

RESEARCH ARTICLE

Analysis of hospital liquid waste management system (case study of Rumah Sakit Mata Masyarakat Jawa Timur)

Julian Daffa Kusuma^{1*}, Abdul Hakim Zakkiy Fasya¹

¹Department of Public Health, Universitas Nahdlatul Ulama Surabaya, Indonesia

*Corresponding author: domkang052@gmail.com

Article history:

Received : 2024/12/02

Revised : 2025/01/20

Accepted : 2025/03/09

Available Online : 2025/04/05

DOI : [10.33086/etm.v5i1.6723](https://doi.org/10.33086/etm.v5i1.6723)

Abstract

Wastewater originating from hospital waste is a very potential source of water pollution. Based on assessment data, the pollutant content in waste water, the impact and volume of waste produced and the low efficiency of hospital Waste Water Treatment Installations (IPAL) in Indonesia. Making hospital waste water needs to be treated with appropriate processing technology. Therefore, an analysis of the liquid waste management system was carried out in the waste water management installation at the East Java Community Eye Hospital. This research uses a qualitative method with a case study design. This research involved 1 informant as a resource person, The data collection techniques in this study were observation and in-depth interviews, which were then analyzed using method triangulation. This research shows that in the output process, laboratory test results for waste water samples were obtained for all parameters which were below the threshold values except for temperature, ammonia, phosphate and coliform levels which exceeded the predetermined threshold values. Researchers concluded that the liquid waste management system at RSM East Java was completely adequate both in terms of input, process and output, but there were several systems that did not work optimally. The advice given to hospitals is to regularly check waste inlets, facilities and infrastructure, plan further processing, and increase human resources.

Keywords: Waste Management, Waste Water Management Installation (IPAL), Evaluation.

INTRODUCTION

According to WHO, hospitals play an important role in achieving development goals in the health sector. According to WHO (World Health Organization) hospitals complement and strengthen the effectiveness of many other parts of the health system, providing continuous availability of services for acute and complex conditions. Hospitals concentrate scarce resources within well-planned referral networks to respond efficiently to the health needs of the population (Al-Abbasi, 2022). They are an essential element of Universal health coverage and will be critical to meeting sustainable development goals (Nofrianty, 2020).

Hospital is a health care institution that organizes comprehensive individual health services that provide inpatient, outpatient, and emergency services (Griffin, 2012). Reference to Permenkes PP NO 2 of 2023 concerning Hospital Environmental Health Requirements. that the Hospital as a health service facility, a gathering place for sick and healthy people or can be a place of disease transmission and allow environmental pollution and the spread of disease. transmission of disease and allows environmental pollution and health problems (Yuwati, 2021).

Waste is all waste generated from hospital activities in the form of solid, liquid and gas. Hospital waste is waste generated from medical and non-medical activities, both solid and liquid, which can cause disease and necessary environmental pollution (Dursun, 2015). Liquid waste generated by hospital activities is a problem that the Hospital must face. As it is known that the hospital wastewater produced is infectious and also toxic, if it does not go through a good treatment process, it will increase the risk of disease transmission, so that it can cause pollution to the surrounding environment and can interfere with public health (Yuwati, 2021).

Waste management that is not optimal will cause various diseases and other health problems. To realize the quality of hospital environmental health, it is necessary to set environmental health quality standards and health requirements, and to meet these standards and protect health workers, patients, visitors, including the community in the hospital, hospital environmental health needs to be organized (Erizal and Makomulamin, 2021). Because of that hospitals should not become hotbeds for disease so that hospitals do not lose their image and do not change their function to become dirty, uncomfortable, and dangerous places. Hospital is a health care institution that organizes health services in a plenary manner that provides inpatient, outpatient, and emergency services (Nofrianty, 2020).

This condition requires any treatment and disposal of liquid waste so as not to cause problems for the environment and for the health of the community around the hospital. In 1999, WHO reported that there were 8 cases of health workers infected with HIV in France, 2 of which were experienced by medical waste handling workers. This shows that the importance of good overall medical waste management. Based on the results of the 2002 Rapid Assessment conducted by the Directorate General of Water Supply and Sanitation involving District and City Health Offices, it was stated that as many as 648 hospitals out of 1,476 hospitals, only 49% have incinerators and 49% have water treatment plants. 49% and those with wastewater treatment plants (WWTP) are 36%, of this amount, the quality of liquid waste that has gone through a qualified treatment process is only 52%. that meet the requirements is only 52% (Madeira et al., 2017; Sukadewi et al., 2020).

Hospital discharge water pollutant parameters that need to be considered are BOD, COD, TSS and phosphate, if the parameters set exceed the threshold can be dangerous and deadly for aquatic ecosystems. The entry of suspended solids (TSS) into the water can cause turbidity which results in a decrease in the photosynthesis rate of phytoplanktons and other aquatic plants, so that the primary productivity of the waters decreases (Buana et al., 2021). High levels of BOD and COD levels can cause a decrease in the dissolved oxygen content in the water, resulting in the death of organisms in the water (Madeira et al., 2017). resulting in the death of organisms in water . Hospital liquid waste management using a good WWTP requires comprehensive handling involving requires comprehensive handling involving many parties, technology, as well as large costs. Hospital liquid waste management needs to be supported by related agencies with facilities and infrastructure in accordance with hospital conditions. hospital conditions (Yuwati, 2021).

MATERIALS AND METHODS

Kind of Study

The research method used in this research is descriptive qualitative method with in-depth interviews and direct observation to collect data. The unit of analysis in this research is all employees who work in the Environmental Health Installation of the Rumah Sakit Mata Masyarakat (RSMM)

Jawa Timur.

RESULTS AND DISCUSSION

General Description of Rumah Sakit Mata Masyarakat (RSMM) Jawa Timur

UPT Rumah Sakit Mata Masyarakat (RSMM) East Java is a class B Specialty Hospital located at Jalan Gayung Kebonsari Timur No. 49, Surabaya. East Java Community Eye Hospital not only organizes eye health services but also develops partnership networks, coordination, education and training with related institutions and institutions. This is in accordance with the vision and mission of the UPT RSMM based on Governor Decree Number 68 of 2014. East Java Community Eye Hospital has a culture called “CARE” (C: Deft, responsive, light handed in solving problems faced by patients; A: Charity as the basis for the best and sincere service regardless of the patient’s social status; R: Friendly, empathetic, understanding, honest, communicative and familial; E: Cost effective, high quality service with integrated technology). They have the vision “To Become a National Standard Community Eye Hospital”, with the Mission: 1) Organizing quality, effective and efficient eye health services in a comprehensive manner in overcoming community eye health problems. 2) Organizing transparent and accountable management. 3) Developing partnership, coordination, education and research networks with related institutions and institutions in handling eye health.

Identification of Liquid Waste Management Inputs

Policy

According to informants, RSMM uses several policies in managing liquid waste, including: Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management. Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 5 of 2021 concerning Procedures for Issuing Technical Approval and Operational Feasibility Letters in the Field of Environmental Pollution Control. Minister of Environment Regulation No. 5 of 2014 concerning Wastewater Quality Standards. Minister of Environment Regulation No. 68 of 2016 concerning Domestic Wastewater Quality Standards Quality Standard for Domestic Wastewater. East Java Governor Regulation No. 52 of 2014 concerning Amendments to East Java Governor Regulation No. 72 of 2013 concerning Wastewater Quality Standards for Industry and/or Other Business Activity.

Manpower or Human Resources

Table 1. Human Resources at RSMM

No	Employee Type	Total
1	Optician Refractionist	9
2	General Practitioner	6
3	Ophthalmologist	19
4	Anesthesia Specialist	1
5	Nurse Personnel	63
6	Pharmacist	4
7	Nutritionist	1
8	Sanitarian Worker	4
9	Other Clinical Staff	34
10	Public Health	8
11	Other Management Per- sonnel	68
Total		217

Based on the explanation from the main informant, the number of liquid waste management personnel of East Java RSMM is 2 people. Consists of the Person in Charge of the Waste Water Treatment Plant (WWTP) and a WWTP operator who is in charge of ensuring the WWTP process runs, as well as ensuring the maintenance and care of the WWTP system.

“The task of a WWTP operator is to ensure the WWTP process runs, maintenance and care of the WWTP system and its supports” (MR).

Based on the results of interviews conducted, the RSMM Jawa Timur also have participated in training related to liquid waste management. Evidenced by the quote from the informant.

“Ever, training in the form of competency certification and webinars on liquid waste treatment” (MR).

Informant MR stated that employees involved in liquid waste management will be given training in the form of competency certification and webinars on liquid waste treatment.

Waste Water Treatment Plant (WWTP) Facilities and Infrastructure

In the process of managing liquid waste, the RSMM also conducts a liquid waste management program. Maintenance of the facilities and infrastructure of the liquid waste management system. The informant mentioned several maintenance activities, those are: Cleaning and maintenance of channels and pipes, channels and pipes are cleaned regularly so that they are not clogged with sediment or garbage to ensure the flow of waste remains smooth; Pump Maintenance, the pumps used to transport the wastewater from one place to another also require regular maintenance. This includes inspection of the pump condition, pump power, and repairs if necessary; Water Quality Monitoring the quality of wastewater needs to be monitored regularly to ensure that the sewage treatment process is running efficiently; Sludge Management, sludge or sediment formed during the wastewater treatment process needs to be removed regularly. Inactive sludge is drained sludge after drying is stored in B3; Electricity, electricity as an important support in the IPAL process electricity is also carried out periodically maintenance of this electricity includes panels, mcb, contactors, selectors etc.

Based on the results of input identification in liquid waste management, RSMM Jawa Timur also pays attention to environmental sustainability. In accordance with the research of Rohim, Rizka, et al., 2021 which states that development that provides benefits is development in the process of paying attention to the concept of environmental sustainability. In this case, RSMM East Java participates in preserving the environment from the impact of RSMM development by paying attention to the liquid waste they release so as not to damage the surrounding environment.

The policy used as a guideline for managing wastewater is government regulation number 22 of 2021 which discusses the Implementation of Environmental Protection and Management. Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 5 of 2021 concerning Procedures for Issuing Technical Approval and Operational Feasibility Letters in the Field of Environmental Pollution Control, Minister of Environment Regulation No. 5 of 2014 concerning Wastewater Quality Standards, Minister of Environment Regulation No. 68 of 2016 concerning Domestic Wastewater Quality Standards, and East Java Governor Regulation No. 52 of 2014 concerning Amendments to East Java Governor Regulation No. 72 of 2013 concerning Wastewater Quality Standards for Industry and Business Activities.

Identification of Liquid Waste Management Process at RSMM

The wastewater installation at the RSMM uses WWTP with aerobic biofilter method and bio ball media and pipe pieces. The wastewater discharge discharged into the WWTP body averages 12 m³/day which is recorded on the automatic low meter. on the automatic low meter. Liquid waste that is at the outlet of the WWTP is carried out monitoring and inspection once a month at the PT.

Sucofindo laboratory. The results of the liquid waste inspection sample are analyzed and compared with the Governor Regulation of East Java Province No.72 of 2013.

RSMM Jawa Timur also uses a flow regulator located in this equalization basin and can control fluctuations in the amount of wastewater that is uneven, namely during working hours water is needed in large quantities, and very little at night. Flow regulators can also control fluctuations in wastewater quality that are not the same for 24 hours by using mixing and diluting techniques. With the help of a diffuser, wastewater from various sources is stirred and mixed to become homogeneous and ready for treatment. In addition, the diffuser can also remove foul odors in wastewater. After that, the biological treatment process occurs in the aeration tank with organic materials contained in wastewater being decomposed by microorganisms into simpler products, causing organic matter to decrease over time.

In its processing efforts, the type of waste is divided into two, liquid waste from the kitchen and that from the laundry. After going through the pre-treatment process, the liquid waste is flowed into the collection well, where this collection well also functions as an equalization pond. According to Manoppo et al., 2023 the equalization basin itself functions as a temporary reservoir for wastewater before it is treated by the existing WWTP system in the hospital. This initial settling basin serves to settle particles of mud, sand and suspended organic impurities.

Based on the results of in-depth interviews with informants, researchers found that the supervision of liquid waste management at RSMM Jawa Timur is in the form of daily monitoring for checking temperature, pH, wastewater discharge, damaged facilities and infrastructure by sanitation officers, checking wastewater quality in the RSMM Jawa Timur laboratory once a month and checking wastewater samples outside RSMM Jawa Timur once every six months. The internal monitoring team by the hospital is in accordance with the director's decree and the external auditor is a team from the Ministry of Environment and Forestry and the Surabaya City Environment Office.

Output Analysis of Liquid Waste Management at RSMM Jawa Timur

WWTP sample inspection is carried out to measure wastewater quality. This wastewater quality measurement is in collaboration with a third party, an accredited laboratory. The regulation used for environmental quality monitoring is the East Java Governor Regulation 2013. This measurement is carried out once a month by taking samples for wastewater quality measurement.

Based on the examination conducted from January to November 2023, it was found that the parameters of TSS, pH, BOD and COD were in accordance with the quality standards of East Java Governor Regulation No. 72 of 2013. The test results of the wastewater did not exceed the threshold of 30 mg/L for TSS, 6-9 for pH, 30 mg/L for BOD, and 80 mg/L for COD. However, there are several parameters that do not comply with the quality standards, including temperature, NH₃-N, PO₄, and Coliform.

Temperature parameter

In the temperature parameter, from January to August 2023, the temperature of wastewater does not exceed the threshold of 30 °C, but from September to November 2023, the temperature in wastewater does not comply with the quality standards of East Java Governor Regulation No. 72 of 2013, the temperature in that month exceeds the threshold, which is 31 °C, 32 °C, and 32.5 °C respectively. It can be interpreted that from September to November the temperature does not meet the quality standards of liquid waste quality, so it is necessary to carry out regular monitoring to stabilize temperature levels at the RSMM WWTP.

Ammonia parameter

Based on the results of the study, it is known that ammonia levels exceed the threshold according to East Java Governor Regulation No. 72 of 2013, which is 0.1 mg/L in February, March, April, May, June, July, August, October and November 2023. Ammonia concentrations in water bodies can mean pollution that can cause eutrophication and death in aquatic microorganisms. In addition,

high ammonia levels can cause water to become cloudy and have an unpleasant odor. In line with Anggraini and Amalia, 2024 which states that the higher the ammonia level in water, the more toxic and corrosive it becomes which can have a negative impact on water consumers. Reducing ammonia and phosphate content in treated wastewater can be done by optimizing oxygen penetration, because the content of free ammonia and phosphate can be reduced by adding oxygen to the WWTP (Hartati et al., 2015).

Phosphate parameter

The quality of liquid waste at the East Java Community Eye Hospital in the results of the examination of the PO₄ (phosphate) parameter at the central WWTP during January to November 2023 has not met the quality standards of East Java Governor Regulation No. 72 of 2013. According to Madik, 2021 phosphate levels in the quality of wastewater from RSI Ibnu Sina Pekanbaru are thought to come from detergent wash water that enters the WWTP, phosphate is also the main source of phosphate. Phosphate is also produced and excreted by humans or animals in the form of urine and feces (Peacock, 2021), so phosphate will also be detected in wastewater released by the hospital.

Coliform parameter

Based on the results of inspections conducted from January to November 2023 it was found that in March, April, June, July, August, and October 2023 the resulting coliforms did not meet the quality standards. The maximum allowed coliform quality standard is 10,000 MPN / 100 mL, but in the results of the examination of wastewater in the WWTP outlet basin obtained coliform as much as 16,000 MPN/100 mL. This can be caused by several things, such as the environment in the wastewater, the optimum temperature is 35°C so that bacteria can multiply quickly (Ririmasse, 2022). In addition, it could be also due to the lack of a maximum wastewater treatment system. If liquid waste is discharged into the river, it can pollute the river and affect the life of marine biota and the surrounding environment. affect the life of marine biota and the surrounding environment (Winarti, 2020). To reduce coliform concentrations can be done by using chlorine because it can cause damage to bacterial cells (Sulistiyawati, 2019).

CONCLUSIONS

Based on the results of the research, management Personnel (HR) have met the qualifications. WWTP facilities and infrastructure are adequate and routinely checked. Analysis of the liquid waste management process at RSMM Jawa Timur through several processes, including pre-treatment, flowing into collecting wells, using aerobic biofilter reactors, settling in the final settling basin which is then flowed into the chlorination basin and then accommodated in the indicator basin. Furthermore, the waste is flowed into the transfer pond. Output analysis of the results of the Community Eye Hospital Liquid Waste parameters is not good enough, some parameters are still above the quality standards. At the Central WWTP where the inspection results for the key parameters namely COD, BOD and TSS and pH mostly meet the quality standards for wastewater quality. However, for ammonia and phosphate parameters, temperature and coliform are still not in accordance with the quality standards according to East Java Governor Regulation No. 73 Year 2.

Author contributions

Julian Daffa Kusuma: Conceptualization, analysis, draft writing, and editing; Abdul Hakim Zakkiy Fasya: Conceptualization and Data analysis.

Conflict of Interest

There is no conflict of interest in this study.

Acknowledgment

The researcher would like to thank all who contributed to this research.

Data availability

Data related to the findings of this study are available at the corresponding author.

REFERENCES

- Al-Abbasi, K. (2022). *A comprehensive evaluation of complex interventions in health: Informing decision-makers* [Doctoral dissertation, The University of Western Australia].
- Anggraini, E. R., & Amalia, A. (2024). Evaluasi efektivitas kinerja instalasi pengolahan air limbah terhadap effluent limbah cair industri pt x. *Jurnal Serambi Engineering*, 9(2), 9132–9137.
- Buana, S., Tambaru, R., Selamat, M. B., Lanuru, M., & Massinai, A. (2021). The role of salinity and total suspended solids (tss) to abundance and structure of phytoplankton communities in estuary saddang pinrang. *IOP conference series: earth and environmental science*, 860(1), 1–9.
- Dursun, S. (2015). Hospital medical waste management. *International Journal of Ecosystems & Ecology Sciences*, 5(4), 541–556.
- Erizal, M., & Makomulamin, M. (2021). Analisis tingkat kebisingan terhadap standar baku mutu tingkat kebisingan di rumah sakit mesra kabupaten kampar tahun 2020: Analysis of noise level of quality raw standard standards in the mesra hospital in kampar district, 2020. *Media Kesmas (Public Health Media)*, 1(2), 111–120.
- Griffin, D. (2012). *Hospitals: What they are and how they work*. Jones & Bartlett Learning.
- Hartati, H., Ahmad, A., & Nazriati, E. (2015). Implementasi pengelolaan limbah cair rumah sakit islam ibnu sina pekanbaru. *Dinamika Lingkungan Indonesia*, 2(2), 87–91.
- Madeira, J. G. F., Delgado, A. R. S., Boloy, R. A. M., Coutinho, E. R., & Loures, C. C. A. (2017). Exergetic and economic evaluation of incorporation of hydrogen production in a cassava wastewater plant. *Applied Thermal Engineering*, 123, 1072–1078.
- Madik, K. R. (2021). Skripsi evaluasi sistem pengelolaan limbah cair di rumah sakit umum daerah dr. saiful anwar karmelinda rambu madik 1307. 13251. 104 ota malang provinsi jawa timur.
- Manoppo, V. N., Riogilang, H., & Riogilang, H. (2023). Evaluasi limbah cair dan limbah padat di rumah sakit advent kota manado. *Tekno*, 21(84), 539–550.
- Nofrianty, D. (2020). *Evaluasi sistem pengelolaan limbah padat medis di rumah sakit umum daerah ulin kota banjarmasin tahun 2020* [Doctoral dissertation, Universitas Islam Kalimantan MAB].
- Peacock, M. (2021). Phosphate metabolism in health and disease. *Calcified tissue international*, 108, 3–15.
- Ririmasse, H. (2022). Kandungan koliform pada outlet air limbah rumah sakit di kota manado. *Indonesian Journal of Public Health and Community Medicine*, 3(2), 31–36.
- Rohim, N., Rizka, S. A., et al. (2021). *Kebijakan pelaksanaan pengelolaan limbah rumah sakit pku aisyiyah boyolali* [Doctoral dissertation, Universitas Muhammadiyah Surakarta].
- Sukadewi, N. M. T. E., Astuti, N. P. W., & Sumadewi, N. L. U. (2020). Efektivitas sistem pengolahan limbah cair di rumah sakit bali med denpasar tahun 2020. *HIGIENE: Jurnal Kesehatan Lingkungan*, 6(3), 113–120.
- Sulistiyawati, I. (2019). Kuantitas total bakteri coliform pada instalasi pengolahan limbah cair medis laboratorium klinik. *Jurnal Ilmiah Universitas Batanghari Jambi*, 19(3), 675–677.
- Winarti, C. (2020). Penurunan bakteri total coliform pada air limbah rumah sakit terhadap pengaruh lama waktu penyinaran dengan sinar ultra violet. *Jurnal Rekayasa Lingkungan*, 20(1), 52–57.
- Yuwati, S. (2021). Sistem pengolahan limbah cair di rumah sakit x sumatera selatan. *Seminar Nasional Lahan Suboptimal*, 9(2021), 384–391.



This is an open access article distributed under the Creative Commons Attribution-ShareAlike 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cite. ©2025 The Author(s)