

A Comparative Analysis of Hazardous Medical Waste Management Compliance Before (2019) and During (2020) the COVID-19 Pandemic in Indonesia

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Parole chiave: Conformità, COVID-19, Ospedale, Rifiuto speciale sanitario, Gestione dei rifiuti

Abstract

Background. As a producer of hazardous waste, hospitals have the responsibility to manage the waste they produce. Hospital non-compliance in managing hazardous waste can have a negative impact on the environment and public health, especially during the COVID-19 pandemic, when the amount of hazardous waste produced by healthcare facilities is increasing. To protect the environment and public health from the negative impact of hazardous medical waste, this study was conducted to determine the level of compliance of hazardous waste management in hospitals in Indonesia before and during the COVID-19 pandemic, from 2019 to 2020.

Study design. Cross-sectional.

Methods. This study was conducted at 343 hospitals in Indonesia using secondary data obtained from Sikelim (Medical Waste Management Information System), which is owned and operated by the Ministry of Health. The data have been analyzed using chi-square tests and logistic regressions of the determinant model.

Results. There was an increase in the level of compliance of hazardous waste management in hospitals from 82% to 86% during the pandemic. Furthermore, the availability of environmental documents and environmental health units were determinant factors of hazardous waste management compliance by hospitals before the pandemic in 2019. The only factor in 2020 was the availability of environmental health units.

Conclusions. Despite the good level of compliance, additional efforts are needed to increase the activities of the treatment of hazardous medical waste by hospitals, as before the pandemic (i.e., in a normal situation) only 8% of hospitals was able to independently manage hazardous medical waste using authorized incinerators, a percentage that was reduced to 6% during the pandemic.

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Introduction

Medical waste management compliance in hospitals refers to obedience of the rules in managing medical waste produced by healthcare activities (1). In general, there are two types of waste generated by healthcare facilities (2): *hazardous* and *non-hazardous*. Hazardous medical waste (HMW) is a waste that is categorized as toxic to humans, animals, plants, and the environment in general (3). HMWs can be grouped into *infectious* waste, *sharp* waste, *pathological* waste, *pharmaceutical* waste, *chemical* waste, *genotoxic* waste, and *radioactive* waste (4). As producers of HMW, hospitals are obliged to manage it following the regulations set by the government. Based on Table 1, the compliance in managing medical waste, especially for solid HMW, includes activities for minimization, sorting waste from the source, collecting and transporting waste out of the medical service unit, storing waste, and applying treatment and disposal activities, either independently or with third-party assistance (5, 6).

Solid HMW management activities may vary from one country to another and can be influenced by several factors: different rules, national policies and regulations, level of education, economic conditions, and availability of resources and technology in each country (7). Therefore, the World Health Organization (WHO) published guidelines regarding HMW management in hospitals that can be used as a reference for each country, particularly countries that do not yet have applicable regulations (8). It is expected that every hospital will be able to follow the guidelines to minimize the negative impact of HMW.

Several studies related to compliance in HMW management in hospitals have revealed an unsatisfactory situation. In a survey conducted by the WHO in 22 developing countries in the Western Pacific Region, it was found that 18% to 64% of hospitals had

not properly implemented HMW management (8). This finding was even worse for the least developed countries. Of the total 54 hospitals in Ebonyi, Nigeria, only 1.9% implemented standard operating procedures for HMW management (9). Thus, the low level of compliance indicates the poor HMW management system in the hospitals that is included in both of studies being mentioned.

It was also found that several factors influenced the compliance of HMW management by hospitals. These factors are (un)availability of specific workers to manage the procedure; poorly functioning committees; lack of standard operating procedure for HMW management (10); poor supervision (11); limited worker's knowledge (12); and (un)availability of adequate facilities, including specific containers for hazardous waste and incinerators (13).

Hospital non-compliance in managing HMWs can cause a negative impact on both the environment and public health. Mistakes in handling HMWs can lead to the disposal of them along with general waste in a dumpsite. Rain that falls on the dumpsite lacking a wastewater treatment system causes the formation of leachate, which can contaminate surface water downstream from the dumpsite (14). This leachate can contain heavy metals in the form of copper, cadmium, chromium, zinc, and lead, which are toxic to aquatic organisms even at very low concentrations (15, 16). In addition, the contaminated groundwater can endanger the health of people around the dumpsite who use it as a source of drinking water. Therefore, not only chemical but also biological hazards can occur (17).

The ongoing COVID-19 pandemic is estimated to have an impact through the increasing amount of HMW production. The increase occurs due to the growing number of hospitalized patients, and it was found that there was a positive correlation between the number of patients and the amount of

Table 1 – Medical waste management flow in healthcare facilities

Stage	Location	Process	Important Point
0		Minimization	The policies related to the purchasing, inventory management, and recycling of certain types of waste
1	Medical service unit	Waste generated	Separate hazardous waste from non-hazardous waste based on the type
2		Sorted	
3		Stored in container	
4	In healthcare facility	Collected	Employees use PPE, closed containers, and special trolleys, which are easy to clean
5		Stored in medical waste storage area	The storage space is locked, has sufficient capacity, and is easy to clean
6		Treatment	Medical waste should be treated immediately within 48 hours since being stored
7		Residue	The results of residue are handed over to the services of a third party for burial
8	Outside healthcare facility (third party)	Transported outside healthcare facilities	Hospitals, which cannot treat medical waste independently, can cooperate with third parties who already have a permit. In addition, residues from independent treatment should be handed over to third parties for burial
9		Treatment	
10		Burial	

HMW produced by hospitals (18, 19). In addition, policies related to the mandatory use of personal protective equipment (PPE) for healthcare workers (HCW) can also be a factor that can cause an increase in the amount of HMW production during the COVID-19 pandemic.

Indonesia is one of the countries that already have regulations regarding environmental health in hospitals, which include indicators of HMW management compliance. Indicators that are used to evaluate the compliance of HMW management in Indonesia are separate waste collection, permitted hazardous waste storage area, compliance with storage time limit, and operating HMW treatment independently using a permitted incinerator and/or cooperating with authorized third parties (20).

Indonesia is estimated to produce 294.66 tons of HMW daily, while the HMW management capacity estimated by the Ministry of Health only reaches 241.02 tons/day; 53.12 of them (22%) are treated autonomously by the hospitals and 187.9 by an authorized third party (21). Consequently, 18.2% (53.64 tons/day) of the total HMW remains untreated. The government's inability to manage this problem can lead to a growing public health issue. Therefore, extra effort to reduce and sort the whole amount of HMWs is urgently needed (9).

The increasing production of HMW should be accompanied by the implementation of good medical waste management. The existence of regulations that are not accompanied by strict supervision can lead to process failures that trigger a hospital's non-compliance in conducting HMW management. Therefore, as a monitoring effort, all hospitals are required to report their HMW management at least quarterly to the Ministry of Health (6), including indicators of compliance variables and several other supporting aspects that are estimated to affect the level of compliance to

HMW management. Some of these aspects include the availability of environmental health workers, environmental health units, environmental documents, standard operating procedures for HMW management, and incinerators (22).

Existing regulations and monitoring efforts conducted by the government are expected to increase the level of compliance to HMW management by hospitals in Indonesia. A study conducted in 2013 at 76 hospitals showed that the level of compliance to HMW management only reached 30% (23); however, the existence of research on this topic is still very limited. Thus, it is not possible to predict the current overview of compliance to HMW management by hospitals, especially during the COVID-19 pandemic, when compliance to HMW management should have been improved. Therefore, the aim of this study was to deeply analyze HMW management compliance by hospitals in Indonesia before and during the COVID-19 pandemic as well as to identify the influencing factors.

Methods

A cross-sectional study design was used. Variables that were used in this research consist of dependent and independent variables (Table 2). The dependent variable in this research was HMW compliance. The compliance level was assessed based on the criteria listed in the Regulation of the Minister of Health Number 7 of 2019 (20); however, due to the unavailability of data related to the length of time for storing waste in the storage area, the level of hospital compliance was only assessed using three indicators.

This study was conducted using secondary data, which are available on *Sikelim* (Medical Waste Management Information System), which is owned by the Ministry of Health (Permit number KL.03.01/4/3576/2021).

Table 2 – Variables and coding of hazardous medical waste management compliance

Variables	Measurement Results	Coding
<i>Independent Variable</i>		
Hazardous Medical Waste Generated	High (> median score)	0
	Low (≤ median score)	1
*median score: 2019 = 31.50 kg/day 2020 = 35.75 kg/day		
Availability of Environmental Health Workers	Not Available	0
	Available	1
Availability of Incinerators	Not Available	0
	Available	1
Availability of Environmental Documents	Not Available	0
	Available	1
Availability of Standard Operating Procedures for HMW Management	Not Available	0
	Available	1
Availability of Environmental Health Units	Not Available	0
	Available	1
Dependent Variable		
	Measurement Results	Score
Hazardous medical waste compliance consists of three indicators:		
Separation of hazardous from non-hazardous waste	No	0
	Yes	1
Holding a hazardous medical waste storage area permit	No	0
	Yes	1
Conducting hazardous medical waste treatment independently using incinerators that already have permits and/or cooperating with third parties who already hold permits	No	0
	Yes	1
	Not Comply (Score < 3)	0
	Comply (Score = 3)	1

The data are the result of quarterly *e-monev* activities on HMW in healthcare facilities from 2019-2020. The unit of analysis of this research was “hospital,” with a “population” of 2,877 hospitals throughout Indonesia (24). Hospitals that were to be enrolled as research samples should have met the inclusion criteria, namely the production of a report related to HMW management activities at least once in the year 2019 and once in the year 2020. Hospitals with

incomplete data have been excluded from the research sample. Thus, the total number of hospitals that met the research criteria and that completed the data collection was 343 (Figure 1).

The minimum size necessary for the sample was calculated using the two-

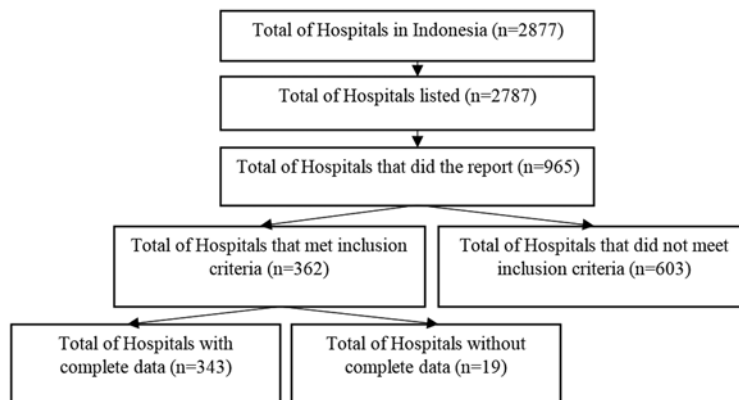


Figure 1 - Sample sorting flow

proportion difference hypothesis formula with a 95% confidence level (1.96) and a test power of 80% (0.84). Furthermore, the minimum number of hospitals required for the sample was 208, while the number of hospitals that met the research criteria was 343. Thus, total sampling was used as a sampling technique.

In addition, the data obtained were analyzed to calculate the averages and the frequency distribution. The data were also tested using the chi-square test and the logistic regression model of the determinants to determine which factors were related to compliance to HMW management in hospitals before and during the COVID-19 pandemic. The analyzed data are presented in the form of graphs and tables.

Results

The Reporting of Compliance to HMW Management by Hospitals

The reporting level of HMW management by hospitals was very low. From a total of 2,787 hospitals that were listed, only 965 hospitals made reports regarding the HMW management in 2019 and 2020; however, only 362 hospitals reported routinely, and

only 343 hospitals submitted complete data in 2019 and 2020, which is 12% of total hospitals.

The proportion of hospitals that reported their HMW management activities was different in each province. Lampung was the province with the highest compliance level, with an achievement of 85% (Figure 2); however, there were also several provinces with 0% achievement (West Sumatra, Special Capital Region of Jakarta, West Nusa Tenggara, South Kalimantan, West Sulawesi, North Maluku, and Maluku).

HMW Management Compliance

Of the 343 hospitals that were sampled, there was a 4% increase in HMW management compliance during the COVID-19 pandemic (Table 3) from 82% before the COVID-19 pandemic to 86% during the COVID-19 pandemic. This is significantly higher compared to previous findings in 2013, where it was found that the compliance level of hazardous waste management in hospitals only reached 30% (23).

HMW generation

There was a decrease in the average amount of hazardous waste produced by hospitals daily (Table 4). Before the

Table 3 - Hazardous waste management compliance by hospitals in Indonesia before and during the COVID-19 pandemic from 2019- 2020 (n=343)

Hazardous Medical Waste Management Compliance	2019 (Before the COVID-19 Pandemic)		2020 (During the COVID-19 Pandemic)	
	N	%	n	%
Comply	280	82	294	86

Table 4 - Distribution of hazardous waste generation at hospitals in Indonesia before and during the COVID-19 pandemic from 2019-2020 (kg/day) (n=343)

Year	Mean	Median	SD	Min - Max
2019 (Before the COVID-19 Pandemic)	84.62	31.50	285.96	1.00 – 4,536.00
2020 (During the COVID-19 Pandemic)	82.43	35.75	259.17	1,00 – 4,448.50

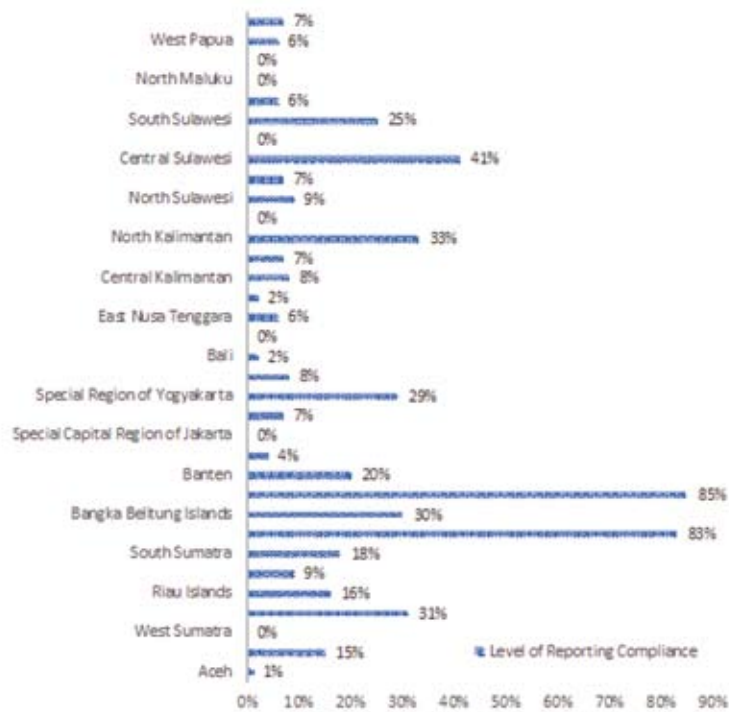


Figure 2 - The level of reporting compliance regarding HMW management activities by hospitals in Indonesia based on provinces from 2019-2020

Table 5 - Frequency distribution of availability of environmental health workers, availability of incinerators, availability of hazardous medical waste management procedures, and availability of environmental health units at hospitals in Indonesia before and during the COVID-19 pandemic from 2019-2020 (n=343)

Variable	2019 (Before the COVID-19 Pandemic)		2020 (During the COVID-19 Pandemic)	
	n	%	n	%
	Availability of Environmental Health Workers	337	98	337
Availability of Incinerators	26	8%	21	6%
Availability of Environmental Documents	335	98%	340	99%
Availability of Standard Operating Procedures for Hazardous Medical Waste Management	336	98%	341	99%
Availability of Environmental Health Units	299	87%	312	91%

Table 6 - Factors related to compliance to HMW management by hospitals in Indonesia before and during the COVID-19 pandemic from 2019-2020 (n=343)

Variable	2019 (Before the COVID-19 Pandemic)				P-value	OR (95% CI)	2020 (During the COVID-19 Pandemic)				P-value	OR (95% CI)
	Compliance						Compliance					
	Not Comply		Comply				Not Comply		Comply			
	n	%	N	%			n	%	n	%		
Medical Waste Generated												
High	27	16	144	84	0.276	0.708 (0.408- 1.229)	26	15	145	85	0.741	1.162 (0.634-2.129)
Low	36	21	136	79			23	13	149	87		
Availability of Environmental Health Workers												
Not Available	1	17	5	83	1.000	0.887 (0.102- 7.728)	2	33	4	67	0.206	3.085 (0.550-17.317)
Available	62	18	275	82			47	14	290	86		
Availability of Incinerators												
Not Available	45	14	272	86	<0.001	0,074 (0.030- 0.179)	42	13	280	87	0.019	0.300 (0.114-0.786)
Available	18	69	8	31			7	33	14	67		
Availability of Environmental Documents												
Not Available	6	75	2	25	0.001*	14.632 (2.880- 74.341)	3	100	0	0	0.003*	7.391 (5.650-9.670)
Available	57	17	278	83			46	14	294	87		
Availability of Standard Operating Procedures for Hazardous Medical Waste Management												
Not Available	3	43	4	57	0.119	3.450 (0.752- 15.818)	0	0	2	100	1.000	1.168 (1.118-1.220)
Available	60	18	270	82			49	14	292	86		
Availability of Environmental Health Units												
Not Available	18	41	26	59	<0.001*	3.908 (1.981- 7.709)	10	32	21	68	0.006*	3.333 (1.462-7.602)
Available	45	15	254	80			39	12	273	88		

Note: *= p-value < 0.05, OR = Odds Ratio, 95% CI = Confidence Interval 95%

Table 7 - Results of logistic regression modelling determinants of HMW management compliance by hospitals in Indonesia before and during the COVID-19 pandemic from 2019-2020

Variable	2019			2020		
	(Before the COVID-19 Pandemic)			(During the COVID-19 Pandemic)		
	<i>P-value</i>	OR	95% CI	<i>P-value</i>	OR	95% CI
Availability of Environmental Health Workers	-	-	-	0.196	3.236	0.546-19.187
Medical Waste Generated	0.059	0.531	0.276-1.024	-	-	-
Availability of Incinerators	<0.001	0.056	0.021-0.148	0.007	0.261	0.098-0.696
Availability of Environmental Documents	0.029*	8.471	1.246-57.600	-	-	-
Availability of Standard Operating Procedures for Hazardous Medical Waste Management	0.626	0.497	0.030-8.265	-	-	-
Availability of Environmental Health Units	<0.001*	4.038	1.888-8.637	0.003*	3.565	1.538-8.261

Note: * = *p-value* <0.05, OR = *Odds Ratio*, 95% CI = *Confidence Interval* 95%

pandemic, the average amount of HMW produced by each hospital was 84.62 kg/day; however, during the pandemic, it decreased to 82.43 kg/day. It was also found that the lowest number of HMW generation was 1 kg/day for both years. The highest number was 4,536 kg/day, but then it decreased to 4,448.5 kg/day during the pandemic. This is different from the findings in China, where there was an increase in the amount of medical waste of up to 300% during the COVID-19 pandemic (25). Another study in Iran showed the same result, where it was found that there was an increase in the amount of medical waste by up to 102% during the COVID-19 pandemic (26).

The Availability of Environmental Health Workers, Availability of Incinerators, Availability of Environmental Documents, Availability of HMW Management Procedures, and Availability of Environmental Health Units in Hospitals

There was an increase in the availability of environmental documents, the availability of standard operating procedures for HMW management, and the availability of environmental health units during the COVID-19 pandemic compared to before the COVID-19 pandemic (Table 5). The increases

that occurred were 98% to 99% (1%) for the availability of environmental documents and standard operating procedures for HMW management and 87% to 91% (4%) for the availability of environmental health units. Indonesia had a very high level of availability of environmental health workers at 98%. This is significantly higher compared to the availability of environmental health workers in hospitals in Pakistan at 25% (27); however, there was a decrease in the availability of incinerators from 8% before the pandemic to 6% during the pandemic. In addition, the availability of incinerators in hospitals in Indonesia is very low compared to Pakistan (56.25%) (27).

Factors Related to Compliance to HMW Management in Hospitals

In Table 6, it can be observed that compliance to HMW management in hospitals had a statistically significant relation with the availability of environmental documents and availability of environmental health units before and during the COVID-19 pandemic in 2019 and 2020.

Following the application of the logistic regression test of the determinant model, it was found that the most dominant factor

that affected HMW management in hospitals in Indonesia is different before and during the COVID-19 pandemic (Table 7). The availability of environmental documents was the most dominant factor before the COVID-19 pandemic with a p-value = 0.029, which is less than 0.05. Furthermore, it was found that the availability of environmental health units was also a determinant factor of HMW management compliance before the pandemic with a p-value of less than 0.001. During the COVID-19 pandemic, the only factor was the availability of environmental health units with a p-value = 0.003.

Discussion

The increase in the level of compliance proves that several efforts were devoted to increasing the safety management of HMW, especially during the COVID-19 pandemic, to protect the environment and public health from the negative impacts of HMW generation. To do so, a series of efforts have been made by the government, such as issuing a circular letter that regulates HMW management activities, which is the Circular Letter of the Minister of Environment and Forestry Number SE.2/MENLHK/PSLB3/PLB.3/3/2020, updated in 2021 by the Circular Letter Number SE.3/MENLHK/PSLB3/PLB.3/3/2021 (28). In addition, the Ministry of Health released guidelines regarding HMW management activities to be used as guidelines for all healthcare facilities in Indonesia (6).

The results show that the reporting level of HMW management compliance was very low. This is because most hospitals do not have specific and/or trained workers to record, report, and submit their HMW management to *Sikelim*.

There has been a decrease in the amount of HMW generated by hospitals during the COVID-19 pandemic. This could be due to the limitation of medical services

conducted by hospitals during the COVID-19 pandemic. In addition, many COVID-19 patients are not being treated in hospitals; they are treated in special isolation locations, such as the Kemayoran Athletes Village. This had an impact on increasing HMW produced by isolation facilities. On the other hand, it led to a decrease in the amount of general medical waste generated in hospitals due to reduced bed occupancy. Moreover, the reduced production had an impact on reducing waste that should be treated by hospitals. Therefore, isolation facilities can collaborate not only with third parties but also with hospitals that already have the equipment and still have the remaining capacity to treat HMW.

Moreover, the data showed that the highest and lowest number of HMW generation among hospitals had an enormous difference in both years. This might be because the number of patients at each hospital was different due to factors that affected accessibility, such as the cost that the patients had to pay, the availability of options to use health insurance, and the difficulty related to transportation access to a hospital (29).

The ownership rate of incinerators by hospitals in Indonesia is still very low (8% before the pandemic, decreased to 6% during the pandemic). This result is much different than that from a study conducted in hospitals in Pakistan in 2019, where it was found that the hospital ownership of incinerators reached 56.25% (27). Although the ownership rate was low, hospitals arranged to manage their HMW by cooperating with third parties that already had permits. The low level of ownership could be caused by economic factors because the use of incinerators requires a fairly high operational cost. Thus, it is necessary to consider the cost-benefit of using an incinerator in treating HMW independently. Moreover, to meet the expected standards, incinerators should be equipped with air pollution control

devices, so additional costs are needed for procurement and use (30). Furthermore, the decrease in incinerator ownership that occurred during the COVID-19 pandemic could be due to a decrease in hospital income caused by reduced bed occupancy. Research conducted in Brazil showed that there was a 10% decrease in hospital income per month during the COVID-19 pandemic (31).

Based on the chi-square analysis, the determinant factors of HMW management compliance for both years were the same, which are the availability of environmental documents and the availability of environmental health units; however, the result of the logistic regression analysis showed that the determinant factors for both years were different. In 2019, the determinant factors were the same as the results from the chi-square analysis. In 2020, the determinant factor was only the availability of environmental health workers.

The existence of environmental health units was the determinant factor for both years. This result can prove that activities of supervision, monitoring, and evaluation have a great influence on the level of compliance. This is in agreement with previous research, where it was found that there is a significant relation between supervision activities and compliance with regulations or policies related to HMW management in hospitals (11).

Environmental documents are important for hospitals to have. Based on Government Regulation Number 27 of 2012, a hospital that already has environmental documents is a hospital that has a plan related to HMW management, where the preparation of the plan is one of the stages in applying for an environmental permit (32). The availability of environmental documents had a significant relation with the compliance of HMW management in hospitals; however, this relation was only found before the COVID-19 pandemic. This might be because

samples that were used in this research were dominated by hospitals that already have environmental documents. Thus, the difference in frequency between categories is quite large and affected the final results of the analysis.

Four variables were not significant to HMW management compliance, which are HMW generation, availability of incinerators, availability of environmental health workers, and availability of standard operating procedures for HMW management. This could be because there was no difference in the proportion of HMW generation between compliant and non-compliant hospitals in 2019 and 2020.

Conclusions

The number of hospitals that routinely reported their HMW management activity from 2019-2020 was very low at only 12%. From the total number of hospitals that submitted their reports, it was found that there was an increase in HMW management compliance in hospitals during the COVID-19 pandemic from 82% to 86%. Moreover, it was found that the availability of environmental documents and the availability of environmental health units were determinant factors of HMW management compliance by hospitals in Indonesia before the start of the COVID-19 pandemic in 2019. During the COVID-19 pandemic in 2020, the only determinant factor was the availability of environmental health units. Because the level of compliance in both years was influenced by the availability of environmental health units, it is important to increase the availability of environmental health units in all hospitals to improve the level of HMW management compliance. In addition, it has been found that the ownership rate of incinerators by hospitals was very low (only 8% before the pandemic and 6% during the pandemic). Furthermore, it is necessary

to improve hospital compliance in reporting related to HMW management activities by providing trained workers in recording, reporting, and submitting data. It is also important to impose administrative sanctions in the form of written warnings, government obligations, and even administrative fines to hospitals that do not report their HMW management activities.

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Riassunto

Un'analisi comparativa di conformità della gestione dei rifiuti sanitari pericolosi prima (2019) e durante (2020) la pandemia di COVID-19 in Indonesia

Premessa. In qualità di produttori di rifiuti sanitari pericolosi, gli ospedali hanno la responsabilità di gestirne lo smaltimento. La non conformità nella gestione di questo compito può causare effetti negativi sull'ambiente e sulla salute pubblica, e ciò è particolarmente vero durante la pandemia di COVID-19, quando l'ammontare dei rifiuti prodotti tende ad aumentare. Per approfondire il tema di come proteggere ambiente e salute, il presente studio ha inteso determinare il livello di conformità nella gestione dei rifiuti sanitari pericolosi da parte di un campione di ospedali indonesiani, confrontando la situazione prima e durante la pandemia di COVID-19, cioè nel 2019 vs il 2020.

Disegno dello studio. Retrospectivo trasversale (cross-sectional).

Metodi. Lo studio è stato effettuato su di un campione di 343 ospedali, utilizzando dati già raccolti dal "Sikelion" o "Sistema informativo sulla gestione dei rifiuti sanitari", posseduto e gestito dal Ministero della Sanità. I dati sono stati elaborati utilizzando chi-quadro e regressione logistica.

Risultati. È stato osservato un incremento del livello di conformità nella gestione dei rifiuti sanitari pericolosi

da parte degli ospedali dall'82 all'86% durante la pandemia. Inoltre, è stato evidenziato che la disponibilità della documentazione ambientale e delle unità sanitarie ambientali è stato fattore determinante della conformità del trattamento dei detti rifiuti nella fase pre-pandemia (2019), mentre nel 2020, durante la pandemia, l'unico fattore è risultato la disponibilità delle unità sanitarie ambientali.

Conclusioni. Benché il livello di conformità sia risultato abbastanza buono, sono necessari sforzi aggiuntivi per incrementare le attività di trattamento dei rifiuti sanitari pericolosi da parte degli ospedali, in quanto prima della pandemia (cioè in situazione di normalità) solo l'8% degli ospedali era in grado di gestire autonomamente, utilizzando inceneritori autorizzati, i propri rifiuti sanitari pericolosi, percentuale che si è ridotta al 6% durante la pandemia.

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