AWARENESS AND PRACTICES ON HOSPITAL WASTE MANAGEMENT IN POLYCLINIC HOSPITAL, ISLAMABAD

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List Of Abbreviations

AMS	Additional Medical Superintendent/Assistant Medical Superintendent
BHU	Basic Health Unit
BMI	Body Mass Index
DFID	Department for International Development
DHQ	District Head Quarter (Hospital)
DoH	Department of Health
DMO	District Monitoring Officer
MWMFP	Medical Waste Management Focal Point
EA	Environmental Assessment
EHS	Environment, Health, and Environment
EIA	Environmental Impact Assessment
EMOC	Emergency Obstetric Care
EMP	Environmental management plan
EMWMP	Environmental and Medical Waste Management Plan
EPA	Environmental Protection Agency
GoP	Government of Punjab
HCW	Health care waste
HCWM	Health care waste management
HIV/AIDS	Human immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
HNP	Health, Nutrition and Population
ICMP	Infection Control Management Project IDU Injection Drug Users
MO	Medical Officer
MS	Medical Superintendent
M&E	Monitoring and evaluation
NEQS	National Environmental Quality Standards
NGO	Non-governmental organizations
OP	Operational policy
OPD	Out patients department

Pak-EPA	Pakistan Environmental Protection Agency
PEPA	Pakistan Environmental Protection Act
PEPC	Pakistan Environmental Protection
PPE	Council Personal protective equipment
WMO	Waste Management Officer Waste World
WMP	World Health Management plan
WHO	Organization Waste management team
WMT	Waste Management Team

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Approval for Examination

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ABSTRACT

The study consists of hospital waste management processes of Polyclinic Hospital. The hospital is situated in sector G6/2 of Islamabad. It is government owned teaching hospital. Proper management of healthcare waste is a critical concern in many resource constrained countries of the world. Pakistan is the sixth most populous country in the world with one of the highest urbanization and population growth rates in South Asia. This study was meant to determine waste management practices in capital city of Pakistan. The hospital was thoroughly analyzed for a week to quantify its wastes by category using a digital balance. This is a cross-sectional descriptive study, aimed to analyze HWM practices of Polyclinic Hospital, Islamabad to describe the qualitative and quantitative results of analysis, observations, interviews, and data collected from different groups of hospital staff by questionnaire. Research was conducted from 1st, Feb to 25th March 2021. Objective of study was to evaluate the current risk waste management practices and compliance level with hospital waste management rules-2005 and to determine the characteristics of hospital wastewater in these hospitals. The HWM practices in hospital were systematic but the hospital staff handling the waste was not fully aware of accurate segregation of the hospital wastes. Our findings reveal a major policy implementation gap among the government andthe hospitals. Wastewater parameters of hospital revealed that wastewater was contaminating the water resources. Effective implementation of waste management strategies, Monitoring. Motivation, Communication, and awareness at all levels is the key to success. Hospital wastewater treatment is not a priority in hospital. It is need of the day that all heath care facilities must follow the national guidelines on HWM and there should be a documented andapproved waste management protocol which should be strictly implemented.

ACKNOWLEDGEMENTS

It is my proud privilege to express the feelings of my gratitude to many people who facilitated me directly or indirectly to conduct this research. I would also like to express my gratitude to my supervisor, **Dr. Asif Javed**, Senior Assistant Professor, Department of Earth and Environmental Sciences at Bahria University, Islamabad for his constant support and encouragement to make this thesis as I wished and for believing in my capabilities. I would also like to thank Dr Said Akbar Khan, HOD, Earth and Environmental Sciences for support and facilitation.

I am indebted to my family without their encouragement it wouldn't be possible for me to achieve this goal and success in life. I am also indebted to the Medical Superintendent and Management of Polyclinic hospital and who gave me permission to complete this research.

DEDICATION

I dedicate my research work to my family and especially to my father Muhammad Fayyaz Baloch for encouraging me to complete my Master’s thesis. It's not possible to complete this thesis without you as my constant support.

CHAPTER-1

INTRODUCTION

1.1 BACKGROUND

Healthcare activities can result in different kinds of waste. Negligence of these wastes can result in environmental and occupational health risks. According to WHO, about 70–80% of the waste resulting from healthcare activities is like the municipal waste; it is the remaining 20– 30%that acts as hazardous infectious waste (Chartier et al., 2013). Safe supervision of hospital wastesis a serious challenge in many resource constrained countries of the world. International standards set minimum requirements for hospital waste management, but the literature reveals that countries with resource constraints have difficulty in implementing them (Caniato et al., 2015; Cole, 2000).

It is important to classify waste into different categories to better analyze the waste stream generated at a healthcare facility. This study involves an investigation of waste generation rates at a public sector teaching hospital at the capital city of country. Mostly existing studies on the topic of hospital waste management in Pakistan are qualitative (Kumar et al., 2015; Ali et al., 2016a) and they are usually conducted from a public health perspective. There have been relatively few studies to quantify waste generation across hospitals in the country (Ali et al., 2016).

According to national and international standards, it is mandatory for the hospitals to handle and finally dispose of all types of waste produced in the hospital without deterioration ofenvironment. Every healthcare facility in Pakistan must abide by the Waste management Rules 2005, of the Government of Pakistan. In the light of these rules, every healthcare facility is accountable for the appropriate execution of waste management of the generated waste till its final treatment/disposal in agreement with the terms/provisions of the act (Environment Protection Act 1997).

The hospital waste management program outlines the rationalization of the legislation or standard protocols to important elements to constitute a suitable hospital waste management system achieve (Shahida R et al., 2005). In 1998, Ministry of Health, Government of Pakistan, Environmental Health Unit prepared guidelines covering all aspects of the vital information required for safe and appropriate waste management and final disposal in the country. These

guidelines also include the risks related with the handling of hospital waste, structure of the hospital waste management team responsibilities and duties of its members and waste management plan.

These guidelines also explain in detail all the procedures associated with hospital waste management from collection and segregation of hospital waste to final dumping, including waste minimization practices, and use of protective clothing, etc. Pakistan is in a stage of implementation of waste management systems in the hospitals and trying to improve awareness in hospital staff members and general population. The good healthcare waste managementdepends on excellent administration and execution beside suitable legislation, financing, and energetic involvement of skilled and well-versed staff (Hashmi S. K, 2003).

According to international and national standards in vogue, the healthcare facilities are legally required to manage and adequately dispose of all types of waste which is produced duringprovision of healthcare facilities and services without any ill effect on the environment. In Pakistan, it is mandatory to implement Waste Management Rules 2005 (Government of Pakistan) for each healthcare facility and abide by with the Environment Protection Act 1993. In the light of these Waste Management Rules each healthcare facility is answerable for the adequate handling and treatment of all categories of its generated waste before its ultimate removal and disposal in agreement with the terms of this act.

1.2. Non-hazardous general Waste:

A healthcare waste which is not contaminated or remained in contact with an infectious agent, toxic or radioactive material and does not cause a sharp's risk is called non-hazardous or general hospital waste. A major part of the healthcare waste is non- risk waste and is alike in composition to solid community waste.

Cardboards, papers. discarded food. plastics. textiles. wood and metals etc. constitute more than 5O% of this non-hazardous waste. Previously, all or major part of non-risk hospital waste was burnt in municipal incinerators or dumped with municipal waste in landfills. Better understanding. awareness and recognition of impacts and burden of waste on environment have changed our strategies to manage general hospital waste. Most of the non-hazardous waste is recyclable or compostable.

Table 1. 1 Different classes / categories of Hospital waste.

Option	Waste category	Treatment & disposal
Category No.1	Human anatomical waste	Incineration/deep burial.
Category No.2	Animal waste	Incineration/ deep burial.
Category No.3	Microbiology and biotechnology waste	Local autoclaving/microwaving/incineration.
Category No.4	Sharp waste	Disinfection (chemical treatment) /autoclaving/microwaving and mutilation/shredding.
Category No.5	Discarded medicines and cytotoxic drugs	Incineration/destruction and drug disposal in secured landfills.
Category No.6	Soiled waste	Incineration/autoclaving/microwaving.
Category No.7	Solid waste	Disinfection by chemical treatment /autoclaving/microwaving and mutilation/shredding.
Category No.8	Liquid waste	Disinfection by chemical treatment and discharge into drains.
Category No.9	Incineration ash	Disposal in municipal landfill
Category No.10	Chemical waste	Chemical treatment and discharge into drains for liquids and secured landfills for solids.

Source: The Bio-medical Waste (Management and Handling) Rules 1998 Schedule-I

1.3 Hazardous waste

Only 15 - 20% of hospital waste constitute hazardous or risk waste and can produce a number of health hazards and risks. This type of waste consists of toxic and infectious substances. Table 1.2 shows summarized classification of hazardous or risk healthcare waste. Potentially toxic waste includes waste contaminated with radionuclide. X-ray processing solutions, associated reagents, chemical waste like disinfectants, base metal debris and pharmaceutical waste.

1.3.1 Infectious waste

Any material which is assumed to be polluted with pathogens i.e. parasites: viruses, bacteria. or fungi etc. in ample quantity or concentration to produce disease in vulnerable hosts is called infectious waste. This waste may be polluted with body fluids, blood components or blood, swabs, bandages, drapes dressings and other waste matter soaked with body fluids or blood. Hospital waste from human autopsies, bodies of animals, other objects and substances that get contaminated, vaccinated or remained in contact with very infectious materials is considered highly infectious waste(Laboratory biosafety manual WHO, 2004). Excreta of infectious patients who are admitted in isolation wards, soaked dressings with body fluids from patients with infected

injuries or infected surgical wounds, and heavily soiled clothes with body fluids or blood also constitute infectious waste. Infectious hospital waste must be assumed to contain an array of potentially pathogenic organisms. Novais et al (2005) have established the transmission of plasmids to indigenous bacteria from laboratory strains present in healthcare waste during the hospital waste management and disposal process.

1.3.2 Pathological waste

It is believed as a subclass of infectious waste, but it can be separately classified — particularly when it requires special techniques for its handling, management and final disposal.It consists of waste removed during surgical procedures on the patients or human autopsies with contagious diseases and may include body parts, tissues, organs, blood and body fluids etc. Infected animal carcasses also constitute pathological waste.

Table 1. 2 Different types of hazardous healthcare waste

Waste Type	**Example with Description**
Infectious waste	Waste suspected to have pathogens e.g., laboratory Cultures
Pathological waste	Human tissue or fluid e.g., body parts and blood
Sharps	Needles, scalpels, and blades.
Pharmaceutical waste	Waste containing pharmaceuticals. E.g., pharmaceuticals which are no longer needed.
Genotoxic waste	Waste substances with genotoxic properties. E.g. waste containing cytostatic drugs.
Chemical waste	Waste with chemical substances e.g., laboratory reagents, disinfectants.
Waste with heavy metal content	Batteries (lead), broken thermometers (Mercury)
Pressurized containers	Gas cylinders, gas cartridges, aerosol cans
Radioactive waste	Waste having radioactive waste e.g., contaminated glass wear, packages, or absorbent paper.

Source: www.who.int/watersanitation_healthimedicalwaste

1.3.3 Sharp waste

Any object which can result injuries like puncture or cuts are called sharps. Sharps cause twofold hazard i.e., transmitting infection by inoculation and physical injury also. To avoid any injury sharps must be handled with care. Hypodermic needles, knives, saws, broken glass, pipettes, scalpels, and infusion sets etc. constitute sharps. It is estimated that 16 billion injections were used globally, but after their use, all the syringes and needles were not

disposed of appropriately. It was estimated that about 66000 hepatitis B, 16000 hepatitis C and 200-500 HIV infections were attributed to sharps injury among healthcare workers in the year 2000 (Priiss U etal., 2005). Despite increased awareness level on employees and continuous educational programs about the secure handling of sharps and their final disposal, needle stick injuries have declined but still do occur. According to a study infected sharps causes stick injuries in more than two million healthcare workers each year (Prtiss U et al., 2005). In low-income countries reuse of contaminated needles and syringes has decreased significantly due to effective efforts for their segregation and final disposal. Despite these efforts and progress, in 2010, about 33800, 315000 and 1.7 million newcases of HIV, hepatitis C and hepatitis B respectively were reported due to unsafe injections (PepinJ et al. 2014). Risks of sharps injury also arise during manual segregation of risk waste and from scavenging at hospital waste disposal sites. Scavenging at hospital waste disposal sites is a frequent practice in countries with low-and middle-income including Pakistan.

1.3.4 Pharmaceutical waste including Genotoxic waste.

Outdated, unused prescribed and proprietary drugs polluted and spilt pharmaceutical goods, sera and vaccines which are no more in use or expired and necessitate to be disposed of cautiously due to their biological or chemical nature constitute pharmaceutical waste. This group may also consist of heavily contaminated discarded items during the management of pharmaceuticals, like empty or broken bottles. Vials, gloves, masks, connecting tubing and boxescontaining pharmaceutical deposits.

1.3.5 Genotoxic waste

Genotoxic waste consists of vomit, urine and faeces of patient who are taking cytostatic, radioactive, or chemical substances as part of their treatment plan. The disposal of genotoxic waste necessitates special consideration because it raises grave safety issues and should be given careful and special attention. Insufficient data is available regarding lifelong impacts of genotoxic healthcare waste on health. Females working with anticancer drugs/agents have an increased risk of spontaneousabortions and malformed children (Dranitsaris et al., 2005).

1.3.6 Chemical waste

Disinfectants, laboratory reagents, solvents/chemicals and heavy metals used in medical equipment / devices and batteries constitute chemical waste. This healthcare waste is believed to be dangerous and risky if it is eroding, toxic (harmful), combustible, reactive or oxidizing in nature. The commonly used hazardous chemicals in healthcare facilities and expected to be present in waste include formaldehyde and photographic fixing and developing solutions.

1.3.7 Radioactive waste

Radionuclides including radio therapeutic and radioactive diagnostic material contaminating hospital waste constitute radioactive waste. This waste is generated because of diagnostic or therapeutic protocols such as in vivo organ imaging and tumor localization, in vitro investigations of body fluid and tissue, and various therapeutic and investigative practices.Literature has reported several accidents due to inappropriate disposal of radioactive waste in healthcare facilities. In 1988, a severe accidental exposure occurred due to radioactive waste in a Brazilian healthcare facility resulting is stern radiation effect on the general population. In this accidental exposure to radiations, 249 people were affected, of whom many people either experienced severe health problems or died (IAEA, 1988).

1.3.8 Pressurized containers

Many kinds of gases, which are stored in pressurized cylinders, aerosol cans and cartridges is used in healthcare facilities. When these pressurized containers, whether potentially harmful or inert, are empty or of no more use should be disposed of safely. These pressurized containers if accidently incinerated or punctured may detonate.

1.4 Person at risk

All the hospital staff members involved in handling and disposal of hazardous healthcare waste are at an increased risk of exposure to hazards. This may include persons working within hospital who produce infectious waste, or staff members involved in handling and final disposal of infectious waste that are subjected to hazards because of casual attitude and procedures. Inappropriate dumping or final disposal of hazardous healthcare waste may increase the risk to general population of infectious diseases.

1.5 Environmental impact

Inadequate treatment and inappropriate final disposal of hospital waste can lead to contamination and pollution of environment by pathogenic microorganisms or other toxic pollutants and substances. Figure 1.2 shows different means of exposure to hazards by open dumping. Incineration of waste is the most commonly and widely practiced, but inadequately designed incineration process or unsuitable materials for incineration can result in the discharge of poisonous and harmful pollutants and gases into the atmosphere and of ash remnants. Now many alternative techniques to incineration are available which includes steam treatment incorporated with internal mixing, and chemical treatment.

1.6 Management of biomedical waste

In 1983, WHO constituted working group on Hospital Waste Management collectively approved that healthcare institutions and facilities must be held legally responsible for their waste management and final disposal methods, according to the universally accepted law that the "generator is responsible". This problem of hospital waste management and its final disposal in the healthcare facilities has surfaced as an issue of emergent concern, forcing hospital management to adopt novel scientific and safe techniques which should be cost effective also for managing and final dumping of the hospital waste.

It is also mandatory for the hospital administration to keep their concerned staff well-versed regarding the recent advancement in this field. Today, the appropriate and scientific management of biomedical waste has turn out to be a humanitarian issue globally. Although, health risks of unsatisfactory management of biomedical risk waste have roused the apprehensionglobally, especially due to its serious consequences on the human health and the environment (Singh V. P et al, 2007). The requirement of an effective healthcare waste management program is of key importance and significance. It is a vital constituent of quality assurance in hospitals. The bio- medical wastes generation in a healthcare facility depends upon several factors including type of health care facility, daily bed occupancy state, availability of specialized care facilities, amount of reusable and disposable items in use, implementation of waste management protocols, availability of resources and infrastructure etc (Mandal S. K et al, 2009).

1.6.1 Hospital waste management structure

An ideal waste-management formation adopted from (WHO WPR 1994) is shown in Figure 1.3. In this structure responsibilities are shown with line-management and link paths

between key staff members concerned with healthcare waste handling (WHO WPR, 1994). This structure can be adapted according to the meticulous requirements of any healthcare facility. Keypersonnel in large healthcare facility can share responsibilities, while in smaller healthcarefacility one individual can carry out two or more sets of duties.

1.6.2. The waste management hierarchy

General public health can be protected by effective management and disposal of wastesby an array of processes. In an order of preference these methods are recapitulated called the 'waste hierarchy' (WHO, 2014). In this waste hierarchy the most enviable method is at the topmost while the least advantageous is at the base as shown in figure 1.2. This waste management hierarchy is primarily built on the concept of `3Rs' namely reduces, reuse and recycle and mostly enlightens the sustainable use of health assets. Ideal waste management protocol will plan to evade or pick up maximum waste in or around a healthcare facility. Avoiding final waste disposal by burial or burning. This strategy is explained as dealing with waste ‘’at source’’ instead of accepting ‘’end- of-pipe’’ solutions.

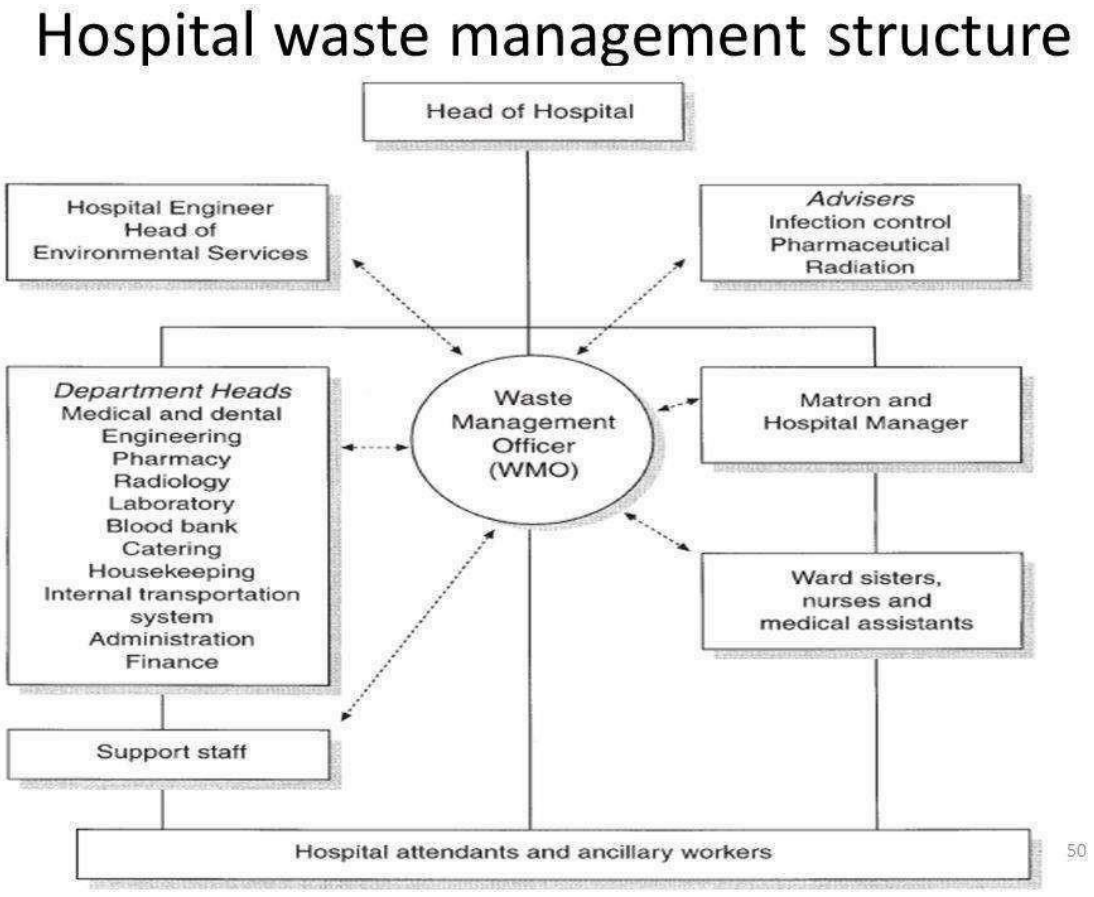

Figure 1. 1 Hospital waste management structure (Adapted from WHO WPR 1994)

1.7. Bio medical waste management processes

To guarantee a healthy and clean environment we require scientifically managed process which ensures appropriate collection and segregation, secure transportation of waste and storage. waste handling, environmentally and eco-friendly final disposal. Different management stages ofhospital Waste are: -

- Identification or categorization and separation of waste
- Internal transport and waste storage.
- Appropriate waste disposal.

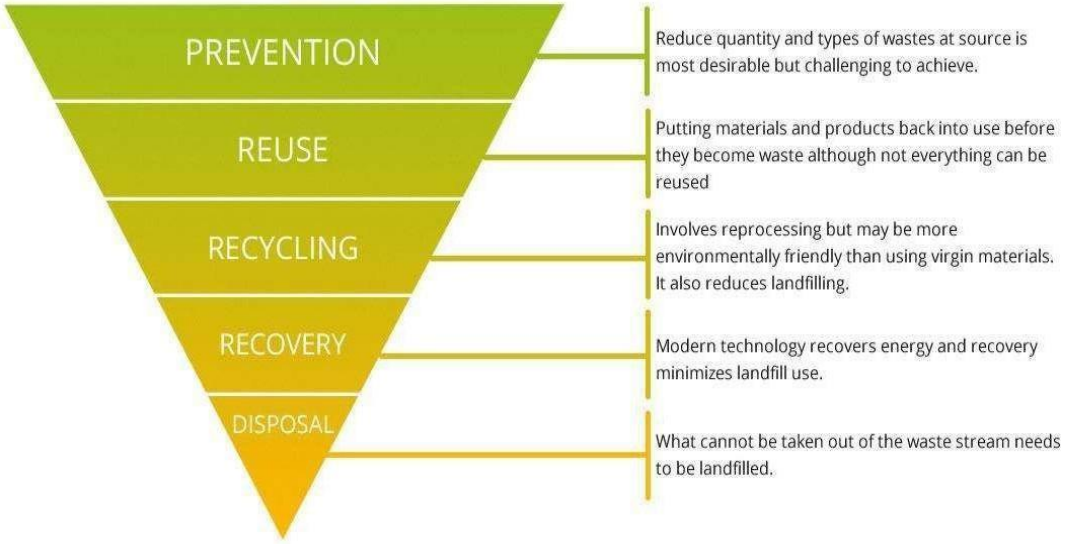

Figure 1. 2 The waste management hierarchy

1.7.1 Identification & segregation of bio medical waste

Segregation means "classification or separation" of various categories of waste or the structured partition of healthcare waste into designated groups. It is the basic and most significant step in the management of hospital waste management process. Infectious or hazardous waste, which may be very small in amount requires special attention in its handlingand management; such practices will not only minimize the hazards but also reduce the waste management and disposal cost. So, when infectious waste and non-infectious general waste are mixed up, then all the waste will become infectious and has to be incinerated which may increasethe total cost. For each category of waste separate different colored containers limed with plastic bags should be placed in each ward and department. Segregation of waste must be adept from theproduction point to handling, transportation till the final removal / disposal of the waste.

The following steps should be observed.

• The basic step in waste management is segregation and special attention is required for separation of infectious/hazardous and sharp wastes from general waste.

• The entire risk waste other than sharps including chemicals waste, radioactive waste, large quantities of pharmaceuticals shall be stored in an appropriate container which may be made of tough plastics or metal, with a swing lid type, limed by a strong yellow plastic waste bag. When bags are three quarters full of waste, must be removed and replaced by new bags. These bags should be sealed with self-locking plastic sealing tags and must not be stapled. For immediate replacement, extra containers and bags should be made available at each location of waste collection. The bags should be replaced immediately with a new bag of similar kind. Each removed bag should be prominently and clearly labelled, mentioning date and place of generation, ward and hospital name, and amount of waste, and also displaying appropriatebiohazard symbol.

• Metallic or thick plastic containers resistant to leakage and penetration should be used for collection of all sharps. Containers used for collection of sharps are yellow in color and prominently marked as "DANGER! CONTAMINATED SHARPS".

• Large quantities of pharmaceutical waste should be returned for disposal to the manufacturers or providers. Small quantities shall be crushed carefully and stored in yellow waste bags.

• Risk waste containing large quantity of heavy metals like cadmium or mercury and chemical waste in bulk shall not be disposed of by incineration.

• Radioactive waste shall be stored in a waste bag in yellow container/drum and allowed to decayto background level. These drums or containers shall be clearly labelled, mentioning the radionuclide's activity on exact given date, and required storage period. These containers shall bemarked "RADIOACTIVE WASTE" displaying the radiation symbol.

• Non-risk/municipal waste shall be collected in an appropriate container wrinkled with a plastic bag white in color. Enough containers should be on hand in all departments and hospital area for the collection of non-risk/general waste and their use shall be encouraged by affixing notices.

1.7.2 Waste collection

In the healthcare facility, the general and infectious waste shall be done separately and at regular times at least once daily. Janitor staff and sweepers shall wear protective clothing while handling the hospital waste. Hospital waste generated daily should be weighed and

recorded routinely.

1.8 Study Objectives:

1. To provide an overview of the different categories of hospital waste.
2. To find out gaps in hospital waste management practices.
3. To determine the characteristics of hospital wastewater in hospital.

CHAPTER-2

MATERIAL AND METHODS

2.1 Study Area:

Federal Government Services Hospital is situated in sector G6/2, Islamabad. It is government owned teaching hospital with the capacity of 545 beds and the hospital is examining 4500 patients in OPD daily.

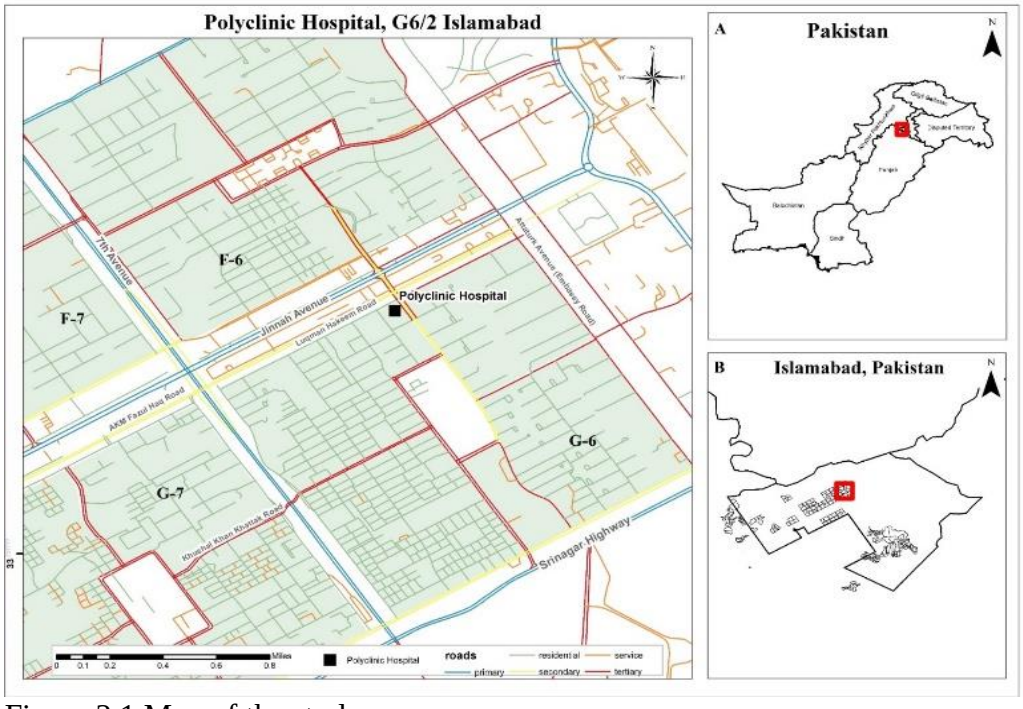

Figure 2.1 Map of the study area

2.2 Description of study hospital:

The study consists of hospital waste management processes of Polyclinic Hospital. The hospital is situated in sector G6/2 of Islamabad. It is government owned teaching hospital. General details, average daily bed occupancy and average daily outpatients' workload of hospitalis given below:

Table 2. 1 Average inpatients/outpatients Workload

Hospital type	Total beds	Avg no of inpatientsdaily	Avg no of outpatientsdaily
Gov. general & teaching	545	550	1550

2.3 Study design:

The study was cross-sectional descriptive to evaluate the existing situation of waste management process, and knowledge of different groups of hospital staff i.e., hospital management, doctors, nurses, other paramedical staff, and janitor staff in Polyclinic Hospital.

2.4 Questionnaire, interviews and surveys:

This study is based on the analysis of accessible information on hospital waste, its characteristic composition, impacts and management practices. Process of waste identification and segregation in vogue, interim storage at ward or department, waste transportation facilities and on site/off- site final disposal of waste were studied in detail. After extensive literature review and discussions. A questionnaire was prepared to collect requisite data concerning management and final disposal of hospital waste being produced in these institutions. The questionnaire was prepared keeping in view the objectives of this study, to principally deal with the problems of different types of biomedical wastes generated; quantity of these wastes; and on hand waste supervision and management practices. Twenty-five questions were included in the questionnaire covering all aspects of hospital waste management process. Supplementary data on hospital waste management processes in hospital acquired from similar groups of hospital staff including sanitary staff, housekeeping staff, nurses, house officers, medical officer, consultants and hospitalmanagement through visual observations, non-formal interviews within the hospitals. In wards, questionnaires were filled by questioning the sanitary staff and the nurses on methods of disposal,location and category of waste generated, containers/bags used with color coding to dispose of various wastes, waste handling staff, use of personal protective equipment during waste handling,regular training of waste handlers, health and safety issues etc. Hospital administration was interviewed in detail to get comprehensive information related to hospital waste management procedure, its

implementation, and staff training. The collected data was analyzed using excel (2014) for estimation of simple percentage.

2.4 Methodology for analysis of hospital waste management practices

Existing hospital waste management protocols in hospital were analyzed by a survey questionnaire containing 25 questions regarding diverse characteristics of hospital waste management based on Hospital Waste Management Rules of Pakistan, 2005 (HWMR-2005). Questionnaires were administered to similar groups of staff of both hospitals including administrative staff, consultants, medical officers, house officers, nurses, Para-medical staff, housekeeping staff and janitor staff. 122 staff members of hospital were included in this survey. These questionnaires were analyzed to ascertain the facilities available in the hospital regarding waste management, health and safety. The questionnaire is annexed at Appendix-1.

2.5 Desk study

Additional data in relation to hospital waste management practices was gathered by search of literature from libraries published reports, internet, and academic journals.

2.6Sampling and analysis of wastewater

Water samples were collected from hospital using Random sampling technique. Such sample presents data at one time and place regarding the hospital Waste water. The collection of wastewater samples was done from laboratory wastewater and the main sewage water. The samples were collected in sterilized sample bottles and different parameters were analyzed using standard methods, discussions below in section 2.7. The parameters analyzed and corresponding standards are shown in Table 2.2.

2.7 Parameters

Water samples collected from both hospitals were analyzed for the following five important parameters:

1. Chemical oxygen demand（COD)
2. Biochemical oxygen demand (BOD)
3. Total dissolved solids（TDS)
4. Total suspended solids（TSS)
5. pH

2.7.1 Chemical Oxygen Demand

Open Reflux Method (dichromate method) was used to determine COD. In this technique, the boiling mixture of sulfuric acid and chromic oxidizes nearly all kinds of organic matter. The sample being analyzed is refluxed in strongly acid solution which contains potassium dichromate ($K_2Cr_20_7$) in surplus amount. On completion of digestion process, ferrous ammonium sulfate was used to titrate unreduced $K_2Cr_2O_7$ and the total amount of consumed K_2Cr_20, was determined and the oxidizable substance in the Sample in terms of oxygen equivalent is calculated. To determine the COD, in a refluxing Flask. 50 ml of sample and several boiling stones were added. Then concentrated H_2SO_4 and $HgSO_4$ of 0.5 ml and 0.1 g respectively were added. Sulfuric acid was added slowly while swirling the solution to ensure that $HgSO_4$ was completely dissolved. Then add 0.1 g of Ag_2SO_4 and finally Potassium dichromate was added to the solution. Continuous swirling of flask in water bath was done to ensure through mixing of solution and to recover volatile matters that had escaped from the liquid state. After attaching the flask to the condenser, it was further cooled. While continuing swirling and cooling, 20 ml of Sulfuric acid to the solution was added in the flask. The solution was allowed to reflux for 1 hour and after cooling, solution was transferred to another flask. The reflex flask was thoroughly rinsed three times and the rinsed water was also added to the flask. More water was added to the solution to make the final volume about 300 ml and about 8 drops of indicator Phenanthroline ferrous sulphate was added. Mohr's salt was used to titrate this solutionand volume required for titration i.e., the change of color from blue green to reddish blue was determined. The procedure was repeated for the blank run. In blank run, 50 ml of distilled water was used instead of sample and simultaneously conducted with the same procedure. Following formula was used to calculate COD.

Calculations:

COD = 8000 * (Vbl-Vs) * M/ original volume of sample taken= mg/1

Where,

Vbl =Titer volume for the blank

Vs =Titer volume for the sample

M=Molarity of Mohr's solution

2.7.2 Biochemical Oxygen demand

Standard dilution method documented by U.S. EPA (Method 5210B in the Standard Methods for the Examination of Water and Wastewater) was used for BOD estimation. The BODtest depends on a measurable reduction of DO over a specified time. To determine BOD, the concentration of dissolved oxygen (DO) in a sample must be measured before incubation and after the incubation period. The BOD was determined by using incubation bottles of 300 ml volume to which buffered dilution water was added with seed microorganisms. These bottles were stored in the dark room for 5 days at 20 °C to avert DO production due to process of photosynthesis. Various dilutions of BOD samples can be used. To confirm the qualityof the dilution water Dilution water blank control was used to dilute the samples. BOD_5 is calculated by:

$$\text{Unseeded} = \frac{(DO - D_5)}{P}$$

$$\text{Seeded} = \frac{(DO - D_5) - (BO - B_5)\, f}{p}$$

where:

Do is the dissolved oxygen of the diluted sample/solution after preparation (mg/l)D_5 is the DO of the diluted sample/solution after incubation for 5 days (mg/l)
P is the decimal dilution factor.
Bo is the DO of diluted seed sample after preparation (mg/l)
B_5 is the DO of diluted seed sample after incubation of 5 day (mg/l)
f is the ratio of seed volume in dilution solution to seed volume in BOD test on seed.

2.7.3 Total dissolved solids

Gravimetric method was used to determine TDS. For TDS estimation, a perfectly mixed sample was filtered using a standard glass-fiber filter then the filtrate was evaporated to get it dry in a weighed dish and desiccated to steady weight at 180°C. The dish was again weighed and an increase in dish weight was equal to the total dissolved solids (TDS).

Calculation

$$\text{Total dissolved solids mg/L} = \frac{(A - B) \times 1000}{\text{Sample volume (mL)}}$$

where:

A = weight of dried residue + dish in mg

B = weight of dish in mg

2.7.4 Total Suspended Solids

Total suspended solids (TSS) were determined by filtering the well mixed sample using a weighed standard glass-fiber filter and then drying the residues retained on the glass-fiber filterto a constant weight at 103°C to 105°C. The increase in weight of the filter was equal to the weight of total suspended solids (TSS).

Calculation:

$$\text{Total suspended solids mg/L} = \frac{(A-B) \times 1000}{\text{Sample volume, mL}}$$

Where

A= weight of the filter + dried residue in mg

B= weight of filter in mg.

2.7.5 pH

The term pH stands for the power of hydrogen. pH of wastewater was measured by using pH meter model no. SM 802

Table 2. 2 Parameters of Wastewater and their NEQs

Parameters of wastewater	**NEQS***
1. COD	150 mg/l
2. BOD	80 mg/l
3. TSS	150 mg/l
4. TDS	3500 mg/l
5. P^H	6-10 pH

CHAPTER 3

RESULTS AND DISCUSSION

3.1. Awareness of staff regarding Hospital waste management.

A prepared questionnaire was distributed among multiple groups of hospital staff i.e. administrative staff, consultants, medical officers, house officers, nurses, paramedical staff, housekeeping staff and janitor staff of hospital. Morning and evening staff of hospital were included in this study. A total of 122 questionnaires from hospital were included in the study randomly selecting equal number of participants from each group of staff members. Out of 122 participants 75 (61%) were female and 47 (39%) were male. Figure 3.1 shows the demographic data of the survey.

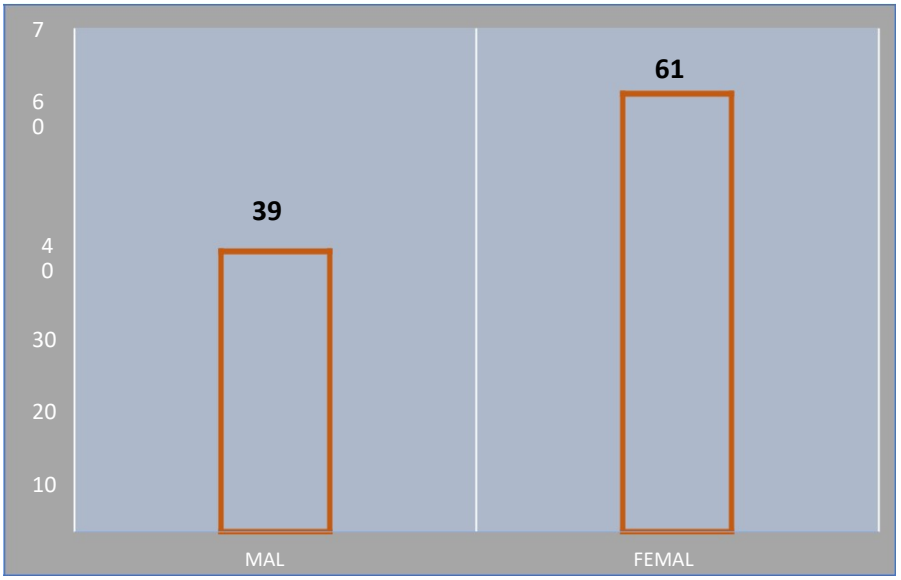

Figure 3. 1 Demographic data of the survey.

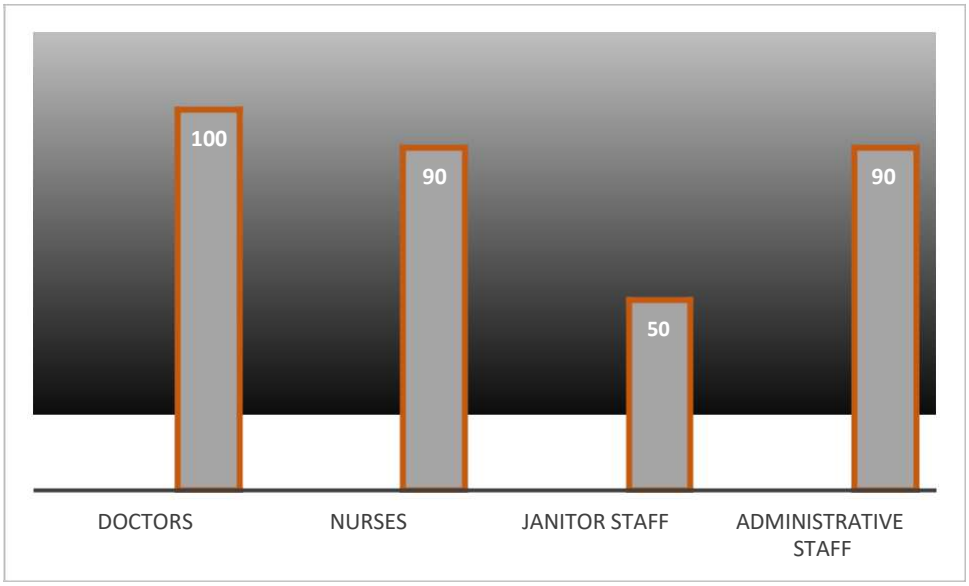

Figure 3. 2 Shows the knowledge about Hospital waste management process.

Data from the survey questionnaires were analyzed. Figure 3.2 shows the knowledge about waste management process. The knowledge about the process of hospital waste management was adequate in well-educated hospital staff. Janitor staffs (50%) of hospital were well versant while the remaining (50%) were not aware of the waste management process of Hospital. Nursing staff (90%) were well aware.

Figure 3.3 shows comparison of the knowledge of all groups of staff of hospital regardingthe health and environmental impacts of hospital waste.

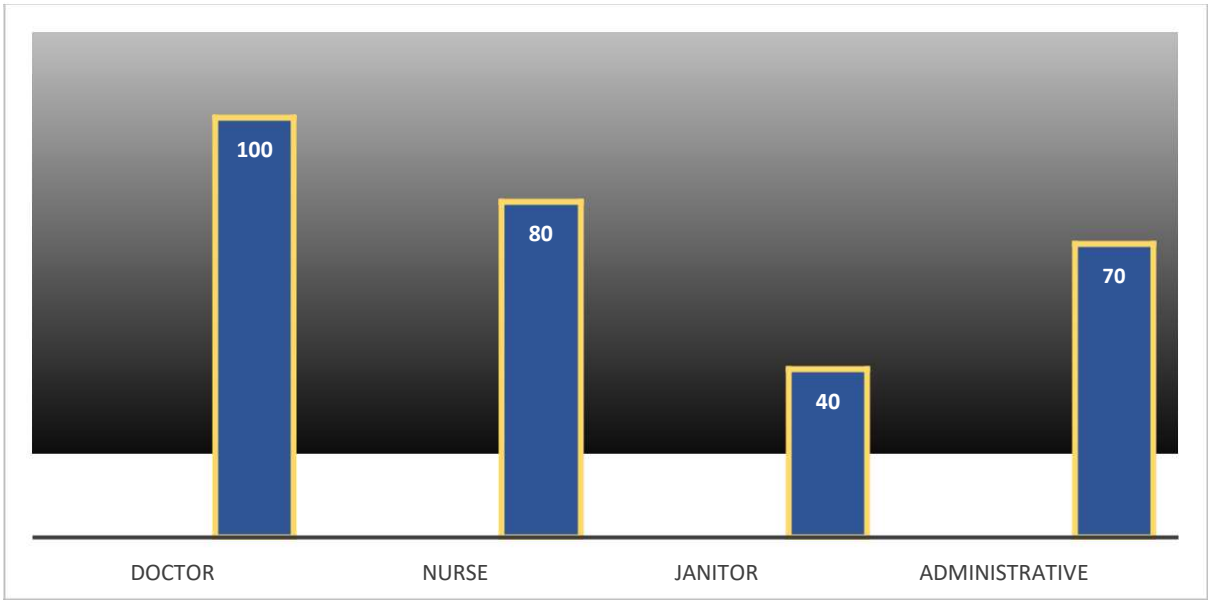

Figure 3. 3 Comparison of the knowledge of all groups of staff of hospital regarding the health andenvironmental impacts.

Disposing process of waste is usually assigned to untrained laborer who perform it without

proper training and with inadequate preservation. (Diaz et al., 2005)

Figure 3.3 shows that well educated group of staff members knew the risks and hazardsof hospital waste to their health and environment. The importance of health hazards of hospital waste was not well known to housekeeping and janitor staff which were more involved in the handling of medical waste.

3.2. Waste management at hospital

Polyclinic Hospital has established its waste plan. The administration of hospital was concerned to implement the waste management plan in harmony with Government of Pakistan's guidelines. The hospital had waste management team (WMT) duties and responsibilities ofwhich were notified. Meetings of the Waste management team were regularly arranged. Waste management officer was nominated by the hospital.

Waste management protocols/system implemented in the hospital was according to the government recommendations but most of the difficulties were due to failure in implementing these strategies in true spirit. It is not possible to implement waste management protocols or system without continuous proper training and awareness of all the hospital staff members and exercises of hospital waste disposal.

The key to successful and efficient healthcare waste management system is the separation/segregation of waste at source. Healthcare waste should be grouped keeping in view its source of generation, allied risk factors during its handling and storage and final treatment/disposal method. There are few breaches in the effective implementation of the guiding principles on hospital waste management systems which requires immediate rectification.

Table 3. 1 Summary of H WM system at Polyclinic Hospital

Practices	**Status**
Waste handling	• Different categories of healthcare waste keptin different color-coded containers with bags at the source of waste generation.
Waste segregation	• On the spot waste segregation being practiced.Infectious and non-infectious waste kept in different color-coded containers.
Waste storage in CSF (central storage facility)	• Infectious waste collection- once a day Municipal waste collection-thrice a day
Incineration facility of Polyclinic Hospital waste management is used for final disposal.	• Incinerator capacity not adequate for wastebeing generated at hospital.
Appropriate transport system of waste to final disposal site	• Practiced.
Wastewater treatment	• No wastewater treatment plant. • Wastewater being discharged in main sewageof Hospital.

3.2.1 Collection and segregation of hospital waste

Different categories of healthcare waste are segregated using different color-coded containers with bags at the source of waste generation. Common types of containers being used for the collection and segregation of different categories of hospital waste and their color codes are given in Table 3.2. Yellow colored strong leak proof plastic bags/containers are used for infectious hospital waste. WHO recommends that non-infectious hazardous waste must be stored in red colored plastic bags/containers. General or municipal hospital waste need be segregated in white plastic bags and containers. Red colored lead boxes with symbol of radiations should be used for the storage of radioactive hospital waste. Yellow colored

puncture proof containers/boxes with lids should be used for sharp waste.

In Polyclinic Hospital groups of hospital waste were segregated and stored in different color-coded containers. Color coding is the best practice for the segregation process.

Table 3. 2 Color coding used for containers for segregation of various categories of hospital solid waste.

Waste type	**Polyclinic hospital**	**WHO recommended color Codes**
Municipal waste	Bags white in color	White
Infectious waste	Bags yellow in color	Yellow
Non-infectious Hazardous Waste & Cytotoxic Materials	Bag white in color	Red
Sharp containers	Box yellow in color	Yellow

In Polyclinic hospital red, green and yellow bins were used to collect and segregate the waste (Fig.3.4).

Colorless or white polythene bags were provided for non-infectious waste. Yellow bags were being used to collect and segregate punctured drip sets and all the material which were contaminated with patient's blood or secretions/ body fluids i.e. bandages, cotton swabs etc. Usedneedles, blades, slides and catheters in the labs were disposed in yellow colored containers. According to nurses it is their duty to cut syringes after using it at the spot. It was mandatory for the staff to cut the syringe after use by needle cutter before disposing it of in appropriate container. Hospital waste management system was adopted by hospital few years ago an administration hospital was conscientious and aware of hospital waste management protocolsand trying their best to implement this system in true spirit.

Figure 3. 4 Colored Collection bins with descriptions at Hospital

Segregation of hospital waste was practiced at the point of generation to avoid mixing of infectious and general / non-infectious waste. Nurses and janitor staff handling the Hospital waste were aware of the fact that if a small portion of infectious waste is mixed the entire waste becomes infectious and risky to treat. With segregation practices conducted at the point of generation as desired in HWM, 2005 rules, has many beneficial effects. So, the benefits associated with the use of the effective segregation includes time and cost saving, low risk of infection and easy waste disposal.

3.2.2 Waste collection

The waste was collected from the wards and theatres by the janitor workers. The hospital administration of Polyclinic Hospital has provided hand carts and hand pulled plastic bins that were used for the collection of the hospital waste from the wards and theatres to the main storagesite. Infectious waste was collected once in a day while municipal waste was collected thrice a day. The janitor staff collecting the waste does not use the personal protective equipment It was observed that color coding system was mentioned in the documents of hospital but not strictly in practice. Only white / colorless polythene bags are used for the collection of waste. Similar practices were observed in (Amin R, Gul R, Mehrab A. Hospital waste management; practices in different hospitals of Distt. Peshawar. Professional Med J 2013;20(6): 988-994).

3.2.3 Waste transportation and storage

Site surveys of hospital showed that the temporary waste storage room was available in the wards and filled containers/bags were stored here for interim period during the day or at night. Afterward all the waste was carried to the central storage area for further appropriate

treatment and final disposal. Municipal or general waste was temporarily stored in designated stands outside each ward. The central storage room of the hospital was found without any locking facility orstructure. In other words, area was accessible by any person, which can be extremely hazardous due to presence of infectious waste.

3.2.4 Hospital waste generation rate

Waste generation rates vary from hospital to hospital and depend upon many factors including the category of the hospital, amount of available treatment facilities and instrumentation and its location. The hospital waste generation of hospital was studied in detail and was worked out to be 5.08 kg/patient/day (Table 3.3). It is observed that hospitals with good facilities, latest instrumentations and high-quality of available services have higher rate of hospital waste production.

Table 3. 3 Daily waste generation rates in Polyclinic Hospital

Days	Total beds	Municipal waste generated Kg/day	Medical waste generated Kg/day	Daily waste generated Kg/day
1	545	2080	820	2900
2	545	2260	800	3060
3	545	1850	830	2680
4	545	2000	760	2760
5	545	1060	870	1930
6	545	2260	880	3140
7	545	2135	790	2925
Average	**545**	**1949**	**821**	**2771**

Average generation of municipal waste per day = 1949 kg/day

Generation rate per day per patient = 1949/545 = 3.5 kg/patient/ day

Average daily generation of medical waste = 821 kg/day

Average daily generation of medical waste per patient = 821/545 = 1.5 kg/day/patient

Average daily generation of waste = 2771 kg/day

Average daily generation of waste per patient = 2771/545 =5.08 kg/patient/day

3.2.5 Comparison of different waste categories generation rates

Comparison of different categories of waste generation rates is given in figure 3.5. Municipal waste generated per day is maximum as compared to other waste categories.

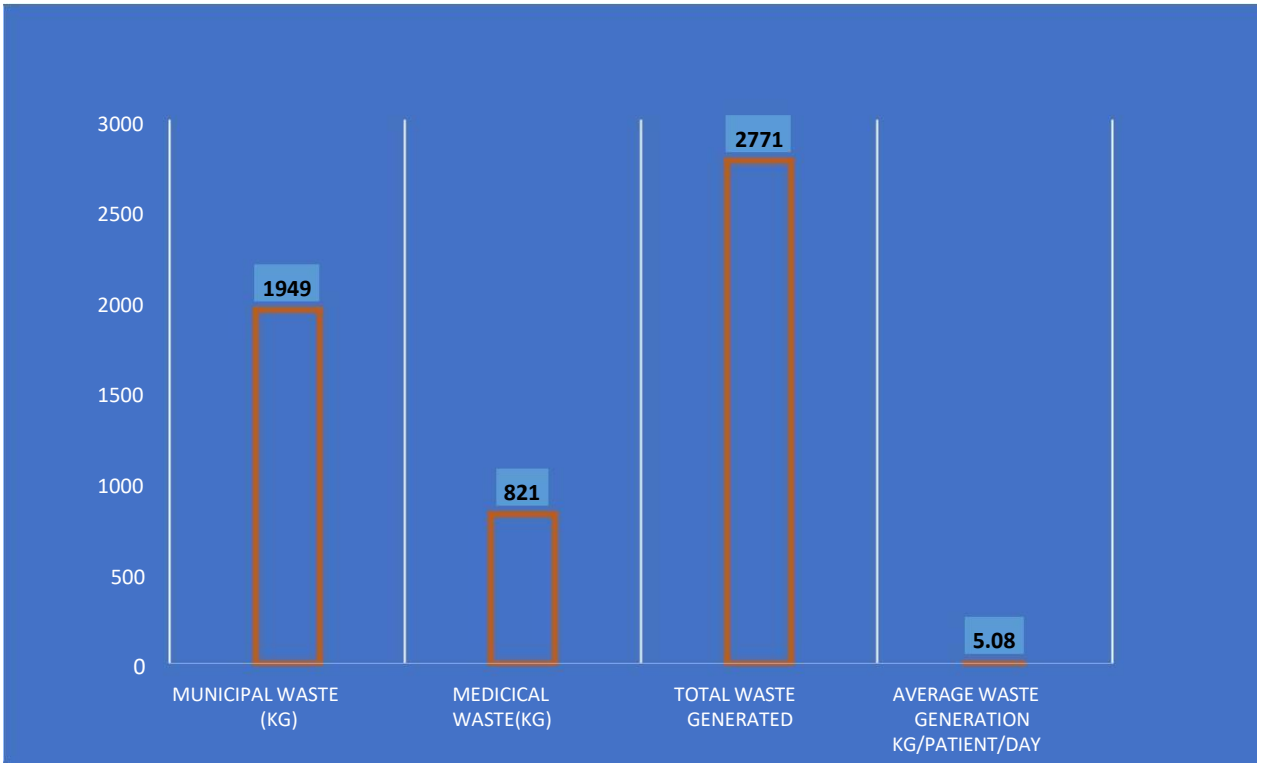

Figure 3. 5 Shows medical waste generation at Polyclinic Hospital.

This waste consisted of hazardous infectious items as well as sharps waste. Medical waste consisted of 6.8% sharps and 93.15% hazardous infectious items. The waste generated during the evenings and the mornings have been shown collectively. The average waste generation rate at the hospital came out as 5.08 Kg/patient/day.

3.3. Hospital wastewater

Water analysis was carried out at hospital. There was no wastewater treatment plant in hospital and wastewater was discharged and mixed with municipal sewage system. Collection site of the hospital wastewater was main sewage of hospital.

The analysis of wastewater was done for five parameters. Comparison of all the five parameters with the national environmental quality standards,2001 is shown in figure 3.6. water analysis showed that the COD, BOD and TSS were above the permissible limit of NEQS.

Table 3.5 Wastewater parameters and their NEQS*

Parameters	**Units**	**NEQS***
COD	mg/L	150.0
BOD	mg/L	80.0
TDS	mg/L	3500.0
TSS	mg/L	150.0
pH	-----	6-10

The hospital wastewater parameters and the NEQS*are shown in table 3.5. The values of BOD, COD and TSS are above the permissible limit. Whereas the analysis showed pH and TDS are in permissible limits. Administration of the polyclinic hospital were in constant struggle to improve the quality of wastewater in accordance with the NEQS.

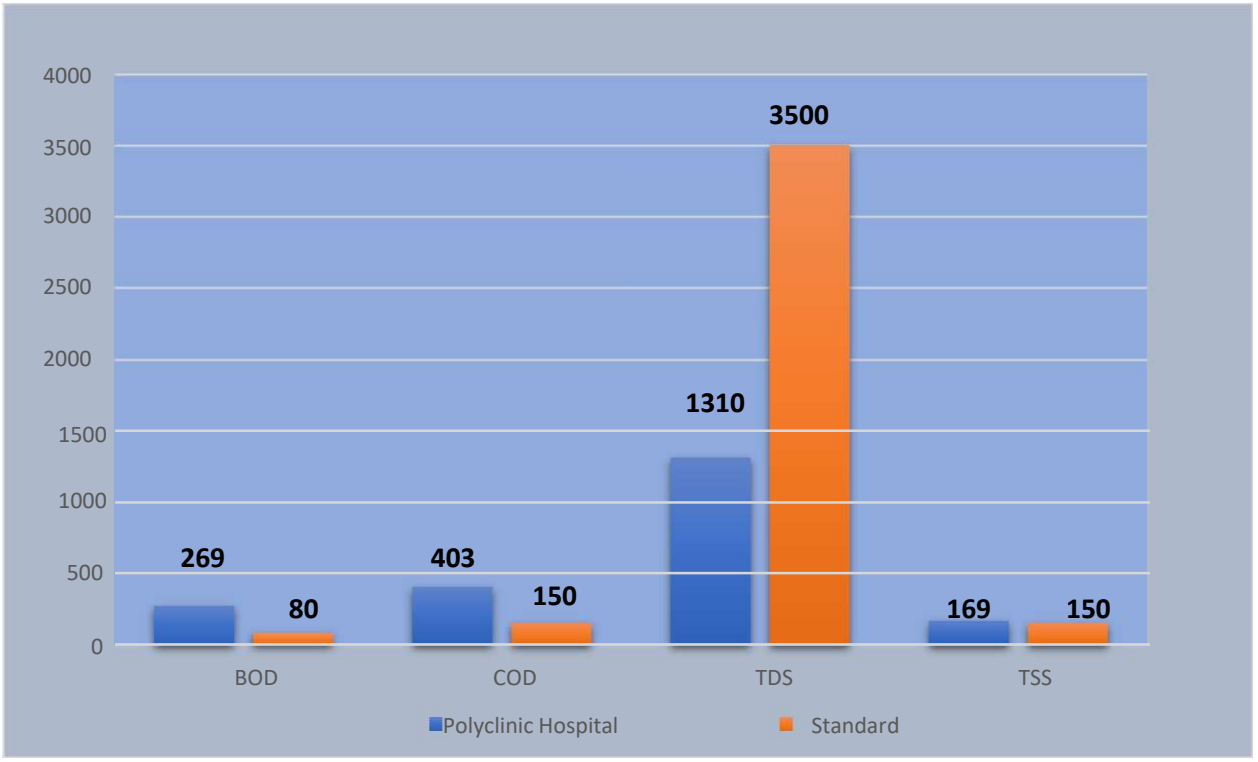

Figure 3. 6 Comparison of waste water parameters with National environmental quality standards,2001

3.4. Health and safety:

Questionnaires and non-formal interviews were conducted regarding Health and Safety issue.It is important to observe the health and safety conditions of a health care facility to ensure a safe, hygienic and clean environment for the patients and the staff or people working there. The indoor environment was satisfactory, with inadequate ventilation system. Humidity and suffocation was felt.Cleanliness condition was satisfactory. The results of the study are as follows:

3.5. Working environment

The working environment in hospital was very humid and suffocating. It was overcrowded due to which there were more chances of infection. Light intensity was also not evenly distributed inside the wards and corridors. At some places open windows were the source of light and were also the source of flies and dust coming inside the wards. It has resulted in an unsafe environment for the patients due to overcrowding in the hospital, noise level was also high, not a good sign in health care centers.

3.6. House keeping

A proper housekeeping is required in hospital for the safety of the patients. In polyclinic hospital the housekeeping conditions were satisfactory. Area cleanliness was observed in most ofthe departments. Safety signs were mentioned where required. Electrical appliances were maintained after specific intervals of time in few departments. The percentage of housekeeping practices were observed at hospitals and the results are shown in Figure 3.7.

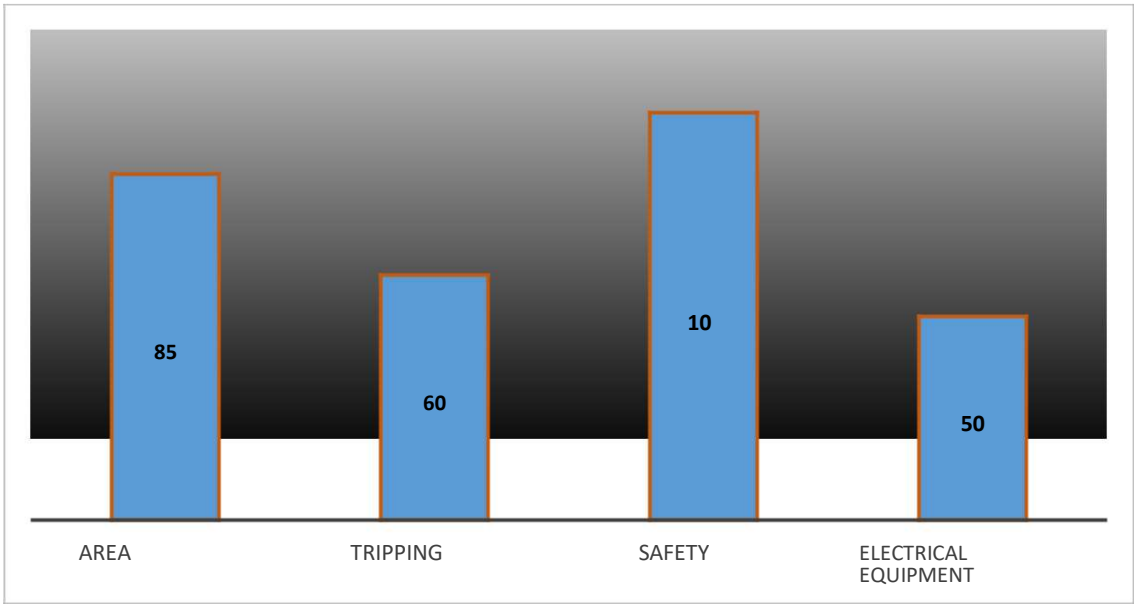

Figure 3. 7 Percentage of housekeeping practices in Hospital

3.7. Personal protective equipment (PPE's)

Personal Protective Equipment (PPE s) are provided to staff working within the premisesof a hospital for their safety, to ensure less contact with the hazardous waste and to prevent them from various problems. It includes hand gloves, masks especially and sometimes earmuffs, boots, aprons depending upon the nature of duty. In polyclinic hospital Doctors that are the well- educated group of the study were completely aware of the significance of PPEs while the janitor staff were not strictly using the PPEs provided and some janitor staff complained that the PPEs were not provided by the hospital administration. If PPEs were issued to them, they will definitely wear them because they knew it's for their own benefit and safety. When the Hospital administration was asked about this shortcoming, they clarified that sometimes the supply stops for several months by the governmental bodies. Comparison of using Personal Protective Equipment (PPE s) by the staff of hospital is shown in Figure 3.8

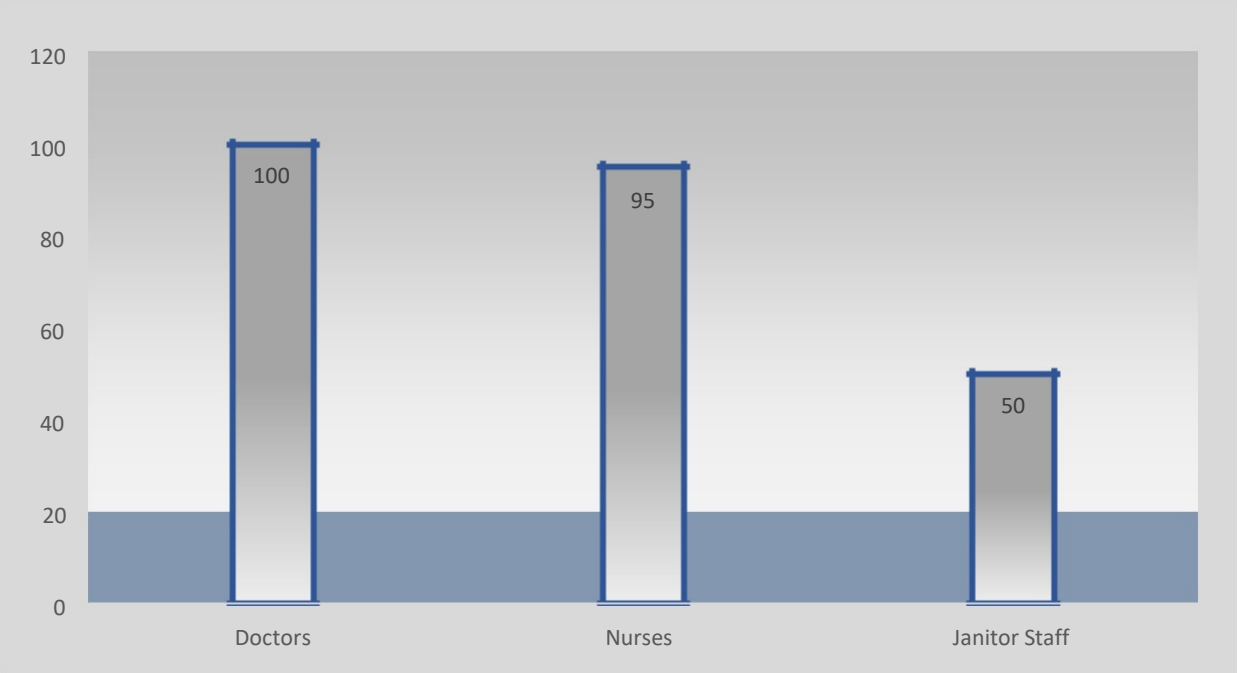

Figure 3. 8 Use of PPEs among Hospital Staff

CHAPTER NO. 4

CONCLUSION AND RECOMMENDATIONS

4.1. Conclusion

1. The average waste generation rate at Polyclinic Hospital was discovered to be 5 . 0 8 kg/patient per day. Medical waste generation was found to be 1.5kg/patient/day.
2. Hospital wastewater treatment was not a matter of major concern for the administration of hospital. Since hospital had no wastewater treatment plant, hospital wastewater was directly mixed with municipal wastewater. Wastewater analysis of Hospital revealed that BOD, COD and TSS were exceeding the NEQS and is highly polluting the city sewage system. The high amounts of BOD, COD and TSS may harm the aquatic life and even human health. This situation calls for immediate attention.
3. Knowledge of doctors, nurses and administrative staff of hospital was adequate about hospital waste management but the practices of all the essential steps in waste management process were unsatisfactory. Segregation of hazardous and non-hazardous waste was missing to some extent in few departments.
4. Lack of resources like adequate capacity of Incinerator, availability of the PPEs for thestaff and Hospital wastewater treatment plant are the issues to be addressed.

4.2. Recommendations

In the light of discussion and conclusions, following is recommended for the development of improved waste management system in hospital.

1. Hospital administration should improve awareness by imparting regular training and health education of all concerned staff in the execution and handling of Bio-Medical Waste process. Hospitals may use common waste treatment facility for economic reasons and must keep Bio-Medical Waste management policy in the priority list, starting from the very beginning.
2. The national hospital waste management guidelines must be executed on immediate basisin every health care facility. There should be an approved and documented waste management protocol which should be implemented strictly.
3. All hospital staff members either generators or handlers of biomedical waste should implement and follow universal safety measure and adopt suitable personal safety precautions while handling the bio-medical waste.
4. All hospital staff members should be immunized against infectious disease for self-protection i.e., Tetanus and Hepatitis B.

References:

Agarwal, R. (1998). Medical Waste: Issues, Practices and Policy. Srishti. June

Ahmed, R. (1997). Hospital Waste Management in Pakistan: Case Study Report Special Waste Fractions: Hospital Waste.

Akter, N. (2000). Medical waste management: a review. Environmental Engineering Program,School of Environment, Resources and Development Asian Institute of Technology, Thailand: 1-25.

Al-Busaidi, Z. Q. (2008). Qualitative research and its uses in health care.

Alagöz, A. Z. & Kocasoy, G. (2008). Determination of the best appropriate management methods for the health-care wastes in Istanbul. Waste Management, 28 (7): 1227-1235.

Ali, M. &Kuroiwa, C. (2009). Status and challenges of hospital solid waste management: case studies from Thailand, Pakistan, and Mongolia. Journal of Material Cycles and Waste Management, 11 (3): 251-257.

Ali, S., Mahmood, U., Malik, A. U., Aziz, F., Naghman, R. B. & Ahmed, I. (2015). Current Hospital Waste Management Practices in Pakistan: Case Study and Curative Measures. Public Health and Preventive Medicine, Vol. 1 (No. 3): 125-129.

Alvim-Ferraz, M. &Afonso, S. (2003). Incineration of different types of medical wastes: emission factors for gaseous emissions. Atmospheric Environment, 37 (38): 5415-5422.

Ananth, A. P., Prashanthini, V. &Visvanathan, C. (2010). Healthcare waste management in Asia. Waste Management, 30 (1): 154-161.

Ansari, S., Habiba, U., Aslam, F. &Hussain, A. (2013). HOSPITAL WASTE MANAGEMENT TACKLING TRASH AS A TEAM. Waste Manag Res, 31 (7): 733-8.

Arshad, N., Nayyar, S., Amin, F. &Mahmood, K. T. (2011). Hospital waste disposal: A

review article. Journal of Pharmaceutical Sciences and Research, 3 (8): 1412-1419.

Asante, B. O., Yanful, E. &Yaokumah, B. E. (2013). Healthcare Waste Management; Its Impact: A Case Study Of The Greater Accra Region, Ghana.

Asante, B. O., Yanful, E. &Yaokumah, B. E. (2014). Healthcare Waste Management; Its Impact: A Case Study Of The Greater Accra Region, Ghana. International Journal Of Scientific & Technology Research, 3 (3).

Awareness of hospital waste management issues among hospital administration and residents of Pakistan. International Journal of Biological & Medical Research, Vol. 3 (No. 2): 1783- 1795.

Assessment of medical wastes management practice: a case study of the northern part of Jordan. Waste management, 27 (6): 746-759.

A Case Study of Hospital Waste Management in Balochistan and Its Impact on Health and Environment. Research Journal of Environmental and Earth Sciences, 5 (2): 98-103.

Alternatives for the treatment and disposal ofhealthcare wastes in developing countries. Waste Management, 25 (6): 626-637.

Berg, B. L. (2001). Qualitative Research Methods for the Social Sciences. 4th ed. Boston. London. Toronto. Sydney. Tokyo. Singapore: Allyn& Bacon.

Bdour, A., Altrabsheh, B., Hadadin, N. & Al-Shareif, M. (2007)

Berg, B. L. & Lune, H. (2012). Qualitative Research Methods for the Social Sciences: Pearson.

Bryman, A. (2008). Social research methods. 3rd ed.: Oxford university press.

Bureau Of Statistics. (2015a). Development Statistics of Khyber Pakhtunkhwa 2015. Department, P. D. Peshawar: Bureau Of Statistic: Planning & Development Department Government of Khyber Pakhtunkhwa. 338 pp.

Bureau Of Statistics. (2015b). Khyber Pakhtunkhwa in Figures 2015. Department, P. A. D. Peshawar: Bureau of Statistic: Planning And Development Department Government Of Khyber Pakhtunkhwa. 15 pp.

Coker, A., Sangodoyin, A., Sridhar, M., Booth, C., Olomolaiye, P. & Hammond, F. (2009).

Caniato (2015). Infectious Waste Disposal in Developing Countries: Recommended Minimal Practices from a Hospital Survey in Southeast Asia

Diaz, L., Savage, G. &Eggerth, L. (2005). Characteristics of healthcare wastes

Dranitsaris et al., (2005).Are health care providers who work with cancer drugs at an increased risk for toxic events? A systematic review and meta-analysis of the literature

El-Salam, M. M. A. (2010). Hospital waste management in El-Beheira Governorate, Egypt.Journal of environmental management, 91 (3): 618-629.

FMOE., F. M. O. E. (2005). Notification, Hospital Waste Management Rules 2005. Islamabad, Pakistan: Ministry of Environment. (Legal Notification). 15 pp.

Geertz, C. (1976). The religion of Java. Chicago: University Press, Chicago.

Global, regional, and national burden of stroke, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016

Hancock, B., Ockleford, E. &Windridge, K. (1998). An introduction to qualitative research: Trent focus group Nottingham.

Haque, A. U. (2006). Hospital Waste & Its Management. International Journal of Pathology, 4 (2): 109-111.

Hassan, A., AbidaShaheen, NadeemEhsan, WajihaArif, Ahsan Amir Khan, Hafiz Mohsin, Ali Khizer & Afzal, A. (2012).

Hashmi S. K, (2003). A socioeconomic and service audit of onocology unit at the national institute of child health, Karachi, J. Pak. Med. Assoc. 2003; 53 (5): 205-207

Hospital Waste Management in the Teaching Hospitals of Karachi

Journal of the Pakistan Medical Association 55(5):192-5

Measuring overall health system performance for 191 Countries. (PDF). pages. stern. nyu. edu.

Medical waste management in Ibadan, Nigeria: Obstacles and prospects. Waste management,29 (2): 804-811.

Pharmacologyonline 1: 604-617 (2009) (Mandal S. K et al, 2009).

Pepin, J. (2014). The early spread and epidemic ignition of HIV-1 in human populations

Rasheed, S., Iqbal, S., Baig, L. A. & Mufti, K. (2005). Hospital Waste Management in

theTeaching Hospitals of Karachi. JPMA, 55: 192.

Rehan, E., Ahmed && Prof. Dr.Noman, A. (2008). Healthcare Waste Management In Karachi, Pakistan.

Rutala, W. A. &Mayhall, C. G. (1992). Medical waste. Infection Control & Hospital Epidemiology, 13 (01): 38-48.

Review of Hospital waste management in Iran. International Research Journal of Applied and Basic Sciences, Vol. 8 (6): 649-655.

Rutala, W. A. &Mayhall, C. G. (1992). Medical waste. Infection Control & Hospital Epidemiology, 13 (01): 38-48.

Sharma, Shalini. &Chauhan, S. (2008). Assessment of bio-medical waste management in three apex Government hospitals of Agra. Journal of environmental Biology, 29 (2): 159.

Syed, E. H., Mutahara, M. &Rahman, M. (2012). Medical waste management (MWM) in Dhaka,Bangladesh: it'sa review. Home Health Care Management & Practice, 24 (3): 140-145.

Source: www.who.int/watersanitation_healthimedicalwaste

Source: The Bio-medical Waste (Management and Handling) Rules 1998 Schedule-I

Sultan Qaboos University Medical Journal, 8 (1): 11-19.

Teimori, G. H., FattahzadehMasoud, Avakh Ali, VahabiMasoomeh, NourianRouhollah, Ali, K. M. &&Abdolhamid, K. K. (2014).

The Netherlands: WASTE, Advisors on Urban Environment and Development, Nieuwehaven 201, 2801 CW Gouda. 1-45 pp.

Tsakona, M., Anagnostopoulou, E. &Gidarakos, E. (2007). Hospital waste management and toxicity evaluation: a case study. Waste management, 27 (7): 912-920.

WHO. (2007). WHO core principles for achieving safe and sustainable management of healthcare waste. Safe health-care waste management: 1-2. WHO. (2013).

WHO. (2000). Air quality guidelines for Europe. Second ed. Copenhagen, Denmark: World Health Organization.

Windfeld, Elliott Steen & Brooks, M. S.-L. (2015). Medical waste management–A review. Journal of environmental management, 163: 98-108.

Zafar, R., Ali, S. S., Uddin, Z. & Khan, M. A. (2013). Hospital Waste Management: Execution In Pakistan And Environmental Concerns - A Review

APPENDICE-1

PROFILE:

1) Hospital name (Location): _____
2) Department of Hospital:_____
3) Number of patients:_____/day
4) Number of beds:_____/ day

Your Position:

- Doctor/House Officer
- Nurse
- Administrative staff
- Janitor staff

Questionnaire: Based on Awareness and Knowledge of Hospital Waste Management.

1. Do you know about Hospital Waste Management process in the hospital?
   a. Yes b. No

2. Do you think Hospital Waste management in the hospital is following the correct procedure?
   a. Yes b. No

3. Can Hospital waste cause risks and health hazards to your health when infected?
   a. Yes b. No

4. Can Hospital waste cause risks and adverse health effects to the environment?
   a. Yes b. No

5. How many categories of clinical waste are there in Hospital?
   a. One b. Two c. Three d. Four
   e. Five f. Six g. More than Six h. Don't Know

6. Do you know the correct method of handling clinical waste based on thecategories?
   a. Yes b. No

7. Are bags and containers for clinical waste marked with symbols?
   a. Yes b. No

8. Are clinical waste containers or bag holder been put in all locations where particular categories of waste may be generated?
   a. Yes b. No

9. Do you segregate general waste from clinical waste?
   a. Yes b. No

10. Do you know about the color-coding segregation of Biomedical waste?
    a. Yes b. No

11. Do you use personal protective equipment in handling clinical waste?
    a. Yes b. No

12. Do needle stick and sharp injuries need to be reported?
    a. Yes b. No

13. Do you know if the Hospital has a set of transport schedule for infectious waste within the organization?
    a. Yes b. No

14. Is clinical waste collected daily (or as frequently as required) and transported to the designated central storage site?
    a. Yes b. No

15. Do you know if the hospital must have standard storage room for keeping hospital infectious waste?
    a. Yes b. No

16. Do you know if the hospital storage room must have good lighting and ventilation?
    a. Yes b. No

17. Do you know if the storage time for infectious waste is 24-48 hours?
    a. Yes b. No

18. Do you know if the hospital has an incinerator for treatment and disposal of infectious waste?
    a. Yes b. No

19. Do you know who is responsible to manage clinical waste in the Hospital?
    a. Yes b. No

20. Do you know the location of the storage area of clinical waste in the hospital?
    a. Yes b. No

21. Safe management of healthcare waste is not an issue at all.
    a. Agree b. Disagree.

22. Waste management is teamwork/ no single class of people is responsible for safe management.
a. Agree b. Disagree.

23. Do you think infectious waste should be sterilized from infections by autoclaving before shredding and disposal?
    a. Yes b. No

24. Do you think that labelling the container before filling it with waste is of any clinicalsignificance?
    a. Yes b. No

25. Would you like to attend voluntarily programs that enhance and upgrade your knowledge about waste management?
    a. Yes b. No

AWARENESS AND PRACTICES ON HOSPITAL WASTE MANAGEMENT IN POLYCLINIC HOSPITAL, ISLAMABAD

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Certificate

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