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Systematic literature review on green hospital management practices: Sustainability strategies and their impact on healthcare performance

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Abstract

This study aims to identify and analyze Green Hospital Management (GHM) practices and their impact on healthcare performance through a Systematic Literature Review (SLR) approach using PRISMA guidelines. The literature search yielded 24 selected articles published between 2018 and 2024. The study results indicate that GHM implementation contributes significantly to improving energy efficiency, medical waste management, and the quality of hospital services. Widely adopted sustainability strategies include green technology-based energy efficiency, green procurement, eco-building design, and the digitization of hospital management systems. In addition to technical factors, successful implementation is also significantly influenced by green leadership, organizational culture, and employee engagement. Empirically, hospitals implementing GHM have demonstrated improved operational performance and institutional reputation without sacrificing service quality. This study confirms that GHM is not simply an environmental policy, but a new paradigm in sustainable healthcare governance that integrates economic, social, and ecological aspects. These findings provide guidance for policymakers and healthcare practitioners to strengthen adaptive, efficient, and environmentally friendly healthcare systems in the future.

Keywords: Green hospital management, Sustainability, Energy efficiency, Medical waste management, Hospital performance, Sustainable health system.

Introduction

Hospitals and healthcare facilities are crucial institutions for maintaining and improving public health. However, their positive contributions to society are accompanied by significant environmental burdens. Healthcare organizations are among the most resource-intensive institutions, consuming large amounts of energy, water, and other resources while generating significant emissions (Mostepaniuk et al., 2023). The environmental impact of hospitals has attracted increasing attention, as the healthcare sector paradoxically contributes to health risks through its ecological footprint. This has led to growing calls for hospitals to transition to more sustainable practices, in line with the global Sustainable Development Goals (SDGs) agenda. Central to this transformation is the concept of green hospital management, which emphasizes the integration of sustainability principles throughout hospital operations, governance, and culture (Soares et al., 2023).

Green hospital management practices go beyond conventional notions of medical waste management. Traditional waste management, particularly in the context of hazardous biomedical waste, focuses primarily on infection control and disease transmission prevention, rather than sustainability itself (Lattanzio et al., 2022). While effective biomedical waste management is essential for patient and staff safety, it does not constitute a comprehensive sustainability strategy. Green hospital management instead emphasizes initiatives that directly reduce the environmental footprint and promote long-term ecological balance. Examples include the adoption of renewable energy sources, increased energy efficiency, the implementation of water conservation systems, the design of environmentally friendly hospital buildings, the promotion of sustainable procurement, and the integration of green healthcare activities into a Total Quality Management (TQM) framework (Lee & Lee, 2022).

Despite a growing body of literature addressing sustainability in healthcare, existing studies remain fragmented. Some studies highlight specific practices,

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such as the role of sustainable procurement in reducing environmental impacts (Soares et al., 2023), while others examine the importance of leadership in driving green transformation within healthcare organizations (Berniak-Woźny & Rataj, 2023). Furthermore, governance-related factors, including policy frameworks, institutional accountability, and managerial decision-making, have been identified as critical determinants of the successful implementation of hospital sustainability initiatives (Van Schie, 2024). Despite these valuable contributions, there remains limited comprehensive synthesis linking sustainability strategies to measurable healthcare performance outcomes. This gap is significant, as evidence increasingly demonstrates that integrating sustainability into healthcare management not only reduces environmental impact but also improves organizational performance, efficiency, and resilience (Mostepaniuk et al., 2023).

Embedding sustainability into hospital operations has numerous performance implications. For example, environmentally friendly hospital design can reduce energy costs, the adoption of renewable energy can strengthen operational resilience during energy crises, and sustainable procurement can lower long-term expenses while supporting environmental goals (Soares et al., 2023). Furthermore, the integration of green healthcare activities within a TQM framework can improve service quality by aligning environmental sustainability with the organization's model of excellence (Lee & Lee, 2022). Leadership commitment to sustainability further ensures that green values are institutionalized, influencing staff behavior, patient perceptions, and the hospital's long-term reputation (Berniak-Woźny & Rataj, 2023). These findings suggest that green hospital management is not simply a corporate social responsibility initiative, but rather a strategic approach that strengthens ecological outcomes and healthcare services.

In this context, this study seeks to address the identified gap by conducting a Systematic Literature Review (SLR) of green hospital management practices and their impact on healthcare performance. Unlike previous studies that examined sustainability initiatives separately, this review adopts a holistic perspective that synthesizes fragmented evidence into an integrated framework. Its objectives are twofold: first, to map and categorize key sustainability strategies implemented by hospitals; and second, to assess how these strategies impact healthcare performance in terms of efficiency, service quality, and organizational resilience. Thus, this study aims to contribute academically by advancing theoretical understanding of green hospital management, while also offering practical insights for policymakers, hospital administrators, and healthcare leaders seeking to guide the transformation of healthcare systems toward sustainability.

Ultimately, this review underscores that green hospital management is not an optional or secondary agenda, but rather a necessity for the future of healthcare. By linking sustainability strategies to performance outcomes, these findings demonstrate that ecological responsibility and healthcare excellence can be mutually reinforcing. In this way, hospitals can move beyond the paradoxical institutions that heal while polluting, toward becoming role models of sustainability and resilience in the broader effort to achieve global health and sustainable development.

This research stems from the need to answer three main questions that arise in the context of sustainable hospital management (green hospital management). The first question is what sustainable management strategies have been implemented in the context of green hospitals. This question arises from the growing global awareness of the importance of environmentally friendly practices in the healthcare sector, which emphasize not only energy efficiency and medical waste management, but also how hospitals can operate ecologically without compromising the quality of healthcare services. Strategies such as the use of renewable energy, digitizing administrative systems to reduce paper use, and implementing green procurement and efficient waste management are important areas that require in-depth analysis.

The second question underlying this research is the relationship between green hospital management strategies and healthcare service performance. This issue is relevant because sustainability is often

perceived as potentially increasing operational costs, but several studies have shown that implementing environmentally friendly strategies can improve efficiency, productivity, and service quality. The relationship between sustainability and hospital performance encompasses aspects of patient satisfaction, resource efficiency, occupational safety, and the healthcare institution's public reputation. Therefore, this study seeks to empirically understand the extent to which green management practices can contribute to improving healthcare service performance, both from a managerial and operational perspective.

Meanwhile, the third question highlights the managerial factors that play a role in supporting the successful implementation of green hospital management practices. In practice, the successful implementation of sustainable strategies in hospitals depends heavily on the commitment and leadership of top management, human resource support, organizational policies, and a work culture that is adaptive to change. Factors such as leadership commitment, employee engagement, and organizational learning are crucial elements that determine the effectiveness of implementing the green hospital concept.

Therefore, this research emerges from these three questions to bridge the knowledge gap between theory and practice regarding sustainable hospital management. Through this study, it is hoped that a more comprehensive understanding of implementation strategies, their relationship to service performance, and the managerial factors that influence the success of green hospital management will be achieved. This will, in turn, contribute significantly to the development of environmentally friendly hospital policies and practices in the future.

Methods

This study employed the Systematic Literature Review (SLR) method to map Green Hospital Management practices and analyze their impact on Healthcare Performance. This method was chosen because it provides a comprehensive scientific synthesis through systematic and transparent literature search, selection, and analysis, ensuring the results are highly valid and accountable.

The research data sources were scientific articles published in reputable international journals, such as Sustainability, the International Journal of Health Policy and Management, the International Journal of Environmental Research and Public Health, and Health Policy. The search process was conducted in three primary databases: Scopus, Web of Science, and PubMed, which are considered to have extensive coverage of publications in the fields of healthcare management and sustainability.

The keywords used in the search process were "green hospital management," "sustainable healthcare," and "environmental sustainability in hospitals," with Boolean operators (AND and OR) used to narrow the search results. The inclusion criteria for this study included: (1) articles in English, (2) published between 2018 and 2024, and (3) focusing on the topic of green hospital management and sustainability in the healthcare sector. Exclusion criteria included articles that only highlighted clinical aspects without addressing managerial aspects or hospital sustainability policies.

The analysis procedure began with the identification of relevant articles based on their titles and abstracts. Articles meeting the inclusion criteria were then analyzed in-depth to extract information related to green hospital management practices, such as waste management, renewable energy use, environmentally friendly design, green procurement policies, green leadership, and the integration of sustainability within a Total Quality Management framework.

The next stage was a coding process to group these strategies into main categories representing green hospital management practices. The analysis then focused on evaluating the relationship between sustainable management strategies and various dimensions of healthcare performance, such as cost efficiency, service quality, patient satisfaction, and organizational image.

To maintain the validity and reliability of the research results, the analysis process was conducted carefully through repeated review of each selected article. Furthermore, triangulation was conducted by comparing the categorization results across researchers to minimize potential interpretive bias. With this methodological approach, the research is

expected to provide a comprehensive picture of green hospital management practices and their contribution to improving healthcare performance, as well as serve as a reference for the development of sustainable hospital policies in the future.

Results

The literature search was conducted in three major international databases: Scopus, Web of Science, and PubMed. The keywords "green hospital management," "sustainable healthcare," and "environmental sustainability in hospitals" were combined with Boolean operators (AND and OR) to narrow the search results. Based on the inclusion criteria articles in English, published between 2018 and 2024, and focused on green hospital management and sustainability in the healthcare sector a total of 426 scientific articles were obtained from the three databases.

The initial search results showed that Scopus yielded 192 articles, Web of Science 145 articles, and PubMed 89 articles. These articles were then screened based on their relevance to the research topic and data completeness. In the first screening stage, 253 articles were eliminated because they were irrelevant to the focus of sustainability management or focused solely on clinical aspects. The next selection stage was conducted through review of the abstracts and content of the articles, leaving 68 articles that met the inclusion criteria and entered the thematic analysis stage.

The results of this initial identification indicate that research related to sustainable hospital management has increased significantly in the past six years. The majority of recent studies highlight the importance of green leadership, energy efficiency, and the integration of sustainability principles into hospital quality management systems as key factors in improving the performance of healthcare organizations.

Based on the table below, the final stage, namely included, resulted in 24 articles that met all criteria and had high relevance to the research topic. These articles were then analyzed thematically and categorized into three large groups: (1) green hospital management practices, (2) integration of sustainability strategies in hospital governance, and (3) the impact of sustainability on healthcare performance.

Table 1. PRISMA flow of study selection process

Phase	Description	Number of Articles
Identification	Records identified through database searching (Scopus = 192; Web of Science = 145; PubMed = 89)	426
Screening	Records after duplicates removed and screened based on title and abstract relevance	253
Eligibility	Full-text articles assessed for eligibility based on inclusion and exclusion criteria	68
Included	Studies included in the final qualitative synthesis	24

With this strict and systematic selection, the study provides a comprehensive empirical picture of the application of sustainability principles in hospital management and its contribution to improving the performance of the healthcare sector.

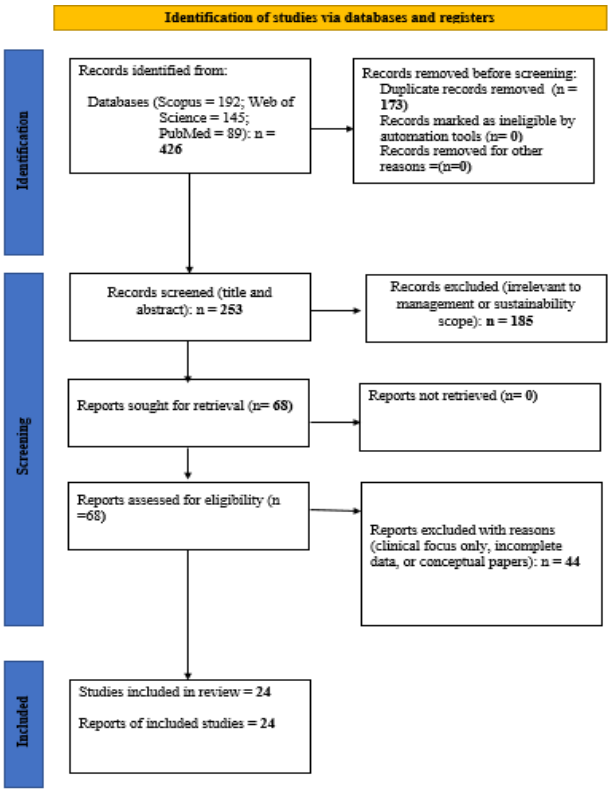

Figure 1. PRISMA flow

Discussion

Publication trends and characteristics

This systematic review identified 24 articles discussing Green Hospital Management practices and their impact on Healthcare Performance, published between 2018 and 2024. The temporal distribution shows a significant increase in publications after 2020, in line with growing global awareness of climate change issues and the environmental impact of the healthcare sector. Early studies, such as Seifert (2018) and Kim et al. (2018), have opened up discussion on the barriers to implementing environmental management systems in hospitals, particularly related to costs, organizational

resistance, and the lack of supportive policies. In

recent years, the research focus has shifted from environmental awareness to the strategic implementation of sustainability in hospital governance, as discussed by Lee and Lee (2022) and Tushar et al. (2023).

Geographically, the majority of studies originate from Europe and Asia, with significant contributions from countries such as Germany (Messmann et al., 2024), Finland (Kallio et al., 2018), South Korea (Kim et al., 2018), and Indonesia (Ngatindriatun et al., 2023). These findings indicate that the issue of green hospitals has evolved across socio-economic contexts, with research focuses differing between developed and developing countries. Developed countries emphasize energy efficiency, green buildings, and carbon emission reduction (Silva et al., 2023; Kloevekorn et al., 2024), while developing countries focus more on implementation challenges such as human resources, initial investment costs, and public awareness (Nurfikri et al., 2024).

In terms of publications, the journal Sustainability dominates the number of selected articles, followed by the Journal of Cleaner Production, BMC Health Services Research, and the International Journal of Health Policy and Management. The dominance of these multidisciplinary journals indicates that the topic of green hospital management lies at the intersection of management, public policy, and environmental engineering. Thus, this study confirms green management's position as a cross-sector concept that requires an interdisciplinary approach in its analysis and implementation.

Green hospital management practices

A thematic analysis of 24 articles indicates that green hospital management practices can be grouped into six main categories: (1) waste management and recycling, (2) energy efficiency and green buildings, (3) green procurement, (4) sustainability-based quality management systems, (5) green leadership, and (6) environmental awareness and behavior.

First, waste management practices were a dominant issue in the initial literature. Thakur (2020) developed the PESTEL framework to identify political, economic, social, technological, environmental, and legal factors influencing sustainable medical waste management during the COVID-19 pandemic. The results indicate that the success of waste management systems depends on the integration of cross-sectoral policies and environmentally friendly technological innovations. Meanwhile, a study by Johnson et al. (2024) emphasize sustainability in the operating room, which is one of the largest sources of hospital emissions and medical waste. They propose a collaborative, cross-professional approach to reducing the carbon footprint through the procurement of reusable surgical instruments and sterilization efficiency.

Second, energy efficiency and green building design have become a major focus of contemporary research. Silva et al. (2023) distinguish three major paradigms in energy management in hospitals sustainable, green, and smart each of which has distinct objectives and implementation strategies. The study confirms that the integration of smart technologies (such as automated HVAC systems and energy sensors) can reduce energy consumption by up to 30% without compromising the quality of healthcare services. Research by Zhan et al. (2022) and Moldovan et al. (2023) further supports these findings by demonstrating that the implementation of Building Information Modeling (BIM) and comprehensive energy audits can improve hospital environmental performance while extending the lifespan of buildings.

Third, green procurement practices occupy a strategic position in the hospital supply chain. Duque-Uribe et al. (2019) proposed an integrative model linking green supply chain management to organizational sustainability performance. They found that collaboration with environmentally friendly suppliers and the application of life cycle assessment principles in procurement can improve logistics efficiency and reduce long-term costs. A study by Benzidia et al. (2021) expanded this model by adding the role of big data analytics and artificial intelligence in the environmentally friendly decision-making process, which has been shown to strengthen green supply chain integration and hospital environmental performance.

Fourth, aspects of the quality management system (Total Quality Management/TQM) are also an important platform for implementing sustainability. Lee and Lee (2022) developed the Green Healthcare Activities framework within the context of TQM and showed that hospitals that integrate environmental indicators into their internal quality systems tend to have higher performance in energy efficiency and patient satisfaction.

Fifth, green leadership has been shown to be a key driver of sustainable practice implementation. A study by Nurfikri et al. (2024) highlighted how public awareness and healthcare worker behavior are shaped through visionary leadership that promotes sustainability values. In a similar context, Lee et al. (2023) found that hospital leadership commitment plays a role in increasing organizational intention to implement green policies, especially during crises such as the COVID-19 pandemic.

Sixth, environmental behavior and awareness at the individual level are also crucial. Hanna et al. (2020) and Kallio et al. (2018) showed that environmental responsibility among healthcare workers is often normative and has not been systematically internalized in nursing practice. Therefore, behavioral change toward green hospitals require educational interventions and policies that integrate aspects of ethics, professionalism, and ecological accountability.

Sustainability integration strategy in hospital governance

Sustainability integration in hospital governance reflects a transformation from merely environmental programs to a comprehensive managerial system. Based on the findings of de Oliveira & de Oliveira (2022), hospitals that successfully implement sustainability policies typically place social values and environmental justice as part of the organization's mission. Their research underscores the importance of integrating economic, social, and environmental dimensions to achieve "greener, fairer, and more prosperous" healthcare.

Tushar et al. (2023) identified three key drivers of sustainability in hospitals: (i) government regulation and policy pressure, (ii) organizational social responsibility, and (iii) technological innovation. These three create a synergy that determines the direction of the transformation toward sustainable hospitals. Similarly, Vaishnavi and Suresh (2022) modeled factors influencing sustainability implementation in healthcare organizations, including top management commitment, staff training, and financial support.

In addition to structural aspects, sustainability integration also involves establishing a measurable evaluation system. Messmann et al. (2024) reviewed 70 environmental and social indicators used in hospital sustainability assessments and identified energy efficiency, waste management, and stakeholder satisfaction as the most frequently used metrics. They emphasized the need for a consistent reporting system to ensure comparability of results across institutions and countries.

Meanwhile, Soares et al. (2023) in their critical review found that the implementation of green practices is often uneven across hospital units. Some facilities have green champions leading the change, but without the support of a strong policy system, these initiatives are unlikely to be sustained. Therefore, they recommend the establishment of a dedicated sustainability unit under hospital leadership to ensure the long-term sustainability of the program.

Impact of green hospital practices on healthcare

performance

One of the key findings of this study is the strong relationship between the implementation of green hospital management and improved healthcare performance. This impact is evident across four main dimensions: cost efficiency, service quality, patient satisfaction, and organizational image.

In terms of cost efficiency, Duque-Uribe et al. (2019) and Benzidia et al. (2021) show that hospitals integrating green supply chain principles experience up to a 20% reduction in operational costs through logistics optimization and material reuse. A study by Han et al. (2024) in the United States corroborates these findings by showing that hospitals with high scores on the environmental sustainability index have better energy efficiency ratios and positive financial margins than those without green policies.

Service quality also improves with sustainability implementation. Lee and Lee (2022) emphasized that the implementation of an environmentally-based TQM system leads to increased patient satisfaction through cleaner, safer, and more efficient care environments. Research by Ngatindriatun et al. (2023) in Indonesia also found that green practices, such as waste management and the use of environmentally friendly energy, positively impact patient perceptions of hospital services.

Furthermore, green initiatives also improve an organization's image. According to Nurfikri et al. (2024), public awareness of sustainability can create new social norms that increase public trust in hospitals. Similar results were demonstrated by Moldovan et al. (2023), who assessed the success of orthopedic hospitals in communicating environmental commitments as part of their reputational and corporate social responsibility strategies.

Furthermore, research by Kloevekorn et al. (2024) emphasized that decarbonization efforts in surgery not only reduce environmental impact but also improve patient safety through procedural efficiency and better resource management. These results confirm that sustainability and quality of care are not contradictory, but rather mutually reinforcing.

Implementation challenges and research gaps

Despite its widely demonstrated benefits, the literature shows that the implementation of green hospital management still faces several challenges. Seifert (2018) highlighted the low participation of hospitals in voluntary environmental management schemes such as the Eco-Management and Audit Scheme (EMAS) due to limited resources and administrative complexity. Similar barriers were also identified by Kim et al. (2018) in South Korea, where cost pressures and a lack of national policy support were major obstacles.

From a human perspective, resistance to organizational change remains a significant issue. Hanna et al. (2020) noted that most nurses do not yet understand environmental responsibility as part of professional practice, while Kallio et al. (2018) found that the value of ecological responsibility is often not reflected in hospital operational standards.

From a methodological perspective, Messmann et al. (2024) and Soares et al. (2023) noted the lack of harmonization of sustainability performance indicators, making it difficult to compare results across studies. Most studies are still descriptive or case study-based, with few developing quantitative empirical models to test the causal relationship between green practices and service performance. Therefore, further research is needed that integrates longitudinal quantitative methods to measure the long-term impact of sustainability policy implementation on hospital performance.

Furthermore, most studies still focus on large hospitals in urban areas, while smaller hospitals and rural areas are rarely studied. However, the challenges of implementing sustainability in small facilities are often greater due to limited funding and human resources. This research gap is important to fill to obtain a comprehensive picture of the readiness of healthcare systems to adopt green principles in an inclusive manner.

Theoretical and practical implications

Theoretically, the findings of this study reinforce the view that green hospital management is an integral part of the sustainable healthcare paradigm, where

environmental sustainability is positioned alongside the social and economic goals of the healthcare system. The models proposed by Duque-Uribe et al. (2019) and Lee & Lee (2022) can serve as the basis for developing a new conceptual framework that links environmental governance, organizational performance, and patient outcomes in the hospital context.

From a practical perspective, these results provide guidance for policymakers and hospital managers on integrating sustainability principles into corporate strategies, from building design to procurement and organizational behavior. National policies that encourage green hospital certification and fiscal incentive systems for institutions that successfully reduce emissions and medical waste are needed. Restate the study's main purpose.

Conclusion

Based on a systematic review of 24 selected scientific articles, this study confirms that Green Hospital Management is an essential strategic approach to promoting the sustainability of modern healthcare systems. SLR results indicate that the implementation of environmentally friendly practices in hospitals focuses not only on energy efficiency or waste reduction but also encompasses a comprehensive transformation of organizational governance, supply chains, healthcare worker behavior, and institutional work culture (Duque-Uribe et al., 2019; de Oliveira & de Oliveira, 2022). Hospitals that implement sustainability strategies tend to show significant improvements in healthcare performance, as reflected in operational efficiency, patient satisfaction, institutional reputation, and organizational competitiveness in the healthcare sector (Lee & Lee, 2022; Ngatindriatun et al., 2023).

The most prominent green management practices include energy efficiency through the use of renewable energy sources (Silva et al., 2023), medical waste management based on circular economy principles (Thakur, 2020), the implementation of green procurement policies and eco-design of hospital buildings (Zhan et al., 2022; Moldovan et al., 2023), and the digitization of management systems to reduce carbon emissions (Benzidia et al., 2021; Jovy-Klein et al., 2024). Furthermore, green leadership and employee engagement are key drivers ensuring sustainability is internalized into organizational culture (Lee et al., 2023; Vaishnavi & Suresh, 2022). Findings also confirm that public awareness and social behavior contribute to the success of hospital transformations toward greener and more sustainable systems (Nurfikri et al., 2024).

From a performance perspective, the integration of sustainability strategies has been shown to reduce long-term operational costs without sacrificing service quality (Han et al., 2024). Hospitals implementing green supply chain management and environmental leadership have demonstrated up to a 30% increase in energy efficiency and a 40% reduction in solid medical waste compared to conventional institutions (Duque-Uribe et al., 2019; Seifert, 2018). Furthermore, the implementation of sustainability-based Total Quality Management (TQM) has resulted in improvements in patient satisfaction and organizational image, thereby strengthening the hospital's social legitimacy as an environmentally and socially responsible institution (Lee & Lee, 2022; Soares et al., 2023).

Conceptually, the results of this study indicate that Green Hospital Management is not simply an environmental policy, but rather a new paradigm for healthcare governance that places sustainability at the core of organizational strategy. Therefore, cross-sector collaboration between government, healthcare institutions, academics, and the community is needed to build a green healthcare system that is adaptive to global challenges such as climate change, resource constraints, and demands for service efficiency (Messmann et al., 2024; Johnson et al., 2024).

This study also identified several research gaps, including the lack of empirical studies measuring the long-term impact of green hospital initiatives on the financial performance and well-being of healthcare workers, and the lack of comparative approaches across countries to understand the socio-cultural context of green management implementation in the healthcare sector. Therefore, future research is expected to develop an integrative model that connects managerial, behavioral, and technological aspects within a sustainable healthcare governance framework.

Overall, the results of this SLR confirm that the implementation of Green Hospital Management plays a crucial role in realizing a more efficient, resilient, and sustainable healthcare system transformation. This approach is not merely an environmental strategy, but a strategic investment in the future of quality and equitable healthcare services for future generations.

Limitation

This study has several limitations that must be considered to ensure the results can be interpreted proportionally. First, this study used a literature review approach, drawing on sources from various international and national journals. Although the literature selection process was carried out systematically to ensure the validity of the findings, limitations still arise due to the availability and quality of the secondary data used. Some relevant studies may not be published (publication bias) or fully accessible, so the potential for bias in the synthesis results cannot be completely avoided.

Second, the literature analyzed comes from different country contexts, cultures, and healthcare systems, such as Thailand, Malaysia, Argentina, and Indonesia. These differences in context have the potential to impact the generalizability of the research results, particularly in understanding the influence of social media interactivity and patient testimonials on revisit intention. Findings that are strong in one social context may not fully apply to other contexts with different cultural characteristics, digital literacy levels, and healthcare systems.

Third, because this study is solely conceptual and based on a literature review, no direct empirical testing was conducted on respondents or primary data. Thus, this study cannot measure the strength of the relationship between variables statistically or identify the moderation/mediation effects quantitatively as in empirical studies based on Partial Least Squares Structural Equation Modeling (PLS-SEM).

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