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Evaluation of Solid Medical Waste Management at East Kolaka Regional General Hospital

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Abstract

Hospitals are among the major generators of medical waste, which has the potential to pollute the environment and transmit diseases if not managed properly. This study aimed to evaluate the compliance of the solid medical waste management system at the East Kolaka Regency Regional General Hospital (RSUD) with the Indonesian Minister of Environment and Forestry Regulation No. 6 of 2021 and the Indonesian Minister of Health Regulation No. 18 of 2020. This study employed a quantitative descriptive approach, and the research sample was determined using purposive sampling. Data were collected through direct observation, interviews, and documentation using an observation checklist based on the applicable regulations. The results showed that the overall compliance level of solid medical waste management reached 68.70%, which was categorized as "Compliant". Although the collection stage achieved a compliance level of 100%, improvements are still required in waste reduction, temporary storage, transportation, and managerial aspects to ensure full compliance with the applicable regulations. Therefore, continuous improvement of medical waste management practices is necessary to enhance environmental protection and public health at the East Kolaka Regency Regional General Hospital.

Keywords: **Solid Medical Waste, Waste Management, Hospital**

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INTRODUCTION

Environmental health problems are among the consequences of environmental pollution and degradation, including air, water, soil, and noise pollution. These conditions may result from both natural processes and human activities across various development sectors. According to Kandari (2024), environmental pollution has adverse effects on public health by reducing quality of life, diminishing environmental comfort, efficiency, and aesthetic value, and disrupting the balance of ecosystems and natural resources.

Environmental conditions and the healthcare sector are closely interconnected, particularly with regard to environmental pollution (Amelia et al., 2020). One significant source of pollution originates from healthcare activities in hospitals, which generate various types of waste, particularly medical waste from different service units (Yustiani, 2019). This is consistent with the Indonesian Minister of Health Regulation No. 18 of 2020, which stipulates that all activities carried out in healthcare facilities have the potential to generate medical waste. If not managed properly, medical waste can degrade environmental quality and pose serious risks to public health. Its impacts include the transmission of various diseases through exposure to bacteria, viruses, hazardous chemical compounds, pesticides, and heavy metals such as mercury (Hg), lead (Pb), and cadmium (Cd) (Putri, 2018).

As the demand for healthcare services continues to increase, the number of hospitals in Indonesia has also grown steadily. According to data from the Indonesian Ministry of Health (2024), there were 3,217 hospitals operating across the country under various management systems. This increase in the number of hospitals has directly contributed to a corresponding rise in the volume of medical waste generated (Alam et al., 2024).

Healthcare activities generate various types of waste, including solid, liquid, and gaseous waste, which may contain hazardous and toxic substances (B3) (Ichsan et al., 2025). Hazardous and toxic waste generated by hospitals originates from all healthcare-related activities conducted within the facility. Approximately 10–20% of the waste produced by healthcare facilities is classified as hazardous and toxic (B3) waste, while the remaining 75–90% consists of non-hazardous or domestic waste (Elvania & Purwaningrum, 2024). Kandari (2024) emphasized that waste has become one of the most significant global environmental challenges, attracting widespread attention from stakeholders at the local, regional, national, and international levels, particularly in efforts to reduce the continuously increasing volume of waste generated each year.

According to Kandari (2024), improperly managed waste can cause environmental pollution and contribute to methane (CH_4) emissions. This is supported by Muhelni et al. (2024),

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who reported that methane gas poses risks to human health. Methane is also one of the major greenhouse gases contributing to climate change. Climate change has serious consequences for both human health and the environment, including rising global temperatures, more frequent extreme weather events, and an increased incidence of disease (Melo & Rahmadani, 2022).

The East Kolaka Regional General Hospital (RSUD) is the only primary referral hospital in East Kolaka Regency, Indonesia. Originally established as the Welala Community Health Center (*Puskesmas Welala*), it was subsequently upgraded to a regional general hospital after obtaining an operational license from the Ministry of Health of the Republic of Indonesia (Ahmadi et al., 2022).

Based on preliminary observations conducted at the East Kolaka Regional General Hospital (RSUD) in 2025, a substantial patient volume was recorded, comprising 15,398 inpatient admissions and 2,704 outpatient visits. This high patient volume, particularly among inpatients, has directly contributed to an increase in the amount of medical waste generated on a daily basis.

These findings underscore the importance of evaluating the solid medical waste management system at the East Kolaka Regional General Hospital (RSUD). This is consistent with the findings of Endika et al. (2023), who emphasized that hospital waste management requires intensive monitoring and effective management to prevent adverse impacts on the environment and public health.

This study aimed to evaluate the compliance of the solid medical waste management system at the East Kolaka Regional General Hospital (RSUD) with the Indonesian Minister of Environment and Forestry Regulation No. 6 of 2021 and the Indonesian Minister of Health Regulation No. 18 of 2020.

METHODS

This study was conducted at the East Kolaka Regional General Hospital (RSUD), located at Jl. Drs. H. Abd. Silondae No. 35, Welala Village, Ladongi District, East Kolaka Regency, Southeast Sulawesi, Indonesia.

Materials and Equipment

The study focused on all aspects of the hospital related to solid medical waste management. The equipment used included a smartphone camera for documentation, stationery for recording research data, and an observation checklist to systematically collect and organize the study data.

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Population and Sample

The study population consisted of all personnel at the East Kolaka Regional General Hospital, totaling 264 individuals, including physicians, nurses, security personnel, pharmacists, environmental health officers, and cleaning staff. Participants were selected using a purposive sampling technique. Informants were chosen based on predetermined inclusion criteria established by the researchers, and selected informants subsequently recommended other individuals who met the study criteria. A total of five key informants participated in the study, comprising a hospital administrative officer, the Head of the Environmental Health Unit and an administrative staff member, the Head of Administration, and the Head of the Supporting Services Unit.

Data Types and Sources

This study employed a quantitative descriptive approach. Primary data were collected through direct field observations, while secondary data were obtained from published journal articles and archival records of the East Kolaka Regional General Hospital.

Data Collection Techniques

The data collection techniques used in this study were observation and documentation techniques.

Research Procedure

This study began with the initial data collection at the East Kolaka Regional General Hospital through field observations and literature reviews from various relevant sources to obtain the basic information required. Subsequently, the researcher collected and prepared the data to be obtained during the study, as well as prepared the necessary materials and equipment. The researcher then prepared and processed the research permit documents as a requirement for conducting field data collection. After all preparations were completed, the research activities were carried out at the East Kolaka Regional General Hospital through interviews with authorized personnel responsible for hospital waste management, as well as direct observations to determine whether the waste management practices complied with Minister of Environment and Forestry Regulation Number 6 of 2021 and Minister of Health Regulation Number 18 of 2020. The data obtained from the interviews and observations were then collected, processed, and organized into a comprehensive dataset to address the research objectives.

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Research Variables

This study uses two variables, with the main variable being Solid Medical Waste Management, which is further described into several sub-variables or assessment aspects based on the indicators stated in Minister of Environment and Forestry Regulation Number 6 of 2021. The supporting variables include hospital management in waste management, Human Resources (HR) involved in waste handling based on Minister of Health Regulation Number 18 of 2020, and climate data of East Kolaka Regency.

Data Analysis

The observation results will be converted into quantitative data using a Likert scale. A Likert scale is a technique used to measure attitudes, responses, and perceptions of individuals or groups of people regarding social phenomena (Nurbayti et al., 2024), which will then be analyzed descriptively. This study will be conducted as follows: the researcher will conduct in-depth interviews with informants to obtain the required data, and then the researcher will analyze the level of compliance with the applicable regulations. A score of 1 is assigned if the facilities and infrastructure listed in the observation table are unavailable. A score of 2 is assigned if the facilities and infrastructure are available but do not comply with the standards specified in the regulations. A score of 3 is assigned if the facilities and infrastructure are available and comply with the regulatory standards. The scoring calculation using the Likert scale is presented in Table 1.

Table 1. Likert Scale Used to Analyze the Evaluation Results

Question	NC	PC	C
Score	1	2	3

NC = Not Compliant

PC = Partially Compliant

C = Compliant (Cahwariwasya et al., (2025)

The formula used to process the data obtained from the Likert scale is as follows: the observed score is the sum of the scores from each checklist statement item multiplied by the score weight according to the Likert scale. The maximum score is the highest score on the Likert scale multiplied by the number of statement items. The expected total score is the maximum score multiplied by the number of respondents. The formula used to process the data from the Likert scale is presented in Equation 1.

$\Sigma_{\text{Observasion Score}} = (n \times 1) + (n \times 2) + (n \times 3)$ = ...(1)

The formula for the feasibility percentage is presented in Equation 2.

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Feasibility Percentage $= \frac{Observasion\ Score}{\text{Expected Score}} \times 100\%$.....(2)

The evaluation results for each management stage will be summed and averaged. Subsequently, the calculated evaluation results will be compared with the predetermined assessment standards to obtain the final evaluation rating. The criteria for determining the final assessment of the compliance percentage are presented in Table 2.

Table 2. Categories for Assessing the Compliance of Solid Medical Waste Management

Percentage Value (%)	Category
0-20%	Highly Non-Compliant
21-40%	Non-Compliant
41-60%	Moderately Compliant
61-80%	Compliant
81-100%	Highly Compliant

Cahwariwasya et al., 2025

The presentation of data in this study aims to provide a clear and systematic overview of the observation results regarding the implementation of solid medical waste management at the East Kolaka Regency Regional General Hospital. The data obtained from the field through observation sheets are presented in the form of tables, graphs, and descriptive explanations to facilitate understanding and analysis. Therefore, the data presentation in this study not only displays numbers or percentages but also provides an overview of the implementation of solid medical waste management at the East Kolaka Regency Regional General Hospital.

RESULTS DAN DISCUSSION

The research findings of this study are presented in Tables 1–5, which provide a comprehensive summary of the data collected and analyzed throughout the research.

Evaluation of Solid Medical Waste Management at the East Kolaka Regional General Hospital

The evaluation of the solid medical waste management system at the East Kolaka Regional General Hospital (RSUD), based on field observations and interviews with key informants, is presented in Table 3.

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Table 3. Evaluation of Hospital Medical Solid Waste Reduction

NO	Criteria Based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 6 of 2021	Existing Condition	Score
1	A reduction in the amount of medical solid waste generated has been implemented	Non-compliant	1
2	Measures have been implemented to reduce the amount of medical solid waste generated	Non-compliant	1
Σ Observation Score= (2 x 1) + (0 x 2) + (0 x 3) = 2			
Compliance Rate $= \frac{2}{6} \times 100\%$ = 33,3 %			

Source: Primary Data, Processed by the Authors (2026)

The evaluation checklist yielded a total score of 2 out of a maximum possible score of 6, resulting in a compliance level of 33.3% for the waste minimization stage. This percentage falls within the non-compliant category. The evaluation results for the waste segregation stage are presented in Table 4.

Table 4. Evaluation of Medical Solid Waste Collection at the Regional General Hospital of Kolaka Timur Regency

NO	Criteria Based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 6 of 2021	Existing Condition	Score
1	Segregation of medical solid waste is implemented	Compliant	3
2	Medical solid waste is collected for a maximum period of 90 (ninety) days	Compliant	3

Σ Observation Score = (0 x 1) + (0 x 2) + (2 x 3) = 6

Compliance Rate $= \frac{6}{6} \times 100\%$ = 100 %

Source: Primary Data, Processed by the Authors (2026)

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The evaluation checklist produced a total score of 6 out of a maximum score of 6, corresponding to a compliance level of 100% for the waste collection stage. This result was classified as highly compliant. The evaluation results for the temporary storage stage are presented in Table 5.

Table 5. Evaluation of Medical Solid Waste Storage at the Regional General Hospital of Kolaka Timur Regency

NO	Parameter	Criteria Based on Minister of Environment and Forestry Regulation No. 6 of 2021	Existing Condition	Score
1	Building Identification	The exterior of the storage facility is equipped with a nameplate	Non-compliant	1
		Appropriate symbols and labels are provided according to the characteristics of the waste generated	Non-compliant	1
2	Protection from Rainwater	The storage facility is protected from rainwater, either directly or indirectly	Compliant	3
3	Ventilation System	Adequate air circulation is provided	Partially Compliant	2
4	Lighting	Adequate lighting is provided through natural sunlight and/or artificial lighting	Partially Compliant	2
5	Lightning Protection	A lightning protection system is installed	Non-compliant	1
6	Roofing Material	The roof is constructed from non-combustible materials	Compliant	3
7	Floor Construction	The floor is impermeable to water	Compliant	3
		The floor is structurally strong	Compliant	3
		The floor surface is even	Compliant	3
		The floor is free from cracks	Non-compliant	1
		The interior floor slopes downward,	Compliant	3

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		and the exterior floor is designed to prevent rainwater from entering the storage area		
8	Packaging	Medical solid waste is packaged using plastic materials	Compliant	3
9	Storage Period	Waste is stored in accordance with the storage period specified in the permit	Compliant	3
10	Location	The storage facility is located in a flood-free area and is not prone to natural disasters	Compliant	3
11	Monitoring	A logbook for recording incoming and outgoing waste is maintained	Compliant	3
		The quantity and type of waste are recorded in accordance with the logbook	Compliant	3
12	Available Facilities	A fire protection system is available	Non-compliant	1
13	Emergency Response Equipment	Standard Operating Procedures (SOPs) for waste storage are available	Non-compliant	1
		Standard Operating Procedures (SOPs) for emergency response are available	Non-compliant	1
14	Maintenance	The cleanliness of the storage facility is properly maintained	Non-compliant	1

$\Sigma_{\text{Total Observation Score}} = (8 \times 1) + (2 \times 2) + (11 \times 3) = 45$

$$\text{Compliance Percentage} = \frac{45}{63} \times 100\% = 71{,}4\ \%$$

Source: Primary Data, Processed by the Authors (2026)

The evaluation of the temporary storage stage yielded a total score of 45 out of a maximum score of 63, corresponding to a compliance level of 71.4%. According to the established assessment criteria, this stage was classified as compliant. The evaluation results for

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the waste transportation stage are presented in Table 6.

Table 6. Evaluation of Medical Solid Waste Transportation at the Regional General Hospital of Kolaka Timur Regency

NO	Criteria	Criteria According to the Indonesian Minister of Environment and Forestry Regulation No. 6 of 2021	Existing Condition	Score
1	Waste Transportation Equipment	Four-Wheeled Transport Vehicle	Compliant	3
		The Company Name Is Displayed on All Four Sides of the Vehicle	Compliant	3
		The Company's Telephone Number Is Displayed on the Right, Left, and Rear Sides of the Vehicle	Non-compliant	1
2	Symbol Placement	Hazardous Waste (B3) Symbols Are Displayed on All Four Sides of the Vehicle in Accordance with the Characteristics of the Hazardous Waste Being Transported	Non-compliant	1
3	packaging	Packaging of the Waste to Be Transported	Compliant	3
4	Monitoring	Transportation Permit Documentation	Non-compliant	1
$\Sigma_{\text{Total Observation Score}} = (3 \times 1) + (0 \times 2) + (3 \times 3) = 12$				
Compliance Percentage $= \frac{12}{18} \times 100\% = 66{,}6\ \%$				

Source: Primary Data, Processed by the Authors (2026)

The evaluation checklist resulted in a total score of 12 out of a maximum score of 18, representing a compliance level of 66.6%. Based on the assessment criteria, the transportation stage was classified as compliant. The evaluation results for the managerial aspects of solid medical waste management are presented in Table 7.

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Table 7. Results of the Managerial Evaluation of Medical Waste Management at the East Kolaka Regency Regional General Hospital

NO	Criteria	Criteria according to the Indonesian Minister of Health Regulation No. 18 of 2020	Existing Condition	Score
1	Regulations and Standard Operating Procedures (SOPs)	Has Standard Operating Procedures (SOPs) for Solid Medical Waste Management	Compliant	3
		A Clearly Defined Organizational Structure Assigns Responsibility for Waste Management	Compliant	3
2	Human Resources (HR)	All Personnel Who Handle Waste Have Received Training/Socialization	Non-compliant	1
		Waste Handling Personnel Are Provided with Personal Protective Equipment (PPE)	Partially Compliant	2
3	Recording	The Regional General Hospital (RSUD) Has a Daily Logbook/Balance Record That Documents the Volume/Weight of Generated Solid Medical Waste	Compliant	3
4	Reporting	The Regional General Hospital Routinely Submits Waste Management Implementation Reports to the Regional Environmental Agency	Non-compliant	1
$\Sigma_{\text{Total Observation Score}} = (2 \times 1) + (1 \times 2) + (3 \times 3) = 13$				
Compliance Percentage $= \frac{13}{18} \times 100\% = 72{,}2\%$				

Source: Primary Data, Processed by the Authors (2026)

The evaluation results from the checklist obtained a score of 13 out of a total score of 18, with the conformity percentage at the managerial stage reaching 72.2%. This percentage is

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categorized as “Compliant.” The results of the evaluation of solid medical waste storage at the East Kolaka Regency Regional General Hospital (RSUD) are presented in Table 8.

Table 8. Results of the Evaluation of Solid Medical Waste Management

NO	Evaluation Stage	Number of Criteria	NC	PC	C	Achievement Percentage (%)	Description
1	Reduction	2	1	0	1	33,3%	Not Compliant
2	Collection	2	0	0	2	100%	Highly Compliant
3	Storage	22	8	2	12	71,4%	Compliant
4	Transportation	6	3	0	3	66,6%	Compliant
5	Managerial	6	2	1	3	72,2%	Highly Compliant
	Total	35	14	3	21		
Average Achievement Percentage of Medical Waste Management at the East Kolaka Regency Regional General Hospital						68,70%	Compliant

Source: Primary Data, Processed by the Authors (2026)

The evaluation results presented in Table 5.8 indicate that solid medical waste management at the East Kolaka Regency Regional General Hospital has been categorized as "Compliant" with an overall achievement percentage of 68.70%. Although the collection aspect obtained a score of 100% and was implemented very well, the managerial aspect (66.6%), storage (71.4%), and transportation (66.60%) still require technical improvements in facilities and distribution efficiency. The main critical point was identified in the waste reduction stage, which only achieved 33.30% and was categorized as "Not Compliant". This indicates that waste reduction at the source has not been implemented optimally. Therefore, efforts to reduce waste and strengthen waste monitoring in each service unit are needed to minimize the generation of medical waste.

DISCUSSION

Solid Medical Waste Reduction

Solid medical waste reduction is an effort to minimize the amount of waste generated by healthcare facilities through strategies such as material substitution, changes in work

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procedures, and efficiency improvements. The objective is to minimize negative impacts on human health and the environment (Agustini et al., 2026). Minister of Environment and Forestry Regulation Number 6 of 2021 Chapter 3 Article 49 Paragraph (1) states that “Every person who generates Hazardous and Toxic Waste (B3 Waste) is required to carry out B3 Waste Reduction.” Therefore, healthcare facilities are obligated to implement solid medical waste reduction measures for the waste they generate.

Based on information obtained by the researcher from the Head of Environmental Health at the East Kolaka Regency Regional General Hospital, it was stated that the hospital has not yet implemented medical waste reduction efforts. The waste generation depends on the number and needs of patients; “if there are many patients, the amount of medical waste will automatically increase.”

Solid Medical Waste Segregation

Solid medical waste segregation at the East Kolaka Regency Regional General Hospital is carried out properly. Solid medical waste originating from each unit is segregated into two waste bags, namely infectious and non-infectious waste. Infectious waste contained in the yellow bags will be sorted again before transportation and handed over to a third party. Needle waste, glass bottles, and infusion sets have their own respective safety boxes, while expired pharmaceutical waste is packaged in boxes and returned to the company. This is in line with (Arlinda et al., 2022), who stated that each medical waste generator is provided with three types of separate containers, namely two waste bins and one safety box.

Solid Medical Waste Storage

Solid medical waste storage at the East Kolaka Regency Regional General Hospital is categorized as compliant. However, there are several aspects that do not meet the criteria used as standards in the evaluation process, namely the absence of building identification displayed at the temporary storage facility, inadequate lighting systems, available facilities, emergency response system equipment, and maintenance. Although the assessment results indicate that solid medical waste storage at the East Kolaka Regency Regional General Hospital is categorized as "Compliant," several aspects still do not meet the required standards.

The role of the local government is needed to facilitate temporary storage facilities as stated in Minister of Health Regulation Number 18 of 2020 Chapter 3 Article 7 Paragraph (4), which states that "temporary collection facilities can be provided by the Regional Government." Therefore, collaboration between the hospital and the local government is necessary to address

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solid medical waste management issues that may pose risks to both waste-handling personnel and the community, as well as its potential to cause environmental pollution.

Solid Medical Waste Transportation

Solid medical waste transportation at the East Kolaka Regency Regional General Hospital is carried out using a four-wheeled vehicle owned by the local Environmental Agency, while the transportation of waste from each hospital unit is conducted by 15 cleaning service personnel. Each waste item to be transported is packaged beforehand as regulated in Minister of Environment and Forestry Regulation Number 6 of 2021 Article 86 Paragraph (1). Unfortunately, the hospital does not have a waste transportation permit as regulated in Minister of Environment and Forestry Regulation Number 6 of 2021 Article 89 Paragraph (1b). Every shipment of hazardous and toxic waste (B3 waste) from the hospital to the processing or disposal party must be accompanied by a B3 waste manifest signed and stamped by the hospital, the transporter, and the B3 waste processor/disposer, which is then archived by the hospital.

Theocentric environmental ethics emphasizes the obligation of hospitals to prevent environmental pollution caused by medical operations. Humans and the environment are actualizations and instruments of God's creation (Sutanto and Karianga, 2023). In the context of medical waste management, this obligation is reflected in every stage of management, including the medical waste transportation process. Transportation that is not carried out according to procedures, such as the use of non-leak-proof containers, vehicles that do not meet requirements, or improper handling, has the potential to cause leakage, waste spills, and the spread of infectious materials that may contaminate soil, water, and air. Therefore, the implementation of safe medical waste transportation procedures is not only an administrative obligation in accordance with regulations but also represents the hospital's ethical responsibility in maintaining environmental sustainability as a trust that must be preserved.

Managerial Aspects of Medical Waste Management

One of the factors supporting the success of hospitals in waste management is managerial support (Sawani et al., 2025). The managerial aspects of the East Kolaka Regency Regional General Hospital in managing waste are still categorized as "Compliant" based on Minister of Health Regulation Number 18 of 2020, particularly Chapter V Articles 14–15 concerning recording and reporting, as well as Chapter VI Articles 16–17 concerning guidance and supervision. However, several deficiencies were still found, including the absence of routine reporting to relevant agencies as regulated in Article 14 Paragraph (3), the lack of training

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provided for all personnel involved in waste handling as regulated in Article 9 Letter c, Article 12 Letter c, and Article 13 Letter e, and the unavailability of adequate Personal Protective Equipment (PPE) for waste handling personnel according to Appendix I, where the available PPE only consists of gloves.

These conditions indicate that managerial functions have not been implemented optimally, particularly in terms of personnel competency development and worker protection. This is in line with the opinion of Aulia et al. (2021) in Lismawati (2024), which states that human resources with knowledge regarding environmental issues and management are important factors in achieving excellent environmental performance. Therefore, the lack of optimal training, guidance, and provision of PPE may reduce the competence of personnel in managing medical waste safely and according to standards, thereby affecting the effectiveness of waste management in hospitals.

CONCLUSION

The evaluation results of solid medical waste management at the East Kolaka Regency Regional General Hospital based on Minister of Environment and Forestry Regulation Number 6 of 2021 and Minister of Health Regulation Number 18 of 2020 indicate that the average achievement percentage of solid medical waste management was 68.70%, which is included in the "Compliant" category. These results indicate that, in general, the solid medical waste management system at the East Kolaka Regency Regional General Hospital has fulfilled most of the requirements specified in both regulations, although several aspects still require improvement to enhance the level of compliance with optimal medical waste management standards.

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