



## Hazardous and Toxic Waste Management Analysis at UNS Hospital Indonesia

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**Abstract** - National development is increasing every year driven by infrastructure development in all fields including hospitals. Hospitals and health care facilities produce B3 waste that enters the environment through soil, water, air, and biota media. The UNS Hospital is a hospital with service types A, B and C located in Kartasura District, Sukoharjo Regency, Central Java, Indonesia. The method used in this study observation and interviews. The data collected is for B3 waste management which includes reduction and sorting, storage, transportation, and processing. The data obtained were then analyzed descriptively and compared with Permenkes No. 7 of 2019 regarding hospital environmental health and Government Regulation No. 22 of 2021 regarding environment management. Basically, there are 2 types of waste generated by UNS Hospital, namely medical and non-medical. Currently, UNS Hospital distinguishes waste into 2 types, namely Covid and Non-Covid. There are 6 stages of waste management in UNS Hospital, namely as follows. Sorting is carried out in each ward or treatment room by sorting waste according to its type. Waste packaging, safety box provided. The collection is by sorting the waste put into the trash and then transported by Cleaning Service in a special trolley and collected at the TPS. Storage of medical waste 1-2 days while non-medical 1 year. The transportation and processing of waste is carried out by a third party. Hazardous and toxic waste is one of the materials that requires special handling. The agency that will handle B3 waste must have permit or certification related to the management carried out. UNS Hospital is a health care agency that participates in producing B3 waste with good waste management according to existing regulations.

**Keywords** - Hospital, Hazardous and Toxic Waste, B3 Waste, Waste Management

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### 1. Introduction

National development is increasing every year in order to improve the economy, and increase the quantity and quality of all aspects in life of people, nations, and countries. This national development is of course driven by infrastructure development in all fields, both industry, transportation, settlements, and all public service infrastructure, including hospitals. Various industrial activities and anthropogenic activities has an important role to contribute that usually not valuable and tends to be detrimental. There are many types of waste with certain classifications. Based on its form, waste is classified into three type which is solid waste, liquid waste, and gas waste. Hospitals are health care institutions that play an important role in improving public health sustain the improvement of the quality of human resources (Purwanti, 2018). Public concern for the improvement of the development and management of quality hospitals. The increase in the number of hospitals will significantly be accompanied by an

increase in the amount of medical waste production directly or indirectly (Ma et al., 2019). The hospital has an array of other units, such as pharmacy, administration, laboratory, operating room, kitchen, waste and waste treatment. Health care facilities, especially hospitals can come from various sources of hospital activities, both in the form of liquid, solid, or gas waste. In addition, hospitals are also a contributor to the production of very large waste, both domestic waste and hazardous and toxic material waste (B3 waste).

Hazardous and Toxic Waste (B3 waste) is the residue or waste from activities whose nature either directly or indirectly, can damage an environment and endanger human health. B3 waste has different characteristics from other wastes because of the unstable, reactive, explosive, flammable, and toxic nature of B3 (Pertwi et al., 2017). B3 waste is waste material produced from various sectors, both industry, household, tourism, and health services. Hospitals and health care facilities include B3 waste

producers with considerable numbers. This damage can occur if B3 waste enters the environment, whether through soil, water, air, and biota media will affect sustainable and unsustainable, directly and indirectly, regularly and irregularly (Putra et al., 2019). B3 waste of hospitals is divided into non-medical B3 waste and medical B3 waste. Non-medical B3 waste is waste from the results of medical activities, such as nutrition, laundry, canteen, bathroom, and toilet. Examples of non-medical hospital waste, such as battery stones, expired drugs, and used bottles of B3 materials. Medical waste can be categorized into infectious waste, pathology, sharp objects, pharmaceuticals, cytotoxic, chemical, radioactive, pressurized containers, and high heavy metal content.

Hazardous and Toxic Waste materials have a very dangerous impact, not only on the environment but also on living things. B3 waste that has polluted the environment will be detrimental, both in terms of the health of living things, sectors of economic activity, and damage to ecosystems (Absori and Latif, 2020). Hospital B3 waste has a huge potential danger because it can be a high chain of disease transmission if not managed properly. Based on the records of the Minister of Environment and Forestry, the hospital's medical waste production reached 383,000 tons each day with a capacity of 493,000 tons each day medical B3 waste processing facility. This number is still increasing in each province, one of which in Central Java Indonesia has increased from 122.82 tons into 502.40 tons. It is necessary to do good and correct B3 hospital waste management. It is also affirmed in the Regulation of the Minister of Environment and Forestry of the Republic Indonesia No. 56 of 2015, that hospitals are obligated to carry out B3 waste management which includes the reduction and sorting, storage, transportation, processing, burial, and stockpiling of B3 waste.

UNS Teaching Hospital is one of the hospitals with services types A, B and C located in Kartasura District, Sukoharjo Regency, Central Java, Indonesia. Based on initial observations, UNS Teaching Hospital has conducted plastic bag separation based on B3 waste type. In a several time there will be transport of B3 plastic bags and handed over to third parties. This third party is required for the treatment of B3 waste UNS Teaching Hospital because there is no B3 waste treatment permit in this hospital. Based on this background, the author is interested in studying more about B3 waste management at UNS Teaching Hospital.

**2. Materials and Methods**

This research is to find out how to manage B3 waste which includes reduction and sorting of B3 waste, B3 waste storage, B3 waste transportation, and B3 waste treatment. Data collection techniques used in this study were through direct interviews or using a questionnaire addressed to the hospital. From these data will produce information regarding B3 waste. Data analysis was carried out through analytical activities with descriptive observational research

through observations on B3 solid waste management at UNS Hospital. The methods used in collecting data in this study were observation, interviews, and questionnaires. The data collected is for B3 waste management which includes the reduction and segregation of B3 waste, B3 waste storage, B3 waste transportation, and B3 waste treatment. The data obtained were then analyzed descriptively and compared with Regulation of the Minister of Health of Republic Indonesia No. 7 of 2019 regarding hospital environmental health and Government Regulation No. 22 of 2021 regarding environmental management. This research was conducted at the Sebelas Maret University Hospital, located at Jalan Ahmad Yani No. 200, Makamhaji, Kartasura, Sukoharjo, Central Java, Indonesia.

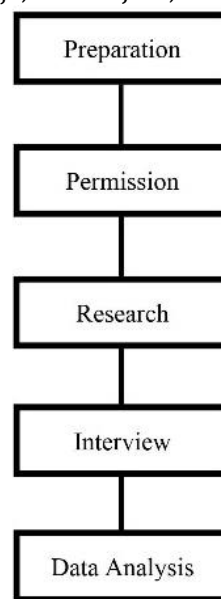


Figure 1. Diagram Research

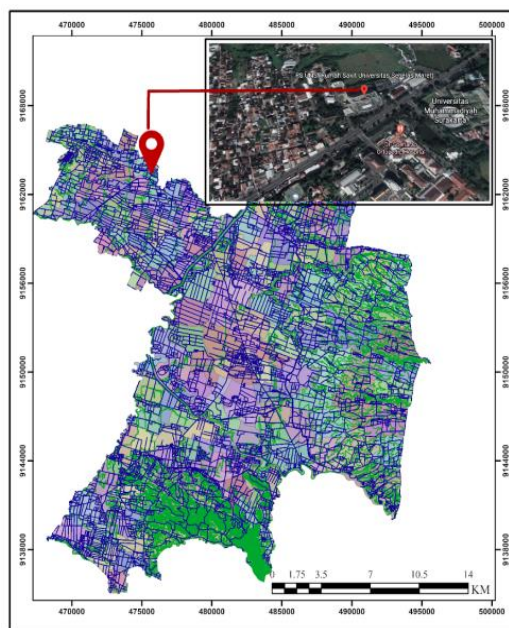


Figure 2. Research Location

### 3. Results and Discussion

#### 3.1 Definition and Classification of B3 Waste

B3 waste can be defined as a waste that have toxic concentration and dangerous substances, so it can give negative impact for the environment, interfere with health, and threaten the survival of humans and other organisms. Based on the source, B3 waste is divided into 3 types, which is: B3 waste from unspecified sources. This waste does not come from the main process, but from equipment maintenance activities, corrosion inhibitors, scale dissolving, washing, packaging and others; B3 waste from specific sources. This waste comes from an industrial process (main activity). B3 waste from other sources. This waste comes from unexpected sources, such as expired products, leftover packaging, spills, and product waste that does not meet specifications. A waste can be classified as a B3 waste and toxic material if it has certain properties, including explosive, easily oxidized, flammable, toxic, corrosive, causes irritation, or causes health symptoms such as carcinogenic, mutagenic, and toxic.

According to PP No 101 of 2014 Article 1 Paragraph 1, Hazardous and Toxic Materials (B3) are defined as substances, energy, and/or other components which due to their nature, concentration, and/or amount, either directly or indirectly can contaminate and/or damage the environment, and/or endanger the environment, health and survival of humans and other living creatures. In general, Hazardous and Toxic Waste (B3) can be defined as waste containing hazardous and toxic substances, so that it can directly or indirectly damage the environment, interfere with health, and threaten the survival of humans and other organisms. According to Kurniawan (2019), B3 Waste can be defined as residual material or waste from a business or activity that contains B3. Types of B3 waste based on hazard are divided into categories one and two. Category one means an acute and direct impact on humans. Category two means having an indirect effect or impact. Based on the source, B3 waste can be divided into 3, namely B3 waste from non-specific sources, B3 waste from specific sources, and B3 waste from other sources. B3 waste from non-specific sources is B3 waste that does not originate from the main processor activity but from other activities such as corrosion inhibitors, equipment maintenance, washing, dissolving scale, etc. B3 waste from specific sources is B3 waste as opposed to B3 waste from non-specific sources, namely waste originating from the main process or activity. B3 waste from other sources is B3 waste originating from unexpected sources, such as expired products, spills, packaging residues, and B3 product waste that does not meet specifications. Based on the source of the waste generation, B3 waste consists of 4, namely industry, tourism, health services, and household. Examples of hazardous waste from industry such as used oil, expired chemicals or chemical spills, fly ash/bottom ash, IPAL sludge. B3 waste products from tourism are IPAL sludge, used electronics, and used lubricants. In households such as used TL lamps, used batteries or batteries and used

electronics. While in health services, it is divided into infectious clinical waste, sharp object waste and expired drugs.

In general, B3 waste can be classified into 6 based on its nature, namely explosive waste, flammable waste, toxic waste, reactive waste, corrosive waste, and waste that causes infection.

1. Explosive waste is waste which, when through a chemical reaction, can produce gas with high temperature and pressure and can quickly damage the environment.
2. Combustible waste is waste which, when close to sparks, flames, friction, or other sources of ignition, will easily catch fire or ignite, and if it is ignited it will continue to burn violently for a certain period.
3. Toxic waste is waste that contain toxins that are harmful for humans and the environment. This type of B3 waste can cause death or illness if it enters the body either through breathing, skin, or mouth.
4. Reactive waste is waste that causes fire because release or accept oxygen or organic peroxide which is unstable with high temperatures.
5. Corrosive waste is waste that can cause irritation to the skin or corrode steel, this waste has a pH equal to or less than 2.0 for acidic waste and greater than 12.5 for alkaline ones.
6. Waste that causes infection, is waste originating from laboratories or hospitals infected with disease or waste containing disease germs, such as amputated human body parts, and infected human body fluids.



Figure 3. Symbol Classification of B3 Waste

Based on the classification and the resulting hazard, B3 waste must be managed properly and correctly so that it does not hurt humans and the environment. B3 waste management can be interpreted as a series of activities that begin with the process of storing, collecting, utilizing, transporting, and managing B3 waste which includes the landfill process (Fajriyah and Wardhani, 2020).

#### 3.2 Management Hierarchy of B3 Waste

The hierarchy of B3 waste management, in general, starts from the agency as a source of B3 waste that carries out storage and collection to reduce it by utilizing B3 waste into products. However, several things must be considered

after utilizing B3 waste into products, namely that processed products must not cause environmental pollution and their safety is maintained. If the utilization activity still produces residue from B3 waste, then the next step that can be taken is to cooperate with a third party who already has a permit to carry out the transportation, management, and stockpiling of B3 waste. Some of the activities carried out by third parties include collection, utilization/processing/hoarding, transportation of B3 waste, and the use of manifests. From these various activities, third parties must meet various conditions or rules that have been set by the government. The conditions that must be met by the collector are to have a Cooperation contract with the B3 waste producer and the party utilizing/processing/hoarding. Meanwhile, the requirements that must be met by the party utilizing/processing/hoarding are to have a valid permit, to have a permit that is appropriate to the type of waste being managed, and to have a Cooperation contract with a party producing B3 waste. Meanwhile, the conditions that must be met by the B3 waste carrier are to have a permit from the Ministry of Transportation and a recommendation from the Ministry of Environment, the type of waste transported must comply with the recommendations, the means of transportation used are by the recommendations/permits, and the transportation area must comply with the recommendations/permits. In this transportation activity, a third party requires a travel document which is commonly referred to as a manifest document. With the distribution of the B3 waste manifest, all parties will have detailed data on various information regarding B3 waste, including the party that produces the waste, the type of waste generated, the processing methods carried out, and so on. This manifest document is the obligation of the party producing B3 waste so that the management of B3 waste is clear.

### 3.3 Packaging Rules of B3 Waste

The packaging of B3 waste has various requirements that must be met, for example, packaging made of materials that can pack B3 waste according to the characteristics of the B3 waste to be stored, the packaging must be able to hold the B3 waste in the package, the packaging must have a strong cover to prevent it from being stored. To prevent spills and leaks, the packaging must be ensured that it is in good condition, does not leak, does not rust and is not damaged, and must have a B3 waste label and a B3 symbol which includes the name of the B3 waste, the identity of the B3 waste producer, the date the B3 waste was generated, and the date the B3 waste was generated. B3 waste packaging.



Figure 4. B3 Waste Label

### 3.4 Regulation of B3 Waste

The Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 12 of 2020 on Waste Storage of Hazardous and Toxic Materials has explained about the management of B3 waste. In article 1 paragraph 10 B3 waste treatment which includes storage is a temporary storage activity of B3 waste carried out by B3 waste producers. Then continued in article 1 paragraph 11 explained that the packaging of B3 waste is a way of placement of B3 waste to facilitate the storage and / or collection and / or transportation of B3 waste to maintain the safety of the environment and human health. This B3 waste treatment has been confirmed in this regulation precisely in article 2 paragraph 1 where every B3 waste producer, B3 waste collector, B3 waste utilization, and B3 waste hoarding must carry out B3 waste storage. In addition to these regulations, there is a Regulation of the Minister of Health of the Republic of Indonesia No. 18 of 2020 on Medical Waste Management of Regional-Based Health Service Facilities, which explains that medical waste management can be implemented internally and externally. Article 6 paragraph 1 explains that internal management of medical waste can be done through reduction and sorting, internal transport, internal storage, temporary storage, and internal processing. Then in article 7 paragraph 1 explained that the treatment of medical waste externally is done through external transportation, collection, processing, and hoarding.

### 3.5 Classification of B3 Waste at UNS Hospital

B3 waste does not only come from industrial activities but can also come from non-industrial activities such as hospitals. According to Dewi (2014), the hospital is one type of institution engaged in health services that are responsible for providing treatment, care, and seeking healing and health of patients where the activities that occur in it have considerable potential in generating waste, either domestic waste, B3 waste, liquid waste, or gas waste. According to Siddik and Wardhani (2020), hospital waste can be in the form of solid, gel or paste, liquid, and gas. Therefore, to minimize the impact on the environment, hospitals must make efforts or management activities for the waste produced (Pusparani et al., 2018). In addition to

having an impact on the environment, the waste produced by hospitals can also cause work accidents (Utami and Musyarofah, 2021). In this study, we will discuss the B3 waste management carried out by the UNS Hospital.

There are 2 types of waste generated by UNS Hospital, namely medical waste and non-medical waste. According to the Regulation of the Minister of Health of Republic Indonesia No. 18 of 2020, concerning Medical Waste Management for Regional-Based Health Service Facilities, it is stated that medical waste is waste resulting from medical activities in health services. This medical waste can be in the form of infectious waste, pathological waste, sharp object waste, radioactive waste, cytotoxic waste, and so on. Even with the covid pandemic, which is still ongoing, a new type of B3 waste has emerged, namely Covid B3 waste which is classified as medical waste. So that currently, UNS Hospital distinguishes medical waste into 2 types, namely Covid B3 waste and Non-Covid B3 waste.

Covid B3 waste is infectious waste that comes from covid patients and comes from health care facility workers who make direct contact and handle Covid patients directly (Nurwahyuni et al, 2020). As for examples of B3 Covid waste, for example, used masks, used Personal Protective Equipment (PPE), used gloves, used syringes, specimens, used tissues, used pharmaceutical materials, food and beverage waste, and other used equipment used in handling covid patients (Buana, 2021). By separating and managing Covid B3 waste properly, it can be a way to control the spread of Covid today (Yolarita and Kusuma, 2020). Meanwhile, Non-Covid B3 waste is B3 waste produced by hospitals related to non-Covid patient handling activities, such as syringes, used infusion bottles, blood spills, organ pieces from patients, and so on. It is different from medical B3 waste, Non-Medical B3 waste is domestic waste generated from activities in hospitals outside of medical service activities (Kinanti et al, 2021). The activities outside of medical services are in the form of activities in the kitchen, laundry room, office, and so on. Examples of non-medical waste are used batteries, used lamps, laundry detergent, used food packaging, and so on.

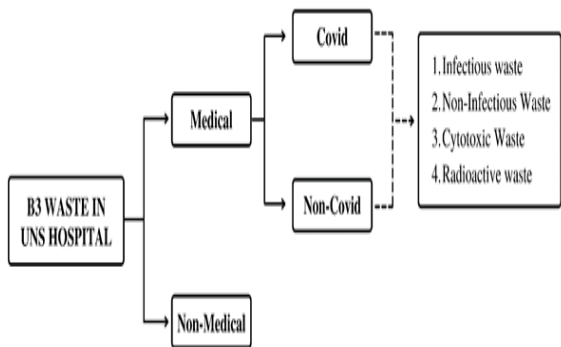


Figure 5. Types of B3 waste at UNS Hospital

To minimize the negative impacts that may occur from B3 waste, UNS Hospital conducts waste management by cooperating with third parties who already have permits in

waste management. Because there is no operational permit for B3 waste management independently, UNS Hospital only collects B3 waste at B3 garbage dump. Meanwhile, B3 waste transportation and processing activities are left to third parties. The guidelines used by the UNS Hospital in managing the B3 waste are based on the Minister of Health Regulation No. 7 of 2019 regarding hospital environmental health and Government Regulation No. 22 of 2021 regarding environmental management. Which is good because they are a from medical institution and have some regulation reference to do the action, it is should be proud. The following is the management system implemented by the UNS Hospital in managing the generated B3 waste:

**1) Sorting by Type of B3 Waste**

The sorting stage is carried out in each ward or treatment room by sorting waste according to its type, whether it is medical waste or non-medical waste. This stage is carried out by providing plastic bags with different colors for each type of waste, and equipped with an information label on the type of waste. At the UNS Hospital, the separation stages are divided into 4, namely infectious waste (specifically infectious waste is put in a jar first and then put into a yellow plastic bag), non-infectious waste in black plastic bags, cytotoxic waste in purple plastic bags, and radioactive waste in red plastic bags.

**2) B3 Waste Packaging**

For the purpose of packaging waste, UNS Hospital provides a safety box that is used to accommodate sharp object waste and containers in the form of trash bins, conductors, or wheelie bin trolleys (large trash bins) to accommodate infectious waste and other types of waste. Waste categorize should be done because waste have they own impact. This is the type of trash that UNS Hospital provide for the various waste to help categorizing to be easier.



Figure 6. Red trash at UNS Hospital



Figure 7. Green trash at UNS Hospital



Figure 8. Yellow trash at UNS Hospital



Figure 9. Infeciuss trash at UNS Hospital



Figure 10. Wheelie bin trolley

### 3) B3 Waste Collection

UNS Hospital collects waste every day intending to avoid waste accumulation. The sequence of stages of waste collection at UNS Hospital is: The results of waste in each ward are put in the trash. Then it is transported by Cleaning Services and put into a special trolley. And lastly, the waste is collected in the garbage dump.

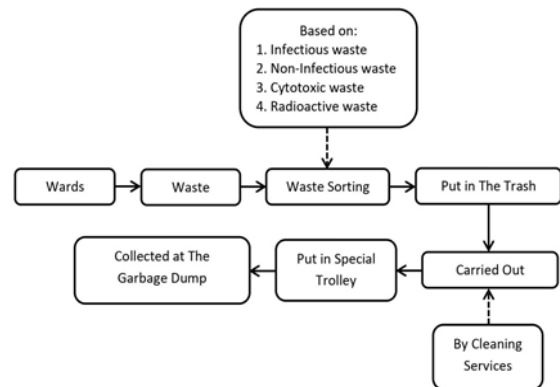


Figure 11. Types of B3 waste at UNS Hospital



Figure 12. Garbage Dump B3 waste Temporary at UNS Hospital



Figure 13. B3 Wasting Collection

**4) Storage of B3 Waste**

B3 waste generated by UNS Hospital is then collected at the B3 garbage dump which is located at coordinate's 7° 33' 32.1" S 110° 46' 24.0" east longitude. The storage period for medical waste is 1-2 days, while for non-medical waste is 1 year.

**5) Transportation of B3 Waste**

Transportation is carried out by a third party. This is because UNS Hospital does not yet have a permit related to B3 waste management operations independently. The collection of medical B3 waste by third parties is carried out 4 times a week, while the transportation of non-medical B3 waste is carried out only once a year.

**6) B3 Waste Management**

For processing activities, UNS Hospital is still cooperating with third parties. UNS Hospital already has a B3 waste management tool, namely an incinerator. However, due to various technical obstacles including obstacles in terms of licensing, UNS Hospital has not been able to operate the incinerator.



Figure 14. UNS Hospital incinerator tool



Figure 15. Incinerator Chimney



Figure 16. UNS Hospital Certification

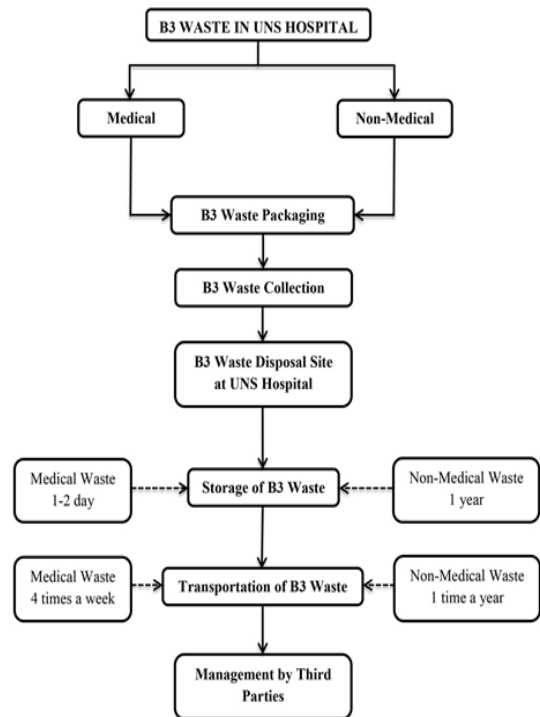


Figure 17. B3 Waste Management in UNS Hospital

#### 4. Conclusion

B3 waste is one of the dangerous wastes that needs more attention. The institution that will handle B3 waste must have a permission by certification related to the management they will do. UNS Hospital is medical institution that results a B3 waste. The methods that we do to know about the B3 waste management system at UNS Hospital is include observation and interview. We are used a couple data which is primer data, and secondary data. There are two types of waste at UNS Hospital including medical waste and non-medical waste, but due to the Covid pandemic, B3 Covid waste was born. B3 Covid waste is a medical waste. UNS Hospital has an action to reduce B3 waste by waste management system as follows: sorting, packaging, collection, and storage. For the transportation and management, UNS Hospital do collaborate with third parties because UNS Hospital don't have a certification that relevant to do an action.

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