

## Original Research

### SKILL IMPROVEMENT FOR PUBLIC HEALTH CENTER STAFF IN THE MANAGEMENT OF TOXIC AND HAZARDOUS MATERIALS

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#### ABSTRACT

*The generation of medical toxic and hazardous material (THM) waste at public health centers tends to increase during the Covid-19 pandemic. Medical waste management practices not in accordance with the procedures can be a source of infection. It is necessary to increase the skills of health center staff in managing medical THM waste. The purpose of this study was to determine the level of knowledge and skills of health center staff in medical THM waste management before and after medical THM waste management training. The training participants were 20 health center staff who filled out a pretest questionnaire to measure their level of knowledge and skills prior to the training. The training materials included THM waste, medical THM waste, medical THM waste management and medical THM Temporary Storage. After the training, a post-test was conducted to measure the knowledge and skills scores of the trainees. The results of this study indicated that there was a significant difference in knowledge before and after training ( $p < 0.05$ ). The average knowledge score before training was 6.2 (sufficient knowledge) and after training 8.15 (good knowledge). There was a significant difference in skill scores before and after training ( $p < 0.05$ ). The average skill before training was 6.3 (adequate) and after training 8.65 (good). In conclusion, there was an increase in the skills of health center staff in managing medical THM waste after participating in medical THM waste management training.*

**Keywords:** Public health center; public health; medical THM waste management; Covid-19 pandemic; training; skill upgrade

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#### Hi i j i j t u

3. There was an increase in the accumulation of B3 waste in health centers during the COVID-19 pandemic.
2. The knowledge and skills level of health center staff in medical THM waste management before and after medical THM waste management training were determined.
3. Medical THM waste management training was increasing the knowledge and skills level of health center staff.

#### INTRODUCTION

Puskesmas or public health center is the spearhead of health services in Indonesia, which provides public health services as well as health services for individuals. The role of the health center is very important in preventing and controlling Covid-19 in Indonesia (Rahayu & Sahli 2020). The health center organizes Individual Health Efforts (IHE) related to Covid-19, including 3T, testing, tracing and treatment (Hakim et al. 2021). As the first level health facility (FLHF), the health center provides first contact services both for Covid-19 and non-Covid-19 patients. It must be able to sort out Covid-19 and non-Covid-19

patients by conducting testing and taking swab sampling (Lindner et al. 2021). Likewise, if a positive Covid-19 patient is found, the health center should follow up with tracing (Wan et al. 2021), conducting contact surveys to families or communities exposed to Covid-19 (Sitompul et al. 2021). As FLHF, the health center also carries out a treatment, provides therapy to Covid-19 patients with mild to moderate symptoms, and makes referrals to Advanced Health Facilities (ALHF) according to the condition of Covid-19 patients.

In carrying out Community Health Efforts (CHE), the health center plays a very important role in the efforts to break the chain of transmission of Covid-19 by empowering the community to do 3M (wear masks, wash hands with soap and keep a distance by implementing Clean and Healthy Lifestyle (CHLB)) from, by and for the community by involving partnerships and across sectors (Fibriana et al. 2021). In carrying out all Covid-19 prevention and control activities at health centers, it is necessary to pay attention to the safety aspects of the staff by providing Personal Protective Equipment (PPE) (Chand et al. 2021, McCarthy et al. 2020, Pangihutan 2019), in accordance with the standards, including headgear, masks, gloves and protective gowns. Some of these PPEs are disposable, so that the generation of medical THM waste at the health center tends to increase in the Covid-19 pandemic era (Prihartanto 2020, Subhi 2020).

According to the Ministry of Health, only 6.89% of the health centers have medical waste management practices that meet the standards. There are still many health centers that do not manage waste according to standards (Ministry of Health 2020). Lack of attention to medical waste management practices and practices that are not in accordance with procedures can be a source of the spread of infection (Cut 2015), whereas in one hospital in Bandung only 56% of the health center staff have good knowledge and attitude towards solid medical waste management (Maharani et al. 2017).

Therefore, efforts to improve the skills of health center staff in managing medical THM waste in the Covid-19 pandemic era need to be carried out. The purpose of this study was to identify the level of knowledge and skills of health center staff in managing medical THM waste before and after training on medical THM waste management.

## MATERIALS AND METHODS

Public Health Center Songgon is a part of the Technical Implementation Unit, Health Office, Banyuwangi Regency, East Java, Indonesia, which is responsible for health development in its working area. Public Health Center Songgon is a rural health center, a small inpatient health center established in 1970. The average number of patients was 85 people per-day for

outpatients and 8 people per-day for inpatients. Songgon Health Center already has UKL-UPL documents as guidelines in managing medical THM waste and has collaborated with third parties as Transporters and Processors of medical THM waste. Songgon Health Center produced 2-3 kg of medical THM waste/day. Currently, Songgon Health Center had attempted to obtain a permit for a Temporary Storage Place (TSP) for THM waste to the Environmental Service, Banyuwangi Regency, Indonesia.

Training to improve the skills of health center staff in managing medical THM waste was carried out at Songgon Health Center with 20 participants from the health center staff. The training was carried out by implementing health protocols. The trainees filled out a pretest questionnaire to measure the level of knowledge and skills prior to the training. The training materials presented by the resource persons included THM waste, medical THM waste, medical THM waste management and medical THM Temporary Storage (TPS).

After the training, post-test was conducted to measure the level of knowledge and skills of the trainees. The instrument to measure the level of knowledge consisted of 10 favorable and unfavorable questions with correct and incorrect answer choices, while the skill level was measured using 10 favorable and unfavorable questions with yes and no answers. Knowledge or skill was considered good if the score was more than 7.5, sufficient if the score was 6 and to less than 7.5, and poor if the score was less than 6.

## RESULTS

Table 1. Characteristics of Training Participants

Characteristics	n	%
Age		
Mean ± SD	38.3 ± 10.362	
Sex		
Male	8	40
Female	12	60

The average level of knowledge before training was 6.2 (adequate) with the lowest score of 3 and the highest score of 8. The average level of knowledge after training was 8.15 (good) with the lowest score of 4 (less) and the highest score of 10 (good)

Table 2. Distribution of participants with correct answers regarding knowledge

Knowledge	Pre-Test		Post-Test	
	n	%	n	%
Difference between THM waste and medical THM waste	4	20	6	30
Those classified as medical THM waste	12	60	18	90
Color of medical THM waste bag	17	85	16	80
What needs to be put into the safety box	13	65	18	90
Storage time for medical THM waste	15	75	19	95
Sorting of medical THM waste	8	40	15	75
Medical THM waste management	12	60	18	90
Transportation of medical THM waste	18	90	17	85
THM waste temporary storage place requirements	16	80	20	100
Who gives permit for the temporary storage place for THM waste	9	45	16	80

Table 3. Distribution of participants with correct answers regarding skills

Skill	Pre-Test		Post-Test	
	n	%	n	%
Sorting medical THM waste from domestic waste	18	90	20	100
Separate sharp and non-sharp medical THM waste	13	65	19	95
Tying up medical THM waste bags	3	15	8	40
Weighing medical THM waste	13	65	20	100
Wearing PPE when transporting medical THM waste	15	75	19	95
Having medical THM waste management SOP	18	90	20	100
Storing medical THM waste at the THM waste temporary storage	4	20	7	35
Having collaboration with 3rd parties	19	95	20	100
Washing hands with soap when handling medical THM waste	20	100	20	100
Participating in medical THM waste management training	3	15	20	100

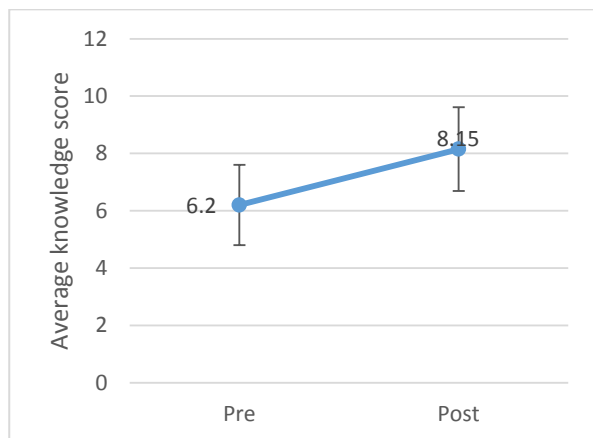


Figure 1. Average knowledge score before and after training

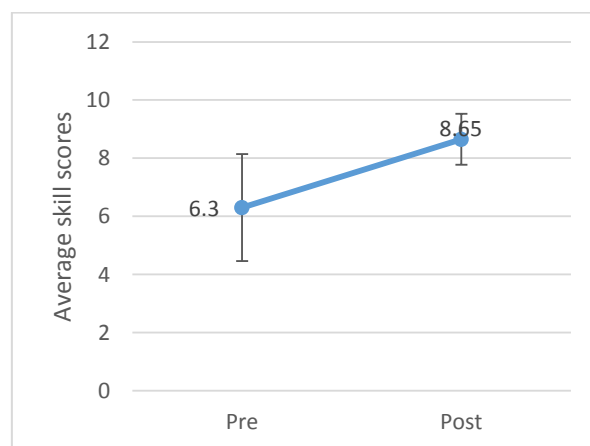


Figure 2. Average skill scores before and after training

The average skill score before training was 6.3 (adequate) with the lowest score of 2 (less) and the highest of 8 (good). The average skill score after training was 8.65 (good) with the lowest score 8 (good) and the highest 10 (good).

Table 4. Testing the normality of the distribution of differences in knowledge and skills data before and after the test

Difference data	n	p-value
Knowledge	20	0.069
Skill	20	0.005

The Shapiro-Wilk test showed that the difference in knowledge scores had a normal distribution ( $p > 0.05$ ). Then to analyze the difference in knowledge before and after training, parametric paired t-test was used, while the data on the difference in skill scores did not have normal distribution ( $p < 0.05$ ). Furthermore, to analyze the differences in skills before and after training, the non-parametric Wilcoxon test was performed.

Table 5. Differences in knowledge before and after training

Knowledge	n	Mean ± SD	Mean ± SD of the Difference	p-value
Pre	20	6.20 ± 1.399	1.95 ± 1.317	<
Post	20	8.15 ± 1.461		0.001

Paired t-test showed a significant difference in knowledge pre- and post-training ( $p < 0.05$ ).

Table 6. Differences in skill scores before and after training

Skill	n	Median (min – max)	Median (min – max) of the Difference	p-value
Pre	20	7 (2 – 8)	2 (0 – 6)	<
Post	20	8 (8 – 10)		0.001

The Wilcoxon test showed a significant difference in skill scores before and after training ( $p < 0.05$ ).

## DISCUSSION

### Before training

Regarding the level of knowledge of Songgon health center staff, less than 50% of the staff already knew the difference between THM waste and medical THM waste (20%), sorting medical THM waste (40%), and the offices that permitted temporary storage of THM waste (45%). Those three topics were related to the topics given in the training, e.g., THM and medical THM waste, medical THM waste management, and temporary storage places for THM waste.

More than 50% of the staff of Songgon health center already knew the classification of medical THM waste (60%), medical THM waste treatment (60%), materials that should be put into the safety box (65%), medical THM waste storage time (75%), requirements of THM waste temporary storage (80%), color of medical THM waste bags (85%) and transportation of medical THM waste (90%). The average level of knowledge of Songgon health center staff regarding the management of medical THM waste before the training was adequate ( $6.20 \pm 1.399$ ).

Regarding skill level, only 15% of Songgon public health centers had attended medical THM waste management training. In the management of medical THM waste, the skills that were still lacking were in the binding of medical THM waste bags (15%) and storage of medical THM waste in THM waste temporary storage (20%). Staff of Songgon health center were skilled in separating sharp and non-sharp medical THM waste (65%), measuring the weight of medical THM waste (65%), wearing PPE when transporting medical THM waste (75%), sorting medical THM waste from domestic waste (90%), had SOPs for medical THM waste management (90%), had cooperation with third parties (95%) and washing hands with soap when handling medical THM waste (100%). The average skill score of Songgon health center staff before the training was 6.3 (adequate).

### Training materials

Waste is the residue of an undertaking activity, and can cause severe hazardous impact on human life (Ayilara et al. 2020). Toxic and Hazardous Materials (THM) are substances, energy, and/or other components which, due to their nature and/or concentration and/or amount, either directly or indirectly, can pollute and or damage the environment (Barinova et al. 2019), and can harm the environment, life, health, survival of humans and other living beings (Ferronato & Torretta 2019). Toxic and Hazardous Materials (THM) waste is waste containing THM (Article 1 Regulation of the Minister of Environment and Forestry 56/2015).

Medical THM waste is residual goods or materials resulted from activities that are not reused which have the potential to be contaminated by infectious substances or in contact with patients and/ or staff at health care facilities who treat patients, including used masks, used gloves, used bandages, used tissue, used food and beverage plastic container, used food and beverage paper, used syringes, used infusion sets, used PPE, patients' food scraps and others, originating from service activities in the ER, isolation rooms, ICU rooms, treatment rooms, and other service rooms (Ministry of Health 2020).



Waste originating from pharmaceuticals that have no contact with patients and staff that has the potential to be contaminated with infectious substances, is included in THM waste, instead of medical THM waste. THM waste management from health care facilities “... is a series of activities that include reduction and sorting, storage, transportation, burial, and/or landfill” (Article 5 of the Regulation of the Minister of Environment and Forestry 56/2015).

The reduction and sorting of THM waste was carried out by avoiding the use of THM waste materials; good management of materials that had the potential to cause health/ environmental disturbances; good management in the procurement of chemicals and pharmaceuticals to avoid accumulation and expiration; periodic maintenance of equipment; sorting according to type, group, characteristics of THM waste; and packaging according to the THM waste group. THM waste sorting was carried out as early as possible, starting from planning, activating up to THM waste temporary storage, not only when THM waste was stored temporarily.

THM waste storage was carried out by the producer in a temporary storage area for THM waste; the color of the packaging/ container corresponded to the waste (red for radioactive waste, yellow for infectious and pathological waste, purple for cytotoxic waste, brown for expired chemicals, spills or packaging residue). Medical THM waste includes infectious and pathological waste, so that the color of the packaging/container/plastic was yellow. In addition to medical THM waste, the health center was also the producer of domestic waste packaged in black plastic containers (Puangmanee & Jearanai 2020).

THM waste storage time depends on the type of THM waste; medical THM waste for 2 days (storage at temperature  $> 0^{\circ}$  C), 90 days (storage at temperature  $\leq 0^{\circ}$  C); expired chemicals, spills, packaging residues, radioactivity, pharmaceuticals, cytotoxics, medical equipment with high heavy metals, and gas cylinders for 90 days (for THM waste generated  $\geq 50$  kg/day), and 180 days (for THM waste generated  $\leq 50$  kg/day).

If the producer does not have THM waste temporary storage, the storage time is only 2 days. For this reason, the health center needs a freezer, so that they can store medical THM waste at a temperature of  $\leq 0^{\circ}$  C. Besides, the storage time for medical THM waste can be a maximum of 90 days or 3 months. This is related to collaboration with third parties in terms of transportation and processing of medical THM waste, which will have an impact on financing.

THM waste transportation is carried out by producers and transporters who have transportation permits. If the

health center as a THM waste producer does not have a THM waste transport permit, then the health center cannot act as a THM waste carrier. The health center can only transfer THM waste from ER, inpatient, outpatient, and others to THM waste temporary storage place.

The management of medical THM waste is as follows: medical THM waste is put into a container/ bin lined with a yellow plastic bag. After full, THM waste is packed and tied tightly; must be transported daily, recorded and stored at THM waste temporary storage; collection of medical THM waste to THM waste temporary storage is carried out using special infectious waste transportation means and officers who are using PPE.

During Covid-19 pandemic, in the temporary storage place for THM waste, the packaging of THM Covid-19 waste is disinfected by spraying disinfectant on the waste bags that have been wrapped. After use, the container/bin is disinfected with disinfectants such as 0.5% chlorine, lysol, carbolic acid, and others. The transport officer who has finished work takes off his PPE and immediately takes a shower using antiseptic soap and running water. Disinfection with 0.5% chlorine disinfectant in THM waste temporary storage place is carried out thoroughly, at least once a day.

Processing can use the services of a licensed processing company, by entering into a cooperation agreement with a third party. THM waste generation/volume must be recorded in a logbook every day; THM waste manifest must be owned; the amount of medical THM waste must be reported to the Ministry of Environment and Forestry through the Provincial/Regency/City Environmental Service electronically.

Temporary storage place (TPS) for THM waste is a place used to store THM waste if processing cannot be carried out, to prevent the release of THM waste into the environment, so that potential hazards to the environment can be avoided. Everyone who generates THM waste is required to manage the THM waste they produce (Article 3 of Government Regulation no. 101 of 2014).

Temporary storage of THM waste must meet the requirements. The location must be free from flooding and not prone to natural disasters and must be under the control of THM waste generators, as evidenced by a Building Permit (IMB). Waste storage facilities are in accordance with the amount of THM waste and the characteristics of THM waste and are equipped with efforts to control environmental pollution as well as the presence of emergency equipment and management

which includes a Light Fire Extinguisher (APAR), emergency response equipment, first aid kit, and sink.

THM waste storage facilities can be in the form of permanent buildings with designs and constructions, capable of protecting from rain and heat, lighting and ventilation and doors, as well as location instructions affixed to doors; the electrical outlet is outside the building; the container is adjusted to the amount and type of THM waste, and there is a separation between sharp and non-sharp solid THM waste. The permit for temporary storage of medical THM waste is issued by the Regency/ City Environmental Service (DLH).

### After Training

There was a significant difference in knowledge before and after training ( $p < 0.05$ ). The average level of knowledge before training was 6.2 (adequate) with the lowest score of 3 (less) and the highest score of 8 (good). The average level of knowledge after training was 8.15 (good) with the lowest score 4 (less) and the highest score 10 (good).

There was a significant difference in skill scores before and after training ( $p < 0.05$ ). The average skill score before training was 6.3 (adequate) with the lowest score of 2 (less) and the highest of 8 (good). The average skill score after training was 8.65 (good) with the lowest score 8 (good) and the highest 10 (good). The training has provided education about behavioral changes at psychomotor level, so that the increase in skill scores was better than the increase in knowledge scores. Before the training, there were participants with low skill scores, while after the training all participants had good skill scores.

### Strength and limitation

The study demonstrates the effectiveness of medical THM waste management training in improving the knowledge and skills of health center staff in managing medical waste during the Covid-19 pandemic. The study's findings can inform the development of more comprehensive training programs and policies to promote proper management of medical waste in health centers to minimize the risk of infection transmission. Furthermore, the study highlights the need for health centers to have adequate medical waste management practices that meet the standards to prevent the spread of infections.

### CONCLUSION

There was an increase in the skill of health center staff in managing medical THM waste in Covid-19 pandemic era after receiving training on medical THM waste management by the Community Service Team of

the Department of Public Health and Preventive Medicine, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia. Medical THM waste management is a shared responsibility of health care facilities, academics and local governments.

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### Conflict of interest

None0

### Funding disclosure

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### Author contribution

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