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THE DESIGN OF MEDICAL WASTE TREATMENT IN PUBLIC HEALTH CENTER (MWT-P) FOR REDUCING TOTAL BACTERIA COUNT IN BANJARBARU

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Abstract

Introduction: The increase in medical waste in health service facilities in Indonesia is linearly consistent. The quantity of medical waste that causes a complex problem is a high cost of processing clinical waste. Legislation requires medical or clinical waste to be processed not to cause nosocomial and other environmental pollution. Medical or clinical waste treatment requires excessive technology and very high processing expenses. Processing medical waste requires innovation in processing medical waste to be applied easily in health care facilities (Public Health Center). *Method:* This research was conducted by simulating variations in the stages of processing medical waste used to be the Experiment Pre and Post Test only without Control Group design. Simulation variations used include contact time Chlorine (5 minutes, 10 minutes) and Chlorine Dose Variation (25 ppm, 50 ppm). This research was conducted in the Public Health Center of the City of Banjarbaru in 2018. *Result and Discussion:* The content of bacteriological numbers in medical waste before processing is, on average, 1,973 MPN / 100 ml; after being treated with MWT-P, the bacteria is reduced to 4 MPN/100 ml. The content of the liquid waste bacterial number of the final processing decreases to 0 MPN/100 ml. *Conclusion:* The study results concluded that the use of MWT-P decreases the quantity of medic or clinical waste microorganisms or bacteria. The final waste processing with MWT-P resulted in the number of medical waste bacteria in the treatment reaching zero. MWT-P is a low cost and easy to perform medical or clinical waste management tool. MWT-P is a stage of the B3 waste management framework, especially medical waste, in health care facilities.

INTRODUCTION

Medical or clinical waste is a consequence of the activities of health care facilities. The more medical services there will be an increase in medical waste. Infectious medical or clinical waste is hazardous because it carries various sorts of microorganisms and viruses that cause disease and environmental pollutants. If not handled properly and adequately, this medical waste will endanger humans and the environment (1). Its existence also causes the function or role of the primary health care or health clinics to create a healthy life for the community precisely as a source of disease. The government as a regulator has release Ministerial Decree of Ministry of Health of Republic Indonesia No. 1204/MENKES/SK/X/2004 about Environmental Health Requirements for Hospital, which require health clinic facilities and primary health care to carry out their medical waste (2). Midwife activities, doctor and dentist practices, health centers and maternity hospitals also play a role in producing infectious waste (hazardous materials), which must be managed. Medical waste is classified as hazardous and toxic (hazardous materials). The principle of hazardous materials waste management, from production to piling up (from the cradle to the grave), is a collection of things to do for the storage, collection, transportation, and treatment of hazardous materials waste, including stockpiling of processed products (3).

Based on the 2020-2020 National Medium Term Development Plan indicators associated with major health services, particularly the wide variety of non-healthcare center and healthcare center (primary health care) that furnish services in accordance to standards, it is predicted to quantity to 6,500 primary health care in 2024. According to the Minister of Health rules regarding primary health care (3). Health centers that can provide standard services are more than the number of existing health centers. Out of the effects of fulfillment in the self valuation equipment by way of the health center, in 2016, there had been 2,692 Health center that had to provide treatment conform to the standard, out of 3,392 primary health care that had reported it to the Directorate General of Health Services at the Ministry of Health of Republic Indonesia (4).

The number of inpatient health centers has persevered to upgrade, as many 3,152 units in 2018, later accelerated to 3,411 health centers in 2020. The range of inpatient health centers tends to fluctuate according to the development of equitable health services. The range of non-inpatient primary health care in 2018 totaling 6,358 primary health care , decreasing to 6,338 Primary health care in 2019 and 2020 increasing to 6,356. The increase in the number of primary health care Inpatients has some other influence on growing medical or infectious waste from the health center.

Health facility service waste generation based on a country's national income level, in high-income nations for all health provider facility waste, can attain an average of 6.05 kg/person-year (5). Medical waste from health care facilities is generated, on average, 3.15 kg/person-year. In medium-income international locations, all healthcare facility waste generates 0.8 to 6.0 kg of waste per year. In comparison, medical waste from health care facilities amounts average to 0.35 kg per individual annually, while low-income countries all facility waste health services produce an average of 2.0 kg per individual every year (5). Based on the results of research in East Nusa Tenggara, it was stated that the polyclinic produced medical waste in the form of goods/rubbish that came out of medical and clinical measures, as follows: In the treatment room, 0.74 kg per patient per day, the transport room 0.167 kg per patient per day, in IGD 0.071 kg per patient per day and activity polyclinic room 0.004 kg per patient per day (5). This study in facility health or one primary health care can produce medical waste as much as 15-25 kg per day.

The amount of medical or clinical waste in Indonesia originates from what primary health care , when added to produce a medical waste average, is 127.1 m³ per day (5). Some medical waste produced by health care facilities reference on study and remark of medical waste has now not been appropriately arranged. Solid waste eradication has not been carried out thoroughly, given the absence of incinerators and other destructive destruction in each primary health care . This condition causes the destruction of medical waste by the primary health care to be not optimal. Regarding the supervision of clinical waste in health facilities (primary health care), there are obstacles in its management, especially if there is an accumulation of medical waste. Clarity of management personnel and their responsibilities in management. The goal is not to treat medical waste properly, and control clinical waste at primary health carecannot be perfect because there are no improvements. Also, the implementation of supervision does not meet the need for medical or clinical waste control methods carried out with the owner's approval at the Primary health care .

Considering that there are still medical or clinical wastes in health centers that do not have adequate treatment and the cost of eliminating hazardous waste is high, researchers provide alternative solutions to overcome infectious waste. Handling hazardous waste is implemented by treatment waste beyond the phase of laundry, chlorination, and devastation as elaborate in the plan of medical waste treatment instrumentation

to the label of medical waste installation treatment for primary health care as a provisional resolution. The plan of the MWT-P device models the treatment of washing, disinfection and drying. The disinfection process using chlorine affects the death of bacteria (6). Based on preceding research, sufficient contact time reduces bacteria at a concentration of 30 parts per million chlorine to a time application of 2 minutes (7).

Consequently, in this research, the chlorine concentration used was 50 ppm chlorine and 25 ppm chlorine. The time application use in this research was once 10 minutes and 5 minutes (8). The resulting instrumentation is designed for a much low-cost price (10 million rupiahs), in contrast with the Incinerator instrument used by health care facilities in destroying infectious waste with an incinerator that has a cost of hundreds of millions.

METHOD

The research design was the experiment pre and post test only without control group design. Research materials included chlorine and a set of waste processing plants and were conducted for nine months in 2018. This research was conducted to collect waste from treatment activities, medical services and other activities in 4 rimary health care (Primary Health Care of Cempaka, Sungai Besar, South Banjarbaru, and North Banjarbaru). Research on designing medical or infectious waste treatment for primary health care (MWT-P) was implemented quantitative and qualitative oncoming (9). The procedure strategy capacity means that the equipment produced was effortless to function and effortless to make themselves by integrating some readily available equipment in the market or shop. Quantitative and qualitative methods in the study were conducted to assess the amount of microorganism or bacteria contained in medical or clinical waste that is process based on the optimal disinfection and washing treatment. In the research preparation, it is found that the pattern or formula is suitable to produce processed medical or clinical waste with a quality that is not potentially infectious, so it is protected for the environment.al. The qualitative and quantitative study uses qualitative descriptive and quantitative analysis. Drawing of the plan MWT- attend figure 1

The experimental design in this study used replication 15 times to obtain a sample of 75 bacterial numbers in medical waste. The examination was also implemented for bacterial wastewater due to processing medical waste produced by the number of bacteria of 60 tests. The number of samples was 135 test samples.

The records conjoined examined the number of MPN bacteria in medical or clinical waste and the outcome of examining the number of MPN bacteria in processed wastewater. The information collected was tabulated through focusing data agree to the cause of the research. Data evaluation of the inspection consequences used to be implemented using statistical analysis; this analysis was to reduce the total of bacteria or bacteria contained in infection waste. The reduction in the total of bacteria resulting from medical or clinical waste treatment has then calculated the efficiency of decreasing the number of MPN bacteria according to various treatment variations. The efficiency value obtained is used in figuring out the scheme and design of medical waste treatment instrumentation in treating waste best optimally.
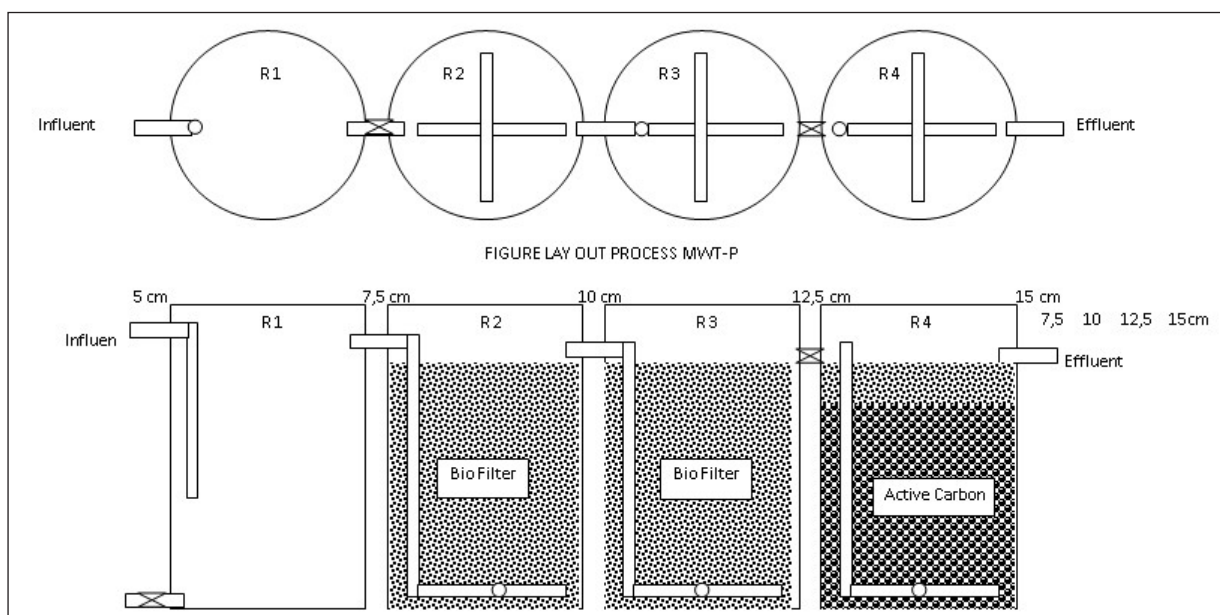

Figure 1. Series of Medical Waste Treatment (MWT-P) looks up and section.

The results of this research also conducted different tests on various concentrations of chlorine and time application. In this research, two variations of chlorine dose treatment (50 ppm, 25 ppm) (8) and time application there were two variations (10 minutes, 5 minutes) to four groups of total bacterial, The statistical analysis tool used SPSS software to test: Normality Test, followed by Multi Variation Analysis or Kruskal Wallis. Data on the number of bacteria in medical waste before processing and the number of bacteria after processing is calculated to get the efficiency of reducing the number of bacteria by operating the MWT-P.

RESULT

The processing of medical waste is implementing by collecting, sorting and treatment. The collection of medical or clinical waste is implementing in phase according to the ability of waste. Medical or clinical waste used as the research object was taken from 4 primary health care , including Primary Health Care of Sungai Besar, Cempaka, South Banjarbaru, and North Banjarbaru. The MWT-P test can process medical waste according to the primary health care 's daily infectious waste production capacity.

The stage of sorting medical waste is carried out to sort waste by distinguishing based on its type, including roller bandage cloth, fleece/cotton, plastic wrap, plaster, paper, mask, plastic pipe, glass bottle, infusion pipe bottle, gloves, infusion tube, needle and syringe. The types of medical waste based on the trial of MWT-P tools that may be processed areas keep up: bandages, cotton, plaster, paper, masks, plastic wrapping, plastic bottles, infusion hose and gloves.

In the treatment of medical or clinical waste, laundry is done, later the chlorination process is carried out. The preparation of washing medical waste is implementing for 30 minutes, and then chlorine disinfection is implementing with varying concentrations and variants in application time. The various chlorine doses used for the premier trial used a chlorine concentration of 50 ppm and 25 ppm. The variant of applied time used in disinfection is 10 minutes and 5 minutes. The total bacterial results are as follows Table 1:

From Table 1. it can be defined that the total bacteria of waste processed using the MWT-P tool is as attend: The value of bacteriological numbers in medical or clinical waste before processing is standard of 1,973 MPN/100 ml. The content of medical waste bacterial numbers after being handled with a chlorine concentration of 25 ppm at a contact time of 5 minutes is 149 MPN/100 ml, so the effectiveness of MWT-P

processing equipment is 92.5%. The measurement of medical or clinical waste bacterial numbers since being treated with a chlorine dose of 25 parts per million at a contact time of 10 minutes is 115 MPN/100 ml, so MWT-P processing equipment's effectiveness is 99.9%. After being processed at a concentration of 50 parts per million within 5 minutes, the measurement of waste bacteria, numbering to 12 MPN/100 ml, and 99.5% processing effectiveness. The content of the total of waste bacteria is treated at a concentration of 50 parts per million within time 10 minutes, numbering to 4 MPN / 100 ml, and treatment effectiveness of 99.8%.

Table 1. The Results of Measurements of Total Bacteria in Medical Waste by MWT-P

Replica-tion	Bacteria Number in Waste Before Processing (MPN/100ml)	Bacteria Number in Waste by MWT-P (MPN/100ml)			
		D.25 ppm T. 5 minute	D.25 ppm T. 10 minute	D.50 ppm T. 5 minute	D.50 ppm T. 10 minute
1	1,400	70	70	11	7
2	2,400	150	130	7	7
3	2,400	120	150	15	7
4	1,400	190	120	7	0
5	1,000	250	120	0	0
6	1,400	110	70	7	0
7	2,400	190	120	15	0
8	1,400	70	70	28	7
9	2,400	150	150	7	7
10	2,400	120	120	11	0
11	2,400	190	150	15	7
12	2,400	250	120	11	0
13	2,400	110	110	11	7
14	2,400	190	150	15	7
15	1,400	70	70	19	0
Average	1,973	149	115	12	4
Efectifity		92.46	99.99	99.46	99.83

Source: Primary research data.
Note: D : Dose Chlorine, T : Time Application

The consequences of bacteria measurements of prepare wastewater in the treatment of clinical waste applies a diverse MWT-P unit. The variety in the use of the Chlorine dose used was 50 ppm and 25 ppm. Variety in the make of application time to 10 minutes and 5 minutes. For clarity, the mensuration output is as attend Table2:

Table 2. The Results of Bacterial Measurement in Liquid Waste After Waste Processing.

Replication	Bacteria Number in wastewater by MWT-P (MPN/100ml)			
	Dose.25 ppm T. 5 minute	Dose.25 ppm T 10 minute	Dose.50 ppm T 5 minute	Dose.50 ppm T 10 minute
1	78	45	0	0
2	67	63	7	0
3	80	80	0	0

Replication	Bacteria Number in wastewater by MWT-P (MPN/100ml)			
	Dose.25 ppm T. 5 minute	Dose.25 ppm T 10 minute	Dose.50 ppm T 5 minute	Dose.50 ppm T 10 minute
4	93	93	7	0
5	110	70	0	0
6	89	67	0	0
7	120	70	7	0
8	70	70	0	0
9	67	67	0	0
10	93	93	7	0
11	80	80	0	0
12	89	89	0	0
13	93	93	0	0
14	78	78	7	0
15	120	67	0	0
Average	88	75	2	0

Source: Primary research data.
Note: D : Dose Chlorine, T : Time Application

From Table 2., we can explain the bacteriological numbers of the treated wastewater as follows: The content of the bacteria number (MPN) of wastewater since being treated with a 25 ppm chlorine concentration in 5 minutes, is 88 MPN/100 ml. The content of the bacteria number (MPN) of wastewater since making at a 25 ppm concentration in 10 minutes is 75 MPN/100 ml. The content of the number of wastewater bacteria after making at a concentration of 50 ppm within 5 minutes is 2 MPN/100 ml. The material of the number of wastewater bacteria after being treated with a 50 ppm chlorine concentration in 10 minutes is 0 MPN/100 ml.

The efficiency of processing equipment to treat infectious waste in reducing the number of bacteria is obtained from the results of the testing of tools against the number of medical waste bacteria after processing. The processing efficiency of tools is obtained by calculating the average number of bacteria in medical waste before processing minus the average amount of medical waste bacteria after processing, divided by the average number of waste bacteria before processing, multiplied by 100. The results of processing equipment can be seen in the following table 3:

Table 3.Efficiency of Decreasing Bacteria (MPN) Medical Waste in MWT-P Testing.

Dose	Bacteria Number (%)	
Time	Chlor 25 ppm	Chlor 50 ppm
5 minutes	92.49%	99.46%
10 minutes	99.99%	99.83%

Table 3, describing the consequences of medical or infectious waste processing trials using a medical or infectious waste treatment tool, has an almost equal efficiency capability. The processing license using a tool

reference on the application of chlorine concentration and chlorination contact time for the number of waste bacteria ranges from 92.5% to 99.9%. These consequences point out that a 25 ppm concentration and an exposure time of 10 minutes can reduce bacteria to 99.9%. This study with a concentration of 50 parts per million chlorine may lower total bacteria to 99.5%. Efficiency 99.8% reduction in bacteria in this matter potential that the wide variety of waste bacteria produced through waste processing still incorporates bacteria. Based on the research outcome, the quantity of waste bacteria produced by MWT-P still contains bacteria of 4 MPN/100 ml to 149 MPN/100 ml.

Table 4. Bacteria Average in Liquid Waste on MWT-P Testing.

Dose	Bacteria Number (MPN/100ml.)	
Time	Chlor 25 ppm	Chlor 50 ppm
5 minutes	88	2
10 minutes	75	0

In Table 4. The outcomes of the test of medical waste treatment using infectious or medical waste processing tools can lower bacteria in the tool. In the make of chlorine concentration and disinfection contact times for MPN wastewater bacteria, for the use of chlorine doses of 25 ppm and application time of 5 minutes, the usual total of bacteria is 88 MPN/100 ml. Using chlorine doses of 25 ppm and application time of 10 minutes, the standard amount of bacteria by 75 MPN/100 ml. While the make of 50 parts per million chlorine concentration and 5 minutes application time, the standard total of bacteria is 2 MPN/100 ml. Furthermore, the make of 50 parts per million chlorine concentration and 10 minutes contact time, the standard number of bacteria is 0 MPN/100 ml.

DISCUSSION

Measurement of bacteria in medical waste after being processed using MWT-P at a chlorine concentration of 50 parts per million within 5 minutes obtained a bacterial number of 12 MPN/100 ml, with processing effectiveness of 99.5%. Whereas in the processing of medical waste with a chlorine concentration of 50 parts per million within 10 minutes, the bacterial number of 4 MPN/100 ml, so the processing's effectiveness was 99.8%. This study's measurement is equivalent to similar studies using a higher dose than other studies using a concentration of 4.5 ppm and a contact time of 20 minutes in killing bacteria *Esceria Coli* and *Enterobacter* (10-11).

Variation of contact time dose (5 minutes, 10 minutes) in the preparation of wastewater to the total of bacteria treatment wastewater has a diverse effect. In our study findings, outcomes represent the signification

of Asimp.sig 0.78> 0.05 what capability that there is no signification diverse in the use of contact time varies on the total of wastewater bacteria. Supported study in drinking water disinfection using chlorine, also equivalent (12).

The application of variety in chlorine concentration (50 ppm, 25 ppm) in treatment waste to the total of bacteria prepares wastewater has a diverse effect. The chlorine concentration on the lessen of total waste bacteria by Asimp.sig = 0.00. This capability that there is significant diversity in applying variations of chlorine concentration on the total of MPN bacteria from processing waste (13)

Variation of contact time (10 minutes, 5 minutes) in preparing solid waste to the total of bacteria prepare wastewater has a diverse share. These outcomes represent the signification of Asymg sig 0.197> 0.05, which ability that there is no signification distinction in the make of contact time variations on the total of wastewater bacteria. These outcomes indicate that an increase in Chlorine doses will improve, showing by decreasing the number of bacteria in wastewater. Increasing contact time will minimize bacterial numbers and suitable for adequate time for the technique of chlorination and bacterial defunct (14). Bacterial death caused by chlorine disinfection can also kill bacteria of *Escherichia coli, Clostridium perfringens* and other types of bacteria (15-16). The outcome of infectious or medical waste treatment at a chlorine concentration of 50 ppm and applied time of 10 minutes produce levels of wastewater bacteria of 0 MPN / 100ml. These results are in approval with standards effluent for wastewater for clinic, hospital, specifically the ordinance of government for the environment (17-18). By looking at medical waste processing, making the research design results can be used for health facilities.

The treatment of variations in the dose of chlorine (50 ppm, 25 ppm) in preparation wastewater to the total of bacteria treatment wastewater has a diverse effect—the variation of chlorine dosage on the number of MPN bacteria from processing waste (19).

Medical waste processing using the MWT-P tool is processing that has a series of sequential processing processes, mechanical processing by turning and flipping the waste back and forth within a specific time using hot water. Processing is followed by disinfection using chlorine with a specific dose and time. Based on the research results that have been carried out on medical waste, the mechanical processing stage with a temperature of 40^0C to wash medical waste from other impurities obtained optimal results takes 30 minutes. The processing performance can be increased so that it is optimal by adding processing time and increasing the treated water temperature. The longer the processing time and the higher the water's temperature, the better the performance will be to the optimal limit (20).

Medical waste is then processed by a disinfection process using chlorine (chlorination). The disinfection process is carried out by adding chlorine at a specific dose and time. Some of the study's chlorine doses are 25 ppm, and 50 ppm produced a good performance in killing bacteria. The use of contact time in this study of 5 minutes and 10 minutes also resulted in optimal bacteria-killing power. The higher the chlorine dose and the time it takes, the better the performance of the tool will be to an optimal point (21).

The results of processing medical waste using the MWT-P tool also leave liquid waste containing bacteria. In this study, the bacterial content in processed wastewater also contains bacteria that are safe for the Environment (22). This condition suggests that the use of the MWT-P tool can solve problems in medical waste processing.

Weaknesses in this research are that the MWT-P testing tool can significantly reduce the number of MPN bacteria but cannot ensure the success of killing/ eliminating pathogenic bacteria in medical waste (14,23). This tool has not ascertained whether the processed medical waste results are free from pathogenic bacteria because the parameters used are only the number of MPN bacteria. Logically, if the number of bacteria can be reduced with this tool, then the number of other pathogenic bacteria will also decrease (15,24).

ACKNOWLEDGEMENT

CONCLUSION

The effectiveness of medical or clinical waste processing equipment (MWT-P) reduces the number of Most Probable Number (MPN) bacteria in medical waste and the number of bacteria in the wastewater. There is a significant variation between the effect of variations in chlorine dose on bacteria in medical waste, the number of bacteria in wastewater, with significance.

There was no significant variation between the portion of the application time variation on total waste bacteria and total wastewater bacteria.

The processing of the MWT-P tool in treating infectious or medical waste must follow established procedures. To repair the achievement of medical or clinical waste treatment outcomes using MWT-P may be passed by increased the abstersion contact time to one hour and increased the water temperature to 60⁰C. The plan of medical waste treatment implements maybe use to health service facilities, which have a minimum electrical power of 2,200 Watt and a water distribution with a high water pressure of 0.5 atm..

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