JLPH:
Journal of Law, Politic and Humanities
https://dinastires.org/JLPH dinasti.info@gmail.com +62 811 7404 455
E-ISSN: 2962-2816
P-ISSN: 2747-1985
DOI: https://doi.org/10.38035/jlph.v5i4

Legal Protection of Medical Waste Management in Community Health Centers : An Environmental Sustainability Analysis.

Made Arry Suarthawan[1], I Gusti Agung Mas Rwa Jayantari[2], Putu Ayu Sani Utami[3], I Gst Pt Bagus Suka Arjawa[4].
[1]Master Program in Health Law, Faculty of Postgraduate, Udayana University, Denpasar, Indonesia, arysuarthawan1981@gmail.com..
[2]Master Program in Health Law, Faculty of Postgraduate, Udayana University, Denpasar, Indonesia, mas_jayantiari@unud.ac.id.
[3]Nursing Program, Faculty of Medicine, Udayana University, Denpasar, Indonesia, putusani@unud.ac.id..
[4]Faculty of Social and Political Science, Udayana University, Denpasar, Indonesia, suka_arjawa@unud.ac.id.

Corresponding Author: arysuarthawan1981@gmail.com[1]

Abstract: This study aims to analyze the regulation of medical waste management in Community Health Centers and its impact on environmental displacement. This study uses a normative legal method with a regulatory approach (statutory approach), contextual (conceptual approach), and analysis (analytical approach). Data sources include regulations, scientific journals, and related literature. The results of the study indicate that although national regulations such as Law Number 18 of 2008 and Minister of Health Regulation Number 7 of 2019 have been implemented, their implementation still encounters obstacles. Factors such as lack of waste management infrastructure, minimal understanding of medical personnel, and weak supervision cause medical waste management to be suboptimal. The impacts include soil, air, and air pollution, as well as the risk of spreading diseases that endanger public health and the environment. Thus, it is necessary to strengthen regulations, improve facilities, and provide effective supervision and training to support environmental demand.

Keyword: Legal Protection, Medical Waste , Community Health Centers, Environmental Sustainability.

INTRODUCTION

The management of medical waste in healthcare facilities, particularly in Community Health Centers (Puskesmas), faces complex challenges related to the increasing volume of waste. Data from the Ministry of Health indicate that each Puskesmas can generate 5-7 kilograms of medical waste per day, consisting of various types, including used syringes, discarded medical equipment, and infectious waste (Widyawati, 2020). The growing volume of medical waste is influenced by several factors, such as the increasing number of patient visits, the rising complexity of healthcare services, and the implementation of health protocols that

require more disposable equipment. This situation not only impacts the internal waste management of Puskesmas but also has significant implications for environmental pollution risks and the potential spread of diseases. The challenges of medical waste management are further exacerbated by limited infrastructure, low awareness among medical personnel, and weak comprehensive regulations for addressing medical waste issues in a sustainable manner. (Abidah et al., 2021).

The phenomenon of increasing medical waste volume in Community Health Centers (Puskesmas) is not merely a matter of quantity but also carries serious consequences for the environment and public health. The environmental risks posed by medical waste from Puskesmas are highly complex and multidimensional. Medical waste has the potential to contain pathogenic microorganisms, hazardous chemicals, and heavy metals that can contaminate soil, water, and air. Contamination processes can occur through various mechanisms, including the seepage of hazardous substances into the soil, pollution of river flows, and the spread of microbial particles through the air (Lee & Lee, 2022). Furthermore, improperly managed medical waste can cause ecosystem damage, degrade groundwater quality, and increase the risk of disease transmission, such as hepatitis, HIV, and other infections. These environmental impacts are not only localized but can also extend and affect surrounding communities in the long term. (Huda et al., 2022).

The complexity of environmental risks posed by medical waste in Community Health Centers (Puskesmas) underscores the urgent need for serious attention to legal protection in its management. The urgency of legal protection in medical waste management at Puskesmas has become a critical necessity to ensure environmental safety and public health. Comprehensive and implementable regulations are required to govern the processes of handling, processing, and disposing of medical waste sustainably (Yustina, 2021). Currently, there are still weaknesses in the legal instruments that specifically regulate the mechanisms of medical waste management, from segregation and transportation to disposal (Nurhayati & Racha, 2024). Legal protection not only focuses on administrative aspects but also encompasses institutional responsibility, legal sanctions, and effective monitoring mechanisms. Therefore, a strong regulatory framework is expected to promote more responsible medical waste management practices, minimize environmental risks, and safeguard public interests. (Nurhayati & Racha, 2024)

Based on the phenomenon and complexity of medical waste management issues in Community Health Centers (Puskesmas), this study aims to address two key research questions: (1) How do current regulations govern medical waste management in Puskesmas? and (2) What are the implications of medical waste management for environmental sustainability? The objectives of this study are to comprehensively analyze the regulations on medical waste management, examine the environmental impacts arising from it, and formulate conceptual recommendations to optimize legal protection and ensure environmental sustainability through responsible medical waste management at the Puskesmas level.

Research on medical waste management in Community Health Centers (Puskesmas) has been extensively conducted by experts, covering various aspects such as regulations, environmental impacts, and sustainable medical waste management practices. A study conducted by K. Ravindra, A. Sareen, S. Dogra, and S. Mor (2022), titled "Appraisal of Biomedical Waste Management Practice in India and Associated Human Health and Environmental Risk" in JEB: Journal of Environmental Biology, reviews regulations on biomedical waste management in India. It highlights poor practices that pose environmental and health risks. The study emphasizes the need for proper segregation programs, training, and awareness to mitigate these impacts in healthcare centers (Ravindra et al., 2023). Another study by Gyanendra Kumar Sonkar, Sangeeta Singh, and Satyendra Kumar Sonkar (2023), titled "Biomedical Waste: Impact on Environment and Its Management in Health Care Facilities" in Current Research Trends and Applications in Waste Management*, shows that proper

biomedical waste management in healthcare facilities is crucial to preventing environmental contamination, including groundwater and air pollution. Regulations should enforce segregation, packaging, and disposal practices to reduce health risks for staff, patients, and the general (Sonkar et al., 2023).

A study conducted by Muhammad Iqbal, Dwi Ragil Febriyani, and Agus Somad Saputra (2023), titled "Solid Medical Waste Management at Puskesmas X" in Sehat Rakyat: Jurnal Kesehatan Masyarakat, indicates that healthcare centers must integrate policies and regulations into daily operations to improve medical waste management practices. This study also highlights the environmental impact of inadequate waste handling, emphasizing the need for staff training and facility improvements to effectively address these challenges (Iqbal et al., 2023). Another study by Mirzatul Nikmah, Nada Vidyan Safira, Nia Selviana Puji Lestari, Najwa Sekar Ayu Nanda Asvianto, and Denny Oktavina Radianto (2024), titled "The Development of Medical Waste Management in Hospitals" in Jwikal: Jurnal Wilayah, Kota, dan Lingkungan Berkelanjutan, shows that medical waste management practices in healthcare centers include the segregation of hazardous and non-hazardous waste, the use of specialized containers, and staff training. Regulations continue to be improved, emphasizing the importance of safe disposal to reduce environmental impact and protect public health (Nikmah et al., 2024).

METHOD

This study employs a normative legal research method with a statute approach, conceptual approach, and analytical approach (Ibrahim, 2007). The data sources include primary data in the form of legislation related to medical waste management, secondary data such as scientific journals and legal books, and tertiary data derived from legal dictionaries and encyclopedias. The data collection technique is conducted through literature review and documentation, using a qualitative analysis method that focuses on the systematic interpretation of regulations, identification of normative weaknesses, and analysis of legal implications in medical waste management at Puskesmas. The analysis process is carried out comprehensively, starting from data inventory, classification, interpretation, and drawing legal conclusions related to environmental protection and medical waste management. (Soekanto & Mamudji, 2003).

RESULTS AND DISCUSSION

Regulation of Medical Waste Management in Puskesmas.

The regulation of medical waste management is a key instrument in ensuring environmental safety and public health. The complexity of medical waste issues in community health centers (Puskesmas) requires a comprehensive and implementable legal framework to regulate every stage of waste management, from segregation, storage, transportation, to disposal. The existence of regulations is not merely an administrative guideline but serves as a mechanism for preventing pollution risks and protecting ecosystems (Ernyasih et al., 2024).

Medical waste management in Indonesia is governed by various national regulations aimed at protecting public health and the environment.

Law Number 18 of 2008 on Waste Management regulates the basic principles of sustainable waste management, including medical waste, which is categorized as hazardous and toxic waste (B3). Additionally, Minister of Health Regulation (Permenkes) Number 7 of 2019 on Environmental Health in Healthcare Facilities provides technical guidelines for handling medical waste, from collection and temporary storage to final disposal.

This regulation also mandates that healthcare facilities, including Puskesmas, establish a medical waste management system that meets health and environmental standards. However, the implementation of these regulations at the operational level often encounters obstacles, such

as the lack of adequate waste processing facilities and limited understanding among personnel regarding proper medical waste management procedures (Debataraja et al., 2023).

Moreover, regional regulations play a crucial role in supporting more effective medical waste management. Local governments have the authority to issue regional regulations (Perda) that govern medical waste management based on the characteristics of each region (Afiyah, 2023). For example, some regions have implemented regulations requiring every healthcare facility to collaborate with licensed third-party entities for B3 waste management. However, the varying quality of regulations across regions often presents challenges in ensuring consistent and equitable medical waste management. The lack of regulatory harmonization may lead to suboptimal waste management, posing risks of environmental contamination and endangering public health near healthcare facilities (Fatimah, 2021).

Although medical waste management regulations in Indonesia are designed to protect health and the environment, they still face significant weaknesses. One major issue is the lack of strict sanctions for violations, which often results in healthcare facilities not feeling compelled to comply with established standards. Additionally, enforcement mechanisms are weak, with infrequent inspections and minimal evaluations of medical waste management in healthcare facilities. This could pose risks to public health and environmental sustainability (Sutanto & Karianga, 2023).

Firstly, legal gaps in medical waste management regulations are evident in the absence of progressive administrative sanctions for repeated violations. For instance, although Puskesmas are required to properly segregate and process medical waste, violations of this obligation often result only in warnings without meaningful follow-up actions. This lack of strict enforcement creates an impression that regulatory violations have no serious consequences. Furthermore, there are weaknesses in defining responsibilities among various stakeholders, including local governments and healthcare facility managers. This ambiguity often hampers effective coordination in medical waste management (Raharja, 2018).

Secondly, weak oversight mechanisms pose a significant obstacle to ensuring compliance with regulations. Many regions lack sufficient human resources or technical capacity to conduct adequate inspections. In many cases, monitoring is carried out sporadically or based on specific reports rather than through a regular schedule. This allows regulatory violations to persist undetected for extended periods, potentially leading to severe environmental and health impacts. Therefore, revising the existing regulatory framework is necessary to address these gaps and establish a more effective monitoring system (Yati et al., 2022).

Despite the existence of regulations, many Puskesmas still struggle to implement medical waste management in accordance with applicable standards. These challenges stem from various internal and external factors that affect healthcare facilities' ability to comply with regulations. Thus, analyzing these challenges is essential to provide relevant recommendations for improving medical waste management systems (Welliana et al., 2022). One major challenge is the limited budget allocated for medical waste management. Many Puskesmas lack sufficient funds to provide adequate waste processing facilities, such as incinerators or autoclaves. Consequently, medical waste is often stored for extended periods or even mixed with domestic waste, which clearly violates safe medical waste management principles. Additionally, limited funding also hinders the training of healthcare workers in proper waste management procedures, leading to suboptimal practices (Welliana et al., 2022).

Another challenge is the lack of adequate infrastructure support in many regions. Some Puskesmas in remote areas face difficulties accessing licensed third-party waste management services. The long distances and high transportation costs often become barriers, preventing proper medical waste management. Furthermore, infrastructure limitations also include the lack of proper temporary storage facilities that meet standards, which can lead to environmental contamination risks and exposure for healthcare workers and nearby communities (Iqbal et al., 2023).

Weaknesses in the regulation and implementation of medical waste management not only impact the operational systems of Puskesmas but also have serious consequences for the environment and public health. The inability to manage medical waste effectively can create widespread threats, ranging from soil and water contamination to increased risks of infectious diseases. Therefore, it is crucial to explore these impacts to emphasize the urgency of improving regulations and medical waste management practices (Asrun et al., 2020).

One significant environmental impact is ecosystem pollution caused by improper disposal of medical waste. Medical waste containing toxic substances, such as pharmaceutical residues or used syringes, often contaminates soil and water when disposed of without proper treatment. This contamination can damage local ecosystems and endanger organisms living nearby, including humans. Additionally, burning medical waste without appropriate technology, such as incinerators equipped with air filters, can produce hazardous air pollutants, including dioxins and furans, which have carcinogenic effects on humans (Asrun et al., 2020).

The impact on public health is equally concerning. Improperly managed medical waste can be a source of infectious disease transmission, particularly for healthcare workers and communities living near waste disposal sites (Lorensyifa et al., 2022). Used syringes, for example, can spread diseases such as hepatitis B, hepatitis C, and HIV if not handled correctly. Additionally, water contamination from medical waste can cause outbreaks of diseases such as diarrhea or gastrointestinal infections, especially in areas with limited access to clean water. Therefore, weaknesses in medical waste management regulations and implementation have far-reaching impacts that require serious attention from all stakeholders (Asrun et al., 2020).

Although Indonesia's medical waste management regulations have been designed to address local issues, it is important to compare them with international standards to evaluate their effectiveness. The World Health Organization (WHO) and the United Nations Environment Programme (UNEP) have established comprehensive guidelines on medical waste management that can serve as references for improving national regulations. One key difference is the level of technical standards applied in medical waste management (Puspita et al., 2024). For example, WHO recommends the use of modern incinerators with strict emission standards for burning medical waste, whereas many healthcare facilities in Indonesia still rely on traditional burning methods that can produce harmful pollutants. Additionally, WHO emphasizes risk-based waste management, where medical waste is classified in detail based on its level of hazard. In Indonesia, this classification system has not been fully implemented, often resulting in inappropriate waste management (Harninda, 2023).

Moreover, UNEP promotes the adoption of a circular economy approach in medical waste management, including recycling and waste reduction at the source. This approach differs from national regulations, which focus more on final waste disposal. For instance, UNEP recommends using autoclave technology to sterilize certain medical waste so that it can be recycled or reused. The adoption of this practice in Indonesia remains limited, primarily due to technological constraints and costs. By integrating elements of international standards, national regulations can be further enhanced to address medical waste management challenges more effectively (Humairoh et al., 2022). By strengthening regulations and adopting international best practices, medical waste management in Indonesia can become more effective and sustainable, ultimately protecting public health and the environment

Implications of Medical Waste Management on Environmental Sustainability.

Improper medical waste management poses a serious threat to the environment and public health. As one of the types of waste categorized as hazardous and toxic materials (B3), medical waste requires strict processing procedures that comply with standards (Mirzatul Nikmah et al., 2024). However, in many healthcare facilities, including community health centers (Puskesmas), infrastructure limitations and a lack of understanding regarding medical waste management often lead to non-compliant practices. Consequently, medical waste can

contaminate soil, water, and air, contributing to environmental degradation and ecosystem disruption. One of the most frequent impacts is soil contamination due to the improper disposal of medical waste (Ghali et al., 2023).

Medical waste is classified as hazardous waste because it contains various dangerous substances, such as toxic chemicals, pharmaceutical residues, and infectious materials. When this waste is improperly disposed of or mismanaged, these substances can seep into the soil, causing pollution that is difficult to remediate (M et al., 2016). For instance, pharmaceutical residues containing active compounds can disrupt soil microorganisms that play a crucial role in maintaining soil fertility and ecological balance. Additionally, heavy metals such as mercury from damaged medical equipment can accumulate in the soil layers, resulting in long-term damage to soil structure and affecting the quality of agricultural yields around disposal areas. Furthermore, contaminated soil can lead to the infiltration of hazardous substances into groundwater sources, further impacting water quality (M et al., 2016).

Water pollution is one of the primary consequences of improper medical waste management. Liquid waste from healthcare facilities, such as chemical solutions, blood, and patients' bodily fluids, is often discharged directly into drainage systems without prior treatment. This condition allows pathogenic bacteria and toxic chemical compounds to enter groundwater or rivers (Yudita et al., 2024). As a result, contaminated water is no longer safe for consumption or use by the surrounding community. Additionally, the chemicals in liquid waste can damage aquatic ecosystems, endangering fish species and aquatic plants while reducing water quality for domestic and agricultural needs. In some cases, inadequate liquid waste management is often accompanied by the incineration of solid waste, which further contributes to air pollution (Ciawi et al., 2022).

Burning medical waste without appropriate technology significantly contributes to air pollution. The incineration of medical waste often produces emissions of hazardous substances, such as dioxins and furans, which are highly toxic even in very low concentrations. These substances can disperse into the atmosphere and be inhaled by humans or animals, leading to severe health issues such as respiratory disorders, cancer, or immune system damage. Additionally, greenhouse gas emissions from burning medical waste contribute to climate change. The lack of emission control technology in many healthcare facilities exacerbates air pollution, ultimately completing the cycle of environmental damage caused by soil, water, and air pollution (Taghilou et al., 2021).

Improper medical waste management has led to various cases of environmental pollution in Indonesia and worldwide. These cases serve as concrete evidence that neglecting medical waste regulations can have serious consequences for public health and environmental sustainability. Some cases highlight the importance of stricter supervision and the adoption of appropriate waste management technologies to prevent wider impacts (Andika Putri et al., 2023). One notable case of pollution occurred in Bandung Regency, West Java, where improper disposal of medical waste was found near residential areas. The waste, including used syringes, IV bottles, and other medical materials, was dumped without undergoing sterilization or proper management. As a result, local residents reported a strong odor, along with health issues such as skin infections and respiratory disorders. Worse, liquid waste from the materials seeped into the soil, contaminating local wells that served as the primary water source (Prakasa, 2018). This incident highlights the weak oversight from authorities and the lack of awareness among healthcare facility managers to comply with medical waste regulations.

Internationally, similar pollution cases have been found in several developing countries. For example, in India, medical waste is often burned in open areas or dumped directly into rivers without treatment. In 2018, thousands of blood bags and other infectious medical materials were found floating in the Ganges River, a vital water source for millions of people in Uttar Pradesh. This waste not only caused water pollution but also disrupted aquatic life in the river. The incident drew global attention to the urgent need for eco-friendly medical waste

management technologies and strict enforcement of regulations against violators (Dutta et al., 2020).

These cases highlight weaknesses in the implementation of medical waste management regulations in various countries, including Indonesia. The lack of adequate infrastructure, low awareness among healthcare workers, and ineffective supervision are the primary factors exacerbating this issue. Additionally, communities near pollution sites often lack sufficient information about the dangers of medical waste, making them unable to report or take appropriate protective measures. Therefore, learning from these cases is crucial to driving changes in medical waste management policies and enhancing community capacity in addressing environmental threats from medical waste pollution.

Apart from the direct impact on ecosystems, uncontrolled medical waste management also has significant socioeconomic implications. Environmental damage caused by contaminated medical waste increases the economic burden on the government, society, and the healthcare sector itself. The cost of restoring contaminated environments is very high, especially when pollution has spread extensively to soil, water, and air (Syafhira et al., 2024). The remediation process requires substantial investment in cleaning technology, ecosystem rehabilitation, and the restoration of public health. Therefore, medical waste management should be viewed as part of a sustainable development strategy that balances environmental protection and economic growth (Mirzatul Nikmah et al., 2024).

The cost of environmental remediation due to uncontrolled medical waste pollution can be overwhelming. When soil and water are contaminated with hazardous chemicals, the remediation process requires advanced technology and extended time, such as wastewater treatment or soil restoration. Additionally, groundwater contamination threatens clean water supplies for local communities, necessitating large investments to ensure safe drinking water (Andika Putri et al., 2023). Environmental damage also reduces the ability of ecosystems to support agriculture and fisheries, impacting local food security. If this situation persists, the costs of repairing environmental damage and restoring the quality of natural resources can reach enormous amounts, which could have been avoided with proper medical waste management from the outset.

As a solution to reduce the socioeconomic impact of medical waste pollution, investment in more efficient and eco-friendly waste management technologies is essential. Implementing proper waste management systems, such as modern incinerators or environmentally friendly wastewater treatment technologies, can minimize environmental remediation costs. Moreover, proper medical waste management reduces the risk of disease transmission and ensures public health, thereby lowering healthcare costs. Public education initiatives are also crucial in raising awareness about the dangers of medical waste and the importance of proper waste management. These measures not only support environmental sustainability but also provide long-term economic benefits that can improve the overall quality of life for society.

CONCLUSION

Based on the conducted study, this research concludes that the regulation of medical waste management in Puskesmas still faces various challenges, including weaknesses in implementation, supervision, and harmonization between central and regional regulations. Although there are legal frameworks such as Law No. 18 of 2008 and Minister of Health Regulation No. 7 of 2019, their implementation has not been optimal due to infrastructure limitations, a lack of understanding among medical personnel, and the absence of strict sanctions. As a result, improper medical waste management has significant impacts on environmental sustainability, including soil, water, and air pollution, as well as an increased risk of disease transmission. Therefore, it is necessary to strengthen regulations, enhance supervision, improve infrastructure, and provide training for medical personnel to ensure safe and sustainable medical waste management.

REFERENCE

Abidah, H. N., Ismah, H. A., Irmayanti, S., Nuria, G., & Wikurendra, E. A. (2021). The Effectivity of Solid Medical Waste Management in Pandemic Era. Journal of Public Health for Tropical and Coastal Region, 4(3), 89–107. https://doi.org/https://doi.org/10.14710/jphtcr.v4i3.10618

Afiyah, L. L. (2023). Implementasi PERMENKES Nomor 18 Tahun 2020 Terhadap Pengolahan Limbah Medis Rumah Sakit. Unes Law Review, 6(2), 6148–6154. https://review-unes.com/https://creativecommons.org/licenses/by/4.0/

Andika Putri, D. A., Zakianis, Z., Asyary, A., & Sofwan, S. (2023). A Comparative Analysis of Hazardous Medical Waste Management Compliance Before (2019) and During (2020) the COVID-19 Pandemic in Indonesia. Annali Di Igiene : Medicina Preventiva e Di Comunita, 35(1), 61–74. https://doi.org/https://doi.org/10.7416/ai.2022.2504

Asrun, A. M., Sihombing, L. A., & Nuraeni, Y. (2020). DAMPAK PENGELOLAAN SAMPAH MEDIS DIHUBUNGKAN DENGAN UNDANG- UNDANG No 36 TAHUN 2009 TENTANG KESEHATAN DAN UNDANG-UNDANG No. 32 TAHUN 2009 TENTANG PERLINDUNGAN DAN PENGELOLAAN LINGKUNGAN HIDUP. Pajoul (Pakuan Justice Journal of Law, 1(1), 33–46.

Ciawi, Y., Dwipayanti, N. M. U., & Wouters, A. T. (2022). Pengelolaan Limbah Medis Rumah Sakit yang Berkelanjutan: Eksplorasi Strategi Ekonomi dan Ramah Lingkungan. Jurnal Ilmu Lingkungan, 22(2), 365–374. https://doi.org/10.14710/jil.22.2.365-374

Debataraja, R. I. C., Hartono, B., & Lubis, M. S. (2023). Implementasi Peraturan Menteri Kesehatan Nomor 18 Tahun 2020 Tentang Pengelolaan Limbah Medis Fasilitas Pelayanan Kesehatan Berbasis Wilayah pada Puskesmas Padang Bulan Medan. Journal of Education Humaniora and Social Sciences (JEHSS), 5(3), 2097–2108.

Dutta, V., Dubey, D., & Kumar, S. (2020). Cleaning the River Ganga: Impact of lockdown on water quality and future implications on river rejuvenation strategies. The Science of the Total Environment, 743, 1–18. https://doi.org/140756. https://doi.org/10.1016/j.scitotenv.2020.140756

Ernyasih, Sulastri, S., & Andiani. (2024). Pengelolaan Limbah Medis Padat Puskesmas Cisoka Kabupaten Tangerang. Environmental Occupational Health and Safety Journal •, 4(2), 19.

Fatimah, N. (2021). Kebijakan Pemerintah Dalam Pengelolaan Limbah Medis Akibat Covid – 19. Jurnal Ilmu Administrasi: Media Pengembangan Ilmu Dan Praktek Administrasi, 18(2), 157–165. https://doi.org/10.31113/jia.v18i2.664

Ghali, H., Cheikh, A. Ben, Bhiri, S., Bouzgarrou, L., Rejeb, M. Ben, Gargouri, I., & Latiri, H. S. (2023). Health and Environmental Impact of Hospital Wastes: Systematic Review. Dubai Medical Journal, 6(2), 67–80. https://doi.org/10.1159/000529432

Harninda, R. (2023). Literatur Review: Pengelolaan Limbah Medis pada Negara Maju dan Negara Berkembang Serta Dampak Lingkungannya. Jurnal Serambi Engineering, 8(3). https://doi.org/10.32672/jse.v8i3.6273

Huda, M. N., Hailemariam, T. G., Hossain, S. Z., Malo, J. S., Khan, S., Hadisuyatmana, S., Ferdous, A., Akombi-Inyang, B., Islam, R. M., & Renzaho, A. M. N. (2022). Medical waste management-related factors affecting health and experiences of health risks among medical waste handlers in low and middle-income countries: A systematic review protocol of qualitative studies. BMJ Open, 12(3). https://doi.org/10.1136/bmjopen-2021-056037

Humairoh, R. T., Syafrani, Herniwanti, Dewi, O., & Zaman, M. K. (2022). Evaluasi Pengelolaan Limbah Medis Padat B3 Puskesmas. Jurnal Kesehatan, 13(2), 146–153.

Ibrahim, J. (2007). Teori dan Metodologi Penelitian Hukum Normatif. Bayumedia Publishing.

Iqbal, M., Febriyanti, D. R., & Saputra, A. S. (2023). Penanganan Limbah Medis Padat di Puskesmas X. Sehat Rakyat: Jurnal Kesehatan Masyarakat, 2(4), 495–501. https://doi.org/https://doi.org/10.54259/sehatrakyat.v2i4.2013

Lee, S. M., & Lee, D. (2022). Effective Medical Waste Management for Sustainable Green Healthcare. IJERPH, 19(22), 2–17. https://doi.org/https://doi.org/10.3390/ijerph192214820

Lorensyifa, A., Berutu, N., Nasution, R. A. N., Lubis, R. D. A., Marpaung, S. Y., Chairani, V., & Harahap. (2022). Isu Masalah Kesehatan Penyakit Menular dan Penyakit Tidak Menular. CV. DARIS INDONESIA.

Lukas, A., Ngudiwaluyo, S., Noor, I. M., & Adinegoro, H. (2018). PENINGKATAN MUTU PENANGANAN LIMBAH RUMAH SAKIT (SNI 3242:2008) DENGAN PENERAPAN TEKNOLOGI KARBONISASI. Jurnal Standardisasi, 20(2), 129–138.

M, A., R, E., B, F.-M., & D, Y.-T. (2016). Heavy Metal Contamination of Soils around a Hospital Waste Incinerator Bottom Ash Dumps Site. J Environ Public Health. https://doi.org/2016:8926453. doi: 10.1155/2016/8926453. Epub 2016 Feb 29. PMID: 27034685; PMCID: PMC4789433.

Mirzatul Nikmah, Nada Vidyan Safira, Nia Selviana Puji Lestari, Najwa Sekar Ayu Nanda Asvianto, & Denny Oktavina Radianto. (2024). Perkembangan Pengelolaan Limbah Medis Pada Rumah Sakit. Jurnal Wilayah, Kota Dan Lingkungan Berkelanjutan, 3(1), 99–108. https://doi.org/10.58169/jwikal.v3i1.369

Nikmah, M., Safira, N. V., Lestari, N. S. P., Asvianto, N. S. A. N., & Radianto, D. O. (2024). Perkembangan Pengelolaan Limbah Medis Pada Rumah Sakit. JURNAL WILAYAH, KOTA DAN LINGKUNGAN BERKELANJUTAN, 3(1), 99–108. https://doi.org/https://doi.org/10.58169/jwikal.v3i1.369

Nugrahaeni, A., & Sulistiadi, W. (2022). Peningkatan Berkelanjutan dalam Pengelolaan Limbah Medis Padat COVID-19 Di Fasilitas Pelayanan Kesehatan : Systematic Review. JURNAL DUNIA KESMAS, 11(4). https://doi.org/10.33024/jdk.v11i4.8105

Nurhayati, S., & Racha, N. S. (2024). Legal Aspects of Medical Waste Management in Health Care Facilities and Protection of Environmental Health. Journal of Law, Politic and Humanities, 4(6), 2544–2552. https://doi.org/https://doi.org/10.38035/jlph.v4i6.786

Prakasa, A. (2018). 3 Sungai di Jawa Barat Tercemar Limbah Medis Rumah Sakittle. BAPPEDA Provinsi Jawa Barat.

Puspita, N. A., Heridadi, & Suhadi. (2024). Pengaturan Pembuangan Limbah Medis Pada Fasilitas Layanan Kesehatan Dokter Gigi. Jurnal Cahaya Mandalika, 3(1), 633–643.

Raharja, I. F. (2018). Analisis Penerapan Sanksi Administrasi Pada Pelaksanaan Pengelolaan Limbah Pada Rumah Sakit Umum Raden Mattaher Jambi. Solusi, 16(3), 352–363. https://doi.org/10.36546/solusi.v16i3.144

Ravindra, K., Sareen, A., Dogra, S., & Mor, S. (2023). Appraisal of biomedical waste management practice in India and associated human health and environmental risk. Journal of Environmental Biology, 44, 541–551.

Soekanto, S., & Mamudji, S. (2003). Penelitian Hukum Normatif: Suatu Tinjauan Singkat. Rajawali Press.

Sonkar, yanendra K., Singh, S., & Sonkar, S. K. (2023). Biomedical Waste: Impact on Environment and Its Management in Health Care Facilities. Current Research Trends and Applications in Waste Management, 139–159.

Sutanto, Y. S., & Karianga, K. (2023). Hukum Terkait Pengelolaan Limbah Bahan Berbahaya Dan Beracun Medis Rumah Sakit. Jurnal Hukum Kesehatan Indonesia, 3(02), 103–115. https://doi.org/10.53337/jhki.v3i02.101

Syafhira, A., Misnaniarti, Idris, H., Windusari, Y., Novrikasari, & Fajar, N. A. (2024). Dampak dan Peraturan LImbah Padat Perawatan Kesehatan Manajemen Selama Covid 19 di Berbagai Negara: A Study Literature. Jurnal Keperawatan, 16(2), 867–881.

Taghilou, S., Torkashvand, J., Kermani, M., & Farzadkia, M. (2021). Incineration of medical waste: Emission of pollutants into the environment. Journal of Air Pollution and Health, 6(4), 287–334. https://doi.org/10.18502/japh.v6i4.8587

Welliana, M., Efendi, I., & Aini, N. (2022). Analisis Pengelolaan Limbah Medis di Puskesmas Kabupaten Aceh Timur. Journal of Healtcare Technology and Medicine, 8(1), 216–227.

Widyawati. (2020). Pengelolaan Limbah Medis oleh RS Sudah Sesuai Standar. Kemenkes. https://kemkes.go.id/id/rilis-kesehatan/pengelolaan-limbah-medis-rs-sudah-sesuai-standar

Yati, D. M., Mubarak, M., & Karnila, R. (2022). Evaluasi pengelolaan limbah bahan berbahaya dan beracun (B3) di Rumah Sakit tipe B Provinsi Riau. SEHATI: Jurnal Kesehatan, 2(2), 30–41. https://doi.org/10.52364/sehati.v2i2.26

Yudita, A., Akbar, A. A., Lingkungan, J. T., Teknik, F., Tanjungpura, U., Namawi, D. H. H., Laut, B., Tenggara, K. P., Pontianak, K., Barat, K., Air, K., & Retok, S. (2024). ANALISIS KUALITAS AIR DAN PENGENDALIAN PENCEMARAN AIR. 10(1), 64–76.

Yustina, E. W. (2021). AspekHukum Pengelolaan Limbah Medis Pada Fasilitas Pelayanan Kesehatan dan Perlindungan Terhadap Kesehatan Lingkungan. Jurnal Paradigma Hukum Dan Pembangunan, 6(1), 98–115. https://doi.org/https://doi.org/10.25170/paradigma.v6i1.2585.