THE EFFECT OF THE COVID-19 PANDEMIC ON INFECTIOUS SOLID WASTE MANAGEMENT IN MOTHER AND CHILD HOSPITALS

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ABSTRACT

Coronavirus Disease 2019 (COVID-19) is a contagious disease caused by Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2). During the COVID-19 pandemic, mother and child hospitals perform their usual routine, same as before, to give service to children and the mothers. To increase the patient's safety and quality of service, the hospital increases the uses of medical personnel's protective equipment (PPE) and manages medical waste to adapt to the pandemic situation. The primary purpose of the research is to examine how COVID-19 affected the number of solid infectious medical waste produced and the management of the waste in mother and child hospitals. The research was carried out in two mother and child hospitals in Malang City with a case study on both hospitals by using quantitative research method for examining the impact that COVID-19 pandemic causes for the infectious solid medical waste number and the management of the waste. The data were analyzed by using the parametric t-test indicating a 95% confidence interval. Thus, it showed that there was a significant increase in the solid infectious medical waste from both Hospitals. The first Hospital (A) showed a p-value of 0.046, and the second hospital's (B) p-value was 0,00. The research concluded that COVID-19 pandemic affected the increased number of solid infectious medical waste produced in mother and child hospitals. There is no difference in waste management before and after the COVID-19 pandemic.

KEYWORDS:

COVID-19, infectious, solid waste, waste management

INTRODUCTION

Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). China identified the case as a new type of coronavirus, and WHO designated COVID-19 as a pandemic on March 11, 2020. The COVID-19 pandemic has been going on for more than one year in Indonesia and has resulted in an increase in the number of victims and property losses, widening the coverage of areas affected by disasters, and has implications for broad socio-economic aspects [1].

Hospitals as health service institutions that provide complete individual health services that provide inpatient, outpatient, and emergency services are vital in a pandemic condition [2]. As a full service, the hospital must be ready to accept patients who come with any condition, whether patients are suspected of having COVID-19 symptoms or without symptoms. The symptoms of COVID-19 vary from person to person, ranging from those without symptoms to having severe symptoms. The most common symptoms are fever, dry cough, fatigue. In contrast, rare symptoms include discomfort and swallowing pain in the throat, diarrhea, conjunctivitis (red eyes), headache, loss of taste or smell,

skin rash, or changes-color on the fingers or toes. Severe cases of COVID-19 can cause pneumonia, acute respiratory syndrome, kidney failure, and even death [1].

The first steps taken by health workers at the hospital are screening based on symptoms, carrying out supporting examinations such as antigens and PCR (Protein Chain Reaction), and applying triage [3]. Therefore, in order to prevent the transmission and spread of the corona virus in hospitals, the hospital equips officers with the use of complete PPE according to their level, improving hospital sanitation, one of which is by managing medical waste properly. The pandemic has triggered hospitals to produce increasingly medical waste, both from the activities of service providers and consumers.

Hospital waste is all waste generated from hospital activities in the form of solid, gas, or liquid waste. Hospital solid waste is all solid waste due to activities that occur in the hospital, consisting of solid medical waste and non-medical solid waste. Solid medical waste is solid waste consisting of infectious waste, pathological waste, sharps waste, pharmaceutical waste, cytotoxic waste, chemical waste, radioactive waste, pressure container waste, and waste with high heavy metal content. Solid medical waste collection from each service location is carried out using closed trolleys. Maximum storage is less than 48 hours [2].

Hospitals are required to have a waste management infrastructure including solid medical waste that is adjusted to the hospital's capabilities and the types of solid waste available, either by autoclaving or incinerating it. For hospitals with an incinerator, it is mandatory to burn the medical waste no later than 24 hours. Whereas for hospitals that do not have incinerators, their solid waste will be destroyed through collaboration with other hospitals or other parties that have an incinerator; the solid waste should be destroyed within 24 hours if it is kept at room temperature [4].

Several COVID-19 medical wastes have the potential to be infectious. They include used masks, used gloves, used bandages, used tissue, used plastic for drinks and food, used food and beverage paper, used syringes, used infusion sets, used Personal Protective Equipment (PPE) from service activities in the Emergency Unit, isolation room, ICU room (Intensive Care Unit), treatment room, and other service rooms. B3 waste (infectious waste) COVID-19 also takes steps in the form of storing infectious waste in closed packaging for a maximum of 2 days since it is generated, transporting, and destroying the B3 waste treatment (incinerator facility with minimum combustion temperature. 8000ºC or with an autoclave equipped with a shredder), the combustion or chopped autoclave residue is packaged and attached with a "toxic" symbol and a B3 waste label which is then stored in a temporary storage place for B3 waste to be subsequently handed over to the B3 waste manager. This waste is handled by reducing, storing, collecting, transporting, utilizing, processing, and landfilling as solid B3 medical waste as well as controlling, preventing, and deciding the transmission of COVID-19 and avoiding the buildup of waste resulting from handling COVID-19 [2].

The Mother and Child Hospital (RSIA) is a referral facility for maternal and child health services. Although there have been many restrictions on almost all routine hospital services during the pandemic, including maternal and neonatal health services, services at Mother and Child hospitals are still ongoing, mainly in the form of services. Health workers who carry out examinations for pregnant women, assist in childbirth, and provide care for newborns are required to use Personal Protective Equipment (PPE) [5]. During the Covid 19 pandemic, RSIA continued to provide services to mothers and children as before the pandemic. To ensure a sense of security and quality service, RSIA is increasing the use of PPE equipment and managing medical waste according to pandemic conditions. The full use of PPE according to the level is strictly applied to protect health workers from COVID-19. The purpose of this study was to determine the effect of the COVID-19 pandemic on the amount of infectious solid waste and the management of infectious solid waste during the COVID-19 pandemic in maternal and child hospitals.

MATERIALS AND METHODS

This research was conducted at two hospitals in Malang City. Both hospitals are privately owned mother and child hospitals that are not COVID-19 referral hospitals. The hospital under study produces solid waste from its service process. The solid waste produced is sorted into separate infectious and non-infectious waste. This research was conducted in May 2021. This research

employed a quantitative approach with a case study method to determine the impact of the COVID-19 pandemic on the amount of infectious solid waste and the management of infectious solid waste during the pandemic period [6]. The data were obtained from interviews with officers responsible for managing infectious solid waste in each hospital. Data on the amount of infectious solid waste were obtained from hospital documentation. The data used in this study were the data before the COVID-19 pandemic from January to December 2019 and data during the COVID-19 pandemic from January to December 2020. Data on the number of patients before and during the COVID-19 pandemic was also collected to support the data on the amount of solid waste generated. The solid waste generated by the hospital is classified into five categories to facilitate measurement. To test the impact of the COVID-19 pandemic on the amount of infectious solid waste produced by the hospital, researchers conducted a statistical test of SPSS version 20 using a normality test and a homogeneity test. The normality test used the Shapiro Wilk test because the sample was small (≤50) with α=0.05. If the data is obtained, it shows a p value> 0.05; then the data is normally distributed. Then, the homogeneity test or data diversity test uses the homogeneity of variances with α=0.05. If the data shows a p value> 0.05, then the data is declared homogeneous so that further parametric tests can be carried out using the t-test with a 95% confidence interval.

RESULTS AND DISCUSSION

Both mother and child hospitals are privately owned, and both hospitals are not COVID-19 referral hospitals. The hospital that was being examined produced solid waste from their service, and the waste were sorted to differentiate between infectious waste and non-infectious waste. The research result was collected from interviewing the hospital employer responsible for sorting the waste in both hospitals. Other data, such as the number of infectious wastes, was collected from hospital documentation.

The first data are collected from interviewing the hospital employee responsible for sorting the waste from both hospitals. Both hospital employees said that there is no difference in sorting the waste before and during the COVID-19 pandemic. The first hospital (A) sorts their waste on each service department. The solid infectious waste is carried with a special cart for the infectious waste to B3 waste management containment. It is not sorted by considering the high-risk department such as the emergency and isolation units. Then, the waste was collected and sorted around 24 hours by a third party cooperating with the hospital. The second hospital (B) has a similar waste management system to the first hospital. However, there is a significant difference in the frequency of waste collected by the third party that collected the waste, which is around 48 hours.

The data used was a document before the COVID-19 pandemic from January to December 2019. The data during the COVID-19 pandemic are collected from January to December 2020. The data are tested using SPSS version 20 with normality test and homogeneity test and continued with a T-Test examination, and the result is shown in Table 1. Based on the SPSS result from the normality test, the significant number of solid medical waste from the first hospital (A) before the pandemic is 0.231, and after the pandemic is 0.154. In the second hospital (B), the normality test result has 0.108 significant numbers before and after the pandemic is 0.161. The result is >0.05 means that the value has a normal distribution.

The average weight of infectious waste before the pandemic was 1038.0833 kg, while after the pandemic, there was an increase in medical waste by an average of 1310.6667 per month. Based on the output of the paired sample test, a significance value of 0.046 is obtained, which is less than 0.05, which indicates that the null hypothesis is rejected. The alternative hypothesis is accepted, or in other words, that the pandemic influences the amount of medical waste in RSIA A Malang.

The average weight of infectious waste before the pandemic was 501.6667 kg, while after the pandemic, there was an increase in medical waste with an average of 935,333 kg per month. Based on the output of the paired sample test, a significance value of 0.000 is obtained, which is less than 0.05, which indicates that the null hypothesis is rejected and the alternative hypothesis is accepted or, in other words, that the pandemic has an influence on the amount of medical waste in RSIA B Malang.

Table 1. Quantity of infectious Solid Waste Before and During the Pandemic in Both Mother and Child Hospital (kg)

Hospital	Before pandemic			During pandemic			Sig (2-tailed)**
	N*	Average	Std. Deviation	N*	Average	Std. Deviation	
A	12	1038,08	309,54	12	1310,66	155,57	,046
B	12	501,66	165,69	12	935,33	225,28	,000

* the number of months in 2019 and 2020

**meaningful if sig.(2-tailed)<0,05 (95% Confidence Interval)

Based on the data that has been analyzed from the two hospitals, several things can be drawn. First, there is a relationship between the pandemic and solid medical waste available. This is the same as what happened to public hospitals in the pandemic. In previous studies conducted in several public hospitals, it was stated that there was an increase in the amount of medical waste during a pandemic. However, the increase in medical waste does not match the number of patients who visit. During the pandemic, there was a decrease in the number of visits at RSIA A, while at RSIA B, there was a slight increase in the number of visits. Even though there was a decrease in visits, the medical waste still increased. This is due to various things, including the addition of waste from medical personnel's protective equipment (PPE), visitor masks, and trash from activities.

This research is in line with the Sentra Medika Hospital Cikarang that the BOR during the pandemic is low (average for the first and second quarters of 2020 is 63.63%) compared to before the pandemic (the average for the first and second quarters of 2019 is 84.9%). This research is also in line with the research of Wulansari, Sudarno, and Muhammad, which states that medical waste increases even though BOR decreases [7].

Infectious medical waste from COVID-19 is B3 waste that will certainly endanger the environment if disposed of in this way. This ex-COVID-19 infectious medical waste is waste resulting from health service facilities, including health service clinics or the like, community health centers, and hospitals. The increase in medical solid waste during a pandemic can occur due to government regulations. The government determines the completeness of PPE for health workers for the safety of health workers by dividing it into several areas and types of work in terms of the level of infectious risk. The workers in the triage area wear PPE, which consists of work clothes according to hospital uniforms, gloves, surgical masks, closed shoes, face shields. The medical waste handling officer should wear double gloves plus PPE like a triage officer. Then, the administrative officers wear work clothes plus laboratory coats, surgical masks, gloves, closed shoes. In addition, security guards and maintenance officers wear work clothes according to the provisions of the hospital-Surgical Masks. Officers in the treatment/action room in the ER wear work clothes according to the hospital requirements, surgical isolation gowns, N954 respirators, goggles, double-layer gloves, closed shoes. Polyclinic officers wear work clothes according to the hospital requirements, surgical isolation gown, N954 respirator, Goggle / Face shield, medical gloves, closed shoes. With this provision, medical waste originating from health workers will also increase. Applying infection control principles in hospitals also increases the amount of medical waste where the hospital requires wearing masks to all hospital visitors [8].

The increase in solid medical waste during the pandemic at RSIA A and RSIA B in Malang city is in line with research conducted at the Hasanah Muhammadiyah Islamic Hospital Mojokerto. COVID-19 waste is increasing every day resulting from activities at Hasanah Hospital. Covid waste includes: gloves, hazmat, consumables such as syringes, injection vials, injection ampoules, waste from PCR laboratories, both infectious and non-infectious, containers of food and drink leftovers for Covid patients with a more significant number than non-COVID-19 medical waste. An increase in medical waste also occurred in the Hospital area in West Sumatra. The amount of B3 medical waste almost doubled during the pandemic; the largest was around 41,670 kg/month [10].

The effect of hospital waste on environmental and health quality can cause various problems such as:

1. Disorders to human health can be caused by various types of bacteria, viruses, chemical compounds, pesticides, and heavy metals such as Hg, Pb, and Cd originating from the dentistry department.
2. Genetic and reproductive disorders.
3. Poor hospital waste management will be potential for disease vectors such as flies and mice.

4. The incidence of dengue haemorrhagic fever increases because the vector of the disease lives and reproduces in used trash cans or stagnant water.
5. If there is a burning of hospital waste that is not sanitary, the smoke will interfere with breathing vision and decrease air quality.

The results of supervision by the Ministry of Environment and Forestry (KLHK) found several problems in the management of B3 medical waste. They include the accumulation of infectious waste, unstandardized temporary storage, improper B3 waste management procedures, unstandardized incinerators (emitting black smoke and pollutant emissions), limitations of B3, and other waste processing services [11]. The Ministry of Health (2020) calculates that the percentage of hospitals that carry out standardized waste management in 2019 has only reached 42.64% [12].

Decreasing the amount of medical waste during the pandemic requires hospitals to manage existing waste best to prevent the spread of COVID-19 by applying the principle of preventing infection from sorting out in service units, transportation from service units to temporary trash cans (TPS), and collection. The regulation stipulated by the Ministry of Health number 1204 of 2004 regarding the requirements for hospital environmental health states that medical waste storage is a maximum of 2x48 hours at room temperature.

Special training on solid medical waste management has been given by hospitals both at RSIA A and RSIA B training given to hospital managerial staff, medical staff, cleaners, waste officers. The training also includes the use and disposal of PPI, but periodic monitoring and evaluation have not yet been done regularly. It requires cooperation from all parties involved in the hospital to jointly monitor this to avoid the risk of infection from COVID-19 transmission in the hospital environment.

Based on Circular letter No.SE.2/MENLHK/PSLB3/PLB.3/3/2020 concerning Management of Infectious Waste (B3 Waste) and Household Waste from Handling Corona Virus Disease (COVID-19). The circular stipulates those hospitals must pay attention to the disposal and management of household waste produced, especially from handling COVID-19 patients. Infectious waste originating from health care facilities is managed by storing it in secure packaging no later than two days after generated, transported, or destroyed B3 waste treatment. The management of waste originating from households is by collecting PPE waste such as masks, gloves, and personal protective clothing by collecting, packing in closed containers, transporting, destroying B3 waste treatment. The community must strive to reduce the piling of masks. It is hoped that hospitals and the community will be able to carry out this circular and possibly prevent and break the chain of spreading COVID-19.

Law No. 32 of 2009 contains the meaning of B3 and B3 waste. In Article 1, point 21 of the Law, B3 is defined as energy, substance, or other components which, due to its concentration, nature, and amount, either directly or indirectly, can pollute and damage the environment, even it can endanger the environment, health, and also the survival of humans and other living things. Based on Article 1 number 22 Law no. 32 of 2009, the definition of B3 waste, which is hazardous and toxic waste (B3 waste), is the residue of a business or activity containing B3 elements as stated in Law no. 32/2009. Referring to the existing definition of B3 waste in Law No. 32 of 2009, B3 waste is prohibited from being disposed of carelessly because it can impact environmental components. The disposal method for B3 waste must be separated according to the B3 waste disposal regulations. Waste can be categorized as B3 waste if, after passing the characteristic waste test, the waste is based on Government Regulation No. 101 of 2014 fulfills the following characteristics: a. flammable; b. reactive; c. easy to explode; d. infectious; e. poisonous; and f. corrosive [14].

Hospitals RSIA A and RSIA B have carried out sorting, containerization, transportation, collection, destruction, and up to the final disposal stage carried out by third parties through collaboration. The process is the same as before the Covid -19 pandemic. Waste sorting in each service unit uses different trash cans according to the type of waste available, namely non-medical waste, medical waste, and sharp, infectious waste, to fulfill the principle of infection prevention. The sorting stage is crucial to pay attention to so that non-B3 medical waste and B3 medical waste are not mixed because large amounts of waste from infected patients can cause disease in susceptible hosts [15].
The process of sorting and reducing waste should be a continuous process whose implementation must consider the smooth handling and storage of waste, volume reduction with the treatment of B3 (Hazardous and Toxic) and non-B3 (Hazardous and Toxic) wastes, and avoiding the use of

hazardous and hazardous chemicals and Toxic), clear packaging and labeling of various types of waste for cost efficiency, management and disposal [16].

The process of transporting waste at RSIA A and RSIA B from the service unit to the TPS uses a closed and different trolley. However, the disinfection process of the COVID-19 waste trolley before and after transportation has not been carried out correctly. The Ministry of Environment and Forestry of the Republic of Indonesia (2018) states that the transportation of B3 medical waste is attempted to use a different means of transportation from ordinary waste to avoid the potential for being confused and mixed. Regarding the transportation route to the TPS and from the Service unit, there is no particular route selection (clean route and dirty route), only the hours for collecting medical waste at the service unit. The incomplete TPS for B3 waste with cold storage in the storage area becomes a problem when the waste is stored for more than two days. Furthermore, based on observations, what needs attention is that both the disinfection procedure on the B3 medical waste plastic tied up and the medical B3 waste TPS has not been carried out correctly. The disinfection process is one of the main things regulated during the COVID-19 pandemic [5].

The transportation stage following the Minister of Health Regulation Number 7 of 2019 is that transportation is carried out during off-peak hours in the morning and evening and does not go through the route/corridor that is crowded with patients or hospital visitors. Meanwhile, both RSIAs do not have a particular route for transportation and still pass the route/corridor, which is crowded with patients and hospital visitors.

In Indonesia, with 2,889 hospitals, only 110 have licensed incinerators. This condition results in the limited capacity of treating B3 medical waste, which only reaches 53.12 tons/day. Coupled with the capacity of processing services by third parties of 187.90 tons/day, the amount of B3 medical waste is predicted to reach 294.66 tons/day [17].

RSIA A and RSIA B do not have their incinerator medical, hazardous waste treatment equipment in their waste management, so they must cooperate with third parties to manage their solid medical waste. Because of this, RSIA A collaborates with third-party waste managers who collect medical waste every day (1x24 hours), while RSIA B, because the average medical waste is less than RSIA A, it collaborates with a medical waste management company that will collect medical waste. Collection at RSIA B does not meet the standards set so that additional infrastructure is needed, namely cold storage at TPS B3 or review of cooperation contracts with third parties so that the retrieval process can take less than 2x 24 hours.

The frequency of transportation of waste is under the agreed cooperation agreement. Waste is transported by officers who have used the specified PPE. According to procedures, the waste is then transported by closed transporter to the designated waste management site and according to procedures. According to regulations, the transportation of waste is carried out by medical waste transportation service providers who have a permit from the government and are appointed by the government to carry out the transportation.

Hazardous waste must be handled specifically and processed in a hospital waste incinerator facility at a minimum temperature of 800 º C (Circular Number SE.2 / MENLHK / PSLB3 / 2020 Regarding Management of Infectious Waste (B3) And Household Waste Handling Corona Virus Disease (COVID-19)). Medical waste management by third parties is carried out by considering the cost according to the weight of the waste as stated in the cooperation agreement. Therefore, of an increase in the amount of waste, there is an immediate increase in management costs of medical waste.

CONCLUSIONS AND SUGGESTIONS

The amount of solid medical waste in RSIA A and RSIA B during the COVID-19 pandemic has increased compared to before the COVID-19 pandemic. Thus, hospitals need to pay attention to the medical waste management process. There is no difference in medical waste management in both RSIA A and RSIA B Hospitals during the COVID-19 pandemic. This has the potential for internal transmission in the hospital. In addition, there is no cold storage for B3 TPS storage which can be a problem when the waste is stored for more than two days, especially for hospitals that do not have their incinerators.

The relevant parties should pay more attention and focus on the processing of sorting and transporting medical and non-medical waste and compliance with the use of PPE not to increase the risk of exposure to disease. It is necessary to do further research using other research methods and designs to determine the comparison and other factors that have not been examined in this study.

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