

CURRENT STATUS AND FUTURE CHALLENGES OF HEALTHCARE WASTE MANAGEMENT IN INDONESIA

KONDISI SAAT INI DAN TANTANGAN KE DEPAN DALAM PENGELOLAAN LIMBAH LAYANAN KESEHATAN DI INDONESIA

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Abstrak

Latar belakang: Dalam memberikan pelayanan kesehatan, rumah sakit maupun sarana pelayanan kesehatan lainnya menghasilkan limbah medik yang mempunyai risiko menularkan penyakit-penyakit tular darah dan penyakit lainnya apabila tidak dikelola secara aman. Tujuan: Diperolehnya gambaran tentang kondisi dan praktik Pengelolaan Limbah Layanan Kesehatan (PLLK) di beberapa rumah sakit umum (RSU) di Indonesia, agar dapat digunakan oleh RSU dan sarana pelayanan kesehatan lainnya untuk melaksanakan PLLK secara aman. Bahan dan Cara: Kajian berupa survei dilakukan oleh Direktorat Penyehatan Lingkungan dengan cara mengirimkan kuesioner terstruktur di 100 RSU pada tahun 2004. Hanya 76 RSU yang mengisi kuesioner. Lingkup survei meliputi aspek sanitasi RSU, di antaranya PLLK yang meliputi variabel ketersediaan unit organisasi yang bertanggungjawab dalam PLLK, rencana pengelolaan limbah medik, ketersediaan pedoman PLLK, praktik pemilahan dan teknologi pengolahan limbah medik. Hasil: Sebagian besar RSU telah mempunyai unit yang bertanggungjawab dalam PLLK, namun hanya sekitar 33% yang mempunyai rencana PLLK. Demikian pula hanya sekitar 30% RSU yang memilah limbahnya menjadi tiga kategori sesuai pedoman PLLK, walaupun lebih dari 60% RSU telah mempunyai buku pedoman PLLK sesuai dengan Keputusan Menteri Kesehatan No. 1204/2004. Insinerasi merupakan cara pemusnahan limbah yang dipilih oleh mayoritas RSU. Kesimpulan: Masih banyak RSU yang disurvei belum mengelola limbahnya sesuai dengan Keputusan Menteri Kesehatan No. 1204/2004 seperti diamanatkan oleh Peraturan Pemerintah tentang Pengelolaan Limbah Berbahaya dan Beracun termasuk limbah layanan kesehatan.

Kata kunci: fasilitas kesehatan, pengelolaan limbah layanan kesehatan, kebijakan, risiko kesehatan

Abstract

Background: In providing healthcare services, hospitals and other healthcare facilities generate medical wastes which can spread blood-borne diseases and other waste diseases if they do not manage their medical wastes safely. Material and Method: Information presented in this paper is part of a survey of Environmental Health Directorate regarding hospital sanitation using a structured questionnaire mailed to 100 general hospitals in 2004. There were 76 hospitals participated in the survey by filling in the questionnaires and sending them back to the Environmental Health Directorate. Study variables include availability of sanitation unit responsible for Health Care Waste Management (HCWM), HCWM plans, HCWM guidelines, waste segregation practices, and HCWM technologies used. Result: Majority of hospitals had sanitation units; however, only about 30% hospitals had HCWM plans. Moreover, only about 33% hospitals segregated their wastes into three categories as recommended by HCWM guidelines, although more than 60% hospitals owned HCWM guidelines according to Health Ministerial Decree No. 1204/2004. Incineration is a preferred means of medical waste treatment technology. Conclusion: There were many surveyed hospitals did not comply with Ministerial Health Decree No. 1204/2004 in terms of safe HCWM as mandated by Government Regulations No. 18 and 85/1999 concerning Hazardous Waste Management, including HCWM.

Keywords: healthcare institution, healthcare waste, policy, health risk.

Introduction

Many healthcare waste facilities in Indonesia have neglected safe healthcare waste management (HCWM) since they have not implemented proper management of their wastes to minimise health risks that may arise. Several adverse health effects have been associated with dioxins, including sarcomas, lymphomas, skin lesions, stomach cancer, biochemical liver-test abnormalities, elevated blood lipids, fatal injuries, immune system and neurological effects.¹ A study in 2004² showed that only about half of surveyed hospitals segregated their wastes into medical waste and general waste, with regard to sharps waste. Similarly, the majority of Health Centers (HC) and other health clinics have disposed of their wastes in dumpsites together with domestic wastes or burn them in their backyards.^{2,3} To treat their medical wastes, the hospitals have used incinerators as the most common technology of medical waste treatment; however, their specifications and operation have not met standards of best practice.^{2,4} The level of knowledge on the harmful consequences of improper handling and disposal of medical wastes is also very low at all level of personnel of healthcare facilities.²

As the fourth highest populated country in the world with total population of around 218 million people, Indonesia has put a significant attention on the development of healthcare facilities which were distributed across 33 provinces, comprising those that are owned by Ministry of Health (MoH), local governments at provincial and district levels, government enterprises, the military, and the private sector.⁵ In 2006, there were 1,012 general hospitals, with 118,504 beds. The number of hospitals annually increased to 1,292 hospitals with total beds of 138,451 in 2010.⁵ There are 593 general hospitals (45.65%) were owned by private companies and the remaining (54.35%) were owned by the governments, with the total beds being 22,860, and 143,428, respectively.⁵ Similarly, in order to provide basic health services in every sub-district, the number of HCs has escalated from 7,237 to 8,931 and sub-HCs (*Puskesmas Pembantu*) in the same period.⁵ While the ownership of HCs and sub-HCs is with local governments, there are many other primary healthcare facilities owned by various parties, including clinics and health posts. There are no regulations that govern healthcare wastes from HCs, as a priority concern of hospitals.

Since the number of healthcare facilities will continue to rise to meet public demands, there is no doubt that the quantity and variety of medical waste will also escalate, posing even more dangerous risks to public health and the environment.⁴ This situation requires an improved as well as sustainable system of HCWM to reduce public health risks and occupational hazards among healthcare workers as a result of poor waste management.

Although the regulation to govern hazardous waste management has been established since 1999,⁶ the majority of healthcare facilities have not yet complied with the regulation. In May 2008, the central government enacted a new Act of Solid Waste Management No 18/2008 and one of its clauses deal with healthcare waste.⁷ This Act is intended merely to regulate municipal waste management. Therefore it should be followed by more technical regulations and policies on how to implement and enforce waste generators to comply with the Act by managing their wastes properly. Other regulation is the Ministerial Health Decree No 1204/2004 concerning Environmental Health Standards of Hospitals including medical waste management.⁸ The Decree has no legal sanction since it is only a guideline for hospitals to improve their environmental health. The limited HCWM regulation and poor implementation, the government should sufficiently provide regulations and policies to direct and guide the hospitals and other healthcare establishments to improve their existing management of healthcare waste in more comprehensive way with other internal program within healthcare establishments. The regulation should also guide how every establishment could develop its own HCWM because the ownership of hospitals varies from MoH at central level to local governments at district levels, the regulations and policies should suit the types of ownership and level of authorities.

This paper attempts initially to describe the current status of HCWM and its future challenges and then contributes to resolve the challenges by proposing incorporation of healthcare waste into infection control program using health promoting hospital approach. This proposed system needs a suitable policy framework that should be formulated to govern the overall safe HCWM. The majority of the information has been obtained through literature review on HCWM and related topics to infection control and health promoting

hospitals and official documents from the MoH and World Health Organisation (WHO).

Method

The design of the study was cross-sectional using mail survey to obtain data on hospital's environmental sanitation. The study was conducted by the Environmental Health Directorate, Directorate General of Disease Control and Environmental Health, Indonesian Ministry of Health. This survey used a structured questionnaire prepared by a national WHO consultant.² The Environmental Directorate mailed the questionnaires to 100 general hospitals in 2004. There were 76 hospitals including 10 private hospitals participated in the survey by filling in the questionnaires and returning them to the Environmental Health Directorate. Studied variables include availability of sanitation unit responsible for HCWM, HCWM plans, HCWM guidelines, waste segregation practices, and HCWM technologies used by surveyed hospitals.

The data from the questionnaires were analysed using IBM SPSS version 19 to generate descriptive data and it was presented in bar charts.

The author also reviewed relevant sources of information regarding HCWM from published articles and official documents of relevant regulations to enhance the discussion of the findings.

Result

Waste management unit

The availability of waste management unit is an indicator of the establishment of HCWM in healthcare facilities, including hospitals. Figure 1 shows the proportion of hospitals which has a sanitation unit plus waste management tasks. Only 75 out of 76 hospitals responded to the question regarding the ownership of sanitation unit. Out of 75 hospitals, 45 hospitals (60.0%) have a sanitation unit. This figure reflects that HCWM system is not a priority in most hospital activities.

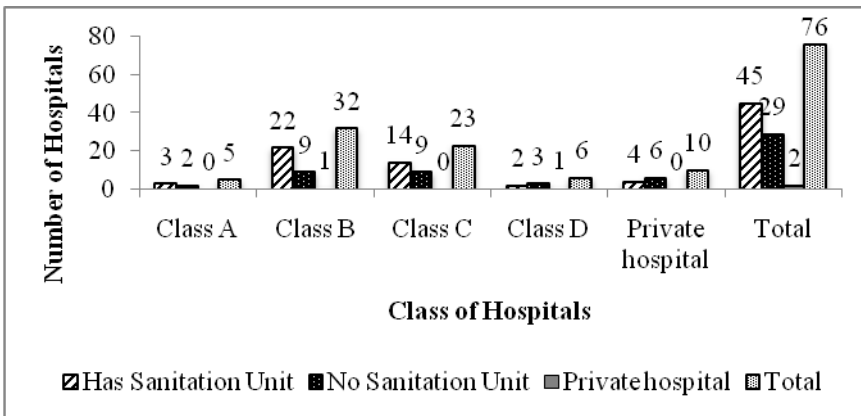


Figure 1. Availability of Sanitation Unit in Sample Hospitals

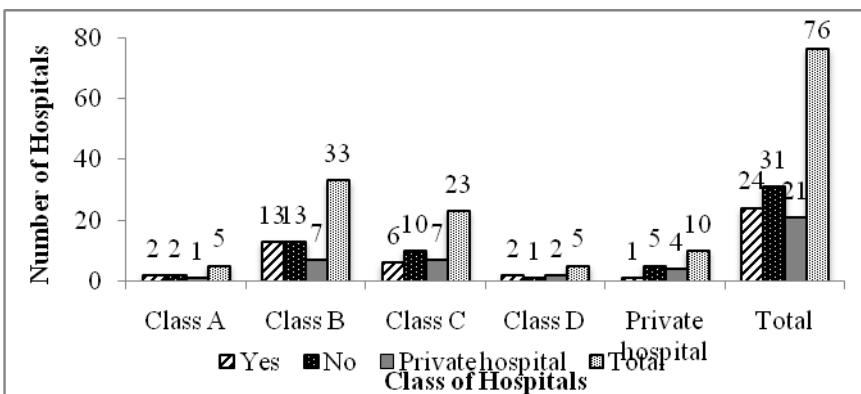


Figure 2. Availability of Waste Management Plan in Sample Hospitals

Waste minimisation program plan

Waste minimisation program plan is an important variable to determine the status of HCWM. It can be seen in Figure 2 that only 55 hospitals answered to the question whether they have a waste minimisation program plan and 44% responded positively. The availability of waste management plans indicates that the sample hospitals have willingness to perform “duty of care” to manage their wastes. Some studies in several developing countries showed that healthcare waste program planning is an important element of HCWM. A study in Istanbul, Turkey, revealed that improper planning influenced the existing HCWM.⁹ Similar study in the northern part of Jordan¹⁰ found that since specific regulation of waste management plan did not exist, resulting in poor segregation at source. Hospitals should formulate a clear goal comprehensively and elaborate it in proper planning that allocates necessary resources to be implemented.¹⁰ A comprehensive planning can be achieved by performing activities such as a waste audit, identification of waste source, assessment of existing equipment and personnel. The planning will guide the direction of each phase of waste management and provide standard operating procedures of the implementation of waste segregation and containment in each source of waste. Segregation is important since it is a prerequisite activity for safe management to prevent mixture of medical waste and general waste.¹¹ A good planning also includes ways of waste

minimisation that in turn will reduce the overall cost of HCWM. Planning should consist of waste reduction, reuse and recycle. As a result, cost effectiveness can be achieved in managing health care waste in hospitals as set in the goal.¹² Several experts in Iran¹² suggested the process of developing a master plan of HCWM by applying analytical hierarchy process in the South-west of Iran. They revealed that improving management technique was more important than establishing a new facility of HCWM. In implementing, they carried out several activities including identification of system elements and its interactions, analysis of socio-economic impacts of poor management of healthcare waste, and selection of comprehensive indicators of solid waste pollution to improve management technique.

Availability of HCWM guidelines

A guideline for safe HCWM is very essential since it provides codes of practice so that hospitals can perform their duty of care. The availability of such guidelines in Indonesian hospitals is presented in Figure 3. There were 71 hospitals responded to the question whether they have HCWM internally or from governments and 62% gave positive responses.

There were many studies confirmed the importance of HCWM guidelines to be a reference for healthcare personnel to perform their daily activities including segregation, containment, storage, treatment and disposal.^{2, 9, 10, 11}

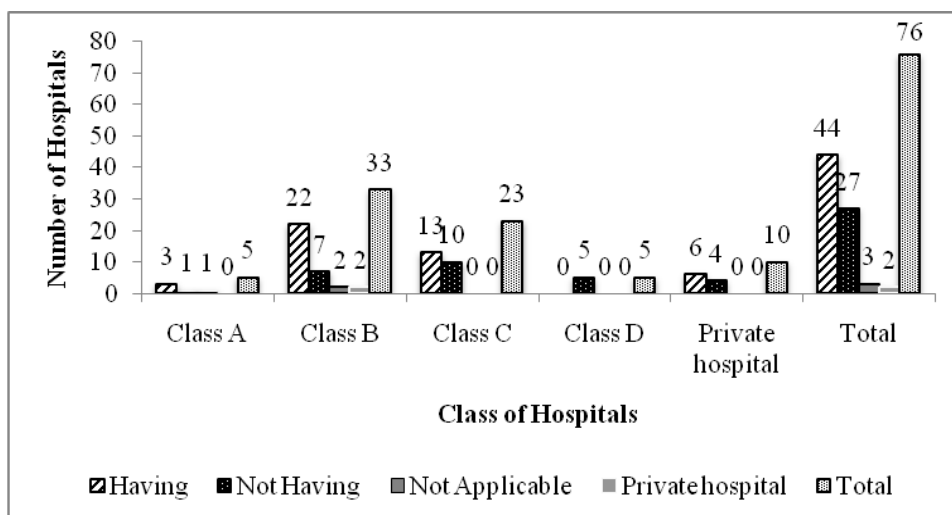


Figure 3. Availability of HCWM Guidelines in Sample Hospitals

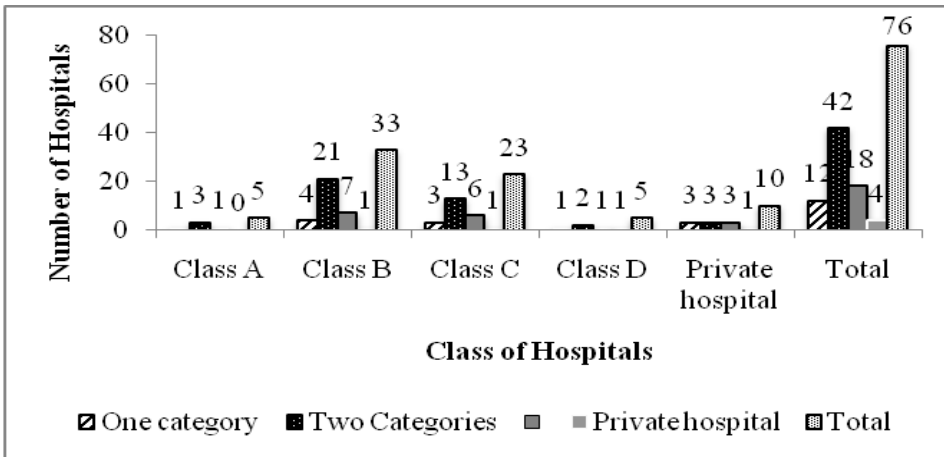


Figure 4. Type of Waste Segregation in Sample Hospitals

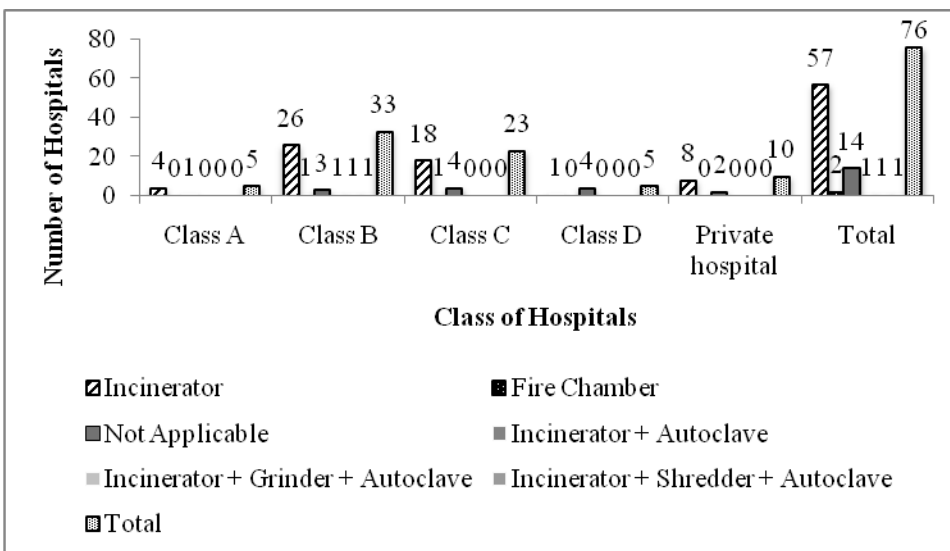


Figure 5. Types of Medical Waste Treatment Technologies in Sample Hospitals

Waste collection and segregation

Figure 4 presented the collection and segregation practice at 76 hospitals. Twenty (17%) hospitals collected their healthcare waste in the same containers regardless of the type of wastes and 42 (58%) hospitals separated the general waste from the medical wastes. The remaining hospitals (25%) separated their general waste from medical waste and they also segregated their medical waste into two or more categories. The small number of hospitals segregated the medical wastes into more than two types indicate that most of hospitals do not have relevant guidelines or policies. Waste segregation at the point of collection is a prerequisite step in HCWM since without careful

segregation, all wastes generated in healthcare facilities would be considered hazardous, thus, they need to be treated and disposed of properly. Moreover, appropriate segregation followed by colour-coded containment would reduce medical waste generation.^{4, 10, 11}

Waste treatment technology

Figure 5 presents type of medical waste treatment technologies used by hospitals. Fifty seven (55%) hospitals use incinerators as a means of treatment technology in all hospitals. Other technologies such as autoclaving and grinding prior to disinfection are not popular. Recent studies also found that most hospitals used incinerators for medical waste treatment.^{13, 14} Although more

hospitals use incinerators, they do not apply best practice since basic requirements such as minimum temperature and type of waste that suit incinerator are not implemented in most hospitals. They load all types of medical waste into incinerators according to the capacity of incinerators without considering that certain incinerated plastic-containing waste could produce dioxin and furans.^{4,10} Sometimes the reason is simply to reduce the amount of wastes they produce and this practice is perceived as a better way than disposing of the waste in dumpsites without prior treatment.^{4,10}

The government continues to allow the use of incinerators, this practice will persist unless some better alternatives are introduced. However, with regard to the study in Africa,¹⁵ the use of small-scale incinerators is considerable be used as long as comply with its best practice. In the meantime, other technologies that are safer and appropriate for limited resources are of necessity to apply. For example, the introduction to autoclaving technology by Etlog Health that is considered to be more appropriate would be a promising outcome.¹⁶ Diaz and his colleagues¹⁷ also describe the advantages and disadvantages of technologies available for developing countries. The use of combustion methods would eventually be replaced by non combustion ones as there is obvious evidence that the first ones has possibility to produce carcinogenic substances.

Discussion

Current status of HCWM

The implementation of HCWM, especially in hospitals and HCs in Indonesia have many influencing factors, therefore the results are in variation. In many other developing countries, factors such as lack of clear policies, resources, and awareness about the risks of poor handling of healthcare waste are amongst the causes of the poor status of HCWM.^{2,3,4} Some examples of the implementation of HCWM in Indonesia happened in Yogyakarta and Pemerintah Aceh. A system of HCWM has been implemented in Yogyakarta since the local government has put such a policy in place that should be followed by the healthcare facilities under its jurisdiction. This policy includes mechanism of off-site treatment for smaller hospitals and all HCs.¹⁸ Even though they still use incinerators owned by large hospitals for final treatment of medical wastes, to some extent they

have implemented segregation at source.¹⁹ Every hospital or a HC that send their wastes to the incinerator should pay for certain amount of cost for operation and maintenance. This system has been damaged by the earthquake for some times, and with the assistance from WHO and other non governmental organisations, eventually the system can be repaired.¹⁶ Another case is different where a similar measure has been applied in Pemerintah Aceh. After the WHO project on safe HCWM terminated, the system failed to sustain due to various reasons.¹⁶ There were different factors influenced HCWM system in Yogyakarta and Pemerintah Aceh. First, the damage caused by the disaster in Aceh was worse compared to Yogyakarta. Secondly, the territory of Pemerintah Aceh is much larger as it comprises 23 districts and municipalities, combining with the complexity of socio-cultural aspects that may influence the situation and there was no such system established before the disaster. It also observed that the level of awareness of healthcare personnel at Pemerintah Aceh was also lower compared to Yogyakarta. Therefore, different approach should be applied to improve HCWM system. At the moment with the on-going technical and financial assistance from some donor agencies and the establishment of clear policy, Pemerintah Aceh would eventually improve the status of HCWM.

There are few studies regarding HCWM in Indonesia which cover all classes of hospitals. In 2000, the MoH has carried out an assessment regarding HCWM in 100 hospitals of Java and Bali islands²⁰. The result revealed that the healthcare waste generation is approximately 3.2kg/bed/day, and incineration was the treatment technology chosen by majority of hospitals. Another study was conducted by Sasimartoyo² revealed some findings on important variables that directly relate to the basic elements of healthcare waste management in hospitals. The basic elements consisted of availability of a waste management unit, waste minimisation program planning, waste segregation, classification, collection, and treatment technology.

Future challenges of HCWM

Managing a fraction of healthcare waste in a safe way is imperative to minimising the environmental impacts and protecting the human health. Indonesia has promulgated the Waste Management Act No. 18/2008 and this is a sign that Indonesian government has great concern about the importance of solid waste management including

healthcare waste. This Act should be followed by relevant regulations and policies to start the implementation of safe HCWM. However, lesson learned from the previous experience that lasted almost a decade since the government has enacted regulation no. 18 and 85/1999, hazardous waste management including medical waste has been overlooked because of lack of enforcement in any level of implementations.

Mbongwe and his colleagues²¹ noted that insufficient monitoring and guidelines of implementation lead to the neglect of safe management as well as it mentioned earlier that unclear policies will bring about the lack of program planning in majority of hospitals. Diaz and his team¹⁷ also highlight the importance of standardised medical waste to avoid the confusion of waste segregation and containment.

Therefore, a suitable policy framework that governs all aspects of healthcare waste management is of paramount importance. This policy should be clear, environmentally friendly, evidence-based, and accommodative to each class of hospitals so that they can establish comprehensive plans to manage their waste complying with relevant regulations. Since implementing decentralization in healthcare services, the policy should also encourage local governments to establish local regulations that govern the implementation of healthcare waste under their jurisdictions, despite of the existing constraints that hamper the program.

The WHO²² advised that some important elements of sustainable management of healthcare waste include government commitment and support, assessment of potential impacts of healthcare, management of healthcare with regard to the waste hierarchy, raising awareness among stakeholders and providing training in best practice, and conducting active surveillance. In applying these elements in Indonesia, government commitment and awareness of stakeholders are the urgent ones since the existing regulations are lacking of enforcement and relevant guidelines for appropriate actions and improvements. In addition, there are two directorate generals within the MOH that have the responsibility to ensure that healthcare waste management will be carried out properly, which is responsible for administrative and financial aspects and is responsible for providing technical assistance including guidelines and standards.

Incorporating HCWM into infection control and health promoting hospital program

One of the main functions of hospitals is dealing with patient safety and infection control to ensure that all patients will have adequate treatments depending on their health status and capability, and also to protect them from hospital-acquired diseases. Moreover, hospitals must protect their workers and health providers. Hospitals should also has to perform their duty of care by managing their wastes properly to prevent the spread of waste related diseases especially blood-borne diseases, such as hepatitis B, hepatitis C and HIV/AIDS. Since the objectives of healthcare waste management are similar to that of infection control, incorporation of the two activities will bring about benefit as they will be more efficient and effective in terms of resources such as personnel, equipment and infrastructure. Of course, to ensure that the approach would be successful, other adequate infrastructure and equipment should be provided. Whitehead²³ suggested that enabling the roles and functions of nurses in promoting healthy hospitals would be one appropriate measure to implement standard precautions and best practice of waste handling at source. The nurses can also be involved as facilitators in raising awareness among hospital personnel. In turn, integration of the two programs will result in improving overall conditions of hospitals. Duerink and his team²⁴ also noted that hospitals in Indonesia should improve compliance with standard precautions to prevent hospital-acquired infections. They found that lack of awareness among hospital personnel especially nurses who administer injections and be in contact with infectious waste that could be at high risk of secondary infection. Therefore, it is suggested that improving compliance with standard precaution is imperative and it can be achieved by applying safe handling of needles, avoiding recapping of used syringes and using personal protective equipment and performing proper hand washing.²⁴ Regarding the relationship between medical waste management and standard precautions, lowering standard of infectious waste would compromise the standard precautions since the latter assume that all blood, secretion or any liquid from patients are infectious and they should be treated differently.²⁵ This problem will be encountered when hospitals face the high costs of managing medical waste. On the other hand, an infection control is of paramount importance in any hospitals and simple infection

control measures should be implemented by conducting epidemiological study to identify risk factors and group.²⁶ Nonetheless, integrating safe management of healthcare wastes with infection control will be a useful approach to reduce the risk of nosocomial diseases.

Conclusion

Indonesia is facing environmental health problems since majority of healthcare institutions, especially hospitals and major health centres, are not managing their wastes properly. Some studies found that many hospitals have not had elements of basic healthcare waste management. The studies also revealed that there is unclear policy framework that governs the implementation of safe management of healthcare waste. The availability of relevant laws and regulations has not been accompanied by relevant policy and guidelines. This is combined with the lack of enforcement and awareness of stakeholders responsible for such management. As far as public health is concerned, efforts should be initiated by central government to determine the main causes of problems and generate suitable policy framework for managing healthcare wastes. It is also important to ensure that the management of healthcare waste should be sustainable, perhaps incorporating it into infection control program that already exist to reduce cost-related management that might be a hindrance.

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Reference

1. Allsopp, M., Costner, P., & Johnston, P. (2001). Incineration and human health: State of knowledge of the impacts of waste incinerators on human health. London: Greenpeace Research Laboratories, University of Exeter.
2. Sasimartoyo, TP. Report on the Assessment of Hospital Sanitation in Indonesia (Laporan Asesmen Sanitasi Rumah Sakit di Indonesia). Unpublished report 2004. Ministry of Health and WHO Representative to Indonesia. Jakarta; 2004
3. Chaerul M, Tanaka M & Shekdar AV. A system dynamics approach for hospital waste management. *Waste Management* 2008; 28:442-9. Accessed on 14 April 2009.
4. Irianti, S and Herat S. Sustainable management of health care waste: existing problems and proposed solutions. Proceeding of the International Conference on Sustainable Environmental Technology and Sanitation for Tropical Region. Surabaya; November 10-19, 2008.
5. MoH. Indonesia Health Profile 2010. MoH. Jakarta; 2011
6. MoE. Government Regulation on Management of Hazardous Waste No. 18 and 85/1999 (Peraturan Pemerintah tentang Pengelolaan Limbah Berbahaya dan Beracun No. 18 juncto 85/1999). MoE, Jakarta; 1999.
7. MoE. Solid Waste Management Act No. 18/2008. (Undang-undang Pengelolaan Sampah No.18/2008). MoE. Jakarta.2008.
8. MoH. Ministerial Decree No. 1204/2004 on Standards of Hospital Environmental Health (Keputusan Menteri Kesehatan no. 1204/2004 tentang Persyaratan Kesehatan Lingkungan Rumah Sakit). MoH; Jakarta; 2004.
9. Alagöz, Aylin Zeren, Kocasoy, Günay. Determination of the best appropriate management methods for the health-care wastes in Istanbul. *Waste Management* 2008;28:1227-35. Accessed on 16 June 2010.
10. Bdour A, Altrabsheh B, Hadadin N, Al-Shareif M. Assessment of medical wastes management practice: A case study of the northern part of Jordan. *Waste Management* 2007;27:749-59. Accessed on 16 June 2010.
11. Sabour MR, Mohamedifard A and Kamalan, H. A mathematical model to predict the composition and generation of hospital wastes in Iran. *Waste Management* 27; 4:584-7. Accessed on 16 June 2010.
12. Karamouz M, Zahraie B, Kerachian R, Jaafarzadeh N, and Mahjouri N. Developing a master plan for hospital solid waste management: a case study. *Waste Management* 2007;27:626-8. Accessed on 14 April 2009.
13. Irianti, S. A Policy Framework for the Improvement of Healthcare Waste Management in Indonesia, PhD Thesis. 2012. Griffith University, Queensland, Australia
14. Laporan Riset Fasilitas Kesehatan 2011. Badan Litbangkes. Kementerian Kesehatan. Jakarta, 2012.
15. Rogers DEC and Brent AC. Small-scale medical waste incinerators - experiences and trials in South

- Africa. *Waste Management* 2006; 26: 1229-36. Accessed on 16 June 2010.
16. Irianti S. Barriers to the implementation of sustainable healthcare waste management in the disaster affected areas of Nanggroe Aceh Darussalam Province. Proceeding of the International Conference of Natural and Environmental Sciences. Banda Aceh; May 6-8, 2009.
 17. Diaz LF, Eggerth LL, Enkhtsetseg SH, Savage G M. Characteristics of healthcare wastes. *Waste Management* 2008; 7:1219-26. Accessed on 16 June 2010.
 18. PATH and USAID. Field evaluation of the acceptability and feasibility of syringe melters in Indonesia, A health tech report. May 2007. PATH. Seattle.
<http://www.uq.net.au/signfiles/Files/SyringeMelterAcceptabilityIndonesiaPATH-May2007.pdf>. Accessed on 24 June, 2008.
 19. MoH. Workshop on handling of sharp waste in primary healthcare (Penanganan limbah medik tajam pada pelayanan kesehatan dasar). Yogyakarta, 1 July 2003. <http://www.depkes.go.id>. Accessed on 24 July 2008.
 20. MoH. Indonesia Health Profile 1997. MoH: Jakarta: 2004.
 21. Mbongwe, B. Mmereki, B. T. Magashula, A. Healthcare waste management: Current practices in selected healthcare facilities, Botswana. *Waste Management* 2008; 28:226-33. Accessed on 16 June 2010.
 22. WHO. International Meeting on Healthcare Waste Management: Meeting Report. Geneva; 2007 <http://uqconnec.net/signfiles/Files/WHO-HCWM%20Meeting-15-Oct2007.pdf>. Accessed on 24 June 2008.
 23. Whitehead D. The European health promoting hospital project: how far on? *Health Promotion International* 19, 259-67. Accessed on 16 June 2010
 24. Duerink DO, Farida H, Nagelkerke NJD, Wahyono H, Keuter M, Lestari ES, et al. Preventing nosocomial infections: improving compliance with standard precautions in an Indonesian teaching hospital. *Journal of Hospital Infection* 2006; 64:36-43. Accessed on 16 June 2010.
 25. Blenkarn JI. Lowering standards of clinical waste management: do the hazardous waste regulations conflict with the CDC's universal/standard precautions? *Journal of Hospital Infection* 62:467-72. Accessed on 16 June 2010.
 26. Raza, MW, Kazi, BM, Mustafa M, Gould FK. Developing countries have their own characteristic problems with infection control. *Journal of Hospital Infection* 2004; 57:294-9. Accessed on 16 June 2010.