The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 11, 2025

KNOWLEDGE, ATTITUDE, & PRACTICES ABOUT BIOMEDICAL WASTE MANAGEMENT AMONG HEALTHCARE PERSONNEL IN AFIC/ MH RAWALPINDI PAKISTAN

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DOI: https://doi.org/10.5281/zenodo.17877697

Keywords

Article History
Received: 08 October 2025
Accepted: 15 November 2025
Published: 29 November 2025

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Abstract

Background: *Biomedical waste (BMW) poses significant occupational, environmental, and public health risks when not managed properly. Safe handling requires healthcare personnel (HCPs) to have adequate knowledge, positive attitudes, and consistent practices.*

Objective: *To assess the knowledge, attitude, and practices (KAP) of HCPs regarding BMW management in AFIC/MH Rawalpindi and identify gaps affecting compliance with national regulations.*

Methods: *A cross-sectional survey was conducted among 50 HCPs, including nurses, registrars, laboratory technicians, and sanitary workers, selected via simple random sampling. Data were collected using a validated structured questionnaire covering demographic characteristics, BMW classification, segregation, storage, transport, treatment, and administrative procedures. Descriptive statistics were used to evaluate KAP levels.*

Results: *Participants demonstrated partial knowledge of BMW protocols. Attitudes reflected moderate compliance intention, while practices were inconsistent, particularly in segregation, container use, and documentation.*

Conclusion: *Deficiencies in KAP exist despite institutional facilities. Targeted training, monitoring, and enforcement of BMW rules are essential to improve compliance, reduce occupational hazards, and protect the environment.*

INTRODUCTION

The essence of cleanliness was aptly captured by Dravidians, who in 5000 BC gave due emphasis on town planning, safe and effective sewage systems which got all solid and liquid wastes generated by the population[1]. They were indeed pioneers as far as scientific waste management is considered which is borne out from excavations of Mohenjo-Daro and Harappa. As a matter of

fact all ancient civilizations insisted specifically for care of cleanliness and hygiene's as to remain free from disease.

The twentieth century has witnessed rapid mushrooming of hospitals in the public and private sector dictating the needs of expanding population and the advent and acceptance of "disposables" has made the generation of hospital waste as significant factor in today's hospitals[2].

Over the years a metamorphic change has occurred in role of hospitals from that of housing the terminally ill patients of communicable diseases to that of social institute providing preventive, promotive and curative care and also a centre of education, research and training[3].

Biomedical or health care waste is a term used for all waste arising from Healthcare establishment[4]. In the persuasion of the aim of reducing health problems, eliminating potential risks, and treating sick people, healthcare services inevitably create waste which itself may be hazardous to health[5]. The waste produced in the course of healthcare activities carries a higher potential for infection and injury than any other type of waste. Inadequate and inappropriate knowledge of handling of healthcare waste may have serious health consequences and a significant impact on the environment as well[6]

Effective management of biomedical waste is not only a legal necessity but also a social responsibility. Common producers of biomedical waste include hospitals, health clinics, nursing homes, medical research laboratories, offices of physicians, dentists, and veterinarians, home health care, and funeral homes[7].

Hospital waste management is an important process that must be dealt with diligently. The management of hazardous waste material requires specific knowledge and regulations and it must be carried out by specialists in the field. Heaps of litter is taken to dumpsites in developed countries. However, in developing countries, waste mostly ends up on road sides and empty plots. Untreated waste bears an economic cost for residents of the area and is also an environmental hazard[8]. Increasing pollution leading to environmental changes and economic cost related to waste in terms of health hazards and negative impact on infrastructure have changed the way authorities view it.

Though waste management is a relatively new phenomenon, it has caught the attention of governments all over the globe. Today the term waste management covers collecting, sorting, processing, recycling and reusing materials that would otherwise be considered as useless[9]. This article is concerned with comparing knowledge, attitude and practices for the management of healthcare waste. Compliance with the Waste Management Rules 2005, under the Environment Protection Act (1997), of the Government of Pakistan was used as the standard. Until fairly recently, medical waste management was not generally considered an issue. In the 1980s and 1990s, concerns about exposure to human immunodeficiency virus (HIV) and hepatitis B virus (HBV) led to questions about potential risks inherent in medical waste[10]. Thus hospital waste generation has become a prime concern due to its multidimensional ramifications as a risk factor to the health of patients, hospital staff and extending beyond the boundaries of the medical establishment to the general population[11].

The adequate management of biomedical waste assumes tremendous importance in developing countries like Pakistan whose economy forces the poverty stricken and the ignorant rag pickers to sift and sort through dumped waste material in order to eke out of living. Time and again the audiovisual and print media has highlighted the desperation and pathetic condition of these people but apathy of powers that have managed to give this problem less importance than it deserved. So that such unscrupulous elements have moved in unorganized sectors[12]. A number of documentaries have been made and reports complied regarding improper waste management in majority of healthcare institutions. To bring out the issue to attention of decision makers, the environment health unit of Southeast Asia carried out a questionnaire survey during june-september 1994, to assess the status of hospital waste management to identify areas that needs improvement[13].

In developing countries, awareness regarding hospital waste management in terms of its segregation, collection, storage, transportation and disposal is lacking.

Studies in Pakistan show that around 2.0 kg of waste/bed/day is produced out of

Which 0.1- 0.5 can be categorized as high risk waste[14]. The management of hospital waste poses a major problem in most of the countries. In recent years, medical waste disposal has posed even more difficulties with the appearance of disposable needles,

Syringes and similar items. There are serious public health risks from the reused syringes: Worldwide an estimated 12,000 million injections are performed yearly with one billion for immunization. Unsafe disposal and reuse of contaminated needles and syringes cause 10 to 12 million infections. 8-16 million cases of hepatitis B (133 in 100,000 persons), 3-4.7 million cases of hepatitis C (39 in 100,000 persons) and 80,000 to 160,000 cases of HIV/AIDS (1.3 in 100,000 persons), are believed to be caused by reuse of needles and syringes[15].

Although the management of hazardous hospital wastes has become a serious concern in Pakistan is also facing this problems. Hospitals in Pakistan produce about 250,000 tons of waste per year. Hospital waste has been reported to be poorly handled and managed by the hospital staff and administration respectively[16]. This leads to environmental and health consequences within hospitals as well as to outside population. The qualitative data was obtained through direct and indirect observations on hospital staff including doctors, nurses, sweepers and laboratory technician and the way they handled the waste. Also direct observations of the hospitals premises inside and outside were made and noted. We also describe the process of involving the hospital staff for trainings. Segregation, handling, storage, transportation and disposal of waste were below WHO and Pakistan Bio-safety rules 2005 standards. There is need of trainings of hospital staff in Pakistan. We also found that such trainings are highly feasible if accompanied with incentives to participants. About 12,000 million injections are used every year. Approximately 15% waste is anatomical with infectious and sharps constituting 1% of total health care waste globally. Waste produced in high income

Countries are higher than that from low income countries with production of about 6 Kg and 3 Kg per person per year[17].

Globally hospital waste is regarded as a hazardous; therefore, it has to be treated accordingly[16]. Healthcare workers, patients, waste handlers, waste pickers and the general public are all exposed to health risks from infectious waste[18]. The improper disposal of bio-medical waste includes open dumping and uncontrolled burning. If bio-medical waste gets mixed with other waste, it contaminates all waste. According to a World Health Organization (WHO) assessment there were about 22 countries in

2002 which had about 64% hospitals with no proper waste disposal methods. Hospitals in developing countries including Asia suffer from a lack of proper management of waste[19]. A study from Nepal showed that it was due to the lack of waste management plan and carelessness of doctors, patients and visitors[20].The clinical staff in developing countries lacks knowledge about the transmission of hospital acquired infections caused by poor handling of health care waste, poor attitude of staff towards hospital discipline, and improper training of staff on HCWM. 6–8 Studies from Pakistan show that around 1.35 Kg of waste is produced every day for each hospital bed occupied[19].There were about 92,000 hospital beds in Pakistan in 2006 and about 2 Kg of waste per bed produced every day. In total about 0.8 million tons of waste is produced every day. In Pakistan, studies suggest that, most hospitals and independently working physicians do not comply with HCWM practices exposing themselves, other staff, and patients to sharp injuries and infection[21]. Hospital waste in Pakistan spreads diseases and it also becomes the target of scavengers who collect used syringes which are recycled and re-sold in the market for personal financial Reasons [22].The janitorial staff in Pakistan, in particular, is found to be involved in selling the used syringes to the open market within a selling price of US$ 0.06–0.2 per syringe [23]. A study noted that about 52% of the doctors

had received needle prick injuries more than once in their lives [24].Health workers in lower tiers of health care in Pakistan suffer from sharp injuries even worse than those in the hospitals and about 54% of health worker had suffered at least one injury within 6 months at first level care facilities.

In 1988 the Federal government of USA passed the [[Medical Waste Tracking Act]] which set the standards for governmental regulation of medical waste. After the Act expired in 1991, States were given the responsibility to regulate and pass laws concerning the disposal of medical waste. All fifty states vary in their regulations from no regulations to very strict ones [25].

In the United States, there are three main methods for medical waste generators to dispose of their waste: On-site, truck service, and mail-back disposal. On-site treatment involves the use of very expensive equipment, and is generally only used by very large hospitals and major universities who have the means to afford such equipment [26]. Truck service involves hiring of a medical waste disposal service whose employees are trained to collect and haul away medical waste in special containers (usually card board boxes, or reusable plastic bins) for treatment at a facility designed to handle large amounts of medical waste. Mail-back medical waste disposal is similar, except that the waste is shipped through the U.S. postal service instead of by private hauler [27]. Although currently available in all 50 U.S. states, mail-back medical waste disposal is limited to very strict postal regulations (collection and shipping containers must be approved by the postal service for use) and only available by a handful of companies[28].

Advances in medical facilities with the introduction of sophisticated instruments have increased the waste generation per patient in health care units . The rapid mushrooming of hospitals has increased the quantity of hospital waste production [29]. Appropriate waste management system have been developed and installed globally to handle both hazardous and non-hazardous Bio- Medical Waste (BMW). In south Asia especially in India the Ministry of Environment and Forests notified the Biomedical Waste (Management & Handling) law in 1998 [30]. The infrastructure requirement for BMW management as per BMW rules is very expensive. Rimsky a private firm of India offers services of handling hospital waste on pay and use basis [31]. They charge Rs. 500/- per month form clinics for collecting waste thrice per week. In India, hospital waste generated is about 1.59 to 2.2 kg/bed/day. Though many training programs are conducted on BMW management for the health care team members and enforcing rules on handling them, improper regulation is continued by the hospitals, nursing homes, and private practitioners' etc [32].

Incineration is one of the final treatment options. Un-regularized incineration leads to harmful effects on health [33]. A common treatment facility looks to be the most promising option along with other technological options. Private sector involvement may benefit the system. The mismanagement of the biomedical waste poses grave risk to people and the environment. Incineration of certain parts of the biomedical waste is necessary because this is the only accepted treatment option. Besides, a scientifically designed landfill can further strengthen the integrated healthcare waste management system whereas a poorly designed and managed landfill can also lead to ground water contamination [34]. It is important to dispose of such waste properly to avoid its dangerous effects. This study was necessitated based on unpublished data from the nationwide survey conducted by the Health Services Academy Islamabad on healthcare waste management unveiling the gloomy picture of the issue [35]. Some of the results show that healthcare waste was found not being managed properly and in accordance with the HCWM rules. HCWM teams and plans were not in place. Training programs had an impact over the overall management of the HCW (p=0.004). The reporting system was not working efficiently among the hospitals (p=0.010). Absence of an on-site treatment facility also resulted in a poor management of HCW (p=0.001) for category and for type of facility (p=0.031). There was therefore need to address the issues highlighted in the

survey and to document gaps and identify remedial measures in terms of trainings so that the implementation in other allied hospitals may move forward. In this regard an incinerator was installed, in a tertiary care hospital in Rawalpindi, which was provided by the WHO and the hospital was later made Combined Treatment Facility (CTF) in 2009 and ten other allied hospitals in the catchment area used this hospital for their waste disposal. Hospital staff went through phases of training and the HCWM system was put in place. Training of health care staff on waste management is said to be associated with a significant reduction in the incidence of sharp injuries to workers in the health facilities [36].

The objectives of this study were to present the significant issues and gaps to implement the HCWM practices at these hospitals which originated from direct Observations and key informant interviews with hospital staff; and to report the process of involvement of the hospitals and their staff, and trainings given to them to Implement the HCWM according to guidelines of WHO.

The absence of proper waste management, lack of awareness about the health hazards from biomedical wastes, insufficient financial and human resources, and poor control of waste disposal are the most critical problems connected with healthcare waste [37]. Adequate knowledge about the health hazard of hospital waste, proper technique and methods of handling the waste, and practice of safety measures can go a long way toward the safe disposal of hazardous hospital waste and protect the community from various adverse effects of the hazardous waste. With this background, this study will conducted with the main objective of assessing knowledge, attitude, and practices of doctors, nurses, laboratory technicians, and sanitary staff regarding biomedical waste management [38].

REVIEW OF LITERATURE

Biomedical waste also known as infectious waste or medical waste, is defined as any waste which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining there. The large volumes of health care waste if not managed properly can lead to a global hazard. This could not only lead to the spread of highly contagious diseases but the hazardous chemical waste produced by the use of items can cause considerable damage to the ecosystem and the environment. Thus health care waste, if not managed properly will be a cause in ushering of "disasters in making" by causing air, water, soil pollutions and helping in emergence of antibiotic resistant strains of microbial ingress of pollutants in the food chain and thus becoming a part of human consumption.

There is also growing concern about the spread of HIV, Hepatitis and other infectious disease that can be caused by needle-stick injuries and other forms of contagion that can result from the improper management of biomedical wastes by hospitals and other health care institutions. As health systems are strengthened and health care coverage expanded in developing countries through efforts to meet the Millennium Development Goals, the releases of persistent organic pollutants (POPs) and other persistent toxic substances (PTS) to the environment can increases substantially. This is often an unintended consequence of choices in materials and processes that seek to improve health outcomes.

Figure -1 biomedical waste

zotential implications biomedical waste:

Risks to health care workers and waste handlers

Improperly contained contaminated sharps pose greatest infectious risk associated with hospital waste. There is also theoretical health risk to medical waste handlers from pathogens that may be aerosolized during compacting, grinding or shredding process associated with certain medical waste treatment practices. Physical injury and health hazards are also associated with high operating temperatures of the incinerators and steam sterilizers with toxic gases vented out into atmosphere after waste treatment.

Hazardous waste refers to any waste that could pose a threat to human health and the environment if managed improperly. The Basel convention on the control of Tran's boundary movement of hazardous wastes and their disposal classified hazardous wastes into 10 types (Y1-Y10). Y1 is clinical waste from medical care in hospital, medical centers and clinics. Y3 is waste from pharmaceuticals, drugs and medicine. Risks linked to infectious health care wastes are 22-53% for hepatitis B cases, 31-59% for hepatitis C cases, and 7-24% for HIV/AIDS. Feces and vomits can spread gastro-enteric infections and viral hepatitis A. Saliva and other human fluids could cause respiratory infections (WHR 2002, in SEAR). People at risks from health care waste are Doctors, Nurses, Auxiliary staff, Laboratory technicians, Patients, Sanitary personnel, Waste handlers, Scavengers and recyclers.

Figure- 2 Risks to public by mixed wastes

Risks to public

Public impacts are confined to esthetic degradation of the environment from careless disposal and the environmental impact of improperly operated incinerators and other medical waste treatment equipment. There may be increased risk of spread of nosocomial infections in patients due to poor waste management. Improper waste management can lead to change in microbial ecology and antibiotic resistance.

Serious public health consequences and significant negative impact on the environment could result from inadequate and inappropriate handling of health care wastes. Sewage from field hospitals treating cholera patients has been implicated in cholera epidemics in some Latin American countries. A hospital housekeeper in the United States of America developed staphylococcal bacteremia and endocarditis after needle stick injury while handling health care wastes. Two of the eight cases of occupational HIV infections in France in1992 occurred in waste handlers through wounds. CDC recognizes 51 cases of HIV in USA in 1996 as occupational (WHO, 1999). There are several categories of hospital wastes according to their weight density and constituents. The World Health Organization has classified medical waste into different categories, which are, infectious, sharps, pathological, pharmaceutical and radioactive. There are several categories of infectious waste like human tissues and body parts, animal carcasses, syringes, blades, saws, drugs, vomits, urine, chemicals and fluid from laboratories. Infectious health-care waste is a major cause of HIV/AIDS, hepatitis B and C viral infections. These viruses are generally transmitted through injuries from needles and sharp objects, which are contaminated with human blood. There are however, numerous other diseases which could be transmitted by contact with health-care wastes. These are urinary tract infections, respiratory tract infections, wound infections, bactermia, and skin infections etc. Healthcare waste disposal in the management of waste poses to be a major problem in most of the countries, especially hospital waste. It is an ongoing problem for many countries.

Types of Biomedical wastes:

Non-Hazardous wastes

This includes 85% of waste generated in health care setups and includes waste comprising of food remains, fruit peels, wash water, paper cartons and packaging material.

Hazardous wastes

Potentially infectious wastes

Over the years different terms for infectious wastes have been used in the scientific literature. These include infectious, infective, medical, biomedical, hazardous, red bag, contaminated and regulated medical waste. It constitutes 10% of total wastes and includes dressing / swabs contaminated with pus, blood and body fluids, laboratory wastes, excised tumors and organs, placenta, extracted teeth, sharps including needles, blades, syringes and blood and blood products.

b. Potentially toxic wastes

1) Radioactive wastes: includes wastes contaminated with radionuclide; it may be solid, liquid or gaseous wastes; these are produced due to in vitro analysis of body fluids and tissues and in vitro imaging and therapeutic procedures.

2) Chemical wastes: includes disinfectants (Hypochlorites, gluteraldehyde, phenol deritives, iodophores and alcohol based preparations, X-rays processing solutions and base metal debris.

3) Pharmaceutical wastes: includes anesthetics, sedatives, antibiotics and analgesics etc.

Steps of biomedical waste management

Medical waste must be managed according to its type and characteristics. For waste management to be effective medical waste must be managed at every step from acquisition to the disposal. The elements of a comprehensive waste management system include waste survey, segregation, waste storage, transportation, treatment, disposal and also waste minimization. A clear policy for waste management should be prepared and made available for proper implementation of waste management system. The policy should describe in detail the methods of waste segregation, collection, storage, and disposal, according to the resources available. Roles and responsibilities of different team

Members should be clarified. One key person should be assigned the responsibility of waste.

Waste survey

The survey should differentiate and quantify the generated waste. It should determine the points of generation, type of waste, the level of generation and disinfection within the hospital. This help to determine the method of disposal.

Only a small percentage of the waste generated by a health care facility is medical waste that must be specially handled to reduce the risk of infections of injury. Therefore, sorting the waste at the point at which it is generated can greatly reduce the amount that needs special handling. Medical waste should be handled as little as possible before disposal. It should not be collected from Patient-care areas by emptying into open carts; this may lead to contamination of the surroundings and to scavenging of waste as well as to an increased

risk of injury to staff, clients and visitors.

Waste segregation

This consists of placing different kinds of waste in coded bags at the point of generation (table 1). It helps to reduce the bulk of infectious waste as well as treatment cost. It also contains the spread of infection and reduces the chance of spreading to other health care workers.

Waste accumulation and storage

It occurs between the point of generation and the site of final treatment and disposal. While accumulation refers to the temporary holding of small quantity of waste near the point of generation, storage of waste is characterized by longer holding periods and relatively large quantity of waste. Storage areas are usually located near to the point of final treatment. Any off site holding of waist is also considered as storage. To contain spills storage area should not have floor drains and adequately recessed to hold liquids. Floor and walls should be impervious to liquids and easy to clean. They should be disinfected regularly.

Refrigeration may be required for prolonged storage of putrifiable materials.

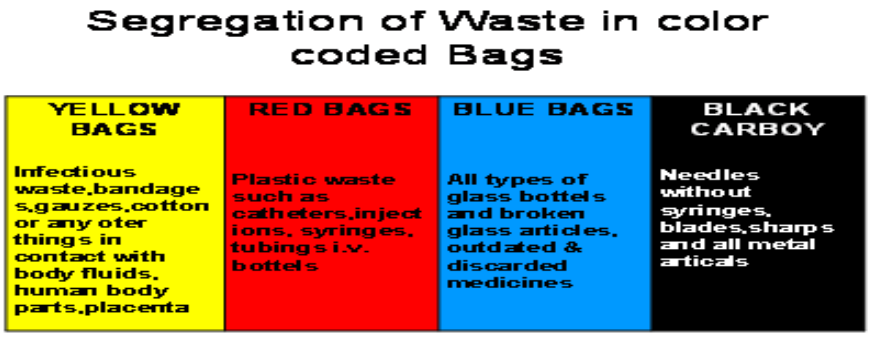
Storage area should be posted with “EXPLICIT” sign.

Fig- 3 Biohazard symbol

Figure - 4 Yellow container for Hazardous waste

Table 1: (The categorization and color coding of containers)

Substance	Category	Color code of bag
Human tissues, blood and blood products, organs	1	Red
Animal and slaughter	2	Orange
Microbiological waste	3	yellow
Sharps	4	Blue
Pharmaceutical	5	Blue
Solid Wastes/ Disposable	6 &7	Yellow / Black
Chemical wastes	9	Yellow / Black



Waste transportation

When medical waste is not treated on site then it must be transported from the .generation facility to another site for treatment and disposal. Transporting solid medical waste is an option for final disposal if a facility is unable to use burn or non-burn techniques. It is the least desirable option for disposal because it is likely that nonmedical personnel will put themselves at risk by being involved in the disposal process. If this option is used, facility staff must educate the waste transport and disposal personnel to the risks involved in the disposal process and must teach them how to dispose of solid medical waste.

Waste treatment and disposal

The term treatment refers to modify the waste in some way before it is taken to its final resting place. Treatment is usually required to disinfect or decontaminate the waste, right at the source so that it is no longer the source of spread of infections or pathogenic organisms. After such treatment residues can be handled safely and transported and stored .following measures are recommended;

1) Needles and syringe nozzles are shredded in syringe cutters and needle destroyers.
2) Scalpel blades/ Lancet/Broken glass should be put in the separate containers with beech, transferred to plastic card board boxes; sealed to prevent spillage and transported to incubators.
3) Glassware should be disinfected, cleaned and sterilized.
4) Culture plates with viable culture should be autoclaved; Media are placed in appropriate bags and disposed off and plates can be reused after sterilization.
5) Gloves should be shredded, cut and mutilated before disposal.
6) Swabs should be chemically disinfected before incineration.
7) Disposable items are often recycled and have the risk of being used illegally; dipping in freshly prepared 1% sodium hypochlorite solution for 30 minutes followed by mutilation should be the adopted policy.
8) Under no circumstances heat be used for disposal of amalgam; it will cause mercury to volatize and be released in the environment, so teeth with amalgam restoration must be treated with a high level disinfectant gluteraldehyde for 30 minutes. Treated teeth can be rinsed.
9) Liquid wastes generated by laboratory are either pathological or chemical in nature. Non infectious wastes must be neutralized with reagents.
10) Liquid infectious wastes should be treated with a chemical disinfectant and neutralized.

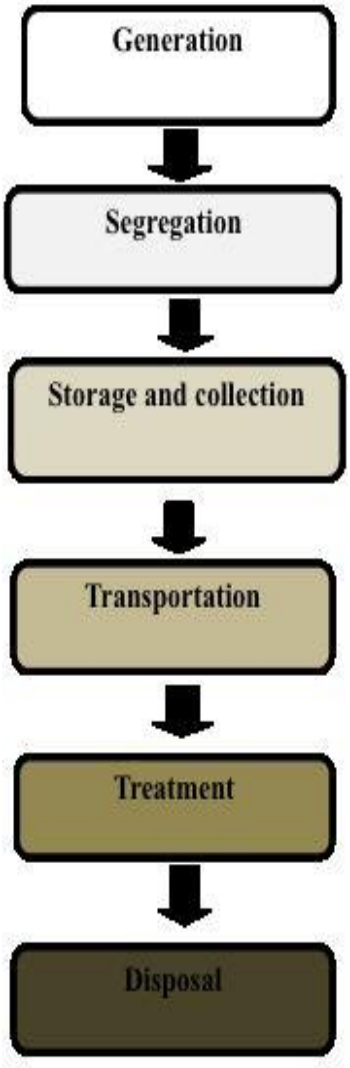


Figure-5 Disposal of biomedical waste

Waste disposal

Methods vary in their capabilities, cost, availability to generation and impacts on the environment. The various disposable methods include incineration, autoclaving, chemical method, thermal methods, ionization radiation process, deep burial or microwaving. Autoclave and incineration are considered traditional methods of waste disposal. Chitins et al have devised a solar heating system for disinfecting infectious waste in economically less developed countries. They obtained a considerable reduction in amount of viable bacteria by this method. However considerable reduction in amount of viable bacteria is a misleading term. The medical waste must be completely free of pathogens before final disposal. This will ensure maximum public hygiene quality. Untreated medical waste can be disposed of in sanitary landfills. Disposal without treatment is not recommended for human tissue, sharps and culture from clinical laboratories.

Table 3: Disposal methods

Category of waste	Disposal Method
1	Incineration / Deep burial
2	Disinfection / deep burial
3	Autoclaving / Microwaving
4	Shredding / Deep burial
5	Shredding / Deep burial
6	Disinfection / Machine cleaning
7	Disinfection/Chemicals/Autoclaving/Shredding

Water Minimization:

Whereas ordinary solid and liquid wastes require no treatment before disposal, particularly all infectious wastes must be first treated. The cost for treatment of infectious waste is ten times higher than disposal of ordinary solid waste. Any measures that decrease amount of infectious waste generated will simultaneously decrease the cost of disposal also.

Incineration:

Incineration of solid medical waste incinerating is the best option for solid waste disposal, since the high temperature (1300 °C) destroys microorganisms and reduces the amount of waste. Burning in an incinerator or oil drum is recommended. Facilities that generate low levels of solid medical waste can use a small drum incinerator. A drum incinerator can be made from a 200 liter or 55 gallon oil drum. The drum incinerator should be sited downwind from the facility. Put a fence around the incinerator or never leave the fire unattended in order to ensure the safety of staff, patients, visitors, and the community at large. Place the incinerator on hard earth to prevent grass or vegetation from catching fire. The drum incinerator should have sufficient air inlet to allow for efficient and complete burning of medical waste. Use kerosene as an accelerant. To avoid an explosion add kerosene before ignition. Treat ash from incineration as general waste and dispose of it properly.

Figure-6 Disposal of sharps

Final Disposal of Liquid Medical Waste

Liquid medical waste can be poured down a sink, drain, and flushable toilet. If none of these areavailable, in a pit. Points to remember when disposing of liquid medical waste always wear heavy utility gloves and shoes when handling or transporting liquid medical waste. Afterwards, wash both gloves and shoes. Consider where the sink, drain or toilet empties. It is hazardous to have medical waste flowing through open gutters or emptying onto the grounds of the facility. When carrying or disposing of liquid medical Waste; avoid splashing the waste on yourself, on others or on surfaces. After disposal rinse the sink, drain, or toilet to remove residual waste, being careful to avoid splashing. Clean the fixture with a disinfectant solution at the end of each day or more often if heavily soiled.

Final Disposal of Hazardous Chemical Waste

Always wear heavy utility gloves and shoes when handling or transporting hazardous chemical waste. Afterwards, wash both gloves and shoes if they become contaminated.

Cleaning solutions and disinfectants should be handled as liquid medical waste.

After disposal, rinse containers thoroughly with water, wash glass containers with detergent and water. Do not reuse plastic containers. Disposing of cytotoxic and radioactive waste should be done in accordance with all local and national laws.

Safe Sharps Disposal

The term "sharps" refers to any object that can cut or puncture the skin including, but not limited to, needles (hypodermic and suture) scalpels, lancets, broken vials or glass, broken capillary tubes, slides and cover slips, and exposed ends of dental wires. The primary cause of occupational exposure to blood-borne pathogens in all health care personnel (HCP) is injury from needle sticks or other sharp objects. At least 20 pathogens have been known to be transmitted following percutaneous exposure to blood. The most important of these pathogens are hepatitis B virus (HBV), hepatitis C virus (HCV), and HIV. Infections with each of these pathogens are potentially life threatening – and preventable.

Disposal of used Syringes

Place all used syringes in designated sharps container and never recap needles.

Sharps Disposal Containers (Safety Box)

Never discard needles and sharps in clinical waste bags, as the housekeeping staff might get injured.

Performance criteria of sharps containers

There are four major criteria for sharps disposal container safety performance:

Functionality, Accessibility, Visibility & Accommodation:

Functionality: Containers should remain in a good state during their entire usage. They should be leak resistant on their sides and bottoms and puncture resistant until final disposal. Individual Containers should have adequate volume and safe access to the opening.

Accessibility: Containers should be accessible to all workers who use, maintain, or dispose of sharp devices. Containers should be placed in all areas where sharps are used and, if necessary, portable within the workplace.

Visibility: Containers should be visible to the workers who use them. Workers should be able to see the degree to which the container is full (for plastic containers only).

Accommodation: Container designs should be convenient, environmentally sound, and easy to Store.

Figure-7 sustainability

Cost of biomedical waste Management

The cost of construction, operation, and maintenance of system for managing wastes represents a significant part of overall budget of the hospital if the BMW handling rules have to be implemented in their true spirit. Self contained on line treatment methods may be desirable and feasible for large health care facilities. They will not be practical or economical for smaller institutes .An acceptable common system must be in place which will provide adequate color coded bags, daily collection of infectious waste, safe transportation of waste to offsite treatment facility and final disposal with suitable technology.

Figure - 8 Large Incineration Plant

Dental wastes of environmental concern

Amalgam

Dental amalgam particles are a source of mercury, which is known to be neuro and nephrotoxic. Fetuses and newborn babies are particularly sensitive to mercury than adults and there seem to be particular difference in sensitivity among the individuals.

Management includes disposal of amalgam scraps as hazardous waste and preferably sent to recycler. Waste mercury is disposed off similarly. Empty amalgam capsules are disposed off in garbage. Since amalgams decompose on heating amalgam scraps should not be disposed in the waste that is eventually to be incinerated. To minimize the amount of mercury vapors emitted from amalgam waste, ADA recommends that it be stored under

a small amount of photographic fixer in a closed container. It should be labeled as scrap amalgam.

X-Ray waste

1. X-Rays fixing solution: It is considered as hazardous waste because of its high silver content. In the environment free ionic silver acts as enzyme inhibitor by interfering with metabolic processes of organisms. These have to be disposed of as hazardous waste or sent to silver recovery system.

2. X-Ray developer solution: Developer solution can typically go into waste water drain. Developer and fixer solutions should not be mixed, if mixed; they should be separated and treated independently.

3. X-Ray cleaner solution: Many cleaners for x-ray developer system contain chromium. It should be disposed as hazardous waste or switch to non chrome cleaner.

4. X-Ray Lead foil or lead shields: These contain pure lead. Lead is heavy metal that affects neurological development and function and can potentially leach from landfills into the environment. These are hazardous waste untill they are recycled for their scrap metal content or disposed of as hazardous waste.

Figure-9 Incinerator for contraband drugs

Plastic in health care system

Disposable syringes, bottles, blood and uro bags, catheters, surgical gloves, etc are some of the examples of plastic usage in health care system. Plastic has been associated with decline in sperm count, genital abnormalities and a rise in incidence of breast cancer. Burning of plastics releases carcinogens like dioxin and furan. Once hailed as 'wonder material' Plastic is serious environmental and health concern especially due to its non bio gradable nature. The options for plastic waste disposal are environmentally compatible long term land filling and recycling.

All disposable plastic should be shredded before dispose off to vendor.

Designing eco-friendly, biodegradable plastics are the need of the hour. Minimizing the generation of plastic waste is also very important.

In this research we has been studied and reviewed the concepts and theories from text, Books, research papers and related documents as a basis for the research approach.

The following content has been consulted.

- Health care waste: Definition, hazards and management
- Universal precaution and health behavior

Relevant researches

Health care waste includes all the waste generated by health care establishments, research facilities and laboratories. It also includes waste produced at home during the course of health care (dialysis, insulin injections, etc.). Between 75-90% of the health Care waste is no risk or general waste, comparable to domestic waste. This waste is dealt by the municipal waste disposal mechanisms. The remaining 10-25% of the health care waste is regarded as hazardous and may create variety of health risks. One-fourths of the biomedical l waste (BMW) is regarded as hazardous with the potential for significant health concern for both medical personnel and general community. So, awareness about various aspects of BMW management is required and it was assessed among health care personal. In Pakistan, not much attention has been aid to the management of biomedical waste (BMW). This thesis describes the collection and disposal of BMW in the hospitals. Lack of segregation between infections and noninfectious BMW as well as a failure to implement the prescribed rules for proper management of BMW; improper treatment and transportation and the final disposal of BMW along with municipal garbage; and an inadequate training of Personnel, insufficient personal protective equipment, and a lack of knowledge regarding the proper use of such equipment.

Figure – 10 use of Incinerator

Good healthcare waste management in a hospital depends on a dedicated waste management team, good administration, careful planning, sound organization, Underpinning legislation, adequate financing, and full participation by train and to design and validate a waste management protocol for the health team in these settings. This cross-sectional study was carried out in hospitals. Hence, waste Management protocols were convenient and sensible. Objective was to assess the knowledge and practice related to waste management among doctors, nurses, laboratory technicians and sanitary workers in AFIC/NIHD, MH and to design and validate a waste management protocol for the health team in these settings. This cross-sectional study will be carried out in AFIC/NIHD, MH Rawalpindi. Hospitals in Pakistan produce about 250,000 tons of waste per year. Hospital waste has been reported to be poorly handled and managed by the hospital staff and administration respectively. This leads to environmental and health consequences within hospitals as well as to outside population. The qualitative data was obtained through questionnaire and indirect observations on hospital staff including doctors,

nurses, sweepers and laboratory technicians. Also direct observations of the hospitals Premises inside and outside were made and noted. It also describes the process of involving the hospital staff for trainings. Our results showed that almost all of the hospitals did not have practice of Health Care Waste management on their priority. Segregation, handling, storage, transportation and disposal of waste were below WHO and Pakistan bio-safety rules 2005 standards. These hospitals did not have HCWM rules and regulations in place hence the staff do not follow the best practices in this regard which causes numerous health and environmental consequences not only within the catchment area but also to patients and staff. Our study highlights the lack of Health Care Waste Management practices in Pakistan. There is need of trainings of hospital staff in Pakistan. We also found that such trainings are highly feasible if accompanied with incentives to participants. The aim is to recognize the health effect of the existing practice, to determine the awareness level of doctors and nurses about hospital waste, to identify the weaknesses, and to provide suggestions for improvement. . The waste is generally dumped together in a public place such as the hospital surroundings, the roadside or City Corporation dustbin. Many doctors and nurses are not fully aware about what constitutes as medical waste. Health care workers have only a basic understanding of health care and do not perceive handling or disposal of medical waste as a hazardous work. Laboratory analysis shows existing contamination of infectious agents in the environment. The study indicates that there is a need to improve the handling and disposal methods of hospital waste in almost all the available medical facilities. hospitals and other healthcare establishments have a "duty of care" for the environment and for public health, and have particular responsibilities in relation to the waste they produce (i.e., biomedical waste). Furthermore, healthcare waste management should go beyond data compilation, enforcement of regulations, and acquisition of better equipment. It should be supported through appropriate education, training, and the commitment of the healthcare staff and management and healthcare managers within an effective policy and legislative framework. To evaluate the current practices of segregation approaches, storage arrangements, collection and disposal systems in AFIC,MH RWP a cross-sectional survey willconducted using convenient sampling technique. The instrument of research will be aself-administered questionnaire. There should be proper training and management regarding awareness and practices of waste disposal. Research must be undertake to seal existing gaps in the knowledge about hospital waste management.

Objective:

The objective was to assess knowledge, attitude, and practices of doctors, nurses, laboratory technicians and sanitary staff regarding biomedical waste management.1) To determine the awareness regarding waste management2) To determine the awareness regarding waste management practices.3) Attitude assessment towards waste management.4) To document the waste management practices5) Suggest possible remedial measures to improve current practices.

Hypothesis:

There is substantial lack of knowledge, attitude and practice about biomedical waste among health care personnel

Scope of the Study

The study aimed at studying behavior and factors relating to it, among health care
workers in infectious waste management.

RATIONAL OF STUDY

The result of the study will help in finding gaps in knowledge, attitude and behavior of health care workers. This information will be utilized in writing a comprehensive waste management plan for the hospital and will serve as contribution for any future legislation on occupational health and safety.

RESEARCH QUESTION

what is the level of knowledge, attitude and practice of health worker in the proper management of hospital waste?

OPERATIONAL DEFINITIONS

Biomedical Waste

The biomedical waste is the waste that is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto, or in the production or testing of biological components.

Knowledge

The level of awareness and understanding of health care personnel about biomedical waste management

Attitude

Specific view or opinion or behavior of HCPs regarding biomedical waste management

Practice

The level of utility of resources related to biomedical waste management

Health care personnel (HCPs)

Individuals who are professionally trained and are providing health care services to the clients in health care institutions, in this study ref to Doctors ,nurses, Nursing and operation room assistants and laboratory technicians.

Biomedical waste management

The actions of managing solid and liquid wastes produced during health care activities

Available facilities

It refers to the resources that help to meet proper waste management for this study following facilities were considered

a. Color coding system
b. inclinators
c. Autoclave
d .Microwave
e. shredder
f. Needle cutter or destroyer

Research methodology

Study design

A cross-sectional study/survey

Setting

The study was conducted among Military hospital and Armed forces institute of cardiology Rawalpindi, Pakistan. These hospitals are 600 bedded tertiary care hospitals providing health and cardiac surgical care to entitled patients of armed forces and civilian population of Rawalpindi and Islamabad. These hospitals are having no of facilities for execution of biomedical waste management including color coding system, incinerators, autoclave, microwave, shredder, needle cutter or destroyer etc.

Sample Technique

Complete enumeration method of simple random sampling (probability sampling)

Sample size

One hundred and twenty (n = 120) Health care personnel were
selected from hospitals mentioned in settings by simple random sampling

Inclusion Criteria

1. Staff Nurses with 5 year's experience
2. All registrars(doctors)
3. Laboratory technician with 5yrs experience
4. Sanitary worker with 5yrs experience

Exclusion criteria

1. All specialist doctors
2. Persons who were new inductees and in prohibition period
3. Persons with less than 5 years of experience

Sample

The sample consisted of medical personnel including doctors (50), nurses (50), laboratory technicians ,and others (20)

Limitations

1. The study was limited to Health care personnel's working in selected hospitals

2. The study was limited to individuals who were willing to participate

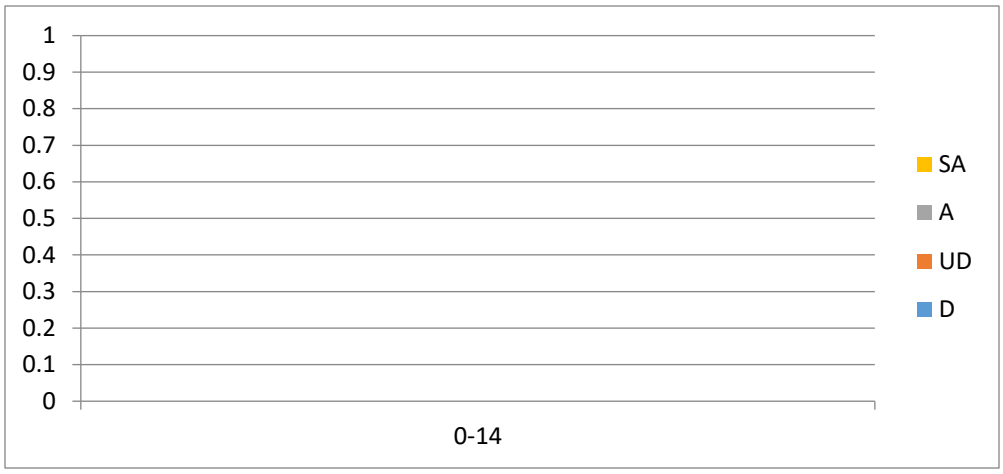
Duration of Study:
The study was carried out from 1st november 2012 to 1stFebruary 2013

Data collection procedure
After obtaining a written permission from hospital ethical committee, whole research plan was formulated and research started in an organized way.The sample was informed about the purpose of study and their cooperation was requested. Informed consent was obtained and confidentiality was assured. The time schedule was planned according to the availability of the sample. It was ensured that the routine of the hospital would not be disturbed. All the health care professionals who met inclusion criteria and were willing to participate in this study were randomly assessed for their knowledge and attitude regarding biomedical waste management by a structured interview schedule and an observational check list was used for assessing practices regarding biomedical waste disposal. The study tool/instrument (ANX A) was prepared after a thorough review of literature and on expert staticians opinion. The first section of the tool consisted of items related to data regarding personal and base line characteristics of participants. It includes age, sex, professional qualification, experience, and designation, and previous orientation, type of hospital, working area, and available facilities where they were working. Section B of tool consisted of knowledge questionnaire related to biomedical waste management. It consisted of 30 items from all aspects of biomedical waste management (ANX A). Part A consists of 4 questions assessing definition and classification, Part B included 10 questions regarding segregation, Part C comprised of 3 questions regarding storage and transport, Part D contained 9 items for treatment and Part E had 4 questions regarding administrative aspects of biomedical waste management. Each correct response carried "One score". The tool was prepared in English language. The knowledge of respondents was arbitrarily organized into three categories. Those who scored 50% were placed in low knowledge category, score of 51-75% in average and score of above 75% in high knowledge category. Section C contained 14 statements attitude scale. Each item was having five options i.e. Strongly agree(SA), Agree(A), undecided(UD), disagree(D),strongly disagree(SD) .There were seven positive and seven negative items (Annexure D).The response for each item was measured on a five point scale. The maximum score was 70. The attitude of respondents was arbitrarily categorized as

Table-4mentioned in table 6.

SD	D	UD	A	SA
0-14	15-28	29-42	43-56	57-70

Negative Attitude **Positive attitude**



The attitude of the respondents was arbitrarily categorized into unfavorable (<40%)moderately favorable (40-70%) and favorable attitude (>70%). Section D of the tool consisted of observational check list comprising of 14 items to assess the practices of HCPs regarding biomedical waste management. Each item was observed by a blind observer and scored. The maximum score was 15.The practices of respondents were arbitrarily categorized into inadequate (score <40%), moderately adequate(40-70%), adequate (above 70%). In order to assess reliability of the tool, test-retest method was used for assessing knowledge and attitude section items. Inter-rater reliability test was used for testing the practice items. Respondents were randomly chosen and the knowledge and attitude items were administered twice with the gap of one week between first and second administration. Kaul pearson's correlation "r" was computed for finding out the reliability of the tool. It was found that the reliability of knowledge items were 0.90, attitude items were 0.95,and practice items were0.91 which was highly positively correlated. So the tool was found to be highly reliable.

Data Analysis Procedure

Data so obtained was planned and analyzed based on the objectives and the hypothesis of the study by using computer software statistical package for social sciences version 12 by using both the descriptive and inferential statistics. The demographic data was analyzed by using percentages. The knowledge, attitude and practices were analyzed in terms of percentage, mean and standard deviation. Chi square test was computed to see association between Age, professional qualification and experience of HCP with his/her attitude level, knowledge and practice of BMWM.The relationship between knowledge, attitude and practices of HCPs regarding biomedical waste management was tested by using Pearson's correlation coefficient.The level of significance was kept to a p-value of 0.05 to test the significance of difference.

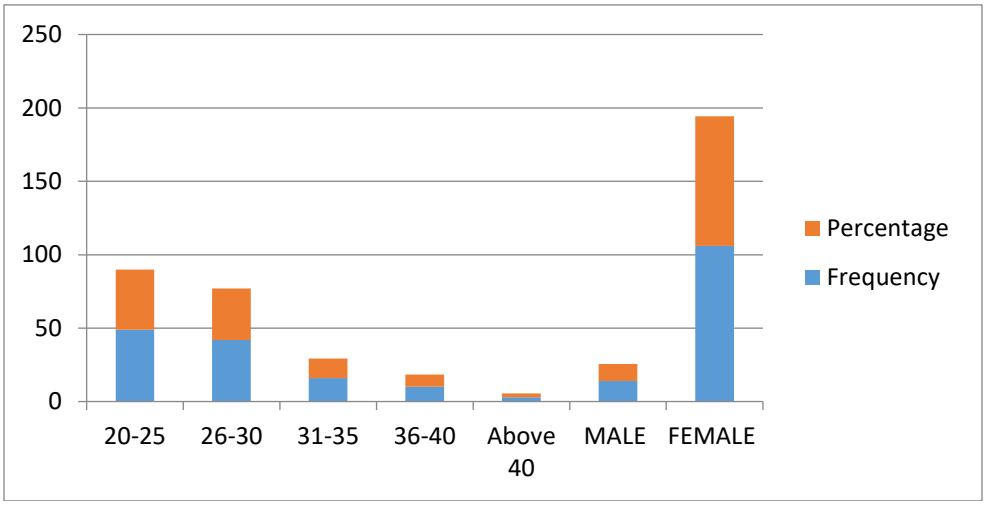
RESULTS:

The demographic characteristics included in this study were; age, gender, professional qualification, experience, previous orientation training, type of hospital, working area, and available facilities.

Table 5 Percentage distribution of HCPs by their age and gender

variable	Frequency	Percentage
Age in Years		
20-25	49	40.8
26-30	42	35
31-35	16	13.3

36-40	10	8.3
Above 40	3	2.5
Gender		
Male	14	11.6
Female	106	88.33



As described in table 5, majority of subjects were between ages of 20-25 years (40.8%) and very low percentage of samples were fallen in age group of 41years and above(2.5%).Majority were female(88.33%) and above one tenth were male(11.6%)

Table 6 Percentage distribution by professional background

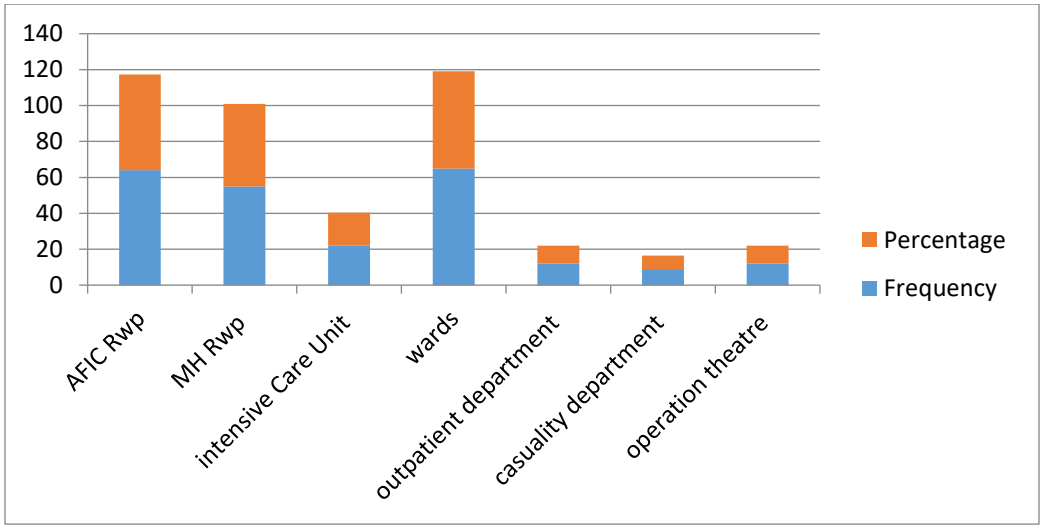
Professional background	Frequency	Percentage
rofessional qualification		
MBBS		
General Nursing	50	41.6
BSc Nursing	27	22.5
Lab technician	23	19.1
Sanitory Persons	11	9.1
Experience(years)	9	7.5
6-10	95	
11-15	14	
16-20	10	
>20	1	79.16
		11.66
Previous orientation training	19	8.3
Attended	101	0.83
Not Attended		15.83
		84.16

Table 6 depicts the sample by their professional background, majority of nurses were diploma holders(67.5%) followed by graduates(32.5%).Most HCPs were having experience between 6-

10years(79.16%).Only one(0.83%) was having experience of more than 20 years. Majority of healthcare professionals had not attended any orientation training programs on biomedical waste management.

Table 7 Percentage distribution of health care personnel by their working background

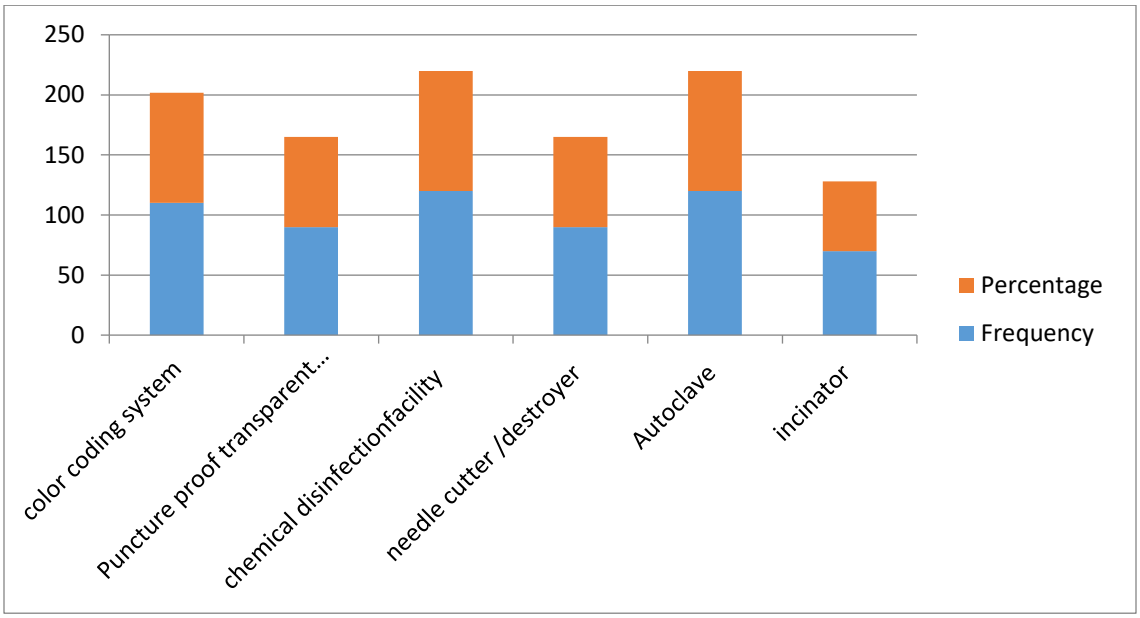
Working background	Frequency	Percentage
Type of hospital		
AFIC Rawalpindi	64	53.33
MH Rawalpindi	55	45.83
Working area		
Intensive care unit	22	18.33
Wards	65	54.16
Outpatient department	12	10.0
Casuality department	9	7.5
Operation theatre	12	10.0



As shown in Table 7 majority of samples were from AFIC Rawalpindi (53.33%) and less percentage of HCPs (45.83%) were from Military Hospital Rawalpindi. Majority of included HCPs were working in wards (54.16%) and a few number (7.5%) were working in casualty department.

Table 8 Working facilities related to biomedical waste disposal

Available Facilities	Frequency	Percentage
Color coding system	110	91.66
Puncture proof transparent container	90	75.0
Chemical disinfection facility	120	100
Needle cutter/destroyer		
Autoclave	90	75
Incinator	120	100
	70	58



All HCPs were working in hospitals where facilities like chemical disinfection, autoclave etc were available. Majority of them working with the facility of color coding system (91.66%).Three fourth of personnel were working with facilities of puncture proof transparent container (75%) and needle cutter (75%).More than half (58%) of sample working with facility of incinator(Table 8).

Management

As shown in table 9, the percentage distribution of the knowledge of HCPs on biomedical waste management. Very negligible percentage had high knowledge (1.7%).One fifth had average knowledge (20%).More than three fourth had low knowledge (78.3%).The knowledge score mean was 11.08 with the standard deviation 5.27.The HCPs were found to have low knowledge regarding biomedical waste management. The effects of improper waste management must be explained and the healthcare professionals must be motivated towards proper adherence to proper biomedical waste management protocols.

Table 9 Percentage distribution of HCPs by their knowledge on Biomedical waste

Knowledge score	Frequency	Percentage	Mean	Standard deviation(SD)
Low (0-50%)	94	78.3	11.08	5.27
Average (51-75%)	24	20		
High (>76%)	2	1.7		

Table 10 Percentage distribution of HCPs based on their attitude on biomedical waste management

Attitude score	Frequency	Percentage	Mean	Standard deviation
Unfavorable 0-40%	10	8.3	42.34	10.50
Moderately favorable 41-70%	78	65.0		
Favorable >70%	32	26.7		

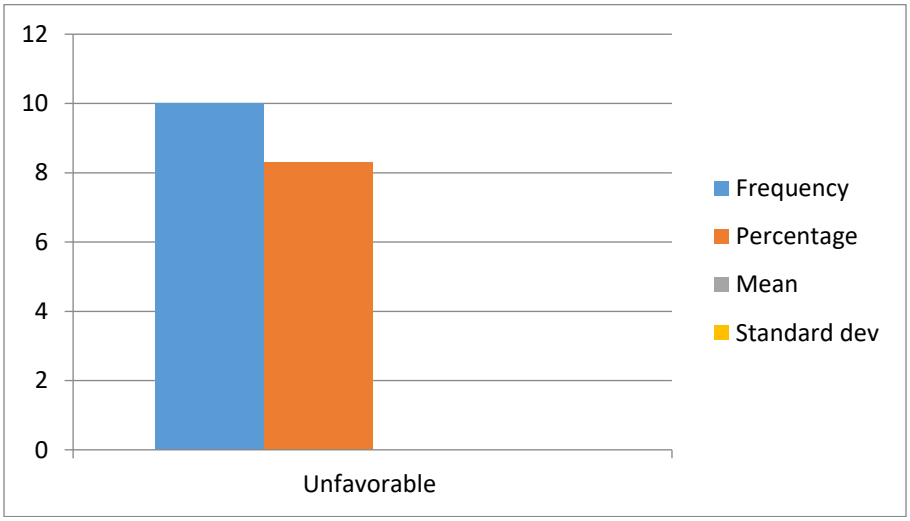
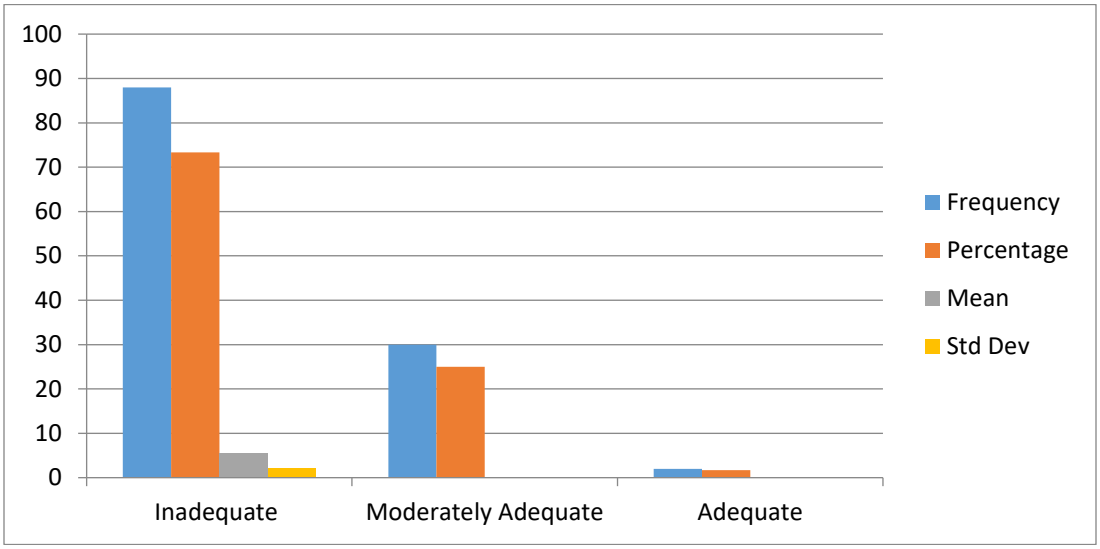


Table 10 shows the percentage distribution of healthcare personnel's attitude on the biomedical waste management. More than one fourth of sample population had favorable attitude (26.7%).More than two third had moderately favorable attitude(65%) and less than one tenth had unfavorable attitude (8.3%).The mean score of the attitude level was 42.34 with standard deviation(SD) of 10.50.

Table 11 Percentage distribution of health care personnel based on their practices of biomedical waste management

Practice score	Frequency	Percentage	Mean	SD
Inadequate 0-40%	88	73.3	5.49	2.09
Moderately adequate 41-70%	30	25.0		

Adequate >70%	**2**	**1.7**		



It was very pathetic to note that very negligible percentage of HCPs had adequate practices(1.7%).One fourth had moderately adequate practices(25%) and nearly three fourth had inadequate practices(73.3%).The mean score of practice was 5.49 with standard deviation(SD) of 2.09 (table 12).

Table 12 Correlation between the Health care personnel's knowledge and attitude, attitude and practice and knowledge and practice

Paired correlation		**Pearson's correlation coefficient value (r)**	
Pair 1	Knowledge and attitude	0.610	**P<0.001**
Pair 2	Knowledge and practice	0.501	
Pair 3	Attitude and practice	0.297	

The knowledge and attitude correlation value was r=0.610.It shows that statistically highly positive correlation between the knowledge and attitude of healthcare personals on biomedical waste

management. The knowledge and practice correlation value was r=0.501 that depicts statistically moderately positive correlation between knowledge and practice on biomedical waste management. The attitude and practices correlation value was r=0.297.It shows that statistically less positive correlation was observed between attitude and practices on biomedical waste management.

DISCUSSION:

Biomedical waste is the most hazardous and potentially dangerous of all the wastes arising in the community. Improper management of medical waste may pose health hazards through transmission of diseases, not only to health workers and their families, but to patients and their relatives, especially children whose play activity and mouthing behavior increases their contact with medical waste, thus exposing them to injuries[39]. Health care personnel are expected to have proper knowledge, practice and capacity to guide others for waste management. Health care workers have an important opportunity to manage the environmental effects of their practice. Their efforts may seem small, but each step builds a base of sound behavior and thinking. The present study was to find out the real state of affairs of the awareness, knowledge, attitude and practices of the HCP (Health Care Personnel) working at AFIC/NIHD Rawalpindi. There is sufficient literature support available for conduct of this study. Most of publications conclude that health care professionals lack sufficient knowledge regarding biomedical waste disposal [40] and emphasizes the importance of teaching sessions on awareness of this critical issue.

In one research conducted at national referral hospital Thimphu [41], Bhutan, awareness of doctors and paramedical staff regarding biomedical waste disposal was assessed in a cross sectional descriptive study. 283 health workers participated in the study. Self-administered questionnaire was used to obtain information from 36 doctors, 112 nurses and 80 technicians. The information from 55 auxiliary staff was obtained through structured questionnaire by two trained interviewers. The completed questionnaires were coded and entered into SPSS and was analyzed. The mean knowledge scores were 8.42, 9.21, 9.94 for auxiliary, technicians, nurses and doctors respectively from total of 10 scores. The mean attitude scores were 41.82, 41.93, 43.42 and 44.91 for auxiliary, technicians, nurses and doctors respectively. The mean behavior scores were 44.48, 42.11, 42.10 and 43.35 for auxiliary, technicians, nurses and doctors respectively from total of 50 scores. Socio-demographic factors like age, gender, level of education, job category, waste management training and duration in service were not significantly associated with behavior. Knowledge and attitude level of professionals was higher than auxiliary staff with significant difference ($p<.001$). The behavior of auxiliary staff was slightly higher than that of professionals but there was no significant difference statistically ($p=0.350$)

The waste produced in the course of healthcare activities carries a higher potential for infection and injury than any other type of waste. Inadequate and inappropriate knowledge of handling of healthcare waste may have serious health consequences and a significant impact on the environment as well [42]. A study was carried out at a medical college and hospital in Bangalore India. The objective was to assess knowledge, attitude, and practices of doctors, interns, nurses, laboratory technicians, attendees and housekeeping staff regarding biomedical waste management[43]. This was a cross-sectional study. A total of 383 health personnel were included in the study with their prior consent. Study subjects include doctors (56), interns (65), nurses (83), laboratory technicians(44), attendees (78) and housekeeping staff (57). Results: Doctors, nurses have better knowledge than other staff regarding health care waste management. Knowledge regarding the color coding and waste segregation at source was found to be better among nurses and laboratory staff. Regarding practices related to health care waste management nurses were better. However, injury reporting was nil across all the groups of health professionals. The

importance of training regarding health care waste management needs emphasis; lack of proper and complete knowledge about biomedical waste management impacts practices of appropriate waste disposal[44].

One-fourths of the biomedical waste (BMW) is regarded as hazardous with the potential for significant health concern for both medical personnel and general community [45]. So, awareness about various aspects of BMW management is required and it was assessed in a research by community medicine department among junior doctors in a tertiary care hospital in Calcutta, India. Objective was to assess the knowledge and awareness about various aspects of BMW management among junior doctors (future physicians) and thus help the authority to develop the strategy for improving the situation in future. In this descriptive observational study [46], they interviewed 200 junior doctors using a pre-designed pre-tested self-administered, semi-structured, anonymous questionnaire. Majority of the participants were in the age group of 22 to 24 years (62%), males (66.5%), host elites (70.2%), belonged to nuclear family (80.1%), and had per capita monthly family income in the range of Rs 5 000 to 20 000 (61.4%). Almost all respondents (99.1%) heard about BMW, 94.4% heard about the BMW rule 1998, and 67.9% knew about the Bio Hazard symbol. Only 55.9% respondents could remember the ten category of BMW. Segregation at source (the golden rule of BMW) was known by 78.8% of the junior doctors, only 29.5% had the knowledge of various methods of final disposal of BMW. Though 98.8% of the study population was aware that improper management of BMW causes different health problems, only 76.4% knew about various types of color-coded bags for collection of BMW. All the junior doctors were trained in all these essential aspects of BMW in their undergraduate curriculum [47]. The study recommended intensive training program and monitoring at regular time intervals with special emphasis on junior doctors [48].

The school of environment resource and development conducted a study to evaluate the current status of hospital waste management in Bangladesh [49]. The aim was to recognize health effects of the existing practices, and to determine the awareness of doctors and nurses about the hospital waste, to identify the weakness and to provide suggestions for the improvement of hospital staff, waste pickers, and local residents. They were interviewed and strictly observed. Through this, the lacking of the system was identified. Hospital waste was dumped together in public places and in city corporation dustbin. Many doctors and nurses were not fully aware what constitutes as medical waste. Laboratory analysis shows existing contamination of infectious agents in the environment.

A study was conducted the existing knowledge and practice in hospital waste management in Iran [50]. A survey was performed in the medical referral center the southern half of the country. The findings of study revealed that, there was no separation of hazardous and nonhazardous waste, an absence of rules and reputation of waste, disposal of hospital waste along with the municipal waste. Insufficient training ineffective treatment was noticed. They recommended having strict rules and regulations on hospital waste management [51].

A survey on community health nurses knowledge and practices on hospital waste management were carried out by university of Glom organ [52]. A questionnaire survey was used for this study. All community learning disability nurses, community mental health nurses and general community nurses were surveyed with response rate of 70%.The investigator noted unique and unpredictable environment. A small number of nurse's resheathed needles were stored inappropriately, inadequately wore gloves, experience in hand washing, and the waste was not stored and transported properly. The knowledge scores were very low that indicates need for training in all these aspects. So its findings support our study.

A study was conducted on effective medical waste management in King Fahd National Guard hospital, Saudi Arabia [53]. The hospital was having two incinator but they were not able to manage waste properly. So they assessed the knowledge and practice of health care workers by using

questionnaire and observational check list. It was found inadequate. So in service training and policies was given for their staffs. After this they found effective results.

A study was conducted on a program for reducing biomedical waste. In the total waste of 18.5% of waste was being disposed of as biomedical waste[54]. In Wellesley hospital in Toronto, waste audit was conducted and they noticed improper techniques. The hospital pays nine times more to dispose of its biomedical waste that it does landfill waste; a goal was set to reduce biomedical waste to 8% of the total waste. They provided training and education to their staff regarding biomedical waste management and redefining and reviewing the biomedical waste. They observed the practices continuously after 18 months they reached the level of biomedical waste of 7.9%.

A study was conducted to evaluate the dental waste because there is cross infection risk and potential danger for the environmental associated diseases with mismanaged waste [55]. Knowledge of waste composition and development of proper waste management alternatives are necessary. In that study eight hospitals were examined in Turkey. Total waste coming from clinics was related to the number of procedures conducted in patient clinics. Only a small fraction of waste was hazardous which was segregated separately. They followed the waste collection rules properly.

A study was conducted in Nigeria on assessing cross infection prevention measures [56]. In that study barrier techniques and waste management was observed in dental clinics. Less than 30% of dental surgeons and less than 50% of students discarded sharp materials into yellow and sharp bin. Liquid waste was well disposed of through drain for onward flow facilities. Poor practices were noted among healthcare professionals in each aspect of disposal of health waste.

A study was conducted on health care risk waste and its management in Saudi Arabia [57]. A questionnaire in this regard was applied in 27 hospitals and 16 primary health care centers and clinics. The total quantity of health care waste in 24 hours in each of these establishments was weighted and practice regarding its management was observed. The mean amount of total waste generated was 25.207 tons/year. The practices were not within acceptable limits. So they recommended formulating standards for appropriate healthcare waste management.

A study on needle stick injuries and needle disposal was conducted in Minnesota nursing home [58]. Responses were received from 297 of 349 (85%) homes; nearly all homes (92.5%) provided education for new nursing employees about use and disposal of needles. Disposal method was generally consistent. But needle stick injuries were noticed at significant rate. No institution was having policy regarding management of safe disposal of used needles and prevention of needle stick injuries [59].

The evaluation of current beliefs and practices on hospital waste management was done in a 400 bedded Brazilian hospital [60]. It was interesting to note that the highest generation rate per patient per day was found in private rooms and lowest rate in public ones. The beliefs were found within acceptable limits. The practices were according to current Brazilian legislation.

A study was done to evaluate knowledge, attitude and practice of personnel with respect to the prevention of nosocomial infection [61]. Five regional hospitals in Senegal were included in study. Data was collected in two ways, a questionnaire was used to evaluate knowledge and by direct observation of attitude and practices of personnel. Reusable instruments were washed directly with bare hands or by individuals wearing used surgical gloves. The equipment for autoclaving was not suitable. Biomedical waste was not decontaminated and it was collected poorly and disposed off directly into the environment. None of the site visited had a program of waste incineration. The scores of knowledge, attitude, and practice were found very low. Again findings were similar to our study.

Conclusion:

Proper collection and segregation of biomedical waste are important and there is not enough information available on medical waste management technologies and its impact on

public health and environment. The knowledge of health care personnel including doctors, nurses, laboratory technicians and sanitary workers on appropriate and effective biomedical waste management is dependent upon each other's and is remarkably unsatisfactory. So in order to avoid spread of communicable diseases and environmental hazards related with biomedical waste it is mandatory to emphasis on education and training and improvement in attitude/practices would improve as a byproduct. The importance of biomedical waste management and techniques pertaining to its safe disposal must be a part of under graduate curriculum of all levels medical education and mandatory workshops with hands on training must be included in criterion for passing such courses. In all hospitals pre-induction orientation training classes must be part of employment schedules. Refresher courses must be run for all those working in health care facilities. Hospitals must endorse SOPs regarding safe disposal of biomedical waste, same must be displayed for easy review at all working areas of hospitals and any violation of such SOPs must be dealt strictly with appropriate disciplinary actions. There is dire need to increase public awareness about this very important but least focused issue and forbidding practice of rag picking, using reused needles. Hospitals administration can play critical role for ensuring adherence of safe practice of biomedical waste management.

	Frequency	Percentage
Inadequate	88	73.3
Moderately Adequate	30	25
Adequate	2	1.7

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