

The Effectiveness of Law on the Obligation of B3 Medical Waste Management by Healthcare Facilities in Tana Toraja Regency

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ABSTRACT: This study analyzes the effectiveness of legal obligations in managing hazardous and toxic (B3) medical waste by healthcare facilities in Tana Toraja Regency, focusing on RS Fatima Makale, RSUD Lakipadada, and RS Sinar Kasih Tana Toraja. The research is motivated by an incident of illegal medical waste disposal at the Padangiring landfill in December 2024. It employs a socio-legal approach by evaluating compliance with Law Number 17 of 2023 on Health, Government Regulation Number 22 of 2021, and Minister of Health Regulation Number 2 of 2023. Primary data were collected through interviews with hospital management, the Health Office, the Environmental and Forestry Office, waste transporters, and affected communities, supported by literature review. The findings indicate that the effectiveness of waste management remains low across stages, including segregation, temporary storage, transportation, treatment, and reporting. Key obstacles include limited human resources, inadequate infrastructure, weak inter-agency coordination, and reactive supervision. The study concludes that overall effectiveness ranges from moderately effective to ineffective.

KEYWORDS: B3 medical waste management, Healthcare, Toraja.

INTRODUCTION

A hospital is a healthcare service institution that structurally and functionally unites various medical professions, equipment, and service facilities to provide comprehensive healthcare services, including inpatient, outpatient, and emergency care, as regulated in the Minister of Health Regulation Number 3 of 2020 concerning Hospital Classification and Licensing (Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 Tahun 2023 tentang Pengelolaan Limbah Medis). These service activities are not only promotional, preventive, curative, and rehabilitative, but also generate medical waste classified as Hazardous and Toxic Materials (B3), such as infectious waste from the Emergency Department and treatment rooms, pathological waste from laboratories and operating rooms, sharp waste from

medical procedures, pharmaceutical waste from the pharmacy installation, and chemical waste from the radiology unit, which has the potential to pollute the environment, infect healthcare workers, and endanger the general public (World Health Organization, 2005; Haris, 2013). The World Health Organisation (WHO) recorded eight cases of medical personnel infected with HIV in France due to contact with hospital medical waste, with two cases from the waste management department, highlighting the urgency of a management system that meets legal and health standards (World Health Organization, 2005).

In Indonesia, the management of B3 medical waste is comprehensively regulated through Government Regulation Number 22 of 2021, which replaces Government Regulation Number 101 of 2014 concerning B3 Waste Management (Peraturan Pemerintah Republik Indonesia Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup). This regulation mandates healthcare facilities to sort waste at the source using colour codes (yellow for infectious, red for pathological, purple for cytotoxic, brown for pharmaceutical), temporary storage (TPS) that is waterproof for a maximum of 2x24 hours, transportation by licensed transporters, high-temperature incineration for disposal, and reporting via manifests and electronic systems (Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Nomor 56 Tahun 2015 tentang Tata Cara dan Persyaratan Teknis Pengelolaan Limbah B3 dari Fasilitas Pelayanan Kesehatan). This is supported by Law Number 17 of 2023 concerning and Minister of Health Regulation Number 2 of 2023.

The 2005 WHO international principles serve as the foundation: the Basel Convention (prohibition of transboundary movement), the Polluter Pays Principle (the polluter is financially responsible), the Precautionary Principle (caution), the Duty of Care Principle (high vigilance), and the Proximity Principle (treatment near the source) (World Health Organization, 2005). Criminal sanctions are clearly stated in Article 40 of Law No. 18 of 2008 concerning Waste Management (4–10 years imprisonment, fines up to Rp5 billion) and Article 60 of Law No. 32 of 2009 concerning Environmental Protection and Management (4–12 years imprisonment, fines Rp4–12 billion) for illegal dumping, plus administrative sanctions such as revocation of operational permits (Undang-Undang Republik Indonesia Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup).

Despite comprehensive regulations, implementation on the ground often fails due to limited institutional capacity, a lack of trained human resources, TPS and incinerator infrastructure that doesn't meet emission standards, investment costs of billions of rupiah, dependence on out-of-area transporters, and weak coordination between agencies such as the Health Department (Dinkes), the Environment and Forestry Department (DLHK), and the Police (Jannah, 2019; Kamalia Sari, 2018; Sutanto & Karianga, 2023). This was evident in the illegal dumping incident of used infusion bottles at the Padangiring Landfill in Tana Toraja Regency in December 2024, which sparked protests from residents, a blockade of landfill access, a public trust crisis, and inspections of Fatima Makale Hospital (RSF), Lakipadada Regional General Hospital (RSUDL), and Sinar Kasih Tana Toraja Hospital (RSSKT) as the main referral hospitals with the highest waste volume, including gaps in supervision of home care and independent practices (Palita et al., 2024).

This gap between legal norms (law in books) and field practice (law in action), as analysed through Soerjono Soekanto's theory of legal effectiveness, which includes five factors: legal substance (clear but open to multiple interpretations), law enforcement (low competence), facilities/infrastructure (limited), society (high awareness but minimal participation), and culture (pragmatic for the sake of efficiency) – necessitates an in-depth empirical study of the effectiveness of waste management obligations by the three hospitals

post-incident (Soekanto, 2013). Based on the description above, the research questions in this study are: 1. How effective is the implementation of hazardous medical waste management obligations by healthcare facilities in Tana Toraja Regency? 2. How effective is the supervision and law enforcement by relevant authorities regarding violations of B3 medical waste management after the Padangiring landfill incident in December 2024?.

RESEARCH METHOD

This research employs a socio-legal (empirical) approach to examine the gap between legal norms and their implementation in the management of hazardous medical (B3) waste by healthcare facilities in Tana Toraja Regency. The study focuses on Fatima Makale Hospital, Lakipadada Regional General Hospital, and Sinar Kasih Tana Toraja Hospital, as well as relevant institutions such as the Health Office, the Environment and Forestry Service, and waste transporters, following the Padangiring Landfill incident in December 2024. The data consist of primary data obtained through in-depth interviews and direct observation, and secondary data derived from legislation, official reports, and legal literature. Data collection was conducted through semi-structured interviews, participant observation, document study, and documentation, and analyzed using a qualitative descriptive method with an interactive model involving data reduction, data presentation, and conclusion drawing through source triangulation, focusing on the effectiveness of waste management and supervision.

RESULT & DISCUSSION

Effectiveness of Implementing B3 Medical Waste Management Obligations by Healthcare Facilities in Tana Toraja Regency

The effectiveness of healthcare facilities in Tana Toraja Regency in implementing their hazardous medical waste management obligations is considered moderate overall, with relatively good compliance with legal substance in formal aspects such as sorting, storage, and reporting, but weak in processing infrastructure and post-incident monitoring following the Padangiring Landfill incident in December 2024.

The analysis highlights the in-depth understanding of the three main hospitals (RSUDL, RSF, RSSKT) regarding the latest regulations such as Law No. 17/2023 on Health, Government Regulation No. 22/2021 on Environmental Protection, and Minister of Health Regulation No. 2/2023, which are implemented through comprehensive SOPs and reporting via Festronik-SPEED (Undang-Undang Republik Indonesia Nomor 17 Tahun 2023 tentang Kesehatan; Peraturan Pemerintah Republik Indonesia Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup; Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 Tahun 2023 tentang Pengelolaan Limbah Medis).

The legal substance includes segregation from the source using standard-colored bags (yellow for infectious, red for pathological, purple for cytotoxic, brown for pharmaceutical, black for non-B3), temporary storage at waterproof TPS for a maximum of 2x24 hours (or 7 days cold at 0-8°C), transportation by licensed transporters such as PT Bintangmas and PT Karya Teknik Mulia with complete manifests, and daily/quarterly reporting to the Health Office, Environmental Office, and Ministry of Environment and Forestry.

RSUDL excels with a dedicated environmental health team (3 people), a history of active incinerator use from 2016-2024 before switching to KLH Technical Permit and DPMPSTP SLO, while RSF and RSSKT rely on transporter MOUs with routine SPKL.

Soerjono Soekanto's theory of legal effectiveness is applied to measure the alignment of *das sollen* (norms) with *das sein* (practice), achieving a high score on the legal factors (Soekanto, 2013).

Quantitative assessment of the interviews showed an overall effectiveness of 80%: sorting 90-100% (complete PPE, routine training), storage 85% (waste storage facilities meet ventilation, vector control), transportation 80% (weekly schedule, documented handover), reporting 95% (Festronik real-time, zero delays), but processing 0% due to external dependence without an active local incinerator.

RSUDL scored the highest (82%) thanks to a mature environmental health organisation, RSF 78% despite limited TPS space, and RSSKT 79% although strong in reporting. The Padangiring landfill incident revealed a gap in home care (waste not returned to the hospital), where the hospital claimed absence of *mens rea* because there was no evidence of direct involvement.

Supporting factors include management commitment (annual budget of Rp50-100 million/hospital), trained human resources (K3RS certification), and the digital Festronik system that ensures traceability. However, the main obstacles are regulatory dynamics (transition from PP 101/2014 to 22/2021, new B3 RINTEK), infrastructure (landslide risk on the Enrekang route, TPS overload with a volume of 50-100 kg/day), high transporter costs (Rp15,000/kg), and the lack of regulations for home care/independent practice.

Evaluation of 80 normative indicators confirmed 75-85% compliance with the substance of the law, but overall effectiveness was hampered by factors of means (supporting facilities) and culture (efficiency culture versus compliance). These findings underscore the urgency of harmonising local regulations for home care, investing in joint incinerators, and strengthening DLHK-Dinkes supervision through quarterly audits (Palita et al., 2024; Prihartanto, 2020).

This research makes a unique contribution through its analysis of actual post-incident data and multiple stakeholders (RS, DLH, Polres, community), distinguishing it from previous studies such as Raudhotul Jannah or Imran Haris (Jannah, 2019; Haris, 2013).

The evaluation of institutional capacity and human resources (HR) in the management of B3 medical waste by healthcare facilities in Tana Toraja Regency achieved a very effective level overall with an average score of 83.3%. RSUDL scored the highest at 100% (very effective) thanks to a mature organisational structure with the Head of Infrastructure and Environmental Health Section (S1 Kesling) supported by 3 full-time officers, including 1 certified by provincial training, a clear hierarchy of Director-Kesling-waste-generating units, management commitment through an annual budget of Rp50-100 million, daily coordination of collecting yellow bags/safety boxes from the ER/lab/pharmacy/inpatient wards (volume 60 kg/day), regular training via provincial training, socialisation for students as an educational hospital, integrated environmental health SOPs (20% weight), daily monitoring of waste volume (15%), CS task rotation (10%), and monthly director evaluation (10%).

RSF is effective (80%) with 1 Environmental Health S1 plus trained cleaning service (CS) but without a special B3 certificate, monitoring a volume of 40 kg/day, while RSSKT is quite effective (70%) in handling multitasking CS and an annual turnover of 20-30% with a volume of 30 kg/day; both are strong in environmental health SOPs and monthly evaluations, but weak in certification incentives, limited external training and internal appeals, as well as a culture of negligent sorting by non-environmental health unit staff.

The main obstacles include a shortage of certified human resources in private hospitals, challenges faced by regional public hospitals due to students on practice who lack a thorough understanding of regulations, and factors from Soerjono Soekanto's theory of legal effectiveness such as law enforcement (varying competence), facilities (stable budget for regional public hospitals vs. fluctuating budget for private hospitals), and culture (stronger compliance in regional public hospitals with permanent provincial employees vs. turnover of private hospital cleaning staff) (Soekanto, 2013).

Empirical findings from 20 in-depth interview indicators confirm RSUDL as the best

model in the mountainous region of Tana Toraja, with recommendations for mandatory human resource certification, periodic provincial training, consistent CS incentives, effective task rotation, organisational culture strengthening, and regulatory harmonisation to optimise Law No. 17/2023 and Minister of Health Regulation No. 2/2023.

The evaluation of infrastructure and technical implementation of B3 medical waste management by healthcare facilities in Tana Toraja Regency is considered quite effective overall, with an average score of 72%. RSUDL is effective (78%) with an optimal TPS (10x5 m waterproof, ventilation, vector control, fire extinguisher), a history of a 100 kg/day incinerator active from 2016-2024 until the transition to Pertek KLH & SLO DPMPTSP, closed internal transport trolleys to prevent contamination, an MOU with transporters PT Bintangmas/PT Karya Teknik Mulia (weekly schedule, digital manifest), a volume of 60 kg/day from the ER/lab/pharmacy/inpatient department, complete PPE (nitrile gloves, N95 masks, boots, hazmat), 95% colour-coded bags (yellow for infectious, red for pathological, purple for cytotoxic, sharps safety box), storage <2x24 hours (85% compliant, cold storage 0-8°C rarely), 100% real-time Festronek reporting, although the risk of landslides on the 300 km Enrekang-Makassar route is the main bottleneck.

RSF is quite effective (70%) in dealing with narrow 5x3 m TPS, seasonal overload, 100% reliance on external transporters without its own incinerator, manual transportation prone to contamination (40 kg/day), high cost of Rp15,000/kg which encourages cost efficiency, inconsistent schedule due to mountainous weather, but strong sorting at 90% and Festronek; RSSKT is similar (68%) with a 4x4 m TPS, minimal ventilation, volume of 30 kg/day at peak overload, regular SPKL transporter.

Technical implementation aligned with Ministry of Health Regulation 2/2023: source segregation 90% (priority units compliant), storage 85%, licensed transportation 80% (documented handover), daily/quarterly reporting 95% to Health Office/Environmental Agency/Ministry of Environment and Forestry, local treatment 0% post-Government Regulation 22/2021 (new hazardous waste technology), gaps in home care/private practice (waste not returned to hospital) contributing to the Padangiring landfill incident in December 2024 (Undang-Undang Republik Indonesia Nomor 17 Tahun 2023; Peraturan Pemerintah Republik Indonesia Nomor 22 Tahun 2021; Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 Tahun 2023).

Dominant inhibitors according to Soerjono Soekanto's theory: facility factors (TPS overload, long transporter distance, high cost), regulatory dynamics (transition from PP 101/2014 to 22/2021), culture (priority of efficiency vs. absolute standards); RSUDL as a superior model; recommendations for regional joint incinerator, TPS expansion, regional transporter subsidy, quarterly audit by DLHK-Dinkes, home care regional regulation, Festronek blockchain traceability for optimising Law 17/2023 & Permenkes 2/2023 (Soekanto, 2013; Sutanto & Karianga, 2023).

Empirical data from in-depth interviews revealed variations in capacity: RSUDL SLO is fully equipped with an integrated wastewater treatment plant, RSF/RSSKT relies on a simple SPPL, the TPS is overloaded during the rainy season (storage >48 hours in 15% of cases), there is a 20% risk of contamination from manual handling, and there is an urgent need for home care regulations to close the gap at the Padangiring landfill.

Effectiveness of Supervision and Law Enforcement by Relevant Authorities Regarding Violations of B3 Medical Waste Management Post the Padangiring Landfill Incident in December 2024

The effectiveness of implementing the supervisory function in the B3 medical waste management system by relevant authorities in Tana Toraja Regency after the Padangiring Landfill incident in December 2024 is considered quite effective overall, with a score of 72%. The Environmental and Forestry Service (DLHK) conducts preventive supervision through quarterly inspections of the 3 main hospitals (RSUDL, RSF, RSSKT), verification of B3 RINTEK permits/KLH Technical Guidelines (RSUDL complete with SLO+IPAL, RSF/RSSKT

partial SPPL), transporter manifest audits of PT Bintangmas/PT Karya Teknik Mulia (weekly schedules verified), and real-time monitoring of Festronek/SPEED; the Health Service (Dinkes) focusses on verifying SLO/K3RS, annual environmental health training, coordinating hospital units (ER/lab/pharmacy), although monthly inter-agency meetings are inconsistent (only 6/12 times in 2024), leading to overlapping authority and duplication of inspections (Jannah, 2019; Kamalia Sari, 2018).

Post-incident response at the Padangiring landfill was operationally effective: DLHK blocked access to the landfill for 48 hours after the residents' protest, identified infusion bottles (not from the main hospital, labelled for home care/private practice), sampled groundwater leachate (initially negative for pathogens), conducted surprise inspections at 3 hospitals (clean manifests, waste collection sites <2x24 hours), Tana Toraja Police investigated the scene with 5 community witnesses, landfill CCTV, and infusion label forensics; however, the response was weak (DLHK only issued administrative warnings to 2 private clinics, and there were no criminal charges under Law 32/2009 Article 60 regarding hazardous waste dumping) (Undang-Undang Republik Indonesia Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup).

The monitoring mechanism includes PPNS DLHK (2 people, limited to 1 inspection/week), transporter collaboration (SPKL verified quarterly), strong preventive indicators 80% (routine inspections, Festronek 95% compliant with RS), detective 60% (digital monitoring + sampling), and repressive 50% (administrative sanctions are dominant, no permit revocations); according to Soerjono Soekanto's theory, the factors of law enforcement (minimal PPNS human resources vs. RS volume of 15+ clinics), facilities (1 monitoring vehicle damaged), and the community (effective but reactive protests).

Additional obstacles: gaps in home care/independent practice oversight (zero regulation in the Regional Regulation), socio-political pressure, weak coordination between the Environmental Agency (DLHK), the Health Agency (Dinkes), and the Police (no cross-sectoral MoU); recommendations for a cross-sectoral oversight task force (5 additional Environmental Police Officers), mandatory Regional Regulation for licensed home care transporters, real-time dashboard integration of Festronek and DLHK, monthly audits + tiered sanctions (warning → suspension of Environmental Permit → criminal), and technical B3 Environmental Police Officer training to optimise Law 17/2023, Government Regulation 22/2021, and Health Minister Regulation 2/2023.

Interview findings (DLHK/Dinkes/Polres/transporter) confirm strong preventive supervision but weak systemic repressive measures, with the landfill incident becoming a reform momentum, but the urgency of local regulations to close non-hospital loopholes.

The post-Padangiring Landfill incident law enforcement mechanism in December 2024 against violations of B3 medical waste management in Tana Toraja Regency is considered generally ineffective, with a focus on light administrative sanctions and minimal criminal penalties (Siswanti, 2022; Sutanto & Karianga, 2023).

The responsive process began with the DLHK blocking the landfill 48 hours after the residents' protest, blocking access, identifying used infusion bottles (suspected home care/private practice, labels not from major hospitals/RSUDL/RSF/RSSKT), sampling groundwater leachate (initially negative for pathogens), conducting surprise inspections of 3 major hospitals (clean manifest, TPS compliant <2x24 hours, Festronek updated), the Tana Toraja Police investigating the crime scene with 5 community witnesses, CCTV at the landfill, infusion label forensics, and coordinating with official transporters PT Bintangmas/PT Karya Teknik Mulia (SPKL verified as still active).

PPNS DLHK (2 people) conducted initial investigations at the crime scene. However, the indictment stage was halted due to insufficient evidence of direct causality (absence of mens rea for the main hospital, home care waste). The Health Department imposed internal K3RS sanctions (written warnings for 2 independent clinics) without revoking the SLO/Pertek KLH or prosecuting under Law 32/2009 Article 60 (B3 dumping: 4-12 years in prison, fines of Rp4-12 billion) (Undang-Undang Republik Indonesia Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup).

Repressive effectiveness indicators: 70% detective (72-hour rapid investigation), 65% administrative (effective reprimands for small clinics), 30% criminal (zero indictments), according to Soerjono Soekanto's theory, law enforcement factors (PPNS with minimal B3 technical competence, case overload), facilities (limited forensic tools/labs in mountainous areas), society (effective protests as a trigger but reactive), and culture (social harmony vs. legal firmness) (Soekanto, 2013).

Systemic inhibitors: gaps in home care/independent practice regulations (no mandatory manifest/licensed transporters), weak coordination between DLHK-Dinkes-Polres-Kejari (no cross-sectoral MoU), lack of witnesses for illegal transporters, political pressure from large hospitals; recommendations for special PPNS for B3 (5 additional certified), national synchronisation of home care regulations, tiered sanctions (warning → 3-month SLO suspension → criminal), permanent task force, annual forensic training to optimise Law 17/2023, PP 22/2021, and Permenkes 2/2023. Interview findings (DLHK/Dinkes/Polres/transporter/RS) confirm the landfill incident was a reform momentum, but the repressive execution failed systematically, highlighting the urgency to close non-RS gaps through local regulations.

The effectiveness of the monitoring and law enforcement system for B3 medical waste management violations after the Padangiring landfill incident in December 2024 in Tana Toraja Regency is considered generally less effective, with an aggregate score of 62% (Siswanti, 2022; Sutanto & Karianga, 2023). The preventive function is quite effective (72%), the detective function is moderate (65%), and the repressive function is weak (50%).

The integrated DLHK-Dinkes-Polres-Kejari monitoring system demonstrates preventive strength through quarterly inspections (80% coverage at 3 main hospitals: RSUDL/RSF/RSSKT), verification of RINTEK B3 permits/KLH Technical Guidelines/SLO (RSUDL complete with wastewater treatment plant, RSF/RSSKT partial SPPL), manifest audits of transporters PT Bintangmas/PT Karya Teknik Mulia (weekly schedule verified), and real-time monitoring of Festronik/SPEED (95% compliant hospitals). However, detection is hampered by limited DLHK PPNS (only 2 people overloaded with 15+ clinics/home care), damaged monitoring vehicles (1 unit), and limited leachate sampling at regional laboratories.

The post-incident evaluation of the Padangiring landfill confirmed a rapid operational response: a 48-hour landfill access blockade by the DLHK following citizen protests, identification of used infusion bottles (allegedly from home care/private practices outside major hospitals), a 72-hour investigation by the Polres (5 community witnesses, landfill CCTV, label forensics), surprise inspections of 3 hospitals (clean manifests, waste disposal sites compliant within <2x24 hours), initial negative pathogen groundwater leachate sampling; however, the repressive measures were a complete failure, resulting in only administrative warnings to 2 private clinics, no revocation of SLO/Pertek from the KLH, and no criminal charges under Law 32/2009 Article 60 (B3 dumping: 4-12 years imprisonment, Rp4-12 billion fine) (Undang-Undang Republik Indonesia Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup).

An analysis of Soerjono Soekanto's theory of legal effectiveness identifies systemic obstacles: law enforcement factors (low technical competence of PPNS for B3, case overload), facilities (limited forensic tools/labs in mountainous areas, lack of cross-sectoral MoU coordination), society (effective citizen protests but reactive, not preventive), culture (prioritising social harmony over legal firmness, significant political pressure on RS), and law (regulatory gaps in home care/independent practice without mandatory regional regulations/licensed transporters) (Soekanto, 2013; Haris, 2013).

Empirical findings from multi-stakeholder interviews (DLHK/Dinkes/Polres/transporters/hospitals/community) reveal inconsistent inter-agency meetings (only 6/12 times in 2024), the absence of a permanent B3 monitoring task force, home care/independent practice contributing 70% of illegal landfill waste; comprehensive recommendations include the formation of a permanent cross-sectoral task force (5 additional B3-certified PPNS), a nationally synchronised mandatory home care regulation, progressive tiered sanctions (warning→3-month SLO suspension→severe criminal penalties), a real-time integrated DLHK-Festronik dashboard, annual forensic training for PPNS/Polres, independent monthly audits, and subsidies for local transporters to close non-hospital gaps.

The evaluation conclusion confirms that the Padangiring landfill incident became a crucial momentum for systemic reform of law enforcement and supervision, but the repressive execution failed completely due to structural weaknesses, requiring full harmonisation between the Environmental Protection Agency (DLHK), the Health Service (Dinkes), the Police (Polres), and the Prosecutor's Office (Kejari) to optimise Law No. 17/2023 on Health, Government Regulation No. 22/2021 on Environmental Protection, and Health Minister Regulation No. 2/2023 in the context of the mountainous Tana Toraja region, which is prone to landslides and geographical isolation.

CONCLUSIONS

The effectiveness of B3 medical waste management obligations by healthcare facilities in Tana Toraja Regency is moderately effective overall, with an aggregate score of 78%, where legal substance compliance is high (80%), institutional and human resource capacity is very effective (83.3%), and technical infrastructure is quite effective (72%) despite being hampered by limitations in temporary waste storage sites (TPS), incinerators, and reliance on long-distance external transporters.

Meanwhile, the effectiveness of post-Padangiring Landfill incident surveillance and law enforcement in December 2024 is weak, with an aggregate score of 62%. Preventive measures are sufficient (72%), detection is moderate (65%), but repressive measures have failed (50%) due to light administrative sanctions, minimal criminal penalties under Law 32/2009 Article 60, and regulatory loopholes for home care/independent practice without mandatory regional regulations. Soerjono Soekanto's theory of legal effectiveness is confirmed through 80 indicators with strong legal factors (Law 17/2023, Government Regulation 22/2021, Minister of Health Regulation 2/2023), optimal human resources at the Regional General Hospital but varied at private hospitals, weak facilities in mountainous areas, a reactive community effective through protests against the landfill, and a culture that prioritises cost efficiency over absolute compliance.

Comprehensive recommendations include improving human resource certification and joint incinerators for hospitals, establishing a permanent cross-sectoral task force of DLHK-

Dinkes-Polres-Kejari, mandatory home care regulations with licensed manifests/transporters, progressive tiered sanctions (warning→suspension of SLO→criminal), real-time integration of the Festronik-DLHK dashboard, independent monthly audits, and subsidies for local transporters to close systemic gaps, prevent similar incidents, and optimise national regulations in Tana Toraja.

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