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Designing an Environmental Accounting Model with an Emphasis on Waste Management to Improve Performance Sustainability (Case Study: Hospitals Affiliated with the Ministry of Health)

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A B S T R A C T

The aim of this research is to design an environmental accounting model with an emphasis on waste management to improve performance sustainability (Case Study: Hospitals Affiliated with the Ministry of Health). The research method is mixed, qualitative and quantitative; first, qualitative data were collected. Then, based on the findings from the qualitative phase, a tool was constructed to facilitate the collection and generalization of quantitative data. To obtain qualitative data, 16 elites, accounting professors, accountants, managers, and physicians from hospitals affiliated with the Ministry of Health were selected using purposive sampling of the snowball type. Data collection was conducted through semi-structured interviews and open-ended questions. Using a thematic analysis approach and based on the findings of this stage, the environmental accounting model with an emphasis on waste management to improve performance sustainability (Case Study: Hospitals Affiliated with the Ministry of Health) was formulated. Subsequently, to explain the model based on the findings of the qualitative method, a preliminary questionnaire was designed for the quantitative section. The validity and reliability of this instrument were reviewed by consulting experts and managers, and it was approved after necessary modifications. The statistical population in the quantitative section consisted of accountants, managers, and physicians in hospitals affiliated with the Ministry of Health, totaling 106,396 individuals. A statistical sample of 383 individuals was selected using the Cochran formula and distributed and collected via stratified random sampling. The analysis and processing of quantitative data were performed using PLS software. Based on the resulting paradigmatic model, components related to environmental accounting with an emphasis on waste management to improve the performance sustainability of hospitals were identified in six categories of causal factors including 6 components; factors affecting environmental accounting with 3 dimensions (strategic indicators, uncertainty indicators, commitment indicators of decision-makers and senior management); environmental accounting with 3 dimensions (social legitimacy, accounting information system, control and supervision); waste management with 6 dimensions (waste segregation at the source

of generation, waste collection from departments, waste transportation, temporary waste storage, waste disposal, human resource status); factors affecting performance sustainability with 7 indicators; performance sustainability with 4 indicators; and consequences of environmental accounting with an emphasis on waste management to improve performance sustainability with 3 dimensions (improvement and optimization of environmental processes with an emphasis on waste management, cooperation with the HSE (Health, Safety, and Environment) department, financial consequences).

Keywords: *Environmental Accounting, Waste Management, Performance Sustainability, Ministry of Health Hospitals.*

1. Introduction

In the contemporary landscape of global business and organizational management, the imperative for sustainable development has transcended mere regulatory compliance to become a central pillar of strategic planning and operational excellence. As societies grapple with the escalating consequences of environmental degradation, resource depletion, and climate change, organizations across various sectors are under increasing pressure to reconfigure their operational frameworks. This shift necessitates a transition from traditional financial-centric management models to holistic approaches that integrate environmental, social, and economic dimensions. Within this paradigm, the role of accounting systems has evolved significantly. No longer confined to the recording of financial transactions, modern accounting must encompass the broader spectrum of organizational impacts, particularly those pertaining to the natural environment. This evolution has given rise to Environmental Accounting (EA) as a crucial instrument for identifying, measuring, and disclosing environmental information, thereby enabling organizations to manage their ecological footprint while ensuring economic viability (Faieq & Cek, 2024; Sukkari, 2025).

The integration of environmental considerations into accounting practices is not merely a technical adjustment but represents a fundamental transformation in how organizations perceive their relationship with the natural world and society. Green Management and Environmental Accounting provide the necessary infrastructure for organizations to internalize environmental costs that have historically been externalized to the broader community (Mazaheritehrani et al., 2023). By recognizing these costs, organizations can make more informed decisions regarding resource allocation, process optimization, and investment in cleaner technologies. This is particularly relevant in the context of public organizations and large-scale service providers, where the mandate extends beyond profit maximization to include social welfare and stewardship of public resources. The Model of Green Management for Iranian public organizations, for instance, underscores the necessity of embedding environmental values into the core administrative fabric, suggesting that sustainability is inextricably linked to efficient and ethical management (Mazaheritehrani et al., 2023).

A critical aspect of environmental management that demands rigorous accounting attention is waste management. Inefficient waste handling not only results in direct financial losses through the disposal of potentially useful materials but also imposes significant environmental and health costs. From the perspective of the Theory of Constraints (TOC), waste—whether normal or abnormal—represents a bottleneck that hinders the flow of value and reduces overall system throughput. Recent investigations into tire manufacturing companies have demonstrated that applying the Theory of Constraints can significantly reduce both normal and abnormal waste, thereby enhancing operational efficiency and cost recovery (Sarhadi, 2025; Sarhadi, 2026). These findings highlight the synergy between operational management theories and environmental accounting. By treating waste as a constraint to be managed rather than an inevitable cost of doing business, organizations can unlock substantial value. The reduction of waste through TOC principles illustrates how strategic management accounting can drive environmental improvements while simultaneously bolstering the bottom line (Sarhadi, 2026).

Furthermore, the strategic deployment of Accounting Information Systems (AIS) is pivotal in facing environmental drivers. As organizations strive to develop their Strategic Management Accounting capabilities, the application of advanced AIS becomes indispensable. These systems facilitate the collection, processing, and reporting of vast amounts of environmental data, transforming raw inputs into actionable strategic intelligence (Khalilpour et al., 2025). The ability to trace environmental costs back to specific activities or products allows for precise cost control and performance evaluation. In this regard, the development

of Strategic Management Accounting through the application of AIS enables organizations to navigate the complex landscape of environmental regulations and market pressures with greater agility and foresight (Khalilpour et al., 2025). It empowers managers to identify trade-offs between environmental performance and financial results, fostering a culture of continuous improvement.

The relevance of Environmental Management Accounting (EMA) is particularly pronounced in the manufacturing sector, where the physical scale of operations often correlates with significant environmental impacts. Studies examining large manufacturing firms in Thailand have identified the use, motivations, and barriers to EMA practices, revealing that while the adoption of these practices is growing, challenges remain regarding standardization and integration into existing management systems (Suranatthakul & Intanon, 2024). Similarly, research focusing on Kurdistan's manufacturing companies has emphasized the role of Corporate Social Responsibility (CSR) and environmental auditing oversight in enhancing sustainable waste management (Faieq & Cek, 2024). A norm activation approach suggests that when organizations and their decision-makers feel a personal obligation to act pro-environmentally, they are more likely to engage in green accounting practices and rigorous environmental auditing (Faieq & Cek, 2024). This psychological and ethical dimension complements the technical aspects of accounting, suggesting that sustainable outcomes require both robust systems and a commitment to organizational values.

In the service sector and growing cities of developing economies, the dynamics of environmental management accounting take on a different complexion. Critical environmental management accounting practices are essential for influencing service delivery, where the direct "product" may be intangible, but the environmental footprint of service delivery infrastructure is substantial (Mukwarami & van der Poll, 2024). A review and conceptual framework for these contexts indicate that EMA practices can lead to improved service efficiency, reduced operational costs, and enhanced community well-being (Mukwarami & van der Poll, 2024). This reinforces the notion that environmental accounting is not the exclusive domain of heavy industry but is equally vital for organizations whose primary function is service provision. By quantifying the environmental costs associated with service delivery, organizations can identify inefficiencies and implement measures that promote sustainability without compromising service quality.

The transparency afforded by robust environmental accounting and reporting mechanisms also plays a crucial role in shaping external perceptions and securing the legitimacy of the organization. Corporate transparency and environmental reporting have emerged as key trends that offer significant benefits, including improved investor confidence and enhanced corporate reputation (Sari & Muslim, 2024). In the Nigerian context, for example, it has been observed that environmental information disclosures in annual reports are instrumental in gaining investors' confidence (Okpo et al., 2024). Investors are increasingly wary of environmental liabilities and view transparent disclosure as a proxy for sound risk management and long-term viability. Consequently, organizations that prioritize environmental reporting are often rewarded with greater access to capital and a more favorable standing in the financial markets (Okpo et al., 2024). This dynamic creates a powerful incentive for organizations to adopt and maintain high standards of environmental accounting and disclosure.

Moreover, the governance structures surrounding environmental accounting are critical for ensuring its integrity and effectiveness. The interplay between internal control, environmental accounting, and auditing forms a triad that supports the transition toward a greener future (Sukkari, 2025). Effective internal controls ensure that environmental data is accurate and reliable, while environmental auditing provides independent verification of the organization's environmental claims. This governance framework is essential for mitigating the risks of greenwashing and for ensuring that environmental accounting data serves as a genuine basis for decision-making (Sukkari, 2025). As organizations face increasing scrutiny from regulators, investors, and the public, the robustness of their internal governance mechanisms regarding environmental matters becomes a key determinant of their overall success.

The role of auditors themselves is evolving in response to these environmental imperatives. Social Role Theory suggests that the expectations placed on auditors extend beyond financial statement verification to include a consideration of the organization's environmental stewardship (Wang & Smith, 2025). A multinational study on auditor environmental accountability indicates that auditors are increasingly expected to assess and report on environmental risks and performance, reflecting a broader societal demand for corporate accountability (Wang & Smith, 2025). This shift necessitates a re-evaluation of the auditor's skill set and the scope of the audit engagement,

integrating environmental expertise into the core audit function. The alignment of auditor accountability with environmental objectives further solidifies the importance of environmental accounting as a central discipline in modern business management.

While the financial and operational benefits of environmental accounting are clear, the implications for financial markets and asset valuation are also significant. Environmental factors can exert a profound influence on the movement of stock prices across different levels. Research utilizing fuzzy techniques to identify these factors has shown that environmental performance and risks are priced into equity markets, affecting the valuation of firms (Hosseinpour et al., 2024). Investors are increasingly factoring environmental sustainability into their valuation models, recognizing that companies with poor environmental performance may face future costs, regulatory penalties, or reputational damage that could erode shareholder value (Hosseinpour et al., 2024). This market discipline serves as another external driver for the adoption of environmental accounting, as organizations seek to manage their environmental profile to maintain or enhance their market capitalization.

In the specific context of healthcare, the application of environmental accounting principles is both urgent and complex. Hospitals are resource-intensive entities that generate significant amounts of waste, including hazardous materials that require specialized handling and disposal. The management of hospital waste is not only an operational challenge but a critical public health issue. Designing a model for waste management accounting, as explored in previous studies, provides a blueprint for capturing the full costs associated with hospital waste generation and management (Jamal Livani et al., 2023). Such a model enables hospital administrators to track the flow of waste from the point of generation to final disposal, identifying opportunities for reduction, recycling, and safer treatment (Jamal Livani et al., 2023). By applying environmental accounting techniques to hospital waste management, healthcare providers can improve their sustainability performance, reduce the risk of infection and contamination, and achieve significant cost savings.

The intersection of environmental accounting and waste management in hospitals offers a unique opportunity to enhance performance sustainability. Performance sustainability in this context refers to the ability of the hospital to maintain high standards of patient care and operational efficiency over the long term, without degrading the environmental resource base upon which it depends. This requires a systemic approach that links the strategic objectives of the hospital with its waste management practices. The literature suggests that aligning organizational strategic objectives with sustainable development goals is a critical step in this process (Mazaheritehrani et al., 2023). For hospitals, this means integrating waste management into the core strategic planning process, rather than treating it as a peripheral support function.

Furthermore, the concept of legitimacy is central to the adoption of environmental accounting in hospitals. As public institutions, hospitals rely on the trust and support of the communities they serve. Failure to manage waste effectively can lead to a loss of social legitimacy and public confidence. Environmental accounting provides the tools needed to demonstrate transparency and accountability in waste management practices, thereby reinforcing the hospital's social license to operate (Faieq & Cek, 2024). The norm activation of hospital administrators and staff—triggering a sense of moral obligation to protect the environment—can drive the implementation of green accounting systems and rigorous environmental audits (Faieq & Cek, 2024). This cultural shift is essential for the long-term success of any sustainability initiative.

The application of the Theory of Constraints to hospital waste management can yield significant insights. By identifying the bottlenecks in the waste management process—such as insufficient segregation at the source, inadequate storage facilities, or inefficient transportation logistics—hospitals can implement targeted interventions to improve flow and reduce waste (Sarhadi, 2025; Sarhadi, 2026). For example, improving segregation at the source reduces the volume of hazardous waste that requires expensive treatment, while optimizing collection schedules reduces the labor and fuel costs associated with waste transport. These operational improvements, driven by accounting data, contribute directly to the sustainability of the hospital's performance.

Moreover, the integration of Accounting Information Systems is crucial for managing the complex data requirements of hospital waste management. An effective AIS can track waste generation by department, monitor compliance with regulations, and calculate the environmental costs of different waste streams (Khalilpour et al., 2025). This information is vital for benchmarking performance, identifying best practices, and setting targets for improvement. The strategic use of this data enables hospital managers to move beyond reactive compliance to

proactive environmental management, optimizing processes to reduce both environmental impact and operational costs (Khalilpour et al., 2025).

Despite the clear benefits, the adoption of environmental accounting in hospitals faces barriers, similar to those observed in other sectors. These may include a lack of awareness, resistance to change, insufficient technical expertise, and the perceived high cost of implementation (Suranatthakul & Intanon, 2024). Overcoming these barriers requires strong leadership, a commitment to training and development, and the establishment of clear policies that mandate environmental accounting and reporting. The role of internal control and auditing is particularly important in overcoming these challenges, ensuring that the systems put in place are robust and that the data generated is reliable (Sukkari, 2025).

In conclusion, the literature establishes a compelling case for the integration of environmental accounting into the management of hospital waste. The convergence of strategic management accounting, the Theory of Constraints, and green management principles provides a rich theoretical foundation for this endeavor. By leveraging Accounting Information Systems and adhering to strong governance frameworks, hospitals can transform their waste management practices from a cost center into a driver of performance sustainability. The potential benefits range from cost savings and operational efficiency to enhanced public health outcomes and strengthened institutional legitimacy. Therefore, building upon the existing body of knowledge regarding environmental accounting, waste management, and organizational sustainability, this study aims to design an environmental accounting model with an emphasis on waste management to improve performance sustainability in hospitals affiliated with the Ministry of Health.

2. Methods and Materials

The execution method of the present research is mixed (an exploratory sequential type). Mixed methods research is a method that emphasizes combining qualitative and quantitative approaches in all stages of research to achieve a precise study. Data collection was conducted using a mixed method; in the qualitative section, the components of environmental accounting with an emphasis on waste management to improve performance sustainability were collected based on existing foundations and with the assistance of respected professors and experts to reach a consensus regarding the influential and intervening variables on the subject. In the quantitative section, data collection involved distributing and collecting questionnaires among accountants, managers, and physicians in hospitals affiliated with the Ministry of Health. Regarding tools and data collection methods, semi-structured interviews were used in the qualitative section, and questionnaires were utilized in the quantitative section.

The statistical population in the qualitative phase consisted of elites (accounting professors, accountants, managers, and physicians in hospitals affiliated with the Ministry of Health). For an in-depth examination of the research subject, 16 individuals associated with the fields of accounting, medicine, and hospital waste were selected using purposive or snowball sampling. After conducting interviews and identifying components in the qualitative phase, in the quantitative phase, several specialists in this field were consulted to validate the model. Following three stages of sending questionnaires to specialists, the components of environmental accounting with an emphasis on waste management to improve performance sustainability were identified, as listed below. Through these stages, a preliminary model and a questionnaire were designed. To ensure the reliability of the designed questionnaire, content validity ratio (CVR) and content validity index (CVI) were used, resulting in a final set of 120 questions. The statistical population in the quantitative phase included accountants, managers, and physicians in hospitals affiliated with the Ministry of Health, totaling 106,396 individuals. Considering the Cochran formula, a sample size of 383 individuals was determined.

3. Findings and Results

According to the table above regarding the description of variables related to the environmental accounting model with an emphasis on waste management to improve the performance sustainability of hospitals, since a 5-option Likert scale was used to answer the questionnaire in this research, the mean value of 3 is considered the midpoint and serves as a criterion. Given that the mean of all dimensions is higher than this midpoint, these dimensions are regarded as being at an average level within the statistical population.

Table 1

Frequency Distribution of Research Variables

Variables	Components	Question Numbers	Mean	Standard Deviation	Minimum	Maximum
Factors Affecting Environmental Accounting	Strategic Indicators	1-6	3.33	1.19	1.00	5.00
	Uncertainty Indicators	7-18	3.57	1.10	1.00	5.00
	Commitment Indicators of Decision-Makers and Senior Management	19-41	3.58	1.25	1.00	5.00
Environmental Accounting	Social Legitimacy	42-53	3.69	1.21	1.00	5.00
	Accounting Information System	54-61	3.72	1.06	1.00	5.00
	Control and Supervision	62-69	3.69	1.26	1.00	5.00
Waste Management	Waste Segregation at Source	70-73	3.67	1.04	1.00	5.00
	Waste Collection from Departments	74-77	3.67	1.22	1.00	5.00
	Waste Transportation	78-82	3.69	1.17	1.00	5.00
	Temporary Waste Storage	83-85	3.54	1.29	1.00	5.00
	Waste Disposal	86-92	3.56	1.25	1.00	5.00
	Human Resource Status	93-96	3.62	1.23	1.00	5.00
Factors Affecting Performance Sustainability		97-102	3.55	1.20	1.00	5.00
Performance Sustainability		103-106	3.71	1.21	1.00	5.00
Consequences of Environmental Accounting with Emphasis on Waste Management to Improve Performance Sustainability	Improvement and Optimization of Environmental Processes with Emphasis on Waste Management	107-112	3.72	1.17	1.00	5.00
	Cooperation with HSE Department (Health, Safety, and Environment)	113-117	3.66	1.29	1.00	5.00
	Financial Consequences	118-120	3.52	1.29	1.00	5.00

According to Table 2, since the significance level for all variables is higher than the error value of 0.05, all research variables are normally distributed.

Table 2

Normality Test for Research Variables

Variables	Components	Question Numbers	Test Statistic	Significance Level
Factors Affecting Environmental Accounting	Strategic Indicators	1-6	1.461	0.098
	Uncertainty Indicators	7-18	2.316	0.124
	Commitment Indicators of Decision-Makers and Senior Management	19-41	1.068	0.095
Environmental Accounting	Social Legitimacy	42-53	1.456	0.086
	Accounting Information System	54-61	1.913	0.098
	Control and Supervision	62-69	2.982	0.191
Waste Management	Waste Segregation at Source	70-73	2.535	0.101
	Waste Collection from Departments	74-77	2.194	0.112
	Waste Transportation	78-82	1.658	0.094
	Temporary Waste Storage	83-85	1.098	0.097
	Waste Disposal	86-92	1.984	0.091
	Human Resource Status	93-96	1.768	0.097
Factors Affecting Performance Sustainability		97-102	1.458	0.128
Performance Sustainability		103-106	1.641	0.092
Consequences of Environmental Accounting with Emphasis on Waste Management to Improve Performance Sustainability	Improvement and Optimization of Environmental Processes with Emphasis on Waste Management	107-112	1.164	0.109
	Cooperation with HSE Department (Health, Safety, and Environment)	113-117	2.216	0.141
	Financial Consequences	118-120	2.194	0.150

As indicated in Table 3, the composite reliability and Cronbach's alpha for all variables related to the model are above 0.70 for each construct; consequently, all constructs in the measurement model are confirmed. The communality (shared reliability) of all variables in the model is above 0.50, which itself indicates high reliability of the model, and all extracted average variance extracted (AVE) values are greater than 0.50; furthermore, CR > AVE. Therefore, this research possesses adequate discriminant validity.

Table 3

Values of Composite Reliability, Cronbach's Alpha, and Convergent Validity for the Measurement Model of Environmental Accounting with Emphasis on Waste Management to Improve Performance Sustainability

Variables	Components	Questions	Cronbach's Alpha	Composite Reliability	Communality	Convergent Validity (AVE)
Factors Affecting Environmental Accounting	Strategic Indicators	1-6	0.922	0.939	0.928	0.722
	Uncertainty Indicators	7-18	0.964	0.968	0.968	0.719
	Commitment Indicators of Decision-Makers and Senior Management	19-41	0.986	0.987	0.988	0.767
Environmental Accounting	Social Legitimacy	42-53	0.971	0.974	0.973	0.759
	Accounting Information System	54-61	0.922	0.937	0.940	0.655
	Control and Supervision	62-69	0.961	0.967	0.962	0.789
Waste Management	Waste Segregation at Source	70-73	0.841	0.883	0.886	0.657
	Waste Collection from Departments	74-77	0.925	0.947	0.930	0.818
	Waste Transportation	78-82	0.924	0.943	0.934	0.767
	Temporary Waste Storage	83-85	0.888	0.931	0.888	0.817
	Waste Disposal	86-92	0.953	0.961	0.956	0.782
	Human Resource Status	93-96	0.921	0.944	0.922	0.809
Factors Affecting Performance Sustainability		97-102	0.940	0.953	0.942	0.770
Performance Sustainability		103-106	0.909	0.936	0.936	0.784
Consequences of Environmental Accounting with Emphasis on Waste Management to Improve Performance Sustainability	Improvement and Optimization of Environmental Processes with Emphasis on Waste Management	107-112	0.938	0.951	0.944	0.765
	Cooperation with HSE Department	113-117	0.930	0.947	0.932	0.782
	Financial Consequences	118-120	0.917	0.947	0.919	0.857

To assess the quality of the measurement model, the CV_com index was used. Since in Table 3, the average CV_com of the variables in the research measurement model is greater than 0.39 and very close to one, this indicates the high predictive power of the model. Considering the three values of 0.01, 0.25, and 0.35, which are introduced as weak, medium, and strong for Goodness of Fit (GOF), and obtaining 0.814 for the quality of the overall structural model in this research, it indicates a very appropriate and strong model fit.

Table 4

Results of the Measurement Model Quality and Structural Model Quality Test

Variables	**Components**	**Questions**	**Communality Validity Index (CV-com)**	**CV Red Value**
Factors Affecting Environmental Accounting	Strategic Indicators	1-6	0.612	0.583
	Uncertainty Indicators	7-18	0.641	0.622
	Commitment Indicators of Decision-Makers and Senior Management	19-41	0.704	0.699
Environmental Accounting	Social Legitimacy	42-53	0.699	0.670
	Accounting Information System	54-61	0.580	0.523
	Control and Supervision	62-69	0.724	0.677
Waste Management	Waste Segregation at Source	70-73	0.402	0.424
	Waste Collection from Departments	74-77	0.732	0.638
	Waste Transportation	78-82	0.644	0.611
	Temporary Waste Storage	83-85	0.662	0.561
	Waste Disposal	86-92	0.703	0.674
	Human Resource Status	93-96	0.710	0.623
Factors Affecting Performance Sustainability		97-102	0.640	
Performance Sustainability		103-106	0.639	0.590
Consequences of Environmental Accounting with Emphasis on Waste Management to Improve Performance Sustainability	Improvement and Optimization of Environmental Processes with Emphasis on Waste Management	107-112	0.680	0.636
	Cooperation with HSE Department	113-117	0.684	0.629
	Financial Consequences	118-120	0.729	0.621

To test the measurement model, two criteria are used: weight significance. These are referred to in Diagrams 1 and 2. According to the diagrams, since the weight significance value obtained for all questions is greater than 2.58, consequently, with a 99% confidence level, the status of the questions is favorable, and none of the questions are eliminated.

After ensuring the sufficiency of the research data for factor analysis, it is necessary to ensure the validity of the measurement models of the research variables. Therefore, the measurement models of these variables are presented in order below. This analysis was performed using structural equation modeling and the PLS statistical software. The following diagrams show the measurement model of the research variables in the standard estimation mode and significance coefficients. In confirmatory factor analysis, it is first necessary to examine the construct validity to determine whether the selected indicators for measuring the intended constructs possess the necessary accuracy. Specifically, the factor loading of each indicator with its construct should have a t-value greater than 1.96 at the 0.05 level and 2.58 at the 0.01 level, and be positive. In this case, the indicator has the necessary accuracy to measure that construct or latent trait.

Figure 1

Software Output Regarding Standard Estimation Coefficients of the Variable Measurement Model

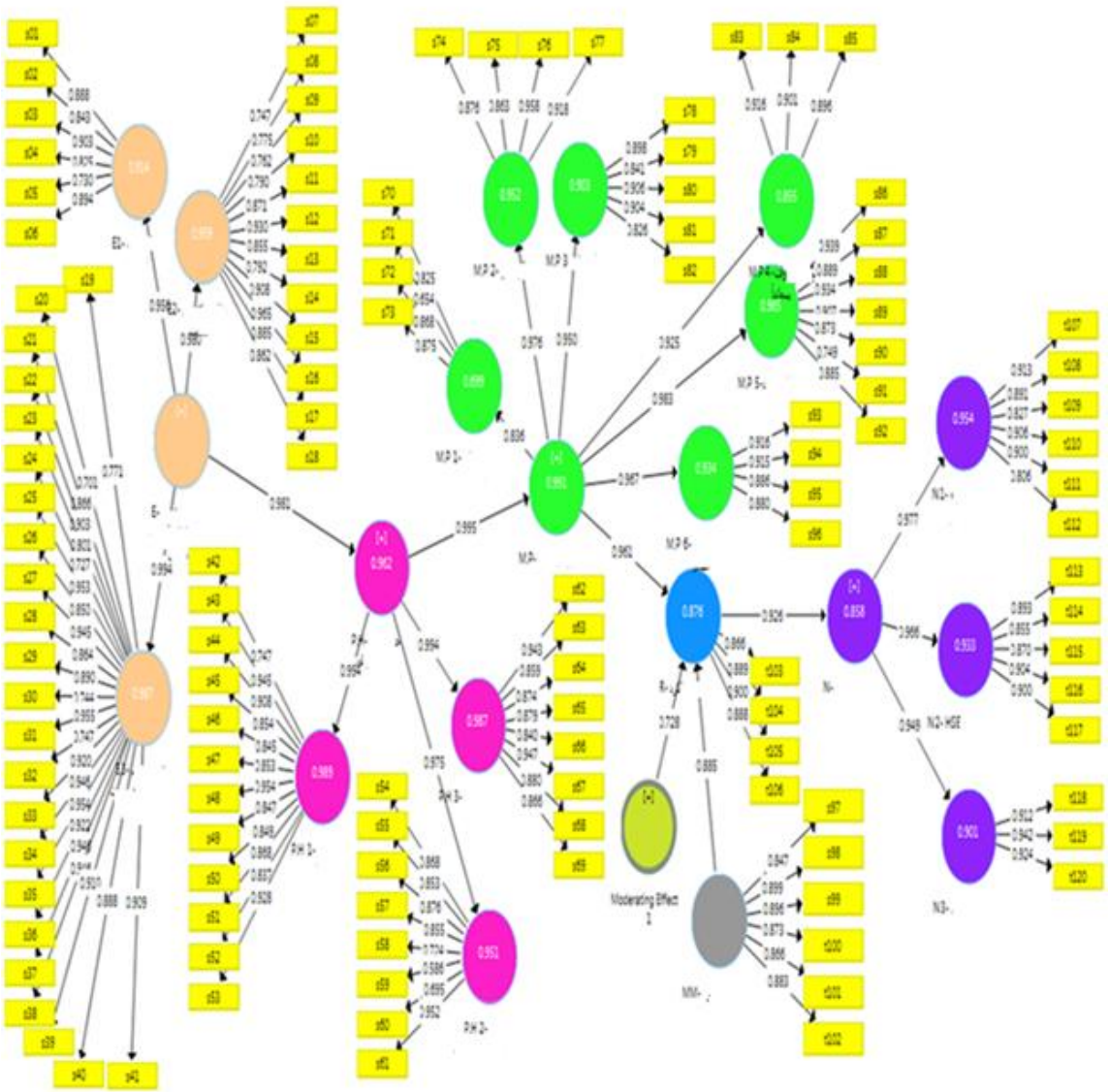
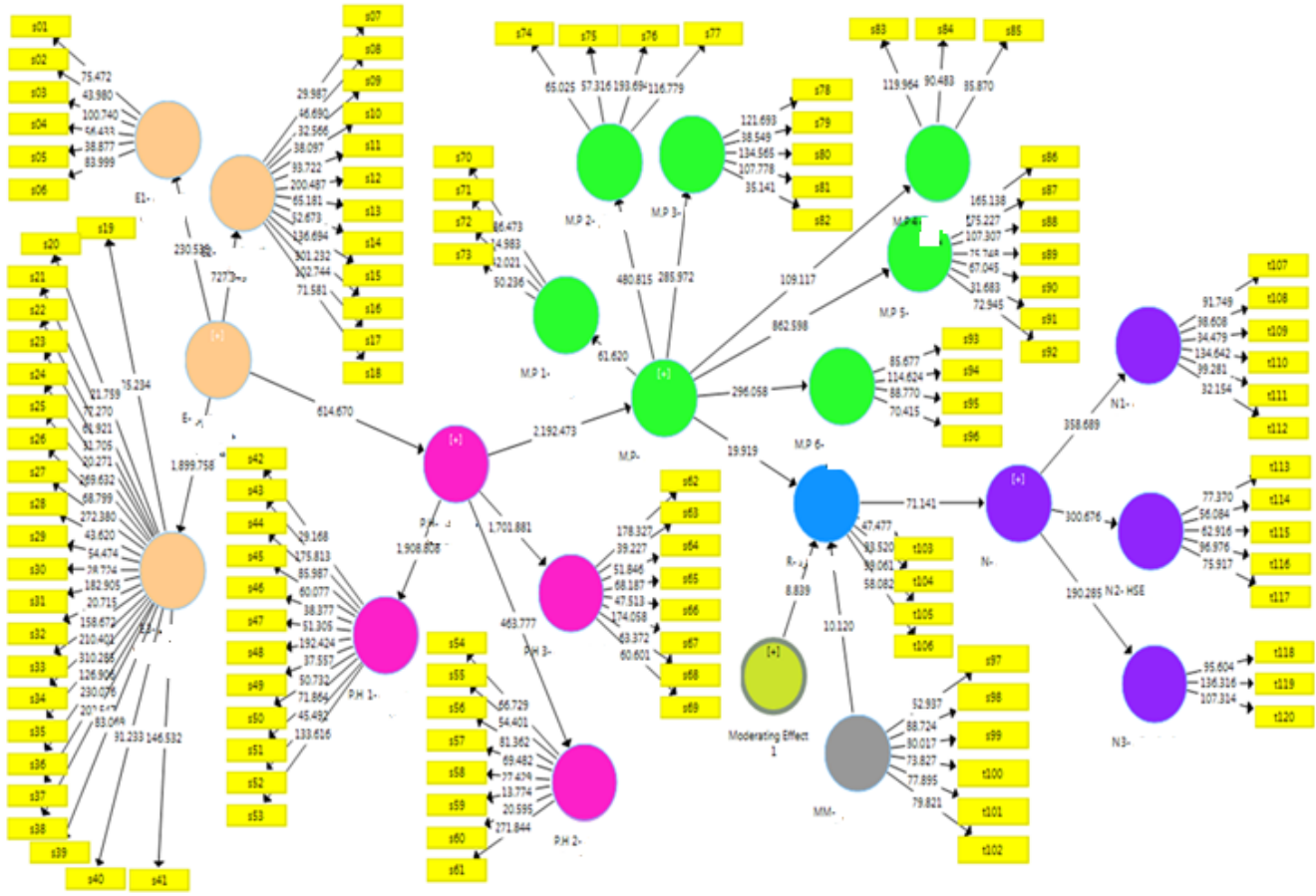


Figure 2

Software Output Regarding Significance Coefficients (t-scores) of the Variable Measurement Model



In the table below, based on the relationships stated in Diagrams (1 and 2), the effect coefficients, t-value, and R2 value of the drawn paths are presented:

Table 5

Effect Coefficients and t-values Related to the Paths of the Environmental Accounting Model with Emphasis on Waste Management to Improve Performance Sustainability of Hospitals

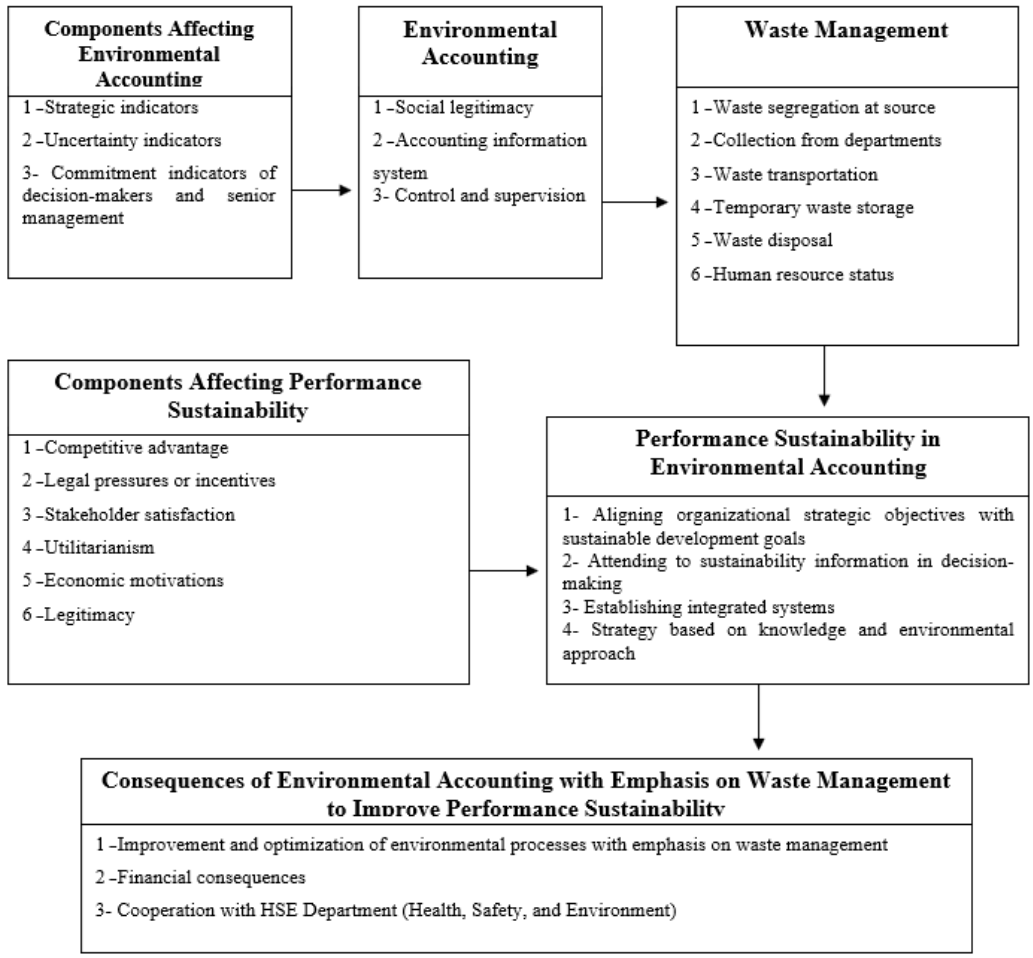
Path	t	Standard Coefficient	p	Result
Components Affecting Environmental Accounting -> Hospital Environmental Accounting	614.670	0.981	0.000	Confirmed
Components Affecting Environmental Accounting -> Social Legitimacy	582.197	0.975	0.000	Confirmed
Components Affecting Environmental Accounting -> Accounting Information System	331.565	0.957	0.000	Confirmed
Components Affecting Environmental Accounting -> Control and Supervision	520.181	0.975	0.000	Confirmed
Environmental Accounting -> Hospital Waste Management	2192.473	0.995	0.000	Confirmed
Environmental Accounting -> Waste Segregation at Source	61.250	0.832	0.000	Confirmed
Environmental Accounting -> Waste Collection from Departments	461.696	0.971	0.000	Confirmed
Environmental Accounting -> Waste Transportation	267.227	0.946	0.000	Confirmed
Environmental Accounting -> Temporary Waste Storage	107.492	0.920	0.000	Confirmed
Environmental Accounting -> Waste Disposal	750.517	0.978	0.000	Confirmed
Environmental Accounting -> Human Resource Status	288.541	0.962	0.000	Confirmed
Hospital Waste Management -> Performance Sustainability	19.919	0.961	0.000	Confirmed

Factors Affecting Performance Sustainability -> Performance Sustainability	10.120	0.885	0.000	Confirmed
Factors Affecting Performance Sustainability -> Consequences of Environmental Accounting with Emphasis on Waste Management to Improve Performance Sustainability	16.907	0.928	0.000	Confirmed
Factors Affecting Performance Sustainability -> Improvement and Optimization of Environmental Processes with Emphasis on Waste Management	9.249	0.903	0.000	Confirmed
Factors Affecting Performance Sustainability -> Cooperation with HSE Department (Health, Safety, and Environment)	8.093	0.896	0.000	Confirmed
Factors Affecting Performance Sustainability -> Financial Consequences	8.172	0.884	0.000	Confirmed
Performance Sustainability -> Consequences of Environmental Accounting with Emphasis on Waste Management to Improve Performance Sustainability	71.728	0.926	0.000	Confirmed
Performance Sustainability -> Improvement and Optimization of Environmental Processes with Emphasis on Waste Management	65.202	0.905	0.000	Confirmed
Performance Sustainability -> Cooperation with HSE Department (Health, Safety, and Environment)	66.357	0.895	0.000	Confirmed
Performance Sustainability -> Financial Consequences	63.611	0.879	0.000	Confirmed
Factors Affecting Performance Sustainability (Intervening Factors) -> Hospital Waste Management -> Performance Sustainability	8.839	0.728	0.000	Confirmed

According to the results obtained in the table above, since the t-value for all questions is higher than 1.96, it can be stated with 95% confidence that all paths are confirmed. Therefore, all paths mentioned in the table are confirmed.

Figure 3

Environmental Accounting Model with Emphasis on Waste Management to Improve Performance Sustainability of Hospitals



4. Discussion and Conclusion

The results of this study provide a comprehensive empirical validation of the designed environmental accounting model with an emphasis on waste management to improve performance sustainability in hospitals affiliated with the Ministry of Health. The structural equation modeling analysis confirmed all hypothesized paths, revealing a robust network of relationships between causal factors, environmental accounting, waste management, and performance sustainability. The findings indicate that factors affecting environmental accounting, including strategic indicators, uncertainty indicators, and the commitment of decision-makers and senior management, exert a profound influence on the implementation of environmental accounting systems. This is evidenced by the high path coefficients and significant t-values for the relationships between these causal factors and the dimensions of environmental accounting, namely social legitimacy, accounting information systems, and control and supervision. These results align with the assertions of (Khalilpour et al., 2025), who argued that developing strategic management accounting through the application of accounting information systems is essential for facing environmental drivers. The strong influence of strategic indicators and senior management commitment suggests that environmental accounting is not merely a technical function but a strategic imperative that requires leadership buy-in to be effectively institutionalized within the hospital structure.

Furthermore, the study found that environmental accounting significantly impacts waste management practices. The path from environmental accounting to hospital waste management, as well as to its specific sub-dimensions such as waste segregation at source, collection, transportation, temporary storage, disposal, and human resource status, was confirmed with high coefficients. This suggests that the implementation of robust environmental accounting mechanisms—encompassing social legitimacy, information systems, and control—directly enhances the efficiency and effectiveness of waste management operations. This finding resonates with the work of (Jamal Livani et al., 2023), who designed a model for waste management accounting and emphasized the necessity of accounting frameworks in managing the waste lifecycle. The ability to track and account for waste flows allows hospitals to optimize processes, reduce inefficiencies, and ensure compliance with environmental regulations. The significant impact on "human resource status" within waste management further underscores that environmental accounting systems also play a role in structuring and improving the workforce responsible for sustainability tasks.

The critical role of waste management as a mediator between environmental accounting and performance sustainability was also empirically supported. The results showed that effective waste management significantly leads to improved performance sustainability. This validates the central premise of the study that managing the physical flow of waste is a prerequisite for achieving sustainable operational performance in healthcare settings. This finding is supported by (Faieq & Cek, 2024), whose study on Kurdistan's manufacturing companies highlighted that sustainable waste management, driven by green accounting and environmental auditing oversight, is a key determinant of organizational success. In the hospital context, where waste poses direct health risks, the link between efficient waste management and sustainable performance is even more critical. The reduction of environmental liabilities and the optimization of resource use through better waste management directly contribute to the long-term viability of the hospital.

Additionally, the study identified that factors affecting performance sustainability, including competitive advantage, legal pressures, stakeholder satisfaction, and economic motivations, have a direct and significant impact on performance sustainability itself. This confirms that external and internal motivators are powerful drivers of sustainable outcomes. The results also showed that these factors significantly influence the consequences of environmental accounting, such as the improvement of environmental processes, cooperation with the HSE department, and financial consequences. This aligns with (Mazaheritehrani et al., 2023), whose Green Management Model for Iranian public organizations posits that organizational success depends on aligning internal management structures with external environmental and social pressures. The significant path from these factors to "financial consequences" suggests that addressing sustainability drivers is not merely a cost but leads to tangible economic benefits, reinforcing the business case for environmental accounting.

The analysis of the consequences of environmental accounting revealed that performance sustainability significantly leads to positive outcomes, including the improvement and optimization of environmental processes,

cooperation with the HSE department, and favorable financial consequences. This indicates that the ultimate goal of environmental accounting and waste management is the creation of value, both environmental and financial. The strong relationship between performance sustainability and financial consequences supports the findings of (Okpo et al., 2024), who demonstrated that environmental information disclosures and performance are linked to investor confidence and, by extension, financial stability. While Okpo's study focused on investor confidence, the underlying principle that environmental responsibility correlates with positive financial metrics is consistent with the current findings in the hospital sector. The optimization of processes leads to cost savings, while cooperation with HSE ensures regulatory compliance and risk mitigation, both of which contribute to the financial health of the hospital.

The study also highlighted the mediating role of waste management in the relationship between factors affecting performance sustainability and performance sustainability itself. The path involving factors affecting performance sustainability (intervening factors) leading to waste management and subsequently to performance sustainability was confirmed. This suggests that external pressures and internal motivations for sustainability must be channeled through operational improvements in waste management to realize performance gains. This finding complements the research by (Suranatthakul & Intanon, 2024), who identified motivations and barriers for environmental management accounting in manufacturing firms. The current study extends this by showing that in the service sector (hospitals), the motivation for sustainability is actualized through the concrete management of waste streams.

Moreover, the high loadings for the "control and supervision" dimension of environmental accounting suggest that governance mechanisms are vital. This finding is in line with (Sukkari, 2025), who discussed the interplay of internal control, environmental accounting, and auditing as a governance framework for a greener future. The confirmation of the path from environmental accounting to control and supervision, and its subsequent impact on waste management, indicates that rigorous oversight is a key component of successful environmental accounting implementation. Without adequate control systems, the data generated by environmental accounting cannot be effectively translated into operational improvements.

The significance of "social legitimacy" as a dimension of environmental accounting also warrants discussion. The results showed that factors affecting environmental accounting strongly influence social legitimacy, which in turn is part of the construct that drives waste management. This supports the view that hospitals adopt environmental accounting practices not only for efficiency but also to maintain their social license to operate. This aligns with (Wang & Smith, 2025), who applied Social Role Theory to auditor environmental accountability, suggesting that societal expectations drive organizational behavior. Hospitals, as public trust entities, are under immense pressure to demonstrate environmental responsibility, and the adoption of this model serves as a mechanism to fulfill that social role.

Finally, the application of the Theory of Constraints (TOC) is implicitly supported by the results. The breakdown of waste management into specific components like segregation, collection, and disposal allows for the identification of bottlenecks. The high coefficients for these paths suggest that addressing these specific constraints leads to overall system improvement. This mirrors the findings of (Sarhadi, 2025; Sarhadi, 2026), who found that applying the Theory of Constraints significantly reduces waste in manufacturing. In the hospital model, the focus on specific waste management processes serves a similar function, allowing managers to apply constraint theory to improve the flow of waste and reduce inefficiencies, thereby enhancing overall sustainability. The confirmation of the path from environmental accounting to specific waste management activities validates the use of accounting information to identify and manage these constraints.

This study, while providing valuable insights into the design of an environmental accounting model for hospitals, is subject to certain limitations that must be acknowledged. First, the research was conducted specifically within hospitals affiliated with the Ministry of Health. While this provides a focused context, the specific regulatory, cultural, and operational characteristics of these hospitals may limit the generalizability of the findings to private hospitals or healthcare systems in other countries with different administrative structures. The model is tailored to the public sector context of the Ministry of Health, and its application in private or international settings would require adaptation to local regulations and market dynamics. Second, the data collection relied heavily on self-reported measures through questionnaires and interviews. Despite efforts to ensure validity and reliability, self-reported data is susceptible to common method bias and social desirability bias, where respondents may answer in a way they believe is expected rather than reflecting actual practices. Third, the study

adopts a cross-sectional design, capturing data at a single point in time. This limits the ability to establish causal relationships with absolute certainty or to observe the long-term dynamic effects of implementing the environmental accounting model. While structural equation modeling suggests causality, longitudinal studies would be required to confirm how these relationships evolve over time. Fourth, the model focuses primarily on waste management. While waste is a critical environmental aspect of hospital operations, it does not encompass the full spectrum of environmental impacts, such as energy consumption, water usage, or carbon emissions. Therefore, the model may not fully capture the breadth of environmental accounting potential in healthcare. Finally, the quantitative phase, while statistically robust, aggregates data across a large sample, potentially masking specific nuances or unique challenges faced by individual hospital departments or smaller facilities that differ significantly from large general hospitals.

Based on the findings and limitations of this study, several avenues for future research are recommended. First, future studies should attempt to validate and test the proposed environmental accounting model in private hospitals and in different geographical or cultural contexts. Comparative studies between public and private hospitals could reveal how ownership structure and funding mechanisms influence the adoption and effectiveness of environmental accounting practices. Second, longitudinal research is essential to examine the temporal dynamics of the model. Tracking the implementation of the model over several years would provide insights into how the relationships between environmental accounting, waste management, and performance sustainability stabilize or change over time, and could identify the time lag required for interventions to yield tangible results. Third, future research should expand the scope of the model to include other critical dimensions of hospital sustainability, such as energy management, water conservation, and carbon footprinting. Integrating these dimensions would create a more holistic environmental accounting framework for the healthcare sector. Fourth, qualitative case studies could be conducted to gain a deeper understanding of the practical implementation challenges and the micro-level processes involved in adopting the model. While this study identified the components, detailed case studies could explore the "how" of implementation, focusing on change management strategies and organizational culture. Fifth, investigating the role of emerging technologies, such as the Internet of Things (IoT) and Blockchain, in enhancing the accounting information systems component of the model would be a valuable contribution. These technologies have the potential to revolutionize data collection and verification in waste management. Finally, future studies could examine the specific impact of this model on financial performance indicators in more detail, moving beyond general "financial consequences" to specific metrics like cost per patient, waste disposal cost reduction, and return on investment for green technologies.

The findings of this study offer several practical implications for hospital administrators, policymakers, and healthcare managers seeking to improve performance sustainability through environmental accounting. Hospital top management should prioritize the integration of environmental accounting into their strategic planning processes. This involves moving beyond viewing waste management as a mere operational issue and treating it as a strategic variable that impacts the hospital's legitimacy and financial health. Administrators should invest in developing and upgrading their Accounting Information Systems (AIS) to capture environmental costs specifically. This requires training accounting staff to recognize, measure, and record environmental costs associated with waste segregation, storage, transportation, and disposal, thereby making these hidden costs visible to decision-makers.

Hospitals should establish dedicated Environmental Management Accounting (EMA) units or assign specific responsibilities within the finance department to monitor waste management metrics. Regular audits based on the "control and supervision" dimension identified in the model should be instituted to ensure compliance with waste management protocols and to identify areas for improvement. Furthermore, hospital management should focus on strengthening the "human resource status" aspect of waste management by providing specialized training to janitorial staff, nurses, and paramedical staff regarding waste segregation at the source. Since the study highlights the importance of "commitment of decision-makers," it is crucial to create incentive structures that reward departments for achieving waste reduction targets and improving sustainability performance.

Policymakers at the Ministry of Health should use the validated model as a framework for developing standardized guidelines and regulations for environmental accounting and waste management across all affiliated hospitals. This could include mandating the disclosure of environmental costs in annual reports and requiring hospitals to set specific Key Performance Indicators (KPIs) related to waste

management. Additionally, fostering collaboration between hospital accounting departments and HSE (Health, Safety, and Environment) units is essential, as the study confirms the importance of this cooperation. Regular cross-departmental meetings should be scheduled to align financial data with environmental operational data. Finally, hospitals should communicate their environmental performance and sustainability efforts to stakeholders to enhance social legitimacy and public trust, using the transparency afforded by the new accounting model to demonstrate their commitment to a greener healthcare environment.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were considered.

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