AWARENESS AND MANAGEMENT OF HOSPITAL WASTE IN DEVELOPING COUNTRIES: A CASE STUDY IN THAILAND

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Abstract

AWARENESS AND MANAGEMENT OF HOSPITAL WASTE IN DEVELOPING COUNTRIES: A CASE STUDY IN THAILAND

Hospitals and medical health centers are places to diffuse disease. Infectious situations at hospitals should be a primary concern. Hospital waste may cause many things to be at risk and lost, including human life, environmental health and funds. Thailand is a country that has been very active in the field of healthcare industries during the past ten years. Currently, there is no research that covers hospital waste management programs in the Thai healthcare industries. Therefore, this researcher has conducted a study in "Awareness and Management of Hospital Waste in Developing Countries: A Case Study in Thailand," This study includes four objectives: 1) to examine the status of hospital waste management and assessments of the hospital waste management process in Thai healthcare industries: 2) to identify the factors affecting the assessment of hospital waste management in Thailand: 3) to compare the standard criteria for hospital waste management in Europe, the United States and developing countries, such as Thailand: and 4) to recommend a course of action for improving hospital waste management in Thailand.

This research is based on data collected from surveys. The population used to collect data consists of all hospitals located in the Bangkok Metropolitan area that have registered with the Ministry of Public Health and are still operating. The sample population is 55 hospitals. The data will be analyzed using descriptive statistics in order to explain the general characteristics of hospitals and information regarding organization characteristics used to assess the hospital waste management programs. The research will look at frequency distribution and present information in terms of

percentages. To test the research hypothesis, the researchers will test for factors that affect assessments of hospital waste management programs using the Multiple Regression Statistic Method.

The results show that most hospitals located in the Bangkok Metropolitan area have hospital waste management programs. For those hospitals that have hospital waste management programs, generally their program is not quite comprehensive. There are two factors that affect the score of comprehensive hospital waste management programs: 1) type of hospital, and 2) knowledge level of participant staff and employees. These factors relate to the score of comprehensive hospital waste management programs in Thailand. This relationship directly follows from the scores of the comprehensive hospital waste management programs, using a statistical significance of .05.

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Chapter 1 – Introduction

Hospitals and medical health centers are places for treating patients, but they can also be places to diffuse disease (Borg 2007). Hospital waste poses a risk for patients and personnel who handle these wastes. “Medical waste is infectious and hazardous. It poses serious threats to environmental health and requires specific treatment and management prior to its final disposal” (Hassan, Shafiul and Anisur 2008). “Hospital waste can be divided into two categories: specific hospital waste and other hospital waste. Specific hospital waste includes human anatomic remains and organ parts, waste contaminated with bacteria, virus, fungi, and larger quantities of blood” (Incineration of hospital wastes 2007). Therefore, “it is a requirement that hospitals and other areas that generate clinical waste comply with good practice and legislation regarding its disposal” (Phillips 1999). Waste is more than just rubbish to be disposed of and forgotten (Technical guideline on the environmentally sound management of biomedical and healthcare and healthcare waste 2000). The waste produced in the course of health care activities “carries a higher potential for infection and injury than any other type of waste. Therefore, wherever it is generated, safe and reliable methods for its handling are essential. Inadequate and inappropriate handling of healthcare waste may have serious public health consequences and a significant impact on the environment” (Giroult, Pruss and Rushbrook 1999). Hospital waste management means the management of waste produced by hospitals using techniques that will help to check the spread of disease. Waste can present risks to the health and safety of workers, members of the public, and the environment (Garner 1996). “Poor management of clinical waste exacerbates the risk of infection for those exposed to it,

compromises hospital hygiene and has infection control applications" (Blenknarn 2007, 177-178).

1.1 Statement of Problem

Today, many developed countries have legal provisions with regard to proper management of hazardous waste. The United States of America (USA) and European countries also attend the proper operation of hazardous waste management. The hospital waste management system in Thailand does not dispose of infectious waste effectively, because the process does not run as well as it can at each step. Every step in the hospital waste management system is considered an important part of hospital waste management operation. The major steps include segregation, handling, transportation and disposal of infectious waste.

Segregation is a very important step in waste management, as "segregation errors present a threat to those managing wastes further along in the disposal chain. This is not a new problem" (Taylor 1988, 57-58). Effective segregation at the source is a key factor in the waste management strategy and it will enable hospital authorities to save on waste disposal costs. Hospital waste is usually divided into two types: noninfectious waste and infectious waste. The waste management process for each type is completely different. The noninfectious waste can be disposed of with normal waste, but infectious waste has to be disposed of in a specific way. What constitutes 'infectious waste' is defined differently in every country, which makes for varied treatment systems.

Recently, the number of hospitals in Thailand has increased rapidly to serve the people. Bangkok is the capital city and also the economic center of Thailand. Its commercial, industrial and service activities have caused an expansion of the city.

Hospitals and medical health centers in Bangkok are continually expanding. Asian patients have believed and expected to get the best healthcare service and treatment from Thai hospitals. Moreover, the cost of treatment is still cheaper than in other countries in this region. The number of foreign patients who come to be treated in Thai hospitals is increasing every year and makes for an increasingly large amount of hospital waste. Thus, hospital waste management systems must to operate correctly. Unfortunately, there are not any studies that compare hospital waste management between developing countries, such as Thailand, and developed countries such as the United States or European countries. For this reason, this study will research and compare hospital waste management systems in Thailand, the United States, and European countries. This includes the management characteristics of hospital waste in Thailand and the level of efficiency of infectious waste management systems operating in hospitals located in Bangkok. Are they following the proper international standards? Thus, all of the sample hospitals are located in Bangkok and the metropolitan region.

The results are used to set new criteria for improvement of the hospital waste treatment system and, moreover, to determine how to make the treatment process run more efficiently. The final results from this research will be used for suggestions and recommendations on the new method and criteria for improving the standards, procedures and policies in the Thai hospital waste treatment system.

1.2 Research Objectives

1. To examine the status of hospital waste management and assessments of the hospital waste management process in Thai healthcare industries.

2. To identify the factors affecting the assessment of hospital waste management in Thailand.

3. To compare the standard criteria for hospital waste management in Europe, the United States and developing countries such as Thailand.

4. To recommend a course of action for improving hospital waste management in Thailand.

1.3 Research Hypothesis

1. Different sizes of hospitals will affect the different hospital waste management systems.

2. Different hospital types will affect the different hospital waste management systems.

3. Different organizational policy and strategy concerns will affect the different hospital waste management systems.

4. Different knowledge levels of participant staff will affect the different hospital waste management systems.

1.4 Limitations of the Research and the Conceptual Framework

This research collects information to form a comparison between the standard criteria for hospital waste management in Europe, the United States and Thailand. The hospitals used are located in the Bangkok metropolitan area and have at least 30 beds. The research information is collected from all governmental and private hospitals

located in the Bangkok metropolitan area. All hospitals have registered with the Ministry of Public Health, Thailand and are now still operating. The information was gathered between the years 2005 and 2008. The following factors were studied:

1. Dependent variable: the hospital waste management

2. Independent variables: the size of hospital, the type of hospitals, the knowledge levels of participant staff, the organizational policy and strategy concerns.

The scope of Conceptual Framework is shown in Figure 1-1.

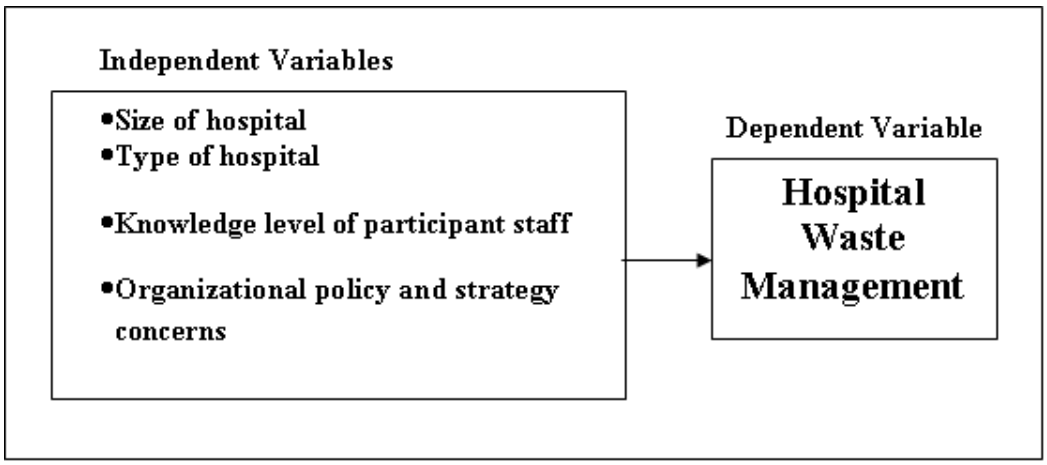

Figure 1-1: Scope of Conceptual Framework

1.5 Definition of Technical Terms

1. The "size of hospital" refers to the number of patient beds that the hospital or healthcare entrepreneur has registered with the Department of Healthcare, Ministry of Public Health, Thailand. The hospitals are divided into the following three groups:
   - 'Small' refers to a hospital with less than 50 patient beds registered.

- ‘Medium’ refers to a hospital with more than 50, but less than 200 patient beds registered.

- ‘Large’ refers to a hospital with more than 200 patient beds registered.

2. The “type of hospital” refers to the characteristics of the hospital that is registered. Hospitals are divided into two groups: government hospitals and private hospitals.
3. “Hospital waste management” refers to the completeness of the hospital waste management process that has followed the regulations and standards from the following:
    - National Institute for Occupational Safety and Health (NIOSH), United States of America

    - United States Environmental Protection Agency (EPA)

    - World Health Organization (WHO), European region

    - Ministry of Public Health, Thailand

4. “Hospital waste” refers to “all wastes produced by hospitals, including infectious and non-infectious waste materials, hazardous wastes and chemicals, and other non-hazardous wastes. Medical waste is often considered to be a subcategory of hospital waste and indicates potentially infectious waste that is produced from healthcare facilities” (Jang et al. 2006).

5. “Clinical waste” refers to any waste which consists wholly or partly of human or animal tissue, blood or other body fluids, excretions, drugs or other pharmaceutical products, swabs or dressings, syringes, needles or other sharp

instruments, which unless rendered safe, may prove hazardous to persons coming into contact with it. It also includes any other waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, care, treatment, teaching or research or the collection of blood for transfusion, which may cause infection to any person coming into contact with it.

6. “Medical waste” refers to all waste materials generated at health care facilities, such as hospitals, clinics, physician’s offices, dental practices, blood banks, and veterinary hospitals or clinics, as well as medical research facilities and laboratories.

1.6 Expected Benefits

The first expected benefit is to use the standard comparison of hospital waste management between Europe, the United States and Thailand. This information would be especially helpful as a guideline for improving and developing the hospital waste management standard criteria in Thailand for effectiveness and efficiency in the future.

The second expected benefit is to use the assessment of hospital waste management as a guideline for resolving problems with the hospital waste management process in Thailand and to give the recommendations to the Thai government, healthcare authorities, private healthcare industries, and those interested in improving their existing hospital waste management strategies and standards.

Chapter 2 – Literature Review

Hospitals are institutions providing various healthcare services to the community. Their activities may include curative, rehabilitation, prevention, patient care services and promotion of health education. “It is the duty of hospitals and health care establishments to look after the public health; this may be directly, through patient care, or indirectly by ensuring a clean, healthy environment for their employees and the community” (Patil and Pokhrel 2005). The management of hospital waste is of the utmost importance due to its potential environmental hazards and public health risks. “To realize sustainable development within hospitals, it is necessary that the need to maintain a balance between effective infection control and a good ecological environment is recognized and supported by health care workers and hospital management” (Daschner and Dettenkofer 1997). In undertaking these activities, the hospital may also produce wastes both from medical and non-medical activities. The infectious components in the hospital wastes could pose a potential risk to patients, neighboring communities, hospital staff, visitors and even the surrounding environment. “Hospital waste is also a special category of waste, which is highly hazardous due to its infectious and/or toxic characteristics. Waste production depends on the hospital‘s capacity, the number of medical staff, and the applied practices” (Tsakona, Anagnostopoulou and Gidarakos 2006). Mehtar states that “infection control programs are cost-effective in the long-term but require serious commitment on the part of management to make the most effective use of them” (Mehtar 1995, 26-27). Despite the fact that current medical waste management practices differ from hospital to hospital, the problematic areas are approximately the same for all hospitals or healthcare units and at all stages of waste management, including segregation,

collection, packaging, storage, transport, treatment and disposal. “Although the health care units or hospitals have existing waste management, there are some problems that arise from poor management of medical waste, which may include damage to humans. Thus, the management of medical waste is a subject of major concern for any regulatory agency” (Giroult, Pruess and Rushbrook 1999). “Inadequate waste management can lead to environmental pollution, unpleasant smell, growth and multiplication of insects, rodents and worms and may lead to the transmission of diseases like typhoid, cholera, hepatitis and AIDS through injuries from syringes and needles contaminated with human blood” (Henry and Heinke 1999). “Hence, collection and disposal of waste in the proper manner is of great importance as it can directly and indirectly decrease health risks to people and damage to flora, fauna, and the environment” (Draft Guideline for Environmental Infection Control in Healthcare Facilities 2001).

2.1 The Definition and Classification of Hospital Waste

“The definitions and classifications of hospital waste have been discussed elsewhere” (Collins and Kennedy 1993). Healthcare and medical waste consists mainly of two types: Infectious wastes (cotton, gloves, syringes, and others) and pathogenic wastes, (sharps and pharmaceutical wastes, chemical wastes and pressurized containers). These are generated in wards, X-ray departments, operating theatres, pharmacies, and laboratories. Mohee R. (2005) found that “around 90% of hospital waste consisted of general wastes that had properties similar to domestic waste. The remaining 10% was infectious and hazardous wastes” (Mohee 2005). Preuess et al. (1999) also found that “10-25% of healthcare waste was termed as infectious, pharmaceutical, radioactive or chemical, which may pose a variety of

health and environmental risks." "To achieve safe waste disposal in hospitals, it is important to consider the classification, potential hazards and methods of disposal for different kinds of waste" (Daschner and Dettenkofer 1997). It is important to point out that the term 'medical waste' has often been used interchangeably with other terms such as 'hospital waste' and 'infectious waste' around the world. 'Hospital waste' is a broader definition and refers to all wastes generated by hospitals, including infectious and non-infectious waste materials, hazardous wastes and chemicals, and other non-hazardous wastes. "Medical waste is often considered to be a subcategory of hospital waste and indicates potentially infectious waste that is produced by healthcare facilities" (Klangsin and Harding 1998).

"Too much clinical or hospital waste is wrongly considered to be infectious and hazardous, which results in special, costly and unnecessary treatment" (Daschner 1993). "Infectious waste is essentially waste that contains hazardous properties that may render it harmful to human health or the environment" (Department of Pollution Control, n.d.). "Only waste that is capable of initiating infectious diseases should be considered infectious" (Blenkharn 1995, 514-515). Chaerul et al. (2008) states that "Ambiguity of definitions of infectious waste might lead to mismanagement of the waste, especially in the process of segregation between general and infectious waste." "This segregation process is considered the most important step in the hospital waste management chain" (Bangkok Metropolitan Administration, n.d.). "There must be a greater emphasis on ensuring that wastes are correctly segregated at the source, rather than relying on steps further along in the waste treatment process" (Thornton 2003). "Initial segregation and storage activities are the direct responsibility of nursing personnel who are engaged in the hospital. If the infectious component gets mixed with the general non-infectious waste, the entire mass becomes potentially infectious"

(Nugget 2003). Segregation of clinical and domestic wastes in healthcare settings is important to avoid accidents and litigation and to contain costs.

Evidence that the majority of clinical waste is a significant hazard to the public is lacking. "More research still needs to be done in the area of clinical waste management to assess the real risks and hazards of this waste" (Rutala and Mayhall 1992). If waste is separated inappropriately and incorrectly, it could cause a serious problem for public health and the environment. "The accurate segregation of wastes into infective and non-infective components is prone to error. Incorrect classification and improper segregation of waste may increase associated risks to ancillary staff and contractors" (Blenkharn 2005, 295-297). Practical segregation at the source is the main factor in waste management strategies and it will enable medical facilities or healthcare authorities to save money on the cost of waste disposal.

Segregation errors present a threat to those managing wastes further along the disposal chain. The proper running of the infectious waste management chain depends on the segregation step. Infectious and non-infectious wastes should be separated at the point of generation. "If the infectious waste contains non-infectious hazards, it should be identified and subjected to additional treatment" (Isolation Techniques for Use in Hospitals 1991). "Proper segregation will significantly reduce the quantity of infectious medical waste. Infectious medical waste should be discarded directly into containers or plastic bags that are clearly identifiable and distinguishable from the stream of municipal solid waste" (Granuzzo 1999). "Plastic bags should be leak-proof and puncture-resistant. In the process of health care, waste is generated that usually includes sharps, human tissues or body parts and other infectious materials" (Baveja, Muralidhar, and Aggarwal 2000, 485-486).

2.2 Hospital Waste Management in Other Countries

Hospital waste management is becoming an increasingly complex matter, not only in developing countries, but also in developed countries. Improving technology and recycling schemes are often insufficient to counter growing hospital waste production, obsolescence of existing hospital waste management facilities, shortage of space for construction of new facilities and lack of education or knowledge concerning effects on the health and well-being of participant staff. Laws and regulations in various countries often use the terms ‘infectious waste’, ‘clinical waste’ and ‘health care waste’ interchangeably. This can lead to problems, as it is essential to understand what the regulation regards as clinical waste and as non-clinical waste. “Various definitions in each country result in different waste management strategies. It is important to draw up a waste management strategy” (Moritz 1995). “In a healthcare setting, the law requires that clinical waste arising from the treatment, investigation or medical care of patients be disposed of in such a manner that it affords adequate protection to staff, patients and the public” (Gifford 1997, 160-162). There are practical considerations in relation to selecting the right process for waste disposal, which result from a clear understanding of the definitions of waste. Each country has its own policies or strategies for controlling waste management. There are three major governing bodies the United States, the European Union, and the United Kingdom that are used as the standard in waste management regulations for comparison with developing countries, such as Thailand. The standards of each of these are described below.

2.2.1 The United States of America

Nowadays, every state and local government in the United States has issued laws and regulations for hospital waste management, following the standard of the National Institute for Occupational Safety and Health (NIOSH) and the Environmental Protection Agency (EPA). “To ensure public safety, federal laws require that infectious waste be segregated from non-infectious waste” (Neely, Maley, and Taylor 2003). These regulations are strictly enforced in every hospital and health care center.

In the United States, “medical waste is defined as all waste materials generated at health care facilities, such as hospitals, clinics, physicians’ offices, dental practices, blood banks, and veterinary hospitals or clinics, as well as medical research facilities and laboratories” (US Environmental Protection Agency, n.d.).

Other laws, such as the Medical Waste Tracking Act of 1988 (MWTA), define medical waste as “any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production of testing biological.” This definition includes, but is not limited to the following: blood-soaked bandages; culture dishes and other glassware; discarded surgical gloves; discarded surgical instruments; discarded needles used to give shots or draw blood; cultures, stocks, or swabs used to inoculate cultures; removed body organs; discarded lancets (Medical Waste Tracking Act, n.d.).

There are six major steps in the hospital waste management chain. Each of these categories is discussed briefly below (National Institute for Occupational Safety and Health n.d.).

1. *Segregation* is the first procedure and separates the disposal waste into ‘infectious waste’ and ‘noninfectious waste.’ Wastes should be separated at the point of generation. If the infectious waste contains noninfectious

hazards, it should be identified and subjected to additional treatment. Infectious waste should be discarded into clearly identifiable containers or plastic bags that are leak-proof and puncture-resistant. Red or orange bags are usually used for infectious waste. The containers should also be marked with the universal symbol for biological hazards.

2. *Identify the types of infectious waste* is the second steps. The classification of hazardous health care waste is summarized as follows:

    - *Isolation wastes* are those generated by patients who are isolated because of communicable diseases.
    - *Cultures and stocks of infectious agents and associated biologicals* include specimen cultures from medical and pathological laboratories, cultures and stocks of infectious agents from research and industrial laboratories, wastes from the production of biologicals, discarded live and attenuated vaccines, and culture dishes and devices used to transfer, inoculate, and mix cultures.
    - *Human blood and blood products* include blood as well as serum, plasma, and other blood products.
    - *Pathological wastes* include tissues, organs, body parts, and body fluids that are removed during surgery and autopsy.
    - *Contaminated sharps* are hypodermic needles, syringes, Pasteur pipettes, broken glass, and scalpel blades. These items should be considered infectious wastes because of the possibility of contamination with blood-borne pathogens.

- *Contaminated carcasses, body parts, and bedding* emanate from animals intentionally exposed to pathogens during research, the production of biologicals, or the *in vivo* testing of pharmaceuticals.
- *Miscellaneous wastes* that are not designated as infectious should be assumed to be infectious and managed as such to maintain consistent levels of protection for both the environment and for persons handling these wastes. Miscellaneous wastes include those from surgery and autopsies, contaminated laboratory wastes, dialysis unit wastes, and contaminated equipment.
    - *Wastes from surgery and autopsies* include soiled dressings, sponges, drapes, lavage tubes, drainage sets, underpads, and surgical gloves.
    - *Contaminated laboratory wastes* include specimen containers, slides and cover slips, disposable gloves, laboratory coats, and aprons.
    - *Dialysis unit wastes* include contaminated disposable equipment and supplies such as tubing, filters, disposable sheets, towels, gloves, aprons, and laboratory coats.
- *Contaminated equipment* refers to discarded equipment and parts that are used in patient care, medical and industrial laboratories, research, and the production and testing of certain pharmaceuticals.

3. *Packaging* is the third procedure of healthcare waste management chain. Infectious wastes should be contained from the point of origin to the point at which they are no longer infectious. The packaging should be

appropriate for the type of waste involved, and it must endure handling, storage, transportation, and treatment. Liquid infectious wastes can be placed in capped or tightly stoppered bottles or flasks. Large quantities may be placed in containment tanks. Moreover, solid or semisolid wastes may be placed in plastic bags.

4. The next step is *handling and transportation*. When the waste is to be moved about for treatment or storage, special handling or packaging may be necessary to keep bags intact and to ensure containment of the waste. The following procedures are recommended:

    - Single-bagged waste and containers of sharps and liquids should be placed within a rigid or semirigid container such as a bucket, box, or carton lined with plastic bags.
    - Containers should be covered with lids during transportation and storage.
    - When handling or transporting plastic bags of infectious waste, care should be taken to prevent tearing the bags. Instead of chutes or dumbwaiters, carts should be used for transporting bags of infectious waste within the facility.
    - Carts and recyclable containers that are used repeatedly for transport and treatment of bagged waste should be disinfected after each use. Single-use containers should be destroyed as part of the treatment process.

- Infectious waste should not be compacted before treatment. This process could damage the packaging and disperse the contents, or it could interfere with the effectiveness of treatment.
- Outside the hospital, infectious waste should be transported in closed, leakproof dumpsters or trucks.
- The waste should be placed in rigid or semirigid leakproof containers before being loaded onto trucks.

5. *The Storage step* is the fifth step in the healthcare waste management chain. Standards for the storage of infectious waste are described below.

    - Infectious waste should be stored for a minimum amount of time and should be packaged securely enough to ensure containment of the waste and to prevent penetration by rodents and vermin.
    - Limited access to the storage area is recommended.
    - The universal biological hazard symbol should be posted on the storage area door, waste containers, freezers, or refrigerators.
    - Containers for biohazardous material should be a distinctive red or orange color.

6. *Treatment and disposal* are the sixth step and a necessary part of the healthcare waste management chain. Several methods are used for infectious waste treatment, depending on the type of waste material.

NIOSH recommends acceptable treatment methods for the various types of wastes, which are listed in Table 2-1.

Table 2-1: Recommended Techniques for Treatment of Infectious Wastes*(EPA 1986)

Type of infectious waste	Recommended treatment techniques[†]				
	Steam sterilization	**Incineration**	**Thermal inactivation**	**Chemical disinfection[§]**	**Other**
Isolation wastes	X	X			
Cultures and stocks of infectious agents and associated biologicals	X	X	X	X	
Human blood and blood products	X	X		X	X**
Pathological wastes	X[††]	X			X[§§]
Contaminated sharps	X	X			
Contaminated animal wastes:					
Carcases and parts	X[††]	X			
Bedding		X			

*Taken from EPA (1986).
[†]The recommended treatment techniques are those that are most appropriate and are generally in common use; an alternative treatment technique may be used to treat infectious waste if it provides effective treatment.
[§]Chemical disinfection is most appropriate for liquids.
**Discharge to the sanitary sewer for treatment in the municipal sewage system (provided that secondary treatment is available).
[††]For aesthetic reasons, steam sterilization should be followed by incineration of the treated waste or by grinding with subsequent flushing to the sewer system in accordance with State and local regulations.
[§§]Handling by a mortician (burial or cremation).

2.2.2 European Union

All countries who are members of the European Union (EU) have set waste management regulations following the criteria of the World Health Organization. There were 53 member countries in 2007.

The World Health Organization states that “Healthcare waste includes all waste that is generated by healthcare waste establishments, research facilities, and laboratories. In addition, it includes the waste originating from “minor” and

"scattered" sources, such as that produced in the course of health care undertaken in the home (dialysis, insulin injections, etc.)." and "Healthcare waste (HCW) is a by-product of healthcare that includes sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials" (WHO 2008).

Clinical waste is defined in the Controlled Waste Regulations 1992 (SI588) as

(a) " Any waste which consists wholly or partly of human or animal tissue, blood or other body fluids, excretions, drugs or other pharmaceutical products, swabs or dressings or syringes, needles or other sharp instruments, being waste with unless rendered safe may prove hazardous to persons coming into contact with it; and

(b) Any other waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, care, treatment, teaching or research or the collection of blood from transfusion, being waste which may cause infection to any person coming into contact with it." (Controlled Waste Regulations 1992)

The classification of hazardous healthcare waste is summarized by the World Health Organization as shown in Table 2-2.

Table 2-2: WHO Categories of Health-care Waste

Waste category	Description and examples
Infectious waste	Waste suspected to contain pathogens e.g., laboratory cultures; waste from isolation wards; tissues (swabs), materials or equipment that have been in contact with infected patients; excreta
Pathological waste	Human tissues or fluids, e.g., body parts; blood and other body fluids; fetuses
Sharps	Sharp waste; e.g., needles; infusion sets; scalpels; knives; blades; broken glass
Pharmaceutical waste	Waste containing pharmaceuticals; e.g., pharmaceuticals that are expired or no longer needed; items contaminated

	by or containing pharmaceuticals (bottles,boxes)
Genotoxic waste	Waste containing substances with genotoxic properties; e.g., waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals
Chemical waste	Waste containing chemical substances; e.g., laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances; e.g., unused liquids from radiotherapy or laboratory research; contaminated glassware, packages or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources

"Some wastes are harmful to human health or to the environment, either immediately or over an extended period of time. These are called 'hazardous wastes', and also include clinical waste that, unless made safe, could be hazardous to anyone who comes into contact with it; that consists wholly or partly of human or animal tissue, blood or other body fluids, excretions, drugs or other pharmaceutical products" (Coad and Christen 1999). There are several procedures used for controlling hospital waste management. There is a considerable body of legislation governing every stage of the clinical waste disposal process, in both the EU and the UK.

It is critical for hospitals and other medical facilities to have a written waste strategy document, and to move towards appointing waste management officers with a good working knowledge of this legislation. This is very important, because of the introduction of duty of care. It will also pay for itself in economic terms, because it will ensure the introduction of a streamlined waste policy, where segregation at the source plays a central role. World Health Organization (WHO) has defined the waste stream that can be segmented schematically into eight steps. The waste stream must be consistent from the point of generation to the point of final disposal.

Step 1: *Waste Minimization*: This step comes prior to the production of waste and aims to reduce the amount of healthcare waste as much as possible. It will be produced by having good stock management and setting up an efficient purchasing policy.

Step 2: *HCW Generation*: This is the point at which waste is produced.

Step 3: *Segregation and Containerization*: This includes correcting segregation of waste at the point of generation and relies on a clear definition of the different categories of waste and disposal of the waste in accordance with the categorization chosen. Segregation must be done at the point of generation. To encourage segregation at the source, (reusable) containers or baskets with liners of the correct size and thickness are placed as close to the point of generation as possible. They should be properly color-coded (yellow or red for infectious waste) and have the international infectious waste symbol clearly marked. When they are three quarters full, the liners should be closed with plastic cable ties or string and placed into larger containers or liners at the intermediate storage areas. Suitable latex gloves must always be used when handling infectious waste.

Step 4: *Intermediate Storage*: In order to avoid both the accumulation and decomposition of the waste, it must be collected on a regular daily basis. The area where the larger containers are kept before removal to the central storage area should be close to the wards, but not accessible to unauthorized people such as patients and visitors.

Step 5: *Internal Transportation*: Transport to the central storage area is usually performed using a wheelie bin or trolley. Wheelie bins or trolleys should be easy to

load and unload, have no sharp edges that could damage waste bags or containers and be easy to clean. Ideally, they should be marked with the corresponding coding color. The transport of general waste must be carried out separately from the collection of risk healthcare waste to avoid potential cross contamination or mixing of these two main categories of waste. The collection should follow specific routes through the healthcare facility to reduce the passage of loaded carts through wards and other clean areas.

Step 6: *Centralized Storage*: The central storage area should be sized according to the volume of waste generated as well as the frequency of collection. The facility should not be situated near food stores or food preparation areas and its access should always be limited to authorized personnel. It should also be easy to clean, have good lighting and ventilation, and be designed to prevent rodents, insects or birds from entering. It should also be clearly separated from the central storage area used for general healthcare waste in order to avoid cross-contamination. Storage time should not exceed twenty-four to forty-eight hours, especially in countries that have a warm and humid climate.

Step 7: *External Transport*: This should be done using dedicated vehicles. They should be free of sharp edges, easy to load and unload by hand, easy to clean and disinfect, and fully enclosed to prevent any spillage in the hospital premises or on the road during transportation. The transportation should always be properly documented and all vehicles should carry a consignment note from the point of collection to the treatment facility.

Step 8: *Treatment and Final Disposal*: There are various treatment options to use, but these depend on the type of infectious waste.

In the United Kingdom, the laws and regulations for hospital or health care waste management are defined by the government. The Environment Agency (EA) is the administrative unit that has the responsibility of issuing the national standard. Every hospital and health care center in the UK must strictly follow this standard.

2.2.3 Thailand

In Thailand, the generation of medical waste has increased in variety and quantity. Healthcare and medical wastes have increased in the past fifteen years due to the increased size and number of hospitals and healthcare facilities, medical service centers and use of disposable medical products. The management of medical wastes has become a major concern due to the potentially high risks to human health and the environment in Thailand. Thailand is divided into seventy-six provinces and the capital city is Bangkok. In the past, medical waste was often mixed with household waste and disposed of in municipal solid waste landfills; the same was true for other developing countries in Asia. In recent years, increased public concern over the improper disposal of medical waste has led to a movement to regulate the waste more systematically and stringently. Hospital and healthcare waste management falls under the responsibility of the Ministry of Public Health and the Department of Pollution Control at the Ministry of Environment. Nowadays the policies and regulations for hospital waste management in Thailand are set by referencing WHO standards. Several guidelines on management and segregation of hospital waste that are directly relevant to the health institutions in Thailand contain the WHO framework. Proper

training must be given to hospital employees to develop an awareness of health, safety and environmental issues. It is important for workers to know and understand the potential risks associated with healthcare wastes, and the importance of consistent use of personal protection equipment.

In Thailand ‘infectious waste’ is defined as waste that is contaminated with disease in a small or concentrated amount. There are risks of harm to human life if anyone comes in contact with it. This includes wastes that are generated from medical treatments, medical research, laboratories, immunizations, and human and organ studies. ‘Medical waste’ refers to any potentially infectious wastes that are generated in the diagnosis, treatment, examination or research by general hospitals, clinics, veterinary offices, and research centers.

Classifications of healthcare waste in Thailand are defined by the Ministry of Public Health as follows (Department of Healthcare, Ministry of Public Health, n.d.).:

1. Tissue: Human or animal pathological waste, including tissues, organs, blood, pus, and body parts and fluids that are removed during autopsy or surgery.

2. Absorbent cotton: Items (e.g., cotton pads, bandages, disposable diapers, or bedding) saturated or stained with human or animal blood, pus, discharge, or secretion.

3. Discarded medical plastics: Disposable syringes, IV bags, blood bags or waste from blood dialysis.

4. Pathological waste: Culture and stocks of infectious agents from tests or examinations, culture dishes, discarded blood fluids and containers, items that were in contact with infectious agents, such as used slides and cover glass.

5. Waste sharps: Discarded sharps, hypodermic needles, syringes, surgical blades and blood lancets.

6. Waste mixed with infectious waste: Wastes that are not classified into the above categories, but are mixed or in contact with waste classes (1) through (5) above.

The Ministry of Public Health in Thailand has also issued the major steps for the healthcare waste management stream as follows:

1. Collection/segregation/packaging
2. Handling and storage
3. Transportation
4. Disposal and Treatment

Moreover the Department of Pollution Control has also issued regulations for healthcare waste management, which are described below:

- Healthcare waste that is generated by hospital establishments can be managed by the establishment itself or by an outside waste contractor.

- The healthcare waste contractor must have the certificate for handling through disposal. This certificate is issued by the Department of Pollution Control.

- Contractors for healthcare waste management have been monitored by the Department of Pollution Control frequently and also have to operate following strict regulations.

- Every healthcare facility where infectious waste is generated must follow strict regulations.

- Disposal and treatment processes of healthcare waste can be managed by themselves or operated by a waste contractor or private company.
- Every healthcare facility should have at least one of the disposal places for healthcare waste.
- Monitor the disposal management process of the hospital or healthcare center.
- Employ at least one staff person who has background knowledge in science to operate the system for handling and disposal of healthcare waste.
- Set the time schedule, route of transportation, constraints, and rules of transportation following the regulations.
- The packages for collecting and handling of healthcare waste must meet regulations.
- The storage facilities in the hospitals have to meet the standard requirement.
- Have regulations and instructions for cleaning the cart, trolley, truck, and storage places.
- For transportation, train drivers regularly, use the international symbol for infectious waste on trucks and have those vehicles meet the waste safety standard program.
- Have safety tools and necessary equipment for operating staff.
- Dispose of infectious waste within 30 days.

- The participant staff will get training and certification and must wear a safety suit.
- The cost of the disposal of infectious waste must be set and follow the government standard.

2.3 Related Research on Hospital Waste Management

M. Muhlich et al. (2003) conducted research by using a questionnaire as a tool for collecting the regulations and strategies data were relevant to waste management from five hospitals, located in five different countries. There were two main groups. The first group consisted of large university hospitals, and the second group was small regional hospitals. The result of this research was that the different hospitals also revealed different strategies for defining infectious hospital waste. Moreover, the differences in the infrastructure were economically and ecologically affected with waste segregation and disposal step (Muhlich, Daschner, and Scherrer 2003)

Robert Garcia (1999) researched hospital waste management at the Brookdale University Hospital and Medical Center (BUHMC) of Brooklyn, New York. Red-bagging of waste containers is used increasingly to reduce the risk of medical waste. It absolutely makes disposal cost more. However, the Assistant Director of Infection Control also set new strategies for improving all waste management system plans to operate more efficiently and reduce disposal cost. Goals should include establishing a practical and understandable policy, standardizing waste container usage and location, increasing the knowledge and motivation of employees, and controlling costs. The effect of these strategies revealed that the Brookdale University Hospital and Medical Center (BUHMC) can effectively reduce costs by using these strategies for the

management of regulated medical waste. As a result, the new strategies can improve operating performance, increase the knowledge and motivation of employees, and effectively reduce the cost of management of hospital wastes (Garcia 1999).

Another study, in the United Kingdom, used questionnaires as a tool for collecting useful information about the policies and procedures for controlling infection. E.T.S. Houang and R. Hurley (1997) conducted research by questionnaire survey at Chelsea Hospital in London. The research assessed the extent to which the hospital's medical and nursing staffs were familiar with the written policies and procedures regarding infection control. The research revealed that nurses were significantly more familiar with written policies and procedures than other medical staff. Many hospital staff members were uncertain about practical details of policies and procedures regarding infection control. Ways to motivate and educate about the national standardization of policies and procedures regarding infection control is also desirable for hospital staff members (Houang and Hurley 1997)

There is another research study about the treatment of infectious waste arising from home health and medical care services in Japan, conducted by Mayazaki et al. (2007) In recent years, the establishment of home health and medical care services (HHMC) has become a basic requirement for the population in Japan at large. HHMC waste materials are collected in a mixed form, and transported and disposed along with municipal solid wastes. Both medical devices and instruments are used while treating patients at home, thereby producing a variety of waste materials. S. Naito (1987) suggested that infectious waste materials from hospitals and clinics (medical institutions) are included in industrial waste classification, and are categorized as a type of hazardous waste material (Naito 1987). In Japan, 'infectious wastes' are defined as waste materials generated in medical institutions as a result of medical care

or research that contain pathogens with the potential to transmit infectious diseases (Management of infectious waste, Japan 2004). Questionnaires were used as a tool for collecting data in this research and were mailed. The results recommended that the Japanese Ministry of Environment has to determine safe and effective management strategies for municipal workers dealing with HHWC waste material, and prevent them from needle prick accidents. Hence, one of the most significant strategies for medical-related facilities is the education of patients and their families. Moreover, improved rules for handling HHMC waste materials are also essential for safe and effective management.

Alumneff and Memish (2003) did research on “effective medical waste management, to show that it can be done.” The authors noticed that the infectious waste problem in developing countries like Saudi Arabia is usually caused by the lack of a universally-accepted definition of ‘infectious’ rather than by financial and technical difficulties (Halbwachs 1994). The waste management plan was introduced**.** It included education, mandatory in-service training, and auditing the volume and type of waste that is generated. As a result, an effective waste management plan can rapidly reduce the amount of infectious medical waste by segregating it from general waste at its point of generation. It also leads to a 50% reduction in total financial costs, and minimizes health risks and costs of environmental hazards.

D. Hagen et al. (2001) also did research about quality improvement in hospitals in Saudi Arabia by using infectious waste surveys. The research team began to study and analyze the composition of the infectious waste stream by weight in order to better segregate waste, reduce disposal costs, reduce the load on the hospital incinerator, identify inappropriate items having significant cost or safety implications, and provide a safer work environment for housekeepers. The four infectious waste analyses were

conducted between 1991 and 1999. Infectious wastes were reduced 65% after implementation of the waste segregation program in 1991. Because of that, incinerator operation was reduced from daily to only three days per week. Moreover, a total of 70% of infectious wastes were reduced between 1991 and 1999. Regardless of the method of treatment and disposal, such surveys are valuable quality improvement tools, because all health care facilities want to reduce disposal costs and identify high-value items mistakenly discarded. The results of these surveys confirm that significant reductions can be made in infectious waste generation through education and segregation programs (Hagen, Al-Humaidi and Blake 2001).

M. Askarian et al. conducted research about hospital waste management in private hospitals in Fars Province, Iran. A questionnaire was used as a tool for collecting the information. The survey was carried out in all 15 private hospitals of Fars Province from the total number of 50 government and private hospitals located in this province, in order to determine the amount of different kinds of waste produced and the present situation of waste management. Private hospitals are less influenced by financial problems than governmental hospitals. There are not any training courses about hospital waste management and the hazards associated with them. The training courses that are provided are either ineffective or unsuitable. The study results indicated that private hospitals are more concerned about their quality than government hospitals and make capital investments, such as letting specialists assess the status of waste management in their facilities, compiling and enacting rules, establishing standards and providing effective personnel training (Askarian, Vakili and Kabir 2004).

Chaerul et al. (2008) also conducted research about “a system dynamics approach for hospital waste management.” The city of Jakarta, Indonesia was used as a case

study. A system dynamics model was developed to analyze hospital waste management. This case study represents hospital waste management in a developing country. The result revealed that the management of hospital waste generation is affected by various factors including the number of beds in the hospital. Waste segregation, as well as infectious waste treatment prior to disposal, has to be conducted properly by hospital waste management in order to minimize the risk to the environment and the public health (Chaerul, Tanaka and Shekdar 2008).

Bdour et al. (2007) conducted another assessment of medical waste management practice. In this research Jordan was chosen as an example with the focus on northern Jordan. A total of 14 healthcare facilities, including four hospitals and 10 clinical laboratories were surveyed. The research includes a survey of procedures available, techniques, and methods of handling and disposing of medical waste at medium to large size healthcare facilities located in Irbid city, Jordan. This study considered both the quantity and quality of the generated wastes to calculate generation rates and physical properties. A statistical method was used to develop mathematical models to predict the quantities of generated hospital wastes. Survey results showed that healthcare facilities have less appropriate practices when it comes to the handling, storage and disposal of waste generated in comparison to the developed world. There are no guidelines, methods, and regulations for segregation, classification, handling, and disposal of medical wastes. The research confirms that the number of patients, number of beds and hospital types were determined to be significant factors on generated hospital waste management (Bdour, Altrabshes, Hadadin and Al-Shareif 2007).

F. Abdulla et al. also conducted research in northern Jordan. The title is “site investigation on medical waste management practices”. Field visits were conducted

to provide information on the different medical waste management aspects from all 21 hospitals located in the study area. A comprehensive inspection survey focused on the level of medical waste segregation, treatment and disposal options practiced. The results showed that segregation of medical waste types in hospitals has not been conducted properly. The study revealed the need for training and capacity building programs for different levels of hospital staff from administrators and top managers to doctors and nurses, down to waste handlers and maintenance and incinerator operation staff involved in the medical waste management practices used by hospitals in northern Jordan (Abdulla, Abu-Qdais and Rabi 2008).

R. Mohee (2005) also studied about characteristics of medical waste in healthcare institutions. Mauritius is chosen as example. This research was commenced to characterize wastes generated in healthcare institutions and supply a framework for the safe management of these wastes. Three major medical institutions were surveyed. As a result, approximately 10% of solid wastes were hazardous in nature. The wastewater was polluted with chemical oxygen demand (COD) and biological oxygen demand (BOD) that was over permissible limits. The number of occupied beds has been related to the amount of hazardous wastes generated in healthcare institutions.

There are still other studies that compare hospitals in developed countries with those in developing countries. S.A. Nzoupe Ngounou (2004) showed that most Cameroonian hospitals have a waste management system, but there is no efficiency of operation when compared to those in developed countries, such as the United Kingdom. According to the study, members of the general public, as well as medical-related professionals and workers, lack awareness regarding the hazards of medical waste. Therefore, improvements in waste management in clinics and hospitals are urgently needed. (Ngounou and Viktor 2004)

Another study, done by J.I. Blenkharn in 2005, investigates the standards of clinical waste management in hospitals in the UK. Twenty-six hospitals providing almost 7,000 beds in London and elsewhere across south and south-east England were studied in this research. In these hospitals," the arrangements for bulk clinical waste handling were observed to obtain a snapshot of overall standards of performance. Storage of waste carts in areas freely accessible to the public and failure to lock individual containers were common. Many clinical waste carts and areas dedicated to their storage were in a state of disrepair. Substantial improvement is required in the management of clinical waste in hospitals in order: (1) to eliminate the possibility of acquired infection through unauthorized, inappropriate access to clinical waste and to minimize adverse effects resulting from contact with waste pharmaceuticals. Safe handling and secure storage of clinical waste in hospitals is an important part of good housekeeping and risk reduction. Clinical waste must be handled with care at all times. Waste carts should be well maintained and kept in locations that do not compromise safety, while security management must ensure that unauthorized access is prevented at all times. A site waste manager should carry overall responsibility for the management of clinical and other waste; (2) to comply with the Duty of Care imposed by UK Health & Safety legislation for ensuring that waste is properly managed to ensure the safety of its employees and of others; (3) to satisfy concerns regarding the general standard of hospital hygiene" (Blenkharn 2006, 300-303).

Yong-Chul Jang et al. (2006) have done research in the past concerning medical waste management in Korea. This research was gathered from surveys, letters, hospital visits, conversations with hospital authorities, and available literature. Medical waste in Korea had been regulated by medical laws under the Ministry of Health and Welfare until 1999. At that time wastes were often mixed with municipal

solid waste and disposed of with residential waste in improper treatment facilities. In recent years, the Ministry of Environment (MOE) was responsible for implementing the Korea national assembly modified waste management act. MOE promulgated several regulations for the definition, segregation, packaging, tracking, and disposal of medical waste. For the research results, the authors summarized the disadvantages as follows: 1) most of the hospitals used waste incinerators that were improperly operated and managed, and which emit toxic air pollutants, because medical waste typically contains a variety of plastic materials such as polyvinyl chloride (PVC); 2) since 1999, the waste has been classified into only two major categories-tissues that are stored individually and the rest of the waste-which are collected together before treatment. Advantages included the tracking system. Researchers found that wastes transported to outside disposal sites are monitored by a tracking system that shows where the waste goes. The tracking process has been operated by using the manifest system since 2002. Also, medical treatment facilities can register with the online manifest system. This online manifest system can track the movement of the waste and find the status of the waste in real time, saving energy, cost and time. Yong-Chul Jang et al. (2006) still "give some suggestions about the possibilities of using alternative treatment methods and promote minimizing the amount of waste, waste recycling and further studying the physical and chemical characteristics and categories of medical waste. Studying only two types (tissue and others) is not enough to development better waste management practices"(Yong-Chul Jang, Cargro Lee, Oh-Sub Yoon and Hwidong Kim 2006).

Chapter 3 – Methodology

This research will study the significant factors that affect the process of infectious waste management, using hospitals in Metropolitan Bangkok, Thailand as a case study. This research is a quantitative research study, using survey research and documentary research. The documentary research consists of a comparison between the standard criteria for hospital waste management in developed countries, such as the United States and the World Health Organization in the European Union, and developing countries such as Thailand. The survey research is used to examine and evaluate the hospital waste management process and to identify the factors that affect hospital waste management. It also examines the problems that make hospital waste management operate inefficiently by using a questionnaire as a tool for collecting information, opinions, and recommendations from the hospital waste management participant staff. This is done in order to determine the amount of different kinds of waste produced, problems and the present situation of hospital waste management.

3.1 Population and Samples

The population in this research consists of 55 hospitals located in Metropolitan Bangkok. All the hospitals have registered as health entrepreneurs with the Department of Health, Ministry of Public Health, in Thailand and are now still operating. The sample size groups consisted entirely of private hospitals and government hospitals operating in the Bangkok Metropolitan area.

3.2 Tools Used in the Study

The tool used in this study is a questionnaire. The desirable questionnaires are created by using the comprehensive standard and policy criteria of hospital waste management to collect information directly from the participant operation staffs. It also consists of one close-ended questionnaire made up from 3 different sections as follows:

- Section 1 asks for general information and characteristics about the hospitals, such as the type of hospital, number of patient beds, and when the hospital was established. This information is in the form of a checklist.

- Section 2 asks for information regarding the characteristics of the organization, such as the surveillance and report systems, and systems personnel organization. This information is in the form of a checklist.

- Section 3 asks for information regarding the assessment of hospital waste management. This section is in the form of an evaluation and assessment about the awareness of knowledge, awareness of practice, infection control practices, education and training.

3.3 Testing the Tools Used in the Study

The questionnaire has been created using modified sample questions from various other studies that are relevant to this study. The questionnaire was examined for validity and reliability by bringing the questionnaire to a qualified person, such as a professor, a scholar or a thesis testing committee, who inspected the content for validity and reliability, and wording and made any necessary corrections.

3.4 Collecting Information

The researcher gathered information through study, while the assistants explained the tools used in the study prior to collecting sample data though questionnaires. The researcher sent out all desirable questionnaires directly to the participating operation staffs of government hospitals and private hospitals. The gathering information from survey also includes the problems that generate in existing hospital waste management process.

3.5 Analyzing information

The information gathered was used for evaluation and statistical analysis. The data was analyzed using of descriptive statistics in order to explain the general information, and characteristics of the hospitals, such as type of hospital, years of operating experience, total number of patient beds, and number of beds in ICU. This also includes information about hospital waste management, such as awareness of knowledge, awareness of practice, infection control practice, education and training. It also includes information about evaluating hospital waste management by looking at frequency distribution and presenting information in terms of percentage, mean and standard deviation.

The data was also analyzed using of inferential statistics in order to test the research hypotheses, which is related to testing for significant factors that affect the assessment of hospital waste management. It also used the Multiple Regression Statistical Method in testing the difference between more than two variable groups.

Chapter 4 – Analytical Results of the Data

After sending out fifty–five questionnaires for two months to a sample population group, located in the Bangkok metropolitan area only thirty-nine questionnaires were returned by the respondents. These questionnaires were returned, because people who worked in the hospitals were used to distribute and collect them. There are four components of the analysis:

- Component 1: General information about hospitals.
- Component 2: Information regarding organization characteristics.
- Component 3: Assessing of hospital waste management.
- Component 4: Testing the research hypothesis.

4.1 Analytical Results of General Information About Hospitals

Table 4-1: Quantity and Percentage of Hospitals in Bangkok Metropolitan Area, Categorized by General Information

General Information	Frequency	Percent
1. Type of Hospital		
-Government	16	41.0
-Private	23	59.0
Total	39	100.0
2. Hospital Characteristics		
-Teaching hospital	6	15.4
-Specialist hospital	11	28.2
-General hospital	21	53.8
-Others	1	2.6
Total	39	100.0
3. Hospital Size		
-More than 50 but less than 200 beds	12	30.8
-More than 200 patient beds	27	69.2
Total	39	100.0

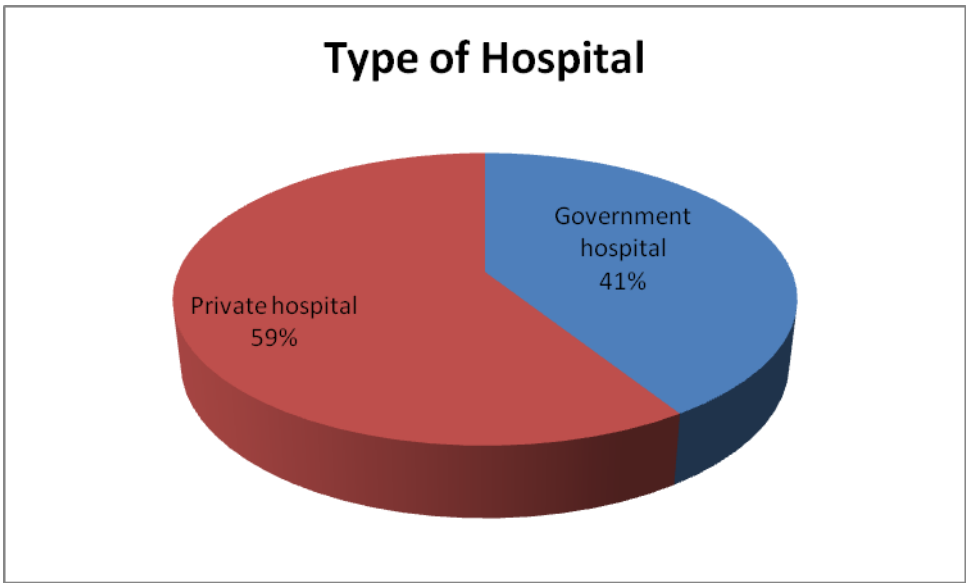

Figure 4-1: Percentage of Hospitals in Bangkok Metropolitan Area, Categorized by Type of Hospital

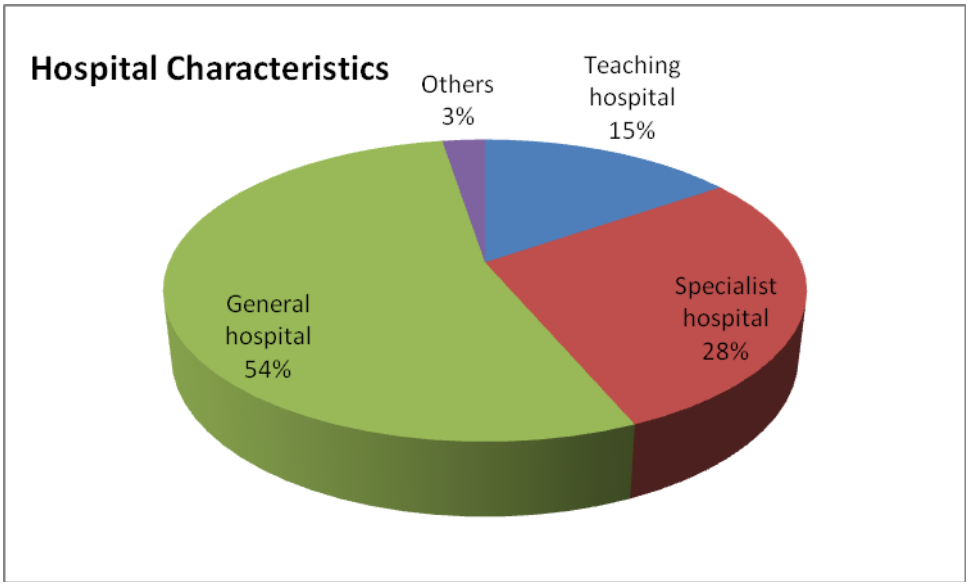

Figure 4-2: Percentage of Hospitals in Bangkok Metropolitan Area, Categorized by Characteristics of Hospital

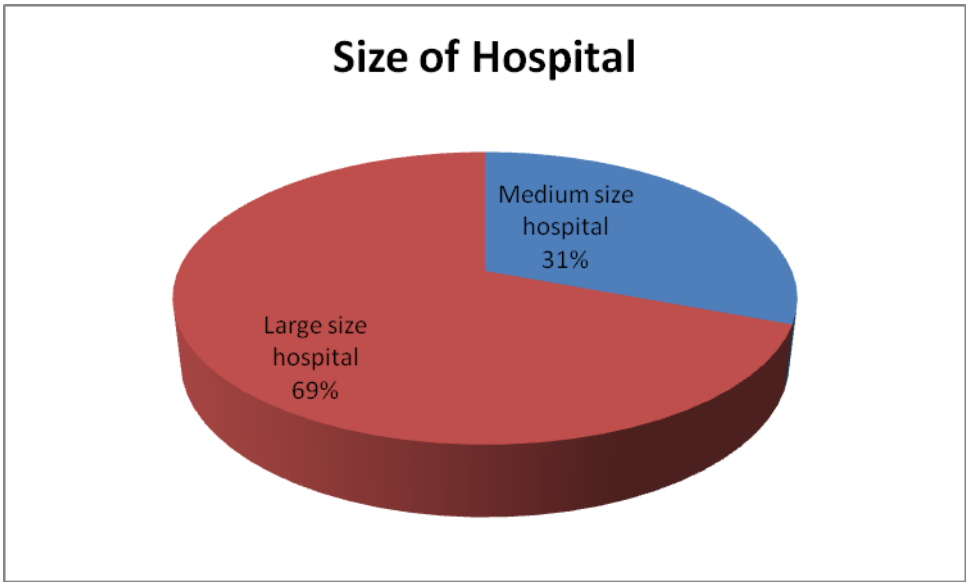

Figure 4-3: Percentage of Hospitals in Bangkok Metropolitan Area, Categorized by Size of Hospital

Table 4-1 and Figures 4-1 through 4-3 present general information on the sample group data from hospitals located in the Bangkok metropolitan area, with a total quantity of fifty-five hospitals.

From the study's sample group of hospitals, all located and still operated in the Bangkok metropolitan area, this research discovered that 59 percent are private hospitals and 41 percent are owned by the government, while others are owned by private healthcare entrepreneurs. All of the hospitals in the sample group have registered with the Ministry of Public Health of Thailand. Of these, 31 percent are medium-sized hospitals that have more than 50, but less than 200 patient beds, while 69 percent are grouped as large hospitals that have more than 200 patient beds. Moreover, the characteristics of the hospitals are divided into three major groups: 54 percent are general hospitals; 28 percent are specialized hospitals; and 15 percent are teaching hospitals. The remaining 3 percent consists of hospitals that service only target patient groups, such as monks and veterans.

4.2 Analytical Results of Information Regarding Organization Characteristics

Table 4-2: Quantity and Percentage of Hospitals in Bangkok Metropolitan Area, Categorized by Organization Characteristics

Information of Organization Characteristic	Frequency	Percent
1. Organization has a HWM policy concern		
Yes		
No	38	97.4
	1	2.6
Total	39	100.0
2. Has an infection control committee		
Yes		
No	38	97.4
	1	2.6
Total	39	100.0
3. How often does an infection control committee meet?		
Never		
Once a year	1	2.6
Twice a year	5	12.8
Four times a year	3	7.7
More than 4 times a year	3	7.7
	27	69.2
Total	39	100.0
4. Does the infection control committee produce an annual report?		
Yes	33	84.6
No	5	12.8
No answer	1	2.6
Total	39	100.0
5. The hospital has a surveillance system for acquired infection		
Yes		
No	38	97.4
	1	2.6
Total	39	100.0
6. Participate in hospital surveillance infection system on any listed level		
Local	2	5.2
Regional	16	41.0
National	10	25.6
International	10	25.6
No answer	1	2.6
Total	39	100.0
7. Sets a definition for determining if hospital infection is acquired		
Yes	32	82.0
No	6	15.4
No answer	1	2.6
Total	39	100.0
8. Calculate the incident rate of hospital acquired infection		
Yes	37	94.8
No	2	5.2
Total	39	100.0

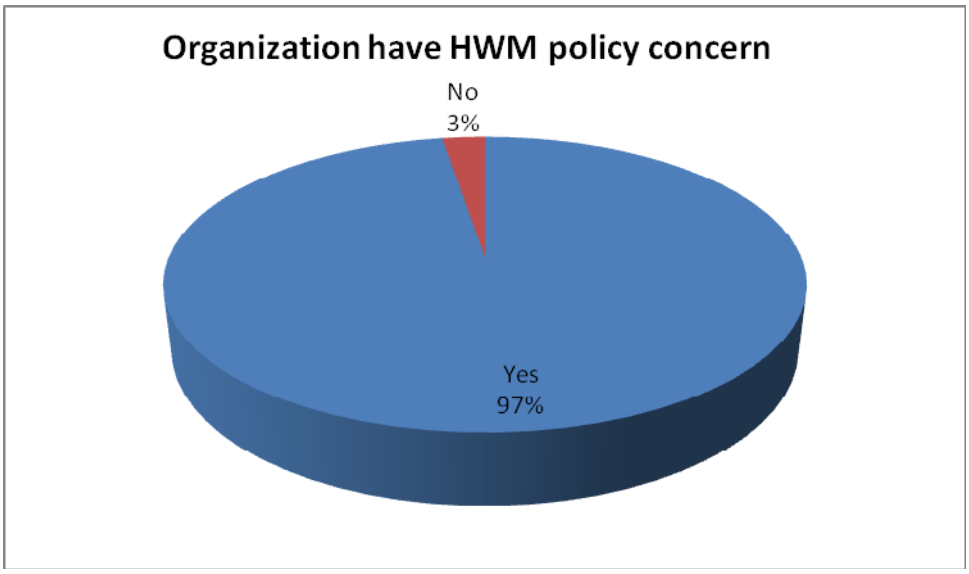

Figure 4-4: Percentage of Organization Characteristics, Categorized by HWM Policy Concern

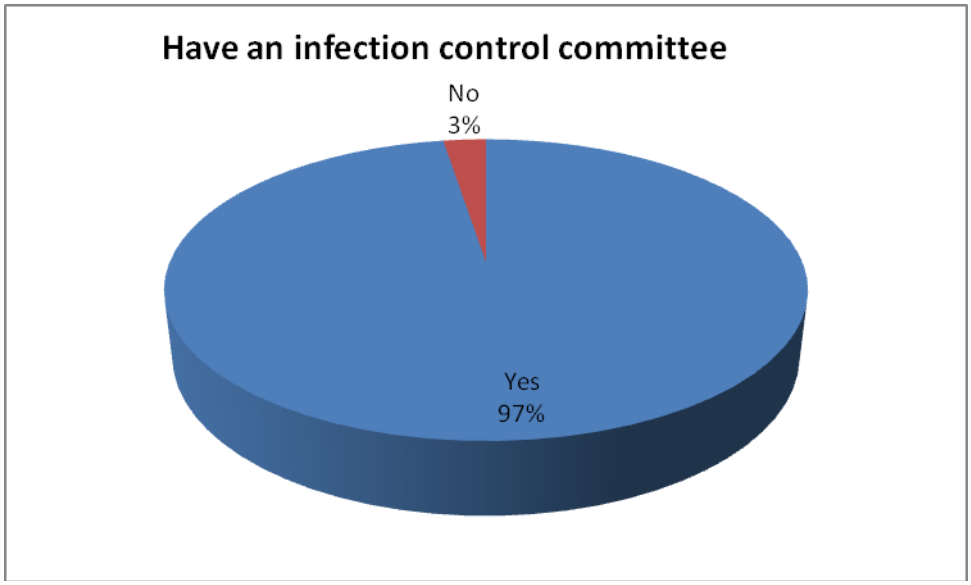

Figure 4-5: Percentage of Organization Characteristics, Categorized by Infection Control Committee

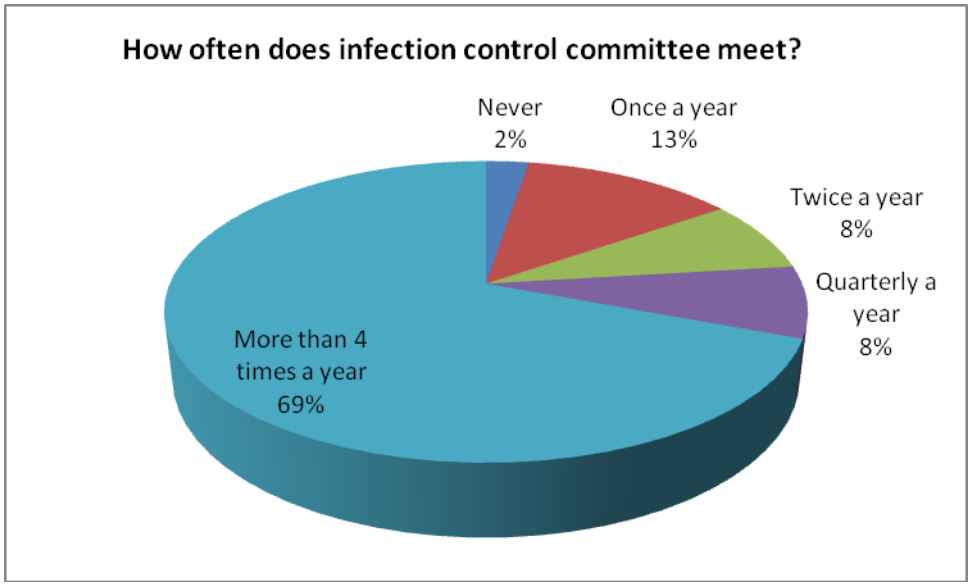

Figure 4-6: Percentage of Organization Characteristics, Categorized by Number of Committee Meetings

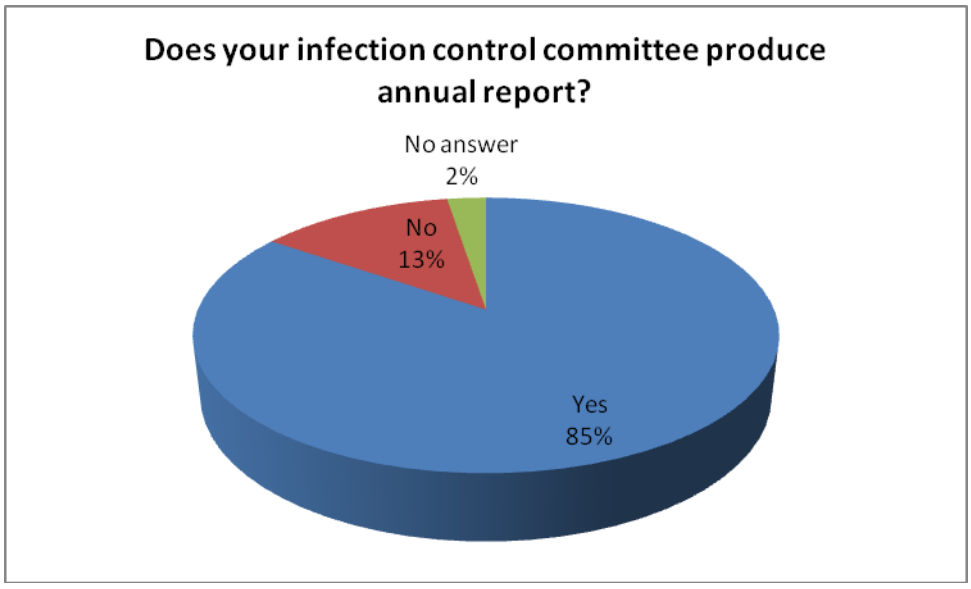

Figure 4-7: Percentage of Organization Characteristics, Categorized by Produce Annual Report

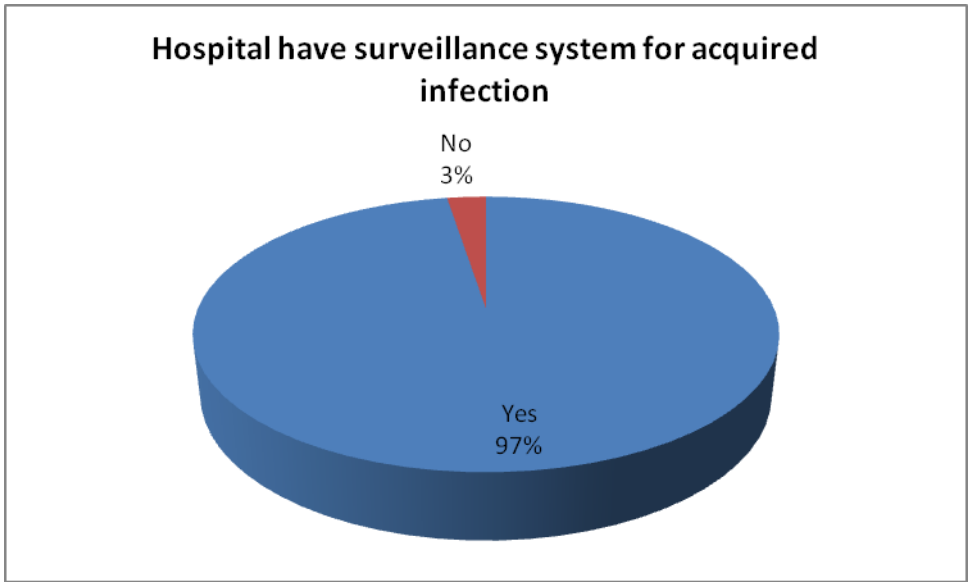

Figure 4-8: Percentage of Organization Characteristics, Categorized by Surveillance System

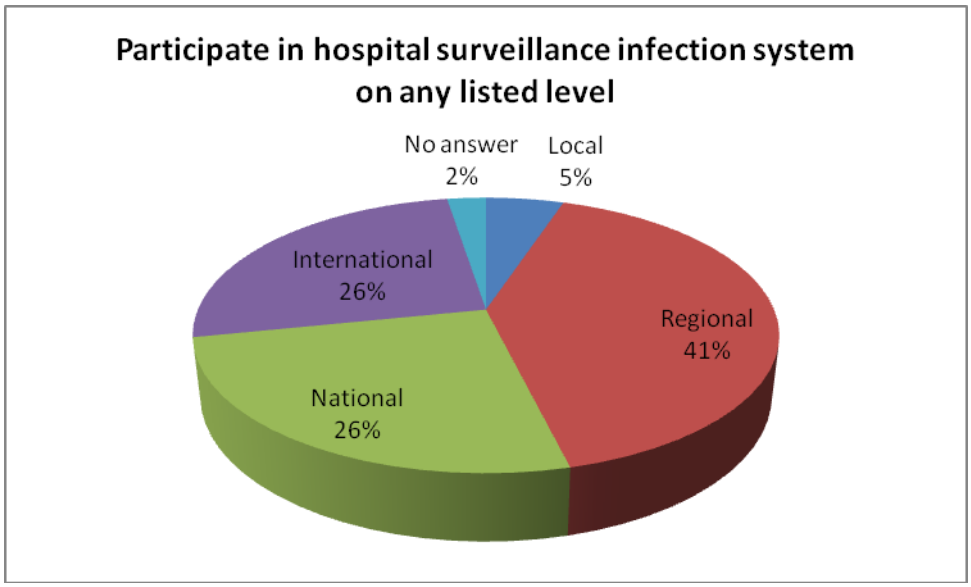

Figure 4-9: Percentage of Organization Characteristics, Categorized by Surveillance Operation Level

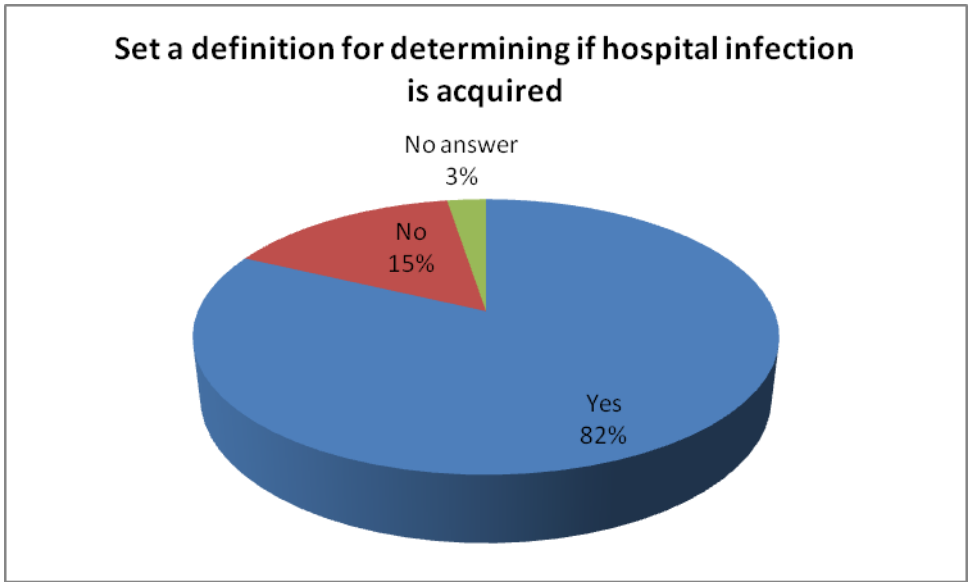

Figure 4-10: Percentage of Organization Characteristics, Categorized by Set Definition

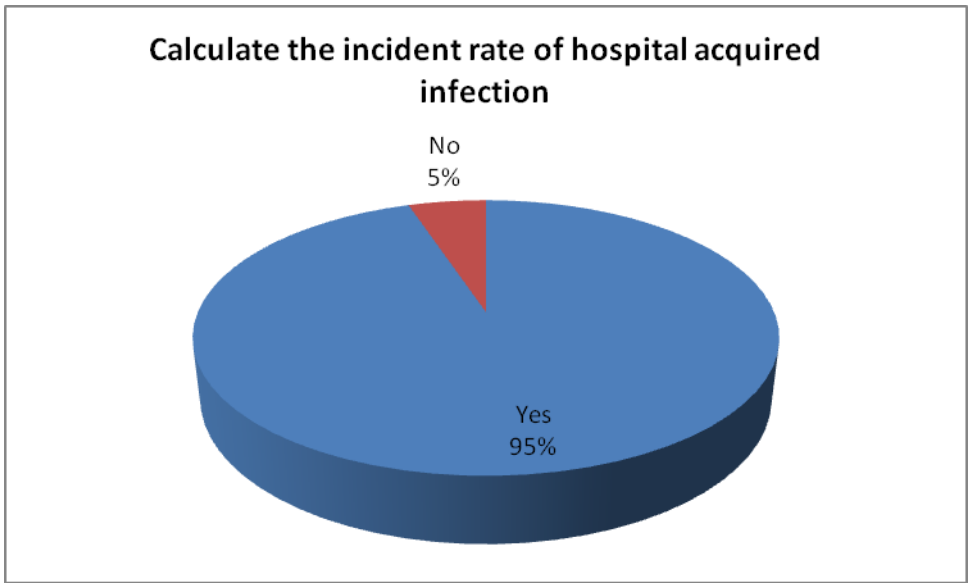

Figure 4-11: Percentage of Organization Characteristics, Categorized by Incident Rate

Table 4-2 and Figures 4-4 through 4-11 present information regarding the organization characteristics of hospitals located in the Bangkok metropolitan area**.** From the study's sample group, this research discovered that 97.4 percent of the hospitals have a mission policy concerning hospital waste management within their organization, while only 2.6 percent do not have any policies concerning hospital waste management. Moreover, almost 97.4 percent of hospitals have an infection

control committee to monitor the hospital waste management process, while 2.6 percent do not have any at all. In addition, 12.8 percent of infection control committees schedule a meeting once a year, 7.7 percent meet twice a year, 7.7 percent meet four times a year, and 69.2 percent meet more than 4 times a year, while 2.6 percent do not have any meetings. About 84.6 percent of infection control committees produce an annual report, while 12.8 percent do not have an annual report and 2.6 percent did not answer this question. Also, 97.4 percent of hospitals have a surveillance system for hospital-acquired infections, while 2.6 percent do not. Besides, the listed levels of participate hospital in a hospital infection surveillance system consists of four levels, including 5.2 percent at the local level, 41.0 percent at the regional level, 25.6 percent at the national level and 25.6 percent at the international level. Furthermore, 82.0 percent of hospitals have definitions for determining when a hospital-acquired infection occurred, while 15.4 percent do not have a set of definitions and 2.6 percent did not answer the question. Finally, 94.8 percent of hospitals calculate the incidence rates of hospital-acquired infection, while, 5.2 percent do not calculate the incidence rates.

4.3 Assessing Hospital Waste Management

Table 4-3: Quantity and Percentages for Assessing Hospital Waste Management in the Bangkok Metropolitan Area, Thailand, Categorized by Awareness of Knowledge About HWM

Awareness of knowledge about Hospital Waste Management		Yes		No		Don't know	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
1.	Do you know about the hospital waste management process?	38	97.44	1	2.56	-	-
2.	Do you know about the basic steps in hospital waste management process?	34	87.18	3	7.69	2	5.13
3.	Do you know if the hospital always separates noninfectious waste from infectious waste?	39	100.0	-	-	-	-
4.	Do you know if the hospital always segregates the waste at the point it is generated?	39	100.0	-	-	-	-
5.	Do you know if the hospital uses color-coded bags for the collection of infectious waste?	39	100.0	-	-	-	-
6.	Do you know if the color-coded bags/ boxes have an international symbol clearly marked?	39	100.0	-	-	-	-
7.	Do you know if the hospital has sharp boxes and biohazard collection containers?	39	100	-	-	-	-

Table 4-3 (cont.): Quantity and Percentages for Assessing Hospital Waste Management in the Bangkok Metropolitan Area, Thailand, Categorized by Awareness of Knowledge About HWM

Awareness of knowledge about Hospital Waste Management		Yes		No		Don't know	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
8.	Do you know if the hospital always keeps the infectious container less than ¾ full?	36	92.31	1	2.56	2	5.13
9.	Do you know if the staff has knowledge about safety for handling infectious waste?	39	100	-	-	-	-
10.	Do you know if the hospital has ever had safety equipment for staff?	39	100.0	-	-	-	-
11.	Do you know if the hospital has a set transport schedule for hospital infectious waste within the organization?	38	97.44	1	2.56	-	-
12.	Do you know if the hospital uses a wheelie bin or trolley for internal transport?	38	97.44	1	2.56	-	-
13.	Do you know if the hospital has dedicated vehicles for external transport?	23	58.97	16	41.03	-	-
14.	Do you know if the vehicle driver always gets a safety training course for external transportation of hospital infectious waste?	32	82.05	7	17.95	-	-

Table 4-3 (cont.): Quantity and Percentages for Assessing Hospital Waste Management in the Bangkok Metropolitan Area, Thailand, Categorized by Awareness of Knowledge About HWM

Awareness of knowledge about Hospital Waste Management	Yes		No		Don't know	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
15. Do you know if hospitals must have a standard storage room for keeping hospital infectious waste?	36	92.31	2	5.13	1	2.56
16. Do you know if the hospital waste storage room has climate control?	31	79.49	8	20.51	-	-
17. Do you know if the hospital storage room has good lighting and ventilation?	35	89.74	4	10.26	-	-
18. Do you know if the hospital has entering access for authorized people?	35	89.74	4	10.26	-	-
19. Do you know if the storage time for infectious waste is 24-48 hours?	34	87.18	4	10.26	1	2.56
20. Do you know if the hospital has an incinerator for treatment and disposal of infectious waste?	2	5.13	37	94.87	-	-
21. Do you know what the penalty is for staff who mismanage hospital waste?	29	74.36	10	25.64	-	-

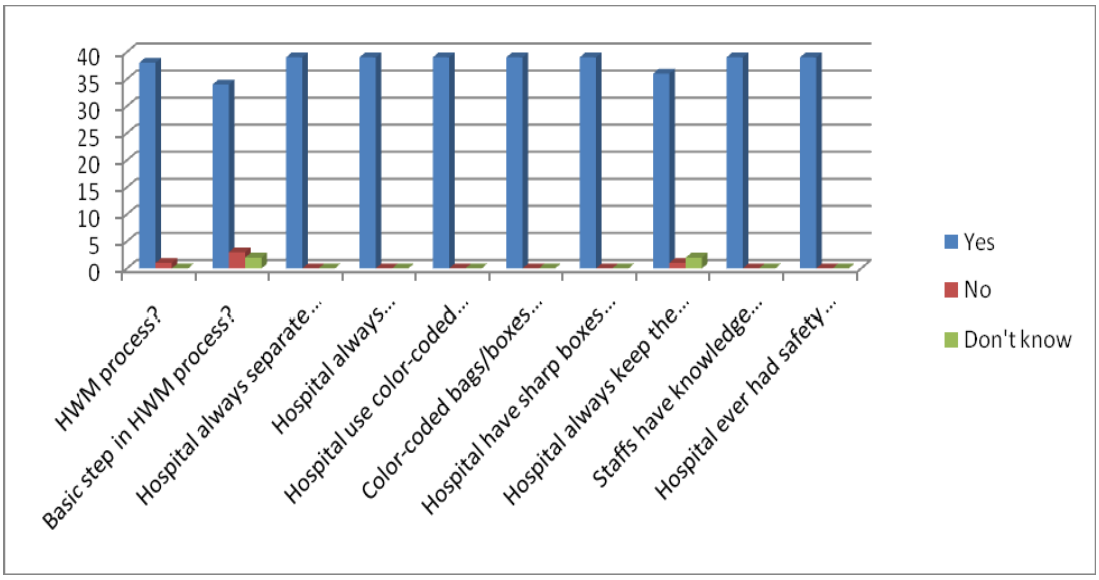

Figure 4-12: Percentage of Hospitals Assessment, Categorized by Awareness of Knowledge

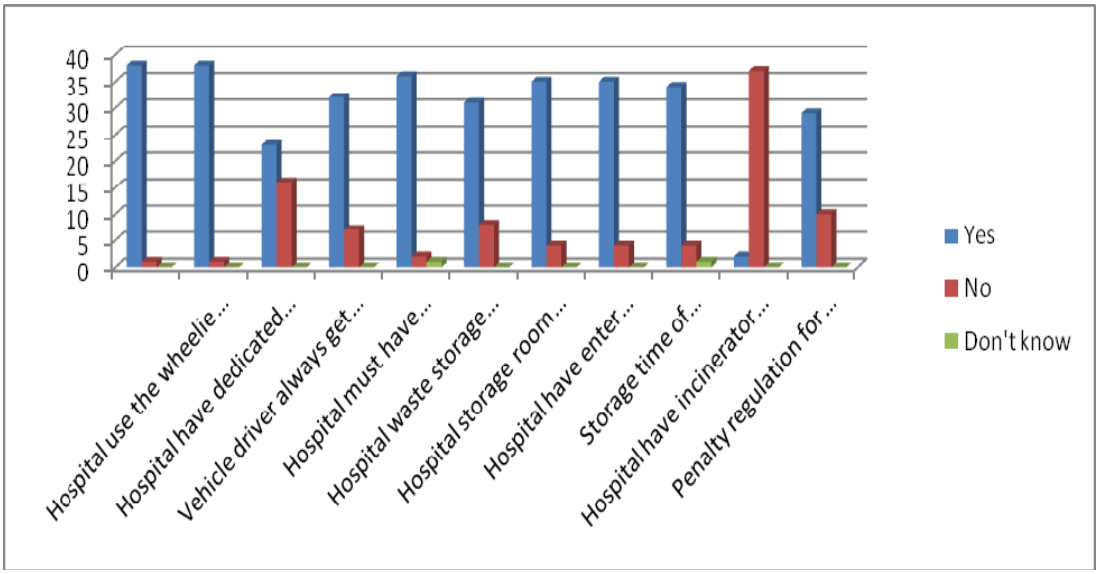

Figure 4-12(cont.): Percentage of Hospitals Assessment, Categorized by Awareness of Knowledge

Table 4-3 and Figure 4-12 present information about the assessment of hospital waste management in the Bangkok metropolitan area, categorized by awareness of knowledge about HWM. From the study's sample group, this research discovered that about 100 percent answered "yes" to these questions. The questions related to these were (1) "Do you know if the hospital always separates noninfectious waste from infectious waste?" (2) "Do you know if the hospital always segregates the waste at the point it is generated?" (3) "Do you know if the hospital uses color-coded bags for the

collection of infectious waste?" (4) "Do you know if the color-coded bags/ boxes have an international symbol clearly marked?" (5) "Do you know if the hospital has sharp boxes and biohazard collection containers?" (6) "Do you know if the staff has knowledge about safety for handling infectious waste?" and (7) "Do you know if the hospital has ever had safety equipment for staff?" Meanwhile, 97.4 percent answered affirmatively to the questions "Do you know about the hospital waste management process?", "Do you know if the hospital has a set transport schedule for hospital infectious waste within the organization?" and "Do you know if the hospital uses a wheelie bin or trolley for internal transport?" Moreover 92.3 percent answered affirmatively to the questions "Do you know if the hospital always keeps the infectious container less than ¾ full?" and "Do you know if hospitals must have a standard storage room for keeping hospital infectious waste?" Finally, 89.7 percent answered affirmatively to the questions "Do you know if the hospital storage room has good lighting and ventilation?" and "Do you know if the hospital has entering access for authorized people?"

Table 4-4: Quantity and Percentage of Assessing of Hospital Waste Management in Bangkok Metropolitan Area, Thailand, Categorized by Awareness of Practice About HWM

Awareness of Practice about Hospital Waste Management		Yes		No		Don't know	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
1.	Does your hospital have hospital waste management process?	38	97.44	1	2.56	-	-
2.	Does your hospital operate waste management following major step?	36	92.31	3	7.69	-	-
3.	Does your hospital always separate noninfectious waste and infectious waste?	38	97.44	1	2.56	-	-

Table 4-4(cont.): Quantity and Percentage of Assessing of Hospital Waste Management in Bangkok Metropolitan Area, Thailand, Categorized by Awareness of Practice About HWM

Awareness of practice about Hospital Waste Management		Yes		No		Don't know	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
4.	Does your hospital always segregation the waste at the point of generated?	38	97.44	1	2.56	-	-
5.	Does your hospital use color-coded bag for collection the infectious waste?	38	97.44	1	2.56	-	-
6.	Does your color-coded bag/ box have an international symbol clearly marked?	37	94.87	2	5.13	-	-
7.	Does your hospital use sharp boxes and biohazard collection containers?	38	97.44	1	2.56	-	-
8.	Does your hospital always keep the infectious container after ¾ full?	37	94.87	2	5.13	-	-
9.	Does your staff have knowledge about safety handling infectious waste?	38	97.44	1	2.56	-	-
10.	Have your hospital ever had safety equipment for staffs?	36	92.31	3	7.69	-	-
11.	Have your hospital set exactly transport schedule for hospital infectious waste within organization?	35	89.74	4	10.26	-	-
12.	Does your hospital use the wheelie bin or trolley for internal transport?	36	92.31	3	7.69	-	-
13.	Does your hospital have dedicated vehicles for external transport?	19	48.72	20	51.28	-	-

Table 4-4 (cont.): Quantity and percentage of assessing of hospital waste management in Bangkok metropolitan area, Thailand. Categorized by awareness of practice about HWM

Awareness of practice about Hospital Waste Management		Yes		No		Don't know	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
14.	Does the vehicle driver always get the safety training course for external transport hospital infectious waste?	24	61.54	15	38.46	-	-
15.	Does your hospital have standard storage room for keeping hospital infectious waste?	34	87.18	5	12.82	-	-
16.	Does the waste storage room have a climate control?	25	64.10	13	33.34	1	2.56
17.	Does your hospital storage room have a good lighting and ventilation?	33	84.62	6	15.38	-	-
18.	Does your hospital have entered access for authorized people?	34	87.18	4	10.26	1	2.56
19.	Is the storage time of infectious waste 24-48 hours?	33	84.62	5	12.82	1	2.56
20.	Does your hospital have incinerator for treatment and disposal the infectious waste?	2	5.13	37	94.87	-	-
21.	Does your hospital have penalty regulation for staffs who mismanage of hospital waste?	29	74.36	10	25.64	-	-

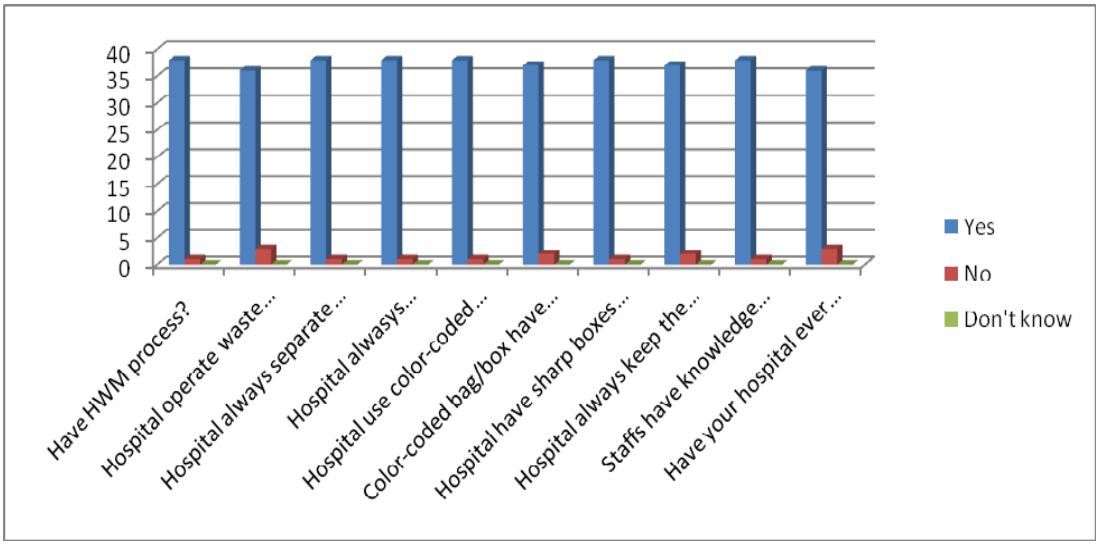

Figure 4-13: Percentage of Hospitals Assessment, Categorized by Awareness of Practice

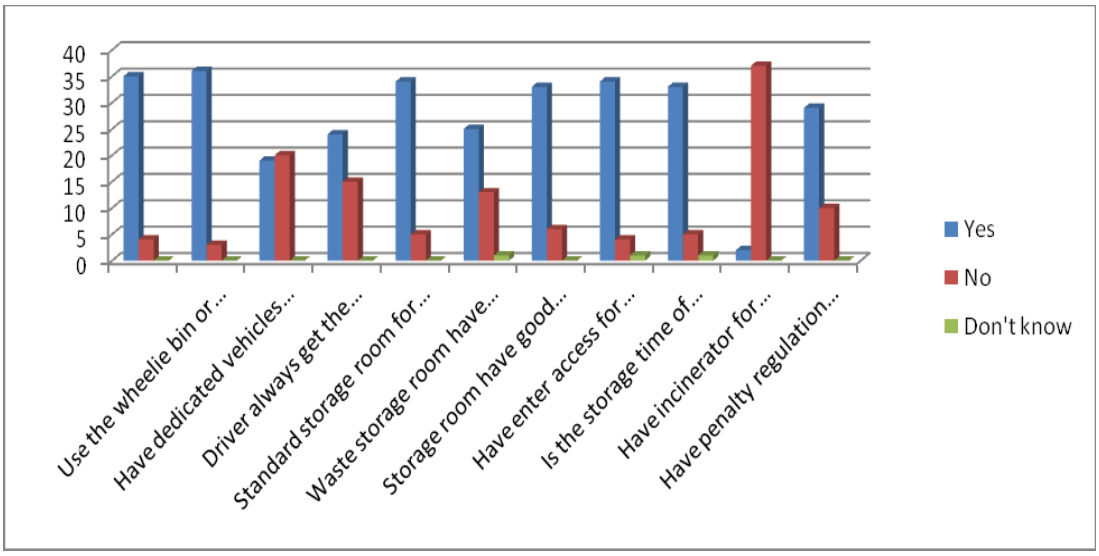

Figure 4-13 (cont.): Percentage of Hospitals Assessment, Categorized by Awareness of Practice

Table 4-4 and Figure 4-13 present information about assessing hospital waste management in the Bangkok metropolitan area, categorized by awareness of practice about HWM. From the study's sample group, this research discovered that about 97.4 percent answered "yes" to these questions. The questions related to these were (1) "Does your hospital have hospital waste management process?" (2) "Does your hospital always separate noninfectious waste from infectious waste?" (3) "Does your hospital always segregate the waste at the point it is generated?" (4) "Does your

hospital use color-coded bags for collection of infectious waste?" (5) "Does your hospital use sharp boxes and biohazard collection containers?" (6)"Does your staff have knowledge about safety handling of infectious waste?" Meanwhile, 94.9 percent answered affirmatively to the question "Does your color-coded bag/box have an international symbol clearly marked?"and "Does your hospital always keep the infectious container after ¾ full?" Finally, 92.3 percent answered affirmatively to the questions "Does your hospital operate waste management following major step?", "Has your hospital ever had safety equipment for staff?" and "Does your hospital use a wheelie bin or trolley for internal transport?"

4.4 Analytical Results of Testing the Research Hypothesis

Table 4-5: Coefficients of Multiple Regression in Independent Variables for Forecasting Hospital Waste Management in Thailand

Model	**Coefficients**		**F**	**Sig F**
Independent Variable	**Unstandardized Coefficients (B)**	**Standardized Coefficient (Beta)**		
Hospital characteristic	1.692	0.387	2.565	0.015
Knowledge	0.467	0.330	2.235	0.032
Constant	7.959		2.053	0.048
r=.534	**r^2=.285**	**SE=1.91**	**F=4.519**	**Sig F=.009**

Table 4.5 illustrates that there are two main independent variables: 1) type of hospital and 2) Knowledge level of participant staff and employees. 'Type of hospital' means whether or not the hospital is in the private sector. Private hospitals have more modern equipment, technology and facilities; are monitored strictly by an authorized officer; have enough funds for support and frequent training for staff; have control and certify the hospital standard annually; motivate their staff (by giving rewards or bonuses); and employ quality staff (engineers or scientists) for controlling and

managing the hospital waste process efficiently. The score for this type of hospital's waste management will be more than those with the characteristics of government hospitals. 'Knowledge level of participant staff and employees' means that participant employees and staff who have more knowledge about hospital waste management can work effectively and operate correctly. As this increase, it will cause the hospital waste management program's score to increase. These two independent variables are related to the score of hospital waste management programs in Thailand respectively. These independent variables can be used to forecast the score of comprehensive hospital waste management programs in Thailand, by using a statistical significance of .05. The model of this forecasting is:

$$\mathbf{Y' = 7.959 + 1.692x_1 + 0.467x_2}$$

Where Y : Comprehensive hospital waste management programs in Thailand

x_1 : Type of hospital in private section

x_2: Knowledge level of participant staff and employees

Chapter 5

– Conclusion

5.1 Discussion

In this research, the author discusses the following research objectives:

Objective 1: To examine the status of hospital waste management and assessments of the hospital waste management process in Thai healthcare industries.

In the Thai healthcare industry, most hospitals located in the Bangkok Metropolitan area have hospital waste management programs (97.4 percent of hospitals have policies concerning hospital waste management program within their organization). For those hospitals that have a hospital waste management program, generally their program is not quite comprehensive. The topic of managing and assessing hospital waste for efficiency is a very important topic, because it can reduce risks to the environment and human health, and help participant staff realize the importance of a hospital waste management program.

Objective 2: To identify the factors affecting the assessment of hospital waste management in Thailand.

After analyzing the collecting information from questionnaires and testing research hypothesis, this research can identify which factors will significantly affect a comprehensive hospital waste management program: 1) type of hospital: and 2) knowledge level of participant staff and employees. These factors relate to the score of comprehensive hospital waste management program in Thailand. This relationship follows directly from the scores of the comprehensive hospital waste management programs, using a statistical significance of .05. These factors can be used as a

forecasting model to score a comprehensive hospital waste management program in Thailand by using a statistical significance of .05.

Objective 3: To compare the standard criteria for hospital waste management in Europe, the United States and developing countries such as Thailand.

After comparing the standard criteria for hospital waste management in Europe, the United States and Thailand, this study found that the standard criteria from WHO, NIOSH, and the Ministry of Public Health, Thailand are generally used in comprehensive hospital waste management programs.

Table 5-1: Hospital Waste Management Stream

WHO	**NIOSH**	**Ministry of Public Health, Thailand**
1. Waste minimization 2. HCW generation 3. Segregation and Containerization 4. Intermediate storage 5. Internal transport 6. Centralized storage 7. External transport 8. Treatment/Final disposal	1. Storage/Segregation 2. Identified types of infectious waste 3. Packaging 4. Handling/Transportation 5. Storage 6. Treatment/Disposal	1. Collection/ Segregation/ Packaging 2. Handling/Storage 3. Transportation 4. Treatment/ Disposal

Moreover, the hospital waste management stream from WHO, NIOSH, and the Ministry of Public Health, Thailand use nearly identical procedures. However, there are some differences between steps in the operation process. The Thailand HWM stream consists of 4 steps, while the HWM streams from NIOSH and WHO have 6

steps and 8 steps, respectively. This study found that Thailand HWM stream does not mention waste minimization, HCW generation or identified types of infectious waste.

Objective 4: To recommend a course of action for improving hospital waste management in Thailand.

After identifying the factors that significantly affect a comprehensive hospital waste management program by testing the research hypotheses, this study found that the type of hospital and an assessment of knowledge of participant staff and employees scored significantly higher, while other factors, such as year of hospital operation, size of hospital, and assessment of practices of participant staff scored significantly lower. For this reason, an interested party such as the government or healthcare authorities, should establish laws or regulations using this research as a guideline for resolving the problems with comprehensive hospital waste management programs in Thailand. After defining some faults of hospital waste management programs, it was found that these are often caused by a lack of knowledge level and safety practices of participant staff about hospital waste. Some of the hospital participant staff do not concern themselves with the rules for the safe handling, storage, transport and disposal of hospital waste. An interested party who can take action should use the WHO or NIOSH safety standard programs as guidelines to improve Thai hospital waste management programs.

5.2 Conclusion

Hospitals and medical health centers are the places to diffuse disease. Hospital waste poses a risk for environmental health, patients and personnel who handle these wastes. Medical waste is infectious and hazardous, and requires specific treatment and

management prior to its final disposal. If the hospitals do not have sufficient safety prevention and comprehensive hospital waste management programs, many things can be put at risk and lost, including the surrounding environment and human life. Therefore, the hospital should prevent these incidents by using a comprehensive and extensive hospital waste management program. In Thailand, hospital and healthcare services are on the rise; thus, this research studies the awareness and management of hospital waste in developing countries, using Thailand as a case study. The results have shown that most hospitals in Thailand do not have comprehensive hospital waste management programs. There are two factors that affect the score of the hospital waste management programs: 1) type of hospital (government or private), and 2) knowledge level of participant staff. These factors cause the score of the comprehensive hospital waste management program to be increased. For these reasons, whoever has authority, (such as the government or owners of private hospitals), can use the results of this study to improve their existing hospital waste management programs or issue laws or regulations using the WHO and NIOSH safety standard programs as guide lines.

5.3 Recommendation for Further Studies

This research is limited in selection of the population area. It only includes hospitals in the Bangkok metropolitan area that are registered with the Ministry of Public Health and are still in operation. If possible, further studies should expand the population areas and sample group to cover hospitals that have registered with the Ministry of Public Health and are still in operation in all provinces in Thailand. Doing so would allow a broad range of data to be collected and would verify the results of this research. Also, this research examined only four independent variables as seen in

many studies. Other independent variables should be examined in future studies. Future research should examine why some hospitals do not have hospital waste management programs. In addition, future research should compare hospital waste management policy concerns between hospitals that have comprehensive hospital waste management programs and those that do not have a comprehensive hospital waste management program.

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Appendix A-Sample Survey

Questionnaire

Section1: General Information and Characteristic about Hospital

Explanation Please place a check mark ✓ or fill in the space next to the statement which is most relevant to you.

General Information

Name of Hospital:

…….

Hospital Characteristics

1. Your Hospital is .....Government section ....Private section

2. Is your hospital characterized as a (check one)

   …..Teaching Hospital …..Specialist Hospital
   …..District General Hospital ....Other (please specify): …….

3. How long has your hospital established? ……..…..

4. How many total patient beds are in your hospital?

   …. Less than 50 patient beds
   ….More than 50 but less than 200 patient beds
   …. More than 200 patient beds

5. How many patient beds are in the Intensive Care Unit (ICU)?
   ……patient beds

6. In 2006, how many patient days did your hospital record? ……
   patient days

Section 2: Characteristic of Organization

Explanation Please place a check mark ✓ in the space next to the statement which is most relevant to you.

Systems personnel organization

7. Does your organization have hospital waste management concern within mission policy?

   ….Yes ….No ….don't know

8. Does your hospital have an infection control committee?

   …Yes …No …don't know

9. How often does your infection control committee meet?

…once a year … twice a year
…quarterly/year … more than 4 times/year

10. Does your infection control committee produce annual reports?

…Yes ….No …don't know

Surveillance & Report

11. Does your hospital have a surveillance system for hospital acquired infections?

…Yes …No …don't know

12. If yes, does your hospital participate in a hospital infection surveillance system on any of the listed levels?

…Local …Regional
…National …International

13. Do you have a set definition for determining if an infection is hospital – acquired?

…Yes …No ….don't know

14. If yes, what is/are your definition(s)?

……
……
……
……
……

15. Did you calculate the incidence rates of hospital-acquired infections for 2006?

…Yes …No ….don't know

Section 3: Assessing of Hospital Waste Management

Explanation Please place a check mark ✓ in the space next to the statement which is most relevant to you.

- Awareness of knowledge about hospital waste management

16. Do you know about hospital waste management process?

…Yes ....No ….don't know

17. Do you know about basic step in hospital waste management stream?

…Yes ….No ….don't know

18. Do you know if the hospital always separates noninfectious waste from infectious waste?

…Yes ….No ….don’t know

19. Do you know if the hospital always segregates the waste at the point it is generated?

…Yes ….No ….don’t know

20. Do you know if the hospital uses color-coded bag (yellow and red) for the collection of infectious waste?

…Yes ….No ….don’t know

21. Do you know if the color-coded bags and boxes have an international symbol clearly marked?

…Yes ….No ….don’t know

22. Do you know if the hospital has sharps boxes and biohazard collection containers?

…Yes ….No ….don’t know

23. Do you know if the hospital always keeps the infectious container less than ¾ full?

…Yes ….No ….don’t know

24. Do you know if the staff has knowledge about safety for handling infectious waste?

…Yes ….No ….don’t know

25. Do you know if the hospital has ever had safety equipment for staff?

…Yes ….No ….don’t know

26. Do you know if the hospital has a set transport schedule for hospital infectious waste within the organization?

…Yes ….No ….don’t know

27. Do you know if the hospital uses a wheelie bin or trolley for internal transport?

…Yes ….No ….don’t know

28. Do you know if the hospital has dedicated vehicles for external transport?

…Yes ….No ….don’t know

29. Do you know if the vehicle driver always gets a safety training courses for external transportation of hospital infectious waste?

…Yes ….No ….don’t know

30. Do you know if hospitals must have standard storage room for keeping hospital infectious waste?

…Yes ….No ….don't know

31. Do you know if the hospital waste storage room has climate control?

…Yes ….No ….don't know

32. Do you know if the hospital storage room has good lighting and ventilation?

…Yes ….No ….don't know

33. Do you know if the hospital has entered access for authorized people?

…Yes ….No ….don't know

34. Do you know if the storage time for infectious is waste 24-48 hours?

…Yes ….No ….don't know

35. Do you know if the hospital has an incinerator for treatment and disposal the infectious waste?

…Yes ….No ….don't know

36. Do you know what the penalty is for staff who mismanage hospital waste?

…Yes …No ….don't know

- Awareness of practice about hospital waste management

37. Does your hospital have a hospital waste management process? [the management process of hospital waste following the standard of Department of Public Health]

…Yes (continue below) ….No (stop here)

38. Does your hospital operate waste management following major step?

… Yes …No …don't know

39. Does your hospital always separate noninfectious waste and infectious waste?

….Yes …No ….don't know

40. Does your hospital always segregate the waste at the point it is generated?

….Yes …No ….don't know

41. Does your hospital use color-coded bag (yellow and red) for collection of infectious waste?

….Yes …No ….don't know

42. Does your color-coded bag and box have an international symbol clearly marked?

….Yes …No ….don’t know

43. Does your hospital use sharp boxes and biohazard collection containers?

…Yes …No ….don’t know

44. Does your hospital always keep the infectious container less ¾ full?

….Yes …No ….don’t know

45. Does your staff have knowledge about the safe handling of infectious waste?

….Yes …No ….don’t know

46. Has your hospital ever had safety equipment for staff?

….Yes …No ….don’t know

47. Has your hospital set an exact transport schedule for hospital infectious waste within the organization?

….Yes …No ….don’t know

48. Does your hospital use a wheelie bin or trolley for internal transport?

….Yes …No ….don’t know

49. Does your hospital have dedicated vehicles for external transport?

….Yes …No ….don’t know

50. Does the vehicle driver always get a safety training course for external transport of hospital infectious waste?

….Yes …No ….don’t know

51. Does your hospital have a standard storage room for keeping hospital infectious waste?

….Yes …No ….don’t know

52. Does the waste storage room have climate control?

…. Yes ….No ….don’t know

53. Does your hospital storage room have good lighting and ventilation?

….Yes …No ….don’t know

54. Does your hospital have entered access for authorized people?

….Yes …No ….don’t know

55. Is the storage time for infectious waste 24-48 hours?

….Yes …No ….don’t know

56. Does your hospital have an incinerator for the treatment and disposal infectious waste?

….Yes …No ….don’t know

57. Does your hospital have penalties for staff who mismanage hospital waste?

….Yes …No ….don’t know

58. Which step of hospital waste management does always get inefficiency?

……
……
……
……
…….....

59. How is/are the inefficiency(s) in hospital waste management?

……
……
……
……
……

60. What is/are the most significant factor (s) that impact with hospital waste management?

…Lack of knowledge and skill …Tool/ equipment
…Budget …Policy/ Strategy
…Staff cooperation/ concern ….Others