Bibliometric analysis of lean and green healthcare integration using Publish or Perish (PoP)

Evi Febianti, M. Adha Ilhami, Ratna Ekawati, Hadi Setiawan

Department of Industrial Engineering, Universitas Sultan Ageng Tirtayasa, Jl. Jend. Sudirman KM 3, Cilegon 42435, Banten, Indonesia

ARTICLE INFO

ABSTRACT

Lean Healthcare is an approach to management systems that can change the mindset of hospitals, making healthcare more organized by reducing waste. Waste can be defined as any activity that does not add value to a process. The study recommends a bibliometric analysis of this problem. This is necessary to identify research trends or gaps that still exist. Data searches use Publish or Perish software, while data analysis uses VOSviewer software. The search results and data analysis suggest that trends for Lean Healthcare problems will likely be resolved by integration with green practices. The final process can be carried out considering environmental sustainability factors.

1. Introduction

Lean is an activity carried out continuously to eliminate waste and increase added value to products, both goods and services, to provide value to customers [1]. Lean requires less time, fewer human resources, lower costs, less space, fewer injuries, and fewer errors. Lean creates an organization that can do more and perform every process well. Lean Healthcare is a management philosophy that aims to develop a culture of continuous improvement in all hospitals and other healthcare services to increase value for patients and other customers by eliminating waste and using the right tools [2], [3].

Lean transforms the workplace into an area of self-expression for employees, challenging their creativity and ideas. Lean implementations are beneficial for patients, managers, owners, and other stakeholders. With Lean, processes are simplified and standardized; process flow, patient and employee satisfaction, quality, service availability, communication, and teamwork are improved [1], [4]. Many organizations have tried to implement Lean not only in the manufacturing industry

but also in the healthcare industry in Indonesia. The Institute of Medicine (IOM) advises that healthcare providers are constantly learning, including adopting methods from other areas outside of healthcare, such as Lean methods, Six Sigma, and others. These methods have significantly increased competitiveness and profitability in various organizations.

Virginia Mason achieved significant results after implementing Lean, such as a 75% increase in productivity, a 55% reduction in costs, and reductions in inventory and waiting times of up to 90% [4], [5]. The concept of Green Healthcare originated from the concept of 'Green Building', which is applied to health service installations, particularly hospitals. According to the US Environmental Protection Agency, Green Building is the practice of creating structures and using buildings that are environmentally responsible [6], [7]. This means that all buildings adhering to this concept do not harm the environment during their construction and operation. Additionally, the buildings must be sustainable, fulfilling their functions for a long period of time.

This study measures the reciprocal relationship and impact of publications on the integration between Lean and Green Healthcare. One limitation of the research area is the absence of integration between Lean and Green Healthcare; existing research focuses on each concept separately.

This study does not discuss methods or propose ways to solve problems with Lean Healthcare and Green Healthcare but provides a bibliometric review. It shows the trends and potential of research in Lean Healthcare. Additionally, the study uses citation rates to assess the academic quality of journals or authors. Bibliometric studies are commonly applied to qualitative analyses of journal papers, books, or other types of writing.

The structure of this paper is as follows: Section 2 describes the literature review on Lean Healthcare and Green Healthcare, while Section 3 outlines the bibliometric analysis methodology and its steps. Section 4 presents the results and discussion. The final section offers recommendations, conclusions, and limitations of the study.

2. Material and method

This section presents a brief literature review and related works. Lean Healthcare problems are problems experienced by a hospital or other health services. One way Lean is transforming healthcare is by eliminating waste in care delivery. Let's look at the eight wastes of Lean in healthcare.

Overproduction of Waste in the process of outpatient and inpatient services which includes issuing the results of repeated laboratory tests with the same information [2]. Waiting Waste occurs when the patient waits for the following process in the waiting room, namely waiting for the doctor's examination, waiting for the administration process, waiting for the test results in the laboratory, waiting for documents, specimens waiting to be tested, waiting for rooms for inpatients and waiting for drug payments, waiting for drugs at the pharmacy [3]. Unnecessary Transportation in outpatient and inpatient services includes excessive patient transfer and taking files located far away, namely sending medical record files to the examination [3]. Overprocessing in outpatient installations and inpatient installations, namely the recording of patient identities repeatedly, namely on medical record documents, register books, control cards, and computers [2]. Unnecessary inventory is an excess supply of medicines, laboratory equipment, documents still being processed, the accumulation of patient documents, and an excess supply of hospital equipment, namely unused medical record cards [4]. Unnecessary motion is looking for medical record documents, collecting medical equipment, the presence of unnecessary movements in the information section and registration to reach items (looking for stationery receipts) and looking for medicine [5].

Defects occur in outpatient and inpatient installations, such as missing patient data, billing process errors, mislabeling, doctors changing drug prescriptions, incomplete patient cards (including treatment visit cards), and patients visiting the wrong examination room. There are also issues with unreadable X-ray results or the need to repeat the X-ray process. Underutilized abilities of doctors who do not educate patients and inpatient nurses who do not provide optimum attention to patients are also considered waste. Such waste must be identifiable to determine how often it occurs. A factor analysis was carried out to determine the most influential factors in implementing Lean Healthcare [6], [7], [8], [9].

The principle of Green Healthcare is to find ways to prevent environmental damage that impacts health services while still providing high-quality health services. One of the principles of Green Healthcare is waste reduction, which has been proven to reduce the amount of waste produced by a health facility. According to research conducted by Irish Green Healthcare in 2012 on health services that have collaborated with the Green Healthcare program, the amount of solid waste produced is about 60% of the total waste. Additionally, health services, especially those providing catering services, risk generating food waste piles of 1,800 to 2,200 tons per country per year [7], [10], [11]. Green Healthcare should not only be an obligation but a necessity for every health facility, from health centers to large hospitals. This concept shares the same principles and aspects as the concept of green buildings and guides the construction of health facilities. Furthermore, this concept encourages every health facility to have high-quality infrastructure, including ventilation design, lighting, and more. Thus, health facilities can achieve a sustainable nature that benefits both the people who use them and the environment [8], [12], [13].

3. Results and discussions

We conducted the methodology of this research using the five steps outlined in Ilhami et al. [14], [15]. We present the five steps in detail as follows.

3.1. Defining search keyword

Bibliometric screening is arranged based on keywords integrating Lean and Green Healthcare from 2019 to 2023. The search keywords include "lean healthcare" and "green healthcare."

3.2. Initial search result

Using the Google Scholar and Scopus databases, we conducted initial searches with Publish or Perish software version 8.4.4041.8250. The search process began with the keyword "lean healthcare." The Scopus database yielded 200 articles, while the Google Scholar database contained 991. We then tried the keyword "green healthcare." The Scopus database found 200 articles for this keyword, while the Google Scholar database found 993 articles.

Table 1.

The results of article refinement

No	Keyword	Google Scholar	Scopus
1	Lean Healthcare	25	19
2	Green Healthcare	15	5
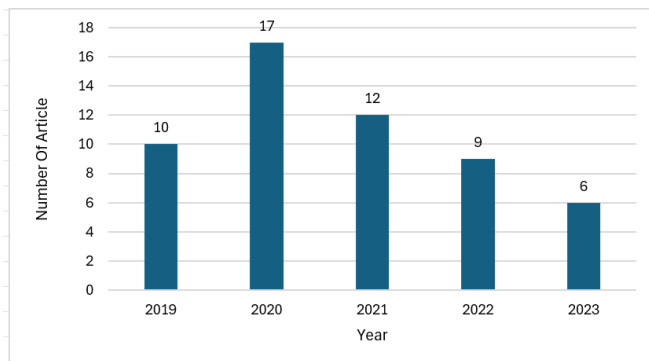
Figure 1. The grouping articles by year

Additionally, it should be noted that the Publish or Perish software shows that searches in the Google Scholar database yield more articles than in the Scopus database. This is due to the limit of 1000 articles from the Google Scholar database in the Publish or Perish software, whereas the Scopus database is limited to 200 articles.

### 3.3. Refinement of search result

In this phase, a selection of existing articles is made. The refinement criteria used in this study were:
1. Articles are from journals.
2. The citation value is above four.
3. The abstract fits Lean Healthcare problem.

After refining, we found 25 articles in the Google Scholar database and 19 in the Scopus database that match Lean Healthcare issues. Additionally, we found 15 articles in the GoogleScholar database and 5 articles in the Scopus database using the Green Healthcare keyword [15], [16].

3.4 Compiling the initial data statistics

After filtering, the next step is to download all remaining articles in CSV (comma-separated values) format. This format is necessary to easily combine articles from the rest of the Scopus and Google Scholar databases. Additionally, this method allows us to complete all the necessary metadata to provide a better source for attributing the remaining items. You can verify that the CSV file contains only one date. Finally, we found 54 unique items in the CSV file. Fig. 1 shows the grouping of 54 articles by year.
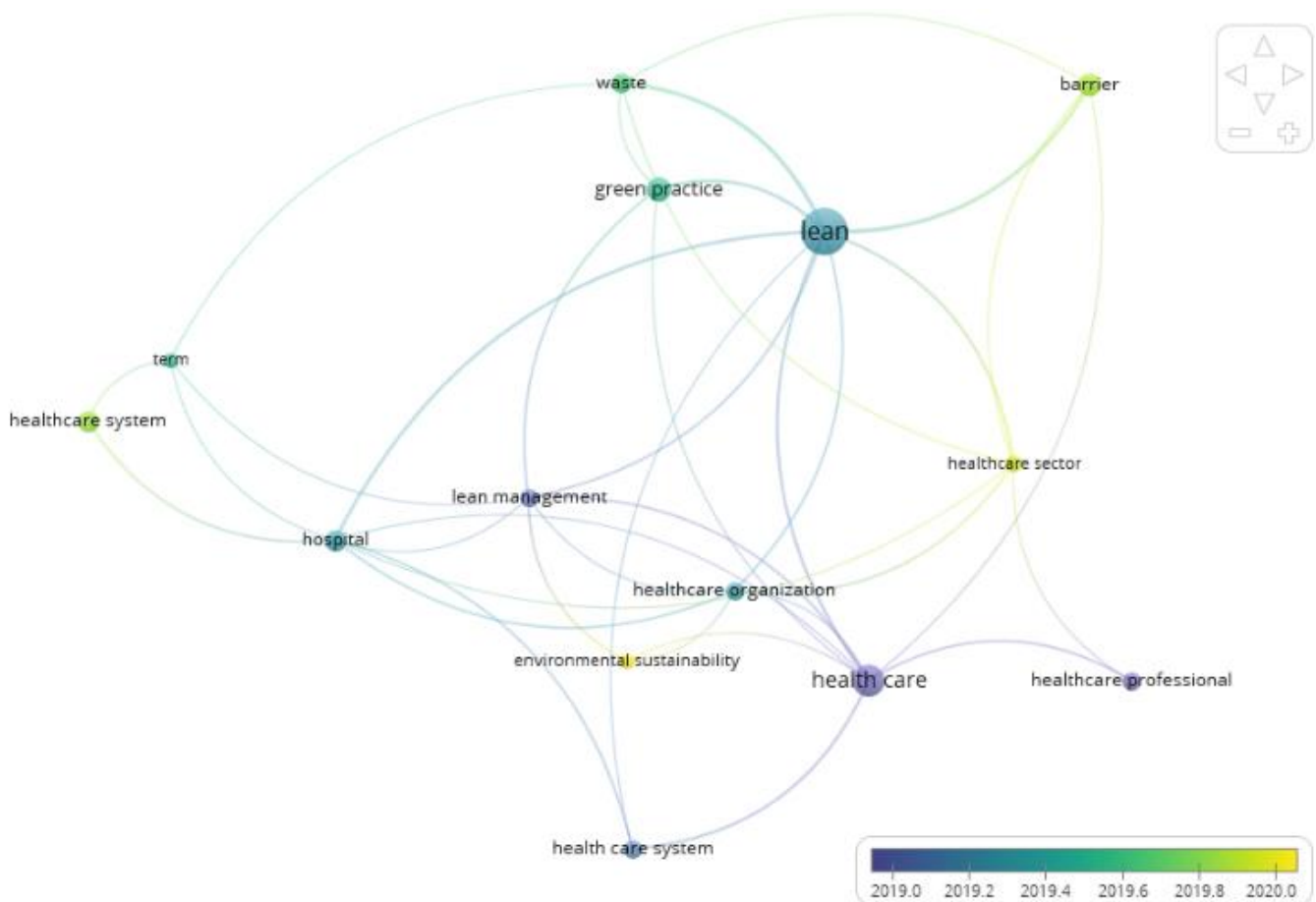
Figure 2. Overlay visualization Lean Healthcare

In addition, the software VOSviewer is used to map these 54 articles and analyze mapping results using co-occurrences. This provides a visualization of the network between keywords. The calculation method for finding the most dominant references uses a "full count" that counts items. VOSviewer visualizes a data set (in this case, journal articles). The VOSviewer software provides three visualization outputs: (1) Network visualization, (2) Overlay visualization, and (3) Density visualization [17], [18].

3.5. Data analysis

The article search with Publish or Perish Software version 8.4.4041.8250 was processed using a PC with an Intel® Core™ i3-6006U CPU @ 2.00 GHz, 4.00 GB RAM, under a 64-bit operating system, X64-based processor [15]. Search results from Google Scholar yielded nearly 900 articles, and 200 articles were obtained from the Scopus database. The compilation of the initial data statistics finally resulted in 54 papers with the keywords "lean healthcare" and "green healthcare."

Based on visualizations from VOSviewer, we can see that research on Lean Healthcare is in high demand. We will integrate the solution to this Lean Healthcare problem with Green Healthcare, as can be seen from the mapping of existing articles. Fig. 2 shows a visualization from VOSviewer.

Fig. 2 shows that the large circle, which often appears in VOSviewer, represents "lean," followed by "healthcare" and "green practice." The colors in the overlay visualization indicate the current trend in lean problems. Dark colors indicate previous events or trends, while lighter colors indicate current trends in the research area. The lighter colors, as shown in Figure 2, represent environmental sustainability and the healthcare sector. Research trends in lean issues still need improvement, and the completion of solutions is still being discussed separately. We can combine these two methods by integrating Lean Healthcare with Green Healthcare to see the continuity in implementation.

4. Conclusions

This study investigates bibliometrics for Lean. We used Publish or Perish software to search for initial articles and then performed analysis using VOSviewer. The search for articles was conducted from 2019 to 2023 using the keywords "lean healthcare" and "green healthcare." Tracking was done using Google Scholar and Scopus databases, with inclusion criteria: (1) from 2020 to the present, (2) subject area: management, service, and ergonomics, (3) limited to journals. There are 54 relevant articles in this study. The results show there are still research gaps, especially regarding the proposed improvement of solution methods, particularly in integrated Lean and Green Healthcare. The keywords "lean healthcare" and "green healthcare" are often represented by several keywords and could lead to miscalculation of occurrences and total link strength. Thus, we can use another keyword.

References

[1]　A. Akmal, R. Greatbanks, and J. Foote, "Lean thinking in healthcare – Findings from a systematic literature network and bibliometric analysis," *Health Policy*, vol. 124, no. 6, 2020. doi: 10.1016/j.healthpol.2020.04.008.

[2]　L. Fitria, B. A. Dery, and H. Prassetiyo, "Implementasi lean healthcare untuk mengidentifikasi dan meminimasi waste di instalasi rawat jalan RSAI Bandung," *Spektrum Industri*, vol. 17, no. 2, 2019, doi: 10.12928/si.v17i2.13921.

[3]　Z. Akrami, S. H. Mirghaderi, and A. N. M. Shirazi, "Waste analysis framework for lean production: Pilot study in a healthcare setting," *International Journal of Productivity and Quality Management*, vol. 34, no. 1, 2021, doi: 10.1504/IJPQM.2021.118080.

[4]　R. S. Bharsakade, P. Acharya, L. Ganapathy, and M. K. Tiwari, "A lean approach to healthcare management using multi criteria decision making," *OPSEARCH*, vol. 58, no. 3, 2021, doi: 10.1007/s12597-020-00490-5.

[5]　C. Cuggia-Jiménez, E. Orozco-Acosta, and D. Mendoza-Galvis, "Lean manufacturing: A systematic review in the food industry," *Informacion Tecnologica*, vol. 21, no. 5, 2020, doi: 10.4067/S0718-07642020000500163.

[6]　Z. F. Ikatrinasari, S. Hasibuan, and K. Kosasih, "The Implementation Lean and Green Manufacturing through Sustainable Value Stream Mapping," in *IOP Conference Series: Materials Science and Engineering*, 2018. doi: 10.1088/1757-899X/453/1/012004.

[7]　S. B. M. Carneiro, I. B. Campos, D. M. De Oliveira, and J. P. B. Neto, "LEAN and green: A relationship matrix," in *IGLC 2012 - 20th Conference of the International Group for Lean Construction*, 2012.

Febianti et al. (2024), Journal Industrial Servicess, vol. 10, no. 1, pp. 7–12, April 2024

11

[8] M. Azmal, R. Kalhor, N. F. Dehcheshmeh, S. Goharinezhad, Z. A. Heidari, and F. Farzianpour, "Going toward Green Hospital by Sustainable Healthcare Waste Management: Segregation, Treatment and Safe Disposal," *Health*, vol. 06, no. 19, 2014, doi: 10.4236/health.2014.619302.

[9] Md. A. I. and M. H. Md. Rajib Hossain1*, "Assessment of Medical Waste Management Practices: A Case Study in Gopalganj Sadar, Bangladesh," *European Journal of Medical and Health Sciences*, 2021, doi: 10.34104/ejmhs.021.062071.

[10] J. Weyer, "Lean, green and healthy: Landscape and health," *Architectural Design*, vol. 87, no. 2, 2017, doi: 10.1002/ad.2150.

[11] Z. Akrami, S. H. Mirghaderi, and A. N. M. Shirazi, "Waste analysis framework for lean production: Pilot study in a healthcare setting," *International Journal of Productivity and Quality Management*, vol. 34, no. 1, 2021, doi: 10.1504/IJPQM.2021.118080.

[12] R. Azizi, "Green healthcare an environmentally sustainable methodology an investigation of the ecological impacts of the healthcare industry and the role of green initiatives in sustainable medical services," *ProQuest Dissertations and Theses*, no, December, 2016.

[13] H. C. Akdag and T. Beldek, "Green Hospital Together with a Lean Healthcare System," 2019. doi: 10.1007/978-3-030-03317-0_37.

[14] M. A. Ilhami, Subagyo, and N. A. Masruroh, "Bibliometric analysis of the term 'Three-Dimensional Concurrent Engineering,'" in *IOP Conference Series: Materials Science and Engineering*, 2019. doi: 10.1088/1757-899X/673/1/012077.

[15] D. L. Trenggonowati *et al.*, "Bibliometric Analysis of University Timetabling Using Publish and Perish," in *Proceedings of the Conference on Broad Exposure to Science and Technology 2021 (BEST 2021)*, 2022. doi: 10.2991/aer.k.220131.047.

[16] A. Khalili, M. Y. Ismail, A. N. M. Karim, and M. R. Che Daud, "Relationships of lean, green manufacturing and sustainable performance: Assessing the applicability of the proposed model," in *Proceedings of the International Conference on Industrial Engineering and Operations Management*, 2016.

[17] Naveen Donthu, S. Kumar, D. Mukherjee, N. Pandey, and Weng Marc Lim, "How to conduct a bibliometric analysis: An overview and guidelines," *Journal of business research*, vol. 133, pp. 285–296, Sep. 2021, doi: 10.1016/j.jbusres.2021.04.070.

[18] K. H. Abdullah, "Publication Trends of Leadership Excellence: A Bibliometric Review Using VOSviewer," *Advances In Business Research International Journal*, vol. 7, no. 1, 2021, doi: 10.24191/abrij.v7i1.12860.

This page is intentionally left blank