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Original Article

Analysis of the Implementation of Environmental Costs in Medical Waste Management at Community Health Centers in Pebayuran District

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Abstract

Medical waste management at community health centers carries environmental and public health risks that require adequate environmental cost planning and monitoring. This study aims to analyze the implementation of environmental costs in medical waste management at the Pebayuran Community Health Center and map the costs based on the Hansen and Mowen classification. This descriptive qualitative case study was conducted at one Community Health Center in Pebayuran Subdistrict and involved three informants. Data were collected through interviews, observations, and documentation, with triangulation used to assess data validity. The findings show that environmental costs are implemented through facility provision, budgeting, recording, sorting, storage, and transportation by a third party. The 2025 medical waste management budget amounted to IDR 29,850,000. The identified costs comprise prevention, detection, and internal failure costs, while external failure costs were not identified. Environmental cost implementation has supported medical waste management, but remains suboptimal as evidenced by improper waste sorting, the need to improve hazardous and toxic waste (B3) storage facilities, and the absence of a specific budget allocation for monitoring. This study provides a mapping of environmental costs based on medical waste management activities at the community health center level, while the classification is used as an analytical lens rather than as the center's existing accounting framework.

Keywords: Community Health Center, Environmental Accounting, Environmental Costs, Hansen and Mowen, Medical Waste.

1. Introduction

Environmental issues have become a global concern as environmental degradation, waste pollution and climate change caused by human activity increase. These circumstances call for more effective environmental management, as waste from various sectors, including healthcare institutions, has the potential to cause harm to the environment and public health if not managed in accordance with regulations (Jumliana et al., 2025). Medical waste requires special management as it contains hazardous and toxic substances (B3) that pose a risk to health and the environment (Mujiono, 2022). Consequently, healthcare facilities need to adopt environmental accounting, although its implementation in primary-level healthcare facilities remains relatively limited (Jumliana et al., 2025). In practice, environmental accounting takes into account the costs associated with efforts to preserve and protect

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environmental quality, and determines the environmental costs to be included in the financial statements (Chyntiani, 2025).

According to the World Health Organization (WHO), around one-third of healthcare facilities worldwide have not yet implemented safe management of healthcare waste, which could have a negative impact on public health and the environment (World Health Organization, 2022). Ministry of Health Regulation No. 18 of 2020 states that the volume of medical waste generated by hospitals and community health centers amounts to approximately 296.86 tonnes per day, whilst the processing capacity of third-party providers is only around 151.6 tonnes per day; consequently, there remains a gap in waste processing capacity. This situation is reinforced by the Ministry of Environment and Forestry (KLH)/Regional Environmental Agency (BPLH), which states that the management of hazardous medical waste still faces a number of challenges, including low compliance with reporting requirements, the use of manual manifest systems, and sub-optimal management of pharmaceutical waste (KLH/BPLH, 2026).

In Indonesia, environmental protection and management have a legal basis in Law No. 32 of 2009, which stipulates the obligation of every business operator to implement environmental protection and management measures as a means of preventing environmental pollution and damage. Furthermore, Government Regulation No. 22 of 2021 sets out provisions on environmental permits, waste management, compliance with environmental quality standards, and the obligations of business operators to control environmental impacts. Furthermore, Regulation of the Minister of Health of the Republic of Indonesia No. 18 of 2020 serves as a guideline for the reduction, sorting, storage, transport and disposal of medical waste at healthcare facilities. From an accounting perspective, PSAK No. 1 and PSAK No. 57 form the basis for environmental accounting disclosures. These two standards provide guidance for entities on presenting financial information that also takes environmental aspects into account (Ramadhan & Rachmadanti, 2023).

The management of medical waste at community health centers continues to face challenges, despite the budget being deemed adequate. Inconsistencies in the sorting of medical waste are still being observed, and facilities for the storage of hazardous waste (B3) have not yet been provided. This situation requires attention, as the failure to sort medical waste in accordance with regulations has the potential to cause contamination of the working environment and endanger the safety of patients and healthcare workers; consequently, nurses play a vital role in the sorting of medical waste, a process influenced by various factors (Melia et al., 2024). In addition to management considerations, this situation also highlights the importance of proper cost management to support the fulfilment of medical waste management requirements. In this regard, environmental costs need to be identified and classified in financial statements as a basis for evaluation and decision-making (Suherti et al., 2024). Consequently, the implementation of environmental cost accounting is necessary to allocate costs arising from environmental impacts through systematic record-keeping, so that budget management can be carried out more effectively and efficiently (Iskandar, 2024).

Studies on the application of environmental costs to support the management of medical waste in healthcare services have yielded mixed results. Research by Azzahra et al. (2026) indicate that Amanah Clinic in Jatisari has optimally implemented environmental accounting through the recognition, measurement, recording, presentation and disclosure of environmental costs in its financial statements. Furthermore, research by Hasanah et al. (2025) revealed that the hospital had carried out waste treatment in accordance with regulations, as evidenced by the availability of specific reports relating to environmental costs. Furthermore, research by Baga and Paramitalaksmi (2024) found that the Yogyakarta City

General Hospital had integrated environmental costs into its medical waste management to improve the quality of environmental management.

On the other hand, a number of studies indicate that the implementation of environmental cost accounting remains sub-optimal. For instance, the study by Lanawati et al. (2025) revealed that the hospital had carried out environmental management activities; however, it had not yet implemented environmental accounting in accordance with theory nor compiled specific environmental cost reports. Research by Shabira et al. (2024) revealed that the Balongsari Public Health Center allocates funds for the management of medical and non-medical waste but has not categorised these separately as environmental costs in its financial reporting. Further, a study by Supriadi (2025) concluded that the hospital has not yet implemented environmental cost accounting practices in accordance with the indicators of control costs, prevention costs, cleaning costs, and environmental revenue costs. The differences in these research findings indicate that the implementation of environmental cost accounting in healthcare facilities is not yet fully consistent. Thus, further research is required to gain a better understanding of the implementation of environmental cost accounting in support of medical waste management at Community Health Centers (Puskesmas).

Medical waste poses a high risk to public health and the environment as it has the potential to become a source of disease transmission and pollution if not managed properly (Efendi et al., 2023). Consequently, healthcare facilities need to manage medical waste in accordance with applicable regulations by incorporating waste-related costs into their environmental accounting systems as part of efforts to manage the environmental impact of their operational activities (Fadilah et al., 2025). Environmental cost accounting helps healthcare facilities manage environmental costs more effectively, reduce the negative impacts of medical waste, and support sustainability-oriented healthcare services (Sandi et al., 2025). Based on the above, this study is necessary because environmental cost analysis can provide information on the management of medical waste costs and serve as a basis for evaluating ways to improve the effectiveness, accountability and sustainability of medical waste management at the Pebayuran Community Health Center.

Research on environmental costs in medical waste management has been a widely studied topic; however, there remains a limited number of studies linking environmental cost classifications to the evaluation of their application in medical waste management. Previous studies have generally focused on the identification and accounting treatment of environmental costs, whilst studies using the Hansen and Mowen classification place greater emphasis on classifying costs according to the categories of prevention, detection, internal failure and external failure. The novelty of this study lies in the use of the Hansen and Mowen classification to analyze the relationship between cost types and medical waste management activities, whilst also evaluating their suitability for waste management needs. This study offers the perspective that the application of environmental costs does not depend solely on the availability of a budget, but is also influenced by an organization's ability to identify, classify, allocate and evaluate costs in accordance with environmental management activities.

This study was conducted to address three research questions. First, it examines how environmental costs are applied in medical waste management at the Pebayuran Community Health Center. Second, it analyzes how environmental costs associated with medical waste management at the Pebayuran Community Health Center are classified according to the framework proposed by Hansen and Mowen. Third, it investigates how the application of environmental costs supports medical waste management at the Pebayuran Community Health Center.

2. Literature Review

2.1. Legitimacy Theory

Legitimacy theory posits that the sustainability of an organization is influenced by the alignment of its operational activities with societal norms, values and expectations. This theory is based on the concept of the social contract; consequently, organizations need to align themselves with public expectations in order to attain and maintain legitimacy (Ghozali, 2020). In practice, legitimacy can be strengthened through reporting on social and environmental responsibilities, including the implementation of green accounting and Corporate Social Responsibility (CSR) programmes (Murni et al., 2025). Legitimacy theory also emphasises that organizations should not only focus on profit but also take responsibility for minimising their environmental impact through improved environmental performance, a green organizational culture, and green innovation (Rahmah et al., 2025).

According to legitimacy theory, an organization's sustainability depends on its ability to carry out activities in line with societal norms and expectations (Suherti et al., 2024). This theory is based on the concept of a social contract, which requires healthcare facilities to manage medical waste responsibly in order to gain legitimacy (Iskandar, 2024). This responsibility is realised through waste management in accordance with regulations, as well as the recording and reporting of environmental costs as a form of accountability (Shabira et al., 2024). In this study, legitimacy theory is used to explain that the application of environmental costs in medical waste management reflects the Community Health Center's responsibility towards society and the environment.

2.2. Environmental Costs

Environmental costs refer to expenditures associated with preventing, detecting, managing, and responding to environmental impacts arising from organizational activities. The literature generally agrees that these costs are not limited to remediation after environmental damage occurs, but also include expenditures intended to prevent environmental degradation, monitor environmental impacts, and manage waste generated by operational activities (Meliniyati et al., 2024; Nurfadila et al., 2025; Pertiwi & Januarti, 2025). Environmental cost information can therefore support transparency, accountability, and management decision-making by showing how organizational resources are used to address environmental responsibilities (Pratiwi & Utami, 2025). In this study, environmental costs are understood as expenditures related to medical waste management activities at the Community Health Center, which are subsequently mapped using the Hansen and Mowen classification as an analytical framework.

Hansen and Mowen classify environmental costs into four categories: environmental prevention costs, environmental detection costs, internal environmental failure costs, and external environmental failure costs (Alimbudiono & Laurencia, 2024). Prevention costs are incurred to prevent environmental impacts before they occur, such as the provision of environmental facilities and training. Detection costs relate to activities for identifying, monitoring, and evaluating environmental impacts. Internal failure costs arise from managing environmental impacts within the organization, including waste collection, treatment, and disposal. External failure costs arise from environmental impacts affecting parties outside the organization, such as compensation, remediation, penalties, or legal claims. These categories are used in this study to analyze the characteristics of expenditure associated with medical waste management.

A. Environmental Prevention Costs

Prevention costs are those incurred to prevent environmental damage resulting from operational activities, such as investment in environmentally friendly technology, pollution control equipment, research and development, staff training, and environmental audits.

B. Environmental Detection Costs

Detection costs are costs incurred to identify, monitor and evaluate environmental impacts through activities such as emissions testing, inspections, monitoring and environmental audits.

C. Internal Environmental Failure Costs

Internal failure costs are primarily reflected in the costs of waste collection or transport by third parties after medical waste has been generated and collected by the Community Health Center. Interview findings indicate that waste collection is a routine expenditure, reported at approximately Rp500,000 to Rp1,000,000 per month. Because the expenditure arises in response to waste already generated within the Community Health Center, it is mapped as an internal environmental failure cost under the Hansen and Mowen framework.

D. External Environmental Failure Costs

External environmental failure costs are costs arising from environmental impacts outside the organization, such as compensation to affected parties, environmental restoration, repair of property damage, payment of fines, and legal claims.

2.3. Medical Waste

Medical waste is waste generated from healthcare service activities and may contain infectious, hazardous, or otherwise harmful substances. The Minister of Health Regulation defines medical waste as waste generated from healthcare services, while Triyaningsih (2024) describes it as residual material from activities that is no longer reused and may be contaminated or have come into contact with patients. WHO (2026) similarly includes used syringes, contaminated dressings, blood, chemicals, medicines, diagnostic materials, and other materials arising from healthcare activities. These definitions share the view that medical waste requires specific management because its characteristics can create risks to human health and the environment if handled improperly.

2.4. Types of Medical Waste

Medical waste generated by healthcare facilities varies according to its characteristics and potential hazards. Regulation of the Minister of Environment and Forestry No. 56 of 2015 identifies several categories of hazardous and toxic waste (B3), including infectious waste, pathological waste, sharps, chemical waste, heavy-metal waste, radioactive waste, pressurized containers, pharmaceutical waste, and cytotoxic waste (Azmiardi et al., 2022). In practice, healthcare facilities may also generate solid, liquid, and gaseous waste, with medical and non-medical waste forming part of the solid waste stream (Fadilah et al., 2025). This classification is relevant to the present study because the characteristics of waste determine the required sorting, storage, transport, and management activities.

2.5. Medical Waste Management

Medical waste management encompasses activities intended to reduce the volume and hazards of waste and to control its potential effects on health and the environment. WHO (2026) emphasizes that inadequate healthcare waste management may expose healthcare workers, waste handlers, and the public to infection, toxic substances, and injury. Management therefore involves appropriate sorting, collection, storage, transport, and treatment according to the characteristics of the waste. Fadilah et al. (2025) and Supriadi

(2025) further indicate that treatment and handling should reduce the hazardous characteristics of waste before final disposal. In this study, medical waste management is examined together with the environmental costs incurred to support those activities.

2.6. Conceptual Framework

The framework in this study is built on the premise that environmental cost reporting is a means for organizations to maintain their legitimacy in the eyes of the community.

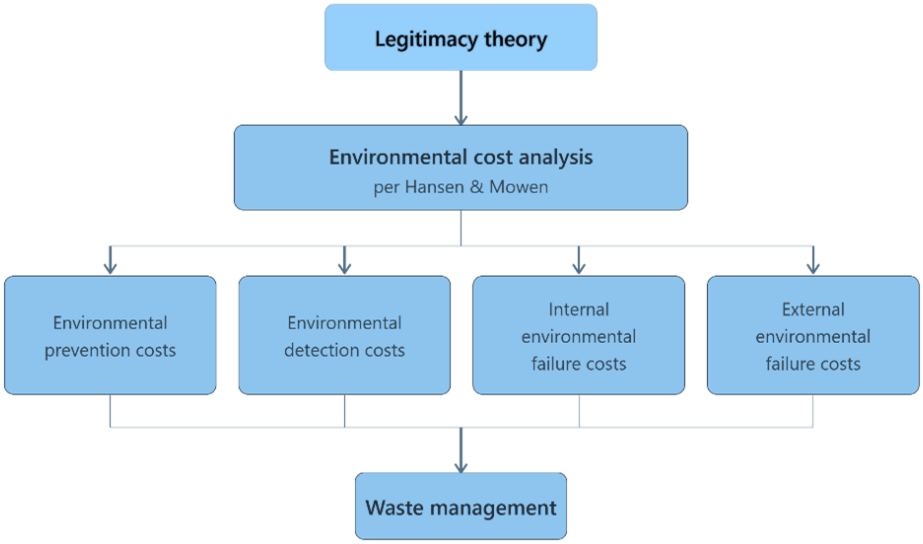


Figure 1. Conceptual Framework

As shown in Figure 1, this research framework utilizes Legitimacy Theory and Hansen and Mowen's classification of environmental costs to analyze the application of environmental costs in waste management at community health centers.

2.7. Research Proposition

A proposition is a statement about a reality whose truth can be tested on the basis of facts or empirical evidence (Rukhmana et al., 2022). A proposition can be understood as a statement in the form of a sentence that has a truth value, so that it can be determined whether the statement is true or false (Agustian et al., 2025). A proposition is a logical relationship between two or more concepts expressed in the form of a statement (Madum et al., 2025). Propositions are used to explain or predict a concept or phenomenon. Therefore, the researchers put forward the following propositions:

P1: The application of environmental costs in the management of medical waste at the Pebayuran Community Health Center is carried out through the provision of facilities, budgeting, cost recording, sorting, storage, as well as the transport and management of waste by a third party.

P2: Environmental costs in the management of medical waste at the Pebayuran Community Health Center can be classified according to Hansen and Mowen's four categories of environmental costs, namely prevention costs, detection costs, internal failure costs, and external failure costs.

P3: The application of environmental costs at the Pebayuran Community Health Center supports medical waste management through the provision of resources, budgeting, record-keeping, transport, and waste management control and evaluation activities.

3. Methods

This study employed a descriptive qualitative case study design to analyze the application of environmental costs in medical waste management at a Community Health Center in Pebayuran Subdistrict (Farida et al., 2026). A case study design was selected because it enables an in-depth examination of environmental cost practices and their relationship with medical waste management within a specific organizational setting. The research data consisted of primary data from interviews and secondary data from Community Health Center documents. Data collection was carried out through observation to directly examine environmental management activities, interviews with parties involved in environmental costs, and documentation to obtain supporting data on medical waste management and environmental costs (Shabira et al., 2024). The study involved three informants: Mr Romli, S.E., the Community Health Center treasurer; Ms Nabila Farhana, S.Tr.Kes, a sanitation officer; and an accounting expert, Mr Rivan Wibowo, S.E., M.Ak. The informants were selected based on their understanding, relevance, and involvement in medical waste management and environmental costs (Jumliana et al., 2025). Data validity was assessed through triangulation by comparing interview, observation, and documentation findings (Mujiono, 2022). Data were analyzed using the Miles and Huberman interactive model through data reduction, data presentation, and conclusion drawing (Hasanah et al., 2025).

4. Results and Discussion

4.1. Research Results

4.1.1. The Application of Environmental Costs in Medical Waste Management

The management of medical waste at the Pebayuran Community Health Center relates to various healthcare activities that generate medical waste. This waste originates from general services, the Basic Emergency Obstetric and Neonatal Care (PONED), inpatient care, the A&E department, and immunization program. The types of waste generated include gauze, intravenous drips and syringes, with the PONED, A&E and immunization program being the activities that generate relatively larger volumes of medical waste. Waste management is carried out through the sorting and collection of waste from each service area before it is subsequently handed over to a third party for further management. The Community Health Center does not process medical waste independently; therefore, transport and management by a third party form a crucial part of the medical waste management process.

Implementing this management requires supporting facilities, particularly segregated waste bins, yellow plastic bags, and safety boxes for waste such as syringes. These facilities are used from the stage of collecting and sorting medical waste. The need for these facilities is ongoing, as yellow plastic bags and safety boxes must be provided in accordance with service requirements. In addition to storage facilities, costs are also incurred for the transport of waste by third parties. Transport is one of the main expenses, as Community Health Center do not process medical waste independently. If transport costs are not available, medical waste cannot be managed and is likely to accumulate.

From a budgeting perspective, waste management at Community Health Centers is categorised into domestic waste and hazardous waste (B3). Domestic waste is managed through the Environmental Agency, whilst hazardous waste (B3) is managed by a third party. The budget for waste management is sourced from BLUD (Regional Public Service Agency) funds and is planned through programme proposals submitted to the planning team, which are subsequently submitted to the Head of the Administrative Section and the Head of the

Community Health Center. The waste management budget used in this study amounted to Rp29,850,000 for one Community Health Center per year. The budget amount may differ from the previous year as planning is based on needs and an analysis of the previous year's budget utilisation. Cost requirements are also influenced by the volume of waste generated.

The availability of the budget is assessed as having met waste management needs. Budget planning is carried out at the start of the year based on requirements, whilst evaluation is conducted by comparing budget expenditure over the course of a year. In the event of a shortfall, the Community Health Center may request a budget increase. Conversely, if there is a surplus, the budget is not fully utilized. In the implementation of hazardous waste management, the costs routinely incurred are primarily related to the collection or transport of waste by third parties. The cost of waste collection is reported to range from Rp500,000 to Rp1,000,000 per month.

Records of waste management costs are kept based on invoices from service providers. Expenditure is recorded according to the amount of the invoice paid and adjusted in line with tax deduction regulations. Waste management costs are also recorded separately under specific account codes. This separation enables the Community Health Center to determine the budget allocated for waste management over the course of a year. In practice, costs for the procurement of waste bins and plastic bags are also incurred, but these are funded from a different budget to the third-party waste collection fees.

The separation of cost recording is also considered important from the perspective of expert informants. Costs relating to third-party contracts must be traceable to ascertain whether payment obligations, budgeting and the implementation of the contract have been fulfilled. Furthermore, the separation of costs helps Community Health Center monitor expenditure on waste management. Thus, the recording of environmental costs relates not only to payments but also to accountability for the management of medical waste.

The research findings also indicate that medical waste management involves a relationship between the Community Health Center's internal management and third parties. Before being handed over to third parties, waste must be collected and segregated according to its characteristics. Once the waste has been handed over, there are documents or handover reports serving as evidence of the transfer and detailing the quantity of waste transported. These reports form one of the bases for monitoring waste management and payments to third parties.

Based on these overall findings, the implementation of environmental costs at the Pebayuran Community Health Center is evident through the provision of waste management facilities, budgeting, cost recording, waste sorting and collection, and transport by third parties. This implementation has been supported by a separate budget and accounting mechanism based on account codes, although there remains a need to improve hazardous waste (B3) storage facilities and the accuracy of waste sorting at the operational level.

4.1.2. Classification of Environmental Costs in Medical Waste Management

According to the research findings, the management of medical waste at the Pebayuran Community Health Center has been supported by budgeting and record-keeping in accordance with the source and type of expenditure. The costs cover sorting, the provision of hazardous waste facilities, storage, and transport by third parties, but have not yet been classified according to Hansen and Mowen. Therefore, this classification is used as an analytical tool to map costs based on medical waste management activities. The resulting cost mapping is presented in Table 1.

Table 1. Results of the Mapping of Medical Waste Management Costs at Community Health Centers Based on Hansen and Mowen

No.	Hansen and Mowen's Classification of Costs	Costs of Medical Waste Management at the Pebayuran Community Health Center
1.	Prevention Costs	Provision of medical waste bins, purchase of yellow plastic bags and safety boxes, and provision of waste storage facilities
2.	Detection Costs	Monitoring and evaluation of waste management by the Health Department; however, no specific budget has yet been allocated for this purpose
3.	Internal Failure Costs	Collection and transport of medical waste by a third party once the waste has been generated
4.	External Failure Costs	No costs arising from the impact of medical waste on external parties have yet been identified

Source: Data processed by the researcher

As shown in table 1, prevention costs are evident in the provision of facilities before medical waste is handed over to a third party. Based on the observations and interviews, rubbish bins, yellow plastic bags, and safety boxes are provided to support waste collection and sorting from the service rooms. These expenditures occur before waste is transferred for further management and therefore correspond to the prevention category in the Hansen and Mowen framework. The findings also show that B3 storage facilities still require improvement, indicating that preventive support is not yet fully adequate.

Detection costs relate to monitoring and evaluation activities concerning waste management. The interview findings indicate that monitoring by the Health Department has been carried out, but the Community Health Center does not allocate a specific budget for these activities. This evidence supports the classification of monitoring as a detection-related activity while also showing that the related cost has not been separately identified in the existing budget.

Internal failure costs are primarily evident in the costs of waste collection or transport by third parties. These costs arise after medical waste has been generated and collected by the Community Health Centers, to be subsequently handed over to third parties. Waste collection constitutes a routine cost and represents the largest cost component compared to other waste management requirements. These expenditure ranges from Rp500,000 to Rp1,000,000 per month.

Meanwhile, external failure costs were not identified in the research findings. The interviews and available documentation did not indicate expenditures incurred because of the impact of medical waste on external parties, such as compensation, penalties, remediation, or legal claims. Therefore, the absence of identified external failure costs should be interpreted as a finding within the scope and period of this study, rather than evidence that such impacts can never occur.

Consequently, the mapping results indicate that expenditure related to medical waste management can be categorised under prevention costs, detection costs and internal failure costs, whilst external failure costs were not identified. This mapping is the result of a research analysis of activities and expenditure observed in the field; it does not imply that the Community Health Centers have implemented the Hansen and Mowen classification system in their accounting records.

4.1.3. Support for the Application of Environmental Costs to Medical Waste Management

The availability of funding and facilities is one of the factors supporting the sustainability of medical waste management. The research findings indicate that the available funding is deemed sufficient to meet waste management needs. This sufficiency is evident from the fact that no management activities were unable to be carried out due to funding constraints, and that no additional funding requirements arose during the implementation of waste management.

Financial support is also evident in the Community Health Centers' ability to provide waste management facilities, particularly yellow plastic bins and safety boxes. The availability of these two facilities is considered crucial, as a shortage of such facilities could result in medical waste not being collected and potentially being disposed of in a manner that does not comply with regulations. Furthermore, the cost of waste collection by third parties is a priority, as a reduction in this cost could lead to waste accumulating at the Community Health Centers.

In terms of monitoring, the Community Health Center is subject to monitoring activities by the Health Department, but these activities do not yet have a dedicated budget. Meanwhile, monitoring of third-party contractors can be carried out through reports on waste collection and the volume of waste transported. Information regarding the volume of waste collected forms part of the collaboration reporting and serves as the basis for determining payments to third-party contractors.

Although costs are deemed sufficient, the research findings indicate that there are still operational aspects that require improvement. One such issue is the accuracy of waste sorting. Staff were still found to be placing infusion waste into red plastic bags, whereas this waste should be placed in safety boxes. The Community Health Center's efforts to address this situation include conducting awareness-raising sessions on the sorting of medical waste.

In addition to sorting, the provision of storage facilities for hazardous waste (B3) remains an area requiring improvement. The Community Health Center plans to increase the supply of plastic bags and B3 storage facilities, as these requirements are also linked to the accreditation process. From the perspective of expert informants, storage facilities for medical waste need to be specifically provided and adapted to the characteristics of the waste, whilst internal management also requires a party specifically responsible for medical waste.

Expert informants also emphasised that an adequate budget does not automatically indicate that waste management is functioning effectively. Internal management prior to the handover of waste to third parties remains essential, including the separation of medical waste from general waste, the provision of storage facilities, and the appointment of responsible staff. Consequently, financial support must be accompanied by internal management and monitoring of the implementation of cooperation with third parties.

Based on the overall research findings, the implementation of environmental costs has supported the management of medical waste through the provision of facilities, funding for transport, budgeting, record-keeping, and collaboration with third parties. However, this support still needs to be strengthened by improving the accuracy of waste sorting, providing storage facilities for hazardous waste (B3), monitoring, and internal management before waste is handed over to third parties.

4.2. Discussion

4.2.1. The Application and Classification of Environmental Costs in Medical Waste Management

The application of environmental costs at the Pebayuran Community Health Center cannot be separated from healthcare activities that generate medical waste. This waste originates from general services, the Basic Emergency Obstetric and Neonatal Care (PONED), inpatient care, the A&E department, and immunisation programmes, with the PONED, A&E and immunisation programmes generating relatively larger volumes of waste. Management is carried out through sorting, collection, storage, the provision of storage facilities, and the transport of waste by a third party. The facilities used include medical waste bins, B3 plastic bags and safety boxes. These conditions indicate that waste management activities entail expenditure at several stages, ranging from the provision of facilities to the transport of waste once it has been collected. Consequently, environmental costs at the Pebayuran Community Health Center are not only related to payments to third parties but are also inherent in the waste management activities carried out from the moment the waste is generated.

These cost requirements are then reflected in planning and budgeting. According to the BLUD (Regional Public Service Agency) Expenditure Realisation document for the 2025 Financial Year, the Pebayuran Community Health Center has a budget of Rp29,850,000 allocated to the 'Waste Management Services' expenditure line. Budget planning is carried out by taking into account operational requirements and budget utilisation from the previous period. In practice, domestic waste management is carried out by the Environmental Agency, whilst hazardous medical waste (B3) is handed over to a third party. Expenditure on waste collection by third parties constitutes a routine cost necessary to prevent medical waste from accumulating on the health center's premises. This demonstrates that waste management has been factored into the health center's financial planning and forms part of its operational service requirements.

In terms of record-keeping, waste management expenditure is recorded according to budget source, account code and type of expenditure. Expenditure on waste management facilities and materials utilizes budget sources appropriate to the specific needs, whilst payments to third parties are recorded based on invoices or payment documents. This approach allows transactions to be traced administratively, but has not yet produced information on the total environmental costs within a single, comprehensive category. The costs of providing facilities, purchasing materials and transport services are still recorded according to their source and type of expenditure. Thus, the application of environmental costs at the Pebayuran Community Health Center is evident through the budgeting and recording of costs, but has not yet reached the stage of specifically categorising environmental costs.

This situation is significant because cost information serves not only to indicate the amount of expenditure but can also be used to identify environmental management needs more clearly. Whilst costs related to waste management are spread across several expenditure categories, the Community Health Center can still exercise administrative control; however, it is more difficult to obtain an overall picture of the specific costs allocated to medical waste management. The views of expert informants also indicate that the separation of costs is necessary so that budgeting, payments, cooperation with third parties, and accountability can be monitored more clearly. Therefore, the fact that environmental costs have not yet been integrated into a single category does not indicate that these costs are not being applied, but rather that their application remains embedded within the Community Health Center' operational cost management system.

These findings are consistent with the study by Baga and Paramitalaksmi (2024) at the Yogyakarta City General Hospital, which showed that medical waste management activities incur costs and that the application of environmental accounting can be used to support the management and monitoring of environmental activities. This consistency is evident in the existence of expenditure directly related to waste management, although the characteristics and recording systems may differ between organizations. Nuwa et al. (2023) also demonstrated that environmental activities in healthcare facilities require budgetary support, including for medical waste management, third-party services, transport and supervision. These findings reinforce the view that waste management in healthcare facilities is an activity that requires a sustainable supply of financial resources.

On the other hand, the findings from the Pebayuran Community Health Center align with those of Shabira et al. (2024), who found that waste management costs at community health centers had been incurred but had not all been specifically categorised as environmental costs. This indicates that the existence of environmental costs is not always reflected through the presence of a separate environmental cost account. Environmental costs may initially manifest as expenditure on facilities, materials, management services, and other activities related to waste management. The differences lie in the characteristics of the objects involved, management requirements, and the recording mechanisms applied by each healthcare facility.

From the perspective of Legitimation Theory, this situation indicates that waste management forms part of the Community Health Center's efforts to carry out service activities in accordance with environmental and community demands. The provision of facilities, budget allocation, recording of expenditure, and collaboration with third parties demonstrate efforts to control the waste generated by healthcare service activities. These expenditures are not merely viewed as operational necessities but are also linked to the Community Health Center' responsibility to safeguard the environment and the safety of the community surrounding its service activities. Consequently, the application of environmental costs can form part of the organization's efforts to ensure its activities remain aligned with social and environmental norms and expectations.

Having identified the application of these costs, the expenditures found were subsequently analyzed based on the characteristics of the activities using the Hansen and Mowen classification. In this study, this classification is not the accounting system used by the Community Health Center, but is employed as an analytical tool to link cost types to waste management activities. The provision of medical waste bins, hazardous waste (B3) plastic containers, safety boxes and storage facilities is categorised as prevention costs, as these expenditures relate to efforts to prevent mismanagement from the outset. Monitoring and evaluation activities were categorised as detection costs, as they relate to efforts to identify non-compliance in waste management. Meanwhile, the transport or collection of waste by third parties was categorised as internal failure costs, whilst external failure costs were not identified in this study.

The mapping shows that Community Health Center expenditure actually has characteristics that can be distinguished based on the purpose of the activity. Costs for facilities and equipment are incurred before or at the time waste is managed to prevent errors; monitoring is used to assess compliance with implementation; whilst transport by third parties constitutes expenditure arising after waste has been generated and collected. The absence of external failure costs also indicates that, during the study period, there were no expenditures specifically arising from the impact of waste on external parties, such as compensation, penalties, or remediation costs due to pollution.

These findings can be compared with the study by Rospani and Handajani (2024), which also utilized the Hansen and Mowen classification to identify environmental costs in healthcare facilities. That study revealed the existence of prevention, detection and internal failure costs. This similarity suggests that expenditure on environmental management in healthcare facilities may have different characteristics depending on the purpose for which it is used. However, there are differences in the level of implementation. At the Pebayuran Community Health Center, the Hansen and Mowen classification has not yet been incorporated into actual record-keeping; rather, it was used by the researchers to map the costs that had been identified. This situation indicates that the application of environmental costs has been taking place at an operational level, but cost information could still be further developed through more systematic identification and categorisation.

Consequently, the application of environmental costs at the Pebayuran Community Health Center is evident from activities such as waste management, the provision of facilities, budgeting, record-keeping, and collaboration with third parties. These costs can also be categorised according to the nature of the activities into prevention, detection and internal failure costs, whilst external failure costs have not yet been identified. However, this classification has not yet been applied in the health center's record-keeping. These findings indicate that the application of environmental costs is already taking place in practice, but there is still scope to improve the integration of cost information so that environmental management can be monitored more systematically.

4.2.2. Support for the Implementation of Environmental Costs for Medical Waste Management

The implementation of environmental costs at the Pebayuran Community Health Center supports the implementation of medical waste management through the provision of a budget, facilities, and funding for transport and management by third parties. A budget of Rp29,850,000 under the 'Waste Processing Services' expenditure item indicates that waste management has been allocated financial resources. Further, the provision of facilities such as medical waste bins, hazardous waste (B3) plastic bags and safety boxes also forms part of the expenditure supporting waste management activities. The existence of this budget enables the Community Health Center to carry out waste management on a routine basis and to hand over hazardous waste (B3) to third parties responsible for its transport and further management.

This financial support is evident not only in the availability of the budget but also in how the budget is utilized to underpin the various stages of waste management. Expenditure on third parties is used to ensure that collected medical waste can be transported from the Community Health Center, whilst the provision of facilities supports sorting and storage. Consequently, there is a direct link between the use of funds and waste management activities. The more waste management stages that require resources, the greater the need for Community Health Centers to ensure that the available funds are commensurate with the requirements of the activities.

These findings are consistent with those of Nuwa et al. (2023), who demonstrated that environmental management in healthcare facilities requires budgetary support for various activities, including medical waste management, third-party services, transport and supervision. These results demonstrate that budgeting is a crucial component in ensuring the sustainability of environmental management activities. The same is evident at the Pebayuran Community Health Center, where waste management cannot be carried out without financial support for transport facilities and services.

Research by Baga and Paramitalaksmi (2024) also indicates that expenditure on medical waste management can support environmental management and monitoring activities in

healthcare facilities. Meanwhile, Saraswati and Musmini (2024) highlight the allocation of funds for waste management and collaboration with third parties regarding the transport and disposal of medical waste at Community Health Centers. Both studies demonstrate that financial support does not stand alone but is linked to the actual activities carried out to control waste.

Nevertheless, the research findings indicate that the existence of a budget does not fully guarantee the optimal management of medical waste. Community health centers still face issues with waste sorting, such as infusion sets that should be placed in safety boxes but are still found in red plastic bags. Furthermore, facilities for the storage of hazardous waste (B3) do not yet fully meet management requirements. This situation highlights a discrepancy between the available resource support and the actual implementation of waste management on the ground. In other words, the nominal adequacy of the budget does not automatically mean that all management activities are functioning optimally.

These issues are also linked to monitoring. Monitoring and evaluation are necessary to ensure that the facilities provided are used in accordance with their intended purpose and that sorting procedures are carried out correctly. However, monitoring activities by the Health Department do not yet have a dedicated budget allocation. This situation indicates that some control functions are still carried out through existing activities, but are not yet supported by a specific budget allocation. In fact, monitoring plays a crucial role in identifying implementation errors and determining the need for improvements in waste management.

From the perspective of Legitimacy Theory, the allocation of funds for waste management demonstrates the Community Health Centers' efforts to fulfil their environmental responsibilities as part of their healthcare activities. However, legitimacy is not only established through the availability of a budget, but also through the actual fulfilment of these responsibilities. Errors in waste sorting and limited facilities indicate that there are still aspects of management that need to be improved so that waste management practices meet the demands of the environment and the community. Therefore, environmental expenditure needs to be directed not only towards meeting routine needs, but also towards supporting the monitoring and improvement of management quality.

These findings are consistent with those of Fitermen et al. (2025), who regard the budgeting and reporting of environmental costs as part of an institution's responsibilities and accountability. Meanwhile, research by Rospani and Handajani (2024) shows that environmental costs in healthcare facilities can cover a range of needs, such as hazardous materials, waste transport, facility maintenance, and environmental quality inspections. This comparison demonstrates that effective cost support should not be directed solely at a single type of expenditure but should also take into account the needs for prevention, monitoring, facility maintenance, and waste management control.

Given these circumstances, efforts to improve environmental cost management at the Pebayuran Community Health Center could focus on enhancing the accuracy of waste sorting, ensuring adequate hazardous waste storage facilities, and strengthening monitoring. These improvements are essential to ensure that the budgeted costs deliver benefits in line with waste management objectives. Consequently, evaluating the implementation of environmental costs is not sufficient if it merely examines whether the budget is available or has been utilized; it must also consider whether these costs are capable of supporting the implementation of waste management in line with requirements.

The implementation of environmental costs at the Pebayuran Community Health Center has ultimately provided tangible support for waste management through budgeting, the provision of facilities, record-keeping, transport, and management by third parties. However,

this support has not yet been fully optimised, as errors in waste sorting are still occurring, there is a need to improve hazardous waste (B3) storage facilities, and there is no specific allocation for monitoring. These conditions indicate that the effectiveness of the implementation of environmental costs is determined not only by the adequacy of the budget, but also by the alignment of cost utilisation with management needs, the availability of facilities, the accuracy of implementation, and continuous monitoring.

5. Conclusion

Based on the research findings, the Pebayuran Community Health Center has implemented environmental costs through the provision of waste management facilities, budgeting, cost recording, sorting, storage, and transport by third parties. The mapping based on Hansen and Mowen identifies prevention costs through the provision of waste bins, yellow plastic bags, and safety boxes; detection-related activities through monitoring and evaluation; and internal failure costs through third-party collection or transport after waste is generated. External failure costs were not identified in the interviews and available documentation during the study period. These findings show that environmental costs support routine medical waste management through financial resources, facilities, record-keeping, and third-party services. However, the implementation remains suboptimal based on the observed sorting error involving infusion sets, the need to improve B3 storage facilities, and the absence of a specific budget allocation for monitoring. Accordingly, the Community Health Center should strengthen waste sorting procedures, improve B3 storage facilities, and strengthen monitoring and cost identification so that environmental cost information can better support management evaluation. Further research should involve more than one healthcare facility and a longer observation period to provide broader evidence on environmental cost implementation.

This study has several limitations. First, it was conducted at a single Community Health Center, so the findings cannot be assumed to represent all community health centers. Second, the study involved three informants, meaning that the findings reflect the perspectives available from the selected participants. Third, the analysis was based on a single budget year and therefore provides a cross-sectional view of environmental cost implementation. Fourth, the study relies on qualitative self-reported information supported by observation and documentation triangulation. Finally, the Hansen and Mowen classification was used as an external analytical lens by the researchers and was not the accounting framework used by the Community Health Center itself.

5.1. Conflict of Interest Statement

The authors declare that they have no known financial or personal relationships that could be perceived as competing interests in connection with this article. The Pebayuran Community Health Center, as the research site and data source, had no role in the analysis, the interpretation of findings, or the decision to publish.

5.2. Author Contributions

S.S.S.: Conceptualization, Methodology, Investigation, Formal Analysis, Visualization, Writing – Original Draft.
R.S.: Supervision, Methodology, Validation, Writing – Review & Editing.
H.N.A.: Supervision, Resources, Validation, Writing – Review & Editing.

5.3. Funding Statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

5.4. Informed Consent

Informed consent was obtained from all participants.

5.5. Ethical Approval

This study involved human participants through semi-structured interviews and therefore required ethical clearance. Ethical approval was obtained from the relevant institutional research ethics committee prior to data collection, and the study was conducted in accordance with the principles of voluntary participation, informed consent, confidentiality, and the use of data solely for academic purposes.

5.6. Data Availability

The data underlying this study consist of interview transcripts, field observation notes, and institutional documents, including the BLUD expenditure realization report for the 2025 financial year. Because these materials contain institutional financial information and identifiable statements from individual informants, they are not publicly available. Anonymized excerpts and the analytical mapping presented in Table 1 may be requested from the corresponding author [S.S.S.], subject to approval by the participating health center.

5.7. Declaration of Generative AI and AI-assisted Technologies

During the preparation of this manuscript, the authors utilized Claude (Anthropic) for language editing and clarity improvement. All outputs generated with the assistance of the tool were critically reviewed and revised by the authors to ensure factual accuracy, faithful representation of the informants' statements and institutional documents, and adherence to academic standards. The authors assume full responsibility for the integrity and content of this manuscript.

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