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Study of Medical Hazardous and Toxic (B3) Waste Management at Ulin Hospital Banjarmasin

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ABSTRACT

Hospitals are health care facilities that generate waste in their operations, including hazardous and toxic waste (B3) in the form of liquid, solid, and gas waste classified as medical and non-medical waste. Medical B3 waste contains pathogens, toxic chemicals, and/or radioactive materials and is unstable, posing a risk of infection and exposure to hazardous substances if not managed properly. In Indonesia, limited treatment facilities including the low number of hospitals with licensed incinerators mean that treatment capacity is not yet commensurate with the amount of medical hazardous waste generated, so management often relies on third parties who are required to meet the requirements and competencies in accordance with regulations. This study was conducted at Ulin Hospital Banjarmasin, a type A hospital in South Kalimantan that has an incinerator but has not yet used it for medical hazardous waste management. This study focuses on hazardous dan toxic waste generation with the aim of analysing the generation and composition of hazardous and toxic medical waste and the management process at Ulin Hospital Banjarmasin. Ulin Hospital Banjarmasin generated 45,774.002 kg of hazardous medical waste over three months (15,258 kg/month, 497.54 kg/day), dominated by infectious waste (35,106.26 kg; 390 kg/day). However, management remains non-compliant with Ministry of Environment and Forestry Regulation No. 56/2015, particularly due to inadequate Hazardous and Toxic Waste storage requirements and missing technical specifications.

Keywords: Ulin Hospital Banjarmasin, medical hazardous and toxic waste (B3), medical waste management

INTRODUCTION

Hospitals are health care facilities that provide health care assistance by operating various facilities such as inpatient care, outpatient care, emergency units, laboratories, and other medical support facilities with the aim of improving the health of the community. As a means of health care for the community, hospitals must pay attention to their relationship with the environment. In carrying out various activities, hospitals produce waste that is categorized as hazardous and toxic waste (B3). Hospitals produce all types of waste, namely liquid waste, solid waste, and gas waste. All types of hospital waste can be divided into two categories, namely medical and non-medical waste (Rochmawati et al., 2022).

Hospital medical waste is hazardous toxic waste (B3) that is very important to manage properly. Hazardous toxic waste has different properties and characteristics and is unstable. The stability of hazardous toxic waste is influenced by external factors such as temperature, pressure/friction, and mixing with other materials, which can trigger the properties of hazardous toxic waste materials, such as reactivity, explosiveness, flammability, or other toxic properties. Medical waste contains hazardous materials such as disease pathogens, toxic chemicals, or radioactive materials. If this waste is not managed properly, it can lead to the spread of infection or exposure to hazardous substances that can endanger health (Larasati et al., 2022).

In Indonesia, with a total of 2,889 hospitals, only 110 have licensed incinerators. This situation has resulted in limited capacity for processing hazardous medical waste, which currently stands at only 53.12 tons/day. Added to this is the processing capacity of third parties, which is 187.90 tons/day, while the amount of medical hazardous waste is predicted to reach 294.66 tons/day (Prasetiawan, 2020). Based on data from the Banjarmasin City Environment Agency, in 2022 the volume of waste reached 511.98 tons/day. Meanwhile, the Ministry of Environment and Forestry (KLHK) estimates that the accumulation of medical waste in hospitals throughout Indonesia reaches 8,000 tons. This is considered to be due to medical waste management that does not yet meet the requirements. Hospitals that have incinerators can certainly manage medical waste themselves. If hazardous waste producers are unable to handle their waste independently, they can hand it over to a third party for processing. Companies providing hazardous waste processing services must comply with applicable regulations and competencies (Nursabrina et al., 2021).

The hospital to be studied is Ulin Hospital Banjarmasin. This hospital has an incinerator, but it is not used in the management of hazardous toxic medical waste. Ulin Hospital Banjarmasin is a type A hospital located in South Kalimantan province that provides health services to the community.

MATERIALS & METHODS

This study was conducted at a hospital in Banjarmasin City. The location for data collection in this study was the Ulin Hospital Banjarmasin. The research used interview and observation techniques. Observations were made using a checklist based on Ministry of Environment Regulation No. 56 of 2015 concerning the reduction, sorting and containment, on-site transportation, storage and transportation of hazardous toxic medical waste. The following are the map of waste collection point locations and concession areas of Ulin Hospital Banjarmasin.

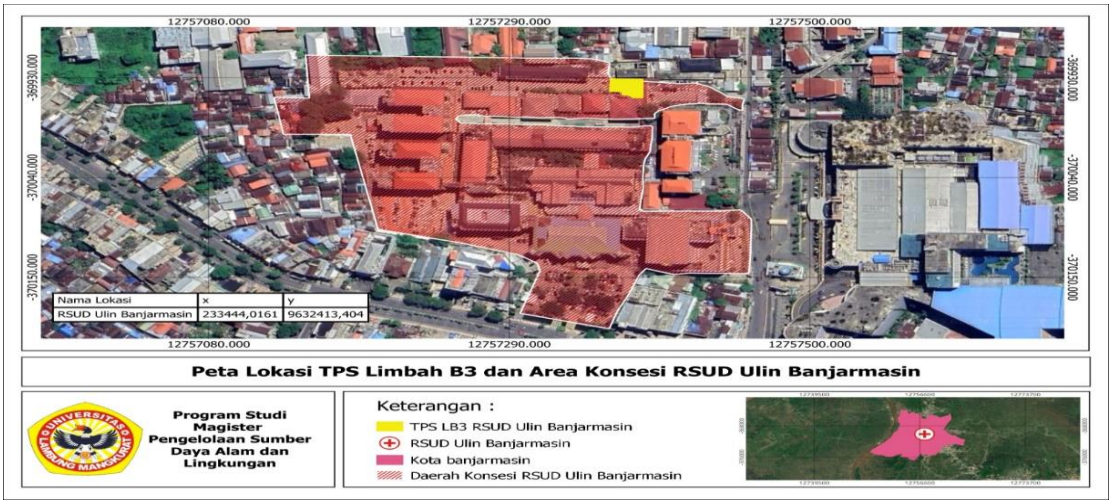

Figure 1. Map of Waste Collection Point Locations and Concession Areas of Ulin Hospital Banjarmasin.

RESULTS

The Ulin Hospital Banjarmasin produces waste from its activities. The waste generated includes medical hazardous toxic waste, such as infectious waste, sharp waste, infusion bottles, cytotoxic waste, pharmaceutical waste, and pathological waste. This waste comes from various sources that produce medical hazardous toxic waste, such as inpatient rooms, emergency rooms, polyclinics, hemodialysis rooms, morgues, and other rooms that produce medical hazardous toxic waste.

Table 1. Medical Hazardous Toxic Waste Generation per Room

Production Room	Waste Generation (Kg/Month)		
	July	August	September
Tulip 1	553.42	610.68	533.19
Tulip 2	777.81	793.99	863
Tulip 3	656.23	468.59	1191.07
Tulip 4	218.59	198.19	685.9
Mawar 1	213.88	262.53	235.77
Mawar 2	590.912	475.84	762.16
Mawar 3	99.04	111.1	161.86
Mawar 4	564.64	567.9	491.61
Mawar 5	364.09	306.12	199.9
Tower 1	17.3	3.5	3.12
Tower 2	9	5.94	0
Tower 3	7.44	20.05	30.58
Tower 4	171.83	122.01	158.06
Tower 5	358.92	309.75	331.78
Tower 6	82.51	140.4	189.38
Anggrek 1	217.61	276.89	354.46
Anggrek 2	32.31	128.36	113.23
Anggrek 3	101.02	170.19	124.6
Anggrek 4	57.24	20.06	46.64
Aster 1	15.32	13.86	2.9
Aster 2	0	7.88	4.4
Aster 3	270.63	249.26	368.7
Aster 4	182.72	156.62	244.29
Icu	937.61	825.33	1268.87
Ok	2541.04	2185.09	2520.34
Igd	359.81	397.69	453.62
Lab Pcr	288.4	115.2	235.46
Lab Cito	143.22	189.14	260.08
Lab Vk	53.18	83.42	50.31
Radiologi	33.32	93.14	50.53
Poli Kaki	213.28	174.75	188.88
Poli Kandungan	2.7	8.6	0
Bank Darah/Utdrs	193.08	115.44	321.46
Inrit Bayi	253.92	332.68	245.79
Seruni	10.92	9.5	0
Dahlia/Paru	299.49	294.31	443.38
Bogenvile	77.74	91.08	85.42
Edelweiss	191.84	201.9	177.4
Laundry	14.42	24.98	38.12
Kamar Mayat	47.64	66.7	39.7
Stroke Center	0	54.32	92.12
Cssd	0	7.66	2
Orthopedi	0	0	0
Smf	4	0	0
Cmu	0	11.02	23.02

Catlab	0	0	6.02
Hemodialisa	4239.96	4289.93	3969.49
Jumlah	15201.57 kg	15014.91	15557.52 Kg

(Source: Secondary Data, 2025)

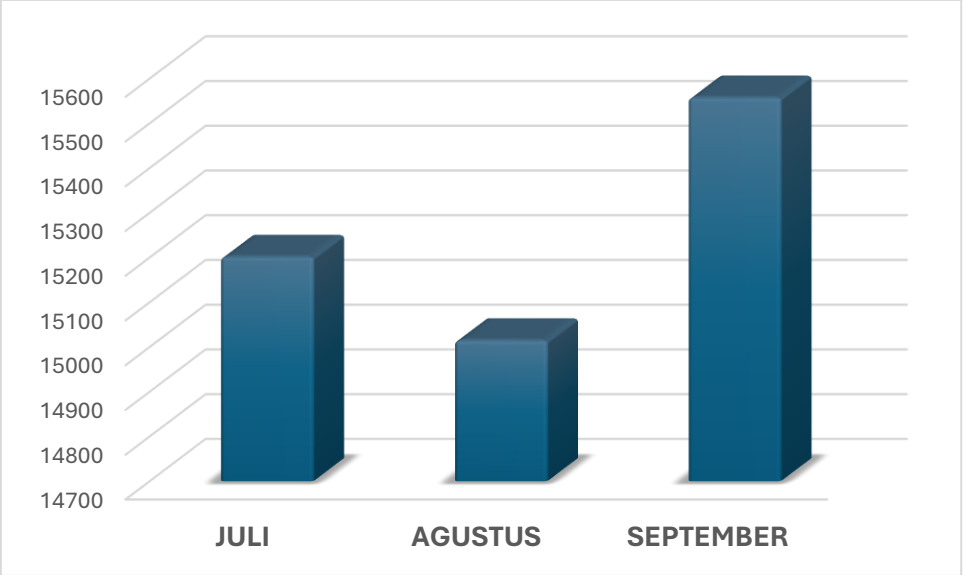

Figure 2. July–September Quarterly Forecast Diagram

The bar chart shows changes in projected values over three months. In July, the value was at a moderate level. Entering August, there was a decline compared to July, indicating a slowdown/decline in volume or achievement during that period. However, in September, there was the highest increase among the three months (reaching its peak). This pattern illustrates fluctuations with a low point in August and a surge in September, which could indicate seasonal factors, increased service activity, or greater accumulation of demand/production at the end of the quarter

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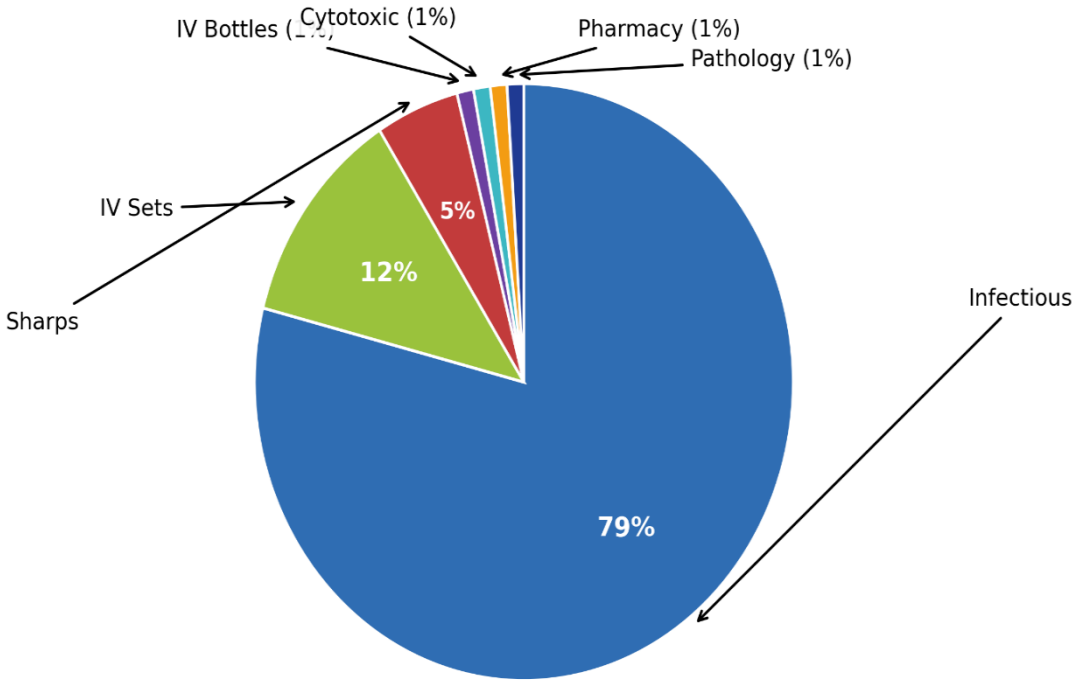

Figure 3. Composition Diagram of Hazardous Toxic Medical Waste at Ulin Hospital Banjarmasin

Based on the data obtained, the composition of medical hazardous toxic waste at Ulin Hospital Banjarmasin is divided into infectious waste, sharp objects, infusions, infusion bottles, cytotoxic waste, pharmaceutical waste, and pathology waste. The highest composition of medical hazardous toxic waste produced during the three-month period (quarter) was infectious waste at 35,106.26 kg, while the lowest was infusion bottles at 347 kg.

DISCUSSION

Figures 2 and 3 show fluctuations in projected values for the July–September period, with values declining in August and then rising sharply in September, while the composition of medical hazardous toxic waste was dominated by infectious (79%), which was much greater than other types such as IV sets (12%) and sharps (5%). The combination of the upward trend in September and the dominance of infectious indicates that increased waste activity/production at the end of the quarter has the potential to increase health and environmental risks. Therefore, further discussion is needed on the factors causing changes in waste volume, the effectiveness of sorting at source, and the readiness of the waste transport and treatment system (especially for infectious and sharp objects) to remain in line with safety and hazardous toxic waste management standards.

Generation & Composition of Hazardous Toxic Medical Waste at Ulin Hospital Banjarmasin

Waste generation is the amount of waste generated by the community in terms of volume or weight per capita per day, or per building extension or road extension (Aulia & Hadju, 2024). Hospital waste is all waste produced by hospital activities and other supporting activities, which is generally divided into two major groups, namely medical and non-medical waste in solid and liquid form (Ahlawat et al, 2025).

Medical hazardous toxic waste was obtained from secondary data from the Ulin Banjarmasin Regional General Hospital for a period of three months (quarter), with 15,201.572 kg generated in July, 15,014.91 kg in August, and 15,557.52 kg in September. The total waste amounted to 45,774.002 kg, with an average of 15,258 kg/month generated by the hospital's waste-producing rooms. From these results, it can be averaged that Ulin Hospital Banjarmasin generates an average of 497.54 kg/day.

Medical Waste Management System at Ulin Regional General Hospital Banjarmasin

a. Reduction of Solid Medical Hazardous Toxic Waste

Based on the interview results, medical waste reduction is achieved by utilising used dialysis fluid containers from the haemodialysis room as a substitute for safety boxes that are reused for medical waste such as syringes. Medical waste reduction is also carried out on used infusion bottles that still contain residual fluid by shredding the infusion bottles. In addition to reducing the amount of hazardous toxic medical waste, this also has an impact on the final amount of hazardous toxic medical waste produced.

Based on the interview results, medical waste reduction was achieved by utilising used dialysis fluid containers from the haemodialysis room as a substitute for reusable safety boxes for medical waste such as syringes. Medical waste reduction was also carried out on used infusion bottles that still contained residual fluid by crushing the infusion bottles. In addition to reducing the amount of hazardous and toxic medical waste, this also has an impact on the final amount of hazardous and toxic medical waste produced.

Figure 4. Haemodialysis Jerigen Waste and Infusion Bottle Shredder

b. Sorting & Storage of Solid Medical Hazardous Toxic Waste

Waste sorting carried out by Ulin Hospital Banjarmasin is based on observations, which is by providing labeled waste bins with symbols indicating the type of waste and different plastic colours. Sorting is carried out based on waste categories such as sharp objects, medical waste, infusion bottle waste and non-medical waste.

Figure 5. Waste Sorting & Storage at Ulin Hospital Banjarmasin

Figure 6. Waste Information on Rubbish Bins

The containers provided by Ulin Hospital Banjarmasin in each service room are yellow safety boxes for sharp waste such as syringes, ampoules and vials. The safety boxes are made of duplex cardboard with a volume of 12.5 litres and a thickness of ± 1-2 cm.

Figure 7. Safety Box Ulin Hospital Banjarmasin

Other solid waste is disposed of in closed bins lined with yellow plastic bags for solid medical hazardous toxic waste, infusion bottles and black plastic bags for non-medical waste. These waste containers are strong, rust-proof, waterproof, closed, and contain disposable plastic inside.

Based on the results of an evaluation in a previous study (Arumdani, 2021), it can be concluded that the sorting and containment of hazardous toxic medical waste in hospitals has not been carried out in accordance with the applicable hazardous toxic waste management regulations. The process of sorting solid medical waste is in the 'poor' category, as evidenced by the continued mixing of medical waste with domestic waste, a condition that should not be permitted as it increases the risk of disease transmission and environmental pollution.

In fact, the containment of hazardous toxic medical waste does not yet meet standards, particularly in terms of labelling and symbolisation. Medical waste containers are not consistently equipped with infectious waste symbols and labels, potentially leading to errors in waste handling at subsequent stages of management. This situation indicates that the implementation of waste sorting and containment is still highly dependent on the availability of facilities, rather than on the suitability of the characteristics and level of hazardous toxic medical waste.

c. On-site Transportation of Solid Medical Hazardous Toxic Waste

The Ulin Hospital Banjarmasin transports solid medical hazardous toxic waste in situ

from the generating unit to the hazardous toxic waste temporary storage facility. Based on observations and interviews, Ulin Hospital Banjarmasin conducts on-site transportation three times a day at 7 a.m., 9 a.m. and 12 p.m. when hospital activity is not busy, using a special route or what is called a dirty route and transported by officers on duty during that shift. Ulin Hospital Banjarmasin has a patient route, a clean route for food and laundry trolleys, and a dirty route or special route used for waste transport trolleys with a capacity of 660 litres. Waste transported from the upper floors also uses waste transport trolleys with a capacity of 660 litres and a special route that then leads to the hazardous toxic waste temporary storage site (TPS).

Figure 8. Dirty Routes and Waste Transportation

The on-site transportation carried out complies with Regulation of the Minister of Environment and Forestry No. 56 of 2015, which stipulates that waste collection must be carried out at least once a day or as needed, each waste bag must correspond to the waste category and new bags must always be available at each waste-producing unit, and the transport trolleys used must be separated from non-medical waste.

Based on previous research (Abbad & Diyanah, 2022), it can be concluded that the management of hazardous toxic medical waste transportation in situ at Dr. R. Sosodoro Djatikoesoemo Bojonegoro Hospital has not been carried out in accordance with the provisions of Minister of Environment and Forestry Regulation No. 56 of 2015. The transport of waste from the source to the Temporary Storage Site (TPS) for hazardous toxic waste has not been carried out in an orderly and scheduled manner, resulting in the accumulation of waste in health service units. In addition, the use of the same means of transport for infectious and non-infectious waste has resulted in the mixing of waste with different characteristics, which has the potential to increase the risk of exposure for officers and reduce the level of work safety.

d. Temporary Storage of Medical Hazardous Toxic Waste

Based on observations and interviews, the Ulin Hospital Banjarmasin waste collection point is separate from the main hospital building and located in a flood-free area, away from hospital services and residential areas surrounding the hospital. The building is enclosed, equipped with doors and ventilation, and has been marked with symbols, labels and coordinates.

Ulin Hospital Banjarmasin has met several requirements Temporary Storage Site for hazardous Toxic waste as stipulated in Regulation of the Minister of Environment and Forestry Number 06 of 2021, which can be seen in Table 2.

Table 1. Requirements for Hazardous Toxic Temporary Storage Site

NO	Regulation of the Minister of Environment and Forestry Number 06 of 2021	Suitable	Unsuitable
1.	The storage space area corresponds to the amount of hazardous toxic waste stored.	✓	
2.	The building design must protect hazardous toxic waste from rain and must be enclosed.	✓	
3.	Have a roof made of non-combustible materials.	✓	
4.	Have a ventilation system available to ensure air circulation.	✓	
5.	Equipped with a lighting system tailored to the design of the Hazardous Toxic Waste Storage Facility	✓	

6.	Has a waterproof and non-wavy floor.	✓	
7.	The interior floor slopes downwards towards the spill containment basin with a maximum gradient of 1% (one per cent).	✓	
8.	The outer floor is designed to prevent rainwater from entering the hazardous toxic waste storage building.	✓	
9.	Having drainage channels for spills, leaks of hazardous toxic waste and/or water resulting from the cleaning of spills or leaks of hazardous toxic waste		✓
10.	Spill containment tank for collecting spills, hazardous toxic waste spills and/or water resulting from the cleaning of hazardous toxic waste spills or leaks.		✓
11.	Equipped with a hazardous toxic waste symbol in accordance with the provisions of laws and regulations.		✓

(Source: Secondary Data, 2025)

Figure 9. Hazardous Toxic Waste Storage Area

The storage of hazardous toxic medical waste carried out by the Ulin Hospital Banjarmasin is conducted for no more than 48 hours or 2 days because the waste is immediately transported by a licensed hazardous toxic waste management service provider. This is in accordance with Ministry of Environment and Forestry Regulation No. 56 of 2015, which states that infectious waste and sharp objects may be stored for a maximum of 90 days at a temperature of ≤0°C and for 2 days at temperatures above 0°C.

Although the location of the Temporary Storage Site (TPS) for Hazardous Toxic Waste has met the basic requirements, the lack of orderliness in the containers and the placement of symbols and labels indicates that the implementation of medical hazardous toxic waste storage standards is not yet optimal. Therefore, improved compliance with technical storage requirements is necessary to minimise health risks and environmental impacts.

e. External Transportation of Hazardous Toxic Medical Waste

Medical hazardous toxic waste generated by Ulin Banjarmasin Regional General Hospital is transported externally by PT Artama Sentosa Indonesia, PT Trans Waste Moda Indonesia, PT Mitra Garuda Palapa, and PT Putra Restu Ibu Abadi. Based on the interview results, the hospital uses these four vendors to anticipate potential operational challenges with any single vendor, ensuring that the transportation of medical hazardous toxic waste remains in line with the storage time specified by regulations. Transportation is conducted in a closed manner using vehicles with strong, sealed containers to prevent the risk of disease transmission from hospital hazardous toxic waste.

This is in line with previous research by Putri et al, (2022), which has met the transportation criteria in Minister of Environment and Forestry Regulation No. 56 of 2015 by transporting hazardous medical waste using vehicles that are marked and labelled, enclosed, and accompanied by a manifest that complies with applicable regulations.

Figure 10. Transportation of Hazardous Toxic Waste with Vendors

Figure 11. Hazardous Waste Transport Truck by Vendor

CONCLUSION

The conclusion of this study is that during a three-month period (quarter), the Ulin Hospital Banjarmasin generated 45,774.002 kg of hazardous toxic medical waste, with an average of 15,258 kg/month or 497.54 kg/day, dominated by 35,106.26 kg of infectious waste (±390 kg/day). However, its management still does not meet the provisions of Ministry of Environment and Forestry Regulation No. 56 of 2015, particularly regarding the medical hazardous waste storage facility, which does not yet comply with storage requirements and lacks technical specifications for the LB3 storage facility.

Declaration by Authors

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