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# Analyzing the Mediating Role of Green Performance in Healthcare Industry Sustainability: Evidence from Accredited Hospitals in Java, Indonesia

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**Abstract**

The global COVID-19 pandemic has generated prolonged uncertainty and triggered a global economic slowdown, with Indonesia recording a deficit of -2.07%. Alongside economic contraction, the healthcare sector experienced a surge in medical waste production, highlighting the urgent need for sustainable practices. Promoting sustainability in the healthcare industry requires not only reducing medical waste but also strengthening social and managerial practices that support systemic change. This study examines the mediating role of green performance in enhancing healthcare industry sustainability through health resource management practices. A quantitative approach was employed, targeting 156 accredited Type B hospitals across Java Island, with 436 respondents selected using purposive sampling. Data were collected via structured questionnaires and analyzed through path analysis using the SEM-PLS technique. The findings indicate that environmental regulation does not exert a significant moderating effect between green performance and healthcare sustainability. However, green performance plays a crucial mediating role in the relationship between collaboration in supply chain networks, technological innovation, and healthcare inventory control systems with sustainability outcomes. These results emphasize that even without strong regulatory reinforcement, managerial and technological factors can substantially improve green performance, which in turn enhances the sustainability of the healthcare sector. Practical implications suggest the adoption of technology-driven inventory systems, such as big data analytics and blockchain, to improve predictive accuracy, optimize resources, and minimize waste. Conceptually, this study introduces a novel sustainability model grounded in the mediating role of green performance, contributing fresh insights to the Triple Bottom Line framework and expanding its application within healthcare management.

***Keywords***: *Green Human Resources, Technology Innovation, Environmental Regulation, Green Performance, Healthcare Sustainability.*

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## INTRODUCTION

The healthcare industry plays a vital role in supporting human well-being, yet it also contributes significantly to environmental degradation through medical waste generation, energy consumption, and resource inefficiency. The global COVID-19 pandemic highlighted these challenges, as healthcare facilities worldwide experienced unprecedented pressure on resources, increased demand for medical services, and rising levels of hazardous waste (Putri et al., 2023). In Indonesia, the pandemic not only triggered an economic contraction of –2.07% but also intensified medical waste production, creating urgent sustainability concerns for hospitals and healthcare providers (Berniak-Woźny et al., 2023).

Sustainability in healthcare involves balancing economic viability, social responsibility, and environmental protection, consistent with the Triple Bottom Line (TBL) framework of profit, planet, and people (Hutajulu et al., 2022). However, many healthcare institutions in developing countries, including Indonesia, face structural barriers to implementing sustainability practices, such as limited infrastructure, weak regulatory enforcement, and insufficient managerial commitment (Khosravi et al.,2025; WHO, 2024). These systemic challenges necessitate examining how specific organizational practices can improve sustainability outcomes.

Several managerial and operational factors are hypothesized to influence sustainability in healthcare. Green human resources practices (GHRM) play a role in shaping organizational culture by embedding environmental values into recruitment, training, and performance evaluation systems (Schwab et al., 2025). Studies show that GHRM enhances employee environmental awareness and contributes to sustainable outcomes in various industries (Lelyana, 2024). Similarly, knowledge management supports innovation and continuous improvement by facilitating the capture, sharing, and application of organizational knowledge, including environmental best practices (Verdonck et al., 2025). Effective KM systems are especially critical in healthcare, where weak documentation and limited environmental training can undermine sustainability initiatives (Saleem et al., 2025). Furthermore, environmental management (EM) encompassing structured waste management, audits, and compliance with environmental standards provides the operational backbone for sustainable performance. However, prior research indicates that EM practices in Indonesian hospitals are often inadequately integrated, limiting their effectiveness (Bobini et al., 2025).

In addition to managerial practices, collaboration in supply chain networks plays an important role in improving resource sharing and promoting eco-efficient operational processes within healthcare organizations (Rahmawanto et al., 2024). Technology innovation, particularly the adoption of digital technologies, further supports sustainability by enabling real-time monitoring, improving operational efficiency, and facilitating environmentally friendly solutions in healthcare services (Khansa et al., 2023). Likewise, healthcare inventory

control systems contribute to sustainability by reducing overstocking, minimizing the expiration of medical supplies, and decreasing the generation of medical waste while ensuring the timely availability of essential materials (Eckelman et al., 2024). Collectively, these organizational practices may strengthen green performance, which refers to the ability of institutions to integrate environmentally responsible practices into routine operational activities and decision-making processes, ultimately contributing to long-term healthcare sustainability (Saunders et al., 2009).

However, the effectiveness of sustainability initiatives in healthcare is also influenced by institutional and regulatory factors. The role of environmental regulation remains widely debated, particularly in developing countries. Although regulatory frameworks are designed to ensure compliance with environmental standards and sustainability goals, their practical impact in Indonesia has often been constrained by inconsistent enforcement mechanisms, limited institutional capacity, and the absence of strong incentives or penalties. Consequently, understanding whether environmental regulation can strengthen the relationship between green performance and healthcare sustainability becomes particularly relevant in the Indonesian context.

Despite increasing scholarly attention to sustainability, several important research gaps remain. Most previous studies have focused on manufacturing sectors or healthcare systems in developed economies, while empirical evidence from hospitals in emerging economies remains limited. Moreover, the mechanisms through which organizational practices influence sustainability outcomes through green performance have not been sufficiently explored in healthcare institutions. Therefore, this study investigates the mediating role of green performance and the moderating role of environmental regulation in explaining healthcare sustainability in accredited Type B hospitals across Java Island.

## METHODS

The study was carried out in hospitals on Java Island, Indonesia, that have been accredited by the Indonesian Ministry of Health. The data collection period spanned six months during 2024-2025. This study employed a quantitative design guided by the research onion framework adapted from Saunders et al 2009. The study adopted a positivist research philosophy, which assumes that reality is objective and measurable. A deductive approach was used, beginning with theory and progressing to hypothesis testing. Data were collected quantitatively through structured questionnaires, and the research strategy adopted was a case survey design to examine associative and causal relationships among constructs. The study applied a cross-sectional time horizon, with observations made at a single point in time. Finally, purposive sampling of accredited hospitals, online questionnaire distribution, and statistical modelling using SEM-PLS were employed as techniques and procedures.

The population included 826 hospitals on Java Island accredited by the Indonesian Ministry of Health. A total of 156 hospitals were

selected for this study based on two criteria: Paripurna accreditation and Type B classification by the Ministry of Health. Within these hospitals, respondents were chosen using a purposive sampling technique to ensure that those selected had relevant managerial or decision-making roles. Initially, a baseline sample size was calculated by assigning three key managerial respondents per hospital (i.e., 3 × 156 = 468). To increase representativeness and account for possible non-responses or outliers, this preliminary number was adjusted using Slovin's formula with a margin of error of 15%, resulting in a final sample size of 436 respondents. Participants must hold structural positions (director, head of division, manager) in the selected hospitals, and have at least 3 years of experience in hospital management.

Data were collected via online questionnaires using Google Forms. Instruments were validated using expert judgement by three subject experts to ensure content validity. Responses used a 7-point Likert scale, adapted from previously validated instruments. Nine variables were measured: green human resources practice; collaboration in supply chain networks; knowledge management; technology innovation; environmental management; environmental regulation; healthcare inventory control system; green performance; and sustainability in the healthcare industry. Each variable was operationalized with dimensions and indicators adapted from literature.

Data were analyzed using SEM-PLS with SmartPLS version 4. PLS-SEM was selected because it is particularly suitable for analyzing complex research models involving multiple latent constructs and mediating relationships. Compared with covariance-based SEM, PLS-SEM requires fewer assumptions regarding data distribution and is more appropriate for predictive and exploratory research designs. In addition, PLS-SEM is effective for estimating models that aim to maximize the explained variance of endogenous constructs and is widely applied in sustainability and management research (Ringle et al., 2023). Therefore, this approach was considered appropriate for examining the relationships among organizational practices, green performance, and healthcare sustainability. The outer measurement model was evaluated via indicator reliability, convergent validity (indicator loadings, average variance extracted), and composite reliability (Guenther et al., 2023). For the inner structural model, $R^2$, predictive relevance ($Q^2$ via blindfolding), and path coefficients significance (via bootstrapping) were assessed (Guenther et al., 2023).

Hypotheses were evaluated using bootstrapping procedures in the PLS-SEM framework to test direct, mediation, and moderation effects. First, direct effects between independent variables (e.g. green human resources practice, supply chain collaboration, etc.) and healthcare sustainability were examined. Next, mediation effects were assessed by testing whether green performance mediates the relationships between independent variables and healthcare industry sustainability. Finally, moderation effects were tested to see whether environmental regulation moderates the relationship between green performance and

sustainability. The criteria for significance were a t-statistic greater than 1.96 and a p-value less than 0.05 (for two-tailed tests), meaning that if the t-statistic exceeded 1.96 and $p < 0.05$, the effect was considered statistically significant

## RESULTS AND DISCUSSION

### General Characteristics of Respondents

From the sample of 436 respondents, the demographic profile indicated that 43.81% were male and 56.19% were female. In terms of age, the majority were over 45 years old (54.59%), followed by those aged 36-45 years (34.86%), 26-35 years (9.63%), and only 0.92% under 25 years old. Regarding educational background, most respondents held a Master's degree (30.73%), followed by Bachelor's (24.77%), Diploma D3 (16.74%), Diploma D4 (13.53%), and Doctoral S3 (14.22%). For work experience, the largest group had more than 10 years of service (37.61%), while 33.72% had 3-5 years, and 28.67% had 5-10 years of experience. These results indicate that the respondents are predominantly senior professionals with extensive work experience and advanced educational qualifications, providing a strong basis for reliable responses in this study. The detailed data are presented in Table 1.

**Table 1. General Characteristics of Respondents**

| Characteristic | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Age | < 25 years | 4 | 0.92 |
| | 26–35 years | 42 | 9.63 |
| | 36–45 years | 152 | 34.86 |
| | > 45 years | 238 | 54.59 |
| Gender | Male | 191 | 43.81 |
| | Female | 245 | 56.19 |
| Educational Level | Diploma (D3) | 73 | 16.74 |
| | Diploma (D4) | 59 | 13.53 |
| | Bachelor (S1) | 108 | 24.77 |
| | Master (S2) | 134 | 30.73 |
| | Doctoral (S3) | 62 | 14.22 |
| Work Experience | 3–5 years | 147 | 33.72 |
| | 5–10 years | 125 | 28.67 |
| | > 10 years | 164 | 37.61 |

The sample (n = 436) was largely composed of senior professionals, with most respondents over the age of 45, holding a Master's degree or higher, and having more than ten years of work experience. This demographic profile likely enhances understanding and reliable reporting of practices such as green human resource management, environmental management, and knowledge sharing, as higher education and extensive experience have been linked to better adoption and implementation of green practices in organizational settings (Lin & Efranto, 2023; Handayani et al., 2024). However, because younger or less-experienced staff are underrepresented, findings may reflect the perceptions and capacities of more established managerial personnel, possibly limiting generalizability to all levels of hospital staff (Palupiningtyas et al, 2025).

**Analysis of Outer Model**

The measurement model (outer model) showed that all constructs satisfy indicator reliability (loading factors > 0.70 except for a few that are between 0.50-0.70 but retained due to theoretical importance), composite reliability (CR > 0.70), and average variance extracted (AVE) > 0.50. These results are clearly presented in Figure 1 and summarized in Table 2.

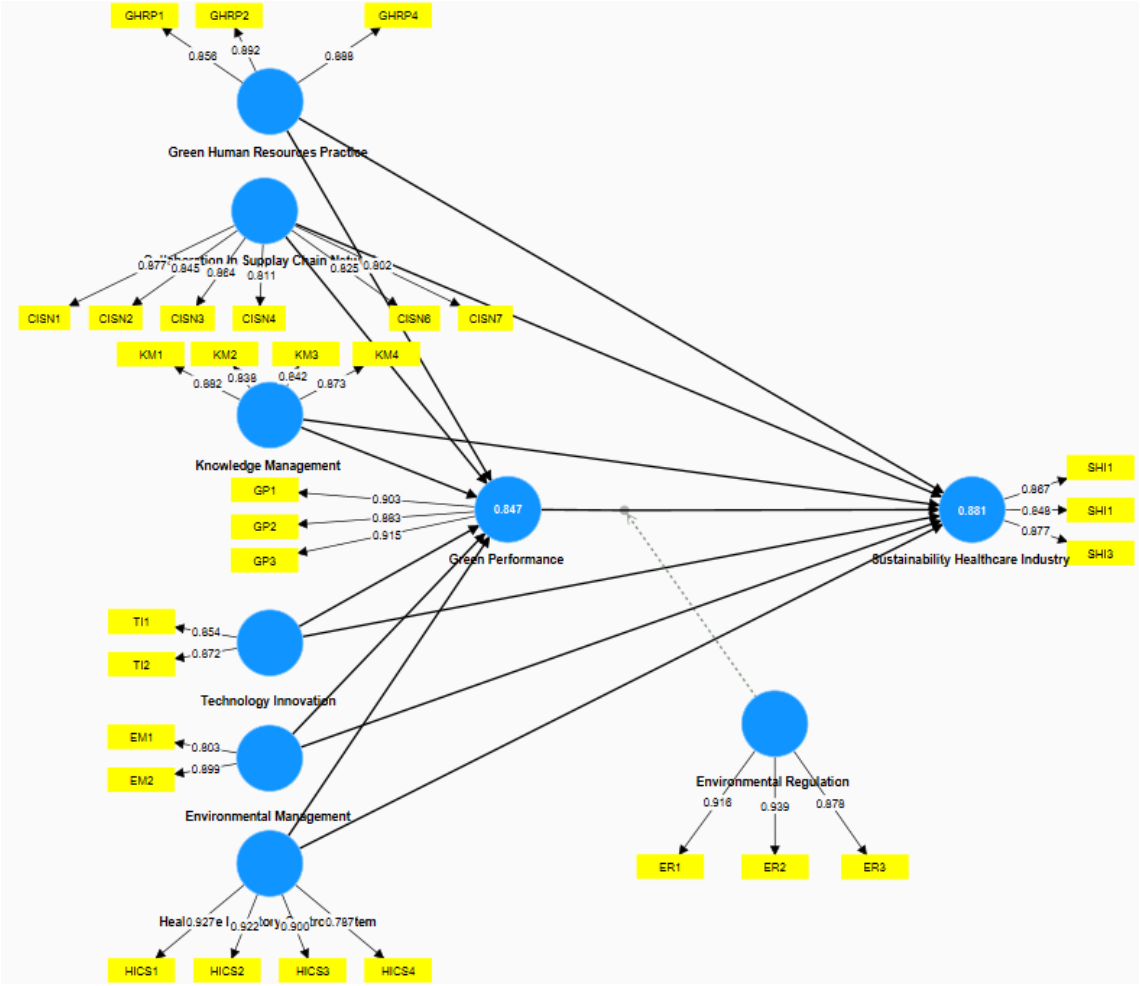


**Figure 1. Modified SmartPLS Model**

**Table 2. Summary of Reliability and Validity of Constructs**

| Variable | Cronbach's Alpha | Composite Reliability | AVE | Remark |
|---|---|---|---|---|
| Green Human Resources Practice | 0.853 | 0.864 | 0.772 | Reliable & Valid |
| Collaboration in Supply Chain Networks | 0.915 | 0.919 | 0.702 | Reliable & Valid |
| Knowledge Management | 0.882 | 0.886 | 0.738 | Reliable & Valid |
| Technology Innovation | 0.700 | 0.700 | 0.745 | Reliable & Valid |
| Environmental Management | 0.700 | 0.700 | 0.726 | Reliable & Valid |
| Healthcare Inventory Control System | 0.907 | 0.914 | 0.720 | Reliable & Valid |
| Green Performance | 0.863 | 0.902 | 0.811 | Reliable & Valid |
| Environmental Regulation | 0.898 | 0.902 | 0.830 | Reliable & Valid |
| Sustainability Healthcare Industry | 0.830 | 0.830 | 0.746 | Reliable & Valid |

The measurement (outer) model demonstrated that all constructs achieved satisfactory psychometric properties. Most indicator loadings exceeded the recommended threshold of 0.70, while a small number fell between 0.50 and 0.70 but were retained because of their theoretical

relevance in capturing essential aspects of the constructs. Composite reliability (CR) values were consistently above 0.70, indicating strong internal consistency, while average variance extracted (AVE) values for each construct were greater than 0.50, supporting convergent validity. These results confirm that the measurement items appropriately represent the underlying constructs and provide a robust foundation for subsequent structural model analysis.

Table 2 shows that all constructs, including Green Human Resource Practices, Collaboration in Supply Chain Networks, Knowledge Management, Technology Innovation, Environmental Management, Healthcare Inventory Control System, Green Performance, Environmental Regulation, and Sustainability in the Healthcare Industry, were found to be reliable and valid. These findings align with the recommended criteria for measurement model assessment in PLS-SEM, which emphasize factor loadings above 0.70, CR above 0.70, and AVE above 0.50 as indicators of construct validity and reliability (Hair et al., 2022; Fornell et al., 1991). The decision to retain some items with slightly lower loadings is consistent with prior methodological literature that allows for theoretical justification in order to preserve the conceptual breadth of constructs (Hulland, 1999). The measurement model results are consistent with other studies in sustainability and healthcare management that employed SEM-PLS, where similar thresholds were applied to establish construct validity (Mousa et al., 2025.This strengthens confidence in the robustness of the measurement model and supports the validity of the subsequent hypothesis testing.

Discriminant validity was also established to ensure that each construct was empirically distinct from the others in the model. This assessment was carried out using the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio of correlations (HTMT), both of which are widely recognized approaches in PLS-SEM analysis. The Fornell–Larcker criterion requires that the square root of the AVE of each construct is greater than its correlation with other constructs, while HTMT values below the threshold of 0.85–0.90 indicate satisfactory discriminant validity (Henseler et al., 2015); Voorhees et al., 2016)]. As shown in Table 3, all constructs satisfied these criteria, with diagonal values (square root of AVE) exceeding inter-construct correlations and HTMT ratios well within acceptable limits.

**Table 3. Heterotrait-Monotrait Ratio (HTMT) – Fornell-Larcker Criterion**

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Collaboration in Supply Chain Networks | 0.838 | | | | | | | | |
| Environmental Management | 0.747 | 0.852 | | | | | | | |
| Environmental Regulation | 0.723 | 0.769 | 0.911 | | | | | | |
| Green Human Resources Practice | 0.808 | 0.745 | 0.792 | 0.879 | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Green Performance | 0.826 | 0.838 | 0.817 | 0.757 | 0.901 | | | | |
| Sustainability Healthcare Industry | 0.807 | 0.839 | 0.842 | 0.816 | 0.898 | 0.864 | | | |
| Healthcare Inventory Control System | 0.810 | 0.861 | 0.780 | 0.777 | 0.863 | 0.873 | 0.886 | | |
| Knowledge Management | 0.736 | 0.783 | 0.831 | 0.839 | 0.782 | 0.836 | 0.760 | 0.859 | |
| Technology Innovation | 0.786 | 0.811 | 0.808 | 0.794 | 0.856 | 0.835 | 0.794 | 0.807 | 0.863 |

These results confirm that the constructs such as Green Human Resources Practice, Collaboration in Supply Chain Networks, Knowledge Management, Technology Innovation, Environmental Management, Healthcare Inventory Control System, Environmental Regulation, Green Performance, and Healthcare Sustainability are conceptually and statistically distinct. Establishing discriminant validity is critical, as it demonstrates that the observed relationships among constructs are not due to measurement overlap but reflect genuine structural associations (Hair et al., 2019). Similar findings have been reported in other sustainability and healthcare management studies using SEM-PLS, further reinforcing the robustness of this measurement model (Mousa et al., 2025)

**Path Analysis of the Structural Model**

The structural model demonstrated strong explanatory power, with $R^2$ values of 0.847 for Green Performance and 0.881 for Sustainability in the Healthcare Industry. This indicates that 84.7% of the variance in Green Performance and 88.1% of the variance in Sustainability outcomes were explained by the predictors included in the model. In addition, the predictive relevance test yielded a $Q^2$ value of 0.981, confirming very strong predictive capability and model robustness (Hair et al., 2022). The results presented in Figure 2 and Table 4 highlight the pivotal role of innovation, collaboration, and system-based management in shaping Green Performance and, through it, advancing sustainability, while pointing to the limitations of regulatory mechanisms in the Indonesian healthcare context.

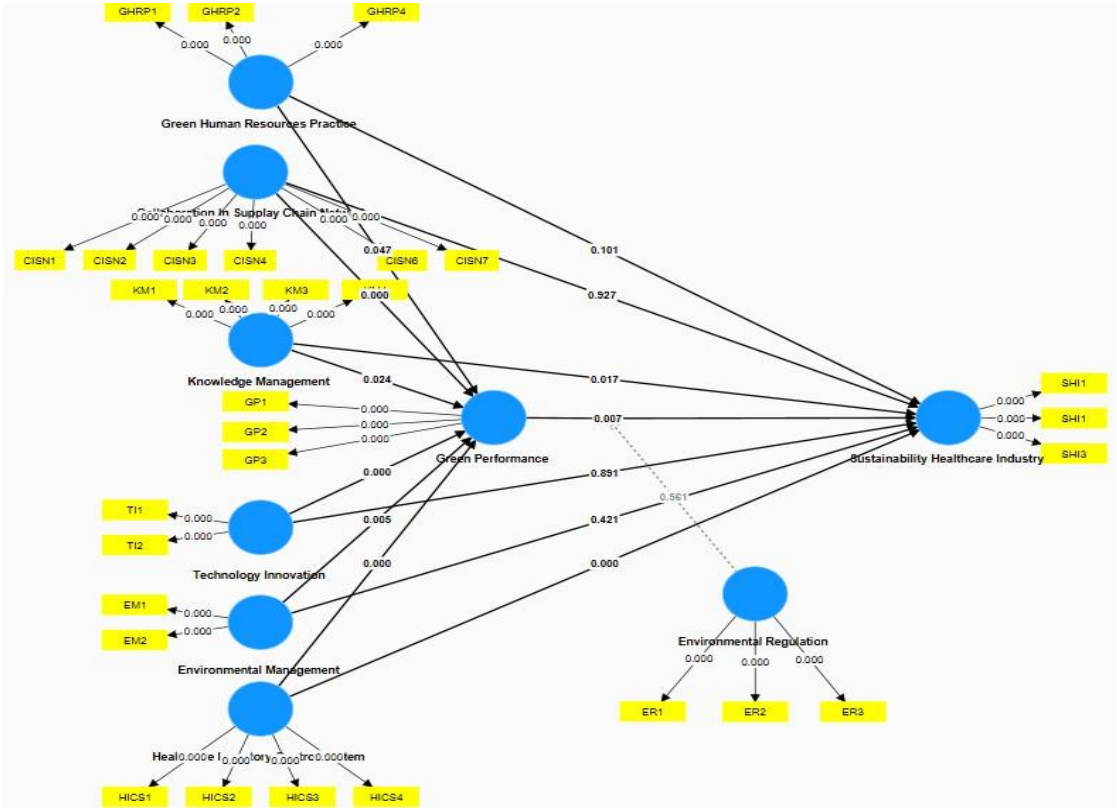


**Figure 2. (Modified Model)**

**Tabel 4. Direct Hypothesis Testing Results**

| Variable Effect | Coefficients | t-statistic | p-Values | Description |
|---|---|---|---|---|
| Environmental Regulation x Green Performance → Sustainability Healthcare Industry | 0.010 | 0.581 | 0.561 | Rejected |
| Green Human Resources Practice -> Green Performance -> Sustainability Healthcare Industry | -0.030 | 1.441 | 0.150 | Rejected |
| Collaboration in Supply Chain Networks -> Green Performance -> Sustainability Healthcare Industry | 0.081 | 2.395 | 0.017 | Accepted |
| Knowledge Management -> Green Performance -> Sustainability Healthcare Industry | 0.034 | 1.555 | 0.120 | Rejected |
| Technology Innovation -> Green Performance -> Sustainability Healthcare Industry | 0.087 | 2.670 | 0.008 | Accepted |
| Environmental Management -> Green Performance -> Sustainability Healthcare Industry | 0.046 | 1.720 | 0.085 | Rejected |
| Healthcare Inventory Control System -> Green Performance -> Sustainability Healthcare Industry | 0.101 | 2.427 | 0.015 | Accepted |

The analysis of path coefficients showed that Collaboration in Supply Chain Networks, Knowledge Management, Technology Innovation, Environmental Management, and Healthcare Inventory Control Systems exert significant positive influences on Green

Performance. Among these, the Healthcare Inventory Control System (β = 0.324) and Technology Innovation (β = 0.278) emerged as the strongest drivers, highlighting the critical role of technology-enabled processes and efficient inventory management in enhancing green outcomes. These results align with prior findings that digital innovations and optimized supply chain systems significantly reduce waste and improve sustainability performance in healthcare and service sectors (Mousa et al., 2025; Rubigha, 2020).

Furthermore, Green Performance itself was found to exert a strong and positive effect on the Sustainability of the Healthcare Industry, confirming its central mediating role. This demonstrates that organizational practices focused on technology, collaboration, and system efficiency contribute to sustainability primarily by first enhancing green performance. Such findings are consistent with the resource-based view, which emphasizes the importance of integrating internal capabilities and knowledge for competitive advantage in sustainability (Barney, 1991).

By contrast, Green Human Resource Practices, Collaboration in Supply Chain Networks, Technology Innovation, and Environmental Management did not demonstrate significant direct effects on sustainability. This suggests that while these factors are valuable for improving Green Performance, their contributions to sustainability outcomes may be more indirect or context-dependent. Similarly, the moderating role of Environmental Regulation was not supported, reflecting the weak enforcement and institutional limitations of regulatory frameworks in Indonesia's healthcare system (Sarwono & Santiago, 2025). This finding is consistent with previous research noting that formal regulations often fail to translate into improved sustainability performance without strong enforcement mechanisms (Keramat et al., 2019).

Taken together, these results underscore the pivotal role of innovation, collaboration, and system-based management in shaping Green Performance and, through it, advancing healthcare sustainability. However, they also highlight the limitations of relying on regulation alone, suggesting that organizational and managerial strategies are currently more decisive determinants in the Indonesian healthcare context.

**Indirect Effects**

The results of the indirect effect analysis are presented in Table 5. Green Performance, as a mediating variable, does not consistently transmit significant effects toward Sustainability Healthcare Industry. Of the six indirect paths analyzed, three demonstrate significant effects while the other three do not.

**Table 5. Indirect Effects**

| Variable | Estimate | t-Statistics | p-Values | Remark |
|---|---|---|---|---|
| Green Human Resources Practice → Green Performance → Sustainability Healthcare Industry | -0.030 | 1.441 | 0.150 | Rejected |

| | | | | |
|---|---|---|---|---|
| Collaboration in Supply Chain Networks → Green Performance → Sustainability Healthcare Industry | 0.081 | 2.395 | 0.017 | Accepted |
| Knowledge Management → Green Performance → Sustainability Healthcare Industry | 0.034 | 1.555 | 0.120 | Rejected |
| Technology Innovation → Green Performance → Sustainability Healthcare Industry | 0.087 | 2.670 | 0.008 | Accepted |
| Environmental Management → Green Performance → Sustainability Healthcare Industry | 0.046 | 1.720 | 0.085 | Rejected |
| Healthcare Inventory Control System → Green Performance → Sustainability Healthcare Industry | 0.101 | 2.427 | 0.015 | Accepted |

The findings show that Collaboration in Supply Chain Networks (β = 0.081; t = 2.395; p = 0.017), Technology Innovation (β = 0.087; t = 2.670; p = 0.008), and Healthcare Inventory Control System (β = 0.101; t = 2.427; p = 0.015) have significant indirect effects on healthcare industry sustainability through Green Performance. This suggests that effective collaboration, technology innovation, and efficient inventory systems enhance sustainability by improving green performance.

Meanwhile, Green Human Resources Practice (β = -0.030; t = 1.441; p = 0.150), Knowledge Management (β = 0.034; t = 1.555; p = 0.120), and Environmental Management (β = 0.046; t = 1.720; p = 0.085) show no significant indirect effects, indicating that their contribution to sustainability through green performance is still limited. Overall, these results confirm that Green Performance plays only a partial mediating role, with stronger mediation observed in strategies related to collaboration, technology, and inventory systems, while other practices require further strategic integration to yield meaningful sustainability outcomes. These findings suggest that collaboration, technology innovation, and efficient inventory systems contribute to sustainability primarily by enhancing Green Performance. This supports prior evidence that green collaboration and digital innovation drive sustainable operations by reducing waste and improving eco-efficiency (Tseng et al., 2019; Chen et al., 2009). In contrast, non-significant mediation for Green Human Resources Practice, Knowledge Management, and Environmental Management highlights the limitations of current practices in Indonesian hospitals, where weak integration of training, knowledge-sharing systems, and environmental audits often undermines sustainability outcomes (Alboliteeh et al., 2022; Massoud et al., 2017). he results confirm that Green Performance acts as a partial mediator, with stronger mediation effects observed in system- and innovation-related practices. To achieve meaningful sustainability, hospitals must strategically reinforce HRM, knowledge management, and environmental frameworks to complement collaboration and technology-driven initiatives (Barney, 2021).

**The Effect of Green Performance on Healthcare Industry Sustainability: The Moderating Role of Environmental Regulations.**

The hypothesis testing results indicate that the interaction between Environmental Regulation and Green Performance on Sustainability Healthcare Industry yields a coefficient of 0.010, with a t-statistic of 0.581 and a p-value of 0.561, which is insignificant at the 0.05 significance level, suggesting that environmental regulations do not act as a moderating variable strengthening the relationship between Green Performance and healthcare industry sustainability in accredited hospitals on Java Island, Indonesia. Within the Triple Bottom Line (TBL) framework, sustainability requires synergy among economic, social, and environmental dimensions; however, the weak influence of environmental regulations reflects suboptimal implementation of the environmental dimension, likely due to inadequate oversight, poorly structured regulatory implementation, and a lack of stringent incentives or penalties. These findings align with Sarwono and Satiago, 2025, who found that environmental regulations in Indonesia have not significantly impacted green performance across industrial sectors, including healthcare, due to inconsistent law enforcement and low organizational awareness of sustainable practices, further Butler et al (2011), who noted that environmental regulations are often formalities without adequate implementation support, thus failing to drive organizational behavior toward sustainability.

**The Effect of Green Human Resource Management Practices on Healthcare Industry Sustainability through Green Performance.**

The mediation path testing of Green Human Resource Management (GHRM) → Green Performance → Sustainability Healthcare Industry produced a coefficient of -0.030, t-statistic of 1.441, and p-value of 0.150, indicating insignificance at the 0.05 significance level. This suggests that GHRM does not indirectly influence healthcare industry sustainability through green performance in accredited hospitals on Java Island, Indonesia. From the TBL perspective, the ineffectiveness of GHRM reflects a lack of balance in the social and environmental dimensions, possibly due to insufficient environmental training, lack of leadership commitment, or weak internalization of green values into the workplace culture. This finding contrasts with (Tandon et al., 2023), who found that GHRM promotes sustainable performance in the manufacturing sector, indicating the need for context-specific approaches in healthcare. Rakhma et al., 2025 also noted that GHRM implementation in Indonesia's public sector is often hindered by inadequate resources and training. Additionally, Bangura et al., 2025 found that an unsupportive organizational culture is a primary barrier to GHRM effectiveness in the service sector.

**The Effect of Collaboration in Supply Chain Networks on Healthcare Industry Sustainability through Green Performance**

The results indicate that collaboration in supply chain networks significantly contributes to healthcare sustainability through improved green performance (β = 0.081; t = 2.395; p = 0.017). Collaboration with suppliers and logistics partners enables hospitals to coordinate procurement processes, share resources efficiently, and adopt environmentally responsible supply practices. Within the Triple Bottom Line framework, this collaboration reflects the integration of economic efficiency and environmental responsibility in healthcare operations. This finding is consistent with Tseng et al. (2019), who reported that effective supply chain collaboration improves environmental performance and resource efficiency in organizational systems. In the healthcare context, coordinated supply networks can reduce redundant procurement, minimize waste generation, and improve the management of medical supplies. Therefore, strengthening collaboration with supply chain partners represents an important strategy for hospitals seeking to improve green performance and achieve long-term sustainability.

**The Effect of Knowledge Management on Healthcare Industry Sustainability through Green Performance**

The testing of the Knowledge Management → Green Performance → Sustainability in the Healthcare Industry path produced a coefficient of 0.034, t-statistic of 1.555, and p-value of 0.120, which is insignificant at the 0.05 significance level. This indicates that knowledge management has not significantly contributed to healthcare industry sustainability through green performance in accredited hospitals on Java Island, Indonesia. Within the TBL framework, knowledge management should support innovation and continuous improvement in social and environmental aspects, but its insignificance may result from weak documentation systems, lack of environmental knowledge training, or absence of structured knowledge transfer. This finding is supported by Mardani et al., 2018, who noted that innovation and knowledge do not always directly impact performance in service sectors. Alboliteeh et al. (2023) also found that the lack of integrated knowledge management systems in Indonesian hospitals hinders sustainable practices. Furthermore, Karamat et al., 2019 identified low environmental knowledge transfer among staff as a key barrier to achieving sustainability in the healthcare sector.

**The Effect of Technology Innovation on Healthcare Industry Sustainability through Green Performance**

The mediation path testing of Technology Innovation → Green Performance → Sustainability in the Healthcare Industry yielded a significant result (β = 0.087; t = 2.670; p = 0.008), indicating that technological innovation positively contributes to healthcare sustainability through enhanced green performance. This finding aligns with Chen et al. (2021), who reported that digital technologies can

improve environmental efficiency in healthcare systems by optimizing resource management and reducing energy consumption. Similarly, Rubigha (2020) emphasized that technology-based operational systems significantly improve sustainable healthcare practices by minimizing medical waste and enhancing operational efficiency. The present study extends these findings by demonstrating that technological innovation influences sustainability indirectly through green performance, highlighting the importance of environmentally oriented operational practices as a key mechanism linking innovation and sustainability outcomes in hospitals. Within the Triple Bottom Line (TBL) framework, technology innovations, such as digital energy management systems or eco-friendly technologies, support synergy between economic efficiency and environmental sustainability. This contribution is likely driven by technology's ability to optimize operational processes, reduce resource consumption, and minimize medical waste, thereby strengthening green practices. This finding aligns with Chen et al. (2021), who found that adopting green technologies enhances environmental efficiency in the healthcare sector through improved energy management. Additionally, Rubigha et al. (2020) stated that technology innovations, such as IoT-based automation systems, accelerate the transition toward sustainability in Indonesian hospitals.

**The Effect of Environmental Management on Healthcare Industry Sustainability through Green Performance**

The hypothesis testing results revealed that the interaction between Environmental Regulation and Green Performance on Sustainability in the Healthcare Industry was not statistically significant ($\beta = 0.010$; $t = 0.581$; $p = 0.561$). This indicates that environmental regulations do not function as a moderating factor that strengthens the relationship between Green Performance and healthcare sustainability in accredited hospitals on Java Island.

Within the Triple Bottom Line (TBL) framework, sustainability requires alignment across economic, social, and environmental dimensions. However, the weak role of environmental regulations observed here suggests ineffective implementation of the environmental dimension, which may be attributed to limited oversight, poorly structured regulatory mechanisms, and the absence of strict enforcement measures. Previous studies have similarly reported that in Indonesia, environmental regulations have not significantly improved environmental outcomes in various industries, including healthcare, due to inconsistent law enforcement and limited organizational compliance (Salim & Palullungan, 2021)

**The Effect of Healthcare Inventory Control System on Healthcare Industry Sustainability through Green Performance**

The path analysis indicated that the Healthcare Inventory Control System had a significant indirect effect on Sustainability in the Healthcare Industry through Green Performance ($\beta = 0.101$; $t = 2.427$; p

= 0.015). This result confirms that efficient inventory control systems positively influence sustainability by improving green performance in accredited hospitals on Java Island.

Within the Triple Bottom Line (TBL) framework, inventory control plays a crucial role in environmental sustainability by reducing waste, preventing the expiration of medicines and medical supplies, and optimizing the use of resources. By ensuring more accurate demand forecasting and streamlined distribution, these systems also help minimize hazardous waste and enhance logistics efficiency. Evidence from previous studies supports this conclusion, showing that technology-based inventory control systems improve hospital operations and reduce environmental impacts (Smith., 2013). Integrated inventory management has also been found to support sustainability by reducing medical waste in healthcare institutions (Lee & Lee, 2022), while digitally optimized systems have been shown to lower the carbon footprint of hospital logistics operations (Selvakuma et al., 2025).

## CONCLUSION

This study shows that collaboration in supply chain networks, technology innovation, and healthcare inventory control systems significantly enhance sustainability in accredited Type B hospitals on Java Island by strengthening green performance. In contrast, environmental regulation, green human resource practices, knowledge management, and environmental management did not show significant contributions. These findings reflect the current conditions of Indonesian hospitals, where digital infrastructure and inventory systems are gradually improving, but challenges remain in human resource capacity, documentation, and regulatory enforcement. Within the Triple Bottom Line framework, economic and environmental synergies are being achieved through collaboration and technology adoption, yet the social and institutional dimensions are still underdeveloped. To move forward, hospitals need to build stronger partnerships with suppliers, expand digital inventory and waste management systems, and enhance staff training and knowledge management. At the same time, government oversight must be strengthened to ensure that environmental regulations are enforced consistently. Together, these strategies can help hospitals achieve balanced sustainability while addressing the institutional challenges faced by Indonesia's healthcare sector.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest. All authors have contributed equally to the preparation of this manuscript and have approved the final version for submission.

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