STUDY ON INFECTIOUS WASTE MANAGEMENT AT STILLWATER MEDICAL CENTER

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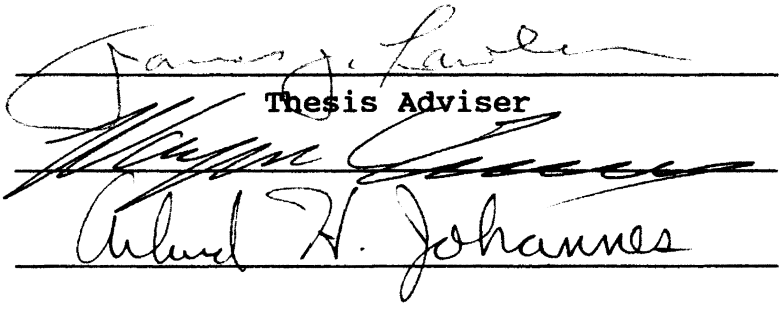

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TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

General

Our nation's environmental problems are not a new phenomena. They represent an accumulation of extensive misuse, mismanagement and mistakes. The waste materials that we as a society have been generating never have reduced, nor will they ever disappear.

Medical waste as an environmental hazard, has only in the recent past captured public attention. Mullany (1991) pointed out that disposable materials have come into common use with little forethought about their environmental impact. The health care field has been driven towards a technologically advanced market, and is now highly dependent on disposable products. One will understand the extent of dependency on disposable by looking at the compositional change of the medical waste in the last few decades.

The growing use of disposable has caused the amount of medical waste to grow at an alarming rate, and more alarming still, the waste is designated as regulated infectious, hazardous or toxic. We now live grappling with the problem of how best to handle the large quantity of this potentially

hazardous waste without affecting the human, health, and environment.

According to a study by Cynthia Spry et al. (1991), in the past three years 77% of all hospital facilities have increased the use of disposable items while only 6% have decreased. Reasons attributable to these figures were

a. Convenience
b. Infection control
c. Time and feasibility
d. Lack of staff
e. Volume of surgical procedures
f. Physician's preference and
g. Storage space limitations

One might ask, is medical waste a crisis now, and if so Why?. Handling, management, and disposal of medical waste in the earlier days were not of professional concern. Health care workers simply would pick up waste and throw it out with other garbage. These wastes were then picked up by waste haulers and sent directly to landfills. In most instances medical waste was a problem only for the waste haulers.

According to Karpiak (1991), awareness about medical waste peaked during the summer of 1987 and 1988 when several beaches experienced washups of debris which was composed of needles, used syringes, blood vials, and other sharp objects used in health care organizations, commonly known as medical waste. These incidence of beach washups received widespread

media attention and there were alarming reports about medical waste washing up on the beaches along the east coast from Maine to Florida, the west coast, the Great Lakes, and the Gulf coast. This resulted in a number of beach closings and loss of revenue to the tourist industries in these areas.

To add to the situation, the news about children playing with syringes, sharps and vials that were disposed by physicians from health care settings focused society's attention on medical waste disposal issues to a closer extent. Even though there was no instance of public illness caused by such exposures, people perceived that health care facilities were not managing their waste responsibly and something should be done for proper management of waste generated by health care organizations. Also, the fear about the capability of AIDS being transmitted by medical waste complicated the situation. According to Rutala (1992), there is no strong scientific evidence that medical waste is capable of transmitting HIV viruses.

These few high-visibility incidents of improper disposal forced both federal and state legislators to act swiftly to the crisis. The result was the enactment of the Medical Waste Tracking Act of 1988 and states became more stringent on infectious waste management regulations. In 1990 Congress passed revisions to the Clean Air Act, and stepped up its regulatory activity which seriously limited or effectively banned incineration at most medical

facilities, since they could not meet emission standards. Literature on the impact of waste to the environment was consistent on one point-that everyone must take a part in waste management to preserve the environment. The study by Thomas Naber (1989) foresee that the volume of infectious waste generated will rise in the 90s due to the longer life span of the American citizens.

Medical Waste Profile

Medical waste includes all types of wastes generated by health care organizations which includes hospitals, clinics, doctor's offices, dental offices, veterinary offices and other medical laboratories and research facilities. Of this, hospitals generate the maximum quantity with varied composition. Typically, a vast portion of the waste is composed of large quantities of sharps, microbiological cultures, stocks of infectious agents, pathological or anatomical waste, human blood, blood products, isolation materials, body parts, tissues, bandages, casts, catheters and other items used in the diagnosis and treatment of patients.

According to Rutala (1989), the amount of infectious waste generated in U.S. hospitals is approximately 909 tons per day. Hall (1989) estimated that the per-patient-perday generation rate to be 13 pounds. According to Fay (1990), this figure is about 15% higher than the amount reported in

a North Carolina hospital survey (13 pounds per patient perday). This difference clearly reflects the increase in use of disposable products.

Hall (1989), estimated that U.S. hospitals designate about 15% of their total waste as infectious waste. Not surprisingly, the percent of medical waste treated as infectious increases with the number of types of medical waste the hospital classified as infectious. Also, Hall reported that in some hospitals, infectious medical waste can account for 50% of the waste generated. Approximately 20% of all medical waste falls into the red bag or infectious waste category. Another 5% consists of toxic, corrosive, flammable, reactive or radioactive materials and is classified as regulated waste. It is interesting to note that 35% of the infectious waste are generated in the operating room and the average rate per procedure weighs about 11.8 lbs.

Nature of the Problem

It is a well known fact that one of the most imposing problems facing hospital management in this decade is the handling, treatment and disposal of hospital waste. The common reasons attributable to this are due to the increase in waste generated and stringent regulations by all levels of government. Also, recently, a number of factors have

made it increasingly difficult for hospital management to classify its waste and manage it cost effectively.

The number of problems encountered is expected to intensify in the near future. The various problems that hospitals have to face in the 90s may include the following;

a. Landfills have become reluctant to accept many hospitals general waste fearing that some infectious materials might be present. In other words, the market is in the hands of the landfill owners and the hospitals need to be at their mercy for disposing their waste.

b. The number of landfills accepting infectious waste even after treatment and rendering it inert has reduced in the past few years.

c. Most of the existing hospital incinerators are closing operations due to their inability to meet pollution standards. Installing pollution control equipments to upgrade these incinerators prove to be uneconomical.

d. The few hospitals who have upgraded their incinerators by adding pollution control equipments are finding it difficult to justify the cost of running the equipment.

e. Incinerators which were treating infectious waste are undersized now due to increase in waste volume.

f. New incineration systems capable of meeting current and future standards are significantly more

expensive than older units and are difficult to locate due to the NIMBY syndrome.

g. Manifest and tracking requirements for offsite disposal of waste complicate an already complex problem and encourage hospitals to use incineration.

h. Generally, it is getting harder and more expensive for health care facilities to have waste hauled for disposal because of the lack of landfill capacity and the so called NIMBY syndrome.

i. The cost of transporting medical waste, has tripled in the last few years and is expected to multiply in the next few years.

j. Recycling of infectious waste is almost impossible, and

k. Proposed regional incinerators to dispose medical waste have been opposed by local communities.

In other words, the problem is that the amount of waste generated by hospitals continues to grow while the disposal options continue to decline. These problems warrant the necessity for hospitals to develop a sound waste management system.

Need for the Study

The nature of waste generated in hospitals is not uniform and varies from one unit to another. The quantity

of waste generated depends on unit capacity, specialized treatments provided, and number of other facilities, such as laboratory, pharmacy, laundry, etc. The life cycle of hospital waste typically consists of generation, handling, storage and disposal phases. Waste management practices and procedures touch upon each of these phases to ensure that the waste is managed efficiently and effectively. By efficiency we mean, the system manages as much quantity and as many varied types of waste as possible, while incurring as little cost as is practicable. By effectiveness, we mean that the system includes waste management in accordance with all applicable regulations. Thus, effectiveness should cater to regulatory requirements and safety of all. The efficiency and effectiveness of a waste management program depends on the waste management policy adopted by the facility. To frame such a policy, one needs to have a thorough understanding of:

a. The various waste streams generated by different units in the hospital, and
b. Regulatory requirements and liabilities resulting from non-compliance.

Good waste management system can rescue the hospital from unwarranted liability issues and disposal costs. The lack of knowledge of different waste streams generated, and legal complexities pose a great difficulty for waste management administrators in establishing a suitable waste management system. Developing such a system, requires

exhaustive study of existing practices, procedures, available technology, constraints of the existing hospital building and regulatory requirements. In the environmental field no one person or organization has a monopoly on all the good ideas. Furthermore, new problems will be unearthed in a study like this when the person takes a first look.

Research Objectives

The purpose of this research is to assess the existing infectious waste management system at Stillwater Medical Center and incorporate changes to make the system more efficient and effective. Achieving this objective requires addressing the following research questions.

What changes to the existing infectious waste management system would result in:

a. Enhanced compliance?
b. Enhanced workers safety?
c. Reduced cost of disposal?
d. Reduced volume of waste generated?
e. Better practices?
f. Reduced liability?

Limitations

The author has limited the study to infectious waste management system currently adopted at Stillwater Medical

Center. Recommendations are based on the information gathered during the hospital visits.

Organization of the Study

Chapter II discusses previous studies on medical waste management. Chapter III presents applicable laws and regulations, and Chapter IV discusses current management practices adopted to handle infectious waste in hospitals.

Chapter V discusses in detail the research methodology adopted for this study.

Chapter VI presents information on the existing waste management system at Stillwater Medical Center. Also, Suggestions of this study are included in this chapter.

Chapter VII contains the conclusions of this study and recommendations about changes that can be made to the existing waste management system.

Chapter II

Review of Literature

Introduction

According to Kyle (1990), Congress enacted the Medical Waste Tracking Act of 1988 in response to public concern over medical waste washup and fear of disease transmission,. The Act warranted hospitals to adopt safe procedures to collect, transport and dispose off medical waste. Uzych (1990) suggested for further research on medical waste management due to lack of basic research data and comprehensive information.about effective methods for the treatment, storage, handling, transportation and disposal of medical waste. This chapter discusses previous studies conducted on medical waste management, and for better understanding, the author has dealt, under separate chapters, with governing regulations and current waste management practices.

Previous Studies

An early study by Clark (1989), concluded that many hospitals were not managing their waste properly. His study at Lincoln, Nebraska showed that 60% of the hospitals were

not aware of applicable regulations, 40% of the hospitals did not have any sort of segregation program and 61% had improper storage areas.

Miller et al. (1990) determined that a comprehensive waste management policy should integrate various issues such as technical, economic, environmental, regulatory, social, liability, and safety. According to Miller, many hospitals do not have the in-house expertise necessary to formulate a waste management system addressing all the issues, and hence, seek outside expertise to conduct exhaustive study and design a suitable waste management plan.

Fay et al. (1990) identified the key elements which must be considered while formulating a waste management program, as follows:

a. The waste classified as infectious must be distinguished based on its characteristic to inflict a significant infectious hazard.
b. Infectious waste must be clearly defined, and should be consistent through out the organization.
c. To effectively enforce the segregation of waste, the management program should receive administrative support, and associated personnel implementing the program should be given sufficient authority.

Hall (1990) and Fay et al. (1990) studied the techniques, and found that a successful waste management program should include techniques to classify, segregate,

pack, store and transport the waste which are cost effective and which limit exposure of personnel involved in handling.

According to Wagner (1991), the two departments that contribute a larger bulk of waste generated in hospitals are laboratory and surgery. Laboratory generate the highest percentage by weight, while surgery generate highest percentage by volume. Hence, concentrating on waste reduction measures in these departments can substantially reduce the overall amount of infectious waste generated by the hospital.

The study by Rutala et al. (1992) concluded that hospitals over designate waste as regulated medical waste because the penalties for violating rules are severe. Another reason attributed to this trend is the terminology used in defining infectious waste. Words such as "saturated and/or dripping" in defining infectious waste create confusion to administrators in classifying the waste. Miller et al. (1990) pointed out that hospitals adopt a conservative approach to classify infectious waste partly because they wish to avoid the embarrassment of infectious waste entering into landfill along with other garbage.

According to DiGiacomo et al. (1992), hospitals have reported substantial reduction in final volume and weight of waste generated by substituting reusables only in surgery and patient care departments. Also, significant cost reductions were observed.

In a study by DiPietro (1991), switching to autoclavable plastic bed pans and reusable underpads for a 529 bed hospital resulted in reduction of approximately 1700 pounds of infectious waste, product supply expenditure by $17000, and waste disposal cost by $1000.

According to Miller (1990), most of the hospitals prefer to incinerate their solid and semisolid waste generated because of stringent waste tracking laws. Hershkowitz (1991) discussing about safe handling of infectious waste points out that two third of the hospitals prefer to incinerate their waste. However, recent emission standards for waste incinerators has made this option an expensive method of treatment.

To sum up, the previous studies have been focused on individual aspects such as determining the quantity of waste generated, classifying the waste generated, identifying opportunities for waste reduction, and in identifying disposal methods. The aim of this study is to integrate the best ways on different aspects as determined by the earlier studies and incorporate them to the existing waste management system at Stillwater Medical Center.

Chapter III

Regulations Governing Medical Waste

An Overview

Infectious waste is governed by largely overlapping local, state and, federal regulations. The crucial environmental health problems posed by the improper disposal of hazardous wastes was first recognized in 1976. During this time, regulation at the federal level began and the Resource Conservation and Recovery Act commonly known as RCRA was enacted for proper management of hazardous waste to protect human health and environment. Also, Congress gave authority to the Environmental Protection Agency under Subtitle C of the Resource Conservation and Recovery Act of 1976 to regulate the management and disposal of solid waste.

RCRA governs more stringently the management of solid waste deemed "hazardous" than the disposal of other solid waste. In the Resource Conservation and Recovery Act, Congress indirectly mentioned medical waste. The act defines the term hazardous waste as, "A solid waste, or combination of solid wastes, which because of its quantity, concentration, physical, chemical, or infectious characteristics may... pose a substantial present or potential hazard to human health or the environment when

improperly treated, stored, transported, disposed of, or otherwise managed".

Although, the above definition of hazardous waste empowered the federal Environmental Protection Agency to consider infectious waste as hazardous waste, Congress also gave the EPA authority to act on its own discretion as far as regulations were concerned. In fact, EPA issued a preliminary rule in 1978 which placed infectious waste under the proposed hazardous waste regulations. But, during the comment period, the agency received responses which overwhelmingly recommended against regulating infectious waste. The Agency concluded that lack of scientific evidence of the health hazards of infectious waste existed to justify federal rule making and did not include infectious waste among the substances to be regulated when the final RCRA rules were published in 1980.

In 1982, the EPA published a guide for managing medical waste. The guide instructed the health care organizations on how to manage their waste safely. The guide was subsequently revised in 1986.

Federal Regulations

On Nov. 1, 1988, President Reagan signed the Medical Waste Tracking Act which created a Subtitle J to the Solid Waste Disposal Act and established a program for managing and tracking medical waste. MWTA was passed swiftly by

congress to react to the beach washups. The intent of the Act was to prevent public exposure to medical waste through illegal dumping and improper labeling or packaging and to protect the environment by controlling the waste disposal practices. For enforcement purposes the regulations are contained in 40 CFR Part 259. Subtitle J of the 1976 Resource Conservation and Recovery Act contains the regulation in 11 sections. They describe the scope of the program, designate the types of waste that need to be tracked and defines tracking procedures. Also, segregation, packaging, labeling, marking, storing of medical waste are included in these sections. The Act went into effect on 22 June 1989.

All medical facilities that produce 50 pounds or more per month are subject to the Act unless their waste is both treated and destroyed on site. Treatment here refers to substantially reducing or eliminating the potential disease causing pathogens and destruction refers to reducing the waste material to unrecognizable state as a medical waste. Waste that are shipped outside for treatment and disposal, should meet the segregation, packaging, special labeling and tracking procedures. Tracking of medical waste is similar to hazardous waste tracking system and uses what is called a manifest form. Each generator must attach a multipart "manifesting" form to each container of waste. The manifest form is signed by the transporter after the waste is loaded on to the container. One copy of the form is then returned

to the generator after the waste is disposed. The form should indicate how it was disposed. Critically, the generator is responsible for following up with transporters who do not return the manifest on time (See Appendix B for Manifest Form).

In case of violation of the MWTA, a civil penalty of up to $25000 per day for each violation can be assessed by EPA. For knownful violation, criminal penalties of up to $50000 per day of violation or two years imprisonment may be assessed. Repeated offenders may be subjected to double the maximum penalty.

State Regulations

Responses by state governments have ranged from very lenient to the imposition of extensive regulations. State health or environmental departments which have the authority to regulate and control infectious diseases, control proper disposal of infectious waste as well. All states have statutory requirements, administrative policies, and guidelines for the disposal of infectious waste. Many of the rules developed by states for regulating the medical waste have no scientific basis. This has resulted in a great amount of variance between state regulations. Also, there are major conflicts between regulations published by various states.

The term "infectious waste" may have different meanings amongst various states. In some states or localities which adopt extremely restrictive approach to waste disposal, infectious waste means, all waste generated in a medical facility or any material exposed to human pathogens or disease carrying organisms. These regulations for the handling of medical waste have added substantially to the cost of healthcare, at a time when heavy pressure is being applied to healthcare institutions to reduce the cost of healthcare.

Most of the states while meeting the federal regulations, have developed their own requirements for handling, packaging, transporting and disposing waste. The medical community is caught in a transitional dilemma of complying with regulations affecting the management and disposal of infectious waste, while not compromising quality health care. Unfortunately inconsistencies exist both among states, and between state regulations and local requirements, leaving hospitals and other medical waste generators with confusing and inconsistent regulations on how to manage infectious wastes.

In the state of Oklahoma, Biomedical waste is defined as materials which are discarded and which have infectious potential. Biomedical waste include, pathological waste, biological tissues, soiled dressings, isolation waste and other patient-care materials, contaminated sharps and other substances which have been in contact with pathogenic

organisms. Also, this definition include any and all substances which contain materials or organisms which may cause injury or disease to man or his environment and which are not regulated as controlled industrial waste.

Infectious waste include waste from the following categories:

a. Cultures and stocks of infectious agents and associated biologicals
b. Human blood and blood products
c. Pathological waste
d. Contaminated sharps
e. Waste from surgery, autopsy and other medical procedures
f. Contaminated animal carcasses, body parts and bedding
g. Laboratory waste
h. Dialysis unit waste
i. Isolation waste
j. Any other material that has the potential to cause infection.

The various methods approved by the State Department of Health to render biomedical waste harmless and biologically inert includes:

a. Incineration
b. Steam sterilization and
c. Chemical disinfection

Liquid infectious waste can be discharged into the sanitary sewer directly provided that the approval of the municipality has been obtained

Generators who ship untreated waste are responsible for proper packing and safe transportation. The packing of waste should maintain its integrity when handling, storage, transportation, and treatment to prevent spillage. Sharps should be placed in puncture proof containers and waste to be incinerated should be boxed in combustible containers. Infectious waste should be double bagged in tear resistant red bags and then placed into rigid or semi-rigid containers marked with the universal biohazard symbol. It is the responsibility of the generator to assure that waste are packed safe for transportation.

The vehicle transporting waste should be leak-proof, closed and secured. Vehicle should be refrigerated to a temperature of 45 deg. F or less if waste is transported for a period of 12 hours or more. Transporter should carry bills of lading from generator showing the name, address and phone number of the generator. Also, description of the waste and the name of the contact person at the generator facility should be included.

Agencies

The Center for Disease Control (CDC) is a federal agency that handles matters of short and long-term health

threats. According to Spry (1991), the CDC does not have any regulatory authority. Its findings and guideline documents on infectious waste management are intended to protect health care workers from the risk of exposure to health threats. However, many hospitals have misinterpreted the guidelines as a regulatory requirement and define infectious waste in consistent with CDC recommendations. In 1985 the Centers for Disease Control issued its recommendation for managing medical waste. The CDC's disposal recommendations were similar to the EPA guide, although the CDC definition of medical waste was narrower because it focused only on materials that have the potential for causing infection. According to the Agency, infectious waste are those which has the potential risk of causing infection during handling and disposal.

Another Agency that came up with standards for hospitals is the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). Participation in the agency accreditation process is voluntary and health care providers and employers are held responsible for implementing the recommendations and standards set by this agency. According to JCAHO, hospitals must manage their hazardous materials, including infectious waste, from the time of generation until ultimate disposal.

Chapter IV

Current Waste Management Practices in Hospitals

Introduction

Health care professionals are concerned about proper management of infectious waste because of aesthetic concerns, state regulations, and the fact that certain waste have been associated with transmission of infection. Fay et al. (1990) discussing the growing issues of management and disposal pointed out that the various infections that are capable of being communicated are hepatitis-B, non-A, non-B hepatitis, acquired immunodeficiency syndrome, malaria, syphilis, enteric diseases and tuberculosis. Hence, the development of a comprehensive management plan to deal with hospital waste is a must and is a complex undertaking.

The federal regulatory atmosphere, local and state regulations related to classification and disposal, economic and community concerns must be studied in great detail before decisions are made. To ensure safe handling of hospital waste, a waste management program should effectively address various components of the waste cycle.

The various important components that a management program needs to incorporate are: classification,

segregation, packaging, storage, transportation, waste reduction, recycling, and reuse techniques. If each of these components are addressed effectively, the organization will be benefited in either minimizing the risk of potential exposure or decrease in the overall cost of disposal.

Classification

Medical waste as a whole is usually categorized into three main groups namely infectious or red bag waste, hazardous (including chemotherapeutic and radioactive) waste, and noninfectious general waste.

There are no fixed tests to characterize medical waste as in characterizing hazardous waste. Hence, the classification of medical waste into different categories depends on the person formulating the management plan. The literature survey was consistent on the point that the term infectious waste is poorly defined and that there are many definitions in use for the word infectious waste.

The definition varies depending on the government agency involved and the scientific background of the person who deals with the waste management program. Hence, in the absence of a fixed definition, most hospitals are highly cautious in classifying their waste.

In some cases, hospitals classify more than three times as much waste as infectious than otherwise. This trend is national. The excessive caution results in shortage of

capacity to dispose the additional infectious wastes at a time when it is becoming difficult to dispose the truly infectious waste. Also, the potential impact of such a trend on hospital waste management could be disastrous as it increases the cost of waste disposal. Hence, it becomes necessary for hospitals to work with a single definition of infectious waste and the best results could be achieved by adopting the EPA definition in establishing hospital wide waste segregation and control policies.

According to the EPA, infectious waste are those wastes which are capable of producing an infectious disease. For waste to be infectious, it must contain pathogens with sufficient virulence and quantity so that any exposure to the waste by susceptible host could result in an infectious disease. The Agency lists the following categories of medical waste to be tracked:

a. Isolation waste;
b. Cultures and stocks of infectious agents and associated biologicals;
c. Human blood and blood products;
d. Contaminated sharps;
e. Pathological wastes;
f. Contaminated animal carcasses, body parts as well as bedding;
g. Waste from surgery and autopsy;
h. Miscellaneous laboratory wastes;
i. Dialysis unit waste; and

j. Contaminated equipment used in patient care.

Center for Disease Control guidelines demonstrate that all patients are considered potentially infected with HIV and/or other blood borne pathogens, and hence, workers must adhere rigorously to infection control precautions. The Agency has categorized that certain body fluids such as blood, vaginal secretions, synovial fluid, cerebrospinal fluid, and amniotic fluid present potential threat of disease transmission from agents such as HBV and HIV. Other body fluids such as nasal secretions, sweat, tears, urine, and vomitus, pose little risk of transmission of HBV and HIV unless they are contaminated with blood.

U.S. hospitals discard infectious waste in a manner consistent with the CDC and EPA guidelines. Rutala et al. (1989) in their study on management of infectious waste by US hospitals observed that the highest compliance rate was with the CDC guidelines (82 percent) since they consider five types of medical waste as infectious. The compliance rate with the EPA guidelines was 75 percent without the optional group and 59 percent when the optional waste was considered.

Segregation

Segregation of infectious from noninfectious waste is an inexpensive procedure. Segregation reduces the risk of exposure of personnel involved in handling and disposal.

Also, more importantly, waste segregation eliminates the added costs of special handling, treatment and disposal.

Planning and implementing a segregation program must be based on "common sense" and should be tailored to work in a specific situation. Also, segregation programs must include staff training to explain the definition of infectious waste, demonstrate the proper segregation procedures, and explain the impact of waste segregation on the operation of the hospital.

The first step in segregation is to study the waste stream generated in the hospital and then define the waste that present a potential threat of infection. In doing so, care should be taken to adhere to EPA guidelines or CDC guidelines.

Although, there is only limited data available on the composition of hospital waste, characteristically the waste is heterogeneous in nature. Generally, non infectious waste generated from a hospital as a whole would include external wrappers, packaging materials, glove wrappers, prepping materials, solutions not contaminated with blood or body fluids, noncontact patient items, etc. These waste, then can be sent to the local landfill as general waste. Waste presenting potential risk of danger may include patient diapers, bloody sponges and laps, gowns and gloves, bloody body fluids, and anatomic or pathologic tissues. These items should be segregated from the general waste stream. It is always better to dispose of any questionable items

along with infectious waste. This way the chance for an accidental exposure or the embarrassment of infectious waste going to the landfill can be avoided.

To avoid confusion, hospitals initiate the process of segregation at the point of generation. Infectious waste that are not capable of inflicting injury to handlers are normally collected in a clearly identifiable red plastic bags. The bags should be tear resistant and confirm to the quality as judged on their thickness or durability evaluated by the ASTM dart test.

Needles, and other sharp objects that pose threat of injury are discarded into rigid puncture-resistant containers. Containers of different sizes are suitably selected depending on the departmental requirements. Needle collection containers should be placed at all convenient locations nearest to the point of generation of waste. Although, other means of needle disposal were widely used in the early days, Cheremisinoff et al. (1991) suggest that such methods are no longer used primarily because they increase the chances for injury.

Canisters are widely used to handle liquid waste. Some canisters have removable liners that are easy and safe to remove. Once removed, the liner is sealed and placed in the red bag. Canisters containing free blood or body fluids should be handled with extreme care. It is not recommended to empty a container due to the risk of exposing personnel to contaminated blood and body fluid. Absorbent gels can be

used to solidify the liquid. Also, solidifying the liquid with an absorbent gel reduces the risk of spilling during transportation and disposal.

Packaging

Proper containment of the infectious waste prior to its ultimate destruction or disposal is the most crucial element of the management program to prevent contamination of personnel or the environment. Also, adequate care in packaging limit hospital exposure to unwanted liability issues.

Infectious waste collected in the red bag are bagged once again for safety and placed in a rigid and leak resistant box. Care should be taken not to fill the bag beyond its volume or weight capacity. The box must be impervious to moisture and should be sealed adequately to prevent any accidental leakage. Sharp containers once full are placed in red bag and then are put in a box. Fluid in quantities greater than 20cc are packed in break resistant and tightly lidded or stoppered.

The outer most surface of all containers must be marked with the name and address of the generator. In addition, the name and address of the generator and the transporter's EPA ID number and the date of off-site transport must be marked on the outer surface of each package. All containers must also be labeled with either the universal

biohazard symbol or the words "infectious waste" or "medical waste". Waste with multiple hazard should be marked accordingly.

Storage

According to EPA guidelines, infectious waste should not be stored on the site for more than seven days before treatment. Otherwise, the storage area should be refrigerated to prevent putrefaction and bacterial growth of waste awaiting transportation. Also, proper ventilation and refrigeration would aid in keeping the storage area free from foul smell. Most of the states stipulate that infectious waste can be stored for seven days or less if unrefrigerated.

The storage area should be posted with biohazard symbols, and access to the area should be limited. The area should be disinfected regularly and only waste that are packed rigidly should be placed. The storage area should be equipped with an emergency spill cleanup kit, which is readily accessible to the person responding to any spill in the area. The kit should have the necessary heavy duty gloves, absorbent material, disinfectant, and collection equipment capable of handling a major spill.

Training

Infectious waste is cited as an occupational hazard to personnel involved in handling. According to Vetter (1991) the risk of occupational hazards for healthcare workers is 1.5 times greater than that of all other workers. Hence, training becomes a vital part of the management system to protect workers and to prevent injury during the handling process.

Employees who handle infectious waste should be trained adequately before they start to perform the work. It is the responsibility of the hospital to provide such a training to its waste handling work force.

The training should include an explanation of the infectious waste management plan and assignment of roles and responsibilities of individuals for effective implementation of the plan. In addition to this, employees should be trained to handle emergency situations such as a spill. The training should be aimed at making the employees familiar with protective measures, appropriate procedures to handle a liquid infectious waste, plastic bags rupture or containers leak and equipment failure.

Treatment and Disposal Options

Hospitals, usually consider disposal a problem due to stringent regulations, limited options and liability issues. Therefore, to determine the best disposal option, they must undertake comprehensive studies on the types of waste generated, quantity generated, disposal cost, local and state laws etc. Recently, the various problems encountered have made hospitals give serious thought to changing their policies, procedures and products that provide better patient care and worker protection while alleviating the disposal problem. Hence, proper disposal procedures minimize the waste disposal problem without compromising on quality patient care and worker safety.

Hospitals treat and dispose of their medical waste in many different ways. Various treatment technologies include steam sterilization, incineration, thermal inactivation, gas/vapor sterilization, and chemical disinfection.

Steam sterilization is most effective with low density material such as plastics, where the steam can penetrate effectively. On high density waste such as large body parts or fluids, steam sterilization is not effective because of poor penetration.

Incineration is opted by many hospitals mainly because this method can treat all types of infectious waste Also, in this method body parts and tissues are destroyed to unrecognizable form and disposed. Hospitals that incinerate

their waste either have their own incinerator on the facility or send waste to an offsite facility for incineration. The incinerated ash is then disposed in a landfill.

Thermal inactivation is another type of treatment method adopted to render infectious waste inert. This method is opted when the waste volumes are high. When compared to steam sterilization, this method requires higher temperatures and longer treatment cycles.

Gas/Vapor sterilization uses ethylene oxide as sterilizing agent. The disadvantage of the process is that ethylene oxide is a carcinogen and employees should be trained adequately to avoid exposure.

The other treatment technologies that could prove successful in the future are laser technology and gamma radiation technology.

Recently, new technologies have emerged for safe handling of needles. For example, polymers are used to sterilize and encapsulate sharps into a solid block-like material. In another method, encapsulation is done by a shredder after chemical treatment of needles and other sharps. These predisposal treatment technologies even though prove to be cost effective alternatives are not successful because the landfills refuse to accept the encapsulated materials.

In a study by Rutala et al., about one-fourth of the hospitals pour liquid blood down the drain connected to a

sanitary sewer. This mode of disposal is legal only if the local sewage treatment facility has the capacity to handle the biomedical waste. Hence, direct discharge into the sewer should be done only after consulting with the local authorities. Also, the study determined that about one-third of US hospitals steam sterilize their microbiological waste before they are sent for disposal. The sterilized waste is either sent to a local landfill or incinerated.

Reduction & Recycling

An effective hospital waste management plan should integrate waste reduction and recycling where appropriate. To implement waste reduction and recycling programs in a hospital environment many obstacles, barriers should be planned and tackled. Escalating cost of hauling, cost of labor and cost of disposal necessiate hospitals to examine their waste streams and explore opportunities either to reduce waste generation or recover recyclable materials from the waste stream. Interestingly, DiPietro (1991) notes that, some hospitals address waste reduction in their management policy in many different forms such as:

a. Sorting waste by department
b. Forming a hospital environmental committee
c. Using fewer disposable
d. Using paper instead of styrofoam
e. Purchasing biodegradable items

f. Presenting education, inservice seminars

g. Constantly reviewing new products in the market

Success of a waste reduction and recycling program in a hospital directly depends on the infectious waste policy adopted. If a hospital adopts an infectious waste policy that basically says anything from the operating room is infectious, the use of custom surgical trays may help to reduce the quantity of packaging and sterile wrappers generated for each surgical procedure.

For a successful waste reduction and recycling program, cooperation of each and every hospital staff is essential. Collecting and separating of recyclable materials may at first seem to be a difficult task for busy hospital housekeeping staff. To overcome this attitude, hospital staff must be made to realize that not much labor is required, since, they have to take the garbage out anyway.

Those hospitals that have a well-developed segregation and training program can have a significant reduction in disposal cost, as well as the reduced risk of unnecessary exposure to staff members. According to a study by Dipietro (1991), the overall effect can be a reduction in disposal cost by as much as 50 percent.

Presently, recycling efforts by hospitals are generally focused on nonpatient contact sources of waste such as glass, scrap metal, aluminum cans, cardboard and packaging material. Although, there are no infectious risk posed by recycling these items of the hospital waste stream,

hospitals are finding it difficult to market certain items for recycling because they are perceived to be infectious waste.

The fact that people need to have better understanding of the risk posed by recycling medical waste is inevitable for hospitals to adopt comprehensive recycling programs. From an infectious disease perspective, only few items like sharps, plastic associated with microbiological cultures generated in the healthcare setting are not suitable for recycling. On the whole, recycling is given serious thought by many hospitals to reduce the waste volume.

Reuse

In recent years, hospitals are slowly shifting from the use of disposable items to reusables due to difficulties faced in disposing the additional quantity of waste generated. Also, with escalating cost of health care, hospitals are considering reuse as a primary method of cost reduction and hence can no longer afford the luxury of convenience which were not cost effective.

Technological improvements have made it viable to manufacture quality reusable products which are comparable to disposable products. Digiacomo (1992) notes that those hospitals which switched over to reusable fabrics, have reported the performance of reusables as equal to their disposable counterparts in terms of comfort, liquid

repellence, and infection rate. Some hospitals face problems to change over from disposable to reusable products due to concerns regarding development of laundry services, increased labor requirements and continued suspicion regarding reusables ability to match disposables quality. Looking into the facts, reusables are preferable for a better social, ecological and fiscal environment.

Chapter V

Research Methodology

This study was conducted at Stillwater Medical Center. The hospital has a capacity of 147 beds and has an occupancy rate of 55%. Data gathering was accomplished by scheduled visits to the hospital. Management had informed the departmental heads about the study through an administrative note. Also, the purpose, nature, and type of information needed for the study were briefed to let people know that the purpose of the study was to improve and enhance management techniques. Exact timing and duration of the study for each department was communicated to assure that the concerned department chief or a responsible person was available to provide necessary information.

The study was carried out in two phases. The initial phase involved an interview with the officials of the waste management program. Also, written policies, appropriate paperwork, documents, and reports were reviewed. The documents such as past JCAHO reports, hospital written policy manuals, emergency plans, and all environmental permits issued to the hospital served as a source of information about the current management system and the extent of compliance. Also, the extent of compliance with

regulations achievable by current management system was reviewed in-depth by answering a set of questions prepared for the study. (Appendix A)

The second phase of the study was a tour of the hospital. This phase was aimed at obtaining as much information as possible about the implementation of the existing management system by physically looking into the current practices. In addition to this, departmental heads and employees encountered were interviewed. Information about the effectiveness of the existing system was evaluated on the basis of:

a. Compliance with documents
b. Staff knowledge about management system
c. Inconsistencies between the documents and actual practices
d. Inconsistencies between practices in different departments
e. Inconsistencies between what employees were supposed to do and what they actually do
f. Waste accumulation areas
g. Posting of warning signs
h. Location of emergency equipment and accessibility
i. Cleanliness of the workplace and evidence of spills and existence of stains
j. The extent of updation of logs and records maintained by the departments
k. The awareness of emergency procedures

l. The awareness of waste disposal methods

m. Type of training received in handling waste and

n. How they avoid exposure to infectious waste

Chapter VI

RESULTS AND DISCUSSION

Presentation of Data

General

This chapter presents the findings about the implementation of each component of the waste cycle based on the information gathered during the hospital visits. The various components of Infectious waste management system adopted at Stillwater Medical Center are:

a. Classification
b. Segregation
c. Packaging
d. Storage
e. Transportation
f. Ultimate disposal
g. Employee training and
h. Waste reduction

The Stillwater Medical Center has a comprehensive waste management program and implementation of the program is supervised by the Risk Management Department. Infectious waste is classified based on state laws, and other governing agencies such as JCAHO and CDC.

The average amount of infectious waste generated by the hospital is approximately 150 lbs/day. The various departments that generate infectious waste are as follows (See Facility Layout in figures 1 to 6)

a. Emergency
b. Surgery
c. Radiology
d. Recovery
e. Laboratory
f. Dialysis
g. GI lab and
h. Patient care rooms

Segregation of infectious waste from noninfectious waste is initiated at the point of generation. Then, the infectious waste is double bagged, boxed in cardboard boxes marked with biohazard symbol, and transported to an offsite facility for incineration. Waste that are rendered noninfectious by sterilization are sent to landfill along with trash. Another route of disposal of infectious waste is through municipal sewer, and this method is limited only to some liquid waste that are determined to be safe by the hospital authorities.

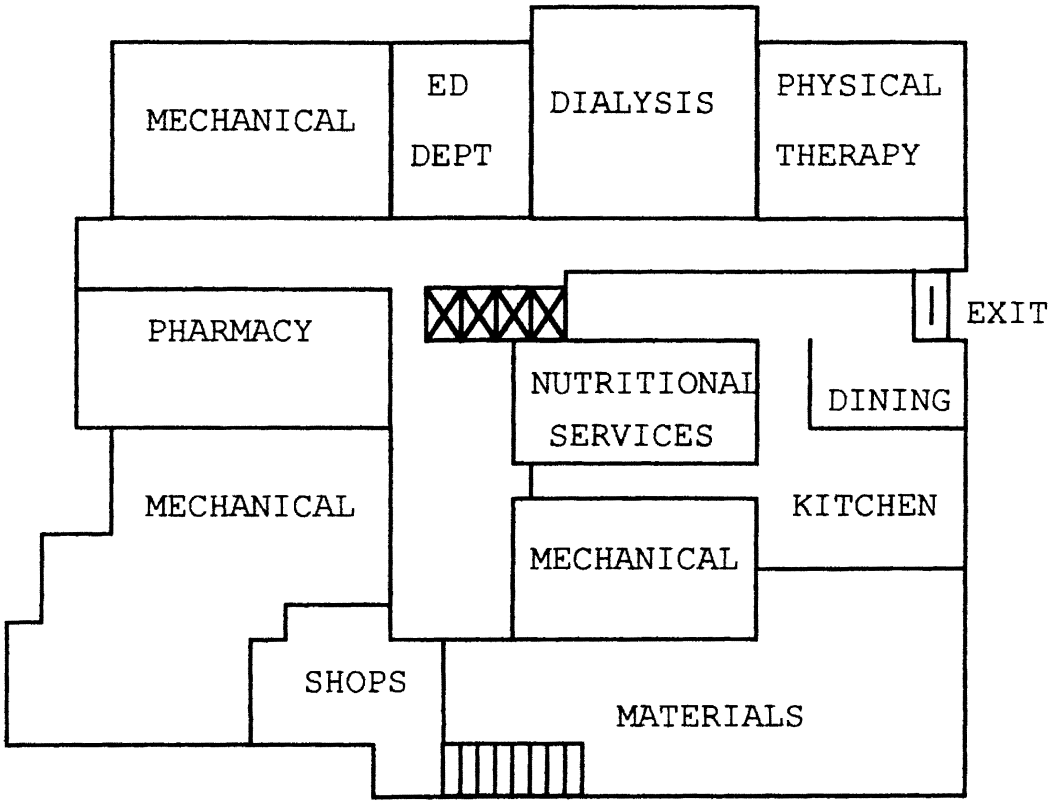

Figure 1. Layout of Basement

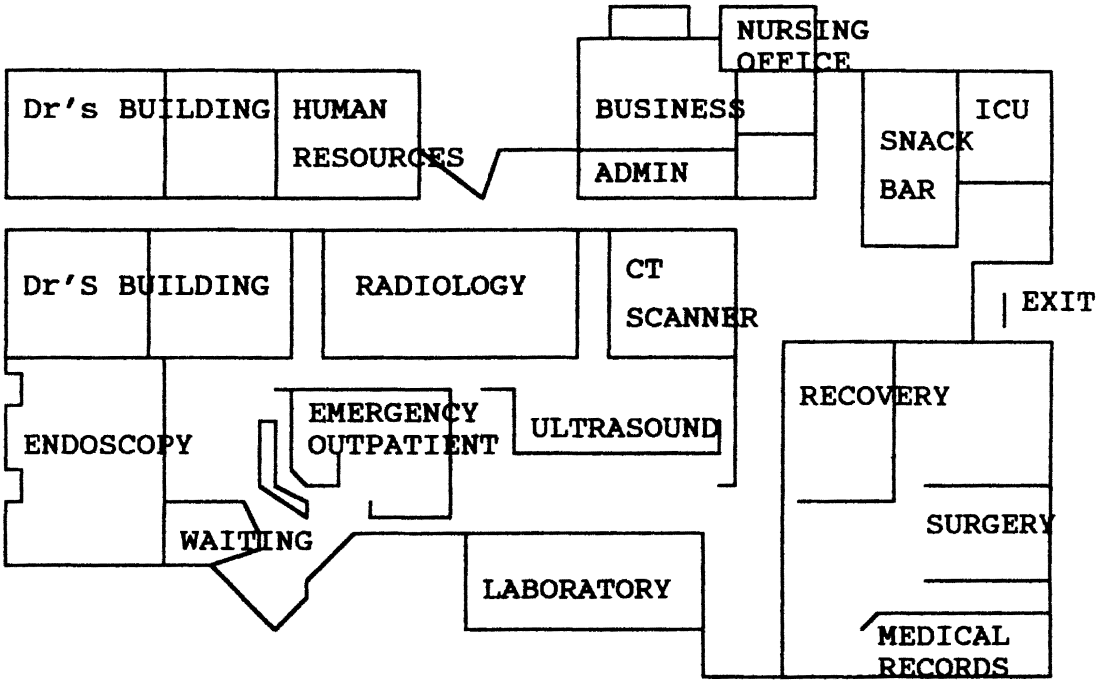

Figure 2. Layout of First Floor

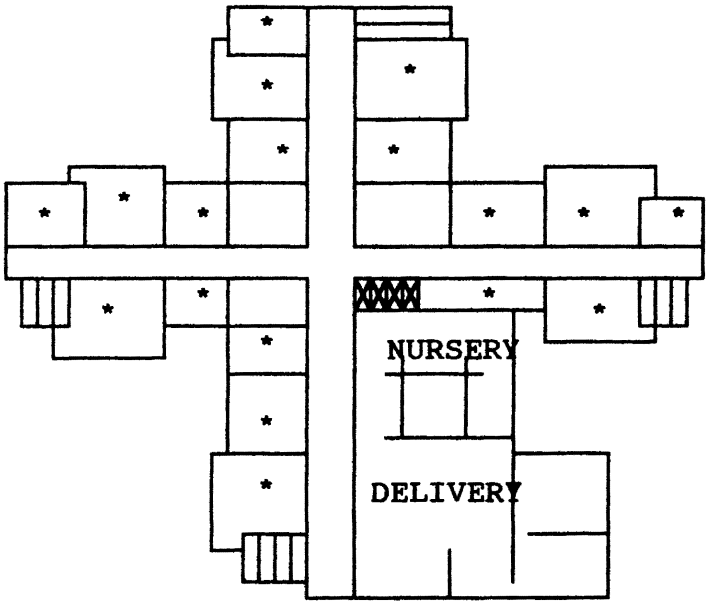

Figure 3. Infectious Waste Generation in Second Floor

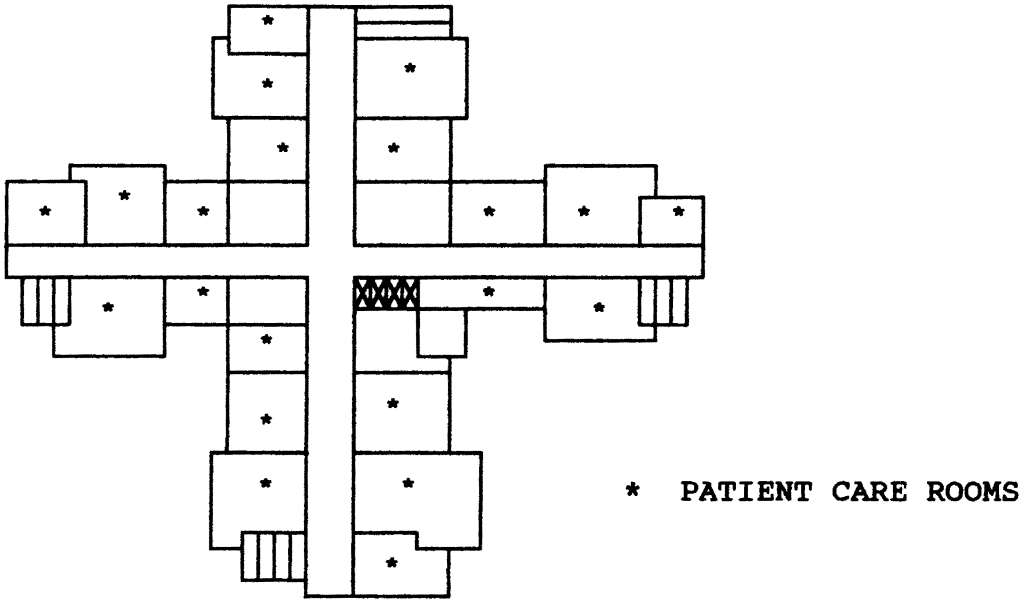

Figure 4. Infectious Waste Generation in Third Floor

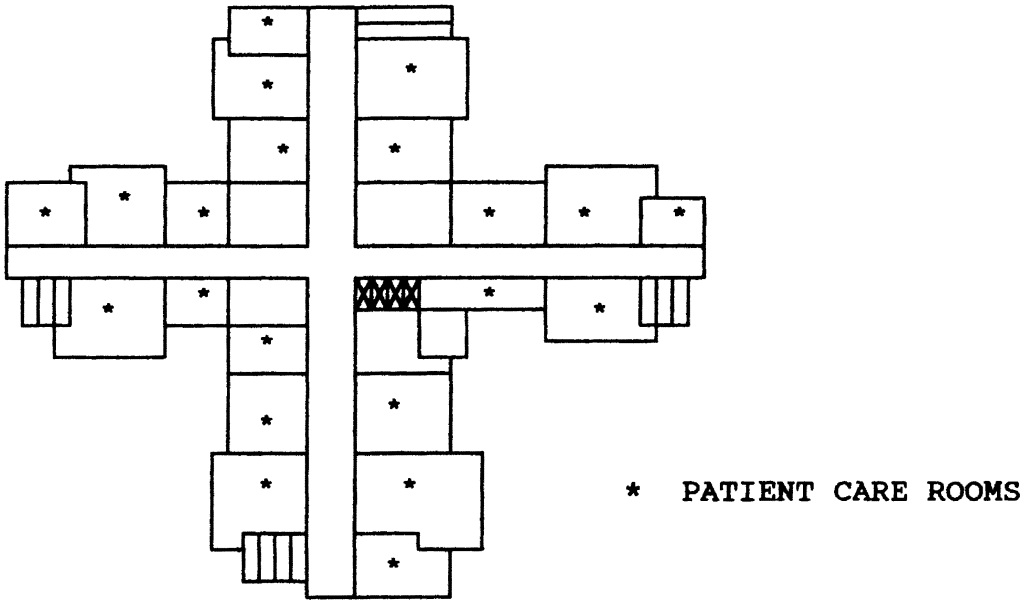

Figure 5. Infectious Waste Generation in Fourth Floor

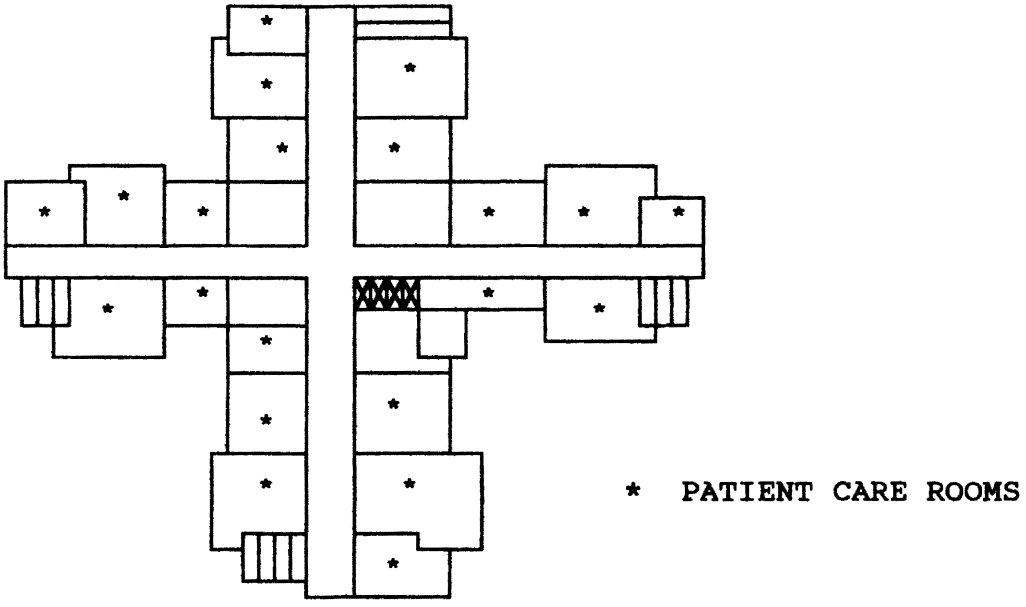

Figure 6. Infectious Waste Generation in Fifth Floor

Classification

The hospital adheres to state regulations concerning the classification of infectious waste. Waste is classified into infectious and noninfectious based on its potential to cause an infectious disease. Accordingly, through out the hospital, the following types of waste are categorized as infectious;

a. Cultures and biological agents
b. Human blood and blood products
c. Pathological waste
d. Contaminated sharp containers
e. Waste from surgery, autopsy, and other procedures
f. Lab waste
g. Dialysis
h. Isolation waste and
i. Any material determined infectious

Segregation

Segregation of waste in all departments of the hospital is uniform, and is in consistent with the classification policy of the hospital.

Infectious waste are collected in red bag lined boxes or puncture resistant containers depending on the nature of the waste. The collection units are place through out the hospital in designated areas.

Infectious waste that are solid or semisolid in nature are collected in red bag lined boxes. Sharp objects such as needles, and other waste that are capable of inflicting injury are collected in secured puncture resistant plastic containers.

In patient care rooms, kick buckets lined with red bag are placed at the bedside to collect all infectious waste. These bags once they are full are tied and placed in the central red bag lined box. Each patient room has a puncture resistant needle collection unit mounted on the wall which is replaced when they fill.

Packaging

Once full, the red plastic liner is tied securely, the box then closed, and sealed using adhesive tape. Each box is marked with the name of the generating department and the date it was packed. The boxed waste are moved to the central storage area by the housekeeping personnel on day to day basis or as and when the boxes are filled and ready to be moved.

Plastic containers used for collecting sharp objects are placed in redbag as and when they are three fourth full, and boxed. In the event of visible outside contamination of the box, the box as a whole is placed inside another container, which is then closed and sealed.

Storage

Infectious waste packed in various departments are moved to the central storage area by housekeeping personnel. Designated carts marked with biohazard symbols are used for internal handling of waste, and these carts are disinfected periodically. Typically, waste is moved from departments which generate large volumes during the late afternoon hours everyday.

Certain waste such as human body parts are kept separate in cold storage and shipped directly to the disposal facility. Normally, waste is stored on the facility for a maximum period of seven to nine days.

The storage area is posted with biohazard symbols and entry is limited only to authorized personnel. The storage area is located on the south side of the hospital close to the freight dock. The area is well ventilated and disinfected periodically.

Transportation

Waste from the storage area are transported to an offsite facility located around 150 miles from the facility for incineration and ultimate disposal. A multipart manifest is prepared by the hospital for each load of regulated medical waste despatched from the facility as shown in Appendix B. Copies of the manifest are kept for a

period of three years. Manifest is prepared on the basis of number of boxes generated by each department. Hence, looking at the manifest it is possible to say which department generated how much waste. A study by the hospital concluded that each box averaged 14 lbs. Typically, for each load of waste transported, following is the number of boxes of waste generated by different departments in the hospital determined by averaging waste generated over two month period.

TABLE I

Waste Generation by Departments (per week)

Department	Number of Boxes
Dialysis	06
Chemotherapy	01
Patient Care 5th floor	02
Patient Care 4th floor	01
Patient Care 3rd floor	02
Patient Care 2nd floor	01
L&D	07
GI Lab	01
ICU	02
ER	03
CPS	01
Surgery	86
Pharmacy	01
PT	01
X Ray	02
Laboratory	09

Disposal

The hospital dispose 50% of the waste by incineration, 40% through local landfill, 5% by sterilization and 5% through sanitary sewer.

The waste that are disposed as solid waste consists of noninfectious waste, mostly office type waste, and packaging materials generated throughout the hospital. The waste is compacted at the facility before disposal. Infectious waste are incinerated at an offsite facility. The cost of disposal is $5/box.

Waste that are sterilized are disposed along with the solid waste. Mostly, lab waste such as cultures and stocks of infectious agents are sterilized. Adequate precautions are taken to maintain proper sterilization temperature and time. Also, to ensure complete sterilization, the load is wrapped with indicator tape which change in color.

The hospital discharge liquid waste such as body fluid into the sanitary sewer system. The hospital has a formal written internal management policy and procedure which detail about the waste which can and cannot be disposed through the sewer system.

Waste Reduction Measures

Products purchased by the hospital are evaluated by the risk management department every year to assess for environmental impact, and to determine a suitable replacement. Also, the hospital review the products to evaluate its policies to achieve cost benefits.

Training

The hospital provides training to all its personnel involved in handling infectious waste. Typically, personnel in housekeeping, engineering, nursing and maintenance are trained on waste management procedures and how to respond for emergency situations such as a spill. Training is conducted by the Risk Management Department in co-ordination with Infection Control Officer.

The training emphasizes the importance of protective measures needed to prevent direct contact with the waste. Personnel attending to spills are strongly advised to;

a. Use gloves and clothing to avoid accidental exposure
b. If the spill is solid or semisolid in nature, the trash should be put in a red bag and sealed
c. If the spill involves liquid, the area should be cleaned thoroughly with hospital approved disinfectant

Housekeeping personnel normally attend to the cleanup of infectious waste spill. Hospital maintains employee training records on file. Also, tests administered to its employees are kept for record purposes.

Based on the information presented in this chapter, it is seen that the present waste management system is well-thought out, carefully designed, and operated. The hospital management actively engages in ensuring that the waste

handling and disposal is safe for human health and environment.

However, any system should be continuously reviewed and changed if necessary to ensure continuous system improvement. Keeping in line with this philosophy, the author feels that there is still some room for improvement. The suggestions for improvement in the present system are presented in the next section.

SUGGESTIONS FOR IMPROVEMENT

Any waste management system can be viewed from several aspects such as compliance aspects, logistical aspects, strategic aspects, operational aspects, and technological aspects. Focusing on only one aspect will not result into overall system improvement. Even if one aspect is weak, the effectiveness of the whole system deteriorates. Keeping this holistic viewpoint as the context, this study recommends improvements\suggestions that can be integrated to the existing waste management system at Stillwater Medical Center.

Waste generated in various departments are transferred to the central storage area during the late afternoon hours or as and when the collection unit gets filled. Since, during this hour, the number of visitors is more and generally the hospital is busy, in case of an accidental spill, the risk of exposure to public and hospital personnel

is more. Hence, to alleviate the problem of accidental exposure, it is advisable to transfer waste during the night hours when there are no visitors and hospital activities are less.

Waste that are boxed are stacked in the central storage area vertically. Stacking of waste boxes is done manually It was noticed during site visit that the height of storage necessitates the person involved to lift the box above his head to stack the box in position. In the event of box yielding, direct exposure to the person is unavoidable. Hence, the safe height of stacking should be determined and marked on the walls. Also, personnel involved in stacking should be advised not to lift the boxes above their head level if they find it difficult to stack upto the safe height.

Infectious waste from central storage area are transported directly to an offsite facility for incineration once every week either on a Tuesday or on a Thursday. However, in doing so, there is a possibility that waste might me stored for a longer period of time at the central storage area. This can happen if on a particular week waste is shipped on a Tuesday and in the subsequent week on a Thursday. Transporting waste on a particular day of the week can help to avoid exceeding the storage time of seven day period as stipulated by EPA guidelines.

The waste is transported to an offsite facility for ultimate disposal. Since, offsite transportation increases

the liability for exposure arising out of spill, the hospital should have some form of an insurance that would cover for any environmental liability.

As of now, the hospital is solely dependent on one regional incinerator to handle the waste. It is always better to have an alternative arrangement finalized and kept so that in case of an emergency such as incinerator breakdown, the hospital does not have to encounter any hazel in disposing of its waste.

In the existing waste management system, the staff handling the waste are required to report any type of accident involving human exposure to the departmental supervisor. Accident reports are filed separately in each department. The system should be altered in such a way that the reports are sent to the Risk Management Department of the hospital. The Risk Management Department should conduct an enquiry on the incident to determine the cause. and should reevaluate the procedures accordingly.

At present, the extent of waste minimization measures adopted by the hospital is very minimal. Measures to recycle office papers, packaging materials, and other items that has the potential for recycling should be studied in detail

Looking at the amount of waste generated, the surgery produces maximum amount of waste in the entire hospital. The bulk of the waste is composed of items such as gloves, gowns, etc. The quantity of waste could be considerably

brought down if reusable surgical attires are used. The author strongly feels that the hospital should think of switching over to resuables to bring down the quantity of waste generated and cost. The above suggestion was based on the following calculation. The only assumption made was that the life of a reusable gown is one year.

Data

Number of surgery per day[1]	20
Number of disposable gowns per surgery[1]	3
Number of reusable gowns required/year[3]	520
Number of boxes of waste generated/load[1]	40
Cost of each disposable gown[1]	$6
Cost of each reusable gown[2]	$12
Cost of laundry/gown[4]	$.84
Cost of sterilization/gown[4]	$.27
Cost of wrapper/gown[4]	$.25

[1]Data provided by hospital

[2]Vendor data

[3]Estimated

[4]Estimated by DiGiacomo (1992)

Calculations

Total cost of using disposable = Material cost + disposal cost

Material cost

= (No.of surgery/day) (No.of gowns/surgery) (cost/gown)
(No. of days/year)

= (20) (3) ($6) (365)

= $131,400

Disposal cost

= (No of boxes/load) (No.of loads/year) (cost/box)

= (40) (52) ($5)

= $10,400

Total cost incurred using disposable/year

= $131,400 + $10,400 = $141,800

Total cost of using reusables = Material cost + Laundry cost
+ Sterilization cost + Wrapper cost

Material cost

= (No of gown/year) (cost/gown)

= (520) ($12)

= $6240

Laundry cost

= (No of gowns) (No of wash/year) (cost/wash)

= (520) (52) ($.84)

= $22,713

Sterilization cost

= (No of gowns) (times sterilized/year) (cost/sterilization)

= (520) (52) ($.27)

= $7,300

Wrapper cost

= (No of gowns) (times wrapped/year) (cost/wrapper)

= (520) (52) ($.25)

= $6,760

Total cost incurred using reusable gowns

= $6,240 + $22,713 + $7,300 + $6,760

= $43,013

Saving/year by using reusables

= $141,800-$43,013

= $98,787

The management on its part should organize environmental shows covering every aspect of the waste management system. This way, the management commitment to safe handling of the waste can be demonstrated and at the same time make the employees feel how vital their role is in achieving the final goal.

To make the waste management system more effective, the hospital should have a employee appraisal form which includes waste management as one of the evaluating criteria.

To make the segregation program work successfully, a video tape for five to ten minutes can be played during the visiting hours at the reception lobby. This way, newspapers, drink containers, coffee cups and other items entering the infectious waste stream from patient care rooms can be successfully curtailed. This may look more trivial, but every initiative to cut down the quantity will result in the overall reduction in the cost of disposal.

Infectious waste is generated in all the floors of the hospital. The waste are then moved to the storage area in designated carts carrying biohazard symbol. To avoid unnecessary movement of waste collected from one point to various other collection points, a fixed route plan should be devised. The route plan should be such that the waste is transferred through the most safest areas and through the shortest distance.

The hospital has a policy not to introduce any kind of infectious waste into the sanitary sewer system. However, there is a possibility of blood entering the sewer system from the reuse area located at the dialysis department. To avoid this, the discharge from the reuse area can be collected in canisters and disposed. To avoid any leakage during handling, coagulant gel can be added to solidify the contents before being disposed.

Chapter VII

SUMMARY AND CONCLUSION

The overall purpose of this study was to analyze the existing infectious waste management system at Stillwater Medical Center. The research was aimed to improve the existing infectious waste management system and suggest improvements that can be incorporated to achieve enhanced compliance, enhanced personnel safety, reduce overall cost of disposal, reduce volume of waste generated, adopt better practices, and finally reduce liability.

The study was conducted in two phases. In the initial phase, the hospital authorities were interviewed, and records maintained were reviewed. The second phase of the study was a tour of all the departments of the hospital. The second phase of the study was aimed at obtaining as much information as possible about the implementation of the existing management system by looking into the current practices.

The study found that the Stillwater Medical Center has a comprehensive waste management program. The waste management system currently followed has various components such as classification, segregation, packaging, storage,

transportation, ultimate disposal, employee training and waste reduction.

Each of the above mentioned components were viewed in various perspectives such as compliance, logistical, strategic, operational, and technological aspects. Based on the existing practices, the study suggested the following recommendations:

a. To transfer waste from various departments to central storage area during the night time.
b. To establish safe height of stacking to avoid accidental exposure while stacking.
c. To establish standard practices for transporting the waste from the facility to the incinerator.
d. To develop an alternative incineration facility to avoid total dependency.
e. To change the existing system of reporting accidents.
f. To conduct environmental shows to cultivate employee commitment to make the waste management system work more effectively.

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APPENDIXES

APPENDIX A

1. Does the hospital have a policy which describes the following waste as regulated medical waste

    a. Cultures and stocks of infectious agents

    b. Pathological waste

    c. Human blood and blood products

    d. Sharps

    e. Isolation Waste

    f. Unused sharps

2. Does the hospital segregate regulated waste intended for off site transport from all other waste prior to placement in transport containers.

3. Is regulated medical waste placed in containers that are

    a. Rigid

    b. Leak resistant

    c. Impervious to moisture

    d. Strong to prevent tearing or busting and sealed to prevent leakage.

4. Does sharps and sharps with residual fluid are placed in puncture resistant containers

5. Does fluid in quantities greater than 20cc are placed in packaging that is break resistant and tightly lidded or stoppered to prevent spilling

6. Does regulated medical waste is stored in a manner that maintains integrity of packaging

7. Does the storage area protected from
   a. Water
   b. Wind
   c. Rain
   d. Animals and
   e. Insects

8. Does the waste stored in secured area.

9. Does containers showing signs of contamination are decontaminated or packed in a secondary box

10. Does each package of regulated medical waste is labeled as medical waste or infectious waste

11. Does each package of regulated medical waste display the universal biohazard symbol

12. Does each package of regulated medical waste has water resistant tag containing

a. Generator name

b. Generator state permit number

c. Transporter name

d. Transporter state permit number

e. Date of shipment

f. Identification of contents as medical waste

9. Does all waste accepted by transporter is manifested and transporter ensures

a. Container contains transporter name

b. Permit number

c. Date of receipt

9. Does the vehicle carrying medical waste is

a. Fully enclosed

b. Leak resistant

10. Does the waste carrying body is in good sanitary condition body is secured when left unattended

11. Does the outside of the body of the vehicle is

a. Identified on two sides and back with:

b. Transporter name

c. Transporter state permit

d. The words "medical waste"

12. Does the transporter refuses to accept waste if not accompanied with tracking forms

13. Does the transporter assures that tracking form accurately reflects the number and total weight of packages to be transported

14. Does the transporter returns signed copy of tracking form to generator

15. Does the transporter upon delivery complete the tracking form with

a. Date of delivery

b. Name of facility where waste is delivered

16. Does all the documents stored for a period of three years by the generator

APPENDIX B

BFI Waste Systems™
BROWNING-FERRIS INDUSTRIES

1 (2) 3 4

RECEIVED IN ACCOUNTING DEPT

16772

NON-HAZARDOUS SOLID WASTE MANIFEST

GENERATOR

Generator Name Stillwater Medical Center
Address 1323 W 6th
Stillwater
Phone No.

Generating Location
Address Same
Phone No.

Description of Waste

BIOMEDICAL WASTE

Bar Code #

Containers Quantity	Size	Type
07		C

Type: D - Drum, C - Carton, B - Box, P - Pounds, O - Other, S - Sharps

I hereby certify that the above named material does not contain free liquid as defined by 40 CFR Part 260.10 or any applicable state law, is not a hazardous waste as defined by 40 CFR Part 261 or any applicable state law, has been properly described, classified and packaged, and is in proper condition for transportation according to applicable regulations.

Generator Authorized Agent Name | Signature | Shipment Date 09/14/93

TRANSPORTER

Truck No. 283 T 802 - 283 T 801
Transporter Name BFI
Address 1616 N. Pittsburg
Tulsa, OK 74115

Phone No. 918-834-2244
Driver Name (Print) Wayne Smith - Joe Kent
Vehicle License No./State P55073 - P55074
Vehicle Certification

I hereby certify that the above named material was picked up at the generator site listed above.
Driver Signature | Shipment Date 09/14/93

I hereby certify that the above named material was delivered without incident to the destination listed below.
Driver Signature | Delivery Date

DESTINATION

Site Name Midway Environmental
Address Hwy. 66 and Allied Rd. - Stroud, OK 74079

Phone No. 918-968-3531

I hereby certify that the above named material has been accepted and to the best of my knowledge the foregoing is true and accurate.
Name of Authorized agent | Signature | Receipt Date 09/17/93

Method of Treatment Incineration Date of Treatment 9-23-93 Time 02:26

Source: Stillwater Medical Center

VITA

Kesavan Mayur Srinivasan

Candidate for the Degree of

Master of Science

Thesis: STUDY ON INFECTIOUS WASTE MANAGEMENT AT STILLWATER MEDICAL CENTER

Major Field: Environmental Science

Biographical:

Personal Data: Born in Kumbakonam, Tamilnadu, India, June 15, 1962, the son of Mr. and Mrs. Dr. Raghavan M. Kesavan.

Education: Graduated from St. Mary's Matriculation High School, Karikal, India, in March, 1978; received Bachelor of Engineering in Mechanical Engineering from Bangalore University, Bangalore, India in March 1987; completed requirements for Master of Science degree at Oklahoma State University in December 1993.

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