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Bridging Policy and Practice: Strengthening Medical Waste Governance in Indonesian Hospitals

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KEYWORDS

Medical Waste Governance; SWOT Evaluation; Environmental Health Policy; Hospital Management; Indonesia.

ABSTRACT:

Introduction: This study evaluates the medical waste management system in Indonesia, focusing on challenges related to policy implementation and waste handling practices within healthcare institutions. Indonesia's growing healthcare sector has led to increased medical waste generation, which requires more efficient management systems to ensure safety and sustainability.

Objectives: The primary goal of this study is to identify actionable strategies to improve Indonesia's medical waste governance. This is achieved through an in-depth analysis of both internal and external factors affecting medical waste management, employing a SWOT (Strengths, Weaknesses, Opportunities, Threats) framework to assess the existing system.

Methods: A qualitative research design was employed, utilizing SWOT analysis to explore key factors influencing medical waste management in healthcare institutions. Data were collected from primary healthcare facilities, including hospitals and community health centers (Puskesmas), and from relevant regulatory bodies and waste management contractors in West Java Province, Indonesia.

Results: The SWOT analysis revealed several internal strengths, including strong regulations, digital tracking systems, and potential for partnerships, alongside weaknesses such as regional infrastructure gaps, staffing, and financial constraints. Externally, the study identified opportunities such as the circular economy, new technologies, and international support, as well as threats like inconsistent enforcement, polluting incineration methods, and regional disparities in resources and infrastructure. Based on these findings, eighteen strategic initiatives were proposed across SO, WO, ST, and WT matrices.

Conclusions: To improve medical waste governance in Indonesia, strategic actions are needed, focusing on modernizing infrastructure, integrating digital tools, enhancing workforce capabilities, and fostering multi-sectoral collaboration. A cohesive, evidence-based approach at the national level is essential to ensuring compliance, environmental safety, and the sustainable management of healthcare waste.

1. Introduction

Indonesia's rapidly expanding hospital sector, driven by rising public health awareness, poses challenges for sustainability and environmental management [1]. Increased healthcare access has led to higher medical waste generation, with about 15% classified as hazardous infectious, toxic, or radioactive requiring special handling. Indonesia mirrors this global pattern, making effective medical waste management an urgent public health priority [1], [2].

To address this issue, Indonesia has established a comprehensive legal framework, including Law No. 32/2009 on Environmental Management, Government Regulation No. 101/2014 on Hazardous Waste (B3), and supporting ministerial decrees from the Ministry of Environment and Forestry (P.56/2015) and the Ministry of Health (No. 7/2019 and No. 18/2020). These mandates obligate healthcare facilities to segregate, store, transport, and treat medical waste according to stipulated safety standards. However, policy implementation remains inconsistent, hampered by infrastructural deficits, weak oversight, and financial constraints [3].

Recent data underscores the scale of the problem: 2,813 Indonesian hospitals produce an estimated 242 tons of medical waste daily, with West Java Province contributing 14.2 tons from 261 facilities (Liputan6, 2023). Of the 290 tons generated nationally, only 170 tons are processed by licensed contractors, 60 tons by on-

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site incinerators, leaving roughly 74 tons mismanaged. Compounding this, a mere 3.6% of healthcare workers demonstrate adequate knowledge of proper waste handling.

These systemic failures expose both healthcare personnel and local communities to heightened risks of infection and environmental contamination [4], [5]. While Indonesia's regulatory structure is conceptually aligned with international standards from the WHO and the Basel Convention, its practical effectiveness is limited by enforcement gaps and inadequate emission controls [6], [7]. Strengthening institutional capacity, workforce proficiency, and technological adoption is therefore crucial for achieving compliance and sustainable outcomes [6].

The integration of green hospital and circular economy principles offers a promising pathway to reduce the sector's carbon footprint and enhance its environmental performance [6]. A systematic SWOT evaluation of Indonesia's medical waste management system is critically needed. This study analyzes the internal and external factors shaping waste handling in Puskesmas and Class C hospitals to develop evidence-based strategies. The objective is to enhance governance, promote sustainable operations, and align national practices with global environmental standards.

2. Methods

The study on medical waste governance in Indonesian healthcare facilities obtained institutional ethical approval. Using purposive sampling, key informants with operational and policy-making roles were selected, including hospital and Puskesmas staff, waste officers, and sanitation personnel, as well as representatives from district health offices and licensed waste contractors [8].

A primary criterion for inclusion was a minimum of three years of hands-on experience in healthcare waste handling, coupled with a working knowledge of the relevant institutional regulatory frameworks [9]. Data collection through interviews continued until theoretical saturation was achieved, culminating in a total of 27 participants. A multi-method qualitative approach was utilized for data collection, ensuring a comprehensive and triangulated understanding. This included in-depth interviews, participant observation, document analysis, and focus group discussions (FGDs). The semi-structured interviews, conducted with hospital administrators, environmental health officials, and regulators, probed governance mechanisms and perceived systemic challenges [10].

A multi-method approach was employed, integrating semi-structured interviews with administrators and officials, participant observations of waste handling procedures, analysis of key policy documents, and focus group discussions [10]. This design enabled data triangulation, enriching the understanding of governance mechanisms while validating findings through multi-stakeholder engagement

Data were analyzed thematically using NVivo 12 [11]. The process involved transcription, open and axial coding to identify key themes policy practice gaps, infrastructural and financial constraints, and organizational behavior followed by selective coding to build a conceptual framework linking regulatory, institutional, and human resource factors. [12]. A SWOT analysis was then applied to synthesize internal and external factors into strategic recommendations for improving medical waste governance.

3. Results

The SWOT analysis revealed major gaps in infrastructure, compliance, and coordination within Indonesia’s medical waste governance. Eighteen strategic initiatives were proposed to strengthen regulatory alignment and sustainability. Externally, opportunities arise from the circular economy agenda, ME-SMILE digital tracking, international support (e.g., UNDP), and growing environmental awareness [13]. However, these are offset by weak regulatory enforcement, limited treatment facilities, uneven infrastructure, and outdated incineration practices. The lack of coordination between the Health and Environment Ministries further hinders effective implementation [14].

Internally, Indonesia’s healthcare sector shows strong regulatory foundations, the presence of environmental health units in hospitals, growing digital monitoring adoption, and inter-facility collaboration in waste handling. However, limited infrastructure outside Java, insufficiently trained personnel, restricted funding for cleaner technologies, and weak data integration between health and environmental agencies continue to hinder

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system effectiveness [15]. Disparities in waste segregation practices between hospitals and community health centers (Puskesmas) further highlight a persistent implementation gap.

The SWOT analysis produced eighteen strategic initiatives. SO strategies leverage strengths to seize opportunities, such as integrating ME-SMILE with circular economy models and fostering public–private partnerships [16], [17]. WO strategies address weaknesses through training, funding optimization, and green hospital certification. ST strategies strengthen regulatory capacity to counter external threats via policy harmonization and stricter emission controls, while WT strategies focus on shared regional infrastructure and local treatment collaboration to reduce vulnerabilities [15].

In conclusion, this SWOT analysis underscores that advancing medical waste management in Indonesia requires a multifaceted and coordinated approach. Key priorities include regulatory harmonization, institutional cooperation, capacity building, technological modernization, and securing sustainable financing. Critical to building a resilient and environmentally sound system is the enhancement of digital oversight, the adoption of non incineration treatment technologies, and the alignment of national regulations with global best practices.

Table 1. Factors in the External Environment Influencing Medical Waste Governance

Opportunities	Threats
O1. National policy commitment to a circular economy. O2. Government-backed digital tracking systems (e.g., ME-SMILE). O3. Access to international funding and partnerships (e.g., UNDP). O4. Growing private sector investment in green waste solutions. O5. Rising environmental health awareness among professionals and the public.	T1. Inconsistent regulatory enforcement across regions. T2. Insufficient certified facilities for final waste treatment. T3. Ongoing pollution from outdated incineration methods. T4. Overlapping authority between health and environment ministries. T5. Geographically unequal distribution of resources and infrastructure.

Table 2. Internal Organizational Factors in Medical Waste Governance

Strengths	Weaknesses
S1. Comprehensive national policy on hazardous waste management. S2. Functional environmental health units within hospitals. S3. Implementation of digital waste monitoring (ME-SMILE). S4. Growing inter-facility collaboration and policy awareness. S5. Strong institutional support from senior leadership.	W1. Insufficient treatment infrastructure, especially outside Java. W2. Inadequate training and technical skills among waste handlers. W3. Limited funding for technology acquisition and modernization. W4. Poor data interoperability between health and environmental sectors. W5. Inconsistent waste sorting and operational practices between facilities.

Table 3. Strategy Archetype Strategic Objective Illustrative Initiatives

Strategy Type	Strategic Focus	Key Initiative Examples
SO (Leverage & Expand)	Leverage organizational strengths to seize external opportunities.	S3-O2: Integrate the ME-SMILE platform with regional databases for comprehensive oversight. S1-O1: Incorporate medical waste management into the national circular economy framework.
WO (Overcome & Capitalize	Address internal weaknesses by capitalizing on external opportunities.	W2-O3: Develop standardized competency frameworks for waste officers, funded through international partnerships.

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		W3-O4: Establish public-private financing models and fiscal incentives to spur investment in sustainable waste technology.
ST (Shield & Fortify)	Apply core strengths to counter external threats.	S1-T1: Establish a joint MoH-MoEF regulatory taskforce to standardize enforcement. S2-T3: Mandate advanced emission controls for incinerators with systematic compliance audits.
WT (Remediate & Secure)	Minimize weaknesses to reduce exposure to external threats.	W1-T2: Establish regional shared-service hubs for centralized waste treatment. W4-T5: Create a unified national data repository integrating health and environmental systems.

4. Discussion

This study analyzed key factors shaping medical waste governance in Indonesia to formulate evidence-based improvement strategies. Despite a robust legal framework, operational gaps persist. Strengths include solid regulations, digital monitoring through ME-SMILE, and inter-facility collaboration [18]. Weaknesses involve limited infrastructure beyond Java, inadequate personnel, and inconsistent protocol enforcement. Externally, opportunities arise from the circular economy, new technologies, and global partnerships, while threats stem from weak enforcement, outdated incineration, and regional disparities [19], [20].

These findings resonate with the global literature, which consistently demonstrates that regulatory existence does not automatically translate to effective operational outcomes. Studies from comparable settings in India and Bangladesh similarly report a pronounced dissonance between policy mandates and on the ground compliance, particularly concerning the segregation and treatment of infectious waste [21], [22]. The World Health Organization (2022) estimates that fewer than one third of healthcare facilities in low and middle income countries manage medical waste appropriately, a statistic that aligns with this study's observation of infrastructural and training shortfalls [23]. A distinctive feature of the Indonesian context, however, is its relatively advanced institutional capacity, evidenced by national digital monitoring tools and cross sectoral policy frameworks a potential that appears under leveraged in many comparable nations [24].

Methodologically, this study offers both contributions and limitations relative to prior work. Its primary contribution lies in the integration of SWOT analysis with rich, qualitative field data comprising interviews, observational notes, and focus group discussions to yield a nuanced, multi stakeholder perspective on governance challenges [25]. This integrative approach is seldom applied in Indonesian healthcare waste research, a field often dominated by compliance audits or purely quantitative surveys. A key limitation, however, is the study's constrained geographical scope, which was confined to West Java Province and specific facility tiers (namely, Type-C hospitals and Puskesmas) [26]. Consequently, the findings may not fully capture the national spectrum of challenges, especially in eastern Indonesian regions where infrastructural capabilities are more limited.

The implications of this research are directly relevant for health policy architects, hospital administrators, and public health practitioners. For policymakers, a critical recommendation is to prioritize the development of a nationally integrated digital platform that interlinks ME-SMILE with the environmental monitoring systems of the Ministry of Environment and Forestry, thereby bolstering coordination and transparency [27]. At the facility level, hospital management should institutionalize continuous training programs focusing on hazardous waste segregation and non incineration treatment technologies to bolster safety and regulatory adherence.

Furthermore, fostering collaborative ventures with private waste management entities and local governments is imperative to address the treatment capacity gap in regions lacking licensed facilities [28], [29]. Embedding circular economy principles for instance, the repurposing of non infectious plastics and energy recovery offers a pathway to simultaneously

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improve ecological sustainability and economic efficiency.

Despite these strategic directions, several critical questions remain unresolved and warrant further scholarly inquiry. Future research should employ quantitative methods to measure the national scale environmental and economic impacts of suboptimal medical waste handling [30]. Longitudinal studies are needed to evaluate the efficacy of digital monitoring systems like ME-SMILE in driving sustained compliance. Furthermore, comparative analyses across different Indonesian provinces and hospital classes (A, B, C, D) would help identify and refine scalable models for waste governance [30]. Finally, investigating the behavioral and organizational determinants of compliance such as staff motivation, the degree of leadership engagement, and institutional culture would provide deeper insights into the mechanisms through which policy is translated into enduring practice [30].

5. Conclusion

This study addresses the complex challenges impeding sustainable medical waste management in Indonesian healthcare. It proposes that strategic interventions, which leverage existing regulatory frameworks and emerging technologies, can transform these obstacles. The findings offer a strategic blueprint for policymakers and administrators to enhance compliance, build resilience, and integrate circular economy principles, thereby advancing both clinical safety and sustainable health systems governance.

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