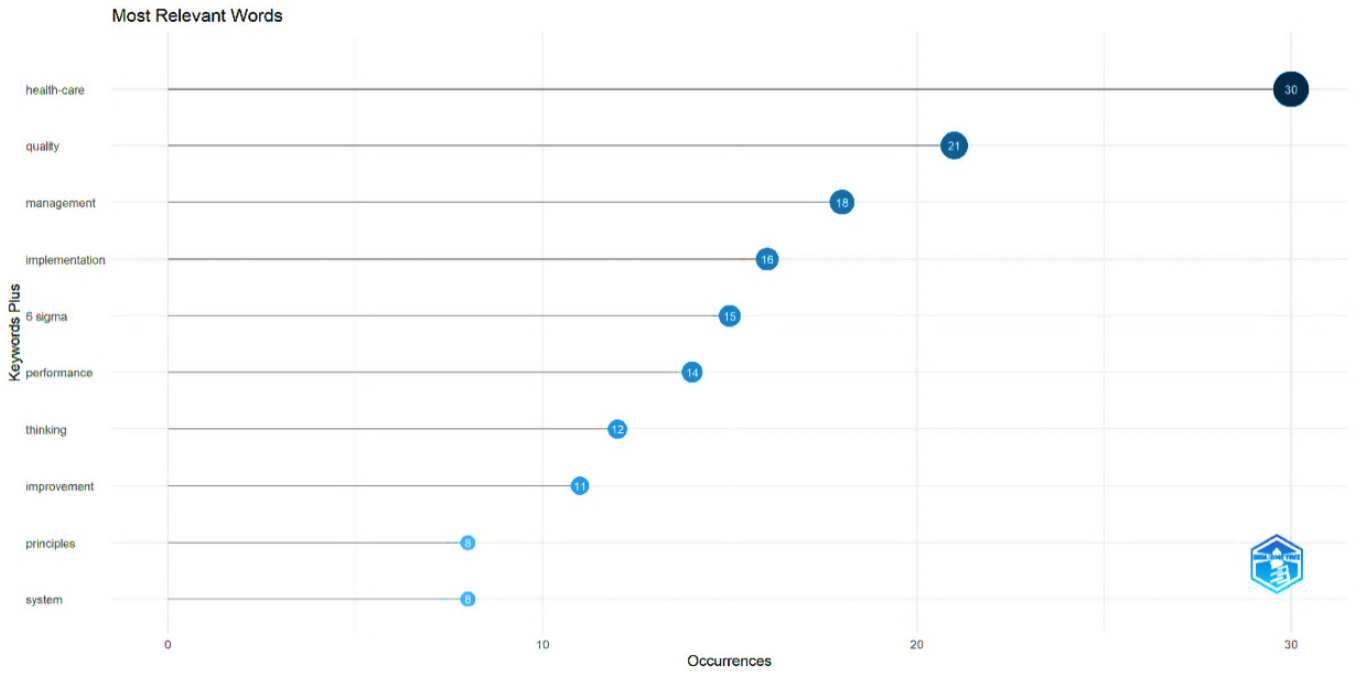

Figure 1. *Most Relevant Keywords in Lean Hospital and Waste Study*

Keywords such as healthcare, quality, and management appear with the highest frequency, reflecting the main focus of studies on improving efficiency, quality of service, and management in the hospital context. This analysis provides insights into research trends and key aspects of concern in Lean Hospital and waste management studies. Healthcare is the most dominant topic as it covers various aspects of medical services, operations, and policies related to improving the effectiveness of the healthcare system [28]. Meanwhile, quality occupies an important position as multiple studies highlight the importance of improving service quality through approaches such as Lean Hospital, which aims to optimize patient care processes and reduce resource wastage.

In addition, the management topic indicates that the management aspect in health services is a major concern in lean hospital studies. Good management includes cost and operational efficiency and the management of the hospital's workforce, facilities, and information systems [29]. In this context, Lean Hospital is one of the approaches often discussed to improve the efficiency of the healthcare system. At the same time, waste management is also an important aspect of maintaining the sustainability of the hospital environment [30];[4]. This analysis provides insight into the growing research trends in improving healthcare effectiveness through better management and quality-based approaches.

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D. Visualization of Keyword Networks in Lean Hospital and Waste Studies

Network visualization of keywords in Lean Hospital and Waste studies, generated using VOSviewer. This graph illustrates the relationship between various terms frequently appearing in related studies.

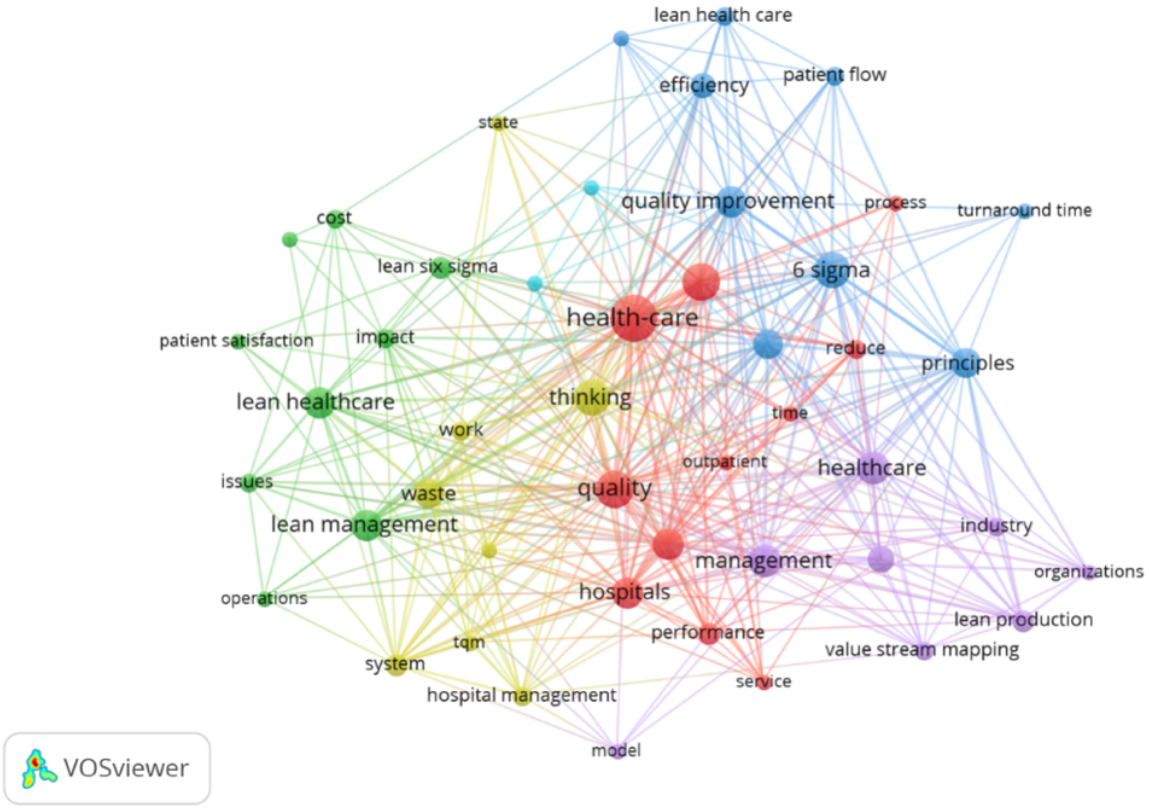

Figure 2. *Network Mapping Based on Keywords*

Keywords such as health care, quality, and management occupy a central position, indicating that they often appear alongside many other terms, reflecting their importance in various aspects of the Health system [31]. In other words, these concepts act as a key link regarding healthcare improvement, efficiency, and health system management. Just as healthcare is at the center because it is a major topic encompassing various management approaches, quality of care, and operational efficiency, so is healthcare [32]. Quality is crucial because healthcare improvements often focus on improving the quality of service to patients, including reducing waiting times, optimizing patient flow, and implementing lean healthcare principles [33]. Meanwhile, management also occupies a central position. After all, the healthcare system focuses on medical aspects and involves resource management strategies, business processes, and organizational policies to achieve effectiveness and efficiency [34];[31]. The strong interconnections between this keyword and other terms such as lean healthcare, efficiency, principles, and value stream mapping indicate that research or discussion in this field focuses on applying efficient management principles to improve healthcare quality.

In addition, some color clusters indicate the interrelationship between concepts such as lean

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healthcare, waste management, and quality improvement. For example, lean healthcare is an approach that aims to improve operational efficiency by reducing waste and increasing patient value [35]. Waste Management in the healthcare system refers to medical and operational waste management strategies to ensure efficiency and compliance with health and environmental standards [36]. Effective waste management principles align with lean healthcare, aiming to reduce waste in various operations [37]. Furthermore, quality improvement in healthcare focuses on improving the quality of services by applying systematic and data-driven methods [38]. This approach often utilizes tools such as Plan-Do-Check-Act (PDCA), Six Sigma, and Total Quality Management (TQM) to identify and address problems in the Healthcare service process [39]. This network visualization reflects the trend in the healthcare industry of increasingly adopting management and quality-based approaches to deliver better services, reduce wastage, and improve the overall patient experience.

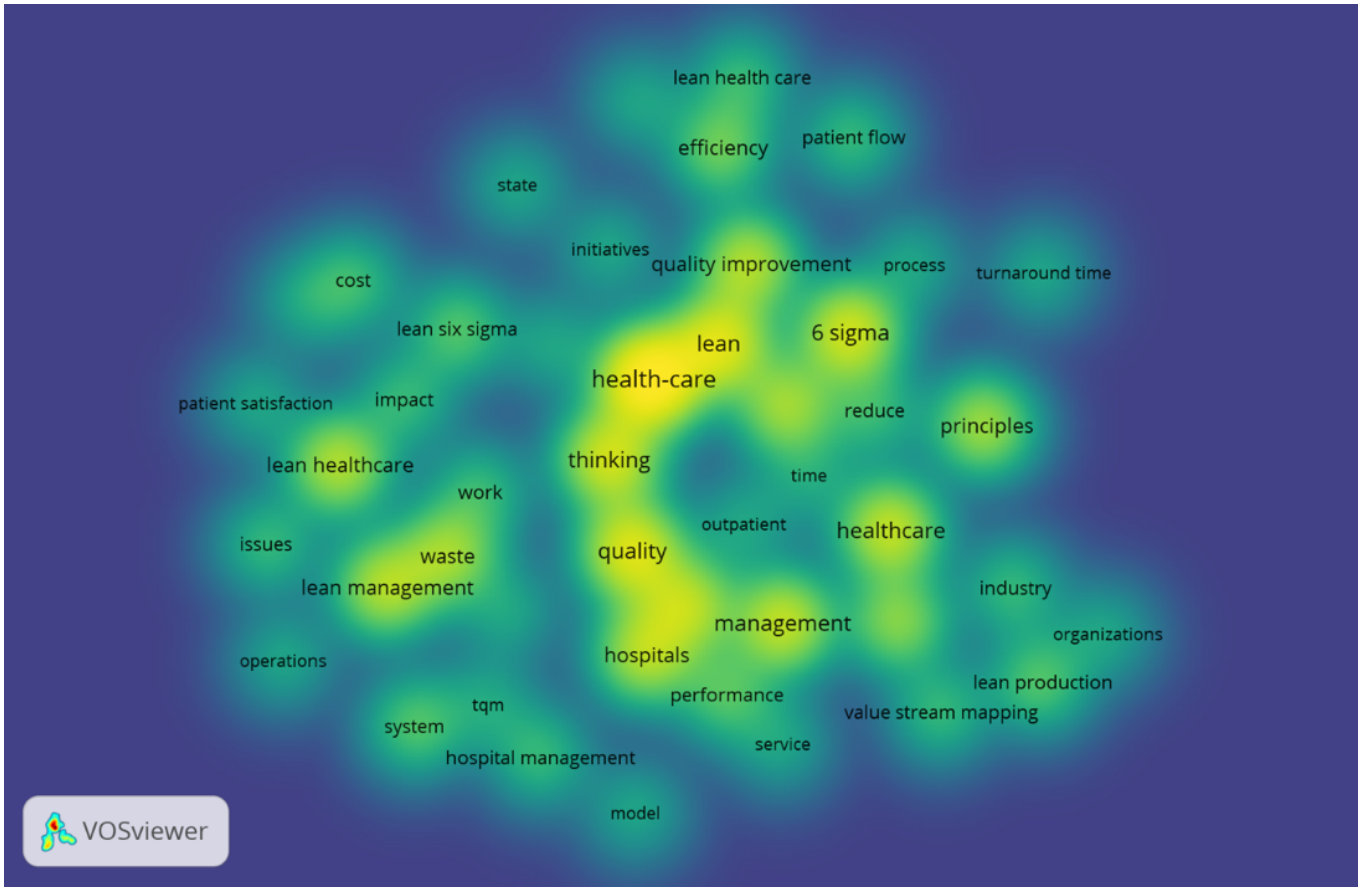

Figure 3. *Visualisasi overlay Lean Hospital*

Based on the analysis above, it can be concluded that Lean Hospital and Waste Management are topics such as Lean, Healthcare, and Quality Improvement that dominate the discussion in the literature. This indicates that the application of Lean principles in the healthcare sector, specifically to improve service quality, is the main focus of research. However, specific aspects such as Waste and Waste Reduction appear less prominent, indicating that the discussion on waste management in the context of Lean Hospital is still limited. In addition, topics such as Value Stream Mapping, Lean Six Sigma, and Turnaround Time, which are important tools and concepts in waste reduction, also received less attention. Thus, while significant attention is paid to the application of Lean to improve efficiency and quality in healthcare, there are still opportunities for further research focusing on waste management and the application of specific tools in the context of Lean Hospitals.

Conclusion

The application of the lean hospital concept in hospital administration, with a focus on identifying critical wastes through bibliometric analysis. This study highlights healthcare systems' challenges in meeting public expectations for efficient and quality services in various countries. The findings show that applying lean principles can improve operational efficiency and quality of healthcare services despite challenges in implementation, such as staff resistance and system complexity. However, this study also revealed challenges in implementing lean principles, such as staff resistance and the complexity of the existing system. Nonetheless, this article contributes significantly to the literature by proposing future research directions and emphasizing the importance of management collaboration in implementing lean approaches. As such, this approach could improve hospital service quality and create a better working environment for all staff.

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