

## Medical Waste Management Practices in Thailand

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**Abstract:** Inappropriate medical waste management practices (WMPs) can cause hazards and risks that affect not only the generators and operators but also the general community. An investigation of WMPs in hospitals in Thailand has shown similar and different patterns of medical WMPs consisting of infectious waste, solid waste and hazardous waste, including wastewater practices. The quantity of infectious waste generated from different size of hospitals in Chiang Mai is at a rate of 0.17 kg/d/bed to 0.97 kg/d/bed. Most hospitals have an incinerator where medical waste is burned. The ash from the incinerator should be properly disposed in a landfill. Solid waste in hospitals is sent to a municipal landfill. In some hospital, there is a thriving recycling program. Some hazardous waste is either burned or sent to a private secured landfill. Others are collected in hospitals and stored for disposal. However, the assigned government agencies and a manual for helping them solve waste problems are needed. All hospitals have wastewater treatment plants (WWTP). Some WWTP need advice for coping effectively with the WWTP problems. In order to provide more effective WMPs in hospitals, a standard operating procedure (SOP) and regulations for segregation of infectious waste, solid and hazardous wastes must be developed. The SOP should outline the method for handling hospital wastes, how to collect, segregate, treat and dispose of these wastes. Furthermore, the agency responsible for regulating incinerators and WWTPs in the hospitals should regularly visit and inspect these facilities for improving their efficiency and solving problems when they occur. [*Life Science Journal*. 2006;3(2):88-93] (ISSN: 1097-8135).

**Keywords:** waste management practices; medical waste; regulations; standard operating procedure

**Abbreviations:** SOP: standard operating procedure; WMPs: waste management practices; WWTP: wastewater treatment plants

### 1 Introduction

According to the World Health Organization (WHO), the waste produced by health care facilities carries a higher potential for hazards and risks from infection and injury than any other kind of waste<sup>[1]</sup>. Medical waste or hospital waste consists of infectious, radioactive and toxic substances, as well as unsafe material from activities in clinics and laboratories in hospitals. It includes human blood and blood products wastes, tissues, animal wastes, microbiology laboratory wastes, radioactive and chemical wastes, pharmaceutical, sharp wastes in addition to general waste like paper, food and plastics<sup>[2]</sup>. Based upon the WHO 1994 report of hospital waste in America, Netherlands, and France, about 85% of the hospital wastes are actually non-hazardous waste, 10% are infectious waste and 5% are non-infectious waste but hazardous wastes. Although infectious and hazardous wastes from hospi-

tals occur in small quantity of waste, there is a high potential of serious threat to spread out various diseases and hazardous materials from these wastes due to improper disposal of dumping and burning. The poor management of medical waste poses risks to public health and the environment, especially, in terms of the transmission of disease by viruses and microorganisms, contamination of underground water tables by untreated medical waste in landfills, as well as contamination of ambient air by uncontrolled burning. The problem of medical waste disposal in hospitals has become an issue of increasing concern, prompting hospital administration to seek new ways of safe and cost effective management of the waste, and keeping their personnel informed of the advances in this field. In Thailand, the estimated quantity of infectious waste by Pollution Control Department (PCD) in 2000 was reported to be a total of 13,250 tons or 36.1 ton/day<sup>[3]</sup>. These are generated from both government and private hospitals. Of 22 tons of infectious wastes are

generated in the regional part while about 24.1 tons of these wastes are generated in Bangkok and the nearby area.

### **1.1 Waste management program**

The concept of waste management program has been introduced to many activities, namely, industries, business and commercial, communities, houses, and hospitals. It includes waste minimization, reduce/reuse and recycle, incinerator and landfill. The adoption and promotion of this program are still very limited in the hospitals because accrediting system is not functioning due to some barriers, such as government regulations on medical waste management, lack of support from hospital administrators, and poor environmental awareness. Therefore, the commitment of hospital directors to better management is the most important criterion in promoting the waste management program to hospitals. Without support from the hospital directors, good government regulations and better environmental awareness of the staff, introduction of waste management program will be difficult.

### **1.2 Waste management procedures**

It consists of waste collection and segregation, storage, transportation, treatment and disposal<sup>[4]</sup>. Segregation of waste is the most important step in the process of waste management. It allows management of small quantities of waste thereby reducing the risks as well as cost of handling and disposal of a large mingled waste. Segregated waste need to be stored in identifiable containers, and must separate infectious waste from hazardous waste. The general waste or solid waste and non-hazardous waste transportation should be kept separate from infectious waste and hazardous waste. The transportation containers should be properly enclosed. The driver must be trained to follow established procedures in case of traffic accidental spillage<sup>[5]</sup>.

### **1.3 Medical waste treatment technologies**

There are several medical waste treatment technologies, namely, mechanical, thermal, chemical, and irradiation processes<sup>[4,6,7]</sup>.

Mechanical process is used to change the physical form of the waste to facilitate waste handling. It consists of compaction and shredding. Compaction involves compressing the waste into containers to reduce its volume. Shredding is used to break the waste into smaller piece. This process is not considered acceptable for medical waste treatment by itself.

Thermal process is designed to use heat at low temperature ( $< 150\text{ }^{\circ}\text{C}$ ) and high temperature ( $600 - 5,500\text{ }^{\circ}\text{C}$ ) to decontaminate medical waste. The thermal processes include autoclaving, mi-

crowave treatment, and incineration. Autoclave is a steam sterilization technique that uses steam to contact with the waste directly to disinfect the waste. Microwave treatment is designed to use the electromagnetic radiation spectrum lying between the frequencies 300 and 300,000 MHz to inactivate microbial organism. Incineration processes use high temperature ( $800 - 1,050\text{ }^{\circ}\text{C}$ ) combustion under controlled conditions to convert wastes containing infectious and pathogenic material to inert material residues and gases. It gives a significant volume and weight reduction and it sterilize the waste. There is limitation of the incinerator due to the occurring pollution during operation. It is needed to control its temperature.

Chemical process involves the use of chemicals like chlorine compounds for disinfection. This system needs shredding step in order to provide sufficient control between the waste and disinfectants.

Irradiation process is designed to use ultraviolet or ionizing radiation for irradiating and sterilizing the medical waste.

Among these technologies, autoclave and incinerator methods are mostly used as a sequence for treatment and disposal of infectious waste.

### **1.4 Laws and regulations for waste management**

In Thailand, there are 4 major Acts related to hospital waste, namely, Public Health, Industry, Factory, and National Enhanced and Preservation of Environmental Quality Act, 1992<sup>[8]</sup>.

## **2 Objectives**

Through this study, the assessment of existing WMPs and the quantification of medical waste generated in Chiang Mai hospitals were performed in order to propose the best WMPs of hospitals.

## **3 Materials and Methods**

The data were collected by surveying and interviewing the key informants who respond to waste management in hospitals and using a questionnaire which broadly included information on the type, quantity of waste generated and existing disposal, including all WMPs. The categorization of the hospital waste was attempted according to the Ministry of Public Health Notification for Infection Waste Management, 2002, and the related regulations under the 4 major Acts as mentioned above. The study was carried out in hospitals in Thailand in 2004 as shown in Table 1.

## **4 Results and Discussion**

The waste management procedures and prac-

tices in hospital are shown in Table 2. The sources of hospital waste come from patients and related equipment and laboratory, various wards, X-ray and pharmaceutical room, building, housing and canteen. The existing of WMPs in hospital showed that most hospitals have similar problems associated with the procedure of medical waste management. There is handling (including initial handling, storage, and transportation) problem that needs to be improved in order to decrease the potential of occupational risks. For example, the transportation of infectious waste in hospital should use elevator that delivers only product materials. The container that provides for general waste and infectious waste should have enough number of container in order to separate infectious waste from solid waste at source. If the infectious waste is contaminated with hazardous waste, it should be considered as hazardous waste and should be separate from infectious waste. In the case of infectious waste and hazardous waste, it should have secondary containment to protect any leak of waste from packaging during their collection, storage, and transportation.

**Table 1.** The sample of hospital in Chiang Mai, Thailand

Size & Type	Number of unit	Number of bed
1. Big, G	1	1,400
2. Medium, G	1	531
3. Medium, P	1	400
4. Medium, P	1	350
5. Small, P	1	180

Note: G= Government, P= Private

In some medium hospitals, there are recycling program that generate income for the hospital. This program should be expanded to other hospitals. In the process of storage, all hospitals have the color code and label system to identify the waste container. For example, black container is used for general or solid waste, yellow container is used for bottles and fluorescent lamps, and red container is used for infectious waste. The containers are made from plastic. In all hospitals, the treatment and disposal of medical waste, particularly, the infectious waste is a very critical step in the process of waste management. Most of this problem comes from the treatment technology. Presently, incinerator is the only accepted treatment option to treat infectious waste such as organic matter, tissue or

amputated human body parts. A limitation of the incinerator is that air pollution problem during operation could not be controlled effectively. Moreover, the ash from incinerator has never been analyzed.

In some hospitals, the ash is buried in the hospital grounds. Furthermore, the operation and maintenance cost of incinerator is very high. Thus, the medium and small hospitals prefer to send their infectious waste for treatment in private incinerators or big hospital incinerators.

The treatment and disposal of hazardous wastes is also another problem of hospital waste due to the quantity of hazardous waste that needs not only special handling and storage but also specific treatment and disposal. In this case, the manual or standard operating procedure (SOP) should provide the important information for handling, storage, transportation, treatment and disposal of hazardous waste. In several hospitals, some liquid chemical waste can be recycled but others are discharged to the WWTP. Although all hospitals have their own WWTP (Table 3), some of them were experiencing problems with their WWTP due to the lack of experienced operators for maintenance and operation of the wastewater treatment system. Therefore, problems of wastewater quality were found during monitoring.

The quantity of medical waste generated in kilograms per day from different hospitals is shown in Table 4. It is found that the total quantity of waste generated from all medium and small hospitals was lower than the waste generated from big hospitals. Perhaps it is due to the big hospitals being equipped with modern facilities, and people prefer this kind of hospital for health care and treatment. It is noted that the solid waste or general waste in big (3,000 kg/day) and medium hospital (< 830 kg/day) was higher than that in small hospital (< 300 kg/day). The amount of hazardous waste in medium and big hospitals was in the same range (about 5 kg/day), but the quantity of this waste in small hospital is not available. In some hospitals, liquid hazardous waste was also generated. On comparison of unit (kg/day/bed) contribution of infectious waste, it is found that the big government university hospitals contribute the most. However, the quantity of medical waste can significantly be reduced if the hospital avoided the use of disposable medical care materials.

**Table 2.** Procedure of WMPs in hospitals

Procedure	Size & Type of Hospital				
	Big, Government	Medium, Government	Medium, Private	Medium, Private	Small, Private
<b>I. Solid Waste (SW)</b>					
- Source	- Buildings, housing & canteen	- Buildings, housing & canteen	- Buildings, housing & canteen	- Buildings, housing & canteen	- Buildings, housing & canteen
- Segregation	- At source & separate from IW	- At source & separate from IW	- At source & separate from IW	- At source & separate from IW	- At source & separate from IW
- Storage	- Black bag & Big bin	- Black bag & Big bin	- Black bag	- Black bag	- Black bag
- Transportation	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)
- Treatment & Disposal	- Municipal Landfill	- Recycle & Disposal in Municipal landfill	- Municipal Landfill	- Municipal Landfill	- Municipal Landfill
<b>II. Hazardous Waste(HW)</b>					
- Source	- Wards, X-ray & pharmaceutical rooms	- Wards, X-ray & pharmaceutical rooms	- Wards, X-ray & pharmaceutical rooms	- Wards, X-ray & pharmaceutical rooms	- Wards, X-ray & pharmaceutical rooms
- Segregation	- Chemical Bottle, Battery, fluorescent lamp	- Chemical Bottle, Battery, fluorescent lamp	- Chemical Bottle, Battery, fluorescent lamp	- Chemical Bottle, Battery, fluorescent lamp	- Chemical Bottle, Battery, fluorescent lamp
- Storage	- Yellow Bin	- Identified container	- Identified Bin	- Identified container	- Bin
- Transportation	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)
- Treatment & Disposal	- Private company	- Storage for disposal	- Storage for disposal	- Private company	- Municipal landfill
<b>III. Infectious Waste (IW)</b>					
- Source	- Patients & related equipment & lab.	- Patients & related equipment & lab.	- Patients & related equipment & lab.	- Patients & related equipment & lab.	- Patients & related equipment & lab.
- Segregation	- At source & separate from SW	- At source & separate from SW	- At source & separate from SW	- At source & separate from SW	- At source & separate from SW
- Storage	- Red bag & Bin	- Red bag & Bin	- Red bag & Bin	- Red bag & Bin	- Red bag & Bin
- Transportation	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)	- In (carriage & lift) & out (Truck)
- Treatment & Disposal	- Autoclave, incinerator & Municipal landfill	- Autoclave, incinerator & Municipal landfill	- Autoclave, incinerator & Municipal landfill	- Autoclave, incinerator & Municipal landfill	- Autoclave, incinerator & Municipal landfill

**Table 3.** Wastewater treatment plant in hospitals

Size & Type	Type of WWTP	Main problem
1. Big, G	Activated Sludge	WWTP maintenance and operation
2. Medium, G	Activated Sludge & Oxidation Ditch	No expertise operator & WWTP maintenance and operation
3. Medium, P	Activated Sludge / Aerated Lagoon	Same
4. Medium, P	Activated Sludge	Same
5. Small, P	Activated Sludge	Same

**Table 4.** Quantity of medical waste generated in hospitals

Size & Type	Type of waste	Quantity generated (kg/day)
1. Big, Government	Infectious waste	0.97 kg/day/bed (1352.08)
	Solid waste	3,000
	Hazardous waste	4 – 5
2. Medium, Government	Infectious waste	0.53 kg/day/bed (279)
	Solid waste	830
	Hazardous waste	3 – 5
3. Medium, Private	Infectious waste	0.17 kg/day/bed (100)
	Solid waste	300
	Hazardous waste	–
4. Medium, Private	Infectious waste	–
	Solid waste	–
	Hazardous waste	6.7 l/day (liquid chemical waste)
5. Small, Private	Infectious waste	0.17 kg/day/bed (29.89)
	Solid waste	–
	Hazardous waste	–

Note: – not available

## 5 Conclusions

The WMPs in hospitals are drawn from the investigation as follow:

1) All hospitals sent general waste or solid waste to the municipal landfill.

2) The handling of medical waste should be properly implemented within hospitals and sent off site for disposal.

3) An adequate infrastructure for collection and transportation of the waste within and from each hospital to treatment facilities should be provided.

4) A pollution prevention plan should be prepared and hospital staff should be trained on the plan's implementation.

5) The incinerator should be improved and inspected to reduce the impact on air quality problem.

6) WWTP should be inspected regularly and be required to solve occurring problems.

7) A manual for handling hazardous waste should be prepared to cope with this waste in hospitals. The small quantity of hazardous waste should be accumulated until sufficient quantity is stored for

transportation to the treatment and disposal facility that is located in the central part of Thailand, a long distance away, to avoid high cost of disposal.

8) The quantity of infectious waste in big hospitals is a higher rate (0.97 kg/day/bed) than that in medium hospital (0.17 – 0.53 kg/day/bed) and small hospital (0.17 kg/day/bed).

9) The standard operating procedure (SOP) that contains the outline of handling method, how collection, segregation, treatment and disposal as well as the regulation for segregation of infectious waste from hazardous waste should be clearly developed and operated.

10) Assigned agency should visit and inspect hospital's treatment facilities such as incinerators and wastewater treatment plants in order to improve the efficiency of these facilities and to solve problem when they occur.

11) Moreover, a website to promote efficient dissemination of information and to improve existing medical WMPs as well as to reduce environmental pollution and health hazards in the region should be done.

In conclusion, based upon the result of this study, it is recommended that the procedure of the

best WMPs in hospital should be provided as the SOP for implementation by the hospital staff. Moreover, the laws and regulations related to segregation of infectious waste from hazardous waste should be urgently imposed.

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