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Evaluation Of Hazardous and Toxic Waste Management at PKU Muhammadiyah Hospital Surabaya Using the CIPP Method

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ABSTRACT Healthcare institutions generate substantial quantities of hazardous and toxic waste that pose significant environmental and public health risks if improperly managed. Despite regulatory frameworks governing medical waste management, compliance and implementation effectiveness remain inconsistent across healthcare facilities, necessitating a comprehensive evaluation of current practices. This study evaluates the hazardous and toxic waste management system at RSU PKU Muhammadiyah Surabaya Hospital, examining its compliance with regulatory standards and identifying areas for improvement to enhance environmental safety and public health protection. A Descriptive research design was employed, incorporating both primary data collection through structured interviews with waste management personnel and secondary data analysis from institutional records. Direct observations of waste handling procedures were conducted to assess practical implementation. The Context, Input, Process, and Product (CIPP) evaluation model served as the analytical framework for a comprehensive assessment of the waste management system's effectiveness. The evaluation revealed mixed findings across CIPP components. Context evaluation, based on interviews and observational data, demonstrated good performance in the policy framework and regulatory awareness. Input, process, and product evaluations yielded positive results from interview data, indicating adequate resource allocation and procedural knowledge. However, observational assessments revealed deficiencies in practical implementation, with several CIPP variables failing to meet established assessment criteria. This discrepancy suggests a gap between theoretical understanding and operational execution. While RSU PKU Muhammadiyah Surabaya Hospital demonstrates general compliance with Ministry of Health Regulation No. 2 of 2023 regarding hazardous waste management, implementation remains suboptimal due to infrastructural limitations and resource constraints. The hospital requires enhanced facilities, updated equipment, and strengthened procedural adherence to ensure comprehensive waste management that protects both healthcare workers and the surrounding community from potential health hazards.

INDEX TERMS Hazardous waste management, Healthcare facilities, CIPP evaluation model, Medical waste, Environmental health.

I. INTRODUCTION

Healthcare institutions globally serve as critical infrastructures providing essential medical services to populations requiring professional healthcare intervention [1]. The proliferation of healthcare facilities, particularly hospitals, has resulted in substantial increases in waste generation, encompassing both conventional solid waste and hazardous medical waste streams [2]. Contemporary hospitals generate two distinct waste categories: non-medical waste analogous to municipal solid waste, and medical waste classified as hazardous and toxic materials requiring specialized management protocols [3]. The cost estimation and assessment of healthcare waste treatment systems for preventing financial and environmental damage are essential, as inadequate waste management practices can precipitate significant medical disruptions and environmental contamination affecting both healthcare facilities and surrounding communities [4].

The magnitude of healthcare waste generation in Indonesia demonstrates alarming trends, with national statistics indicating daily production of 48,985 tons of liquid medical waste and 376,089 tons of solid medical waste across healthcare networks [5]. Despite regulatory frameworks mandating proper waste management, compliance remains suboptimal, with only 26.7% of healthcare facilities implementing waste management according to established standards as of 2021, representing a marginal improvement from 18.9% in 2020 [6]. Analysis reveals that the amount of hazardous healthcare waste has increased by 20.19% over the recent five-year period, with generation rates varying between 1.13 and 1.31 kg/bed/day. Contemporary healthcare waste management evaluation employs various

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methodological approaches to assess system effectiveness and regulatory compliance. Descriptive cross-sectional survey methods have been utilized to assess medical waste management practices in hospital settings, while economic evaluation frameworks provide comprehensive analyses of treatment system performance [7]. The Context, Input, Process, and Product (CIPP) model represents a comprehensive evaluation perspective that provides information to facilitate optimal decision-making processes [8]. Recent applications of the CIPP model in healthcare contexts have demonstrated its efficacy in systematic program evaluation, with mixed-methods approaches utilizing CIPP frameworks for developing comprehensive evaluation criteria and indicators [9].

Advanced evaluation methodologies incorporate circular economy principles and life-cycle assessment approaches to optimize waste management systems [10]. Contemporary evaluation frameworks emphasize the development of systematic assessment systems based on CIPP models for quality evaluation in healthcare contexts [11]. While extensive literature addresses healthcare waste management practices globally, significant gaps persist in comprehensive evaluation frameworks specifically tailored for Indonesian healthcare contexts. Limited studies have employed CIPP evaluation models for systematic assessment of hazardous waste management in hospital settings, particularly within developing nations facing resource constraints and regulatory enforcement challenges [12]. Furthermore, existing research lacks integration of regulatory compliance assessment with practical implementation evaluation, creating disconnects between policy frameworks and operational realities [13]. The scarcity of comprehensive evaluation studies addressing the full spectrum of waste management processes from generation to final disposal represents a critical knowledge gap requiring systematic investigation [14].

This study aims to comprehensively evaluate the hazardous and toxic waste management system at RSU PKU Muhammadiyah Surabaya Hospital through a systematic application of the CIPP evaluation model, assessing compliance with Ministry of Health Regulation No. 2 of 2023 while identifying operational deficiencies and improvement opportunities.

This research contributes to the academic and practical domains through several significant aspects:

1. Provides a comprehensive evaluation framework specifically adapted for Indonesian healthcare waste management contexts, offering a replicable methodology for similar institutional assessments [15].
2. The study bridges the gap between regulatory compliance assessment and practical implementation evaluation by employing mixed-methods approaches combining observational and interview-based data collection [16].
3. Establishes baseline performance indicators for hospital waste management systems in developing country contexts, contributing valuable data for policy refinement and institutional improvement initiatives [17]. Fourth, the research demonstrates practical application of CIPP evaluation methodology in healthcare waste management contexts, expanding the model's application beyond traditional educational program evaluation [18]. Fifth, it provides evidence-based recommendations for infrastructure enhancement and procedural optimization that can inform similar healthcare institutions facing comparable challenges [19].

This article is organized into six principal sections following this introduction. Section II presents the comprehensive literature review examining current healthcare waste management practices and evaluation methodologies. Section III details the research methodology, including CIPP model application, data collection procedures, and analytical frameworks. Section IV presents comprehensive findings from context, input, process, and product evaluations. Section V discusses implications, limitations, and comparative analysis with existing literature. Section VI concludes with key findings, recommendations, and future research directions.

II. METHOD

A. RESEARCH DESIGN AND STUDY SETTING

This investigation employed a descriptive cross-sectional research design utilizing the Context, Input, Process, and Product (CIPP) evaluation framework to systematically assess hazardous and toxic waste management practices at RSU PKU Muhammadiyah Surabaya Hospital [20]. The CIPP evaluation model was selected based on its comprehensive perspective for evaluating healthcare programs and its demonstrated efficacy in medical education and healthcare service assessment contexts [21]. This approach provides a structured methodology for examining multiple dimensions of waste management implementation while facilitating evidence-based decision-making processes [22]. The research was conducted at RSU PKU Muhammadiyah Surabaya Hospital, a tertiary healthcare facility located in Surabaya, East Java, Indonesia. The study population comprised healthcare personnel directly responsible for hazardous and toxic waste management operations, including environmental health officers, waste management coordinators, nursing supervisors, and housekeeping personnel involved in waste handling procedures. Purposive sampling was employed to select participants based on their direct involvement in waste management activities and their comprehensive knowledge of institutional waste management protocols.

B. STUDY VARIABLES AND FRAMEWORK

The investigation focused on four primary evaluation components aligned with the CIPP model structure. The context component assessed organizational foundations, regulatory alignment, and institutional objectives concerning hazardous waste management implementation. Input evaluation examined human resource capabilities, infrastructure adequacy, budgetary allocations, and equipment availability supporting waste management operations [23]. Process evaluation investigated the implementation of waste management procedures, including

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waste minimization strategies, segregation protocols, packaging standards, internal transportation systems, and temporary storage facilities. Product evaluation measured the conformity of current waste management practices with Ministry of Health Regulation No. 2 of 2023 and assessed overall program effectiveness [24].

C. DATA COLLECTION INSTRUMENTS

Data collection utilized a mixed-methods approach incorporating structured interview protocols and systematic observational checklists. The interview instrument consisted of standardized questionnaires with dichotomous response options (yes/no) designed to assess compliance with established waste management standards and regulatory requirements. Observational checklists were developed to document actual waste management practices, infrastructure conditions, and procedural adherence during real-time operations. Both instruments were validated through expert review and pilot testing to ensure content validity and reliability [25]. Primary data collection was conducted through semi-structured interviews with key personnel responsible for hazardous waste management operations. Each interview session lasted approximately 45-60 minutes and was conducted in the Indonesian language to ensure participant comprehension and response accuracy. Systematic observations were performed during multiple visits to document waste management activities across different operational periods, including peak and non-peak hospital activity times. Secondary data were obtained from institutional records, standard operating procedures, waste management policies, and regulatory compliance documentation.

D. ANALYTICAL FRAMEWORK AND DATA ANALYSIS

Descriptive analytical techniques were employed to interpret collected data according to CIPP evaluation criteria. Each component was assessed using predefined performance indicators derived from regulatory standards and best practice guidelines [26]. Context evaluation examined the alignment between institutional objectives and regulatory requirements for hazardous waste management. Input assessment analyzed resource adequacy and infrastructure capabilities supporting program implementation. Process evaluation investigated procedural compliance and operational effectiveness across all waste management stages. Product evaluation measured overall program outcomes and regulatory conformity. Quantitative data from interview responses were analyzed using descriptive statistics to calculate compliance percentages for each CIPP component. Observational data were systematically categorized and coded according to predetermined criteria reflecting regulatory compliance levels. Triangulation of interview and observational data was performed to enhance the validity and reliability of findings. Results were interpreted using a three-level categorization system: good (>80% compliance), sufficient (60-80% compliance), and poor (<60% compliance) based on established evaluation frameworks [27].

E. ETHICAL CONSIDERATIONS

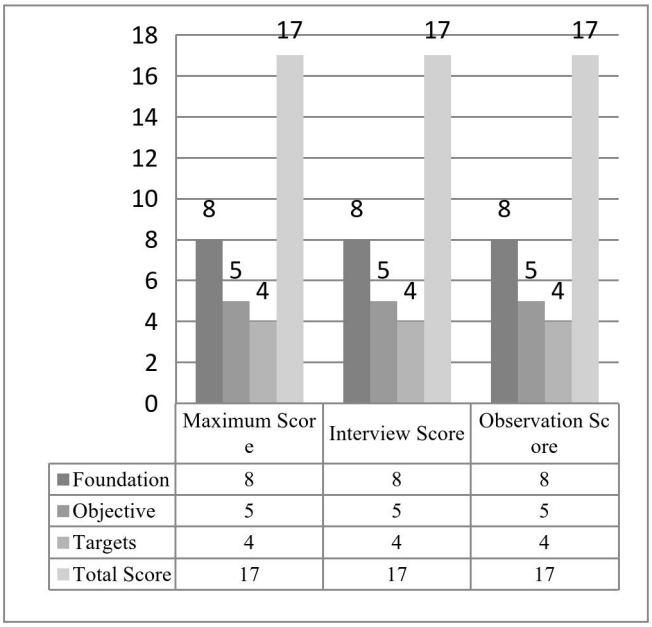
The research protocol received ethical approval from the institutional review board of RSU PKU Muhammadiyah Surabaya Hospital. Informed consent was obtained from all participants before data collection, ensuring voluntary participation and confidentiality protection. Participants were informed of their right to withdraw from the study at any time without consequences. All collected data were anonymized and stored securely according to institutional data protection protocols.

F. STUDY LIMITATIONS

This investigation was limited to a single healthcare institution, potentially affecting the generalizability of findings to other hospital settings. The cross-sectional design provided a snapshot of current practices without examining temporal variations in waste management performance. Reliance on self-reported data through interviews may introduce response bias, although observational validation was employed to mitigate this limitation [28].

III. RESULTS

FIGURE 1
Empirical Data Result of the Input for Hazardous and Toxic Waste Management at PKU Muhammadiyah Hospital Surabaya



	Maximum Score	Interview Score	Observation Score
Foundation	8	8	8
Objective	5	5	5
Targets	4	4	4
Total Score	17	17	17

Based on empirical data obtained through structured interviews and systematic field observations conducted within the environmental health domain at RSU PKU Muhammadiyah Surabaya, the context evaluation component, as illustrated in FIGURE 1, demonstrates uniform assessment outcomes across all evaluated variables about the foundational framework, institutional objectives, and strategic goals of hazardous and toxic waste management implementation. The foundational variable achieved optimal performance with a score of 8 points from a maximum possible score of 8 points, while the objectives variable attained full compliance scoring 5 points out of a maximum allocation of 5 points, and the goals variable demonstrated complete adherence with a score of 4 points from a maximum of 4 points. The aggregate score derived from both interview responses and observational

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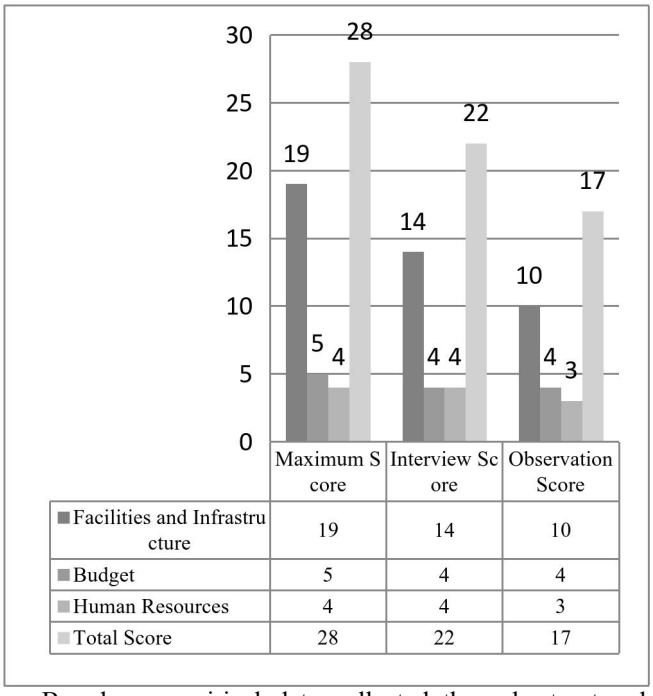
assessments for the context evaluation component yielded a cumulative score of 17 points, representing 100% achievement of the maximum possible score of 17 points. The comparative analysis of context evaluation scores for hazardous and toxic waste management indicates performance levels that satisfy the criteria for exemplary assessment classification.

FIGURE 2
Evaluation Result of the Input for Hazardous and Toxic Waste Management at PKU Muhammadiyah Hospital Surabaya

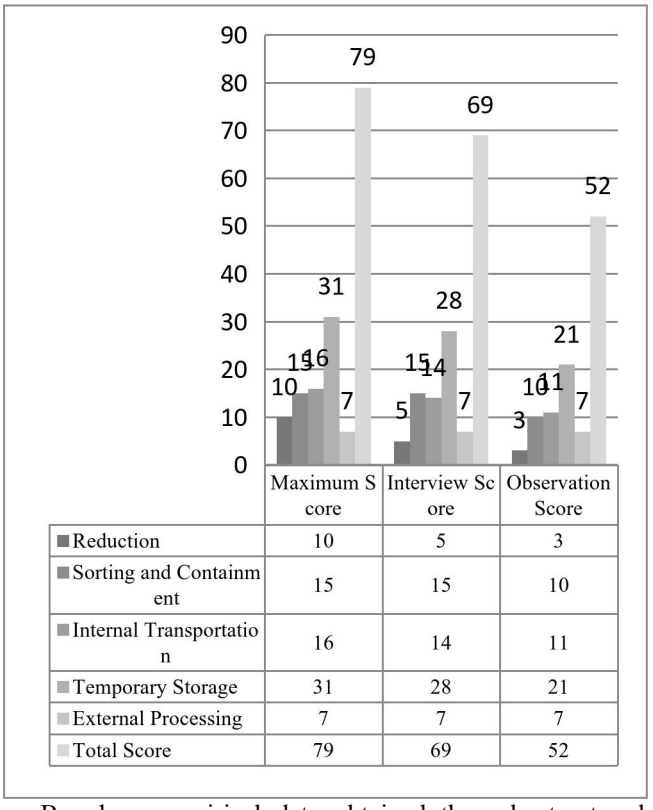


	Maximum Score	Interview Score	Observation Score
Facilities and Infrastructure	19	14	10
Budget	5	4	4
Human Resources	4	4	3
Total Score	28	22	17

Based on empirical data collected through structured interviews and systematic field observations conducted within the environmental health sector at RSU PKU Muhammadiyah Surabaya, the input evaluation component, as depicted in FIGURE 2, reveals notable discrepancies between assessment outcomes derived from interview responses and observational findings. The infrastructure variable demonstrated differential performance, achieving a score of 14 points through interview assessment compared to 10 points through observational evaluation, both measured against a maximum possible score of 19 points. The budgetary allocation variable exhibited consistent performance across both assessment methodologies, obtaining a score of 4 points from both interview and observational evaluations, relative to a maximum score of 5 points. The human resources variable showed variation between assessment approaches, with interview data yielding a score of 4 points while observational data produced a score of 3 points, both evaluated against a maximum threshold of 4 points. The cumulative input evaluation score derived from interview assessments totaled 22 points (78% achievement rate), whereas observational assessments yielded 17 points (60% achievement rate), both calculated against a maximum possible score of 28 points (100%). The comparative analysis of input evaluation scores for hazardous and toxic waste management indicates that interview-based assessments satisfy the criteria for exemplary performance classification, while observational findings correspond to adequate performance standards.

Based on empirical data obtained through structured interviews and systematic field observations conducted within the environmental health domain at RSU PKU Muhammadiyah Surabaya, the process evaluation component, as illustrated in FIGURE 3, demonstrates substantial disparities between assessment outcomes derived from interview methodologies and observational analyses.

FIGURE 3
Evaluation Results of the Process for Hazardous and Toxic Waste Management at PKU Muhammadiyah Hospital Surabaya



	Maximum Score	Interview Score	Observation Score
Reduction	10	5	3
Sorting and Containment	15	15	10
Internal Transportation	16	14	11
Temporary Storage	31	28	21
External Processing	7	7	7
Total Score	79	69	52

Based on empirical data obtained through structured interviews and systematic field observations conducted within the environmental health domain at RSU PKU Muhammadiyah Surabaya, the process evaluation component, as illustrated in FIGURE 3, demonstrates substantial disparities between assessment outcomes derived from interview methodologies and observational analyses. The waste reduction variable exhibited differential performance metrics, achieving a score of 5 points through interview assessment compared to 3 points via observational evaluation, both measured against a maximum possible score of 10 points. The segregation and packaging variables demonstrated notable variance, with interview data yielding a score of 15 points while observational data produced a score of 10 points, both evaluated against a maximum threshold of 15 points.

The internal transportation variable showed consistent discrepancy patterns, obtaining 14 points through interview assessment versus 11 points through observational evaluation, relative to a maximum score of 16 points. The temporary storage variable reflected similar assessment divergence, with interview responses generating a score of 28 points compared to 21 points from observational

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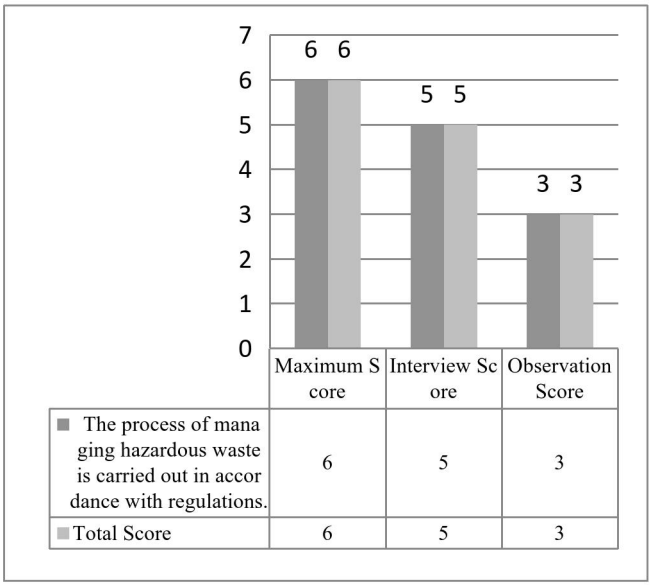
findings, both calculated against a maximum possible score of 31 points. The external processing variable demonstrated uniform performance across both assessment methodologies, achieving optimal scores of 7 points from both interview and observational evaluations against a maximum score of 7 points. The aggregate process evaluation score derived from interview assessments totaled 69 points (87% achievement rate), whereas observational assessments yielded 52 points (65% achievement rate), both measured against a maximum possible score of 79 points (100%). The comparative analysis of process evaluation scores for hazardous and toxic waste management indicates that interview-based assessments satisfy the criteria for exemplary performance classification, while observational findings correspond to adequate performance standards.

FIGURE 4
Evaluation Results of the Product for Hazardous and Toxic Waste Management at PKU Muhammadiyah Hospital Surabaya



Based on empirical data collected through structured interviews and systematic field observations conducted within the environmental health sector at RSU PKU Muhammadiyah Surabaya, the product evaluation component, as presented in FIGURE 4, reveals significant disparities between assessment outcomes derived from interview methodologies and observational analyses. The aggregate score obtained through interview assessment achieved 5 points, representing an 83% achievement rate, while observational evaluation yielded 3 points, corresponding to a 50% achievement rate, both measured against a maximum possible score of 6 points (100%). The comparative analysis of product evaluation scores for hazardous and toxic waste management demonstrates that interview-based assessments satisfy the criteria for exemplary performance classification, whereas observational findings correspond to adequate performance standards.

IV. DISCUSSION

The comprehensive evaluation of hazardous and toxic waste management at PKU Muhammadiyah Hospital Surabaya using the CIPP (Context, Input, Process, Product) model reveals a multifaceted perspective on the current state of B3 waste management practices. The systematic application of this evaluation framework demonstrates both significant achievements and critical areas requiring immediate attention within the hospital's waste management infrastructure. The context evaluation findings indicate that while the hospital operates under a solid regulatory foundation established by Ministerial Regulation No. 2 of 2023, the practical implementation of these guidelines reveals substantial gaps. The existence of comprehensive Standard Operating Procedures (SOPs) and formal partnerships with licensed waste management entities provides a robust theoretical framework. However, the absence of clear hazardous waste symbols on specialized bins and the lack of comprehensive awareness programs suggest a disconnect between policy formulation and operational execution. This finding aligns with contemporary healthcare waste management literature, which emphasizes that regulatory compliance extends beyond documentation to encompass behavioral changes and practical implementation [29].

The input evaluation reveals critical deficiencies in infrastructure and human resource management that significantly impact the effectiveness of the waste management program. The inadequate provision of essential safety equipment, including the absence of hand rub in spill kits and incomplete Personal Protective Equipment (PPE) for staff members, represents a fundamental breach of occupational safety standards. These findings are particularly concerning given that healthcare workers face elevated risks of exposure to hazardous materials during routine waste handling procedures. The financial adequacy demonstrated through dedicated budget allocations for environmental health teams indicates institutional commitment; however, this financial investment appears insufficient to address the comprehensive infrastructure requirements necessary for optimal waste management practices [30].

The process evaluation unveils the most significant operational challenges within the hospital's waste management system. The limited implementation of waste reduction strategies, particularly the absence of reuse policies and recycling initiatives, represents a missed opportunity for sustainable waste management practices. The inadequate segregation and packaging procedures, evidenced by the provision of single bins for multiple waste categories and suboptimal placement away from public areas, create potential health and safety risks. Furthermore, the use of public corridors for internal transport of hazardous waste without complete PPE compliance by cleaning personnel represents a serious protocol violation that could compromise patient, visitor, and staff safety [31]. The product evaluation demonstrates that while the hospital achieves regulatory compliance through licensed external processing partnerships and proper documentation procedures, the overall effectiveness of the waste management program remains suboptimal. The temporary storage facility's authorization by the Surabaya Environmental Agency indicates adherence to regulatory requirements; however, the identified deficiencies in storage practices and facility maintenance suggest that

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minimum compliance standards may be insufficient for optimal waste management outcomes [32].

The findings from this evaluation demonstrate both convergence and divergence with contemporary research in healthcare waste management. Recent studies examining hazardous healthcare waste treatment systems have emphasized the critical importance of comprehensive economic evaluation and systematic infrastructure assessment [33]. The economic analysis conducted by researchers examining 43 hospitals in Tehran revealed similar patterns of inadequate resource allocation and infrastructure deficiencies, particularly in Personal Protective Equipment provision and temporary storage facility optimization. These parallel findings suggest that the challenges identified at PKU Muhammadiyah Hospital Surabaya represent broader systemic issues within healthcare waste management practices globally. However, the current study's application of the CIPP evaluation model provides a more comprehensive analytical framework compared to traditional waste management assessments that focus primarily on compliance metrics. Previous research examining hospital waste management strategies has typically emphasized quantitative measures such as waste generation rates and disposal costs, with limited attention to the qualitative aspects of program implementation and stakeholder engagement [34]. The CIPP model's systematic evaluation of context, input, process, and product components offers a more nuanced understanding of the multifaceted challenges inherent in healthcare waste management systems.

Contrasting with international best practices documented in recent literature, the study reveals significant gaps in sustainable waste management approaches. European healthcare facilities increasingly emphasize circular economy principles and comprehensive waste reduction strategies, including material substitution and reuse policies [35]. The limited implementation of these approaches at PKU Muhammadiyah Hospital Surabaya suggests opportunities for adopting more progressive waste management methodologies that align with global sustainability initiatives. The comparative analysis also reveals variations in regulatory enforcement and compliance monitoring systems. While the hospital demonstrates adequate documentation and external processing partnerships, the operational implementation challenges suggest that regulatory frameworks may require enhanced enforcement mechanisms and continuous monitoring protocols to ensure effective practice implementation [36]. This finding contrasts with more rigorous compliance systems documented in developed healthcare systems, where comprehensive auditing and continuous improvement processes are standard practice.

Several methodological limitations must be acknowledged when interpreting these research findings. The single-site case study design, while providing comprehensive insights into PKU Muhammadiyah Hospital Surabaya's waste management practices, limits the generalizability of findings to other healthcare facilities with different organizational structures, resource availability, and regulatory contexts. The reliance on observational data and interview responses may introduce subjective bias and incomplete information gathering, particularly regarding sensitive operational practices or compliance issues that staff may be reluctant to disclose fully. The temporal limitations of the evaluation process represent another significant constraint. The assessment captured a snapshot of current practices without longitudinal analysis of improvement trends or seasonal variations in waste generation and management effectiveness. Healthcare waste patterns often fluctuate based on patient census, seasonal disease patterns, and emergencies, factors that were not comprehensively addressed in this evaluation framework [37].

The study's focus on the CIPP model components, while comprehensive, may have overlooked emerging evaluation frameworks that incorporate stakeholder engagement, environmental impact assessment, and community health considerations. Contemporary healthcare waste management evaluation increasingly emphasizes broader social and environmental implications beyond facility-specific operational metrics [38].

Despite these limitations, the research findings have significant implications for healthcare waste management policy and practice development. The systematic identification of infrastructure deficiencies and operational gaps provides a foundation for evidence-based improvement initiatives. Healthcare administrators can utilize these findings to prioritize resource allocation, focusing on critical areas such as PPE provision, staff training programs, and temporary storage facility upgrades. The research implications extend beyond individual facility improvements to encompass broader healthcare system considerations. The identified challenges in regulatory compliance implementation suggest the need for enhanced monitoring systems and continuous quality improvement processes within healthcare waste management oversight. Policy makers should consider developing more comprehensive evaluation frameworks that incorporate the multifaceted nature of healthcare waste management while ensuring practical implementation feasibility.

Future research directions should include longitudinal studies examining the effectiveness of intervention strategies based on CIPP evaluation findings. Comparative studies across multiple healthcare facilities with varying organizational characteristics would enhance understanding of contextual factors influencing waste management effectiveness. Additionally, cost-effectiveness analyses of comprehensive waste management improvements could provide valuable insights for resource allocation decisions within healthcare systems operating under financial constraints. The integration of emerging technologies, including digital monitoring systems and automated waste tracking mechanisms, represents an important area for future investigation. These technological innovations could address many of the operational challenges identified in this evaluation while providing continuous data collection capabilities for ongoing program assessment and improvement initiatives [39].

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V. CONCLUSION

This comprehensive evaluation aimed to assess the effectiveness of hazardous and toxic waste management practices at PKU Muhammadiyah Hospital Surabaya using the CIPP (Context, Input, Process, Product) evaluation model to identify strengths, deficiencies, and areas requiring improvement within the existing waste management framework. The systematic analysis revealed distinct performance levels across the four evaluation components, with the context evaluation demonstrating superior implementation quality, achieving a "good" categorization that reflects the hospital's robust regulatory foundation established through Ministerial Regulation No. 2 of 2023, comprehensive Standard Operating Procedures, and formal partnerships with licensed waste management entities spanning one-year contractual agreements. However, the input, process, and product evaluations collectively attained "sufficient" categorizations, indicating fundamental compliance with regulatory requirements while simultaneously revealing substantial opportunities for operational enhancement and optimization. Specifically, the input evaluation identified critical infrastructure deficiencies, including incomplete Personal Protective Equipment provisioning for 100% of waste handling personnel, the absence of hand rub supplies in spill response kits, and inadequate specialized uniforms for hazardous waste management staff.

The process evaluation uncovered significant operational shortcomings, particularly the utilization of single waste collection bins per room instead of categorized segregation systems, suboptimal placement of collection containers within public access areas, implementation of twice-daily internal transport schedules through patient corridors without complete PPE compliance, and temporary storage facilities equipped with non-functional exhaust ventilation systems. The product evaluation demonstrated regulatory compliance through twice-weekly external processing schedules and appropriate documentation protocols, yet highlighted the absence of comprehensive waste reduction strategies, limited recycling initiatives, and inadequate implementation of circular economy principles. Future research endeavors should focus on longitudinal effectiveness assessments of targeted intervention strategies, comparative multi-site evaluations across diverse healthcare facilities with varying organizational characteristics and resource availability, cost-effectiveness analyses of comprehensive infrastructure improvements, and integration of emerging digital monitoring technologies for continuous waste management optimization. This research contributes valuable empirical evidence to the healthcare waste management literature and provides a methodological framework for systematic evaluation that can be utilized by future researchers as a comparative reference and analytical foundation for similar investigations in hospital environmental management systems.

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FUNDING

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DATA AVAILABILITY

The datasets supporting the conclusions of this study were not generated or subjected to quantitative analysis during this investigation. The research findings are based on qualitative observations, interviews, and direct field assessments conducted at the study site.

AUTHOR CONTRIBUTION

Fani Rida Wanti conceptualized and designed the study, conducted comprehensive field observations and data collection at PKU Muhammadiyah Hospital Surabaya, and led the data analysis and interpretation using the CIPP evaluation model. Ferry Kriswandana contributed to the study methodology development, supervised the research implementation, and provided critical guidance throughout the evaluation process. Ernita Sari participated in the literature review, assisted with data collection and field observations, and contributed to the manuscript writing and editing process. Setiawan supported the data analysis and interpretation phases, provided expertise in hazardous waste management protocols, and contributed to manuscript revisions and critical feedback. Ts. Seow Ta Wee contributed to the conceptual framework development, provided methodological oversight, and participated in manuscript review and final editing. All authors collaborated in the interpretation of findings, reviewed and approved the final version of the manuscript, and agreed to be accountable for all aspects of the work, ensuring the integrity and accuracy of the research.

DECLARATIONS

ETHICAL APPROVAL

This investigation was conducted by ethical principles and received formal approval from the Institutional Review Board of RSU PKU Muhammadiyah Surabaya Hospital. Before the commencement of data collection procedures, comprehensive informed consent was secured from all study participants, thereby ensuring voluntary engagement and maintaining strict confidentiality safeguards throughout the research process. All participants were explicitly apprised of

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their unconditional right to discontinue participation at any stage of the study without incurring adverse consequences or penalties. Data management protocols adhered to rigorous anonymization procedures, with all collected information securely archived in compliance with institutional data governance standards and privacy protection regulations.

CONSENT FOR PUBLICATION PARTICIPANTS

All participants involved in this study provided explicit written consent for the publication of their anonymized data and research findings. Participants were fully informed about the intended publication of study results and granted permission for the dissemination of information obtained during the evaluation process, with assurance that individual identities would remain confidential and protected throughout the publication process.

COMPETING INTERESTS

The authors declare that they have no financial, personal, or professional relationships that could potentially influence or bias the conduct, analysis, or reporting of this research. No competing interests exist that could compromise the objectivity and integrity of this investigation into hazardous and toxic waste management practices at PKU Muhammadiyah Hospital Surabaya.

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