Sanitasi: Jurnal Kesehatan Lingkungan
Volume 16(1), 2023, pp. 9-19
https://e-journal.poltekkesjogja.ac.id/index.php/Sanitasi

Analysis of hazardous medical waste in dr. Soehadi Prijonegoro Hospital using a life cycle assessment approach

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Receipt: 7 December 2022; Revision: 31 January 2023; Accepted: 7 February 2023

Abstract: Hospitals are health services that produce waste and sources of pollution for human health and the environment. dr. Soehadi Prijonegoro Hospital produces the most medical waste in the sragen regency and still needs cold storage. This research evaluated the management of hazardous toxicity material medical, solid waste. Life cycle assessment calculations can be performed using a software application, Simparo 9.0. This scope of research with gate to gate approach. Inventory data was obtained from primary and secondary data collection. Daily medical waste is about 135 kg, while the average month is 3961 kg—medical waste management in dr. Soehadi Prijonegoro includes reducing, sorting, labeling, storage, transporting, and processing have been following applicable regulations. The results of the TCLP test of solids incinerator ash and chimney incinerator emissions meet the quality standards. The most significant impact on the ecosystem is the global warming potential in the emergency service room. For impacts, the natural resources and the impact on the ecosystem is the inpatient room due to excessive use of medical waste. Use of energy and materials to minimize emissions and waste.

Keywords: Hospital; Management; Method; Waste; Impact

INTRODUCTION

Hospitals are healthcare facilities, but their activities produce waste that becomes a source of pollution for the environment. Therefore, proper waste management is needed not to harm the surrounding environment (Noor, 2020). Hospital waste is considered the chain of transmission of infectious diseases. Medical waste that is not managed correctly can harm health and the environment. The impact on health that often occurs is nosocomial infections in health facilities, such as the potential transmission of Hepatitis B virus (HBV), Hepatitis C virus (HCV), Human Immunodeficiency virus (HIV), and other pathogenic bacteria that may be carried on blood and body fluids that are wasted into the environment.

Meanwhile, environmental pollution occurs. With its properties and characteristics, medical waste can cause environmental pollution to the point of damaging natural ecosystems. The impact of this environmental damage can occur irreversibly. Some medical waste, especially those derived from drugs, can be imperfectly degraded in the environment so that it accumulates in animals and plants that are then consumed by humans, which in the future can harm health (Zamparas et al., 2019).

The global problem is waste management in health facilities. The capacity of medical waste treatment carried out by all private parties and all hospitals with licensed incinerators is still different from the waste produced by health facilities, so there is still a lot of unprocessed medical waste generation (Nabavi-Pelesaraei et al., 2022). The condition of medical waste management in Indonesia still needs to improve. Starting from the aspects of regulation, processing capacity, the role of local governments, coordination between institutions, human resources, infrastructure, licensing, the role of the private sector, and financing (Nurwahyuni et al., 2020). The capacity of medical waste treatment needs to be improved in quantity and

DOI: 10.29238/sanitasi.v16i1.1675

uneven distribution. The number of health facilities that have licensed waste processing facilities or incinerators currently only amounts to 120 hospitals out of 2,880 hospitals. In addition, the distribution of private waste processors still needs to be evenly distributed in Indonesia, which is still dominated by Java (Prihartanto, 2020). Every district should have a medical waste processing device in their area so that the handling of medical waste can be completed in each region with the concept of region-based medical waste management (Marbun, 2020). The problem of medical waste management at dr. Soehadi Prijonegoro hospital that the collection of infectious medical waste is carried out every three days by PT. Wastec Semarang needs temporary shelter, such as cloud storage. *Cold* storage is temporary medical waste storage in a room below zero degrees Celsius. The tool can reduce the potential for infection of the environment and humans around the medical facility. Furthermore, the incinerator tool has not worked for a long time because it has been damaged, and the licensing of the incinerator tool is no longer active (Lemma et al., 2022).

dr. Soehadi Prijonegoro hospital was built on 38,730 M^2 of land with a building area of 28,000 M^2. This hospital is on Sukowati No. 534 Sragen Regency, Central Java Province. dr. Soehadi Prijonegoro Sragen Hospital is classified as a type B educational hospital where health service activities will generate medical waste every day from 315 beds from inpatient, outpatient, emergency room activities and etc (Peraturan Menteri Kesehatan Republik Indonesia Nomor 340/Menkes/PER/III/2010 Tentang Klasifikasi Rumah Sakit, 2010).

The research problem is based on secondary data from the Sragen District Health Office for health facilities with the highest amount of medical waste. In dr. Soehadi Prijonegoro Hospital is the largest producer of toxic, hazardous material hospital waste in the district compared to other hospitals in the sragen regency. With an average amount of infectious waste of 3500 Kg per month, while the amount of waste from Sarila Hospital is 1800 Kg/month, Amal Sehat hospital is 1200 Kg/month, Mardi Lestari Hospital is 700 kg/month (source from sragen district health office in 2021). So that the more hospital waste is generated, the more significant the environmental impact and impact on health workers (Pemerintah Kabupaten Sragen, 2020). Furthermore, medical waste management from medical waste storage has yet to have cold storage because PT carries out medical waste every three days Wastec Semarang.

The definition of LCA (Life Cycle Assessment) is an approach used to analyze the impact of a product on the environment during the product life cycle. *Life Cycle Assessment* is based on the idea that an industrial system cannot be separated from the environment in which the industry is located. *Life Cycle Assessment* is generally an approach to measure the environmental impact caused by products or activities, starting from the taking of raw materials, followed by the production and use process, and ending in waste management.

This research has advantages and disadvantages to other studies. The advantages of this research lie in the place of research, approach methods, research samples, and time. The place that was carried out for the research was dr. Soehadi Prijonegoro Sragen Hospital, which had never been researched before. Then another difference is that there has never been researched conducted in health facilities (Hospitals, Community Health Centers, or Clinics) regarding managing toxic, hazardous material waste using the Life Cycle Assessment method.

Meanwhile, this study's shortcomings are because LCA in the health department is tiny, so the literature and journals obtained are also very few. The disadvantage of this software is that not all databases are available, so it is necessary to take a material approach to suit existing conditions. The study aims to analyze technical and environmental aspects, identify waste sources and characteristics, and evaluate and compare the potential environmental impact of toxic, hazardous material waste management in dr. Soehadi Prijonegoro Hospital waste management using a life cycle assessment approach.

METHODS

This study used qualitative descriptive research using a life cycle assessment approach. To evaluate medical, solid waste management, the primary and secondary data needed to be collected (Fikri et al., 2015). This research was conducted in September 2022 in dr. Soehadi Prijonegoro Hospital. The scope of this research is gate-to-gate, starting from the toxic, hazardous material waste generated from rooms that produce toxic, hazardous material waste until the last stage of the hospital's toxic, hazardous material waste treatment. The function unit for calculating life cycle assessment in this study is each amount of toxic, hazardous material waste managed in dr. Soehadi Prijonegoro Hospital (Torkayesh et al., 2022).

Primary data was obtained through laboratory tests, observations in the form of direct observation in the existing conditions of hospital toxic, hazardous material medical waste management, interviews with parties related to hospital toxic, hazardous material medical waste management such as the Sanitation Unit and waste generating unit. Meanwhile, secondary data was obtained from the general description of dr. Soehadi Prijonegoro Hospital, especially hospital profiles, organizational structure, and human resources. The study was used as a measuring tool to collect data in the field, including observing the amount and type of waste in the waste generating unit and laboratory testing TCLP (Toxicity Characteristic Leaching Procedure) test for incinerator ash waste solids (Liu et al., 2019).

The data analysis method was carried out regarding the life cycle assessment, which included Goal and Scope, Life Cycle Inventory, Life Cycle Impact Assessment, and data interpretation. Life cycle assessment calculations were performed using the Simparo 9.0 software (Mahastuti, 2017), in which the inventory data was obtained from field observations and calculations (Peraturan Pemerintah Republik Indonesia Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup, 2021).

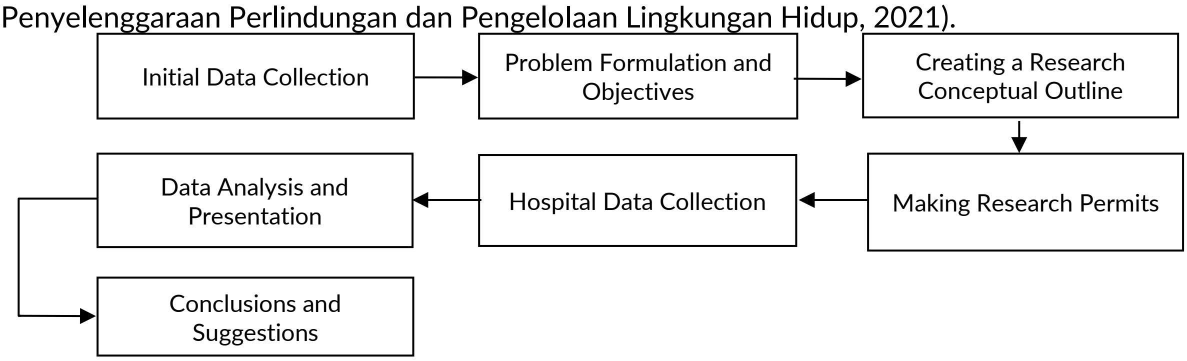

Figure 1. The flow of research stages in dr. Soehadi Prijonegoro Hospital

RESULTS AND DISCUSSION

Previous research on waste management in industry and household waste management with the Life Cycle Assessment approach (Fikri et al., 2015), while research for toxic, hazardous material hospital waste management in hospitals with the Life Cycle Assessment approach, so far there has yet to be. Toxic hazardous material Hospital Medical Waste includes: Infectious Waste, Liquid Waste, Expired Chemical Waste, Expired Pharmaceutical Waste, Sharps Waste, Compressed Gas Waste, Radioactive Waste, and Cytotoxic Waste (Rachim, 2017). The flow of solid medical waste management at public hospital dr. Soehadi Prijonegoro Sragen can be seen in Figure 2.

The flow of medical waste management dr. Soehadi Prijonegoro Hospital can be seen in the Figure 2, where the source of waste comes from various rooms such as inpatient wards, outpatients, emergency installations, pharmacies, laboratories, radiology, nutrition, laundry, CSSD, offices, and IPSRS. Both medical and non-medical waste management is the same: sorting, breeding, and labeling. Then the waste is divided into two, namely non-infectious solid waste and infectious solid waste. Infectious solid waste such as sharp object waste, medical waste, pharmaceutical waste, and cytotoxic chemical materials. All waste is stored in black plastic bags for non-infectious and purple plastic bags for cytotoxic waste. Infectious solid waste derived from hospital service activities is further divided into medical waste specifically for sharp objects and medical waste for non-sharp objects. Unique medical sharp objects such as syringes, surgical needles, lancets, and ampoules are thrown into a *safety box*. Meanwhile, medical waste of non-sharp objects consists of non-sharp medical waste such as bandages, gauze, masks, body scraps, bottles of drug residue, infusion/flavor bottles, urine bags, remaining lab samples, and blood bags thrown into yellow plastic bags. All solid waste, both infectious and non-infectious, is sorted and laid according to the type of waste, then transported using non-infectious and infectious trolleys to the TPS room before being handed over to third parties. For non-infectious waste, it is transported by a third party, namely the Environmental Agency of Sragen Regency, while for infectious waste, a third party is carried out, namely PT. Wastec Semarang. Before the stage of transportation of infectious waste by third parties, it is rechecked and recorded in the manifest sheet of medical waste by the sanitary department. The following management stage is carried out by third parties, namely, burning or destroying medical waste.

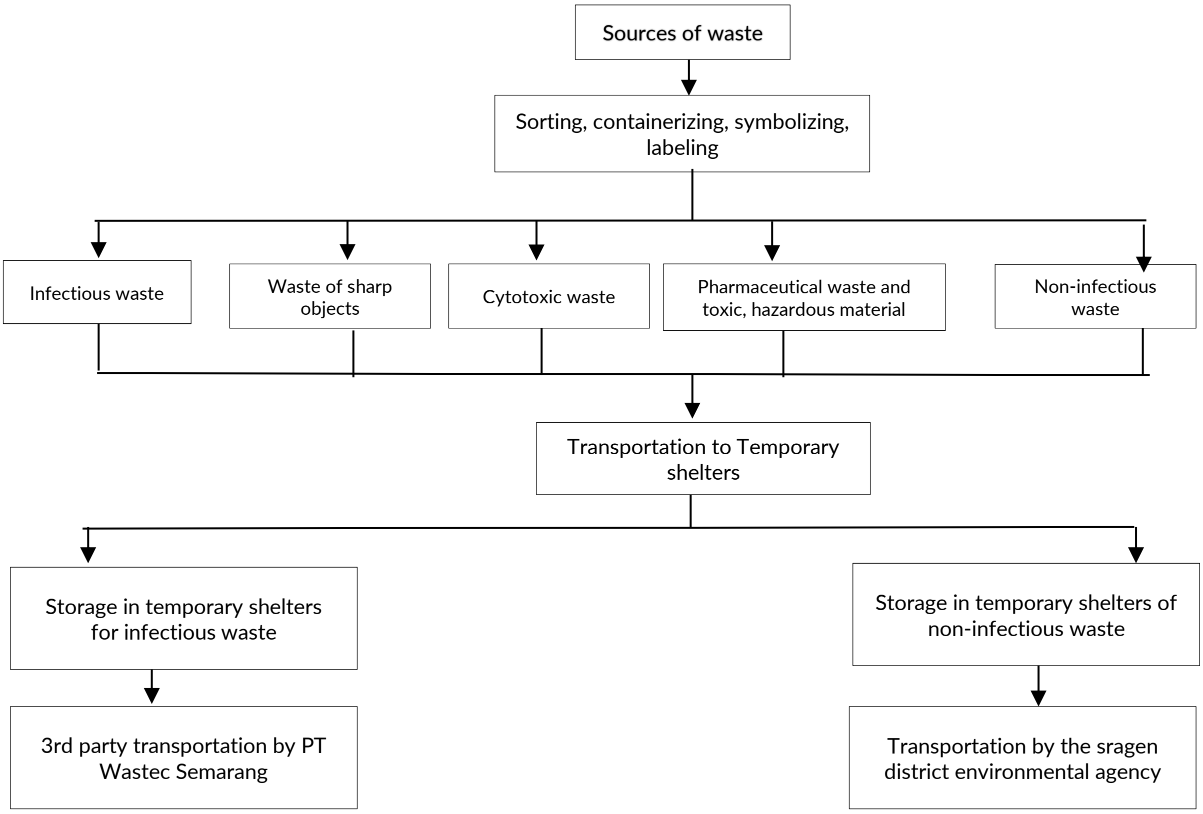

Figure 2. The flow of Solid Medical Waste Management

Toxic, hazardous material medical waste from the hospital is under the responsibility and management of the Sanitation Installation. The toxic, hazardous material medical waste management programs implemented in Table 1 regarding the management of toxic, hazardous material medical waste. Toxic, hazardous material medical waste generated in hospitals is affected by the ability of hospitals to provide medical services. Most of the medical waste generated is in the treatment room. Medical activities at the hospital produce waste that varies depending on the number of patients being treated (Lemma et al., 2022)—the amount of infectious medical waste in dr. Soehadi Prijonegoro Hospital can be identified by daily weighing conducted by medical waste transporters. The Table 1 shows the amount of medical waste from January until September 2022, dr. Soehadi Prijonegoro Hospital's amount of medical waste from January until September 2022 is 35,650 Kg, for a monthly average of 3,961 Kg/month. Generation of medical infectious waste from January to September 2022 in dr. Soehadi Prijonegoro Hospital can be seen at the Table 1.

Table 1. Amount of medical infectious waste

No.	Month	Amount (Kg)
1.	January	3,648
2.	February	5,671
3.	March	6,653
4.	April	3,623
5.	May	3,045
6.	Juni	2,987
7.	July	2,914
8.	August	3,722
9.	September	3,387
	Amount	35,650
	Monthly Amount	3,961

Non-Technical Aspects

Implementation of toxic, hazardous material waste management in dr. Soehadi Prijonegoro Hospital is not only referring to the Minister of Health Regulation No. 7 of 2019 concerning Hospital Environmental Health but also based on the current guideline that must be considered. The guideline is Standard Operating Procedures and hospital waste management policies, which were created as simple as possible so that the employees can easily understand waste management in waste-producing rooms. In this case, dr. Soehadi Prijonegoro Hospital conducted Socialization regarding managing Toxic, hazardous material medical waste in rooms. This was conducted internally. Internal Socialization of all toxic, hazardous materials in hospitals that produce medical waste is essential to medical, solid waste management conducted by Hospital Occupational Health and Safety. This Socialization aimed at all employees who worked in the waste-producing room (Putri, 2018).

Technical Aspect

Technical aspects of toxic, hazardous material medical waste management in dr. Soehadi Prijonegoro Hospital refers to the Minister of Environment and Forestry Regulation No.6 of 2021. Meanwhile, managing toxic, hazardous material medical waste includes reduction, sorting, labeling, storing, transporting, and processing (Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 6 of 2021 concerning Procedures and Requirements for Hazardous and Toxic Waste Management, 2021).

Reduction

The type and generation of solid infectious waste in each waste-producing room varies, depending on the service provided. It also depends on patient visits to the service room—estimating the amount of medical waste generation in dr. Soehadi Prijonegoro Hospital is 135 kg/day, average monthly, and the amount of infectious waste generation is 3900 Kg/month. Efforts to reduce medical waste in hospitals are by socializing the staff of the medical waste-producing room using materials that can make medical waste to a minimum. In the inpatient room, haemodalisa can sort out uncontaminated infusion bottles or Jirigen haemodalisa room can be recycled or resold for an efficiency level of hospital medical waste reduction of 15%. to reduce hospital spending Types of solid infectious waste are in the form of syringes, syringes, infusion hoses, placon, catheters, used gauze, catheters, disposable gloves, disposable masks, disposable blood lancets, medicine bottles/ampoules, used sanitary napkins, cotton/bandages/rags that contaminated with blood or body fluids, blood transfusion hoses, used sanitary napkins, and alcohol swabs (Deepak et al., 2022). The generation of solid infectious waste usually comes from inpatient rooms, emergency units, laboratory units, mortuary rooms, anatomical pathology rooms, operating rooms, isolation units, and pharmacy units(Noor, 2020). Actually, in dr. Soehadi Prijonegoro Hospital has also reduced solid waste by reusing unused waste. For example, reusing plastic containers for hemodialysis fluids as safety boxes can reduce waste and minimize costs incurred for buying safety boxes and selling plastic infusion bottles that were not exposed to the patients' blood (Nabavi-Pelesaraei et al., 2022).

Sorting

The sorting was conducted at the place where the waste was first generated. This process was carried out by nurses or staff on duty in each room, generating toxic, hazardous material waste. Then, the waste was put according to the type of waste in the provided containers. In addition, giving a label to the waste container lid can facilitate and indirectly remind nurses. Thus, before putting the waste into the container, the staff should read the type of waste which can be put into the correct container—the process of putting the waste into the container in dr. Soehadi Prijonegoro Hospital has been done correctly according to the characteristics of the waste (Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 6 of 2021 concerning Procedures and Requirements for Hazardous and Toxic Waste Management, 2021).

Labelling

The labeling stage was carried out to facilitate the sorting and to process toxic, hazardous material medical waste. This was done by providing symbolic information about the plastic bag's color and the waste's source according to the waste's characteristics. Hence, the risk of the container being swapped during cleaning will not occur. For infectious, sharps, pharmaceuticals & Toxic, hazardous material waste, and cytotoxics were sufficiently represented because they contain detailed waste contents and symbols. Meanwhile, infectious and sharp waste containers have a yellow biohazard symbol. The plastic bags were blinded by cleaning services staff in each room with tight ties. Then, the amount of medical waste in plastic bags is ¾ of the volume of medical waste plastic provided in the medical waste bins in room (Deepak et al., 2022).

Transportation

The In-situ waste transportation stage is the process of transporting the medical and solid waste done by hospital staff. Then, the waste is transported from the waste-producing source to the hospital's temporary storage of toxic, hazardous material waste. Furthermore, cleaning service officers collected medical waste generated from each room and transported it to the temporary storage of toxic, hazardous material waste in the dr. Soehadi Prijonegoro Hospital. In-situ waste transporting from the source room using the dirty route to the toxic, hazardous material medical waste temporary waste storage was done using a wheeled bin trolley with a capacity of 100 L. Then, it will be transported to the toxic, hazardous material medical waste temporary waste storage in dr. Soehadi Prijonegoro Hospital (Putri, 2018). The dirty route was chosen to prevent contamination of toxic, hazardous medical waste among visitors, employees, and other patients. Meanwhile, the ex-situ toxic, hazardous material waste transport system transports toxic, hazardous material waste stored at the toxic, hazardous material temporary waste storage to the destruction or processing site. A third party, PT Wastec Semarang, carries out the transport of toxic, hazardous material waste. The waste transport is carried out every two days, according to a predetermined storage time limit (Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 6 of 2021 concerning Procedures and Requirements for Hazardous and Toxic Waste Management, 2021).

Storage

The medical solid waste that has been collected is stored in the temporary waste storage of the hospital. Medical waste is placed and stored in the toxic, hazardous material temporary waste storage for 2 days (Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 6 of 2021 concerning Procedures and Requirements for Hazardous and Toxic Waste Management, 2021). The infectious waste is stored according to toxic, hazardous medical waste characteristics in 5 large bins with a capacity of 500 L. Each toxic, hazardous material medical waste temporary waste storage is equipped with a symbol, including an infectious symbol for infectious, toxic, corrosive, and hazardous material waste.

Life Cycle Inventory (LCI)

The LCI stage is intended to build a system model in the form of a flow model of a technical system with a specific type of system boundary. The data of this study consists of primary and secondary data. This system modeling uses the Simparo 9.0 software application and the Ecoinvent database (van Straten et al., 2021).

Input Data

The estimation of the amount of toxic, hazardous material medical waste generation in dr. Soehadi Prijonegoro Hospital is as follows: the amount of medical infectious waste is 135 kg/day, the average monthly, and the amount of infectious waste generation is 3900 Kg/month. The data input in this study includes the number of electrical power needs used by rsud sragen from various service rooms and offices that produced B3 waste in September, producing State Electricity Company energy of 486102.12 KWH/month. Every month, data from the State Electricity Company's electricity needs are entered into the Simapro 9.0 software.

Output Data

The balance of the toxic, hazardous material waste burning process in dr. Soehadi Prijonegoro Hospital is the waste burned by a third party, PT Wastec Semarang. Meanwhile, the combustion residue is obtained from the ash content (kg) in toxic, hazardous material waste TCLP (Toxicity Characteristic Leaching Procedure) test of the ash residue incinerator of infectious waste in dr. Soehadi Prijonegoro Hospital was performed on solidified materials to determine the contaminants of waste to determine its toxic characteristics. Then, the test results are matched with quality standards. The metal parameters being studied are Arsenic (As), Mercury (Hg), Copper (Cu), Silver (Ag), Lead (Pb), Cadmium (Cd), Chrom (Cr), Boron (B), Selenium (Se) and Zinc (Zn) (Liu et al., 2019). The test result of the Incinerator Ash chemical characteristic shows that incinerator ash increases with time. Thus, it potentially causes environmental pollution. Incinerator ash was examined for metal parameter content using the AAS method. After that TCLP test was performed (Bero & von Braun, 1995), and the research results can be seen in Table 2 about laboratory test results at the Center for Industrial Pollution Prevention Technology (BBTPI) Semarang. The result reveals that the heavy metal concentration of incinerator ash from PT. Wastec Semarang with TCLP test value does not exceed the quality standard (Bero & von Braun, 1995).

Table 2. Laboratory tests result from TCLP incinerator ash

No.	Parameter	Unit	TCLP Test Result	Maximum content	Description
1.	Arsen (As)	(mg/L)	<0,003	6	Fulfilled
2.	Kadmium (Cd)	(mg/L)	<0,001	0,9	Fulfilled
3.	Copper (Cu)	(mg/L)	0,702	60	Fulfilled
4.	Silver (Ag)	(mg/L)	<0,050	40	Fulfilled
5.	Lead (Pb)	(mg/L)	1,004	3	Fulfilled
6.	Mercury (Hg)	(mg/L)	<0,001	0,3	Fulfilled
7.	Boron (B)	(mg/L)	0,772	150	Fulfilled
8.	Selenium (Se)	(mg/L)	<0,002	3	Fulfilled
9.	Zinc (Zn)	(mg/L)	0,993	300	Fulfilled
10.	Hexavalent Chromium (Cr^{+6})	(mg/L)	0,006	15	Fulfilled

As for testing the air quality of the chimney incinerator, secondary data is taken from the results of the PT. Wastec semarang in June 2022 is as follows:

Table 3. Laboratory tests result from air quality testing from the incinerator chimney

No.	Parameter	Unit	Test Result	Maximum content	Description
1.	Partikel	(mg/Nm^3)	40	50	Fulfilled
2.	Sulfur Diokasida (SO_2)	(mg/Nm^3)	5	250	Fulfilled
3.	Nitrogen Dioksida (NO_2)	(mg/Nm^3)	85	300	Fulfilled
4.	Hidrogen Flourida (HF)	(mg/Nm^3)	<0,3	10	Fulfilled
5.	Karbon Monoksida (CO)	(mg/Nm^3)	11	100	Fulfilled
6.	Hidrogen Peroksida (HCL)	(mg/Nm^3)	<0,4	70	Fulfilled
7.	Total Hidrocarbon (CH_4)	(mg/Nm^3)	4	35	Fulfilled
8.	Arsen (As)	(mg/Nm^3)	<0,0001	1	Fulfilled
9.	Cadmium (Cd)	(mg/Nm^3)	<0,0001	0,2	Fulfilled
10.	Chromium (Cr)	(mg/Nm^3)	<0,0001	1	Fulfilled
11.	Timbal (Pb)	(mg/Nm^3)	<0,0009	5	Fulfilled
12.	Mercury (Hg)	(mg/Nm^3)	<0,0001	0,2	Fulfilled
13.	Thallium (Tl)	(mg/Nm^3)	<0,0001	0,2	Fulfilled
14.	Opasitas	(%)	-	10	Fulfilled
15.	Chlor (Cl)	(%)	<0,000003	10	Fulfilled
16.	Ammonia (NH_3)	(%)	<0,000003	0,5	Fulfilled
17.	Combustion Efficiency	(%)	99,99	99,99	Fulfilled

The Table 3 shows the air quality measurement of the incinerator chimney emission test for the type of Pressure Jet engine from PT. Wastec Semarang shows that all parameters of the measurement results have met the required standards so that air quality at the time of incineration of medical waste is said to be safe for human health and the environment.

The data processing result obtained at the inventory analysis stage were analyzed using the Simapro 9.0 software application and produced a network that provides an overview of the relation in each production process of toxic, hazardous material waste management in dr. Soehadi Prijonegoro Hospital. The red lines in the resulting diagram show the interrelations between processes—the red lines on the network run from the bottom to the top. The activities shown at the bottom of the diagram support the activities shown at the top of the diagram. The thickness of the red line is directly proportional to the produced emission. A thicker red line 21 will indicate (Rasul & Arutla, 2020) the more significant the emission. Overall, the network generated in the toxic, hazardous material waste management process at public hospital dr. Soehadi Prijonegoro Sragen can be seen in Figure 3.

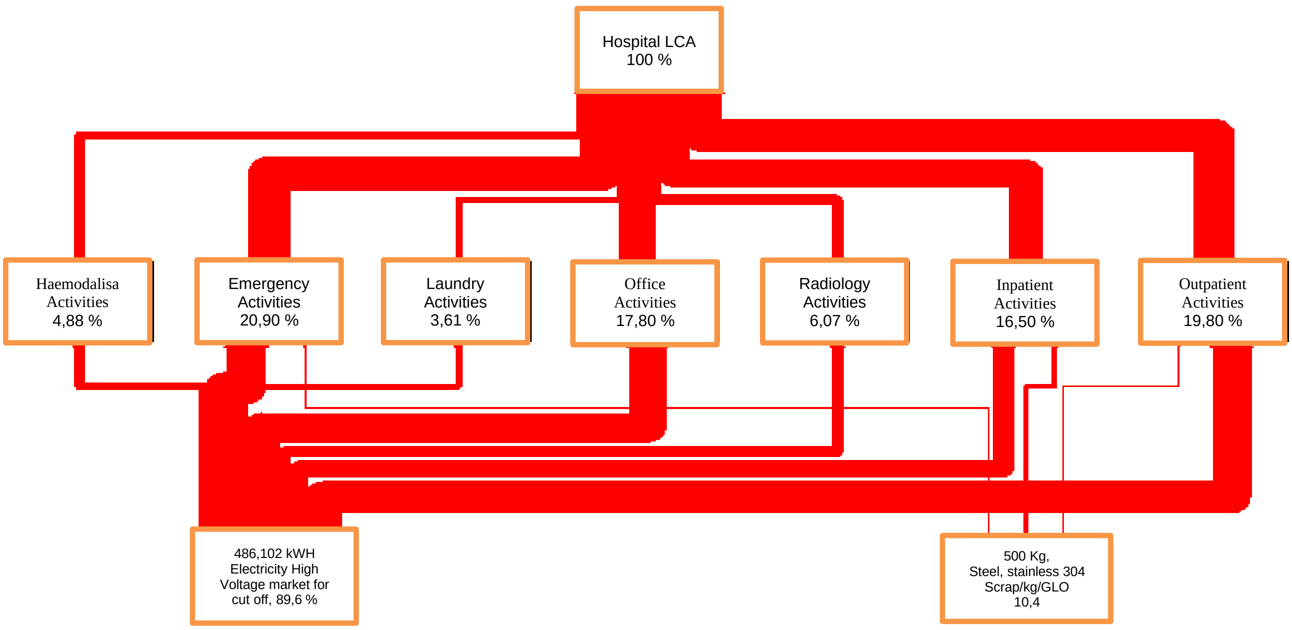

Figure 3. Network of the toxic, hazardous material waste management process at public Hospital dr. Soehadi Prijonegoro Sragen

From the chart above, it is the source of emissions that produces the most significant impact, namely from state electricity company energy sources used during the service process at dr. Soehadi Prijonegoro Hospital, during September, the electricity used was 486,102 KWH which produced emissions of 89.6%, while 10.4% was from medical waste materials. The most significant heat line indicates an enormous emission impact, where the room that produces the most emissions and impacts the environment is the emergency room and inpatient room services. At the same time, the most negligible impact is on the laundry space.

Life Cycle Impact Assessment (LCIA)

After conducting an inventory of each stage of the hospital's toxic, hazardous material waste management, the next step is to analyze the potential environmental impact of each of these stages. This stage is called the life cycle impact assessment. Life cycle impact assessment aims to explain consequences or impacts on the environment. This stage also provides additional information to assess the life cycle inventory product system. Thus, we can better understand its importance to the environment (Iqbal et al., 2021). The impact results are as follows:

Impact on Human Health

The impact is 5.43 kPt. The room that contributed the most to this impact was the emergency room, which was 1.12 kPt. This is due to the use of electrical energy from PLN (state company supplying the electricity) in which the most significant substance/parameter was Particulate <2.5µm.

Impact on the Ecosystem

The impact is 0.0697 kPt. The room that contributed the most to this impact was the inpatient room, which was 0.0288 kPt. The consumption of syringes, cotton, and gauze causes it. This consumption produces the most significant substance of 4.35 Pt CO_2 emissions.

Impact on Resources

The impact is 0.0145. The room that contributed the most to this impact was the inpatient room, which was 0.00698 kPt. It is due to the use of infusion tubes and catheter tubes. This consumption has an impact on crude oil resources of 3.07 Pt.

Overall, from the *output* of SimaPro, the one that contributes the most to the environmental impact is electrical energy. In a day, logistics in the inpatient room amounted to 1740 kWH. The use of electricity has an impact on the destruction of natural resources. The role of electrical energy is quite significant in helping health service activities in hospitals, according to previous research. In addition, carbon dioxide (CO2) emissions from burning carbon contained in fossil energy indirectly contribute to the impact of *climate change*. It takes electricity-saving efforts, one of which is by increasing equipment efficiency. Replacement of old equipment can be one of the alternatives to improving the efficiency of the equipment. The use of materials is as efficient as possible that can produce medical waste during health services.

CONCLUSION

The results research the gate-to-gate analysis using a life cycle assessment approach of the hospital's toxic, hazardous material waste management. The process shows that the most significant impact on the ecosystem is the potential for global warming in the Emergency room, while the impact on resources and the ecosystem is in the inpatient room due to excessive medical waste. The potential for environmental impacts is based on running the Simparo 9.0 application. With all the limitations, life cycle assessment remains one of the exciting methods to use. This method can quantify the environmental impact of each stage of production activities. This method can also be used to determine the best technological alternatives that provide the minimum environmental impact to help decision-making. Stakeholders can use this method, but consistent discipline is needed in collecting data. This research is expected to provide insights related to life cycle assessment in environmental impact assessment in health facilities. Further research on environmental impacts using the life cycle assessment method is still very wide open, particularly about emission factors and characterization models.

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