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An Investigation of Waste Management Practices in Pakistan: A Case of Ayub Teaching Hospital Abbottabad

¹ Babar Bashir, ² Hamza Zareen, ³ Saqib Hussain Shah, ⁴ Sohail Shah
^{1, 2, 3, 4} Institute of Management Sciences, University of Haripur, Pakistan

Corresponding Author: Babar Bashir

Abstract

The study aimed to assess waste management practices at Ayub Teaching Hospital and identified several shortcomings that call for improvement and redesign. In healthcare institutions, especially in developing nations like Pakistan, managing waste generated during medical activities is crucial due to its potential adverse impact on both the community and the natural environment. Effective waste management is imperative to ensure a sanitary environment for the public, prevent infections, and curb nosocomial issues. The study's focus was to scrutinize prevailing waste management practices in Pakistan, concentrating on Teaching Hospital Abbottabad. The research was conducted within the confines of Ayub Teaching Hospital Abbottabad, utilizing a descriptive cross-sectional methodology. For data collection, three questionnaires were modified to align with the study's objectives and distributed among healthcare and sanitation staff. Respondents filled these questionnaires, and the collected data was subsequently analyzed using SPSS

software. The findings underscored several critical inadequacies in waste management practices. These encompassed a dearth of training and educational initiatives, improper temporary storage that lacked safety measures, absence of documented hazardous waste records, failure to utilize appropriate color-coded bags, improper disposal of hazardous waste mixed with general waste, an evident lack of a responsible oversight committee, absence of logistical mechanisms, and a void in rule and regulation enforcement. The study sheds light on the inadequacies of waste management practices at Ayub Teaching Hospital, suggesting a comprehensive overhaul to rectify these issues. The absence of effective regulations, coupled with deficiencies in training, supervision, and safety protocols, underscores the urgency of implementing stringent corrective actions within the healthcare waste management framework.

Keywords: Healthcare Waste Management, Infectious Wastes, Healthcare Institutes, Ayub Teaching Hospital Abbottabad, Pakistan

Introduction

The "Environment Protection Department" of the Punjab Government defines the term 'hospital' as a healthcare center, laboratory or pharmacy service centers, dispensaries or BHUs (Basic Health Units), maternity institutes, physician's private clinics, nursing homes, healthcare units, autopsy centers, blood banks, mortuaries, research centers, veterinary centers, and other facilities engaged in medical or healthcare activities. Similarly, the World Health Organization (WHO) characterizes hospital waste, healthcare waste, or medical waste as waste generated during healthcare activities that contains infectious or potentially infectious materials. The definition of Hazardous Waste Management (HWM) pertains to waste generated by healthcare services such as hospitals, physician's offices, laboratories (including X-ray departments), dental practices, medical research facilities, and veterinary hospitals.

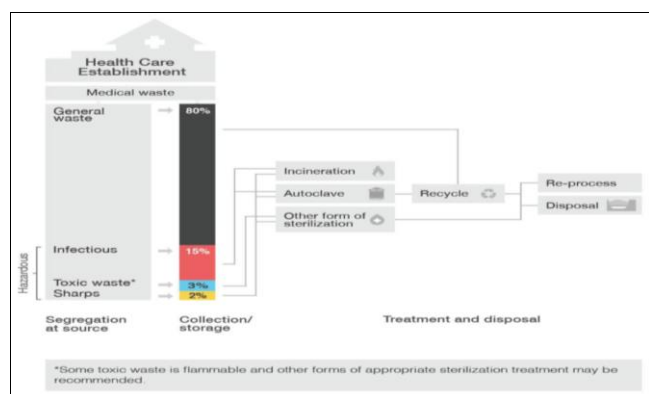
According to Pasupathi *et al.* (2011)^[49], a hospital is an institution that is visited by people of all nationalities, without any distinction of religion, race, age, or gender. It encompasses more than just the hospital's staff and patients. All these individuals contribute to the generation of waste, and with the advancement of modern knowledge, there is an increase in both the quantity and variety of waste produced, which has negative effects. This waste is not only hazardous for patients and hospital staff but also poses a serious threat to the community and the environment.

Healthcare waste can be defined as the disposal of any equipment or human infectious agent that may cause illness or disease in humans. *Histoplasma capsulatum* can serve as an example of a human illness or disease agent. Healthcare waste is a major

concern because it not only contains dangerous toxic pollutants like chlorinated plastics, solvents, and mercury, but also various toxic components not typically found in household waste (Omofunmi *et al.*, 2016)^[47]. Hospitals are designed primarily to provide patient care facilities to the general public. Therefore, it is the core responsibility of hospital management and other healthcare institutions to safeguard community health. These institutions can achieve this goal directly by providing healthcare services to patients and indirectly by maintaining a healthy and clean environment for their staff and the public. Throughout the healthcare process, a significant amount of waste is generated, including human body tissues or different body parts, sharp materials, and other infectious items (Kargar *et al.*, 2020)^[27].

According to Thakur and Sharma (2021)^[56], medical waste management is a vital component of infection control and hygiene assurance within healthcare institutions. Proper waste management plays a key role in effectively controlling healthcare-associated infections, thereby streamlining all activities within an institution. Staff in hospitals who are directly or indirectly involved in waste management and fail to handle it appropriately are at risk of infection or injury. This includes sanitation staff, those responsible for maintaining hospital waste, doctors, nurses, and other personnel engaged in waste-related activities. Similarly, patients undergoing treatment in hospitals, their attendants, and the general community are also exposed to hazards from improperly managed medical waste.

The study of Khalid *et al.* (2021)^[30] indicates that in Pakistan, healthcare centers produce around 2 kg of waste per bed per day, of which 0.1-0.5 kg may be harmful. However, mishandling occurs at all stages, from collection to final disposal. Apart from mismanagement at the source of waste production, improper disposal like open dumping can lead to waste being collected by scavengers, who then sell these items to dealers for resale and recycling. The World Health Organization (WHO) has recommended standard multi-chambered incinerators for proper treatment of healthcare waste. However, in countries like Pakistan and many other developing nations, incinerators often have primary and secondary combustion chambers. These high-temperature burners require substantial amounts of fossil fuels to achieve the necessary temperature control and duration in these chambers. While incineration is globally considered the ultimate solution for medical waste, inappropriate burning can have hazardous impacts on community health, such as causing cancer in populations residing near incineration sites and affecting the sex ratio in childbirth.



In Pakistan, like many other developing countries, proper management of healthcare-related waste is frequently overlooked (Mokhtar *et al.*, 2018)^[43]. The existing practices in place are inadequate in addressing this issue. Hospital waste materials and items are still being manually handled and disposed of alongside regular household waste. This situation poses significant health risks to municipal staff, the community, and the environment. To effectively address this concern, it is imperative to implement comprehensive segregation and disposal methods for hospital waste, starting at the initial stages. Despite the regular dissemination of information about the harmful implications of this waste through electronic media, the authorities in Pakistan have not yet succeeded in adequately addressing the challenges associated with hospital waste.

Ayub Medical Complex is situated in district Abbottabad KPK Pakistan. AMC is territorial hospital and considered in top hospitals of KPK, having above 1350 beds with 30 wards/units and above 3500 employees (1600 doctors). A large number of patients from northern areas (GB), AJK, district Kohistan and from the different areas of KPK and whole Pakistan as well visits ATH for treatment, about 1.2 million annually according to Ayub Medical Institution annual report of 2021. This study will investigate the waste management practices in Ayub Medical Complex Abbottabad KPK, Pakistan.

The core objective of study work is to investigate current waste management practices in Ayub Teaching Hospital Abbottabad. Some specific objectives are: To investigate waste management practices in Ayub Teaching Hospital Abbottabad? To investigate any procedures or regulations and the extent to which they are followed in Healthcare Waste Management at Ayub Medical Complex Abbottabad. To examine the obstacles and difficulties which the hospital faces in managing wastes.

Various research questions are explicated to achieve the research objectives are as: How does Ayub Teaching Hospital waste produced during healthcare activities? Is there any documented policy or regulation concerning to hospital waste management at Ayub Teaching Hospital? What type of issues/obstacles does AHT's staff face in managing hospital waste?

The study was deemed necessary due to the severe impact of improper waste treatment and management on healthcare services. Medical waste management is a critical concern in Pakistan and other developing countries, where hospital-generated medical waste is inadequately handled (Ali *et al.*, 2017)^[8]. Despite this evident issue, there has been a lack of comprehensive experimental studies in the field of healthcare waste management (HWM). The Ayub Medical Complex (AMC) was chosen as the focal point of investigation, as it generates a substantial amount of waste, yet no prior research has addressed waste management within the institution. The matter of proper waste management at AMC has received limited attention in scholarly studies.

Literature Review

The literature review of this research study is divided into different parts. The first part starts with some definitions related to medical waste and its types to understand the concept of HWM more broadly. In second part of literature review practices of HWM globally are discussed. Hospital waste generation, its management in Pakistan, the grounds

for HWM practices failure, and developing steps taken by Gov't of Pakistan for a better arrangement of HWM in Pakistan are discussed in the third phase. The next phase of the study discussed the hospital waste arrangements i.e. its segregation, handling, storage, relevant staff training, and disposal and dumping. The fifth and final part of the study is related to the Pakistan healthcare waste management (HWM) law and regulations.

Healthcare Waste Classification/Type

Classification of healthcare waste can be done upon its function or effects or its sources of generation of waste as under:

General or Non-Hazardous Waste

As name suggests that in this type of waste do not have any harmful or negative effect of human health or environment and don't need any particular or systemic pattern in its handling. This type of the waste is generally produced by patients in the hospital out patients day (OPD), wards, emergency section, offices, house room, kitchens etc. (Tfaily & Moussa, 2020) [55].

Hazardous or Harmful Waste

According to Manzoor and Sharma (2019) [41] report the hazardous waste is only 10% to 25% to the total waste generated in healthcare institutes. Harmful waste usually generated in laboratories, blood banks, operation theatres (OT), labor wards, etc. in form of infectious, chemical, sharps and pathological waste, separately discussed as under.

Infectious Waste

Infectious waste is that kind of hazardous waste which may have microorganism and pathogens i.e. various etc. or as a source of its production which leads to different diseases public or badly effects the environment (Sharma & Gupta, 2017) [52].

This hazardous waste contains patients body fluids that may cause infections and can cause for a serious diseases, because this nfectious iwaste consist of stocks infectious and microbial cultures agents from laboratories (Zand, & Heir., 2021) [61].

Sharps

Tesfahun *et al.* (2016) [53] observed that sharps wastes are usually considered very hazardous because it can directly cause of cuts or wounds to humans. Sharps include scalpels, knives, needles, saws, broken glass and other blades used in operations etc. It is observed that negligence in handling sharps waste results in serious injuries to humans or animals as well.

Pathological Waste

This type of hazardous waste is generated in healthcare institute's operation theaters (OT) and surgical units or wards in form blood, human body tissues, or any other surgery waste, body parts used during medical procedures, and even animal organs, body parts, tissues etc., that are used in medical research (Mosquera *et al.*, 2014) [44].

Chemical Waste

According to Chartier (2014) [16] chemical waste is harmful or hazardous when it became reactive, flammable, corrosive, toxic, and in this type of hazardous waste contains chemicals like liquid, solid and gaseous produced in process of experimental or diagnostic activates or housekeeping or cleaning or sterilization.

Pharmaceutical Waste

Malekahmadi and Yunesian (2014) [39] studied that in this type of hazardous waste discarded mistrials or items like vials, connecting tube, and bottles etc. which are used in arranging medicine. Pharmaceuticals waste includes unused, expired, contaminated or spilt pharmaceutical drugs, vaccines and other products.

Radioactive Waste

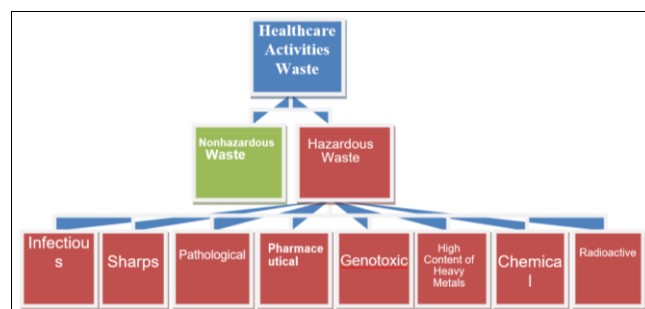
Radioactive waste is very danger to human health, patients and staff may be affected badly from hospital's laboratory from these radiations. This category of hazardous waste contains radioactive material like liquids, gases, and solids that badly affects human health (Alves *et al.*, 2014) [10].

Waste with High Contents of Heavy Metals

According to Fu and Wang (2011) [20], waste with high contents of heavy metals is a sub-category of chemical waste; however, it is handled separately. This category includes waste containing mercury or cadmium from manometers or thermometers, which can have adverse effects on human health.

Genotoxic Waste

Ghasemi *et al.* (2014) studied that geno-toxic waste is a very harmful waste, patients who are treated with cytostatic, radioactive or chemicals materials are causing diseases like vomit, faeces or urine. In this waste materials exist that may cause for carcinogenic, teratogenic etc.



Source: Mosquera *et al.*, 2014

Fig 1: Healthcare waste Classification

Impacts of Healthcare Waste on Health and Environmental

According to the study of Alabi *et al.* (2019) [4] since some decades, change in human life and its activities i.e. lifestyle and usage habits gave birth to the production of a heavy and various kinds of waste. Consequently, this high volume waste in various forms is not alarming for humans and other living beings but many other natural resources which are key necessary for human life.

Healthcare waste has a large part of infectious waste and ultimately dangerous because of having pathogenic microorganism. This dangerous microorganism may anti-treatment because of possessing high pathogen or capable of disease. inappropriate waste handling and management produce unhealthy atmosphere for all living being in form of annoying smell, growth of insects, worms, rodents, mosquito etc. likewise this also cause of different diseases like hepatitis b and hepatitis c, human immunodeficiency virus (HIV), typhoid etc. through sharps material polluted with human blood. The proper management of the healthcare waste is an emerging problem which is boosted by lack of financial resources, awareness and training

(Kenny & Priyadarshini, 2021) [28].

According to Adane (2019) [2], 75% of healthcare activities waste is non-risky and same like domestic waste but the remaining 25% is risky and harmful because it can be toxic or infectious, or irradiated. Estimates shows that from healthcare hazardous wastes up to 20% is infectious waste, sharp genotoxic, heavy metals all covers about 2% and pharmaceuticals and chemicals covers 4% represent rest risky hazardous waste.

Plastic waste were generated in a large amount in form of sharps plastic, blood bags, IV bags, tubing, medical packaging and cafeteria plastic etc. In hospital the main source of plastic generation were laboratories, OTs, wards, emergency units, cafeterias and OPDs (Latan *et al.*, 2018) [37].

Exposure of healthcare waste may cause to injury or disease. All worker and patients particularly the healthcare worker i.e. doctors, laboratory technicians, nurses, sanitation staff etc. exposed to such waste are possibly at danger. Waste care staff working in wards or units in healthcare centers while handling waste like blood or in laboratory or so must be follow precautionary measures to remain safe from the transmission of Hepatitis-B, C and other diseases. Healthcare institutions staff frequently reported with different Transmissible diseases and particularly the Hepatitis-B rate is 4 four to eight percent higher than normal (Govender *et al.*, 2018) [23].

A study by Wei *et al.* (2021) [58] described that properly not controlled and monitored, technologies used in diagnostic practices release different type of radioactive particles in air, most of them travel to high and goes other areas, spread pollution in air which result cause of different diseases on inhabited areas.

According to World Health Organization report (2018) [60] proper arrangement of healthcare waste should be given before this waste creates hazards to community health and environment. healthcare waste is generated in different healthcare centers i.e. hospitals, laboratories, clinics, etc. and dangers waste like plasters, swabs, discarded syringe needles and other infectious waste are usually disposed of in a similar manners with non-hazardous waste. If hospital waste do not manage properly from its segregation to its final disposal at all level, it can cause different diseases like blood infections, eyes, Parasitic infections, Meningitis, Skin infections, Candida, Bacteremia, HIV, Lung Infections and Hepatitis B, Hepatitis C and different wounds infecting from sharps etc.

Operationalization of Variables

According to Hossain *et al.* (2013) [26] the ideal healthcare waste management practices averts by controlling and limiting the production of wastes. In healthcare waste management following practices are observed:

Segregation

A study by Musa *et al.* (2023) [45], elaborated the meaning of segregation is to divide in to specific categories. However, waste segregation can be defined as the process of splitting of or categorizations of waste. Medical waste is commonly spited of or segregated into colour-coded waste bins or bags. This must take vicinity, where the waste is created. For an appropriate and economical way for segregation of all different type of wastes proper segregation guidelines must be follow. So, there must be an efficient and stronger segregation system with a nominated place for its storage. To

make simple the process of segregation strategy like color of medical waste must be follow to while categorization or segregation of waste (Alhadlaq, 2014) [5].

Healthcare Waste Containers Labeling

All categories of healthcare waste must be labeled for separate identification. For example hazard waste assembled in a red bag labeled with the international symbol used for hazards waste or with the words "Hazards Waste". Where labeling is for easy identification of waste at the same time it also protects irrelevant individuals to touch those (Alabi *et al.*, 2019) [4].

Healthcare Waste Storing

Latan *et al.* (2018) [37] depicts that the meaning of storage of waste is retaining the waste in safe custody until it's far treated on-site or transported off-site for its disposal or treatment. For keeping the storage of waste multiple options can be used i.e. different bags, containers, tanks and totes, dumpsters, sharps containers etc. Administration authority can fix a specified time for the storage of waste according to their requirements.

Healthcare Waste Transportation

According to Alabi *et al.* (2019) [4] for the treatment of waste healthcare institutes can use two paths for transportation of waste: Some institutes can hire a private contractors for haul away the waste. Some institutes where huge amount of waste are generated they may have own transportation system especially for off-site process.

Healthcare Waste Disposal and Treatment

Alhadlaq (2014) [5] studied that with regard to healthcare hazardous waste treatment means "any technique, approach, process or method adopted to convert the biological composition or form or nature of waste to nonhazardous waste". It is key to make preliminary approaches minimum price, easy and simple to enforce, focusing the crucial issues. Furthermore, healthcare waste handling can be accomplished through processes such as treatment, the reclamation of valuable materials, and the alteration of its inherent nature or properties. These measures aim to mitigate risks, enhance environmental friendliness, and ultimately improve overall safety.

Healthcare Waste Handling

The process of moving healthcare waste between the place of its production, amassment locations, on-site treatment and area of its storage is called Handling waste. The staffs who are involved in the process of healthcare waste handling must follow all standards precauseries measures in whole process (Kulkarni & Anantharama, 2020) [33].

Alternative Treatment for Infectious Healthcare Waste

According to Ali *et al.* (2017) [8] in many developing countries like Pakistan commonly used methods and practices for the disposal and treatment of hazardous hospital wastes are: Microwave methods for disinfection, Retorts and autoclaves, Incineration, Land disposal i.e. controlled filling land, site dumping, sanitary and pits filling land and Chemical etc.

Healthcare Waste Management globally an Overview

Reno (2015) studied that due to hazardous and harmful effects of healthcare waste global research interest in this area is growing day by day. In last few years a number of research work have been divulged for better arrangement of healthcare waste management like HCWM generation, modern technologies for proper disposal of waste, models

for evaluating healthcare waste management, HCWM practices and policies etc. such research work can be found particularly in journals concerning like waste management and atmosphere protection like 'The Journal of Waste Management & Research' and "International Journal of Environment and Waste Management" etc. (Latan *et al.*, 2018) [37]. During recent years particularly after Covid-19 globally many conversations in form of conferences etc. are held, on the agenda of environmental protection and better healthcare activities for developing healthcare institutions greener and safer for public. According to Kulkarni and Anantharama, (2020) [33] many steps have taken on international level like Healthcare Without Harm (HWH), Global Healthy and Green Hospitals and etc. with aim to observe the healthcare centers system in respect of reducing costs and waste generated from these institutes effect the community and environment.

In spite of these developments of handling healthcare wastes it is also observed by researchers that in many countries the regulatory control or policy framework is lacking yet. In many developing countries of world healthcare sector have no even a fundamental system of waste segregation due to primitive practices, and for the disposal of waste these countries does not have option or if it exist are outdated and risky. Furthermore, different studies literature review shows that developing countries in the area related to HCWM the staff involved in the healthcare waste activities are uninformed and untrained (Caniato *et al.*, 2015; Ananth *et al.*, 2010) [15, 11].

The disposal of medical waste from healthcare institutes is also major issue because it is still unsolved question that who have final and endmost duty to manage the healthcare's produced waste (Ananth *et al.* 2010) [11]. These issues got strengthen in the findings of a research study conducted in 2015 about south asian 10 countries, where recommendations were given by researcher that there is immediate need to change the mind set of policy makers, healthcare staff (sanitation staff, doctors, nurses etc.), funders, stakeholders, etc. Mainly three sectors were suggested to support for healthcare institution facilities and state governments: Knowledge management and use of technology to handle waste, advocate budgeting and proper and effective legislation and policies framework for whole healthcare waste process (Caniato *et al.*, 2015) [15].

Healthcare Waste Generation in Neighbor Countries

In a study by Hasan and Rahman (2018) [24] in Chittagong Medical College Hospital, Bangladesh observed that in a day total from 2650 k.g healthcare waste 0.57 k.g/bed/day, 0.36 k.g/bed/day was non-hazardous and the rest of waste 0.21 k.g/bed/day was harmful which was positively correlated with total beds in CMCH Bangladesh. Khoshbeen *et al.* (2019) [32] studies that in Afghanistan in public hospitals the mean of Healthcare waste generation rate per unit was varied form 0.31 kg form per day and per bed to 0.682 kg/day/bed.

Kumar *et al.* (2017) [35] studied 15 different public hospital of district New Delhi and observed that in India average healthcare waste production rate was 2.15 kg on single bed in a single day. In all surveyed healthcare institutes the production of hazardous waste rate was 0.96 and 1.19 was nonhazardous.

In a study conducted by Eslami *et al.* (2017) [19] 20 healthcare institutes of Iran were observed and depicted that

the production rate of waste was 45.2% general waste, 51.5% was infectious in nature and remaining 3.3% was sharps waste.

Healthcare Waste Generation in Pakistan

The production of healthcare waste in Pakistan is growing in its quantity and kind. A study by Kumar *et al.* (2015) [34] depicts that by analyzing few past years it can be observed that due to alarming soar in population of Pakistan, healthcare institutes i.e. hospitals etc. medical services centers, the use of disposable healthcare product and medical facilities has increased which reflects huge production of waste as well. So, in Pakistan the proper arrangement of healthcare waste is become a serious issue and need a solution in a systematic manner. The administrative/governmental structure of Pakistan is based on four provinces i.e. Punjab, Khyber Pakhtunkhwa, Baluchistan, Sindh plus Capital Territory Islamabad. Moreover, two reigns are under administration i.e. Gilgit-Baltistan, Azad Jammu and Kashmir (Pakistan Administered Kashmir). Like other Asian and developing countries before last decade healthcare waste was usually mix or handled with home generated waste and discarded with municipal solid waste. Literature shows that in some recent years, govt of Pakistan took steps for the better arrangements of healthcare waste. According to Ali *et al.* (2016) [7] different Governments of Pakistan formed successive policy framework at provincial and federal level to handle the healthcare waste according the WHO standards. Hospital Waste Management Rules-2005, Punjab Hospital Waste Management Rules-2014, Rules for Hospital Waste Management Khyber Pakhtunkhawa, Environmental Protection Act-2014, the Sindh Hospital Waste Management Rules-2014 are the examples of effect by the governments of Pakistan (Nasir *et al.*, 2016) [46]. In spite of these efforts by Govt of Pakistan, still the in the areas of healthcare waste management more practical measures are the need of the day to safeguard the public and environment and to meet the international standards of healthcare waste management (Masood & Barlow, 2013) [42].

HCWM Failure in Pakistan Reasons

In a study Ali *et al.* (2019) [6] describe that if systematically see the reasons of failure of proper management of HCW in Pakistan it includes multiple aspect: Inadequate human and financial resources, Insufficient trained staff to handle the waste, Unsuitable management to handle waste, Lack of priority or pre-eminence to topic and Lack of awareness and recognition of hazardous waste produced during healthcare activities.

The above-mentioned list acts as the basic reasons for failure of management of healthcare waste in Pakistan. Like many other developing countries in Pakistan there is no relevant or suitable mechanism in form of regulation, if exist, have no worth because of non-applicability or not according to tradition or nature of nationals. As per the principle of "polluter pays" the ultimate responsibility or duty of proper handling of waste produced in healthcare activities from its segregation to disposal lies to its producer, or the other institutes involved in these related activities (Kulkarni & Anantharama, 2020) [33].

Proposed Hypotheses

H1: Container and segregation facilities for of ATH are up to the mark.

- H2:** Transportation facilities for of ATH are up to the mark.
- H3:** Waste storing facilities for of ATH are up to the mark.
- H4:** Disposal and treatment facilities for of ATH are up to the mark.
- H5:** Training facilities for support staff of ATH are up to the mark.

Methodology

This research work was done in Ayub Teaching Hospital, Abbottabad to investigate the hospital waste management practices. Ayub Teaching Hospital is satiated in city Abbottabad Khyber Pakhtunkhwa, and includes 29 different wards and units to provide healthcare activities. Patients visits AMC not only from Hazara region but comes from whole province and Pakistan as well. Being a governmental Institute AMC have many departments for healthcare services to the public i.e. the casualty ward, the minor major operating OTs, Wards, a big maternity unit, X-ray, blood banks and laboratories etc.

Conceptual Framework

Fundamentally the purpose of study is to investigate the hospital waste practices at AMC. So, to find the answers of many study questions this part of study discusses the overall conceptual framework for gathering related data. This part of the study will also elaborate dependent variable and independent variables of the research. The dependent variable of the study is hospital waste management practice. Whereas, five main independent variables that will effect investigation in HWMP in AMC are: Containers & Segregation, transportation mode, storage zone/areas, disposal & treatment and training facilities waste management in AMC Abbottabad. Composition and quantity of waste produced during healthcare activities have a significant effect on waste management practices. Method, Place, and period of training have an impact on the hospital waste management practices. Segregation of waste on spot or later on can may have also important role as applicable ways for handling hospital waste. Lack of suitable containers and storage areas may also effects the waste management. Similarly, proper transportation and final disposal mainly effects the proper management of hospital waste. Likewise, proper occupational health and safety to relevant employee has also vital to affect the HWMP. Proper Policy and regulations framework is also key factor to affect the hospital waste management practices.

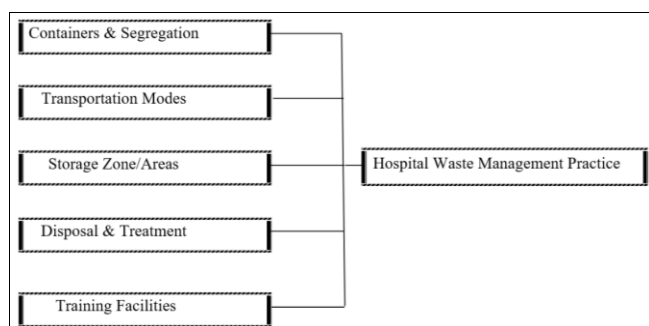


Fig 2: Conceptual Framework (Barr et al., 2001) [14]

Research Design

This study would be quantitative and descriptive cross-sectional in nature to examine the waste management practices of Ayub Teaching Hospital Abbottabad.

Questionnaire will be used for data collection form healthcare staff i.e. doctors, nurses, pharmacists, laboratory technician and cleaner. Whereas, the aim of secondary data is to ensure the precision of findings and to provide a clear picture of the current waste management practices at ATH.

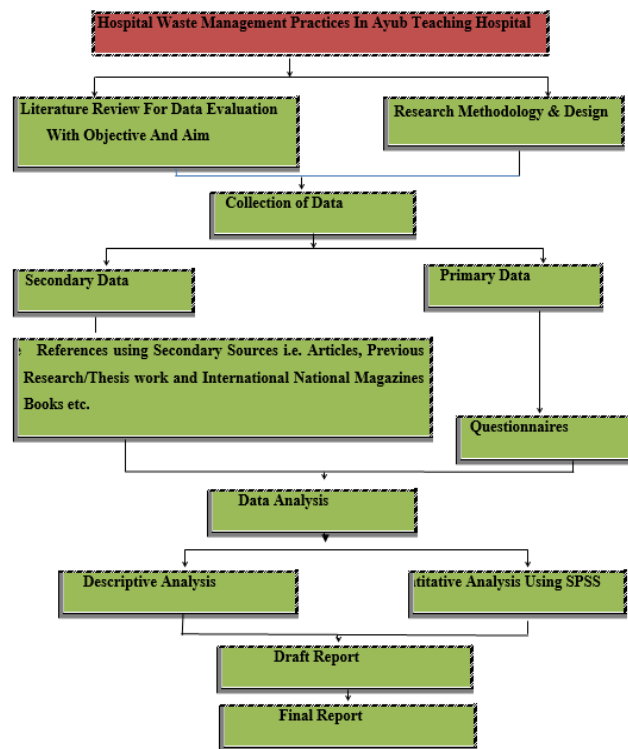


Fig 3: Research Study Design

Population

William (2007) [59] intuited in research, the term population denotes to the subjects and members who are being studied. Total population of study comprises of 1225 members, divided into two groups: 1. Doctors (650), nursing staff (180), and support staff (45). 2. Sanitation staff (350).

Research Sample

Sampling Technique

Convenience sampling technique was used for the collection data. Since this study is performed for the purpose of degree, the scholar was strapped with time and finance resources. Participants/respondents selection was done conveniently from targeted staff of ATH for evading selection bias.

Data Collection

For data collection, two approaches are used: Primary and secondary data. Primary data denotes the collection of research data from the field, and secondary data pertains to the review of literature, including journals, reports, etc. Both types of data were gathered by the researcher to conduct this study.

Primary Data

The researcher personally collected the data from the staff involved in HCWMP in Ayub Teaching Hospital, Abbottabad by using self-administered questionnaires. These questionnaires' were served randomly to the different departments wards and workers etc. involved in waste management practices in AMC. These questionnaires' contained variety of subjects i.e. hospital waste evaluation,

collection, segregation, storage, transportation, training, and safety etc. Questionnaires were spitted into eight main parts. First part contained demographic data about respondents/workers i.e. name, age, gender, education level, field of work, departments', experiences, working hour and knowledge etc. In 2nd part composition of hospital waste and its types were asked. From third part of questionnaires basic theme of the study was carried out, in which data about segregation and containers were gathered. This part of questionnaires was expectation of segregation of waste, containers monitoring and sacks condition. Next part of questionnaires was for the collection of hospital waste. Part five asked about the transportation of waste. While in part six, information was asked about storage of waste i.e. place inside hospital and its aptness. In part seven, information was asked concerning about the occupational safety and health of staff involved in waste handling practices i.e. protective uniforms, gloves uses and vaccination etc. In final part of questionnaires questions were about the tanning of staff, wheatear the respondents got training about waste management or not, palace and duration of tanning.

Validity of Research Questionnaire

Validity ensures that the complete scope of the issue is covered, and that the measurement device does as well (Long, 2014). Researcher got data himself by using such questionnaires' and it were discussed with experts from Department of Management Sciences, The University of Haripur and expert researchers of ATH, many time for validating it and revamped to observe all interested factors. They put some observations. These observations were removed, tools were refined and opinion and suggestions were incorporated accordingly.

Secondary Data

The collection of secondary data was accomplished by studying various journals and other available documents.

Data Analysis

Questionnaires were checked very carefully to revamp and to avoid any incomplete questions or answers. The data entry and analysis was done by using SPSS program. After first step of collection of data, in second phase for coding questionnaires SPSS program version 22.0 was used, by entering coded questions into computer. After filtering data study variables were numerically coded. The descriptive statistics was including statistical analysis. Descriptive analysis was used to process incomplete raw data in a way that makes its interpretation and understanding easier. In this research, descriptive statistical tests were used to calculate the percentage of data.

Study Period

The collection data for study commenced in 09/02/2023 and accomplished at the 25/03/2023. Data entry was done at 15/04/2023, then data analysis and final report writing done till 01/05/2023.

Ethical Consideration

Before starting the study in ATH proper approval form the authority was sought by the researcher. The researcher made aware the AMC authority and respondents regarding this study that: The research work is totally for academic purposes and Gathered data will be used confidentially.

Results and Discussions

In this section of study, results and discussion are highlighted from the data compiled with questionnaires. About 300 questionnaires were distributed among respondents/participants. Among which 250 were completed by them (178 from healthcare staff and 78 from sanitation staff of AMC). On the other hand to conduct an appropriate results maximum journals and related documents were also studied. The data and analysis of this study revealed that in Pakistan HWP are still need to many improvements almost in all phases from generation to its last disposal, because negligence in this sector will not only cause harmful outcomes for human being but for environment also. Similar results are found in many other studies conducted on HWMP by different researchers. Hospital waste produced during healthcare activities, if mishandle in any phase will cause negatively. For example if HW has mishandled in it generation and didn't segregated according to proper mechanism may started its hazardous effects form the same place by injuring healthcare staff or infecting staff or patient nearby them (Tiwan *et al.*, 2009). Amassed data from the staff of different wards, departments and sections and later on its analysis divulged following drawbacks in the practices of hospital waste management of ATH:

Participants Demographic info

Table sum ups the socio demographic distribution of participants/respondents. This research work includes a total size of sample of 248, having 170 healthcare workers/officials and 78 sanitation workers.

Table 1: Participants Distribution on Socio-Demographic Segments

Participants Distribution On Socio-Demographic Segments		
Gender/sex	Male	177(71.5%)
	Female	71(28.5%)
Age group	(19-29) years	50(20.3%)
	(30-39) years	120(48.3%)
	(40-50) years	46(18.5%)
	(50) years	32(12.9%)
Education level	No Schooling	24(9.6%)
	Certificates/Diploma	45(18.1%)
	Graduate/Degree	94(37.9%)
Duty hours	Above	42(16.9%)
	(06) hours	41(16.5%)
	(07) hours	51(20.5%)
	(08) hours	156(63.0%)

Table 1 indicates that Male workers/officials were in majority i.e. 177(71.3%), whereas female workers/officials were 71(28.6%) in samples. Table 1 highlights in education section respondents built on age group indicate that 50(20.1%) of participants were in 19-29 years, 120(48.3%) were between 30-39 years those were on highest in numbers, in 40-50 years 46(18.5%) and above 50 years were 32 (12.9%), these figures shows that major portion of young workers were involved in managing hospital waste at ATH. Education level results shows that major numbers of workers were bachelor degree holders having total score 94(37.9%). Table 1 show in education level section on 2nd position was diploma holders having 45(18.1%) and the lowest numbers were uneducated staff of 24(9.9%) at ATH.

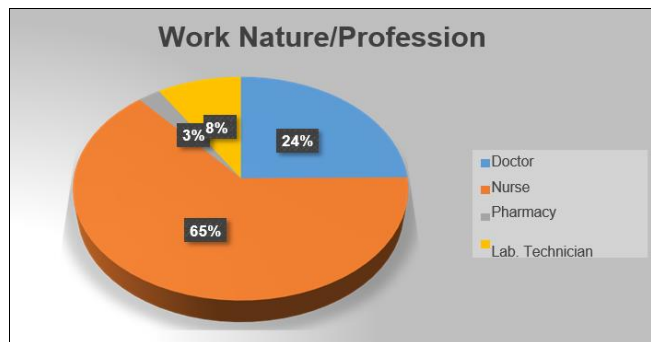


Fig 4: Work Field /Profession

Figure indicates that in sampling officials/staff nurses were in maximum numbers 112(65.1%), doctors were on 2nd position 42(24.4%), whereas laboratory technicians were on 3rd number by 15(8.7%) and pharmacy workers were least in sample size with 4(2.3%).

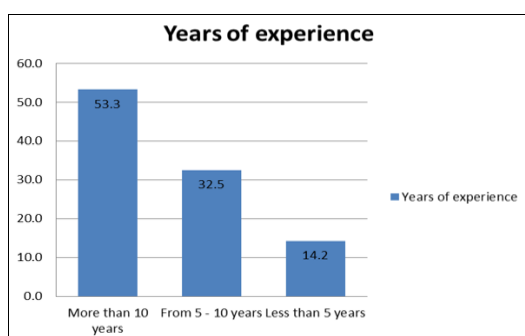


Fig 5: Work Experience in Years

Fig 5 shows healthcare workers 91 (53.3%) from sample have above 10 years of work experience, 56 (32.5%) have in range of 5-10 years while remaining staff has less than 05 years of experience.

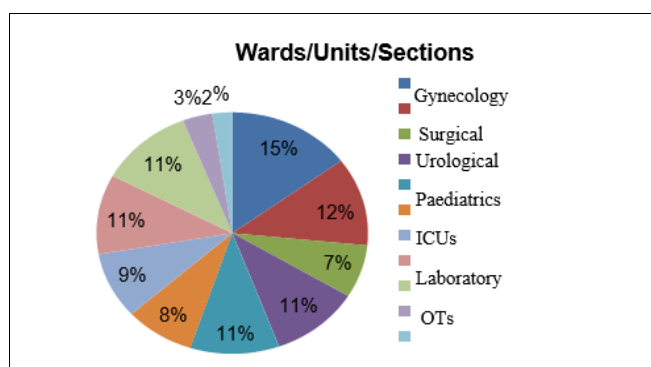


Fig 6: Wards/Units/Sections/ Departments

Figure shows that in sample following Wards/Units/Sections/ Departments are included as Gynecology Department, Surgical wards, Medicine wards, Urology ward, Peads unit, Intensive care units, Laboratories, Operations theatre, Emergency section, Radiological section and Pharmacy. Gyne wards are on top with 26 (14.8%)

whereas Pharmacy was on lowest level with 4 (2.3%).

Hospital Waste Composition and Quantities

Table indicates different kinds based on nature of healthcare waste in produced in Ayub Teaching Hospital during routine healthcare from activates.

Table 2: Categories of Hospital Waste Produced Daily at ATH

Categories of Waste Produced at ATH	
General waste	170(100.0%)
Sharp waste	141(81.8%)
Pathological waste	111(64.5%)
Infectious waste	136(79%)
Pharmaceutical waste	53(30.8%)
Chemical waste	37(21.5%)
Pressurized containers	36(20.9%)
Radioactive waste	0.0(0.0%)

Sample participants pointed out the General waste produced in ATH with 170(100%), sharps waste by 141(81.8%), pathological waste by 111(64.5%) and infectious waste by 136(79%) respectively on huge quantity. Hospital wastes other kind's i.e. pharmaceutical, chemical, pressurized containers and radioactive are also produced during healthcare activates but in low quantities. A study research conducted in Bangladesh with same theme results that non-harmful hospital waste, harmful waste, sharps and needles are major forms of produced hospital wastes in surveyed healthcare institutions (Uddin *et al.*, 2014) [57].

On other hand, the quantity/amount of hospital waste production is not identified due to having no record generated by relevant department. Nevertheless, a research conducted on similar topic in Ayub Teaching Hospital April 2015 showed results hospital waste generated from one bed in Ayub Teaching Hospital is 1.78 kg per day, are harmful/infectious in nature (Manan, 2015) [40]. However, literature shows that infectious harmful waste is 10–25% of total production of waste, which lies in range of Ayub Teaching Hospital (Khalid *et al.*, 2021) [30].

Noteworthy, in Ayub Teaching Hospital normal or general waste is waste in huge quantity because the inpatient's attendants and families bring food and other meal times form home and dumped in the boskets lying with patient's bed. Also, Ayub Teaching Hospital remains open to provide healthcare activities day night patients, who bring foodstuff in hospitals.

Another reason of big amount of general waste is the employee and staff working in Ayub Teaching Hospital is high which boosts the overall waste production. Alabi *et al.* (2019) [4], in study explained the outpatients of emergency generate 100g waste, in which 23% is infectious waste, while waste generate in external clinics or centers outpatients may 80g of waste with 11% is infectious. Such amount of waste justified and sustained in clinics and centers because there patients comes for short time only to checkup and produce less percentage of waste.

Segregation and Containers

Table 3: Summaries the Segregation Practices of Hospital Waste in Ayub Teaching Hospital

Segregation practices at hospital waste at ATH		
Each ward/Dept/unit separates Hospital waste?	Yes	55(31.9%)
	No	98 (56.9%)
	I do not know	18(11.4%)
Hospital waste is separated from general waste?	Yes	59(34.3%)
	No	94(55.6%)
	I do not know	19(11.0%)
Hospital wastes are identified and its containers are distinguished from general waste?	Yes	60(34.8%)
	No	66(38.3%)
	I do not know	46(26.7%)
Bags and containers are available to each Dept/ward/unit in sufficient quantity?	Yes	98(56.9%)
	No	41(23.8%)
	I do not know	33(19.1%)
Bags and containers conforms color codes?	Yes	29(16.8%)
	No	111(64.5%)
	I do not know	32(18.6%)
The produced waste is stored considering color code?	Yes	54(31.3%)
	No	84(48.8%)
	I do not know	34(19.7%)

Table 3 shows 55(31.9%) of participants highlighted that hospital waste segregated by every wards/deptt/section/unit in ATH, while 98 (56.9%) stated that no separation of waste exist in hospital, and 18 (11.4%) respondents fill questionnaires with the option i do not know. It contains the two reasons: First one is lack of particular criteria and second is two different nature sanitation staffs are handling waste (hospital own regular sanitation staff and private company staff). A number of respondents denied the segregation of waste which shows an alarming position in ATH.

Analysis shown in Table 3, elaborate sometime waste segregation has not done properly and both type of waste i.e. hazardous and general are handled in similar way. Because of handling harmful waste with general waste, which is not harmful in nature, makes this general waste as harmful to human being and nature (Ananth *et al.*, 2010)^[11]. Table 3 of data analysis section shows majority Color bags are used to carry waste separately according to the nature and effects.

But in ATH without any discrimination bags and dust bins are used to carry all type of waste in same one.

About 59 (34.3%) from participants replied that waste produced during healthcare activities are segregated. On the other hand 94 (55.6%) respondents divulge denied about the any separation of waste, and 11 (11.0%) say that they do know whether the waste is separated or not. This is because of the institute did not communicate any particular criteria to staff about the separation of hospital waste.

Table shows that 29 (16.8%) participants stated the color of bags and containers provided by institute are according to color code specified by World Health Organization, ISO 14000 and Hospital Waste Management Rules 2005 Pakistan. But 111(64.5%) respondents marked the option of no and remaining 32(18.6%) ticked on do not know. This shows the real situation at ATH that no real application of WHO standards particularly in usage of colored containers and or bags.

Table 4: Segregation of Hospital Waste Practice in ATH for Sanitation Staff

Segregation of Hospital waste practice in ATH for Sanitation Staff		
Containers & Bags are in all locations that can Produce hospital waste?	Yes	55(70.5%)
	No	13 (16.6%)
	I do not know	10(12.8%)
Sharps are carried separately in these bags or containers?	Yes	65(83.3%)
	No	8(10.2%)
	I do not know	5(6.4%)
Bags or containers are different for different wastes?	Yes	37(47.4%)
	No	38(47.4%)
	I do not know	3(3.8%)

Table 5: Transportation of hospital waste in ATH for Sanitation Staff

Transportation of Hospital waste in ATH		
Trolley used for transportation are washed and sanitized daily?	Yes	60(76.9%)
	No	4(5.1%)
	I do not know	14(17.9%)
If yes, who is responsible for Cleaning of trolley?	Sanitation workers themselves	60(100.0%)
Waste transportation trolleys in the hospital are appropriate with waste volume?	Yes	66(84.6%)
	No	8(10.2%)
	I do not know	4(5.1%)
Waste are transported in-side the hospital with the use of?	Trolley/ wheel barrow	78(100.0%)
Waste are transferred from the hospital to the storage area using?	Trolley/ wheel barrow	78(100.0%)

Table 4 clarified that maximum number of respondents 55(70.5%) form sanitation staff replied that bags and containers are available in each dept. /ward/section, while in similar way 65(83.3%) stated in ATH sharp waste is accumulated individually/separately with special bags and containers. As a result, H1 is rejected.

Hospital Waste Transportation Concerns

Table 5 indicate sample all participants 78(100.0%) chose option of wheel barrow/ trolley are used for inside hospital transportation and also outer side of dumping area or municipal container. Respondents 66(84.6%) from sample indicated number of transportation wheel barrows/trolleys available at ATH in appropriate quantity and commensurate with waste volume, 8(10.2%) respondents replied with answer no. While 4(5.1%) said don't know.

Research conducted in Nigeria Omofunmi (2016) [47] and Awodele *et al.* (2016) [12] (search site) stated same results that wheel barrows and trolleys are used for inside hospitals

waste transportation form the generation point to its storage area for temporary storage, similar results are described in a research study at Uganda by Kwikiriza *et al.* (2019) [36] that full bins are flattened in larger bins and transported with the help of trolleys to temporary storage areas. As a result, H3 is accepted.

Temporary Storage

The area or place in side hospital where waste is retained temporarily before sending it to final disposal area or site is called temporary storage (Pasupathi *et al.*, 2011) [49]. This storage area may be in side hospital premises or specified by authorities for purpose. Date gathered shows in Table 5 shows special Trollies/wheel-barrows are used to carry the waste form point of generation to temporary storage area. According to WHO standards temporary storage area of hospital area must be Well cleaned, sanitized and protected one and Secured and accessible for authorized persons.

Table 6: Storage Zone at ATH for Sanitation Staff

Waste storage at ATH for Sanitation worker		
Hospital waste is stored temporarily in-side ATH?	Yes	50(64.1%)
	No	21(26.9%)
	I do not know	7(8.9%)
ATH storage zone is enough in airing, easy access and lighting?	Yes	10(12.8%)
	No	64(82.05%)
	I do not know	4(5.1%)
The size of storage place in-side ATH is sufficient?	Yes	7(8.9%)
	No	71(91.1%)
For how much days it is stored in this zone? More than 03 days?	Yes	69(88.4%)
	No	11(14.1%)
Clear mark in storage zone in-side ATH specifying presence of hospital waste?	No	49(96.0%)
	I do not know	2(3.9%)
Storage area in-side ATH is authorized only to staff only? Any Record maintained by Relevant depart/section of stored waste?	Yes	24(45.2%)
	No	27(50.9%)
	I do not know	2(3.7%)
	Yes	20 (25.6%)
	No	58 (74.4%)

Table 6 confirms that 50(64.1%) of sample participants indicated that hospital waste is temporarily stored inside hospital. Respondents 21(26.9 %) selected option no and the remaining 7(8.9 %) selected option with don't know. However, in respect of appropriateness of inside hospital storage area, 64(82.05%) indicated storage zone in-side the ATH is not appropriate regarding easy access, ventilation, and lighting. It's a matter of serious thinking that maximum participants indicated that in ATH storage area in-side hospitals is not enough to store waste produced during healthcare activities and lying their above 03 days which is clear against the international standards.

Analyzed data revealed that ATH has an open place for temporary storage of waste, behind hospital building, which unsafe and unsuitable to store the hospital waste. In this storage area waste of whole hospital and also waste of college side are accumulated. The storage area at ATH being open and very near wards where patients are being treated not only effect negatively them but also effect surrounding atmosphere. According to WHO regulations, the storage duration for waste within healthcare facilities should not exceed 72 hours during winter and 48 hours in summer, specifically in cold regions. Conversely, in hot areas, the stipulated storage limits are 48 hours in winter and

24 hours in summer (WHO, 2005). A careful examination of the current conditions for transferring and storing medical waste reveals a significant disparity when compared to the established WHO guidelines. It is imperative to minimize this gap in order to enhance the safety of hospital personnel, staff, patients, and visitors. Likewise, Hospital Waste Management Rules 2005 Pakistan section 19 Waste Storage provides a complete guide line for proper storage of HW, but results show that ATH is fail to adopt such practices.

Approximately 49(96%) of sample participants indicated no clear mark is fixed on in-side ATH storage zone, while remaining 2(3.9%) stated don't know option. In Tamil Nadu, India a study by (Pasupathi *et al.*, 2011) [49] similar results are found with 93% of healthcare institutes having their own temporary storage facilities. As a result, H4 is rejected.

Likewise, Thakur and Sharma (2021) [56] stated, parallel outcomes in USA 83% healthcare institutes have temporary storage areas with equipped facilities. But these results have no similarity with local research in Islamabad by Ali *et al.* (2015) [9] which exposed that no that no distinctive storage area for hospital waste in healthcare institutes in which institutes can occasionally store harmful or hazardous type of waste.

Disposal and Treatemnt

Table 7: Disposal and Treatment of Hospital Waste at ATH

Disposal and Treatment of Hospital waste at ATH		
Incinerators facility for treatment of Healthcare waste?	Yes	5(100.0%)
Incinerators facility is inside hospital premises or outside?	Inside	5(100.0%)
After how many days is the waste incinerated?	1-5 days	3(60.0%)
	After week	2(40.0%)
Does the hospital have its own waste disposal facility?	Yes	1(20.0%)
	No	4(80.0%)
How much waste sent for its final disposal?	No record	4(80.0%)
	Record Available	1(20.0%)
Do the waste landfilled or left open?	Landfill	1(20.0%)
	Open	4(80.0%)

Table 7 indicate that all 5(100%) from the sample respondents answered that in ATH have its own Incinerators plan inside the institute. A similar results from the study conducted in Fars, Iran Tiwan *et al.* (2023) ^[54] show that 90% institutes have its own Incinerators plans inside premises for treatment of waste generated form the production of healthcare activities. Results in table show 60% responded that the treatment of infectious medical waste in incinerators plans done in 1-5 days regularly, while 40% said it's done in after week. Analysis shows relevant department is failing to prepare a periodic and proper record of waste produced in ATH at all. As a result, H5 is rejected. Table results indicate that there is no proper system exists in ATH for the disposal of waste. 80% respondents answered that hospital have no its own waste disposal system, while with same percentage respondents replied that waste are thrown openly and not disposed by landfill and have no proper record of the waste. Throwing medical waste openly is not only harmful for human being ling in surrounding areas but it also negatively affects the nature (Caniato *et al.*, 2015) ^[15].

Training and Awareness of Waste Management

Table 8: Training Regarding Hospital Waste in ATH for Sanitation Staff

Training Regarding Hospital Waste at ATH for Sanitation Staff		
Do you have knowledge about hospital waste management?	Yes	20(25.6%)
	No	58(74.3%)
Do you know capacity that hospital waste bags must filled?	Yes	29(37.1%)
	No	49(62.8%)
Did you receive any training to handle hospital waste?	Yes	7(8.9%)
	No	71(91.0%)
If yes, where training was received?	In hospital	78(100.0%)
Training duration?	01day	78(100.0%)

Table 8 show the results with regard to knowledge about hospital waste management process 58(74.3%) participants stated that they do not have knowledge about hospital waste handling whole process, and about 20(25.6%) said they have.

Table 8 show the results that 71(91.0%) of sample participants stated that they did not get any regular training to manage hospital waste, but 7(8.9%) said that they did receive training regarding the waste handling in hospital. Tables 4.11 show that 71(91.0%) sample participants said that they do not get training about hospital waste

management process. Similar results are reported in a study conducted in India by Sharma and Gupta (2017) ^[52] reported that training programs for hospital waste handling among healthcare staff, such as doctors, nurses, and technicians, were limited. According to their findings, in Himachal Pradesh, India, 81% of healthcare staff, including doctors, nurses, technicians, and other workers, had not received training in healthcare waste management.

Table 8 of study analyzed that staff involved in the practices of waste management in ATH is untrained to handle enough the waste produced in hospital and unaware from its hazardous effects. It is worth noting that dedicating adequate time to training can significantly diminish the potential for infections. Training initiatives should primarily focus on the health and safety of workers, ensuring their comprehension of potential risks associated with healthcare waste. This entails providing appropriate training to workers, along with furnishing them with the necessary equipment and protective clothing, and implementing an effective occupational health program.

Many other studies conducted in other states shows that they provide an appropriate training to their staff to handle medical waste. Results of a study by Ongondo *et al.* (2011) ^[48] are reported that in China 98% of hospital and other healthcare institutions are providing training courses to their worker regarding hospital waste. As a result, H7 is rejected. Another study conducted in Istanbul Turkey by Demirbas (2011) ^[18] indicated that systematic trainings and workshops regarding hospital waste management were arranged in all healthcare institutes as per their demands and needs in Turkey.

“Pakistan Federal Hospital Waste Management Rules 2005” section 9C emphasize proper training of all relevant parties involved in HWMP. Likewise ISO 23907 Sharps injury protection section provides HWMP training procedure, which is not seen practically enforced in ATH.

Conclusions

The recent study reveals a pressing need for significant improvements in hospital waste management within Pakistani government hospitals, including ATH. This sector has been largely neglected, with inadequate attention given to essential aspects such as waste collection, segregation, storage, disposal, and final treatment. Poor and improper practices in hospital waste management pose serious concerns for the health of healthcare staff, patients, the general public, and the environment, disrupting the balance of the ecosystem.

Waste segregation, a crucial practice for distinguishing between hazardous and non-hazardous waste, is not being observed according to established standards and rules at ATH. Both general and infectious wastes are not being properly separated. Hazardous waste is not appropriately labeled with the required "Biohazard mark." Sanitation workers, who ultimately handle the waste at ATH and similar healthcare institutions, are not equipped with proper protective measures and equipment, such as gloves, gowns, and specialized shoes. Use of a single color for bags/dustbins for all types of waste, rather than utilizing different colors based on waste nature, Occasional mixing of general waste with medical waste.

Appropriateness of inside hospital storage area, indicated storage zone in-side the ATH is not appropriate regarding easy access, ventilation, and lighting. It's is matter of

serious thinking that maximum participants indicated that in ATH storage area in-side hospitals is not enough to store waste produced during healthcare activities and lying their above 03 days which is clear against the international standards. For final disposal no proper mechanism to seen by management of ATH.

Waste generated from various sections, wards, and departments is transported to temporary storage areas and subsequently to the disposal site using wheelbarrows, trolleys, and contractor vehicles. At Ayub Teaching Hospital, the incinerator facility is located within the premises. However, there are issues with the disposal process. A private contractor is responsible for the final disposal of incinerated medical infectious waste and general waste. Unfortunately, these wastes are openly discarded at the final disposal site, raising serious concerns about environmental and public health impacts.

The research highlights the existence of two types of waste in hospitals: Medical waste and general waste. General waste originates from patients' attendants, offices, and wards, among other sources. Hazardous waste, on the other hand, results from healthcare activities and medical procedures such as dialysis, organ resection, biopsies, surgeries, deliveries, and para-medical examinations. Unfortunately, ATH lacks a proper waste quantification system due to the absence of adequate records, making it challenging for researchers to determine the exact daily waste production. There is a absence of reliable or computerized records.

Regrettably, ATH does not provide adequate training to healthcare staff, sanitation workers, and other personnel regarding proper hospital waste management and associated hazards. This lack of training extends to sanitation staff employed by private contractors.

ATH lacks a well-defined plan or policy for waste handling and management, including the procurement of necessary equipment. Although the government of Pakistan and the government of KPK have established rules and regulations based on WHO standards, compliance by the staff is not being strictly enforced. There is an absence of a dedicated committee for monitoring the whole waste management process from its birth to its final disposal in ATH.

In conclusion, the study findings clearly indicate that ATH does not adhere to the standards and recommendations set forth by WHO for hospital waste management. Certain aspects of waste management at ATH are inadequately addressed. Addressing the associated risks of healthcare waste requires urgent and substantial investment.

Recommendations

Strictly adhere to the hospital waste management standards introduced by the World Health Organization (WHO). These internationally recognized standards should be followed across all hospitals. Based on the discussion and results mentioned, several recommendations can be made to improve the hospital waste management process in all governmental hospitals of Pakistan, with a focus on Ayub Teaching Hospital (ATH).

Hospital management should organize appropriate training programs to raise awareness among healthcare staff regarding safety, health, and environmental concerns. These training sessions can take the form of on-the-job training, workshops, hands-on training, coaching, or mentoring.

Establish dedicated teams, including infection control units

and environmental health experts, along with specialists in hospital waste management. These teams will ensure the implementation of proper waste management systems in hospitals.

Emphasize the importance of segregating waste at the point of generation. Waste should be segregated immediately wherever it is produced within healthcare facilities. On-site segregation will facilitate the handling and disposal of hazardous waste, reducing health risks.

Ensure that all healthcare facilities, whether primary or secondary, have sufficient storage space for waste, typically ranging from 4 to 5 days. These storage areas should be designed with easy access, proper ventilation, and should be located away from the general public, following international standards.

Maintain accurate and up-to-date records of waste generated in different departments, units, and sections. This will help identify which areas are producing the most or least waste, aiding in targeted waste reduction strategies.

Hospital management should collaborate with all stakeholders to create clear policies and plans for the proper handling and management of waste generated during healthcare activities.

Develop a comprehensive plan for the establishment and design of sanitary landfills, specifically for hazardous infectious waste. Proper disposal sites are crucial for preventing environmental contamination.

Allocate sufficient funds from the regular budget of healthcare institutions for the management of hospital waste. A dedicated budget will ensure that waste management processes receive the necessary resources.

By implementing these recommendations, ATH and other healthcare institutions in Pakistan can enhance their operating efficiency for handling and managing waste generated during healthcare activities. It is important to ensure that these recommendations are adapted to local contexts and regulations, and that continuous monitoring and evaluation take place to track their effectiveness.

Study Implication

The study will be beneficial for all stakeholders, decision-makers, and policymakers involved in the handling and proper management of hazardous waste generated by ATH. However, this study is important to assess and improve management systems and to increase public awareness regarding the health hazards of medical waste. The study will be crucial in evaluating and enhancing medical waste management systems while raising public awareness about the associated health risks. Additionally, the study may provide pertinent recommendations to health institutions, stakeholders, and decision-makers regarding suitable methods for medical waste management. Furthermore, the study will serve as a valuable source of information for future research in related areas.

Recommendations for Future Research

An adequate Hazardous Waste Management (HWM) system is crucial in safeguarding both the community and the environment, a fact underscored by the findings of the current study. Nevertheless, there is room for more extensive research, employing more dependable research methodologies, particularly within a larger population. Therefore, it is recommended to evaluate the efficacy of this technique across various medical institutes. Additional

research endeavors are necessary to comprehensively evaluate HWM from the perspectives of both public and private medical institutions. The insights gleaned from the resultant data can then be integrated into the practices of medical institutions operating in both the public and private sectors.

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