Evaluation of Waste Management Practices in One of the Leading Public Sector Hospitals at Karachi

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Abstract

The purpose of this research was to find out about the waste management practices being carried out in the public sector hospitals in Karachi, Pakistan. Appropriate waste management practices are very important for the safety and well-being of all hospital staff, patients and also for a safe healthy environment. The research, being explanatory in nature, involved primary quantitative data collected through a questionnaire. The data was collected from a sample of 152 healthcare waste handlers belonging to different departments of Jinnah Postgraduate Medical Centre. To analyze the data, statistical tools Pearson's Correlation and Regression analysis were applied with the help of Statistical Package for Social Sciences (SPSS), version 22. The investigation and analysis results have revealed that waste management practices are being carried out in different departments of Jinnah Post graduate Medical Centre. There is difference in the practices being followed when different variables are considered. The Healthcare waste management system requires proper planning, implementation of the plans for hazardous healthcare waste management and supervision of the practices being carried out. The findings of this research are likely to help the management of Jinnah Postgraduate Medical Centre specially the Waste Managers about effectiveness of Waste Management System and also about its weaknesses. Likewise, other hospitals of the industry, both public and private sector, can also benefit from the study.

Keywords: Waste Generation, Collection and Segregation, Waste Handling and Storage, Waste Treatment and Disposal, Effective Healthcare Waste Management.

1. Introduction

Waste generation and environmental pollution have become a great concern over the last few decades. The reasons related to these concerns are associated with the human beings, their lifestyles and patterns of consumption which have resulted in generation of large volumes of waste of different types (Hossain, Santhanam, Nik Norulaini, & Omar, 2011). Increase in the population eventually increases all matters related to the population manifolds. The government authorities eventually face a challenge in meeting the demands of the increased population. Every healthcare facility must have a waste management policy and a waste management plan. Through the policies and plans, standard operating procedures could be set out which could define the operating procedures, training, roles and responsibilities for employees taking up different waste management tasks. Therefore a lot of authorities concerned with healthcare matters have given significant attention to waste management practices. But hospital or healthcare waste management is still a major challenge in developing countries. This could be overcome by following certain basic steps for waste management, which includes identifying, evaluating, treating, transportation and disposing hospital waste. Setting rules and regulations, appointment of specialized staff, educating the concerned non-specialized staff regarding the rules for handling waste, supervision and audits are very vital to ensure safe practices for disposal of hospital waste (Tabasi & Marthandan, 2013). There would be a positive impact on the environment and population if the waste management practices are conducted appropriately.

The World Health Organization (WHO) handbook, commonly known as "The Blue Book" is a safe, sustainable and affordable handbook on management of health-care waste. This book has been used widely in healthcare sector for guidance in adoption of healthcare handling safe guidelines (Organizzazione mondiale della sanità & Chartier, 2014). Over the years, an increasing number of healthcare facilities such as clinics, hospitals, rehabilitation centers etc. have resulted in a significant and proportionate increase in healthcare waste production (Khadem Ghasemi & Mohd Yusuff, 2016). The healthcare waste generated as a result of the improved and expanded medical facilities is a combination of hazardous and non-hazardous materials. Apparently, the hazardous waste which is approximately 10-25% of the total waste produced, ends up damaging the environment with its toxins (Mohamed, Ebrahim, & Al-Thukair, 2009).

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Hospital waste management is an ever growing hazard in developing countries like Pakistan. The poor management of hospital waste is associated with increased risk of spread of deadly infections like HCV, HBV and HIV1 (Blenkharn, I. 2014). The dangerous component of hospital waste i.e. infectious waste makes about one third of total waste generated in a healthcare facility (TOHEED et al., n.d.).The management of waste is a global concern due to the increase in the population in the urban areas compared to rural areas. Along with the increase in population the consumption patterns have also increased. Concerns arise when the systematic management of waste is not carried out. This issue is observed more in developing countries than the developed and industrialized countries as the latter follow an engineered system for waste disposal and treatment. The systematic waste disposal helps address issues related to health, environmental factors, resources, and economic concerns (Marshall & Farahbakhsh, 2013). The waste generated is a great concern for the population at large including the individuals, communities, local authorities, non-government authorities and government authorities. The main reason for the inappropriate methods for hospital waste management in developing countries is lack of resources and lack of awareness as well. Most of the models for effective waste management have been designed in developed countries. With the resources being able to cater to the needs of the systematic disposal and other treatments, this has not been much of an issue in the developed countries. Though the models were there for guidance but a holistic approach was not considered in the developed countries, earlier, rather environmental and economic concerns were of focus. It has been in recent years that government officials, stakeholders, communities and non-government organizations, have been part of this chain of systematic activities involved in effective waste disposal. The focus should be with a more futuristic approach.

1.2   Profile of Jinnah Postgraduate Medical Centre

Jinnah Postgraduate Medical Centre, Karachi is a tertiary care hospital which provides specialized medical care to the residents of Karachi and its catchments areas. It has 1185 beds to provide inpatient facility covering all aspects of medical and surgical specialties. Teaching and training facilities are extended to undergraduate and post graduate medical education, undergraduate and post graduate nursing education, paramedics, medical technologies and Physiotherapists. At present Jinnah Postgraduate Medical Centre is generating approximately 2.5 tons of hospital waste on daily basis, which includes approximately 700 kilograms of infectious waste comprising of disposable syringes, drips, surgical blades, dressing material, body viscera, tissue, etc. For safe disposal of infectious waste, incinerator has been installed in March 2000. The incinerator was installed by Pakistan Council of Scientific and industrial Research, Karachi. Repair/maintenance and operation is being carried out by Pakistan Public Works Department through Environmental Management Division. The engineer deputed by Pakistan Public Works Department Environmental Management Division supervises/ monitors the combustion of hospital waste in incinerator. Sanitary Superintendent and two Sanitary Inspectors with the assistance of sanitation staff ensure the proper disposal of hospital waste. Necessary equipment for collection and shifting of garbage from wards to designated collection place are available including trolleys, dustbins, plastic bags, etc. Furthermore, garbage trucks and road sweeper along with a tractor are also available for transportation of non-infectious waste from Jinnah Postgraduate Medical Centre to municipal land fill area and cleaning of road side and open areas within Jinnah Postgraduate Medical Centre premises.

1.3   Statement of the Problem

Healthcare waste management in general and specifically the hazardous waste has become a global concern for the healthy living. The hazardous waste is only one quarter of the total waste produced but still the management of this portion of waste is a menace. Although the rules for safe management are not new to all the concerned personnel dealing with the waste, but the problems still exist. It is necessary to have regular reinforcement of the rules by conducting safe management workshops, regular rounds should be taken for supervision of the practices to ensure the waste is managed well. This study is an observation of the waste management practices (including Collection / generation of hospital waste, segregation, storage, collection, transportation, waste treatment, disposal within and outside hospital premises), followed in various wards and departments of Jinnah Postgraduate Medical Centre in Karachi, Pakistan.

1.4 Objectives of the Study

Following are the research objectives:

- To assess whether the collection and segregation of hospital waste is undertaken as per International standards.
- To investigate if waste handlers are conversant with safe handling and transportation procedures.
- To examine influence of waste treatment and disposal on healthy environment.
- To propose measures to the hospital for improving waste management practices.

1.5 Scope and Significance of Research

The scope of research is limited to only five departments of Jinnah Postgraduate Medical Centre. These departments are actively involved in waste management activities of the hospital. This research will help Hospital administrators and the safety managers to improve the healthcare waste management, in the following context:

- Compliance with Healthcare waste management standards will minimize risks to health and safety of the staff, patients, public and environment.
- Regular check-up of the waste handlers for infectious diseases and subsequent medical treatment if found infected.
- This will increase the awareness of the waste handlers and their motivation for following directives for safe handling of waste.
- It will help decrease the cost of waste management by decreasing the cost on treatment.

2. Literature Review
2.1 Significance of Waste Management

The health of healthcare workers or hospital staff and patients may be directly or indirectly at risk with incorrect practices for hospital waste management (Khadem Ghasemi & Mohd Yusuff, 2016).The WHO (Reidy, 2014) defines healthcare waste as " the waste generated by healthcare activities that can include a wide range of materials, such as needles and syringes, soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals ,medical devices and radioactive materials". Hospitals generate a lot of waste but only one quarter of that waste pose a threat to the patients, staff and the environment. In order to reduce the risks it is important to consider methods to reduce the high rates of waste generation.

Waste generation in general and especially hospital waste is a challenge, the waste generated in hospitals if not managed appropriately could be a threat for healthy living (Hossain, Santhanam, Nik Norulaini, & Omar, 2011). Waste generation has increased all over the world with the increasing population and consumption patterns, in this regard healthcare sector is no exception as they also face an increase in the waste produced in hospitals and other units related to health. The hazardous or infectious waste produced in hospitals is only about 15-25% of the total waste produced, but if not handled properly can cause a potential threat. The important factor is managing this waste appropriately to decrease risks related to it (Hamadan et al., 2012). Healthcare waste contains both infectious and non-infectious waste. Handling the types of waste according to the nature of the waste is very important.

Hindrance in appropriate planning for hospital waste management in developing countries is due to many factors that affect the performance of the system(Guerrero, L. A., Maas, G., &Hog land, W.(2013)., this includes insufficient documentation on waste management practices, resulting in incorrect waste management. The Gondar University hospital, Ethiopia faces waste management problems due to lack of accurate waste segregation practices, insufficient protective kit/tools, insufficient knowledge of the waste handlers about proper waste management (Mesfin, Worku, & Gizaw, 2014).Accurate waste segregation practices reduce the risk of infections/injury to the waste managers/handlers, eventually waste management is cost controlled as it decreases the cost of treatment. Blenkharn, J. I. (2006) mentioned in a study on conditions in Brazil, that improvement is required in terms of provision of adequate resources and work has to be done for setting up a basic healthcare waste management system. Such investments will eventually improve the health conditions and eventually reduce the financial problems.

Safe and appropriate healthcare waste management practices have not attained much attention in developing countries. Disposal of infectious waste together with the general waste has been observed, this is a serious concern as the infectious waste may expose the waste handlers with Hepatitis B, Hepatitis C or HIV (Hassan, Ahmed, Rahman, & Biswas, 2008).Hospital waste handling without the necessary steps for care can cause harm to people and the environment.

Involvement of all concerned with the issues of healthcare waste management, that is the service providers and the service users, also all at risk of exposure; in general the whole community/population is important(Marshall & Farahbakhsh, 2013). The interest and involvement of the local leaders in waste management issues will increase the funding for equipment and organization.

2.2   Waste Collection and Segregation

Significant factors for waste generation are the type of the hospital, hospital capacity for patients, and the in-patient and out-patient turnover rates (Cheng, Sung, & Li, 2009). This information on waste generation rate helps plan for waste storage, transportation, treatment and disposal of the hospital waste (Tabasi & Marthandan, 2013). A study conducted in Bahrain comparing Salmaniya Medical Centre and other hospitals over some years revealed that generally there was an increase in the hospital waste generated, but the pattern at Salmaniya Medical Centre remained the same (Mohamed, Ebrahim, & Al-Thukair, 2009). This was because of the introduction of new ideas for hazardous waste reduction like traditional sphygmomanometers (blood pressure measuring apparatus) and X-ray films with digital technology. This eradicated exposure to mercury from the blood pressure apparatus and destructive chemicals which were used for processing X-ray films. A case study conducted in Nabulus, Palestine compares different types of hospitals and the waste generated from them. The model designed was to predict the treatment cost and waste generation in different types of hospitals (Al-Khatib, I. A., Eleyan, D., & Garfield, J. 2016).

The results of a study in Portugal (Ferreira, V., & Teixeira,2010) reveal deficiencies in waste segregation practices which are resulting in exposure to infectious waste. Botelho, A. (2012). Stated that in the European Union, the focus is on waste segregation at the site of the source, this is planned through emphasis on training and education of waste handlers. Hospital waste comes from various sources within the vicinity of the hospital. It includes any waste that is generated during diagnosis, treatment or immunization of the patients (J. Blenkharn, 2006). Major sources include different wards with hospitalized patients, clinics, blood banks, laboratories, Daycare units, and Nursing homes. Minor sources include the consulting clinics, dispensaries, offices, pharmacies, cafeterias, etc. It is important to know the quantities of waste generated for safe disposal. The generation of healthcare waste not only depends on the size and the available facility of the hospital but it also reflects on the economic development of the country. Waste generated in developed countries is more due to the demand of high consumption of goods and services. There is more use of disposable items like instruments and packing materials, also proper rules are followed for waste segregation (Hossain, Santhanam, Nik Norulaini, & Omar, 2011). It is very vital to know the types and quantities of waste generated in a healthcare facility as it is the initial step towards safe disposal. It is very important to ensure that the clinical waste is not mixed with the other municipal or household waste. This not only increases risks for the waste handlers but eventually increases the cost to the hospital (Ciplak, N., & Barton, J. R. 2012).The data collected initially on the waste produced is helpful in estimating the required capacities for containers, storage areas, transportation, disposal and treatment Waste-generation information can be used to provide information on production of waste in different areas of the hospital and for attaining specifications, planning, budgeting, calculating revenues from recycling, optimization of waste-management systems, and environmental impact assessments. A survey was conducted in Iran for waste minimization (Javadi, &Tayyebi et al 2013), the results revealed waste segregation practices were significantly higher in Public hospitals. This assessment of the waste management process makes grounds for improvement opportunities in practices currently followed, sensitize health workers regarding waste and determine ways for waste minimizing. Quantitative waste assessments are the best way to obtain data on healthcare waste generation. If healthcare waste is not segregated then the presence of sharps or other infectious material could endanger the health of the population moving around these waste sites (Hossain et al., 2011). The segregation of general waste as, non-hazardous waste and potentially hazardous waste into different containers is often known as the "three-bin system":

S. No	Color of Bin	Type of Waste
1	Black	Non-infectious waste (waste, paper, card board, food packing waste, etc.).
2	Red	Infectious waste (clinical Laboratory waste, blood bank waste, syringes) Sharps are kept in separate red colored containers.
3	Yellow	Pathological and Pharmaceutical waste (tissues, organs, body parts, blood, body fluids, expired medicines, etc.).

Mesfin, A., Worku, W., & Gizaw, Z. (2014) conducted a study and the results showed that 46.3% of the waste handlers had practiced waste segregation correctly, non-availability of color coded containers influenced the practice of segregation of healthcare waste. The sharps are disposed in sharps containers that are marked properly to avoid any risks of contact (usually red in color). If there is uncertainty of the type of waste then as a precaution the waste should be placed in the container for hazardous healthcare waste. The hazardous waste is separated into two parts used sharps and potentially infectious waste items (like bandages, swabs, tissues tubing, and disposable medical items)

Blenkharn, J. I. (2006) mentions clinical waste as an expensive commodity and dangerous as well. The exposure to infected clinical waste may cause serious consequences and eventually the treatment is necessary and costly too. Waste assessment programs are designed differently according to the availability of facilities and resources. The general observation is that data is collected regularly (usually daily) from each area of the healthcare facility or hospital, waste items are segregated into separate containers or bags. The waste containers or bags are weighed and compared to the number of beds occupied or number of patients in the facility or unit. An adequate stock of containers and bags should be available in the area where waste is produced. This availability of these bags and containers is the responsibility of the local waste manager and the Hospital administrator.

The non-hazardous waste is disposed in black bags but before disposal the waste should be separated as recyclable materials and compostable materials at the source of generation of waste. The black bags must be placed in rigid containers or castor-fitted stands. Anatomical waste is collected in yellow bags but in case the bags are not available then, the waste should be handled keeping cultural and religious norms in mind for disposal, mostly buried. Chemical and pharmaceutical waste is sorted and treated separately. The sharps are placed in separate containers and treated differently.

Hospitals in Bahrain use black plastic bags for segregation of general waste or the domestic waste, yellow or red bags are used for infectious waste, and for hazardous objects yellow containers are used(Mohamed et al., 2009). This was observed as a common practice but some facilities did not follow the correct color coding pattern for collection of hazardous waste, instead of yellow bags, black bags were used. Lack of supervision in the area was the reason for this negligence. Segregation of waste from the point of generation of waste is generally effective ,but when similar waste of different departments is handled in bulk then the required level of satisfaction may not be met (J. Blenkharn, 2006).Accurate segregation of waste can avoid waste of resources and help in cost savings. Generally waste is segregated in each area of the hospital on a daily basis. Specific color coded containers are used to separate the types of waste. Bags from the container are weighed, which are compared to the number of patients handled. Such data collected over a period of a month is more accurate compared to data collected for a week or certain number of days. If collection of this data is repeated at different times in a year it gives more accurate information of the quantities of waste generated in individual units/departments of the hospital. Hence, hypothesis for this aspect of waste management would be:

H 1: Waste Collection and Segregation contributes towards effective waste management.

2.3   Waste Handling and Storage
Blenkharn, J. I. (2007) mentioned in the results for a study conducted in UK hospitals that there is evidence of need for improvement in Healthcare waste segregation, storage and security of the stored waste storage areas. The staff responsible for collecting the waste gets a visual indication of the risk exposed by the bags or containers. The process of waste collection actually starts with weighing the containers and bags with the waste produced in a particular unit of the hospital reasons. The collection is done on a daily basis. Data collected on a daily, weekly or monthly basis provides limited information and

may not be accurate due to seasonal variations or other. An accurate picture could be achieved by data collection for a month or longer and repeated at different times in the year.

Waste carts or trolleys with lock lids are used for collection transport and storage of the clinical waste (J. Blenkharn, 2006). At times it was observed that these carts were blood stained. These carts after bulk collection and transportation of waste is kept in a satellite storage area and then moved to a central storage area which has unauthorized access restricted in its area. The area is used for storage till the bulk collection is done. The problems of waste management are not just a menace in the developing countries but in certain developed countries similar problems exist. A study conducted in UK hospitals a year after an initial audit exposed a lot of areas which required improvement. The waste interim storage sites were accessible and not secured (Blenkharn, J. I. 2007).

In a study involving five teaching hospitals in Lahore, it was observed that only one hospital implemented waste management practices as per the standards set by the government (TOHEED, AYUB, & MUMTAZ, n.d). The temporary storage areas were small and in unhygienic condition. Wheelchairs were used for transportation of this waste (sometimes infectious waste), 60% of the institutions did consider protective measures for the staff which handled this waste. Timings for collection of waste must suit the timings of the staff that has to handover the waste as it should not be a busy time of the day (Guerrero, Maas, & Hogland, 2013). Another study conducted in Malaysia (Hamadan et al., 2012) revealed that there is a discrepancy between the instructions given to the staff and the practices followed. This shows a carefree attitude of staff handling the waste. The yellow bins did not have yellow bags fitted in certain shifts; waste was directly discarded in the bin. Proper plastic taping for the interim storage of waste was not followed. A study conducted in hospitals in Thailand (Manowan, V. 2009) mentions that presence of a waste management system in a hospital is important and along with that the awareness of waste handlers about the risks related to waste handling are also vital.

The indiscriminate and erratic handling and disposal of waste within health-care facilities is now widely recognized as a source of avoidable infection, and is synonymous with public perception of poor standards of healthcare. The healthcare waste that requires careful management because of being infectious or hazardous is only 10% to 25% of the waste produced; rest of 75% to 90% is non-hazardous waste or general waste. All personnel working within a healthcare facility and working in close proximity with healthcare waste specially the hazardous waste are potentially at risk of exposure to hazards. Waste handling instructions should be given to all those handling hospital waste (Organizzazione mondiale della sanità & Chartier, 2014), including use of personal protective equipment and avoiding physical contact with hazardous/infectious waste items.

During an audit in UK in the year 2005-2006, it was observed that despite specific instructions for securing the waste prior to transportation for treatment and disposal, two third of the hospitals failed to follow the instructions, eventually having poor standard of performance (J. I. Blenkharn, 2007). There was shortage of trolleys for waste collection, resulting in unlocked trolleys as they were overloaded. This resulted in spillage waste being transported. Some containers were seen left behind on the ground in the hospital most probably the waste collection carts were not enough to take the load, or the collection was not done frequently. Hence, hypothesis for this aspect of waste management would be:

H 2: Waste Handling and Storage contributes towards effective waste management.

2.4 Waste Treatment and Disposal
Safe disposal of the hazardous waste ensures safety of all waste handlers (Blenkharn, J. I. 2009). Appropriate measures used for treatment of healthcare waste help reduce the potential hazards to the patients, healthcare workers, hospital staff population in general and protect the environment. An organized approach from generation of waste to treatment and disposal, ensuring that the clinical waste is not mixed with the non-clinical waste, keeps the population and the environment safe and healthy (Hossain et al., 2011b). A study on disposal practices of healthcare waste in Nigeria revealed that the waste is not being disposed properly. Unclaimed dead bodies, waste from the labor rooms were seen in unlined pits and other waste was openly disposed (Oladepo, Jeje, & Ogedengbe, 2011). A study was conducted in Iran to observe the changes implemented as in the past the practice was mixing up of municipal waste with clinical waste

(Dehghani, Azam, Changani, & Fard, 2008). Following are the waste treatment and disposal techniques/technologies (Borg, M. A. 2006):

- Thermal process: Waste is treated with heat or thermal energy to kill the pathogens. This type of treatment used in facilities globally
- Biological Treatment: Pathological waste is buried for decomposition.
- Mechanical Treatment: This process involves shredding (needles and syringes), grinding and mixing to minimize the bulk (size), but the microorganisms are not destroyed. This process is mostly followed by other treatments for complete destruction of pathogens.
- Treatment of Waste with Radiation: Microorganisms are destroyed with radiation, strong enough to penetrate through closed containers and bags. The staff dealing in such areas requires appropriate protection, or shielding for avoiding occupational hazards.

The technology selected for hospital waste treatment and disposal must have least risks for health of all the people involved in the process, must ascertain a healthy environment ,must be economical and easy to implement (Khadem Ghasemi & Mohd Yusuff, 2016). Waste treatment (safe disposal) is the responsibility of the government authorities, unfortunately the arrangements are inadequate (Blenkharn, J. I. 2008). This may include the type of facilities available for patients in the hospital and the availability of resources. It is very important for the hospital to have the resources available to ensure effective and safe management of waste. The key factor for a safe and healthy population and environment is safe disposal and treatment practices of healthcare waste. In Dhaka and other developing countries it has been observed that needy children and adults have gained access to improperly disposed hospital waste like syringes, saline bags, blood bags, for reselling (Hassan et al., 2008). Such practices are a threat and expose the population to Hepatitis B, Hepatitis C and HIV. Similar problems of improper infectious waste disposal practices have been reported in India as well, this pose a threat to the population in general (Taneja, N., & Biswal, M. 2006).

The WHO has stated (Angel, 2009) that for developing countries, incineration may be an adequate method if used appropriately, until they have more safe choices for healthcare waste management to ensure a healthy and safe environment. Segregation of the waste from the point of generation makes it convenient and easy for selection of treatment options. Non-hazardous waste, for example, food waste items collected from different departments in the hospital are collected in the kitchen, these items could be composted or if rules permit could be used for animal feed. Waste that contains viscera (body parts) must be handled according to the cultural and religious norms. Most commonly this type of waste is either buried or cremated. Certain highly infectious waste (laboratory samples and waste of infectious patients) treated by being autoclaved at the initial site of generation, for the purpose of disinfecting, and then placed in the infectious waste containers. Some of the infectious waste like sharps (needles) is placed in the respective containers. Certain healthcare workers remove the needle from the syringe and dispose the needle in the sharps container; the others simply use the container which has a needle cutter. The chances of exposure to physical injuries are less in the later practice. It is very important to ensure protection of waste handlers from sharps injury and exposure to body fluids (Shiferaw, Abebe, & Mihret, A. 2012).

Since 2002 (Mohamed et al., 2009) a common incineration plant, operated by a private company, has been used in the Kingdom of Bahrain by all healthcare facilities for disposing their hazardous waste. Other methods include autoclave for certain types of infectious pathogens before incineration, certain pharmaceutical waste (like expired medicines, etc.) and radioactive waste is sent to the original supplier for the purpose of appropriate disposal. In certain facilities hazardous waste in liquid form is disposed in the sanitary drainage systems. Hence, hypothesis for this aspect of waste management would be:

H 3: Waste Treatment and Disposal contributes towards effective waste management.

3. Methodology
3.1 Type of Research
This is an applied research of explanatory type which shows the impact of three independent variables on Effective Healthcare Waste Management, measured through quantitative data. The data was collected through a well-structured questionnaire, by using Likert scale; with the range of 1-5. The

explanatory research creates a cause and effect relationship between two variables. This type of research answers the "why" and "how" questions.

3.2   Target Population
The survey population includes all employees who are involved in waste handling in Jinnah Post Graduate Medical Centre, which is 400. This was the target population for this research which included Waste Manager, Head nurses, duty nurses, nursing assistants, laboratory technicians, and others (general staff / housekeeping staff) involved in collection, segregation, handling and transportation from interim storage sites to treatment and disposal sites.

3.3   Sample Size and Sampling Technique
The sample size of this research is approximately 130 employees (both male and female), working in various departments of Jinnah Postgraduate Medical Centre. Around 160 questionnaires were distributed for data collection, out of which 152 were received in complete form. Response rate was 95%. Non-probability, convenience sampling method was used for this survey. The purpose was to approach respondents at their convenience so that their daily routine work is not disturbed.

3.4   Data Collection and Treatment
The data collection was through questionnaires (hard copy), distributed among the employees. The sampling technique used in this research is non-probability convenience and judgmental sampling due to easy access and having relevant knowledge and experience of the target population. The gathered data were analyzed and treated with statistical tools, including Pearson's Correlation, Regression analysis and The T-test, using software SPSS, version 22.

4.   Analysis
4.1   Profile of Respondents
Demographic description of the respondents is shown in the tables below. All the respondents are related with the healthcare waste management. The characteristics include Gender, Age group, Profession and Experience (in years).

Table No. 1:   Gender

Gender		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	57	37.5	37.5	37.5
	Female	95	62.5	62.5	100.0
	Total	152	100.0	100.0	

The information in the above table shows that maximum respondents were females and males respondents were less. Female respondents were 95 (62.5%) and Male respondents were 57 (37.5%).

Table No. 2:   Age Group

Age Group		Frequency	Percent	Valid Percent	Cumulative Percent
	22-30	25	16.4	16.4	16.4
	31-40	54	35.5	35.5	52.0
Valid	More than 40	73	48.0	48.0	100.0
	Total	152	100.0	100.0	

The table above shows the Age Groups of the respondents. 16.4% are between 22-30 years of age, 35.5% are between 31-40 years of age, 48% are more than 40 years old.

Table No. 3: Profession

Profession		Frequency	Percent	Valid Percent	Cumulative Percent
	Doctor	34	22.4	22.4	22.4
	Head Nurse/ Nurse	35	23.0	23.0	45.4
Valid	Nursing Aid/Lab Tech	45	29.6	29.6	75.0
	Others	38	25.0	25.0	100.0
	Total	152	100.0	100.0	

Table 3 shows that out of 152 respondents, 22.4% were Doctors (including interns, Resident Medical Officers and Postgraduate Officers), 23.0% were Head Nurses and Nurses, 29.6% were Nursing Aids (Assistants) or Laboratory Technicians and 25% were other staff members (including housekeeping staff, waste handling support staff and waste truck loaders/drivers).

Table No. 4: Job Experience

Job Experience		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 2 Years	7	4.6	4.6	4.6
	2-5 Years	11	7.2	7.2	11.8
	6-10 Years	39	25.7	25.7	37.5
	>10 Years	95	62.5	62.5	100.0
	Total	152	100.0	100.0	

The respondents' data displayed in the table above indicates 4.6% were with less than two years of experience, 7.2% with 2-5 years of experience, 25.7% with 6-10 years of experience and 62.5% with more than 10 years of experience.

4.2   Test of Reliability

Cronbach's alpha Test of Reliability is a measure of internal consistency, meaning how closely related a set of items/variables are as a group.

Table No. 5: Reliability Statistics

Variable	Value of Cronbach's Alpha	N of Items
Waste Collection and Segregation	0.779	8
Waste Handling and Storage	0.744	8
Waste Treatment and Disposal	0.848	5
Effective Waste Management	0.830	4

The value of Cronbach's alpha in case of all variables is mentioned in table 5. Since Cronbach's alpha value is greater than 0.7, it shows internal consistency of the items.

4.3   Pearson's Correlation

Correlation tells us about the relationship between research variables. Correlation results are displayed in table 6.

Table No. 6: Correlation

		WCS	WHS	WTD	EWM
WCS	Pearson Correlation	1			
	Sig. (2-tailed)	0.000			
	N	152			
WHS	Pearson Correlation	0.491**	1		
	Sig. (2-tailed)	0.000			
	N	152	152		
WTD	Pearson Correlation	0.287**	0.253**	1	
	Sig. (2-tailed)	0.000	0.002		
	N	152	152	152	
EWM	Pearson Correlation	0.400**	0.152	0.407**	1
	Sig. (2-tailed)	0.000	0.062	0.000	0.000
	N	152	152	152	152

**Correlation is significant at the 0.01 level (2-tailed).

WCS = Waste Collection and Segregation, **WHS =** Waste Handling and Storage, **WTD** = Waste Treatment and Disposal, **EWM** = Effective Waste Management.

Table 6 indicates the correlation between three variables and Effective Waste Management. A strong positive relationship has been found between Waste Collection and Segregation, and Waste treatment and Disposal with, Effective Waste Management. Effective waste Management is correlated with Waste Collection and Segregation Value of r is 0.400 and the value of P is 0.000, this relationship is statistically significant at 1% significance level. Similarly there is a correlation of Waste Treatment and Disposal with Effective Waste management where r is equal to 0.407 and P is 0.000, this relationship is statistically significant. There is a weak positive correlation of Waste Handling and Disposal, with Effective Waste Management, where the value of r is 0.152 and value of p is 0.062 (> 0.05).

So with the help of Pearson Correlation results, the first (Waste Collection and Segregation) and the third (Waste Treatment and Disposal) variables have a positive statistically significant relationship, whereas the second variable (Waste Handling and Disposal) has a weak positive relationship. Thus the first and third hypotheses have been accepted and the third has been rejected.

4.4   Regression Analysis Statistics

Table No. 7:   Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.511[a]	0.262	0.247	0.85624

a. Predictors: (Constant), Waste Treatment and Disposal, Waste Handling and Storage, Waste Collection and Segregation

Regression determines the strength of the relationship between one dependent variable and independent variables (0.511) represents the correlation between observed and predicted value, whereas R square column (0.262) represents 26.2% variation in the Effective Waste Management (dependent variable),which can be explained by "Waste Collection and Segregation", "Waste Handling and Storage" and " Waste Treatment and Disposal" (independent variables).

Table No.8:   ANOVA[s]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	38.435	3	12.812	17.475	0.000[b]
	Residual	108.505	148	0.733		
	Total	146.941	151			

a. Dependent Variable: Effective Waste Management
b. Predictors: (Constant), Waste Treatment and Disposal, Waste Handling and Storage, Waste Collection and Segregation

The ANOVA table represents how well the regression equation fits the data (i-e. predicts the dependent variable). ANOVA table is divided into two parts Regression and Residual. In this table df means "Degree of freedom" and F means "frequency". ANOVA is used to compare differences of means among more than two groups. The table shows that the independent variables statistically significant predict the dependent variable, F = 17.475 at the significance level of 0.000, p < 0.005.

Table No.9:   Coefficients

Model		Non-standardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.198	0.423		2.831	0.005
	WCS	0.456	0.105	.357	4.326	0.000
	WHS	-0.157	0.119	-0.108	-1.319	0.189
	WTD	0.355	0.080	0.332	4.458	0.000

a. Dependent Variable: Effective Waste Management
WCS=Waste Collection and Segregation, WHS= Waste Handling and Storage, WTD= Waste Treatment and Disposal.

The Coefficient table indicates that whether independent variables are significant to the model or not. According to our analysis, the coefficient table shows the 'Sig' values in the last column, which predicts

the significance of the independent variables and shows whether the variables are useful estimators or not. In the first independent variable "Waste Collection and Segregation" the p value is 0.000 which is less than 0.005, that means this variable is a useful variable and creates a positive impact on Effective Waste Management. The p value of the second independent variable is 0.189 which is greater than 0.005; it means this variable is not a useful estimator of Effective Waste Management. The p value for the third independent variable is 0.000 which is less than 0.005; it means the variable creates a positive impact on Effective Waste Management. Hence "Waste Collection and Segregation" and "Waste Treatment and Disposal" are useful estimators of Effective Waste Management but "Waste Handling and Storage" is not a useful estimator.

4.5   The T Test

Table No.10: One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
WCS	152	3.0526	.39516	.03205
WHS	152	3.5263	.59743	.04846
WTD	152	3.1579	.93572	.07590
EWM	152	3.0000	1.12762	.09146

Table No.11:   One-Sample Test

	Test Value = 0					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
WCS	95.241	151	.000	3.05263	2.9893	3.1160
WHS	72.771	151	.000	3.52632	3.4306	3.6221
WTD	41.608	151	.000	3.15789	3.0079	3.3079
EWM	32.801	151	.000	3.00000	2.8193	3.1807

The T-test assesses whether the means of two groups are statistically different from each other. The analysis is appropriate whenever means of two groups are compared. If the value of mean is more than 3 then the particular task is being done acceptably well. Table 11 indicates that all variables have significant effective waste management, since value of p is <0.05 and the value of mean is more than 3.

Table No. 12:   Summary of Result (Hypotheses Testing)

Hypotheses	Statement	Result
H1	Waste collection and segregation contribute towards effective waste management	**Accepted**
H2	Awareness of waste handlers about safe handling and Storage of waste contributes towards effective waste management.	**Rejected**
H3	Appropriate treatment and disposal of waste contribute towards effective waste management.	**Accepted**

5.1   Waste Collection and Segregation

With reference to the first variable, the results in Table 4.6 indicate a strong positive relationship between Waste Collection and Segregation with Effective Healthcare Waste Management. This result is compatible with the study conducted by Tabasi & Marthandan (2013). These findings are also matching with the study conducted by Simil, Ciplak, N., & Barton, J. R. (2012). The Null Hypothesis (Ho1) is rejected and the Alternate Hypothesis (Ha1) is accepted. The significance of the values indicates that Waste Collection and Segregation practices are being appropriately carried out at various departments of Jinnah Postgraduate Medical Centre which is among the largest public sector hospitals in Karachi, Pakistan. Most of the waste collection and segregation is handled by Doctors, Nurses, and Laboratory technicians or nursing assistants, they are well aware of the precautionary measures and try their best to avoid any sort of negligence when handling the infectious healthcare waste, so as to stay away from related complications. The value of T-test in table 4.10 and 4.11 also support the impact of the variable.

5.2   Waste Handling and Storage

In reference to the second variable, the results in Table 4.6 indicate a weak positive correlation of Waste Handling and Storage and Effective Waste Management, this relationship is not statistically significant. The value of T-test in table 4.10 and 4.11 also support the impact of the variable. Although awareness of any sort creates a positive affect but in this case it is sheer negligence and casual attitude which has affected negatively. During the process of waste handling and storage the personnel who are involved in this transportation must be aware of the problems related to unsafe practices. There should be emphasis on practical application of the steps for careful handling, transportation and storage (Blenkharn, J. I. 2007). Casual and carefree attitude and ignorance about the safety rules and regulations also affect the health of the personnel, thus ending with serious health issues, costing the hospital for treatment (increasing the expenses/budget) and a hazard to the safety of the environment. While the waste handlers are ill-trained and perhaps unaware of the consequences of poor handling and storage, their supervisors could be equally blamed for this malpractice. It appears from the findings that in addition to casual attitude / unawareness of the waste handlers, the In-charges of the waste management personnel are either themselves not qualified to supervise the whole process or they are intentionally neglecting the importance of standard practices for Healthcare Waste Management.

5.3   Waste Treatment and Disposal

The result indicates a strong and positive relationship between 'Waste Treatment and Disposal' and Effective Waste Management. Hence the third Null hypothesis (Ho3) was rejected and the Alternate hypothesis was accepted. This proves that appropriate healthcare waste 'Treatment and Disposal' contributes towards Effective Waste Management. The same has been emphasized in a study conducted by Shiferaw, Abebe, & Mihret, A. (2012). Safe and appropriate methods of disposal ensure not only safety of the waste management personnel but the population at large, hence, contributing to a safe and healthy environment. The findings match with the study conducted by Hossain et al., (2011). The value of T-test in table 4.10 and 4.11 also support the impact of the variable. From the information gathered through the survey it was evident that the hospital has improved the services by increasing the load of waste disposal, which was previously done twice a week but the waste is disposed through waste disposal trucks on daily basis.

6.   Conclusion

The study has investigated the waste management practices in different departments of the Public Sector Hospital (Jinnah Postgraduate Medical Centre). It is a well-known fact that "Health is Wealth", so far any population health and healthy living should be a priority. It is essential for health providers and all the personnel working in the health providing services to avoid unhealthy practices in order to avoid spreading diseases. Spreading awareness to the healthcare personnel and the general public is important. In this research three salient factors of waste management process, including 'Waste Collection and Segregation', 'Waste Handling and Storage' and 'Waste Disposal and Treatment' were examined to see the extent to which the waste management is effective. Out of these, 'Waste Handling and Storage' is not suitably contributing towards waste management due to multiple reasons. The main reasons that could be gathered from the information collected through the questionnaires is handling of waste without implementation of international standards, protective gear is not used, improperly sealed bags once filled in the departments, waste handlers (from non-medical background) are not provided proper training, handling practices are not supervised and regular medical checkups are not a practice for the waste handlers.

7.   Recommendations

On the basis of weaknesses highlighted in analysis and also found through the responses of the respondents, following are the recommendations:

- Proper waste handling practices, as per international standards, may be implemented in all departments of the hospital.
- Head nurses or Waste Managers should ensure proper supervision of the practices in the ward.
- Regular Medical checkups should be held annually for waste handlers.
- Proper containers should be available in all areas for waste collection and segregation. The sharps containers should be puncture proof

- There should be charts available with pictures of items for respective containers/bags at the collection and segregation site of waste.
- Bags should be sealed properly once filled and kept in the interim storage area, which should not be accessible to other staff. Waste containers should be properly sealed before transportation to the treatment and disposal site with proper labeling of the contents.
- Protective gear should be available for all waste handlers.
- Liquid infectious waste like body fluids and other chemicals should not be thrown in the drains as this could get mixed up with the drinking water through underground leakages.
- Waste disposal sites should be secure from public access.

8. Suggestions for Future Research

Due to paucity of time and other resources, this research was limited to only one large hospital at Karachi. Besides, only one aspect of the healthcare industry 'Waste Management Practices 'was examined. Future scholars may undertake a similar study on other public and private sector hospitals. Moreover, other related topics may be selected for examining various aspects of healthcare industry.

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