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Financial Impact Of Medical Waste Management In Hospital "X" Surabaya

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ABSTRACT

The increase in the volume of medical waste is in line with the improvement of medical waste management performance and compliance with government regulations. Hospitals have another challenge in medical waste management with higher treatment costs that have a direct impact on financial aspects. Based on these problems, this study aims to evaluate medical waste management by comparing the level of hospital compliance with regulations and technical aspects, assessing the generation of medical waste and assessing the financial aspects of recycled medical waste management. The research method is structured observation to collect information and facts in the field so that a systematic description can be accomplished. The results of this study show that X Hospital, Surabaya has complied with the laws and regulations. The results of the study of medical waste generation obtained an average generation in the inpatient room of 88.20 Kg / day and the average waste generation per inpatient patient of 1.15 Kg / day and for outpatients of 0.05 Kg / day. The composition of recycled waste is 18.94%, infectious waste is 57.50%, pharmaceutical packaging waste (Hazardouse waste) is 10.90%, cytotoxic waste is 0,06% and sharps waste is 1.25%. The financial analysis generated from recycling activities on used hazardouse waste packaging, used syringes, used infusion bottles other than blood and/or body fluid infusions, and/or used hemodialysis fluid packaging obtained a NPV value > 0 and BCR value = 1.98 > 1, so this investment is economically feasible and the investment plan is recommended to be implemented.

Keywords: Medical, waste, hospital, recycle, financial

INTRODUCTION

Hospitals is a medical facility that generates waste in its operational activities, where the composition of waste generated according to WHO (2018) is 85% general waste and 15% is hazardous waste including infectious waste, toxic or radioactive waste (Kanbar et al., 2020;

Oteri et al., 2021; Rahman et al., 2022). Every year an estimated 16 billion injections are performed worldwide, but not all needles or syringes are disposed of properly (Mazzei & Specchia, 2023; Nandy et al., 2022; Sazuan et al., 2023). Medical waste generation in developed countries averages 0.5 kg/day, and developing countries generate an average of 0.2 kg/day (Abanyie et al., 2021; Emara, 2023). The Ministry of Health also said that the capacity of medical waste treatment services in 2020 in health facilities is 53.12 tons/day, third party services are 187.90 tons/day (Sedana et al., 2022).

Medical waste generation from health facilities in Surabaya is 163.9 tons/month of which 97.1% comes from hospitals (Wilujeng et al., 2020). Community health center and clinics contribute 1.1 tons/month and 3.5 tons/month respectively . Surabaya city survey results show that only 29.6% of medical waste from hospitals is treated in their own incinerators, 66% of medical waste is treated elsewhere, 0.7% from community health center and clinics, and 0.6% from garbage. Furthermore, hospital waste from used packaging can be recycled (1%), while 1.5% of medical waste from clinics is unknown

Government of the Republic of Indonesia has issued several policies to address the problem of poorly managed medical waste such as Government Regulation No. 22 of 2021 on the Implementation of Environmental Protection and Management and other regulations. Hospitals have other problems in medical waste management due to lack of awareness and willingness of healthcare workers, non-comprehensive policies and lack of laws and regulations on medical waste management (Diana et al., 2022; Mathis et al., 2024; Singh et al., 2023). Lack of awareness about health hazards, inadequate training in proper waste management, absence of waste management and disposal systems, inadequate financial resources and human resources (Debnath et al., 2023; Kurniawan et al., 2023; Meena et al., 2023; Suryawan & Lee, 2023; Vinti et al., 2023).

The difference in the volume of medical waste generation between public and private hospitals requires further study of the composition of waste and the management of medical waste recycling in hospitals (Coban et al., 2023; Hosseinzadeh et al., 2023; Hou et al., 2023). This study aims to determine the composition of recycled medical waste and financial analysis of medical waste management in hospital X in Surabaya. The study of waste generation rates and compositions that differ in each hospital both within and outside the country requires hospitals to assess their medical waste management. This data is needed by hospital managers or owners to maximize their operations so that the waste managed is safer, financially beneficial and cost-efficient.

RESEARCH METHODS

The Study location was in the private healthcare facilities in Surabaya, Indonesia. Data Collection used primary data survey with sampling to calculating waste generation is carried out in accordance with SNI 19-3964-1995. There were 6 types of solid waste sample, namely

infectious waste, Chemical/ Unused hazardous medicines, Cytotoxic, medical waste sharps, and recycled waste. Sample took place during the 6 working days in November 2023, using direct weighting in the source of solid waste to determine waste production in Kg/bed/day or kg/patient/day. Calculating the composition and generation of hazardous waste, an economic analysis is carried out to see the potential financial value of recycled medical waste that is managed. Financial analysis was conducted using the NPV (Net Present Value), BCR (Benefit Cost Ratio) methods to determine the feasibility of the medical waste recycling project. The research method is carried out by means of structured observation to collect information and facts in the field so that a systematic description can be achieved. The research steps include research ideas, literature studies, preliminary studies, research preparation, variable determination, analysis and discussion to conclusions.

RESULTS AND DISCUSSION

Solid waste management of X Hospital in Surabaya

Hospital X is one of a network of type B private hospitals with 200 beds and 34 polyclinics. Based on statistical data in June, the bed utilization rate is 52%. Hospital X has served nearly 2 million patients annually. To serve the needs of world-class medical services for all people in Indonesia, the company's business strategy based on economies of scale allows each of its hospital units to operate at a lower cost. The total estimated monthly generation from the hospital is 3.6 tons per month. Previously, medical waste was managed by a third party. The cost of hospital waste management at Hospital X, Surabaya is increasing steadily every year, so the hospital is making efforts in minimizing the cost to the third party. The recycling process became an option and had a direct impact on hospital finances. With recycling activities, medical waste that should have been processed by a third party is managed independently by the hospital with several processes in accordance with applicable laws and regulations.

Solid waste segregation of X Hospital in Surabaya

Sampling that has been carried out on solid medical waste generation at X Hospital for 8 days results are as follows:

Tabel 1. Waste Generation

Solid Waste	Amount of waste (Kg/day)	Numb. of patient (Person)	Average Waste (Kg/day)
Infectious waste (Yellow bag)	57,50	77	1,15
Pharmaceutical packaging waste (Chemical) (brown bag)	10,90		
Recycled waste (White bag)	18,49		

Solid Waste	Amount of waste (Kg/day)	Numb. of patient (Person)	Average Waste (Kg/day)
Cytotoxic waste (purple bag)	0,06		
Sharps waste (sharp container)	1,25		
Waste Generation	88,20		

Based on Table 1, it can be concluded that the amount of waste generated is 1.15 kg/patient/day, it is known that the largest composition of waste is the infectious waste category 65.19% of the total waste generated. Recycled waste is a concern because the amount is quite a lot, namely 20.96 percent. It is known that recycled waste has economic benefits due to its selling value and utilization. The amount of waste is obtained from the treatment room or excluding outpatient care. Based on research conducted by Rumi and Karim (2018), the amount of waste per patient in health facilities in Norway is 0.68 Kg/day/patient, Taiwan 0.19 Kg/day/patient, and Turkey 0.63 Kg/day/patient (Rumi and Karim 2018). According to research, the amount of waste per patient per day is 0.824 Kg/day/patient (Wilujeng et al. 2020). Large amounts of hospital medical waste occur due to the use of single use or disposable medical equipment. Some considerations from the medical side are more emphasis on patient safety aspects due to minimal risk of infection. The United Nation Environmental Program (UNEP) has set up that as it were 10% of the healthcare squander is considered to be ''potentially infectious". This proportion can be reduced to 1-5% with appropriate sorting practiced at the sources. The average medical waste generation rates (2.79– 3.86 kg/bed/day) in Taiwan were much greater than that in Poland (2.6 kg/bed/day), in Japan (0.25 kg/bed/day), in Jordon (0.1–3.0 kg/bed/day) and in Korea (0.48 kg/ bed/day).

In this study, we found that the total amount of infectious waste generated was much higher compared to other countries, possibly due to the types of drugs, treatments used, and consumables because health centers generally provide treatment depending on the treatment performed on the patient. On the other hand, local hospitals in Taipei generated the highest infectious waste (0.88 kg/bed/day), followed by health centers (0.60 kg/bed/day) and district hospitals (0.44 kg/bed/day) (Cheng et al. 2008). This could be attributed to practices in local hospitals, which may provide the same services as larger hospitals. Our observation in the survey found that local hospitals spend less effort in waste management. Hospital waste has been found to have a high proportion of recyclable waste (30.7% of total hospital waste), which is made up of paper, plastic, glass, and metal.Based in the data of sanitarian X Hospital that has been carried out on total solid waste at X Hospital Group.

Tabel 2. Comparison of the amount of solid hazardous waste generation in each hospital unit X

Hospital Unit	Amount of waste (Kg/day)	Potential of recycled (15% from total) (Kg/day)	Total of Recycled (Kg/day)	Ratio Recycled from Medical Waste (Kg/day)
Jakarta 1	521.48	78.22	22.35	4.29%
Jakarta 2	343.74	51.56	10.20	2.97%
Jabar	203.61	30.54	14.41	7.08%
Jambi	76.79	11.52	1.71	2.22%
Surabaya	88.20	13.23	18.49	20.96%

The data obtained from the sanitarian of hospital X shows that the highest total daily generation from hospital X Jakarta 1 unit is 521 Kg/day. The results of the evaluation of the ratio between the amount of recycled waste and the total waste generation show that Surabaya has the highest percentage of 20.96% recyclable waste. The largest average potential recyclable waste is the Jakarta 1 unit, but the total waste recycled is only 22.35 Kg/day or can only recycle 4.29 percent of the waste. Surabaya can recycle as much as 20.96%. This is due to several factors such as: The number of workers who carry out the recycling process is the same , The number of management hours per day is the same, namely 2 hours to 3 hours, Shredding process with the same flow and frequency of 2 times a week.

Recycling Treatment

Most medical plastics have the potential to be recycled back to the industry as feedstock for the production of new plastics or refined fuels. There should be better awareness of recycling possibilities among healthcare workers and a commitment to collect and recycle plastic waste is essential for a sustainable future. The hospital conducts sorting of non-infectious medical packaging waste to obtain waste that has economic value. Based on WHO, Recycling offers advantages for the environment and the economy over incineration. Segregation and disinfection of recyclables are two methods used in the recycling process. Depending on the type of waste and necessary level of decontamination, either steam sterilisation or chemical disinfection should be used as the decontamination method. Using disinfectants such alcohols, phenols, peroxides, aldehydes, quaternary ammonium compounds, and chlorine compounds, chemical disinfection is a technique used to get rid of biological agents and spores. Bleach, or sodium hypochlorite (NaOCl) solutions, are frequently used to disinfect contaminations.

The amount of accessible chlorine in each solution is expressed in parts per million, or ppm. The efficiency of chemical disinfectants is influenced by a number of variables, including concentration, organic matter, pH, contact time, spectrum of microbial activity, and temperature. Segregated waste such as: disinfectants, hand sanitizers, etc., used syringes, plabots or infusion bottles that are not contaminated with blood, used hemodialysis fluid packaging.

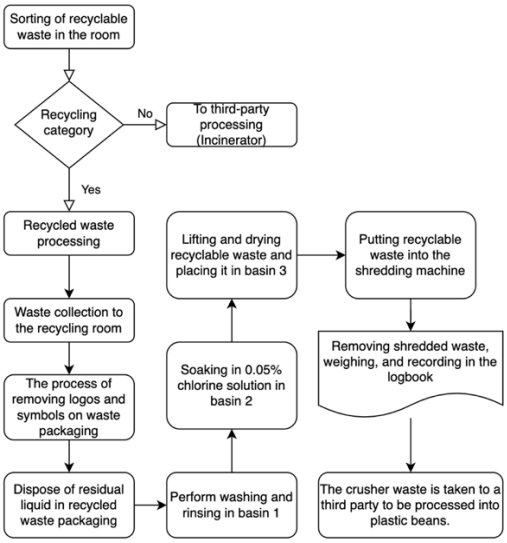


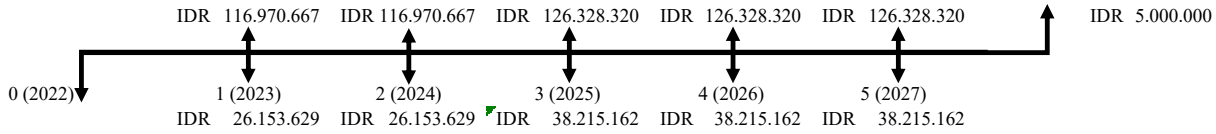
Figure 2. Flowchart Recycling

Financial Analysis

Financial analysis is the process of analyzing the value of benefits and sacrifices for the company. Investment costs are required in the financial analysis study. Benefits are in the form of income obtained from the sale of recycled waste. Recycled waste is the result of evaluating the conditions in the sorting and collection of solid medical waste made from plastic that has a high selling value. This waste is grouped into one such as: used hemodialysis fluid packaging, solcart, handrub or hand sanitizer packaging, used non-infectious syringes, dialyzer diacap, infusion bottles, plastic packaging used hazardous waste and other chemical packaging. Financial benefits are obtained from the sorting and collection of recycled waste. The average recycled waste generated is 20.96 percent of the total waste generation every day or around 18.49 Kg/day. The projected generation in the third year will increase along with the development of the hospital, the total occupancy will increase. Currently the average number of daily patients is 88 patients/day. The hospital development is projected to increase the number of patient bed utilization to 160 patients/day. The development is targeted to be completed by 2025, which will result in increased operations in medical waste management. The projected generation of recyclable waste will increase by 20%.

The results of the calculation on investment and operational costs before the development were calculated previously and then the investment and operational costs were

increased to adjust operations in the third year due to the development as projected previously, the results were further analyzed by looking at the net present value (NPV). The difference between the present value of cash inflows and the present value of cash outflows over a period of time. The investment value is set for 5 years, with annual income of Rp 116,970,666.67, this income is projected to increase in year 3 by Rp 126,328,320.00 due to an increase in the amount of recycled waste and with operating costs per year increasing from Rp 26,153,629.00 to Rp 38,215,162.00. After calculating the investment and operational costs, the flow of money is calculated as shown in the cash flow diagram of recycled waste management.



Cash Flow Period	*Net Cash Flow*	*Cummulative Cash Flow*
0	IDR (41.090.000)	IDR (41.090.000)
1	IDR 90.817.038	IDR 49.727.038
2	IDR 90.817.038	IDR 140.544.076
3	IDR 23.423.158	IDR 163.967.233
4	IDR 88.113.158	IDR 252.080.391
5	IDR 93.113.158	IDR 345.193.549

(…): Menunjukkan Nilai Negatif

Figure 2. Diagram Cashflow

After determining the value of cash flow, the analysis continues by looking for NPV or net present value, here are the details of the calculation of the value of NPV:

$$\sum_{n=1}^{N} \frac{Cn}{(1+r)^n} \text{ - Initial Investment} = \textbf{NPV}$$

Where in the above formula :
N = total number of periods
n = positive integer
C = cash flow
r = discount rate
NPV = net present value

Rate of Return 10% Per annum
Investment Cost : IDR 41,090,000.00
NPV : IDR 330,567,475.00 (+)
BCR : 1,98
NPV : C1/(1+r)1 + C2/(1+r)2 + C3/(1+r)3 + C4/(1+r)4 + C5/(1+r)5
BCR : (Present Value of Benefits / Present Value of Sacrifice or cost)

Based on the BCR value, it can be concluded that the BCR value is 1.98> 1, then this investment is economically feasible and the investment plan is recommended to be implemented.

CONCLUSION

The results of this study show that X Hospital, Surabaya has complied with the laws and regulations. The results of the study of medical waste generation obtained an average generation in the inpatient room of 88.20 Kg / day and the average waste generation per inpatient patient of 1.15 Kg / day and for outpatients of 0.05 Kg / day. The composition of recycled waste is 18.94%, infectious waste is 57.50%, pharmaceutical packaging waste (Hazardouse waste) is 10.90%, cytotoxic waste is 0,06% and sharps waste is 1.25%. The financial analysis generated from recycling activities on used hazardouse waste packaging, used syringes, used infusion bottles other than blood and/or body fluid infusions, and/or used hemodialysis fluid packaging obtained a NPV value > 0 and BCR value = 1.98 > 1, so this investment is economically feasible and the investment plan is recommended to be implemented. It can be used as a comparison with other hospitals in medical waste management, besides that it can be studied the contribution of human resources in increasing the amount of recycled waste.

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