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Effect of Green Procurement Practices in Enhancing Cold Supply Chain Performance: A Case of Rwanda Medical Supply

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Abstract: *This study examined the effect of Green Procurement Practices in Enhancing Cold Supply Chain Performance at Rwanda Medical Supply. Specifically, the study sought to determine the effect of green training and monitoring practices on cold supply chain performance at RMS. The study adopted a quantitative research approach using a cross-sectional research design. A total of 109 employees involved in procurement, warehouse and inventory management, logistics and distribution, quality assurance, and cold chain management were targeted and participated in the study. All 109 questionnaires were successfully completed and returned, representing a response rate of 100%. Primary data were collected through structured questionnaires administered to the selected employees. Quantitative data were analysed using descriptive statistics, Pearson correlation analysis, and simple linear regression analysis using SPSS Version 2.7. The findings revealed a strong positive and statistically significant relationship between green training and monitoring practices and cold supply chain performance ($r = 0.761$, $p < 0.001$). Regression results showed that green training and monitoring practices explained 57.9% of the variation in cold supply chain performance ($R^2 = 0.579$). The study concluded that regular employee training, environmental sustainability awareness, effective temperature monitoring, and timely correction of storage deviations were important for improving cold supply chain performance at RMS. The study recommended strengthening continuous employee training, improving environmental sustainability awareness, enhancing temperature monitoring systems, and establishing effective procedures for reporting and correcting storage deviations.*

Keywords: *Green training, Monitoring practices, Cold supply chain performance, Rwanda Medical Supply; Temperature-sensitive products*

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1. Introduction

Cold supply chains play an important role in maintaining the quality, safety, and effectiveness of temperature-sensitive medical products during storage, transportation, and distribution. Medicines, vaccines, and other medical products may lose their quality when exposed to temperatures outside the conditions recommended by manufacturers. The World Health Organization (WHO, 2020) emphasizes that medical products face different risks during purchasing, storage, transportation, and distribution, making appropriate storage and distribution practices essential for protecting product quality. Temperature mapping and monitoring are also important because they help organizations identify temperature variations in storage facilities and ensure that appropriate conditions are maintained (WHO, 2026). Effective cold chain management therefore requires suitable equipment, reliable monitoring systems, clear operational procedures, and employees with the necessary knowledge and skills. Green training and monitoring practices are consequently important because they equip employees with knowledge of sustainable supply chain operations while supporting continuous monitoring of storage and distribution conditions.

In developed countries, healthcare supply chains have increasingly adopted structured procedures and regulatory standards to maintain the quality of temperature-sensitive medical products. In the United States, the Centers for Disease Control and Prevention (CDC, 2024) emphasizes that healthcare personnel responsible for receiving, storing, and handling vaccines should receive appropriate training and follow established storage and handling procedures. CDC also recommends the use of reliable temperature monitoring devices, regular recording of storage temperatures, and immediate action when temperature deviations occur. Similarly, the European Commission (2013) requires personnel involved in the distribution of medicinal products to receive initial and continuous training relevant to their responsibilities, particularly when handling temperature-sensitive products. These guidelines also emphasize the importance of monitoring storage conditions, maintaining equipment, documenting training, and investigating temperature deviations. Such practices demonstrate the importance of combining employee training with effective monitoring systems to protect medical products and improve cold supply chain reliability.

Across Sub-Saharan African countries, healthcare supply chains continue to experience challenges related to cold chain infrastructure, equipment maintenance, temperature monitoring, and employee capacity. Tilley (2025) observed that vaccine cold chains in the region face difficulties associated with outdated equipment, insufficient temperature monitoring, limited training, and inadequate information management systems. These challenges can expose temperature-sensitive medical products to inappropriate storage conditions and increase the possibility of product wastage. Similarly, Erassa et al. (2023), in their study of vaccine cold chain management in Ethiopia, emphasized the importance of appropriate cold chain practices and operational conditions in maintaining vaccine quality. Effective training can improve employees' knowledge of product handling, temperature control, and the procedures required when deviations occur. Therefore, strengthening green training and monitoring practices is important for healthcare supply chain institutions in Sub-Saharan Africa because these practices can improve employee competencies, promote responsible resource utilization, and support the reliable management of temperature-sensitive medical products.

In East African countries, maintaining effective cold supply chains remains important because healthcare institutions depend on appropriate storage, handling, and transportation conditions to preserve the quality of vaccines and other temperature-sensitive medical products. Aguma et al. (2024) examined the effects of selected training modalities on vaccine cold chain management and highlighted the importance of training in improving the knowledge and practices of personnel responsible for vaccine handling. Their study demonstrated the relevance of employee capacity development in strengthening cold chain management practices. Similarly, Feyisa et al. (2021), in their assessment of cold chain management performance for temperature-sensitive pharmaceuticals in public health facilities in Ethiopia, emphasized the importance of proper cold chain management in protecting pharmaceutical products. These studies indicate that effective cold chain operations require not only appropriate equipment but also employees who understand storage requirements, temperature monitoring, and corrective procedures. Consequently, green training and monitoring practices are important for strengthening cold supply chain performance in East African healthcare institutions.

In Rwanda, the management of medical supply chains is important for ensuring the availability, quality, and timely distribution of medicines and other health commodities to healthcare facilities. Rwanda Medical Supply (RMS) is responsible for managing important supply chain activities, including procurement, storage, and distribution of health commodities to public health institutions across the country (RMS, 2024). The institution maintains medical products under recommended storage conditions using appropriate facilities and equipment, including cold rooms and heating, ventilation, and air-conditioning systems. Furthermore, the Rwanda Food and Drugs Authority (Rwanda FDA, 2024) provides guidelines for good storage and distribution practices, emphasizing appropriate temperature control, monitoring, equipment maintenance, and compliance with established procedures. Kigenza et al. (2023) also highlighted the importance of workforce development, refresher training, and supervision in strengthening Rwanda's health supply chain. These developments demonstrate the importance of employee competencies and effective monitoring arrangements in maintaining the quality and reliability of medical supply chain operations in Rwanda.This study focused on determining the effect of green training and monitoring practices on cold supply chain performance at Rwanda Medical Supply. Green training and monitoring practices were examined through regular raining on green supply chain activities, training on the handling of temperature-sensitive products, environmental sustainability awareness, and the application of acquired knowledge in daily operations. The study also considered the use of temperature monitoring systems, compliance with cold chain requirements, and reporting and correction of deviations in storage conditions. These practices are important because employees need appropriate knowledge and skills to maintain required storage conditions and respond effectively to operational challenges. Therefore, examining this specific objective provides an opportunity to establish how green training and monitoring practices are associated with the performance of the cold supply chain at Rwanda Medical Supply

1.2 Statement of the Problem

Cold supply chain performance depends on the ability of healthcare supply institutions to maintain appropriate conditions for temperature-sensitive medical products throughout storage, handling, and distribution. Even when

suitable storage and transportation equipment is available, inadequate employee knowledge, poor handling practices, and ineffective temperature monitoring can expose medical products to unsuitable conditions. The World Health Organization (2020) emphasizes the importance of appropriate storage and distribution practices in maintaining the quality of medical products, while the European Commission (2013) highlights the need for trained personnel and continuous monitoring during the distribution of medicinal products. Green training and monitoring practices can help address these challenges by equipping employees with relevant skills and ensuring that storage conditions are regularly checked. However, their effectiveness depends on regular training, employees' application of acquired knowledge, reliable monitoring systems, and timely reporting of temperature deviations.

In Rwanda, healthcare supply chain institutions continue to require skilled employees and effective monitoring systems to ensure the proper management of medical products. Kigenza et al. (2023) identified the importance of workforce development, continuous training, and supervision in strengthening the performance of Rwanda's health supply chain. Similarly, the Rwanda Food and Drugs Authority (2022) emphasizes appropriate personnel training, temperature monitoring, equipment maintenance, and proper documentation to maintain the quality of stored and distributed medical products. At Rwanda Medical Supply, these requirements make it necessary to strengthen green training and monitoring practices, particularly employee understanding of environmental sustainability, proper handling of temperature-sensitive products, and timely reporting of storage deviations. Although training and monitoring are recognized as important operational practices, some aspects may require further improvement to ensure their consistent application. This creates a need to examine how green training and monitoring practices relate to cold supply chain performance at RMS.

The problem addressed by this study was the need to establish the effect of green training and monitoring practices on cold supply chain performance at Rwanda Medical Supply. Descriptive findings indicated that training on environmental sustainability practices recorded a mean of 3.69, while the contribution of combined training and monitoring to cold supply chain performance recorded a mean of 3.90. Although these findings indicate general agreement among respondents, the difference suggests that environmental sustainability training requires additional attention. Kigenza et al. (2023) emphasize that continuous capacity development and supervision are important for addressing performance gaps in Rwanda's health supply chain, while the World Health Organization (2020) highlights the importance of proper storage and distribution practices in protecting medical products. Therefore, this study examined whether green training and monitoring practices, including employee training, application of acquired knowledge, temperature monitoring, and reporting of deviations, had a statistically significant effect on cold supply chain performance at Rwanda Medical Supply.

This study sought to achieve the following research objective:

i. To determine the effect of green training and monitoring practices on cold supply chain performance at Rwanda Medical Supply.

2. Literature Review

This section reviews existing literature on the effect of green training and monitoring practices on cold supply chain performance, with particular reference to Rwanda Medical Supply. It examines the concepts of green training and monitoring practices and cold supply chain performance, explaining their meaning and relevance to healthcare supply chain operations. The review also discusses relevant theoretical perspectives that explain how employee knowledge, skills, environmental awareness, and monitoring systems contribute to effective supply chain management. Furthermore, empirical studies conducted at international, regional, and national levels are examined to establish findings concerning employee training, temperature monitoring, and the management of temperature-sensitive medical products.

2.1 Conceptual Review

The conceptual review explains the key concepts and variables that form the foundation of this study and clarifies how they are related to one another. This review explains the main concepts related to green training and monitoring practices and cold supply chain performance. It discusses the meaning, characteristics, and importance of green training and monitoring practices in healthcare supply chain operations. It also examines cold supply chain performance in relation to the proper storage, handling, monitoring, and distribution of temperature-sensitive medical products. Particular attention is given to how employee knowledge, practical skills, environmental awareness, and monitoring systems contribute to maintaining appropriate cold chain conditions.

2.1.1. Green Procurement Practices

Green procurement practices refer to the integration of environmental, social, and economic considerations into purchasing decisions to reduce negative environmental impacts while ensuring value for money. These practices encourage organisations to consider the environmental effects of goods and services throughout their life cycle, including production, transportation, use, and disposal. In the health sector, sustainable procurement is important because medical supply chains involve the purchase, storage, transportation, and distribution of different health

commodities. The World Health Organization (WHO, 2025) explains that health systems can reduce their environmental impact by changing how they select, procure, and use goods and services. Similarly, Rwanda Public Procurement Authority (RPPA, 2024) emphasises the integration of sustainability considerations into public procurement decisions.

In Rwanda, green procurement practices are supported by the Sustainable Public Procurement Policy Framework approved by the Cabinet in October 2024. The framework encourages public institutions to consider environmental responsibility, social inclusion, and economic efficiency when purchasing goods, services, and works (RPPA, 2024). It also promotes the selection of environmentally friendly products, efficient use of resources, waste reduction, and consideration of life-cycle costs. These principles are relevant to Rwanda Medical Supply because the institution is responsible for procuring, storing, and distributing medical commodities to public health facilities across the country (Rwanda Medical Supply, 2024).

In this study, green procurement practices are considered through four dimensions: green supplier selection criteria, regulatory compliance and standards, eco-friendly procurement equipment, and green training and monitoring practices. Green supplier selection criteria involve considering suppliers' environmental performance and their ability to provide quality products responsibly. Regulatory compliance and standards concern adherence to applicable environmental, procurement, and health-product requirements. Eco-friendly procurement equipment focuses on selecting and using equipment that supports energy efficiency, resource conservation, and reduced environmental impact. Green training and monitoring practices involve equipping employees with environmental knowledge and regularly assessing whether sustainable practices are applied during procurement, storage, and distribution activities (WHO , 2025).

2.1.2. Green Training and Monitoring Practices

Green training and monitoring practices are increasingly recognized as critical enablers of effective Cold supply chain performance, particularly in healthcare and pharmaceutical logistics where precision, compliance, and sustainability are essential. These practices enhance staff capacity, strengthen adherence to environmental and operational standards, and ensure continuous monitoring of temperature-sensitive medical products. In cold chain systems, where even minor deviations can lead to product spoilage and financial losses, green training and monitoring play a vital role in improving efficiency, reducing waste, and ensuring regulatory compliance.

Globally, green training and monitoring practices have been shown to significantly improve Cold supply chain performance through enhanced environmental awareness, operational efficiency, and technological integration. In countries such as Morocco, the adoption of green supply chain management practices, including structured employee training and environmental monitoring systems, has led to improved sustainability performance and reduced greenhouse gas emissions (Lhassan & Ezzaher, 2025). Similarly, in developed economies, the integration of advanced monitoring technologies such as telematics, IoT sensors, and data analytics has improved logistics efficiency by reducing fuel consumption and emissions while ensuring temperature control in pharmaceutical cold chains (Reynolds, 2024). Studies also indicate that effective training and monitoring systems contribute to improved regulatory compliance and competitiveness, with logistics performance improvements of up to 20–25% in organizations adopting structured green supply chain practices (Rastogi et al., 2025).

In Rwanda, green training and monitoring practices are increasingly integrated into healthcare supply chain systems, including Rwanda Medical Supply. Evidence shows that regular training in green logistics significantly improves supply chain performance by enhancing staff capacity and reducing inefficiencies such as stockouts and delivery delays (Daniel, 2024). Monitoring practices, including the use of temperature data loggers and electronic inventory systems, have contributed to improved cold chain storage conformity, which stands at approximately 73% in health facilities (Nyirimanzi et al., 2023). However, compliance challenges persist, particularly in equipment calibration, where only a limited proportion of facilities consistently meet required standards. Despite these gaps, Rwanda has made progress through the adoption of electronic systems and green procurement policies, which have improved overall supply chain efficiency and accountability.

2.1.5. Level of Cold supply chain performance at Rwanda Medical Supply

Cold supply chain performance refers to the ability of an organisation to store, handle, transport, and distribute temperature-sensitive products under appropriate conditions while maintaining their quality and availability (WHO, 2026). In the pharmaceutical and healthcare sectors, effective cold supply chain performance ensures that medicines and other medical products remain within their recommended temperature ranges from procurement to final delivery. Maintaining appropriate temperatures is important because exposure to unsuitable environmental conditions may affect the quality, safety, and effectiveness of medical products. The Rwanda Food and Drugs Authority (Rwanda FDA, 2024) requires organisations involved in the storage and distribution of medical products to maintain appropriate storage and transportation conditions and monitor temperature deviations. Similarly, the World Health Organization (WHO, 2026) identifies temperature mapping and monitoring as important activities for maintaining appropriate pharmaceutical storage conditions.

Cold supply chain performance is also reflected in the efficiency and reliability of storage and distribution activities. Organisations are expected to maintain suitable storage facilities, use appropriate cold chain equipment, monitor temperature conditions, and ensure that medical products reach their destinations without compromising their quality. In Rwanda, Rwanda Medical Supply (RMS) is responsible for procuring, storing, and distributing health commodities to healthcare facilities across the country. Its operations include temperature-controlled storage, stock monitoring, order management, and nationwide distribution to support the availability of essential medical products (Rwanda Medical Supply, n.d.). Furthermore, Nyirimanzi et al. (2023), in their study of medicine cold chain storage conformity in health facilities in the Eastern Province of Rwanda, identified the importance of appropriate storage conditions and temperature monitoring in protecting the quality of temperature-sensitive medicines.

In this study, cold supply chain performance is assessed through indicators related to temperature control, product quality preservation, timely distribution, product availability, and reduction of medical product wastage. Temperature control involves maintaining and monitoring the required conditions during storage and transportation to prevent temperature deviations. Product quality preservation concerns ensuring that medical products remain safe and effective throughout the supply chain process. Timely distribution measures the ability of the organisation to deliver medical products to healthcare facilities within the required time, while product availability concerns ensuring that the required commodities are accessible when needed. Reduction of medical product wastage involves minimising losses resulting from expiry, improper storage, damage, and temperature-related incidents. T

2.2 Theoretical Review

This study is guided by Green Supply Chain Management (GSCM) theory, which explains how organisations integrate environmental considerations into supply chain activities to improve sustainability and operational performance. GSCM extends traditional supply chain management by incorporating environmental practices into procurement, production, storage, transportation, distribution, and product disposal. These practices aim to reduce environmental pollution, minimise resource consumption, control waste, and improve the efficient use of organisational resources. Jain et al. (2024) explain that green supply chain practices have developed into an important organisational approach for addressing environmental challenges across supply chain activities. Similarly, Govindan et al. (2024) identify sustainability as an important consideration in supply chain management and discuss the theoretical perspectives that guide sustainable supply chain research. In the healthcare sector, the World Health Organization (WHO, 2025) also emphasises the need to integrate environmental sustainability into the selection, procurement, and use of healthcare goods and services.

Furthermore, GSCM theory emphasises the importance of green supplier selection and compliance with environmental and quality standards in promoting sustainable supply chain operations. Green supplier selection involves considering suppliers' environmental practices, product quality, resource utilisation, and ability to meet applicable standards when making procurement decisions. The selection of responsible suppliers can help organisations reduce environmental risks and improve the sustainability of purchased goods and services. Tetteh et al. (2025) identify sustainable sourcing and other green supply chain practices as important components of environmentally responsible supply chain management. In addition, the WHO (2025) recommends that healthcare organisations consider sustainability when selecting and procuring goods and services. In the context of Rwanda Medical Supply, these principles are relevant because suppliers must provide medical commodities that meet the required quality and safety conditions. Compliance with applicable procurement, environmental, and medical product requirements also helps protect product quality and supports the reliable management of temperature-sensitive medical products (Rwanda Food and Drugs Authority [Rwanda FDA], 2022).

The application of GSCM theory provides a theoretical foundation for examining the relationship between green procurement practices and cold supply chain performance at Rwanda Medical Supply. The theory guides this study by explaining how green supplier selection criteria, regulatory compliance and standards, eco-friendly procurement equipment, and green training and monitoring practices can support sustainable supply chain operations. These practices are relevant to performance because they address supplier responsibility, compliance with required standards, efficient equipment use, employee capacity, and monitoring of storage and distribution activities.

2.3 Empirical Review

Green supplier selection criteria have become an essential component of sustainable procurement strategies, particularly in Cold supply chain systems where product integrity, temperature control, and environmental sustainability are closely linked. In healthcare logistics, selecting suppliers based on environmental performance, regulatory compliance, and operational efficiency is increasingly recognized as a key strategy for improving time delivery, reducing operational costs, and minimizing waste of temperature-sensitive medical products. As a result, green supplier selection is now considered a critical driver of Cold supply chain performance globally.

Globally, green supplier selection criteria have been widely implemented to enhance Cold supply chain efficiency and sustainability. In India’s health sector, the application of multi-criteria decision-making frameworks incorporating

environmental and economic indicators has shown significant improvements in supply chain performance, particularly through renewable resource utilization and job creation (Ecer et al., 2023). Similarly, pharmaceutical supply chains in developed countries such as the United States and Germany have integrated environmental management systems and eco-design standards, resulting in up to a 25% reduction in temperature deviations and approximately 20% reduction in operational costs due to improved supplier performance and monitoring systems. In addition, studies show that eco-design and green supplier evaluation practices can improve sustainability compliance by more than 30%, particularly in pharmaceutical cold chain systems (Mabrouk, 2021; Mishra, 2021).

In Africa, green supplier selection criteria are increasingly being adopted to strengthen healthcare supply chain performance. In Kenya, the Ministry of Health has implemented supplier evaluation systems that emphasize environmental compliance and delivery efficiency, resulting in a 22% improvement in delivery efficiency and significant reductions in logistics-related delays (Mungai et al., 2025). In Tanzania, adherence to environmental and regulatory supplier standards has been associated with improved healthcare logistics reliability and a reduction of operational inefficiencies by approximately 18–20% (Shatta, 2025). Furthermore, studies in Nigeria indicate that integrating environmental compliance into supplier selection contributes to improved supply chain sustainability and reduced product loss, particularly in pharmaceutical distribution systems (Balogun et al., 2021). These findings highlight the growing importance of green procurement practices in improving Cold supply chain performance across African healthcare systems.

In Rwanda, green supplier selection criteria are gradually being incorporated into healthcare procurement systems, including Rwanda Medical Supply. Evidence indicates that supplier evaluation based on environmental performance, energy efficiency, and waste management contributes to improved cold chain outcomes. However, implementation remains partial and inconsistent across health facilities. For example, studies show that while green procurement practices contribute to approximately 1,700 tons of CO_2 emissions reduction annually, gaps in supplier evaluation and compliance still affect cold chain efficiency (Harriet & Ndolo, 2025). Additionally, challenges in supplier monitoring and equipment calibration have resulted in only about 66.7% compliance with cold chain standards, indicating significant room for improvement in procurement-driven performance (Nyirimanzi et al., 2023). Despite ongoing reforms such as e-procurement systems, the integration of structured green supplier selection frameworks within Rwanda Medical Supply remains limited.

3. Methodology

This section presented the research methodology that was used to examine the effect of green training and monitoring practices on cold supply chain performance at Rwanda Medical Supply (RMS). It described the research design, study population, sample size, sampling techniques, data collection instruments, pilot study, data collection procedures, ethical considerations, and data analysis methods. The methodology focused on collecting relevant information from employees who were directly involved in activities related to medical product storage, handling, transportation, and distribution. It provided a systematic approach to examining how employee training and monitoring activities contributed to cold supply chain performance. The study considered green training and monitoring practices as the independent variable and cold supply chain performance as the dependent variable.

The study adopted a quantitative research approach to collect numerical information from selected employees of Rwanda Medical Supply. This approach enabled the researcher to measure respondents' opinions regarding regular employee training, environmental awareness, application of acquired knowledge, and monitoring of cold chain activities. Quantitative data also helped establish the relationship between green training and monitoring practices and cold supply chain performance. The information collected was organised, coded, and analysed using appropriate statistical techniques. This approach supported the objective interpretation of findings in relation to the specific research objective.

A cross-sectional research design was adopted because data were collected from respondents at a particular point in time. The design allowed the researcher to assess the existing level of green training and monitoring practices within Rwanda Medical Supply. It also facilitated the examination of the relationship between these practices and cold supply chain performance without requiring repeated data collection over an extended period. Descriptive and analytical procedures were applied to understand respondents' views and examine the relationship between the study variables. This design provided an appropriate framework for addressing the research objective.

The target population comprised 150 employees of Rwanda Medical Supply who were directly involved in procurement, warehouse and inventory management, logistics and distribution, quality assurance, and cold chain management activities. These employees were considered relevant because their responsibilities involved handling, storing, monitoring, and distributing medical products. The sample size was determined using Yamane's formula at a 5% margin of error, resulting in a minimum sample of 109 respondents. Stratified random sampling was applied to ensure representation of the relevant departments, followed by simple random sampling to select eligible employees. Only employees with at least six months of relevant working experience were included in the study.

Primary data were collected using a structured questionnaire administered to selected employees of Rwanda Medical

Supply. The questionnaire contained statements measuring green training and monitoring practices, including regular training, proper handling of temperature-sensitive products, environmental sustainability awareness, application of acquired knowledge, temperature monitoring, and reporting of storage deviations. It also included statements measuring cold supply chain performance, particularly product quality preservation, timely delivery, operational efficiency, and reduction of medical product wastage. A four-point Likert scale was used to measure respondents' levels of agreement. A pilot study involving 15 employees from Africa Medical Suppliers Ltd was conducted to assess the clarity, relevance, and reliability of the questionnaire before the main data collection.

The data collection process involved distributing questionnaires to selected respondents and explaining the purpose of the study. Participation was voluntary, and respondents were informed of their right to decline participation or withdraw without facing any negative consequences. Ethical considerations were observed throughout the research process by obtaining the necessary authorisation to conduct the study and seeking informed consent from participants. Confidentiality and anonymity were maintained by avoiding the inclusion of respondents' names in the research report and ensuring that the collected information was used strictly for academic purposes. Completed questionnaires were checked for completeness, coded, and entered into Microsoft Excel before being transferred to Jamovi Version 2.7 for analysis. Electronic records were password-protected, while hard copies were stored securely to prevent unauthorized access.

Finally, inferential statistical analysis was conducted using Pearson correlation and simple linear regression to examine the effect of green training and monitoring practices on cold supply chain performance. Pearson correlation established the strength and direction of the relationship between the two variables, while regression analysis determined the extent to which green training and monitoring practices predicted cold supply chain performance. The coefficient of determination (R^2) indicated the proportion of variation in cold supply chain performance explained by the independent variable. A significance level of 0.05 was applied to determine statistical significance. The results provided evidence regarding the contribution of green training and monitoring practices to cold supply chain performance at Rwanda Medical Supply

4. Results and Discussion

This section presents the findings and discussion of the study on the effect of green training and monitoring practices on cold supply chain performance at Rwanda Medical Supply (RMS). The analysis focused on the specific objective of examining the effect of green training and monitoring practices on cold supply chain performance. Data were collected from 109 respondents, and all 109 questionnaires were returned, representing a 100% response rate. The collected data were analysed using descriptive and inferential statistical techniques with the support of statistical software.

4.1.1 Results

The study examined green training and monitoring practices at Rwanda Medical Supply (RMS) to establish their implementation level in relation to cold supply chain performance. The findings were obtained from 109 respondents who participated in the study. Descriptive statistics, particularly means and standard deviations, were used to analyse respondents' opinions regarding employee training, application of acquired knowledge, temperature monitoring, and corrective actions.

4.1.2 Descriptive Findings on Green Training and Monitoring Practices

Descriptive statistics were used to examine respondents' opinions regarding green training and monitoring practices at Rwanda Medical Supply (RMS). The analysis focused on regular employee training, proper handling of temperature-sensitive products, environmental sustainability awareness, application of acquired knowledge, temperature monitoring, and correction of storage deviations. A four-point Likert scale was used to measure respondents' levels of agreement with the statements. The responses were assigned numerical values ranging from 1 to 4, where 1 represented Strongly Disagree and 4 represented Strongly Agree. The mean scores were interpreted using the following rating scale

Table 1: Level of agreement of Green Training and Monitoring Practices

Statements	N	Mean	Std. Dev.
I receive regular training on green supply chain practices.	109	3.71	0.70
My organization provides training on proper handling of temperature-sensitive products.	109	3.78	0.68
I receive training on environmental sustainability practices.	109	3.69	0.71
I apply knowledge acquired from training in my daily work.	109	3.74	0.69
Green training improves efficiency in cold supply chain operations.	109	3.83	0.66
Temperature monitoring systems are used effectively.	109	3.86	0.64
Compliance with cold chain temperature requirements is regularly monitored.	109	3.80	0.67

Effective monitoring reduces wastage of medical products.	109	3.88	0.63
I report and correct deviations in storage conditions.	109	3.76	0.69
Combining training and monitoring improves cold supply chain performance.	109	3.90	0.62
Overall mean	**109**	**3.80**	**—**

Source: Field data, 2026

The findings presented in Table 1 showed that respondents generally expressed a very high level of agreement regarding green training and monitoring practices at Rwanda Medical Supply (RMS). The analysis was based on 109 respondents, with an overall mean of 3.80. Based on the four-point Likert scale, mean scores ranging from 3.26 to 4.00 represented very high agreement. Therefore, all the statements recorded very high levels of agreement, indicating that green training and monitoring practices were widely recognised by employees as important activities in cold supply chain operations.

The findings indicated that the statement "Combining training and monitoring improves cold supply chain performance" recorded the highest mean of 3.90 and a standard deviation of 0.62. This was followed by the statement "Effective monitoring reduces wastage of medical products", which recorded a mean of 3.88 and a standard deviation of 0.63. These results demonstrated that respondents strongly recognised the importance of combining employee training with continuous monitoring to improve cold supply chain performance. The findings also suggested that effective monitoring played an important role in reducing medical product wastage and identifying potential problems during storage and handling.

Furthermore, the statement "Temperature monitoring systems are used effectively" recorded a mean of 3.86 and a standard deviation of 0.64, while "Green training improves efficiency in cold supply chain operations" obtained a mean of 3.83 and a standard deviation of 0.66. Similarly, regular monitoring of compliance with cold chain temperature requirements recorded a mean of 3.80 and a standard deviation of 0.67. These findings indicated that respondents highly agreed that temperature monitoring systems and employee training contributed to effective cold chain operations. The results highlighted the importance of maintaining appropriate temperature conditions and ensuring that employees understood the procedures required to protect temperature-sensitive medical products

The findings also showed that training on the proper handling of temperature-sensitive products recorded a mean of 3.78 and a standard deviation of 0.68. Reporting and correcting deviations in storage conditions obtained a mean of 3.76 and a standard deviation of 0.69, while the application of knowledge acquired through training in daily work recorded a mean of 3.74 and a standard deviation of 0.69. Regular training on green supply chain practices obtained a mean of 3.71 and a standard deviation of 0.70. Training on environmental sustainability practices recorded the lowest mean of 3.69 and a standard deviation of 0.71. Although this was the lowest score, it still represented very high agreement, suggesting that respondents generally recognised the importance of training while indicating an opportunity to strengthen environmental sustainability awareness among employees.

Overall, the mean score of 3.80 demonstrated a very high level of agreement regarding the implementation of green training and monitoring practices at RMS. The standard deviations, which ranged from 0.62 to 0.71, indicated relatively low variation in respondents' answers, suggesting that their opinions were generally consistent. The findings particularly highlighted the importance of combining employee training with effective temperature monitoring to improve cold supply chain operations and minimise medical product wastage. They also demonstrated the need to maintain regular training programmes and strengthen employees' ability to apply acquired knowledge in their daily responsibilities. Therefore, green training and monitoring practices were considered important contributors to improving cold supply chain performance at Rwanda Medical Supply.

From the findings, the study revealed that green training and monitoring practices were highly implemented at Rwanda Medical Supply. Respondents acknowledged that regular employee training improved their knowledge and skills in handling temperature-sensitive medical products and applying environmental sustainability practices in their daily activities. The findings further showed that effective temperature monitoring helped identify and correct storage deviations, maintain appropriate cold chain conditions, and reduce medical product wastage. Combining employee training with continuous monitoring was also recognised as an important approach to improving operational efficiency and cold supply chain performance. However, the findings indicated the need to strengthen regular training and environmental sustainability awareness to ensure the consistent application of green practices.

These findings are in agreement with Gelagay and Werke (2024), who established that green human resource management practices, including employee training and development, contributed to the implementation of internal green supply chain management practices and improved operational performance. Their findings emphasised the importance of developing employees' environmental knowledge and encouraging the application of sustainable practices within organisational operations. Similarly, the World Health Organization (2025) emphasised the importance of strengthening sustainable practices in healthcare supply chains through improved procurement and the responsible use of goods and services. The findings are also consistent with the Rwanda Food and Drugs Authority (2024) guidelines, which highlight the

importance of monitoring storage and distribution conditions to maintain the quality and safety of medical products. These studies support the present findings that regular employee training, effective temperature monitoring, and timely correction of storage deviations are important for reducing medical product wastage and improving cold supply chain performance at Rwanda Medical Supply.

4.1.3. Correlation Analysis

Pearson correlation analysis was conducted to establish the strength and direction of the relationship between green training and monitoring practices and cold supply chain performance at Rwanda Medical Supply (RMS). The analysis involved 109 respondents and was performed to determine whether improvements in employee training and monitoring practices were associated with improvements in cold supply chain performance. The Pearson correlation coefficient (r) was used to measure the relationship between the two variables, while the significance value (p-value) was used to determine whether the relationship was statistically significant. A significance level of 0.05 was applied in interpreting the results.

Table 2: Correlation Between Green Training and Monitoring Practices and Cold Supply Chain Performance

Variables	Green training and monitoring	Cold supply chain performance
Green training and monitoring	1	0.761**
Cold supply chain performance	0.761**	1
Sig. (2-tailed)	—	<0.001
N	109	109

Source: Field data, 2026

Table 3 presents the correlation between green training and monitoring practices and cold supply chain performance at Rwanda Medical Supply. The findings revealed a strong positive relationship between the two variables, as indicated by a Pearson correlation coefficient of 0.761. The significance value was less than 0.001, which was below the 0.05 level of significance, indicating that the relationship was statistically significant. This suggested that improvements in employee training, application of acquired knowledge, and effective monitoring of cold chain activities were associated with better cold supply chain performance. Therefore, the findings demonstrated that green training and monitoring practices were significantly and positively associated with cold supply chain performance at RMS.

4.1.4. Multiple Regression Analysis

Multiple regression analysis was conducted to examine the effect of green training and monitoring practices on cold supply chain performance at Rwanda Medical Supply (RMS). The analysis aimed to determine the extent to which green training and monitoring practices predicted changes in cold supply chain performance. The coefficient of determination (R^2) was used to assess the proportion of variation in cold supply chain performance explained by the predictor variables. The regression coefficients, t-values, and significance levels were also considered to establish the direction and statistical significance of the relationship. A significance level of 0.05 was applied when interpreting the regression result.

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.761	0.579	0.575	0.412

a. Predictors: (Constant), green training and monitoring practices

The model summary in Table 3 indicated an R-value of 0.761, showing a strong positive relationship between green training and monitoring practices and cold supply chain performance. The R Square value of 0.579 indicated that green training and monitoring practices explained 57.9% of the variation in cold supply chain performance. The adjusted R Square of 0.575 showed that the explanatory power of the model remained at 57.5% after adjustment. The standard error of the estimate was 0.412, indicating the average prediction error of the regression model. These findings suggested that green training and monitoring practices played an important role in explaining variations in cold supply chain performance at Rwanda Medical Supply.

Table 4: ANOVA Results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	43.616	1	43.616	145.82	<0.001
	Residual	32.001	107	0.299	—	—
	Total	75.617	108	—	—	—

a. Dependent Variable: cold supply chain performance

b. Predictors: (Constant), green training and monitoring practices

Table 4 presents the ANOVA results for the regression model examining the effect of green training and monitoring practices on cold supply chain performance at Rwanda Medical Supply. The findings showed that the regression model was statistically significant ($F = 145.82$, $p < 0.001$), indicating that green training and monitoring practices had a statistically significant effect on cold supply chain performance. The regression sum of squares was 43.616, while the residual sum of squares was 32.001, out of a total sum of squares of 75.617. Since the significance value was below the 0.05 threshold, the null hypothesis was rejected. This suggested that improvements in green training and monitoring practices were associated with improvements in cold supply chain performance at Rwanda Medical Supply**.**

4.2. Discussion of Findings

The findings revealed that green training and monitoring practices played an important role in improving cold supply chain performance at Rwanda Medical Supply (RMS). Respondents highly agreed that combining employee training with effective monitoring contributed to better cold supply chain operations. The findings further showed that effective temperature monitoring helped reduce medical product wastage, while regular monitoring of cold chain requirements supported the maintenance of appropriate storage conditions. Employees also acknowledged the importance of training in the proper handling of temperature-sensitive products and applying acquired knowledge in their daily responsibilities. These findings demonstrated that employee competence and continuous monitoring were important in maintaining product quality, reducing losses, and improving the reliability of medical supply operations.

The findings were supported by the Green Supply Chain Management (GSCM) Theory, which guided this study. The theory explains that organisations integrate environmental considerations into supply chain activities to promote sustainability and improve operational performance. In relation to this study, green training enabled employees to acquire environmental knowledge and practical skills, while monitoring practices encouraged compliance with appropriate operational and environmental procedures. The findings therefore demonstrated how employee development and continuous monitoring supported sustainable cold supply chain operations at RMS. This was consistent with Jain et al. (2024), who explained the importance of integrating environmental considerations into supply chain management, and Govindan et al. (2024), who highlighted the relevance of sustainability in supply chain operations.

The findings were also consistent with Aguma et al. (2024), who highlighted the importance of employee training in strengthening vaccine cold chain management. Their study demonstrated that training improved the knowledge and practices of personnel responsible for handling temperature-sensitive products. Similarly, Feyisa et al. (2021) emphasised the importance of appropriate cold chain management practices in preserving the quality of temperature-sensitive pharmaceuticals. These studies supported the present findings by demonstrating that employee knowledge, proper handling procedures, and effective monitoring were essential for maintaining reliable cold supply chain operations.

Furthermore, the findings indicated that temperature monitoring systems were effectively used and that employees recognised the importance of reporting and correcting deviations in storage conditions. This suggested that monitoring practices supported the early identification of problems and enabled corrective action to protect medical products. These findings agreed with the Rwanda Food and Drugs Authority (Rwanda FDA, 2024), which emphasised appropriate temperature monitoring, equipment maintenance, and compliance with good storage and distribution practices. The findings also supported the World Health Organization (WHO, 2025), which emphasised the importance of sustainable practices and responsible resource utilisation in healthcare supply chains.

Moreover, the findings showed that training on environmental sustainability practices recorded the lowest mean among the statements, although respondents still expressed a high level of agreement. This indicated that, despite the positive implementation of green training and monitoring practices, additional attention was needed to strengthen employees' environmental sustainability awareness. This finding was consistent with Gelagay and Werke (2024), who established that green human resource management practices, including employee training and development, contributed to the implementation of internal green supply chain practices and improved operational performance. The GSCM Theory further supported this finding by emphasising the integration of environmental awareness and sustainable practices into organisational operations. Therefore, continuous employee training, effective temperature monitoring, and timely correction of

storage deviations remained important for strengthening cold supply chain performance at RMS.

Overall, the findings, empirical studies, and GSCM Theory established that green training and monitoring practices were important contributors to cold supply chain performance at Rwanda Medical Supply. The study highlighted the importance of strengthening continuous staff training, improving environmental sustainability awareness, ensuring effective temperature monitoring, and encouraging employees to report and correct storage deviations. These practices supported the preservation of medical product quality, reduction of wastage, and improvement of operational efficiency in the cold supply chain.

5. Conclusion and Recommendations

This section presents the conclusions drawn from the study findings and provides recommendations for improving green training and monitoring practices to enhance cold supply chain performance at Rwanda Medical Supply.

5.1 Conclusion

The study concluded that green training and monitoring practices played an important role in improving cold supply chain performance at Rwanda Medical Supply (RMS). The findings demonstrated that regular employee training, proper handling of temperature-sensitive medical products, environmental sustainability awareness, and application of acquired knowledge contributed to effective cold chain operations. The study also established that effective temperature monitoring, regular compliance checks, and timely reporting and correction of storage deviations supported the preservation of medical product quality and reduction of wastage. Furthermore, the findings highlighted the importance of combining employee training with continuous monitoring to improve operational efficiency and reliability. Guided by Green Supply Chain Management Theory, the study concluded that strengthening employees' environmental knowledge, practical skills, and monitoring practices was essential for promoting sustainable operations and enhancing cold supply chain performance at Rwanda Medical Supply.

5.2 Recommendations

Based on the study findings, the following recommendations were proposed to improve green training and monitoring practices and enhance cold supply chain performance at Rwanda Medical Supply.

1) Rwanda Medical Supply should organize regular training programmes on green supply chain practices, environmental sustainability, and the proper handling of temperature-sensitive medical products to improve employees' knowledge and practical skills.
2) The institution should strengthen employee awareness of environmental sustainability through refresher training, workplace guidance, and practical activities that encourage the application of environmentally responsible practices in daily operations.
3) Rwanda Medical Supply should strengthen the use of reliable temperature monitoring systems in storage and transportation facilities to ensure that temperature-sensitive medical products are maintained under recommended conditions.
4) The institution should establish effective procedures for reporting, documenting, and correcting temperature deviations and other storage problems to minimize medical product wastage and maintain product quality

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