Journal of Climate Change and Space Science *(JCCaSS)* 2(1)(2026): 4
https://doi.org/10.17576/jccass.0201.2026.04

Investigation of The Proactive Strategies in Green Healthcare Supply Chain towards Environmental Sustainability

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Received: 20 November 2025; Accepted:24 December 2025; Published: 31 January 2026

ABSTRACT

This research aims to discover the proactive strategy through green healthcare supply chain that contribute to environmental sustainability of Malaysia's healthcare industries. This research was carefully explored, evaluated, and described in depth from the viewpoints of numerous literatures. This research uses a qualitative method that utilizes multiple case study methodology. In this research, eighteen green coordinators serving acted as informants and samples in this research. Additionally, it investigates and clarified the qualitative information gathered from Malaysia's healthcare sector. the objective of this research is to investigate the environmental management system as a proactive strategy across the green healthcare supply chain that has an impact on environmental sustainability in Malaysia's healthcare industries. This research is also an effort to discover a proactive strategy for green healthcare supply chains in a single setting in a developing country. It also contributed to one of the pillars of sustainable development in Malaysian private hospitals. The research findings enlighten the view on green healthcare supply chain practices. Besides, it also contributes to the knowledge and a promise to expand the research stream on proactive strategy, environmental management practices, green healthcare supply chain and environmental sustainability. The empirical findings suggest environmental management system by green healthcare supply chain initiatives to practitioners to obtain environmental sustainability in Malaysia's healthcare industries.

Keywords: Green Healthcare Supply Chain; Proactive Strategy; Environmental Management System; Environmental Sustainability; Healthcare Industries

1. INTRODUCTION

Healthcare facilities around the world, including in Malaysia, are facing an increasing difficulty. It promises to deliver superior patient care while minimizing environmental damage (Hu et al., 2022). This difficulty has been made worse by increased worldwide awareness of climate change and pollution, both of which have a direct impact on public health (Ventriglio et al., 2021). Globally, the healthcare business accounts for around 5% of greenhouse gas emissions (Ramgolam et al., 2025). Hospitals, clinics, and medication factories emit hazardous gases such as carbon dioxide and methane while also producing a large amount of garbage, including many single-use plastics. As more people require healthcare, the environmental situation worsens. It generates an endless loop in which a dirty environment makes people ill, and healthcare services increase environmental stress.

Nowadays, the healthcare industry is in dire need of proactive strategy (PS) through green healthcare supply chain (GHSC) initiatives that prioritize early action to reduce environmental impact. These techniques integrate sustainability into procurement, logistics, and waste management through environmental management systems (EMS) like the Malaysian Society for Quality in Health (MSQH), with the goal of reducing carbon footprints and hazardous waste. Key activities include procuring eco-certified materials, implementing energy-efficient technologies, and building reusable medical devices, all aided by digital tools such as blockchain for traceability and AI-driven demand forecasts (Ribeiro, 2024). Despite obstacles such as cost constraints and regulatory complexity, proactive initiatives are increasingly being prioritized under global frameworks such as the UN Sustainable Development Goals (SDGs), resulting in sector-wide movements toward carbon neutrality.

Besides that, EMS such as MSQH and ISO 14000, have demonstrated considerable benefits to environmental sustainability (ES) (Gogoi et al., 2024). Healthcare institutions must adhere to strict environmental rules and standards to limit their ecological footprint and waste generation. By implementing EMS, hospitals and other healthcare facilities can monitor and improve their environmental performance, reduce energy usage, and

implement sustainable practices like waste segregation and recycling. This benefits the environment by reducing greenhouse gas emissions and pollutants, while also improving the overall quality of healthcare services delivered. According to a recent Ministry of Health Malaysia report, implementing EMS in healthcare facilities has resulted in an important decrease in carbon emissions and waste output, as well as increased resource efficiency and cost savings. The incorporation of EMS into hospital management procedures is key to achieving ES and guaranteeing a healthier future for all (Uralovich et al., 2023).

Currently, the advancement of ES within the GHSC is being significantly driven by the implementation of effective EMS, such as ISO 14001 and MSQH. As noted by Dion et al. (2023), these systems provide structured frameworks for proactive environmental stewardship, moving beyond mere compliance to strategic integration. These frameworks incorporate sustainability into the fabric of core operations, mandating eco-procurement of low-impact commodities, energy-efficient logistics, and comprehensive waste reduction strategies, including hazardous waste minimization and recycling initiatives. Furthermore, modern EMS implementations are increasingly leveraging digital transformation, utilizing IoT sensors for real-time monitoring and Artificial Intelligence (AI) to optimize resource utilization and forecast maintenance needs (Amirova et al., 2024). Strategically, EMS promotes alignment with evolving regulatory standards and global mandates, such as the UN Sustainable Development Goals (SDGs), while cultivating an internal culture of continuous environmental improvement. However, existing literature has predominantly focused on the adoption rates and functional benefits of EMS, leaving a significant gap regarding the synergistic integration of EMS within these frameworks (Berniak-Woźny et al.,2023). Despite acknowledged barriers, including high implementation costs and data integration challenges, EMS remains indispensable for establishing systemic environmental resilience and operational efficiency. Specifically, previous studies have not sufficiently empirically quantified the extent to which AI- and IoT-driven EMS directly correlate with supply chain resilience metrics during external disruptions.

Consequently, the deployment of EMS has become indispensable for navigating multifaceted operational challenges, with global standards like ISO 14001 and MSQH offering rigorous frameworks that transcend mere regulatory compliance to ensure the functional longevity of the healthcare system. By actively pursuing "greener healthcare," Malaysia is uniquely positioned to directly address the environmental determinants of morbidity; therefore, the primary objective of this research is to investigate EMS as a proactive strategy (PS) across the Green Healthcare Supply Chain (GHSC) and its consequential impact on Environmental Sustainability (ES). This study contributes significantly to the existing literature by providing empirical insights into the specific mechanisms that enhance green healthcare supply chains, offering a robust framework for aligning clinical operations with international environmental standards, and informing policy and management practice regarding the transition to strategy-based environmental management.

2. LITERATURE REVIEW

2.1 Environmental Sustainability

Environmental sustainability is becoming an increasingly important strategic goal for the Malaysian healthcare business, moving from a peripheral concern to a critical requirement for operational resilience and public health protection. Nowadays, the sector's considerable environmental footprint results from energy-intensive operations, high resource consumption, and the development of planned clinical waste that requires immediate care (Woc-Colburn, 2024). Aligning with national goals, such as the Net-Zero Carbon 2050 aim and the Sustainable Development Goals (SDG), directs healthcare providers to decarbonize and implement circular economic concepts (Ministry of Health, 2025). Furthermore, climate change poses a direct physical risk to Malaysia's healthcare infrastructure, with occurrences such as heavy rainfall and flooding demanding stronger mitigation efforts to ensure continuity of service (IHH Healthcare Berhad, 2024). Successfully, a holistic transformation is required, focusing on energy efficiency (e.g., Green Lab Concepts, solar panel adoption), waste reduction through better management practices, and incorporating ecological stewardship into facility design and service delivery (Al-Sheyadi et al., 2024; Ministry of Health, 2025).

2.2 Green Healthcare Supply Chain

The Green Healthcare Supply Chain (GHSC) is an important proactive method for reducing the healthcare sector's most significant environmental consequences, which are mostly focused in its procurement and logistical networks. GHSC incorporates environmental requirements across the supply chain, from the selection of environmentally friendly medical supplies and low-carbon technology to the final disposal of medical products (Rezali et al.,, 2021; Dinesh et al.,, 2024). Green procurement prioritises suppliers with approved environmental management systems and sustainable packaging, while effective reverse logistics for medical equipment and

consumables facilitates recycling and reuse (Zeinuddin et al.,, 2024). Malaysia's push for GHSC adoption is motivated by the need to handle the considerable volume of clinical waste (CW), which requires complicated and costly segregation, treatment, and disposal processes that are currently under concession contracts until 2025 (Pariatamby, 2025). The complexity of the healthcare supply chain, combined with challenges such as high initial investment costs and a scarcity of readily available green suppliers, requires strong collaboration among all partners, including vendors, to achieve shared sustainability goals (Sakala, 2024; Zeinuddin et al.,, 2024).

2.3 Proactive Strategy

Implementing a formal Environmental Management System (EMS), particularly one that meets the ISO 14001 standard, is a major proactive strategy that allows Malaysian healthcare businesses to systematically manage and reduce their environmental footprint. Healthcare firms should carefully monitor and reduce their environmental footprint. The EMS framework establishes explicit environmental regulations, defines quantifiable objectives (example CO^2 reduction targets) and allocates resources for continual improvement (Isfianadewi & Kusumaningrum, 2025). Unlike reactive compliance, an EMS incorporates environmental considerations into the core decision-making process, ensuring that the use of green suppliers or low-carbon technologies within the GHSC is supported by formal internal controls and regular audits (IHH Healthcare Berhad, 2024). Furthermore, a strong EMS promotes a "culture of sustainability" within the company by prioritizing staff training, monitoring consumption (electricity, water, fuel), and identifying potential for increased resource efficiency (Rezali et al., 2021; Ministry of Health, 2025). This proactive approach boosts the organization's market competitiveness and resistance to regulatory risks and increased stakeholder pressure for sustainability (NIH, 2023).

2.4 Environmental Management System

Investigating the feasibility of the EMS as a proactive method for advancing environmental sustainability across Malaysia's Green Healthcare Supply Chain is crucial for designing focused and effective regulatory interventions. Empirical research is required to evaluate the direct impact of ISO 14001 adoption on measurable environmental outcomes, such as reducing clinical waste volume per patient-day, GHG, emission intensity, and compliance rates with environmental legislation (IHH Healthcare Berhad, 2024). Internal factors, such as top management support and employee environmental visibility (key elements of an EMS), should be investigated to see how they influence the successful implementation of GHSC practices, such as green purchasing and waste segregation at the source (NIH, 2023; Zeinuddin et al., 2024). Furthermore, the investigations can validate the economic benefits of EMS (e.g., operational cost savings through efficiency) and identify the specific organizational and technological barriers faced by Malaysian hospitals, thereby providing evidence-based recommendations for policymakers, such as the Ministry of Health, to accelerate the sector's transition to a truly sustainable and resilient future.

3. METHODOLOGY

The present research aims to investigate the phenomena of the complexity of the proactive approach by utilizing GHSC initiatives in private hospitals. This study employs multiple case study methodologies. This study also examines the context of EMS as PS in Malaysian private hospitals using GHSC principles. Theoretical selection identifies private hospitals based on the services they provide. Private hospitals must be registered with the Ministry of Health (MOH). Then six private hospitals agreed to participate. The private hospitals were chosen as a sample, and interviews were conducted with senior top management personnel as informants. This study employed institutional theory as a theory-driven method. It is also based on current EMS literature, such as PS by GHSC efforts. Data analysis is completed in two stages. The first level is within-case analysis, which examines the EMS by applying GHSC in a specific situation. The next stage is the cross-case analysis for replication, which will test the construct of interest in the other circumstance. The GHSC project generates description consistency for each case through within-case analysis, which captures all important information about private hospitals associated to EMS. This research uses coding techniques with ATLAS.ti version 23.0 software to discover the fundamental categories or patterns in the collected data.

3.1 Data Collection

In-depth interviews were performed with eighteen green coordinators serving as informants in various departments across Malaysia's private hospitals. The interview questions are based on existing research on PS implemented through GHSC activities that affect ES. It is performed in English and preceded by an email notification. Table 1 presents a list of informants. Each interview lasted from 45 minutes to 2 hours. All discussions were audio-recorded, with extensive notes taken and transcribed afterwards. Even though picking informants is limited to individuals identified by private hospitals, it provides broad selection criteria that allow for varied perspectives, which are vital in exploratory research (Yin, 2018). Then, to minimize bias as the greatest risk in this study, do not identify the private hospitals that participated. Thus, this study examines six situations

frequently mentioned by Eisenhardt (1989). Then, to achieve data saturation through triangulation, data from informant interviews and GHSC projects reports were examined.

3.2 Data Analysis

This study employed theme analysis to analyze PS through GHSC activities in a unified manner. Essentially, data were evaluated using a within-case approach. The quality of each case's definition is created via within-case analysis, which collects all pertinent PS-related causes via GHSC efforts. The field notes were then written up prior to consolidation and coding. The researchers then review the field notes. The analysis reduced confirmation bias by constraining the categorization of each individual case to the previously stated construct. Thus, the output data from the case analysis was subjected to cross-case analysis. Cross-case analysis is used in replication to evaluate the construct of interest in the other setting. It involved looking for data trends about the interactions of PS through GHSC efforts with ES. Next, coding algorithms were conducted using ATLAS Ti 23.0 to classify core categories and patterns in the data obtained.

Table 1. List of informants.

Cases	Informants	Job Position
C1	C1.1	Director, Facility Support Services
	C1.2	Manager, Pharmaceutical Department
	C1.3	Senior Executive, Purchasing Department
C2	C2.1	General Manager, Hospital Support Services Department
	C2.2	Senior Executive, Hospital Support Services Department
	C2.3	Manager, Pharmacy and Supplies Department
	C2.4	Executive, Procurement
C3	C3.1	Engineer, Healthcare Department
	C3.2	Manager, Pharmacy Department
	C3.3	Officer, Safety Department
C4	C4.1	Manager, Pharmacy Department
	C4.2	Assistant Manager of Procurement Department
	C4.3	Manager, Facility Department
C5	C5.1	Assistant Manager, Admin Department
	C5.2	Assistant Manager, Pharmacy Department
	C5.3	Manager, Facility Department
C6	C6.1	Manager, Pharmacy Department
	C6.2	Manager, Quality Assurance Department

4. RESULTS AND DISCUSSION

Informants were requested to submit perceptual information about PS through GHSC efforts that affect ES. Field data coding as viewed by Malaysian private hospitals. The data from in-depth interviews with informants was analyzed and summarized in Table 2 to investigate PS, which resulted in a similar theme. This theme was reached after removing unnecessary responses. Themes were then organized into groups based on responses to the same subject.

Table 2. The summary of the environmental management system from the perspective of ES.

Proactive Strategy	Sub Themes	Cases	Total
Environmental Management System	• MSQH • ISO 14001	C3 C5	2/6

Firstly, C3 revealed that Environmental Management System (EMS) is a proactive strategy (PS) implemented as part of the green healthcare supply chain (GHSC) program with the goal of achieving environmental sustainability (ES). The EMS establishes a structured framework that allows the institution to systematically manage its environmental impacts, enhance its sustainability performance, and increase operational efficiency (Waxin et al., 2023). It entails developing explicit environmental policies, creating quantifiable goals (for example, lowering energy consumption, limiting hazardous waste, optimizing water use), and putting in place systems for resource management, pollution control, and regulatory compliance (Thakur et al., 2021). In the current study, EMS from the perspective of ES refers to a structured framework such as the Malaysian Society

for Quality in Health (MSQH) and ISO 14001 that reduces the environmental consequences of private hospital operations.

Finally, two of the six cases (C3 and C5) identified EMS as a PS that affects ES (Table 2). Majority informants (three out of eighteen) stated that they were addressing EMS at private hospitals through MSQH accreditation to protect the environment. It also demonstrates that the EMS had only been deployed in medium-sized and chain hospitals. It reveals that medium-sized and chain hospitals were aware of the high value of MSQH accreditation and the benefits of providing quality services in a low-risk environment. Then, based on the findings of the impact on EVP, the EMS is accredited by MSQH for the purpose of reducing the environmental impact (Abd Jalil et al., 2021). These findings are consistent with earlier research indicating that EMS, when entrenched in policy, has an impact on ES (Khan et al., 2021). Overall, these findings show that the EMS is entrenched in private hospital policies and accredited with the MSQH and ISO 14001 through the GHSC initiative in order to protect the environment, which has an impact on ES. C5.2, C5's Assistant Manager, Pharmacy Department, discussed EMS as a PS through GHSC program and its impact in EMS. C5.2 of C5 indicated that:

"(..)MSQH, in terms of buying medicine, the auditor only asks for evidence documentation of how the hospital buys the medicine. MSQH also have specified how to store the medicine. Furthermore, MSQH requires the proper facilities to store medicine, especially those with different storage requirements. The performance indicators of MSQH related to the pharmacy is the amount of expired stock. Therefore, that is a good indicator for monitoring and managing our stocks. It also to reduce our wastage…".

(C5.2, Assistant Manager, Pharmacy Department)

This statement is supported by C3.2 of C2 by highlighting that:

"(..)Because when you comply with the 'MSQH', people view your identity as a hospital follows the quality standard. The hospital disposes clinical waste properly and follows 'MSQH' which is very demanding in the standards. So, it helps us to gain more business as a certified and as an accredited hospital…"

(C3.2, Manager, Pharmacy Department)

Thus, from the lens of Institutional Theory, the adoption of EMS in private hospitals is not merely a technical adjustment but a response to coercive and normative pressures within the healthcare sector. Moreover, institutions integrate environmental frameworks to gain legitimacy and align with evolving social expectations regarding corporate responsibility (Boiral et al., 2023). In this context, the EMS serves as a "signal" of institutional values. When employees perceive these formal structures as a commitment to long-term welfare, it fosters a climate of psychological safety. As noted by He et al. (2023), institutionalizing green practices reduces perceived organizational risk, allowing employees to engage more authentically, which is a prerequisite for sustained human resource performance (ES). By viewing EMS as a socio-institutional tool rather than just a regulatory requirement, private hospitals can bridge the gap between high-level policy and individual employee wellbeing. As a result, to attain ES through PS, they must also consider stakeholder perspectives. The working proposition (Figure 1) states: P: To identify the environmental management system as a PS for ES through GHSC efforts from the perspective of the healthcare industry.

Figure 1. The working proposition.

5. CONCLUSION

This research confirms that the implementation of a clarified Environ mental Management System (EMS) is the decisive factor in moving Malaysian healthcare providers beyond reactive compliance towards a systematic, preventive framework. The findings reveal that an EMS effectively institutionalizes core Green Healthcare Supply Chain (GHSC) operations, specifically securing the long-term viability of green procurement, waste segregation, and energy management. Additionally, the study demonstrates that the EMS serves as a necessary catalyst for cultural change, fostering the staff engagement required to bridge the gap between policy and ground-level execution. By transforming environmental management into a core strategic advantage, the successful adoption of an EMS protects organizations from regulatory risks and strengthens market reputation, establishing it as a critical component for a resilient and future-proofed healthcare sector.

This research also offerings are significant. First and foremost, this study makes significant theoretical and practical contributions to this vital topic. Theoretically, institutional theory explains the coercive, mimetic, and moral pressures that drive adoption, as well as how to leverage unique EMS for competitive advantage and resilience. Aside from that, the EMS, PS, and GHSC literature provide a substantial contribution to this research. Second, it applies institutional theory to develop a conceptual model that is linked to ES. Third, the synergetic mechanism established in this study should help institution groups appreciate the notion of EMS as a PS by highlighting the GHSC actions that contributed to ES. As a result, they could modify their firm policies and strategies to encourage healthcare top executives to support GHSC activities to use EMS as a proactive strategy. Furthermore, managers can use this understanding to successfully grow EMS as PS by adopting GHSC projects in their organizations. Finally, based on the findings, research proposals were discussed and put forward because the importance of ES in healthcare supply chains is highlighted by their significant global carbon footprint, massive waste generation, and strategic imperative for a healthier planet and population. Therefore, future research could test the research proposition in a cross-discipline context.

The findings of this investigation also have major significance for Malaysian healthcare policy and future academic research. From a policy standpoint, the Ministry of Health and related regulatory bodies should consider establishing stronger incentives, if not mandates, for hospitals to obtain ISO 14001 certification as a requirement for certain government tenders or operational licenses, thereby accelerating EMS adoption Furthermore, there is a strong need to create national guidelines that expressly connect EMS frameworks with GHSC best practices, with an emphasis on local complications such clinical waste disposal and the availability of local green suppliers For researchers, the next step should be empirical studies using structural equation modeling (SEM) to quantify the direct and mediating effects of core EMS components (e.g., top management support, auditing frequency) on the GHSC's measurable environmental performance outcomes Longitudinal study is also advised to track the cost-benefit analysis of EMS adoption over time, giving conclusive financial proof to stimulate increased investment in sustainability programs across Malaysia's public and commercial healthcare facilities.

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Acknowledgments
Not applicable