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Regional Case Study

Analysis of Solid Medical Waste Management at X Hospital, West Sumatra

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Abstract

X Hospital is one of the referral hospitals for handling COVID-19 patients, with 2,347 positive confirmed cases on November 12, 2021, which caused an increase in solid medical waste in 2022. Because solid medical waste has hazardous characteristics, there's an urgency to give more attention to potential risks. The impact can be reduced through proper waste management, starting with the waste stack. This study aims to identify sources and characteristics, waste stack, and implementation of solid medical waste management at X Hospital. This study uses quantitative and qualitative descriptive analysis, primary and secondary data collection, observation, interviews, and measurement of solid medical waste by SNI-19-3964-1994. The results found that solid medical waste originates with three characteristics of waste, the average stack generated is 56.53 kg/day, and the correlation between patients and solid medical waste obtained a Spearman rank correlation (r) value of 0.851 with a very strong correlation. Implementing solid medical waste management at X Hospital refers to applicable regulations with a percentage of good 80%. Sorting decomposing 82.5%, container 76%, collection 73%, storage 85%, and external transportation 100%. However, several indicators must be improved to comply with applicable regulations, especially minimization, container, collection, and storage.

Keywords: Management; generation; solid medical waste; hospital

1. Introduction

The COVID-19 pandemic affected several sectors. The Indonesian health sector has experienced a high increase in the number of patients since the declaration of COVID-19 in March 2020. The increasing number of patients will increase the hospital's medical activities and health services. The increase in health service facility units is also marked by increased medical waste (Morfi et al., 2020). The Ministry of Health of the Republic of Indonesia in 2021 stated that the percentage of medical waste management according to WHO standards is 18.9%. The province with the highest rate is Bengkulu (43.5%), and the lowest is Papua (0.2%). West Sumatra is in 20th place out of 34 provinces, namely 6.5% (Kementerian Kesehatan Republik Indonesia, 2021).

The amount of medical waste in West Sumatra 2018 was 1,899 tonnes/year. The prediction of medical waste in West Sumatra in 2040 is 8,445 tons/year or 23.1 tons/day (Unand, 2019; Yolarita & Kusuma, 2020). Research conducted at 17 hospitals in West Sumatra stated that from April to June 2020, medical waste has increased by 41,760 kg and 88.24%. One of the health service facilities that is a reference for handling COVID-19 patients in West Sumatra is X Hospital. At X Hospital, on 12 November 2021, there were 2,347 positive confirmed cases of COVID-19 (Pemerintahan Kota Solok, 2021). Medical waste at X Hospital from October 2021 to November 2021 has increased by 491 kg. So, the increase in the number of patients and the weight of solid medical waste in 2021 can have a significant relationship. Apart from that,

the COVID-19 pandemic will not end in 2022, so there is the potential for an increase in the number of patients and the generation of solid medical waste. Another problem is that data that provides information regarding the type and rate of solid medical waste generation at this hospital is needed. This statement is from previous research conducted at a hospital that has experienced an increase in the generation of abundant solid medical waste since the COVID-19 pandemic (Andeobu et al., 2022; Chowdhury et al., 2022). Based on the above, it is necessary to research the characteristics and rate of generation of solid medical waste produced, review solid medical waste management, and provide recommendations for improving solid medical waste management.

Solid medical waste contains pathogens that cause disease in humans and carriers for the spread of infectious diseases, including typhoid fever, cholera, dysentery, and hepatitis. Based on this statement, hospital solid waste can potentially carry the COVID-19 virus. In addition, solid medical waste has the potential to pollute the environment and cause work accidents. Based on this statement, X Hospital medical waste has the potential to cause negative impacts on the environment and humans if it is not treated according to solid medical waste management standards (Andi Muhammad Asrun et al., 2020). The standard of medical waste management can create safe and healthy health facilities. Based on the description above, this study identified the sources and characteristics of solid medical waste at Hospital X, identified the implementation of a solid medical waste management system at Hospital X, analyzed the relationship between the number of solid medical waste and the number of patients at Hospital X. Correlation analysis is helpful to prove that the number of patients can potentially influence the amount of solid waste. This evidence helps determine the direction of hospital policy for the better.

2. Methods

2.1 Research Time and Location

The location of this research is X Hospital, located in Solok City, West Sumatera Province, Indonesia. This research was observed in the inpatient, emergency, radiology, and laundry rooms until the temporary shelter. This research was conducted in 8 days. Sampling is carried out over eight days following SNI, and this statement is also supported in the survey, the sampling frequency should be carried out over eight consecutive days to describe existing daily fluctuations. The data sampling was taken from 6 October 2022 until 13 October 2022.

2.2 Data Collection

The study employed primary data and secondary data from X Hospital. The primary data was taken using an observation method of Characteristics of Solid Medical Waste (Figure 1) and Percentage of Conformity of Solid Medical Waste Management at X Hospital (Table 4). Besides that, the primary data was also collected using the measurement of solid medical waste that refers to SNI 19-3964-1994 and an in-depth interview method. In-depth interviews were conducted with workers involved in social life for a relatively long time, namely over three years of work experience. They had responsibilities related to solid medical waste management at X Hospital. In-depth interviews were conducted to determine the existing conditions of solid medical waste management. Interviews were conducted with three informants, namely:

a. Head of the Environmental Health Unit
b. Environmental Health Unit Staff 1
c. Environmental Health Unit Staff 2

The secondary data was collected using the study of literature method. The secondary data needed was the number of patients, hospital facilities, and government regulations that affect the observation area.

Table 1. Data collection of solid medical waste at x hospital

Characteristic of solid medical waste	Waste produced	Measurement Method	Measuring Instrument
Infectious waste	safety gloves, Mask, Infusion tube, Infusion plate, Cotton, used sanitary napkins, Catheter (urine bag), PPE (Protective Personal Equipment), blood bag, Swab test, Syringe without needle (sonde syringe), Gauze, Diaper with contaminant, Placon, Antiseptic packaging, Hand soap bottle, The patient's bracelet is contaminated with blood, Dialyzer, Infusion bottle, Aqua injection.	Weighing solid medical waste per component uncalculating the weight of solid medical waste. The formula used to determine solid waste generation following equation (1): $Generation\ \left(\frac{kg}{day}\right) = \frac{\sum weight\ of\ solid\ medical\ waste}{8\ days}$ .....(1) The following is the formula used to determine the average generation of solid medical waste and the weight of solid medical waste following equation (2): $Average\ generation\ (kg/patient/day) = \frac{\sum weight\ of\ solid\ medical\ waste}{8\ days}$ .....(2)	50 kg scales
Sharps waste	Syringe, needle syringe, vial, ampoule, Nald, knife or mess.		
Pharmaceutical waste	Used medicine wrappers, medicine bottles, and used medicines.		

Table 1 shows that the characteristics of the solid medical waste studied at X Hospital were dominated by infectious, sharps, and pharmaceutical waste. The types of solid medical waste produced by X Hospital were infectious waste, including handscoons, masks, infusion hoses, infusion plates, cotton, used pads, catheters (urine bag), hazmat, blood bags, swab test, syringes without needles (sonde syringe), gauze, diapers contaminated with blood, betadine bottles, hand sub bottles, patient bracelets contaminated with blood, dialyzers, infusion bottles, aqua injection. Sharp waste included syringes and needle syringes. vials, ampoules, knives or messes. Pharmaceutical waste used medicine packets, medicine bottles, and used medicines.

The results of this study are based on research conducted at the "X" educational hospital in Semarang; in this hospital, there are three types of solid medical waste, particularly waste from sharp objects, chemicals, pharmaceuticals, and infectious diseases. Disposable medical masks, gloves, infusion hoses, contaminated used cotton/gauze, ampoules, vials, catheters, syringes, used blood pads, blood bags, used drug bottles, urine bags, body tissues, body fluids, syringes, alcohol swabs, drug waste, expired drugs, PPE, ampoules, infusion needles, oxygen release hoses, and infusion pads are among the medical, solid waste items produced. The COVID-19 pandemic developed regarding the same quantity of medical waste as regular medical waste (Arumdani et al., 2021). Due to the presence of COVID-19 patients at the “X”

educational hospital in Semarang, several types of solid medical waste left over from COVID-19 patients are not found at 'X' Hospital. The resulting medical waste isolation in the treatment room includes swabs, rapid test kits, the plastic used food and beverages, and food and beverage waste from COVID-19 patients. Personal protective equipment worn by COVID-19 patient service personnel, such as disposable masks, eye protection, disposable head protectors, face protectors, and disposable shoe covers, leads to COVID-19 medical waste (Arumdani et al., 2021).

2.3 Data Analysis

2.3.1. The Weight of Solid Medical Waste

Determining the total weight of medical waste by weighing each component separately and using a 50 kg scale. The weight of medical solid waste was measured using formulas (1) and (2).

2.3.2. Guttman scale rating

The collected data from observations and interviews was adjusted to the data category. Data categories were grouped based on the suitability of solid medical waste management against applicable regulations. The usefulness of existing conditions based on applicable regulations is determined using the Guttman scale. The following is a Guttman scale score following equation (3) (Rianse and Abdi, 2012).

Table 2. Guttman scale rating

Index	**Score**	
	Positive	Negative
Yes	1	0
No	0	1

$$P = \left(\frac{f}{n}\ x\ 100\%\right) \quad \text{.....(3)}$$

Information:
P = Suitability percentage
f = The suitable total of indicators
n = The total of all indicators
100% = Constant

2.3.3. Spearman rank test

Information about the number of patients and the prevalence of solid waste in hospitals was not normally distributed, so the researchers used the Spearman Rank method. Spearman correlation using the Microsoft Excel application. The Spearman rank correlation test was carried out as following equtation (4) (Larasati et al., 2020):

$$s = \left(\frac{6\ \sum_{i-1}^{N} d^k}{N^3 - N}\right) \quad \text{.....(4)}$$

Where:
s = correlation coefficient
N = The total of data
d = Difference between the two rankings
Interpretation r:
0,00-0.25 = Very weak
0.26-0.50 = Enough
0.51-0.75 = Strong
0.76-0.99 = Very strong

3. Result and Discussion

3.1 Characteristics of Solid Medical Waste at X Hospital

Based on observations, the characteristics of solid medical waste at X Hospital can be seen in Figure 1.

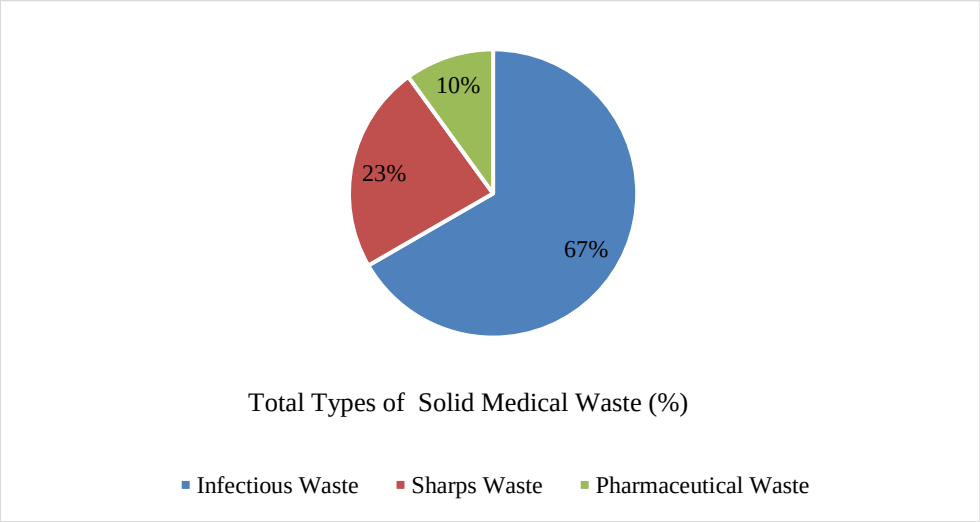

Figure 1. Characteristics of solid medical waste at x hospital based on percentage

Based on Figure 1, the characteristics of the solid medical waste studied at X Hospital were dominated by 67% of infectious waste, 23% types of sharps waste, and 10% types of pharmaceutical waste. Based on Tabel 1, the types of solid medical waste produced by X Hospital were infectious waste, including handscoons, masks, infusion hoses, infusion plates, cotton, used pads, catheters (urine bags), PPE, blood bags, swab tests, syringes without needles (sonde syringe), gauze, diapers contaminated with blood, antiseptic packaging, hand soap bottles, patient bracelets contaminated with blood, dialyzers, infusion bottles, aqua injection. Sharp waste included syringes and needle syringes. vials, ampoules, knives or messes. Pharmaceutical waste had used medicine packets, medicine bottles, and used medicines.

This condition was researched at a class A hospital in Sidoarjo District General Hospital (Warmadewanthi, 2020). The result explained that the types of solid medical waste produced at the hospital consist of cotton, bandages, tissues, hand scoops, masks, used infusion hoses, oxygen support hoses, waste blood bags mixed with used infusion bottles, vials, cloth contaminated with blood, syringes, and syringes, broken glass from vials, used infusion bottles, used vials, packaging and used (Warmadewanthi, 2020). In addition, this statement was supported by research on waste management of health facilities in the Sidoarjo Regency. The results of the research state that the weight of solid medical waste was dominated by infectious waste by 73%, sharps by 16%, and pharmaceutical waste by 11% (Warmadewanthi, 2020). In addition, previous studies at Fatmawati General Hospital with type A certification weighted infectious medical waste at 89.09%, sharp medical waste at 2.96%, and pharmaceutical waste at 0.5% (Ayu Salma et al., 2015).

Each room unit produced different types of waste according to the medical service activities of the room (Asmadi, 2013). The factors influencing the type of solid medical waste produced are waste management practices at the source, the type of service provided in each room, and the use of disposable equipment (Himayati et al., 2018). This statement can be explained through the hemodialysis room at X Hospital, which had dialysis therapy outside the body. This therapy produced infectious waste in disposable masks, handscoons, infusion hoses, used sanitary napkins, blood bags, blood-stained patient bracelets, jerry cans, and sharps waste in the form of syringe. Meanwhile, the pharmacy room produced pharmaceutical waste through used medicine packets, medicine bottles, and used medicines.

3.2 The Total Weight of Medical Solid Waste

The average quantity of solid medical waste produced by X Hospital was 56.53 kg/day. The total stack of each room unit of solid medical waste at X was presented in graphical form in Figure 2.

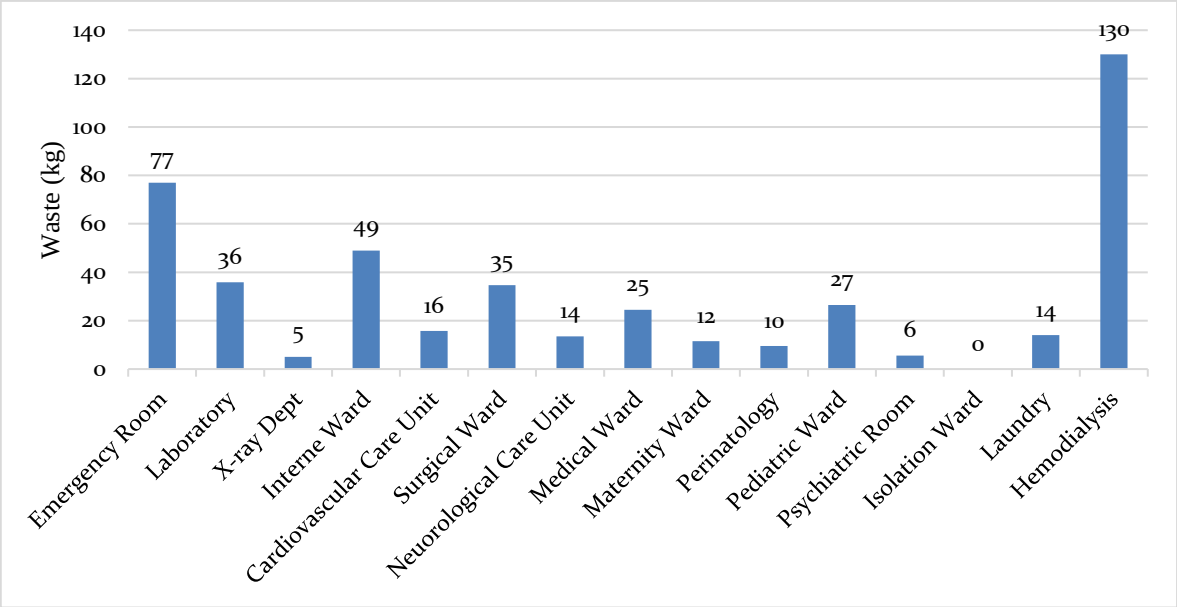

Figure 2. Total stack of each room unit of solid waste (kg) at x hospital period 06-13 october 2022

Based on the graph in Figure 2, the highest solid medical waste stack for eight days was the hemodialysis room at 130 kg, followed by the emergency room at 77 kilograms and the internal room at 49 kg. This situation was caused by patient care activities in the form of dialysis, which requires high medical equipment and materials. This statement was supported by research at an X hospital in Surabaya, showing that the hemodialysis room was a support unit that produced the highest solid medical waste stack. The medical waste in the hemodialysis room was equal to 110 kg/day (Hanako and Trihadiningrum, 2020). The emergency room has the second-highest waste stack because emergency activities were responded to quickly. In realizing responsive patient safety, it was necessary to use medical materials in high quantities. The medical material aims to provide first aid quickly. In addition, the emergency room required sharp objects such as scissors to cut patients' clothing. This situation was by the type B hospital, the Datu Beru Takengon Hospital, which states that the emergency room has the second highest medical waste stack. The medical waste produced by the emergency room was 45.70 kg. (Yusril, 2022).

The factor that influenced the stack of hospital waste was the bed occupancy rate (BOR) (Askarian et al., 2004). BOR was a determinant of the scoring rate in measuring the use of a bed in a particular time unit. This indicator was used to assess the community's utilization of the hospital. The ability of hospitals to provide services was a factor that affected the amount of solid medical waste. This statement was supported by research at a hospital in Bandung, which explains that influencing aspects of hospital waste stack is the number of patients, medical staff, and the bed occupancy rate or BOR (Ulya Bunga and Damanhuri, 2021). The ideal BOR of a hospital was between 60-85% (Departemen Kesehatan R, 2011). In 2021, X Hospital showed an ideal BOR of 64.18%.

Other factors influencing the hospital's solid waste were the type of health services provided, the number of patients, and geographic location (Mita Diwanti, 2018). Based on the number of Patients at X Hospital from 06-13 October 2022, an average of 165 patients were found. The types of health services at the X Hospital were by type B hospitals, namely providing several services supported by specialist doctor services, outpatient services, inpatient services, and diagnostic support. X Hospital was in a strategic geographical location. X Hospital was a provincial referral hospital with easy access to six districts or cities, namely Solok and Tanah Datar Regencies. To the south with Solok and South Solok Regencies. To the

west is Solok Regency, Sawahlunto City, Sijunjung and Dharmasraya Regencies. This statement supports the potential for the stack of large solid medical waste. This discussion is on the conditions of previous research at Hajar Hospital, this hospital has the potential to experience a significant increase in solid medical waste, reaching a total of 640 kg/day of solid medical waste because this province is strategic, the provincial health service center and most of the industrial sector based in this province (Sadeghi et al., 2020).

The average solid medical waste generation was obtained for one patient/day based on the total stack of medical waste. The average stack of solid medical waste for each patient generated by X Hospital for eight days can be seen in Table 3 below.

Table 3. Average stack of solid medical waste generated by patients per day for the period 06 october - 13 october 2022

Days to-	Average (kg/ patient.day)
1	0.323
2	0.355
3	0.297
4	0.411
5	0.312
6	0.352
7	0.350
8	0.313
Average	0.339

Source: (Sample measurement, 2022)

Based on Table 3, the average solid medical waste stack per patient per day was 0.339 kg/patient per day. The highest value was on the fourth day at 0.411 kg/patient.day. The lowest was on the third day at 0.297 kg/patient.day. Due to this assertion, the quantity of solid medical waste piled up may differ according to the number of patients. This situation was supported by earlier research. Based on earlier studies, the average yearly quantity of medical waste units per hospital bed increased from 0.43 kg per bed day in 2000 to 1.68 kilogram per bed day in 2017. This is due to an increase in patients yearly (Korkut, 2018). The previous study stated that the increase in the amount of solid medical waste stack was caused by the increasing number of patients, the type of disease, and the severity of each patient treated at the hospital. The previous research found that the number of patients obtaining medication at the hospital, the type of disease, and their severity all contributed to the increase in the volume of solid medical waste stack. (Nur Aida and Sulistyorini, 2008).

3.3. The Correlation Between the Number of Patients and the Weight of Medical Solid Waste

It was based on the data processing results using the Spearman method with a significance of 0.05, and the value of r or correlation value of 0.851 was obtained. This value stated that the correlation between the two variables is very strong. The value of the correlation coefficient (r) was positive. It was concluded that the relationship is unidirectional.

The relationship was said to be unidirectional. If the X variable has a high value, the Y variable will also have a high value. Thus, the correlation between the number of patients as X and the amount of solid medical waste stack as Y. This statement shows that if the number of patients is high, it will produce a high solid medical waste stack (Sarwono, 2006). Previous research supported this, where medical services involved medical personnel, medical skills, tools, and medical materials. Preparation, processing, and post-medical services produced solid medical waste from medical devices and materials. This statement supported the results of correlation statistics, which state that the higher the number of patients, the higher the stack of solid medical waste (Abu-Qdais et al., 2020). In addition, the Bandung

City Hospital type B utilizes medical devices and medical personnel to provide patient services. The services provided aim to treat and prevent patients from contracting the disease. The services provided were in the form of surgery and medical checkups. To carry out these services, medical personnel must utilize existing medical tools and materials according to the needs and number of patients. This statement can explain the high correlation value of the number of patients with the stack of medical waste (Ulya Bunga and Damanhuri, 2021).

Research on type B hospitals, namely Bali Mandara Hospital, found a relationship between knowledge, attitude, and management of sorting solid medical waste at UPT. Bali Mandara Hospital. It was found that a good management category was 65 or 26.7%. Meanwhile, the attitude of medical service personnel towards sorting solid medical waste with a moderate attitude category was 178 or 73.3% (Widayani et al., 2019). It can also be concluded that medical personnel's knowledge, attitudes, and behavior influence the stack of solid medical waste.

3.4. The Management of Solid Medical Waste at X Hospital

The suitability of solid medical waste management to the applicable regulation starts from minimization of 82.5%, container of 76%, collection of 73%, storage of 85%, and external transportation of 100%. The percentage conformity of solid medical waste management in X Hospital can be seen in Table 4.

Table 4. Percentage of Conformity of Solid Medical Waste Management at X Hospital

Indicators	**Appropriate indicators**	**Total Indicators**	**Percentage Suitability of Solid Medical Waste Management**	**Category** (Arikunto, 2006)
Minimization	99	120	82.5%	Very Good
Container	80	105	76%	Good
Collection	16	22	73%	Good
Storage	22	26	85%	Very Good
External Transportation	10	10	100%	Very Good
Total	227	283	80%	**Good**

Based on Table 4. Regarding the Conformity Percentage Rating Category (Arikunto, 2006), overall management of solid medical waste at X Hospital had complied with the applicable regulations by 80%, which was classified as a good category. The management of solid medical waste that X Hospital has carried out is as follows:

3.4.1. Minimization

Reduction in research locations was carried out by avoiding the use of materials that contain hazardous and toxic materials. The reduction effort was to reuse jerry cans from former hemodialysis rooms into safety boxes for sharp medical waste. This statement is made through in-depth interviews with three informants.

Informant 1:

"Reuse means using jerry cans from the hemodialysis room into a safety box for sharps waste."

Informant 2:

“Through promotion and outreach regarding the dangers of medical waste and using used jerry cans into safety boxes.”

Informant 3:

“Reusing jerry cans from hemodialysis into safety boxes.”

Established regulations have carried out sorting. Sorting was carried out by separating sharps waste and solid medical waste. Sharps waste was placed in a sharps collection box, while medical waste was sorted using yellow plastic by applicable regulations.

3.4.2. Container

Solid medical waste container in the room unit that produces solid medical waste is made of plastic trash cans and is closed, with at least one trash can in each room unit that produces solid medical waste. The container is made of strong, light, rust-resistant, waterproof plastic, has a smooth surface on the inside, and has a lid that is easy to open and close again. Each medical waste bin is lined with a plastic bag to wrap the medical waste. The color of the plastic bag corresponds to the hazardous and toxic waste category. Infectious waste is coated in yellow plastic containers, and non-medical waste is covered in black plastic. Sharps waste uses used jerry cans from hemodialysis units in safety boxes. The collection activity was done when the medical plastic reached full, about 2-3 days. This collection was not by the regulations because it was not carried out daily at the temporary shelter. In-depth interviews with three informants support this statement.

Informant 1:

" For infectious waste containers, use yellow bags; for sharps waste, use jerry cans from the hemodialysis room, which are modified safety boxes."

Informant 2:

“Storage for infectious waste uses yellow bags and black non-medical waste for sharps waste using jerry cans from used hemodialysis rooms.”

Informant 3:

“Sharps waste uses jerry cans from used hemodialysis rooms, modified into safety boxes. Infectious waste is covered in yellow plastic, and non-medical waste is black.”

Based on Table 4, containers are categorized as good, with a score of 76%. However, 24% of container activities do not comply with applicable regulations. These shortcomings are that the containers are not cleaned periodically, and some units have containers and waste bags that need to be equipped with lids and are fitted with symbols for hazardous and toxic materials. Based on this statement, a particular container that is strong, rust-proof, watertight, airtight, equipped with a lid, symbols for hazardous and toxic materials, and easy to clean and clean periodically is required.

So, it is necessary to print infectious waste container bags that have infectious symbols screen printed on them. This situation can benefit the hospital because there is no need to attach infectious symbol stickers, and the bags are ready to use. This recommendation has been implemented at type B and COVID-19 referral hospitals, namely West Sulawesi Provincial Hospital, which states that the use of hazardous and toxic waste bags that have been screen-printed with symbols according to the characteristics of hazardous and toxic waste (Mappau et al., 2022).

3.4.3. Collection

Collection is carried out from every waste-producing source and collected in a closed place. Collection of medical waste is carried out by the cleaning service every day starting at 07.00 am, depending on the medical waste capacity of each room. Transport officers have received PPE (Personal Protective Equipment) that meets occupational safety and health standards. Medical and non-medical solid waste trolleys are separated. Medical waste trolleys cannot be used sustainably because collection from source to storage is only done by cleaning services without trolleys. The collection route starts from the furthest area to the one closest to the storage location.

Collection of solid medical waste is carried out when the solid waste has reached ¾ of the maximum volume. Medical waste contained in temporary shelters is packaged using plastic lining bags before being transported by transport vehicles. Storage of solid medical waste is stored for up to 1 week.

Temporary storage conditions have ventilation that can protect solid medical waste from sunlight and rainwater and have a waterproof floor. In-depth interviews with three informants support this statement.
Informant 1:

" Transportation is assisted by the cleaning service once a day, depending on the medical waste capacity of each room, starting from 07.00 – 08.00 in the morning. Medical and non-medical waste trolleys are separated."
Informant 2:

"Transportation with the help of a cleaning service every day, usually in the morning, starting at 7 am with separate medical and non-medical waste trolleys."
Informant 3:

"Transportation is assisted by a cleaning service every day at 7 am with separate medical and non-medical waste trolleys."

Based on Table 4, solid medical waste collection is very good. However, there is a need for 27%. Based on existing conditions, solid medical waste is collected only a few times weekly. In addition, infectious waste bags are not marked according to the infectious symbol. Apart from that, no trolleys are marked with the hazardous and toxic materials symbol and cleaned periodically. Based on this statement, facilities and infrastructure are needed in trolleys equipped with hazardous and toxic materials, waste symbols and sizes, cleaned periodically, and shaped according to standards. The use of these trolleys has been implemented in type A hospitals, namely RSUD Dr Soetomo Surabaya, which states that the use of trolleys for hazardous and toxic waste is very efficiently implemented, thereby reducing the collection process time (Girsang & Welly Herumurt, 2013).

3.4.4. Storage

Field observations show that the temporary medical waste storage location is far from the food storage location. There is cold storage for infectious waste. Supplies for cleaning equipment (brooms, bins, trash, etc.), protective clothing, and plastic lining bags for packaging medical waste in sanitation rooms where the location is quite close to the temporary medical waste storage location. The area of the temporary waste storage location can be locked to prevent unauthorized persons from entering. The light fire extinguisher used is a dry chemical powder with a capacity of 6 kg. This light fire extinguisher comprises a dry chemical powder and a combination of monoammonium diammonium sulfate (Hutauruk, 2020).

A temporary storage place made from concrete and watertight consisting of 4 rooms for storing waste, including a storage room for medical waste, sharps waste, liquid waste, and used oil waste. The temporary storage has an eyewash, and the building is equipped with rooms according to the characteristics of solid waste; apart from that, the temporary storage has location coordinate points. In-depth interviews with three informants support this statement.
Informant 1:

" Collection to temporary storage areas is carried out every day. Infectious waste is placed in cold storage for a week at a temperature of $0^{o}C$– $4^{o}C$ and out of reach general. Easy access, there is a special lane for transport vehicles. The storage is Closed."
Informant 2:

"Collection to temporary storage areas is carried out every day. Storage place away from public reach. Easy access, because there is a special route for transport vehicles. Infectious waste is placed in cold storage for a week every Tuesday."
Informant 3:

"Collection to temporary storage areas is carried out every day. Storage place away from public reach. Access for transporters is easy because there is a special lane. Infectious waste is placed in cold storage for a week."

Based on Table 4, storage of solid medical waste at X Hospital is included in the very good category. However, there is a shortage of 15%, namely that medical waste is stored for 2-3 days at room temperature. So, if storage is to be carried out for more than two days, storing it at 0° C is best.

The following recommendation is to improve the quality of temporary storage areas for infectious medical waste to comply with applicable regulations. Infectious waste and sharps waste must be stored in a particular waste room. Special storage for toxic, hazardous waste materials must be affixed with symbols for hazardous toxic materials according to their characteristics and directional signs covering the size and shape according to standards.

This recommendation has been implemented by the type B hospital, namely RSUD Raden Mattaher Jambi, which states that the symbol for toxic, hazardous materials is affixed according to the storage characteristics of toxic hazardous materials waste. Storing medical waste far from the community can prevent disease transmission into the community. Apart from that, it is necessary to maintain the temporary storage area by cleaning all parts of the temporary storage, such as walls, floors, and ceilings, so that the storage lasts a long time (Zuhriyani, 2019).

3.4.5. External Transportation

The storage of solid medical waste was easy to access for toxic, hazardous carrier vehicles and Closed to the public. The solid medical waste was saved in cold storage for a week before being transported by the transporter. The transport of solid medical waste was carried out once a week on Tuesday. The transfer of solid medical waste from the toxic, hazardous storage to the vehicle starts at 08.30 - 09.30. The toxic, hazardous carrier had special lane access to the contaminated, hazardous storage area equipped with a manifest document of toxic, hazardous material during transportation. The stack of solid medical waste has infectious properties. Solid medical waste carries a high risk of disease transmission and environmental pollution if not managed by applicable regulations (Anindya Dwita and Mohammad Zamroni, 2021). To prevent the spread of disease by solid medical waste, it was necessary to carry out better management based on applicable regulations.

In-depth interviews with three informants support this statement.

Informant 1:

" External transportation using truck containers. The carrier comes every Tuesday around 08.30 or 09.00 in the morning."

Informant 2:

“External transportation using box cars. The carrier comes every Tuesday at 08.30 in the morning.”

Informant 3:

“External transportation using container trucks. Transporters come every Tuesday at 08.30 am.”

Based on the summary of in-depth interviews with the three informants, it could be concluded that solid medical waste management implemented at X Hospital has been well managed; however, several problems have been experienced in sorting, containing, and transporting it at the source. There is a large amount of medical waste at each source, and cleaning services need more understanding regarding sorting and containerization at the source. Labeling and information on sorting medical waste were conducted for each infectious and non-infectious container. Still, several cleaning services need to be more careful with sorting and containerization of applicable criteria. Then the transportation workers who do not use personal protective equipment in the form of aprons, only wear masks, safety gloves, and boots.

4. Conclusions

The sources of solid medical waste in X Hospital were inpatient rooms, emergency departments, pharmacy rooms, laboratory rooms, and laundry. The characteristics of solid medical waste in X Hospital were infectious waste of 20 types, sharps waste of 7 kinds, and pharmaceutical waste of 3 types of waste. The stack of solid medical waste generated for eight days was 452.2 kg. The average per day was 56.53 kg/day. The average solid medical stack is 0.339 kg/patient.day. A correlation of 0.851 was found between

the number of patients and the obtained stack of solid medical waste. So that this value states that the number of patients influences the amount of solid medical waste stack very strongly. The suitability of solid medical waste management starts from minimization of 82.5%, container of 76%, collection of 73%, storage of 85%, and external transportation of 100%, with an overall proportion of 80%, which is classified as a good category. Based on this study's results, Hospitals must increase the facilities required to manage medical waste, such as procuring waste transport equipment through trolleys or carts and coordinating with officers directly handling medical waste. Hospitals need to control facilities and infrastructure, management, and the role of all staff in the hospital. Hospitals also need to conduct outreach regarding solid medical waste management, particularly separating trash into contagious and non-infectious materials, workplace health and safety, and the potential dangers of solid medical waste for workers who directly manage solid medical waste. For further research, measuring solid medical waste over a more extended period is necessary to obtain more accurate data.

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