HOSPITALS' SHARPS WASTE MANAGEMENT AND RELATED HEALTH HAZARDS AMONG HEALTH WORKERS

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Spring 2012

Accession No TH-9405

MS

363.7288

ADH

Medical Wastes

Infection Wastes

DATA ENTERED

9/2/13

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Thesis submitted to the Department of Environmental Sciences, FBAS, International Islamic University, Islamabad as a partial fulfillment of requirement for the award of MS degree in Environmental Sciences.

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June, 2012

IN THE NAME OF ALLAH,
THE MOST GRACIOUS,
THE EVER MERCIFUL

DEDICATED

TO

MY LOVING PARENTS

&

OTHER FAMILY MEMBERS

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Accepted by the Department of Environmental Sciences, Faculty of Basic and Applied Sciences, INTERNATIONAL ISLAMIC UNIVERSITY, ISLAMABAD, in partial fulfillment of the requirements for MS Degree in Environmental Science.

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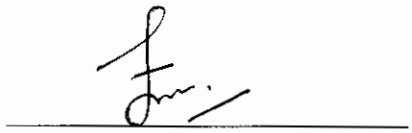

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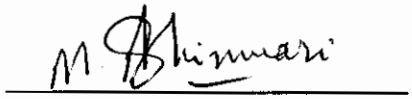

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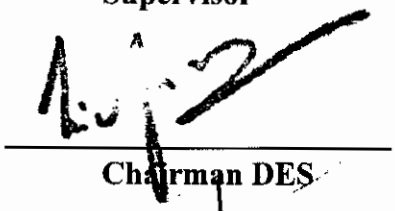

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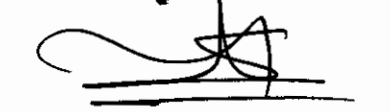

Dean FBAS

Date: 12th June, 2012

ACKNOWLEDGEMENTS

In the name of Allah the most beneficent and merciful, I praise my best to the only one creator and owner of life, due to His blessings I am able to finish this task. I would like to send Durood on our Holy Prophet Hazrat Muhammad (SAWW), Whose sayings are the way of success both in this world and on the Day of Judgment.

I would like to thank my Supervisor, Dr. Islam ud Din, Assistant Professor and Dr. M. Irfan Khan, Chairman/Dean, Department of Environmental Sciences, FBAS, IIUI, for their kind guidance and advice during my research work and thesis writing as well as helping in the approval of my research topic. Their endless support and invaluable critics have helped me to a great extent in this research.

I would also like to thank Dr. Muhammad Ibrar Shinwari, Assistant Professor, Department of Environmental Sciences, IIU Islamabad, Dr. Hamayun Khan, Associate professor, Department of Chemistry, Islamia College University Peshawar, Dr. Ibrahim Mughal (NIH Islamabad), DG EPA Khyber Pakhtunkhwa, Chief Analyst EPA Peshawar, Medical Superintendents/Administrators of the hospitals, the Doctors, Nurses, and Laboratorial Staff, Surgical staff of the hospitals, Sanitary Inspectors, Incinerator operator and other Sanitary staff for their cooperation in my research completion. I would also like to thank my friends specially M. Asif and Anwar-ul-Haq, Monitoring Inspectors EPA Peshawar, M. Aamir, Department of Environmental Sciences, University of Peshawar, M.Atif, Lecturer, Department of Statistics, University of Peshawar for their kind advices and support and all kind of assistance.

Finally, I would like to thank my parents and guardians and my relatives for their love and support. I would like to thank my other friends and class fellows, who have helped me directly or indirectly in this research.

ADIL JAN

LIST OF ABBREVIATIONS

AD	Auto Disable
AIDS	Acquired Immune Deficiency Syndrome
AKH	Al-Khidmat Hospital
CDC	Centers for Disease Control and Prevention
D.I.Khan	Dera Ismail Khan
EMRD	Eastern Mediterranean Region D
ENT	Ear, Nose and Throat
EPA	Environmental Protection Agency
EPI	Extended Programme on Immunization
EPINet	Exposure Prevention Information Network
HBV	Hepatitis B Virus
HCV	Hepatitis C Virus
HCW	Healthcare Waste
HCWs	Healthcare Workers
HIV	Human Immunodeficiency Virus
IDUs	Intravenous Drug Users
KPK	Khyber Pakhtunkhwa
KTH	Khyber Teaching Hospital
KuTH	Kuwait Teaching Hospital
LRH	Lady Reading Hospital
MH	Maternity Hospital
NSIs	Needle Stick Injuries
NSSIs	Needle Stick and Sharp Injuries
PPE	Personal Protective Equipments
SPSS	Special Package for Social Sciences
UNAIDS	United Nations programme on Adeno Immune Deficiency Syndrome
UNICEF	United Nations International Children Emergency Fund
UNFPA	United Nations Population Fund
WHO	World Health Organization
WHORC	World Health Organization Regional Classification

ABSTRACT

Healthcare wastes has many categories in which sharps waste is considered as risk wastes or hazardous wastes because of its infectious nature and its potential of transmitting blood borne pathogens, which can cause blood borne diseases, such as Hepatitis B (HBV), Hepatitis C (HCV) and Human Immunodeficiency Virus (HIV) in healthcare workers and also in general community. The aim of the study was to assess the current status of sharps waste management and their effects on the health of medical staff in both the government (GH) and private sector hospitals (PH) in district Peshawar. In this study, three government sector tertiary care hospitals, two private sector secondary hospitals and one government sector maternity hospital were selected. The total bed capacity in these hospitals was 3740. The data was collected through questionnaires, interviews, hospitals records, and observations. Total sharps waste produced in those six hospitals ranged from 115-215 kg/day. The total number of hepatitis positive patients registered per month ranged from 630 to 1800 in government hospitals (GH) and 30 to 150 in private hospitals (PH). Similarly, about 4 HIV positive patients in GH and up to 3 patients in PH were registered each month. Labeling or color coding during segregation was done in 92% GH and 65% PH. In both sector hospitals, 30% needle stick injuries occurred in the staff. According to the record, 37% and 30% staff got hepatitis infections in government and private sector hospitals, respectively. Similarly, 43% of the staff in GH and about 61% staff in PH were vaccinated against hepatitis. 74% staff both in GH as well as PH were using protective equipment during segregation and handling while 78-79% staff were using during transportation of sharps waste. About 72% of the GH and 61% of the PH were using separate waste bins for sharps wastes storage. 83% of the GH and 87% of the PH were using plastic bags for the storage of all kinds of wastes including sharps waste, the remaining were using plastic containers. 65% GH and 61% PH were autoclaving their sharp instruments for sterilization, the remaining were only boiling. Both sector hospitals were disposing injections by burning in open, incineration, syringe cutter and open dumping, where open dumping was widely practiced in majority of the hospitals. By incinerating injections and other wastes, air pollution was created because 34-35% of the GH and PH had not installed any air pollution control devices at the incinerator. The management of sharps wastes was not satisfactory in the hospitals of Peshawar. Strict rules and regulations must be promulgated and enforced by the government for better management of sharps waste so that healthcare workers and other people could be protected from injuries and infections.

CONTENTS

ACKNOWLEDGEMENTS V
LIST OF ABBREVIATIONS VI
ABSTRACT VII
CONTENTS VIII
LIST Of TABLES IX
LIST OF FIGURES X
CHAPTER 1 INTRODUCTION 1
1.1. Objectives of the Study 8
1.2. Significance of Study 8
CHAPTER 2 LITERATURE REVIEW 10
CHAPTER 3 MATERIALS AND METHODS 16
3.1. Study Area 16
3.2. Sample Size 16
3.3. Data Collection 17
3.4. Data Analysis 18
CHAPTER 4 RESULTS AND DISCUSSION 19
4.1. Results 19
4.1.1. Patients and workers infections 20
4.1.2. Segregation, handling, storage and transportation 21
4.1.3. Treatment and disposal options 25
4.2. Discussion 31
CHAPTER 5 CONCLUSION AND RECOMMENDATIONS 37
5.1. Conclusion 37
5.2. Recommendations 39
REFERENCES 42

LIST Of TABLES

Table 1 Total waste (infectious and non-infectious) generated in hospitals 19

Table 2 Total sharp waste generated in hospitals 19

Table 3 Hepatitis and HIV positive patients in hospitals 21

Table 4 Needle injuries, vaccination and infections of hospitals' workers with Hepatitis 23

Table 5 Use of separate waste bins for sharps waste and using other protective measures in hospitals 24

Table 6 Types of containers for the storage of wastes in hospitals 25

Table 7 Sterilization of sharps instruments in hospitals 25

Table 8 Air pollution control devices installed at incinerator in hospitals 27

Table 9 Chi-Square Tests for association between the use of protective measures during segregation and handling of wastes and number of Hepatitis cases in hospitals' workers 29

Table 10 Chi-Square Tests for association between needles stick injuries in staff and number of Hepatitis cases in hospitals' workers 30

Table 11 Chi-Square Tests for association between vaccination given to staff and the number of workers infected with Hepatitis 30

LIST OF FIGURES

Figure 1 Sharps waste after use within these hospitals.....20

Figure 2 Used syringes in the hospitals 20

Figure 3 Labeling or color-coding during segregation in GH & PH.....22

Figure 4 Segregation in government sector hospitals.....22

Figure 5 Segregation in private sector hospitals.....23

Figure 6 A nurse handling sharps having no proper protective clothing.....24

Figure 7 Injections disposal methods in government hospitals.....26

Figure 8 Injections disposal methods in private sector hospitals 26

Figure 9 Burning of hospital waste at dumping site.....27

Figure 10 Burning of hospital waste at dumping site 28

Figure 11 Open dumping of hospital waste at dumping site.....28

Figure 12 Scavenging hospital waste at the dumping site 29

waste which is unless rendered safe, may prove to be hazardous to any person which comes in contact with it, and any other waste produced by medical, nursing, dental, veterinary, pharmaceutical or other similar practice, investigation, treatment care, teaching or research, or the blood collection for transfusion, being waste which may cause infection to any other person which comes in contact with it" (Fisher et al., 2006) . Studies have shown that such wastes are the most problematic types for municipal solid waste authorities in developing countries because of their infectious nature. And when this type of waste enters the municipal solid waste stream, pathogens and hazardous substances pose a great risk to both the humanity and the environment (Mbongwe et al., 2008). Clinical waste or medical waste is further classified in to two broad categories, i.e., non-infectious waste and infectious waste (Longe and Williams, 2006). The category of non-infectious or general wastes is not infected and is similar in composition to domestic wastes. Normally it constitutes about 75 to 90% of the total waste generated and includes paper and cardboard, packaging materials, food waste and aerosol cans etc. (Pruss et al., 1999). The category of infectious wastes often includes such items which are chemically reactive, corrosive, flammable, explosive, or toxic to living organisms (Daschner, 2000). Infectious waste consists of materials which are susceptible to contain pathogens to cause disease to a potential host. This kind of waste may be contaminated by one or more types of bacteria, viruses, parasites or fungi. Normally, it constitutes about 10 to 25% of the total waste generated in medical facilities (WHO, 2006). The real amount depends on the types of facility being higher in emergencies, acute treatment, and surgical units and lower in chronic convalescence and nursing homes. Since, the infectious waste is relatively less in amount but it requires significant handling. Infectious wastes include anatomical wastes, sharps, pharmaceutical wastes, genotoxic wastes, radioactive wastes and highly infectious wastes. Despite the relatively lower quantity of hazardous waste is generated, the risk to cause adverse effects are significant if it is not

managed appropriately. Therefore, the hazardous healthcare waste should be identified, quantified, segregated, handled, treated and disposed off properly (Mohamed et al., 2009). In the last few years, many researchers in developing countries have investigated the practices of healthcare waste management at selected healthcare facilities within their countries (Da Sliva et al., 2005; Bdour et al., 2007; Nemathaga et al., 2008; Coker et al., 2009). They concluded that management practices of such waste; especially the hazardous portion represents a challenge in their countries due to deficiency in waste generation data and/or gaps in the management framework (Mohamed et al., 2009). In addition, absence of healthcare waste management plan at the country level and unavailability of suitable treatment and disposal options can further hinder the waste management efforts (Mohamed et al., 2009). The improper management of medical wastes causes serious environmental problems in the form of air pollution, water pollution and land pollution. The nature of pollutants can be classified as biological, chemical and radioactive. Environmental problems can arise from the mere generation of medical waste and from the process of handling, treatment and disposal (Manyele, 2004).

Sharps waste a category of infectious or risk waste consists mainly used sharps that can be defined as "any device or object which is used to puncture or lacerate the skin" (Manyele et al., 2010). According to the World Health Organization (WHO), used items like syringes and needles, intra-venous (IV) tubing with needles attached, giving sets, scalpel blades, knives, lancets, blades and broken glass, form a class of medical waste known as sharps waste (WHO, 2005). This type of waste is classified as hazardous waste which requires careful handling (Taghipour and Mosaferi, 2008). The commonly known sharps includes syringes, needles, scalpers, blades, sets for infusion, saws and knives, damage glass pieces, and all those things or products which can cut or pierce etc. According to estimation, each year 16 billion injections are administered worldwide for preventive and curative purposes

(Simonsen et al., 1999). In order to shrink the quantity of sharps wastes, an immediate action is to decrease the amount of superfluous injections. The risk associated with unsafe injections is the transmission of infections from patient to patient, patient to medical staff and also from the medical staff to patients, and to the public at large. Immunization injections producing sharps are found to be insecure with more or less 30% of them are either re-used or recycled throughout the world (Simonsen et al., 1999). Realizing the associated problems with reusable sharps, the World Health Organization (WHO), United Nations International Children Emergency Fund (UNICEF) and United Nations Population Fund (UNPF) in 1999 jointly issued a proclamation on the need to use auto-disable (AD) injections and safety boxes in vaccination campaigns (WHO, 2005). The joint proclamation urged that all the nations must use only auto-disable injections for inoculation or vaccination by the end of 2003. For achieving the goals, every partner has decided to finance not only the vaccine but also safe and sound administration devices and disposal units and will support related education, supervision and sensitizing actions for ensuring secure vaccinations. But the most important challenge related with the use of auto disable syringes is the volume of waste that will be generated in the process and its management.

Since sharps waste is a perilous material, so, sharps waste injuries can cause a huge community health apprehension. By piercing the skin, there is possibility that this waste can spread blood-borne pathogens, which is straightforwardly liable for transmitting blood-borne diseases such as Hepatitis B (HBV), Hepatitis C (HCV), and HIV (Shapiro, 1995). When the health specialists handling sharps waste, they are rendering themselves to the hazard of transmitting such diseases. The incidence of injuries increases with the increase in amount of such waste; the healthcare professionals are handling on daily basis. The general public is also at direct risk from sharps waste injuries. If the sharps waste is not separated from general waste, the persons unintentionally come in contact with these hazardous materials. Further, if

this hazardous material is not disposed of and is not removed from the surroundings, there is possibility of its re-use and misuse both intentionally and unintentionally. It is particularly valid in those regions where blades and hypodermic needles are used in huge amounts.

In developing nations, the sharps waste is of great concern. The developed countries have made advancements in sharps waste management like using non-burn technologies i.e., needle cutter/destroyers, chemical disinfection, autoclaves and microwaves and finally disposing them by making sharp pits and encapsulation, which is not seen in developing regions. Implementation of the same protocols and technologies become unrealistic because of its striking social and economic differences. In developing regi ons, the high disease occurrence and deficiency of medical professionals intensify the vulnerability associated with sharps waste. Sharps' discarding is a burning issue in developing regions especially when addressing public health (Blair, 2007). As compared to the other regions of the world, the injection wastes in these developing nations creates the major part of sharps waste, and also the use of injections in developing world segment is much more prevalent. The contributors to this increase are the use of injections for therapeutic purposes. In developing regions, it has been reported that about 95% of all the injections are used for therapeutic purposes (Simonsen et al., 1999). The diseases which are treated with injections include the fever symptoms, upper respiratory infections, colds, infections of ear and skin, diarrhea, fatigue etc. Each person receives an average of 8.5 injections a year throughout the world (Simonsen et al., 1999). AD syringes, a newly developed injection technology and single handed capping mechanisms, are not often used to administer these injections because of its higher cost which is unaffordable for the people of these regions, instead, normal disposable syringes are used (Harner, 2004). The infrastructure in the developing countries is not well outfitted to handle this huge amount of unhygienic sharps waste. As compared to the developed world, the incinerators for disposal and the network for carrying such waste also do not exist. The

buying of solitary use disposable containers becomes idealistic because of the cost restraints. The unsafe mass of sharps waste especially the inoculation devices are left in the surrounding which can lead to accidental needle sticks, reuse, or mishandling. The comparison between the developed and less-developed world fragment can also be seen within the form of unplanned or unintentional Needle Stick Injuries (NSIs). The rate of NSIs in developed regions is about 0.18 to 0.74 per individual for each year, whereas, in rising or emerging countries, it is about 0.93 to 4.68 per individual for each year (Hutin et al., 2003).

Improper sharps management is a major factor involved to declare these sharps as unsafe injections. Annually, about 21 million new HBV cases, 2 million new HCV cases, and 260,000 of new HIV cases are reported throughout the world (Dziekan et al., 2003). Between 2000 and 2030, such diseases are modeled to charge the general public more than 270,000 lives each year (Armstrong and Bell, 2002). Additionally, it has been shown that most exposures to disease among healthcare workers in developing regions are attributable to sharps waste injuries. Percutaneous occupational exposures are responsible for about 40-65% of new HBV and HCV (Pruss-Ustun et al., 2003). In developing regions, the majority of death, disability, and ailment cannot be accredited only towards the poor management of sharps wastes. Conversely, the efficient and realistic management promotes civic healthiness and minimizes the increase of diseases.

A needle stick injury can be defined as "a percutaneous piercing wound by a needle and also by other sharp instruments or objects". The hazard related with NSIs is the spread of blood borne diseases like Hepatitis B Virus (HBV), the Hepatitis C Virus (HCV) and the Human Immunodeficiency Virus (HIV), the virus which is responsible for causing AIDS. Needle stick injuries have been ignored and the majority of them are not reported, regardless of their significance as a medical incident (Mulder, 2005). The needle sticks as a professional hazard, their prevention has become the subject of regulations in an effort to

minimize and remove this preventable event (Pruss-Ustun et al., 2005). The frequency of needle stick injuries in USA alone has been likely to be more or less 800,000 cases (Rivers et al., 2003). Another investigation estimated that globally about 3.5 million individuals have been affected by such injuries (Pruss-Ustun et al., 2005). Among all the healthcare workers, nurses and physicians are particularly at risk (Chalupa et al., 2008), another investigation shows that among the American surgeons community, approximately each surgeon has experienced at least single such type of injury throughout their training (Makary et al., 2007). The risk of NSIs is different in different specialties, so, the surgery, anesthesia, ENT, internal medicine, and dermatology have a tendency to show comparatively high rate of injuries as compared to radiology and pediatrics (Diprose et al., 2000). About two quarters or more events are not reported as the injured healthcare workers has no time for reporting, downplay the hazard, or otherwise fear stigmatization and professional cost (Mulder , 2005). Needle stick injuries may occur not only with freshly contaminated sharps, but also, after some time, with needles which carry dry blood. After few hours, the infectiousness of Human Immunodeficiency Virus and Hepatitis C Virus decreases, but Hepatitis B Virus remains stable in desiccation and contagious for over a week (Kesieme et al., 2011).

The lack of a sound medical waste management structure, the hazard related to sharps waste reuse produced from inoculation and the ecological impact from inappropriate disposal are the most important concerns which requires to find solution on urgent basis. The communicable diseases through sharps waste are preventable if it is properly managed and disposed off. For needle stick injuries prevention, it is required to take several preventive steps at numerous stages and also to reduce or eliminate the utilization of sharps to a great extent if possible, engineering controls like needles along with protection devices, the organizational controls which includes guidance and the provision of sufficient resources, and work practice controls; the other steps include the use of instruments not fingers to grab

needles, load scalpels, and avoid direct passing of sharp instruments without any safety (Chalupa et al., 2008). From the engineering point of view, the advances include the improvement of safety needles in addition to needle removers. The adherence to "no-touch" protocols which reduce or remove the direct contact with needles during their utilization and also in their discarding can significantly minimize the hazard of injuries. The blunted-tip stitching needles in the surgical setting are able to minimize needle stick injuries (Val et al., 2007). For the protection of healthcare workers, some countries have enacted legislation. The needle stick safety act in the year 2000 and blood borne pathogens standard in the year 2001 was signed in the US. These regulations authorizing the utilization of safety devices and needle-removers by any sharps or needles (Jagger et al., 2003).

1.1. Objectives of the Study

- Assessment of present status of hospital waste management particularly sharps waste management and its effects on the health of the medical staff in both public and private sector hospitals in district Peshawar.
- Identifying the inefficiencies and ineffectiveness in the present hospital and sharps waste management system.
- Creating awareness regarding the risks associated with improper sharps waste management among the healthcare staff.

1.2. Significance of Study

- This will be helpful for the decision makers to think and initiate efforts for its proper management, making and enforcing strict rules and regulations regarding sharps waste handling and treatment in order to protect the medical staff and general community from the injuries and diseases associated with sharps waste.

- This study will be also helpful in creating awareness regarding the risks associated with improper sharps waste management among the healthcare workers.
- This study could be a platform for conducting more research on such issues in a more comprehensive way.

CHAPTER 2 LITERATURE REVIEW

Asia is the largest and most populous continent, which has grown richer and faster than any other region of the world (Ananth et al., 2010). Evidently, all kind of developmental activities leave behind waste up to some extent, which have to be managed properly. It is a common fact that ineffective and inefficient management of refuse or trash is one of the pressing ecological issue or problem faced by many cities, especially in the developing nations (Coker et al., 2009). Healthcare services are also included in an industry producing a high quantity of waste. The conditions of hospital waste management is very severe in the developing world, because of fulfilling their food requirements, shelter and clothing, which is the prime concern for governments of Asian developing nations, so, their concentration for the secure discarding of hospital waste is generally diluted (Ananth et al., 2010) . Although, the healthcare services are gaining their aims and objectives of minimizing health risks and eliminating or diminishing the possible human health hazards and also increasing the human life expectancy. But on the other side, they are inevitably creating waste that can be itself posing a health hazard (Pruss et al., 1999). It is also a fact that medical and healthcare wastes have been significantly raised in the last few decades. The reason behind its increase is rise in inhabitants, figure, and dimension of medical facilities and also the increase in the utilization of disposable healthcare products (Mohee, 2005). The World Health Organization (WHO), for many years has advocated that healthcare refuse should be consider as an exceptional trash (WHO, 1985), and at present, it is now generally recognized that some categories of hospital refuse are included in the most harmful and potentially perilous of all kinds of trash produced within the community. Hall (1989) defines medical wastes as "those waste which is produced in the healthcare facilities, such as hospitals, clinics, doctor's offices, dental offices, and veterinary offices and other medical laboratories and research facilities". The Chinese defines healthcare wa stes as "those wastes characterized by infections, toxic, and oth er

hazardous properties, deriving directly or indirectly from medical treatment, prevention, health protection and other related activities in healthcare institutions" (Yang et al., 2008). When healthcare waste is improperly managed, then it causes serious environmental pollution such as air pollution, water pollution and soil pollution, distasteful smells, can increase the intensification and development of insects, rodents, and worms and also can leads towards disease transmission like Typhoid, Cholera, Human Immunodeficiency Virus (HIV), and Hepatitis both B and C (Abdullah et al., 2008). Looking into the current practices of waste handling, the probability is that a large number of such diseases may be linked with inappropriate contact with medical refuse. In the developing and transitional world, the healthcare waste is still handled, treated and discarded with municipal waste, which are creating immense health hazards to medical staff, municipality, the general public and also the surroundings (Da Silva et al., 2005).

Sharps are one of the categories of healthcare waste s and are acknowledged as hazardous or risk waste. Sharps includes hypodermic needles, syringes with or without attached needles, Pasteur pipettes, scalpel blades, blood collecting vials, needles attached with tubing, culture dishes, suture needles, slides, cover slips and other broken or unbroken glass or plastic ware that have been in contact with infectious agents or used in patient care or treatment (Khan et al., 2005). The quantity of sharps, throughout the world is approximately 1% of the entire waste generated from medical facilities (Khan et al., 2005). According to WHO estimation, more than 16 billion injections are administered annually throughout the world (WHO, 2004). The needles and syringes are not properly disposed of, due to which there is a peril of injury, infection and also the chances of its re-use. The African, Asian, Central and Eastern European nations are the areas where the needles and syringes are re-used for injections (Bari et al., 2001; Raza et al., 2001). An additional hazard in the developing nations is scavenging and manual sorting of waste, which is occurred at the waste

disposal sites. These actions are noticed in various regions of the globe, the instant risks associated with such practices and actions are in the form of needle stick injuries and contact with toxic or contagious materials (Khan et al., 2005). The Needle Stick and Sharps Injuries (NSSLs) are also the most important occupational injuries among the medical staff (Sepkowitz, 1996). A Needle stick or sharps injury can be defined as "The par literal introduction into the healthcare worker body, in the performance of their duties, of blood or other potentially hazardous material by a hollow bore needle or sharps items, including, but not limited to needles, lancets, scalpels, and contaminated broken glass" (Ng et al., 2002). Needle stick and Sharp injuries can also cause infections if they are contaminated with pathogens (Ayranci and Kosgeroglu, 2004). These injuries have the potential of transmitting various infectious agents, like HBV, HCV and also the HIV (Shapiro, 1995). A rise in the occurrence of such lethal infection because of its greater exposure to microbes and viruses that can cause blood borne diseases, like HIV, HBV and HCV, and other diseases like Typhoid, Cholera, Tetanus has led the health community to think and start hard works for its prevention and also to limit the exposure in healthcare staff (Siddique et al., 2008). Sharp Injuries and needle sticks are responsible for the communication of over 40 different pathogens, also including HBV, HCV and HIV (Khan et al., 2005). Sharp waste as compared to other waste categories has the highest potential for disease transmission. About 85% of injuries with sharps are occurred in the usage and subsequent disposal and about 20% or more are occurred in those who handle them, in the form of "stick" injuries (Khan et al., 2005). The risk associated with transmission varies according to specific blood borne pathogen after percutaneous exposure to infected blood. The risk for HBV can be up to 30% depending on serological markers presence in patient blood. The risk of HCV transmission is up to 3-4% while the risk of transmission for HIV is 0.3% (Beltrami et al., 2000). A rise in the reported cases of blood borne infections in healthcare workers has been noted since 1980,

and also a concomitant increased awareness regarding work related or professional risks of blood borne virus conduction (May and Brewers , 2001). By the year 1990s, about 600000–800000 needle stick injuries has occurred per annum, on the average of about 2000 every day, due to which about 1000 healthcare workers contracted serious blood borne sickness like Hepatitis C or HIV (Lee et al., 2005). A recent studies reviews that the rate of sharps injury/10000 healthcare workers/year ranges between 113-623 (1%-6.2%) with a mean of 405 (4%) (Trim and Elliott, 2003). The published data is about the reported registered cases only; the real figure can be much more as most of the cases go unreported (Trim and Elliott, 2003). And we cannot determine or find the exact data, until the healthcare workers does not knowing or understanding the importance of reporting such injuries (Elliott et al., 2005). Another study indicates that about 60-95% of the exposures are not reported by house staff (Ferguson, 1992). Since, the risk of injury for each use is small, but several needles utilized in the medical settings, even at a very low pace of injury translates into a striking number of injuries (Carsley et al., 1997). The transmission of infectious diseases and probable exposures are not restricted to needle stick alone, but also the other sharp instruments or mucous membrane exposures to contaminated bodily fluids can also results in the conduction of such contagious diseases (Siddique et al., 2008). Some other studies showed that globally about 1/3rd of the inhabitants have been infected by HBV; more or less, 350 million individuals are lifelong carriers. The WHO estimated that about 170 million individuals throughout the world are infected with HCV (Hamid et al., 2007). The UNAIDS estimated that about 39 million people throughout the world are positive with HIV as of December, 2006 (UNAIDS/WHO, 2009). EPINet System provided the data that the hospital employees acquire about 30 needle stick injuries/100 beds/per annum on average, an alarming figure by no exaggeration (EPINet, 2003). The HBV and HCV infections are amongst the major health challenges faced by the rising or non-developed world today. The results of a study

conducted shows that about 90% of all needle-stick injuries occurred in nurses of third world countries due to the lack of knowledge, resources and training (Zafar et al., 2009). About 2 million needle-stick injuries are reported to occur in healthcare providers every year (Wilburn and Eijkamans, 2004). But these are only the reported cases, because in developing nations, about 40-70% cases of needle-stick injuries go unreported (Wilburn and Eijkamans, 2004). A European survey of needle stick injury indicates that nurses (91%) are the only group in healthcare providers, which are more exposed to needle stick injuries as compared to doctors and phlebotomist (Wilburn and Eijkamans, 2004). A survey of WHO indicates that in the year 2000, about 16000 HCV, 66000 HBV and 1000 cases of HIV might have occurred globally in medical staff especially nurses because of their exposure to needle stick injuries (Merchant, 2006). According to World Health Organization Regional Classification (WHORC), Pakistan comes in the region of Eastern Mediterranean, Region D (EMRD). Unfortunately, as compared to the entire world, this region has the highest rate of needle stick injuries (Pruss-Ustun et al., 2005). An Indian study revealed that most of the needle-stick injuries occurred in nurses among medical staff (Mehta et al., 2005).

In Pakistan , the estimated occurrence of Hepatitis B within the population is about 4% and the occurrence of Hepatitis C is 6% (Abbas et al., 2003) (Hamid et al., 2003), while the occurrence of HIV/AIDS in Pakistan among the general population is 0.1% , whereas , the elevated-risk inhabitants occurrence is as 1-2% (Saleem et al., 2010). According to the most recent statistics, HIV/AIDS occurrence among Intravenous Drug Users (IDUs) is at alarming rate and has been reported to be 7.6% to 27% (Rai et al., 2007). According to data from Center for Injection Safety, in Pakistan, the occurrence of HBV disease in commercial blood donors is 10% while the occurrence of HCV disease for commercial blood donors is 20% (Choudhary, 2009). Most of the patients come for admissions, consultations, procedures

and bio-chemical investigations to healthcare facilities every day where they are encountered by unwary healthcare workers.

Some studies have been conducted in different developing countries on sharps waste management. A study conducted by World Health Organization in India in the year 2005, and Manyele and Mujuni in Tanzania in the year 2010 has made research on this issue. In both these developing countries along with Pakistan, there is lack of resources, knowledge, training, and facilities. In all these three countries also included other developing regions, the infectious waste particularly sharps waste is still mixed with other non-infectious or general waste. These developing regions are still unaware of the danger involved in improper sharps waste management. The incinerator and open dumping are the options used for the disposal of sharps waste, which are not safe options. Improper sharps waste treatment and disposal results into risk to healthcare workers, the public and environment. In developing countries, an irrational and unsafe injection practices are riffed (Rajasekaran et al., 2003). Through the use of safety devices and effectively safety programs over 80% of the needle stick and sharp injuries can be prevented (Ng et al., 2002). By applying "Universal Precautions" as a protection measure in healthcare facilities, needle-stick injuries can be prohibited (Danchaivijitr et al., 1995).

CHAPTER 3 MATERIALS AND METHODS

3.1. Study Area

The study was conducted in Peshawar, the capital city of Khyber Pakhtunkhwa (KPK) and the administrative center and an economic hub for the Federally Administered Tribal Areas (FATA) of Pakistan. Peshawar is located in a large valley near the eastern end of the Khyber Pass. Known as "City on the Frontier", Peshawar's strategic location on the crossroads of Central Asia and South Asia has made it one of the most culturally vibrant and lively cities in the greater region. Peshawar is irrigated by various canals of the Kabul River and by its right tributary the Bara River.

The total covered area of Peshawar is 1257 km^2 (485.3 Sq. mi), and comprising 25 union councils. The city was selected for the study because of large number of medical facilities and high number of patients not only from Peshawar but also from the adjacent areas of Peshawar, FATA, northern areas of KPK and even from the neighboring country Afghanistan.

3.2. Sample Size

In this study six hospitals were selected. All the hospitals are teaching hospitals and linked with medical and nursing colleges. In these six (06) hospitals, three (03) were government tertiary care hospitals namely Lady Reading Hospital (LRH), Khyber Teaching Hospital (KTH) and Hayatabad Medical Complex (HMC), having bed capacity of 3400. These three (03) hospitals comes in the category of 'Tertiary Care Unit', because it contains modern equipment and abundance of specialists qualified in dealing a variety of health

problems, and furthermore, these hospitals are also used as a referred hospitals to various other healthcare facilities in district Peshawar. Large hospitals with the ability to handle uncomplicated to fairly complicated health problems are categorized as secondary healthcare facilities (HCFs), and including two (02) private hospitals namely Kuwait Teaching Hospital (KuTH) and Al-Khidmat Hospital (AKH) and one (01) government Maternity Hospital (MH), with a combined bed capacity of 340. The total persons interviewed were 99, in which 76 were interviewed at govt. sector and 23 were at private sector hospitals. Beside these six (06) healthcare facilities, data was also collected from primary healthcare facilities like thirty five (35) private clinics, two (2) government dispensaries and one (1) government center for Extended Program on Immunization (EPI) attached with mother and child health center were personally visited. The management system for hospital waste particularly sharps waste of each hospital was investigated, while collecting information on segregation process, handling, storage, transportation and disposal options.

3.3. Data Collection

The primary data regarding sharps waste management in each healthcare facility was collected using a simple data collection checklist based on the National Institute of Health (NIH) and World Health Organization (WHO) Sharps Waste Management Assessment Tool. People interviewed during the study were nursing staff, paramedical staff, doctors and pathologist, and other relevant people. The assessment was about the total waste and sharps waste generated in these facilities, number of Hepatitis positive patients (both B and C) and HIV positive patients visited per month, vaccination given to staff against Hepatitis, healthcare workers infected with Hepatitis, segregation of wastes, use of protective clothing during segregation, handling and transportation, needle stick injuries occurred in staff, storage and transportation system of waste, treatment and disposal options. The secondary data was collected from previous reports in Department of Environmental Sciences,

University of Peshawar, Environmental Protection Agency (EPA) Peshawar, Health Department, KPK, and also reports and articles available at net.

3.4. Data Analysis

The data collected was entered in Microsoft Excel, a pre-created database, and was then analyzed by Statistical Package for Social Sciences (SPSS 16.0).

CHAPTER 4 RESULTS AND DISCUSSION

4.1. Results

According to the data collected from hospitals and other sources, the total waste and sharps waste produced in these 06 government and private sector hospitals on daily basis in Peshawar city are given in Table 1 and 2.

Table 1 Total waste (infectious and non-infectious) generated in hospitals

Sector	Hospital Name	Total waste generated/day (Kg)
Government Hospitals (GH)	Lady Reading Hospital (LRH)	2000-2200
	Khyber Teaching Hospital (KTH)	2000-2200
	Hayatabad Medical Complex (HMC)	700-900
	Maternity Hospital (MH)	50-70
Private Hospitals (PH)	Kuwait Teaching Hospital (KuTH)	100-120
	Al-Khidmat Hospital (AKH)	40-50
Combined total waste		4890-5540

Table 2 Total sharp waste generated in hospitals

Sector	Hospital Name	Sharp waste generated/day (Kg)
GH	Lady Reading Hospital (LRH)	40-70
	Khyber Teaching Hospital (KTH)	40-70
	Hayatabad Medical Complex (HMC)	20-40
	Maternity Hospital (MH)	05-10
PH	Kuwait Teaching Hospital (KuTH)	05-15
	Al-Khidmat Hospital (AKH)	05-10
Combined total waste		115-215

Some examples of sharps waste are given in Figure 1 and 2 below. The main portion of these sharps waste includes used syringes, followed by other sharp items.

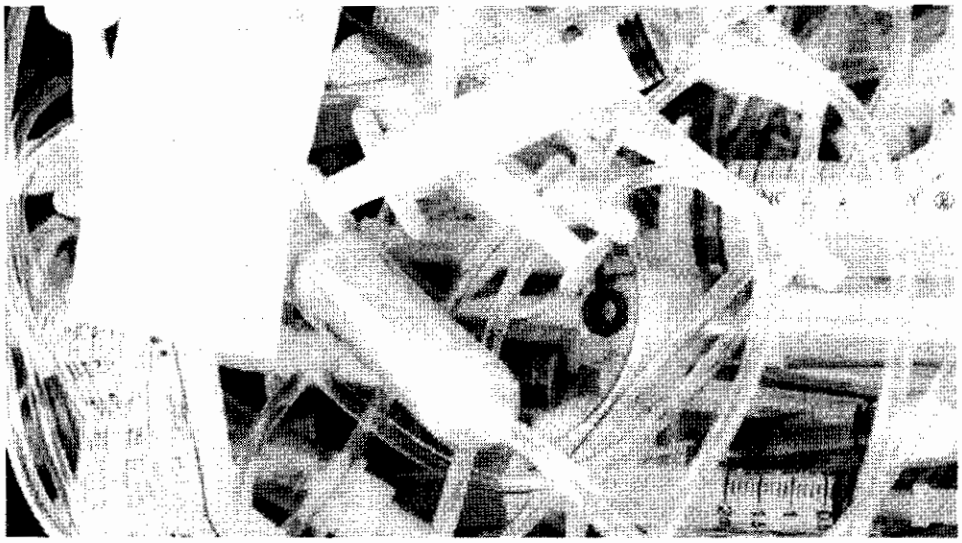

Figure 1 Sharps waste after use within these hospitals

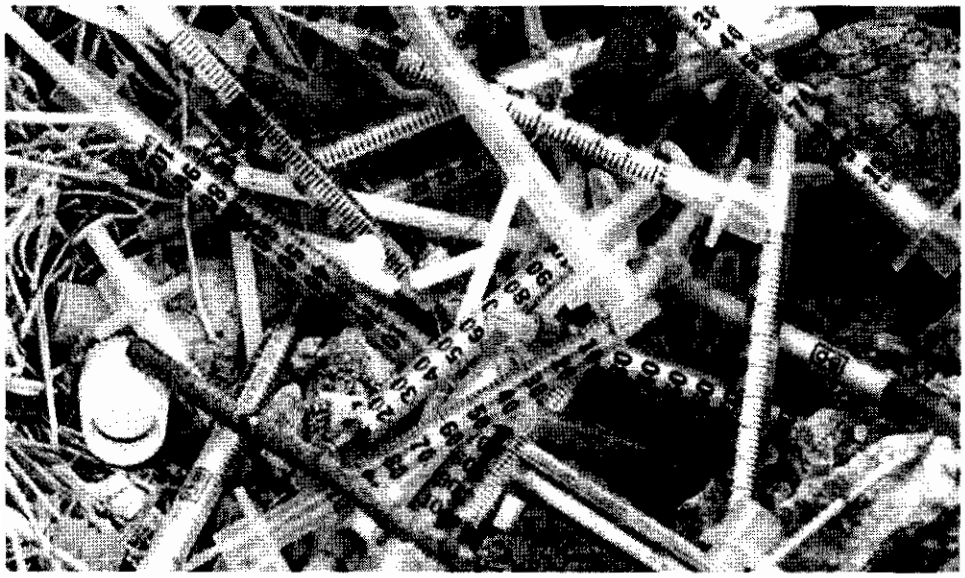

Figure 2 Used syringes in the hospitals

4.1.1. Patients and workers infections

According to the data collected from different wards and hospitals' record, about 630 to 1800 hepatitis positive patients were registered each month, on the average of about 21 to 60 patients per day in government sector hospitals, and the number of HIV positive patients in

GH was up to 4 or above. While in PH about 30 to 150 hepatitis positive patients and up to 2 or 3 HIV positive patients were registered each month (Table 3).

Table 3 Hepatitis and HIV positive patients in hospitals

Sector	Disease	No. of patients/ month	No. of staff responded	Percentage of staff responded
GH	Hepatitis	30-600	8	10.5
		630-1200	23	30.3
		1230-1800	23	30.3
		1830-2400	15	19.7
		2430-3000	7	9.2
	HIV	0 – 4	53	69.8
		5 – 9	23	30.2
PH	Hepatitis	30-150	13	56.5
		180-300	10	43.5
	HIV	0 – 1	10	43.5
		2 – 3	13	56.5

4.1.2. Segregation, handling, storage and transportation

For easy and safe handling of the sharp waste, it is important to label properly the storage bags and containers. Figure 3 shows the status of using labeling or color-coding during the process of segregation at government and private sector hospitals. About 92% of the government sector hospitals and about 65% of the private sector hospitals are using labeling or color-coding during segregation. Figure 4 and 5 shows the process of segregation and the persons which are involved in the process of segregation, which are not properly equipped when segregating waste in both government and private sector hospitals.

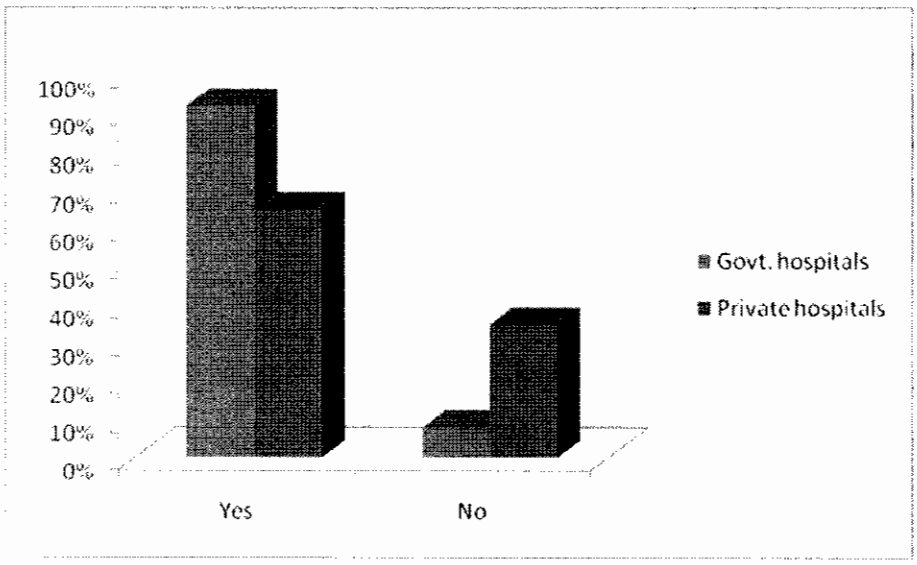

Figure 3 Labeling or color-coding during segregation in GH & PH

Figure 4 Segregation in government sector hospitals

Figure 5 Segregation in private sector hospitals

During handling many workers are injured by the sharp waste esp. needles and in turn get infected with communicable diseases like Hepatitis and HIV. According to the data about 30% workers got injuries by sharp waste during handling in government as well as private sector hospitals. Because of injuries, about 37% workers in government hospitals and 30% workers in private sector hospitals were infected with hepatitis. To protect the health workers from such like incidence, they need to be vaccinated against Hepatitis, etc. The data provided by the health workers showed that only 43% workers in government hospitals and about 61% in private sector hospitals were vaccinated against Hepatitis (Table 4).

Table 4 Needle injuries, vaccination and infections of hospitals' workers with Hepatitis

Sector	No. of staff responded	Vaccination		Needle injuries		Infection	
		Yes	No	Yes	No	Yes	No
GH	76	43%	57%	30%	70%	37%	63%
PH	23	61%	39%	30%	70%	30%	70%

During segregation and handling of sharp waste, precautions and protective measures are important to avoid any incidence of infections among health workers. The data provided by the health workers showed that about 74% of the workers both in government as well as

private sector hospitals were using protective measures like cloths, masks, gloves, etc. during segregation, storage and other handling processes. While during transportation of these wastes, about 79% of the workers in government sector hospitals and 78% of the workers in private sector hospitals were using protective measures (Table 5).

Table 5 Use of separate waste bins for sharps waste and using other protective measures in hospitals

Sector	No. of staff responded	Using waste bins		Protective measures			
				During segregation		During transportation	
		Yes	No	Yes	No	Yes	No
GH	76	72%	28%	74%	26%	79%	21%
PH	23	61%	39%	74%	26%	78%	22%

Table 5 also indicates the status of using separate waste bins for the collection of sharps waste at government and private sector hospitals. About 72% of the government hospitals and 61% of the private hospitals are using separate waste bins for sharps collection. Some of the staff in these selected hospitals is using no protective clothing during handling sharps (Fig. 6)

Figure 6 A nurse handling sharps having no proper protective clothing

Table 6 Types of containers for the storage of wastes in hospitals

Sector	No. of staff responded	staff responded about containers used	
		Plastic bags	Plastic container
GH	76	83%	17%
PH	23	87%	13%

Table 6 show the types of containers used for the storage of wastes at government and private sector hospitals. About 83% of the government hospitals are using plastic bags and 17% of the hospitals are using plastic containers for the storage of all types of wastes. Similarly, about 87% of the private hospitals are using plastic bags while 13% of the hospitals are using plastic containers for the storage of all types of wastes.

4.1.3. Treatment and disposal options

Table 7 Sterilization of sharps instruments in hospitals

Sector	No. of staff responded	staff responded about Treatment options	
		Autoclaving	Boiling
GH	76	65%	35%
PH	23	61%	39%

The sharp instruments in the hospitals are sterilized for reuse. The treatment methods used in both government as well as private sector hospitals are either autoclaving or boiling. According to 65% of the government hospitals' workers and 61% of the private sector hospitals' workers, autoclaving is done to sterilize the sharp instruments. On the other hand, 35% government hospitals' workers and 39% private hospitals' workers confirmed that boiling of sharp instruments is done for sterilization (Table 7).

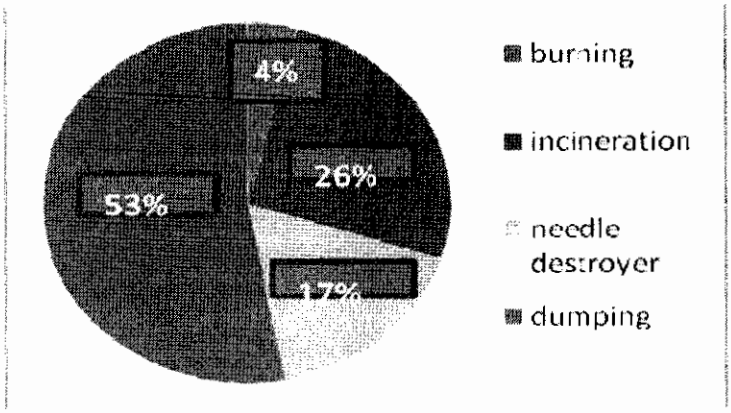

Figure 7 Injections disposal methods in government hospitals

About 4% of the government hospitals are burning the injections in open, 26% of the hospitals are using incinerators, 17% of the hospitals are using needle destroyer or syringe cutter, and 53% of the hospitals are using the option of dumping (Fig. 7).

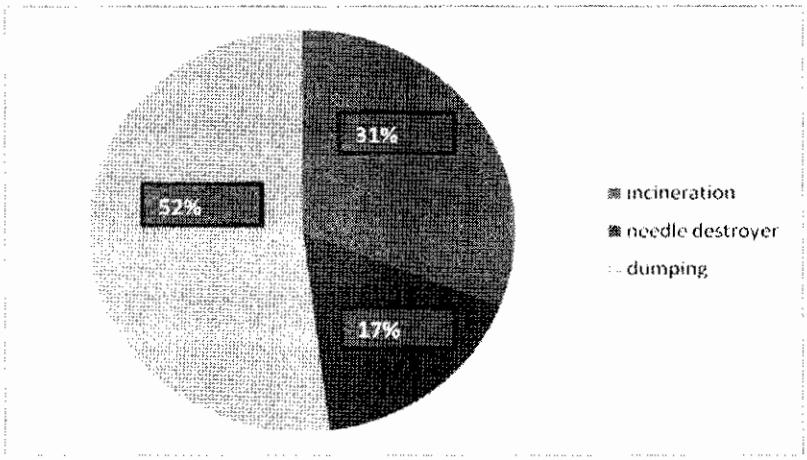

Figure 8 Injections disposal methods in private sector hospitals

Figure 8 shows the disposal methods for injections and other types of wastes provided at private sector hospitals. About 31% of the hospitals are doing incineration, 17% of the hospitals are using needle destroyer or syringe cutter, and about 52% of the hospitals are using the option of dumping.

Table 8 Air pollution control devices installed at incinerator in hospitals

Sector	No. of staff responded	staff response about air pollution control devices	
		Yes	No
GH	76	66%	34%
PH	23	65%	35%

About 66% of the officials in government sector hospitals have confirmed that they have installed air pollution control devices at the incinerator. Similarly, according to 65% of the officials of private sector hospitals' have confirmed that they have installed such devices at the incinerator (Table 8).

Healthcare waste is often burns in an irregular manner at the dumping sites. This can cause different air pollution problems and are affecting both the surrounding and general public (Fig. 9 and 10).

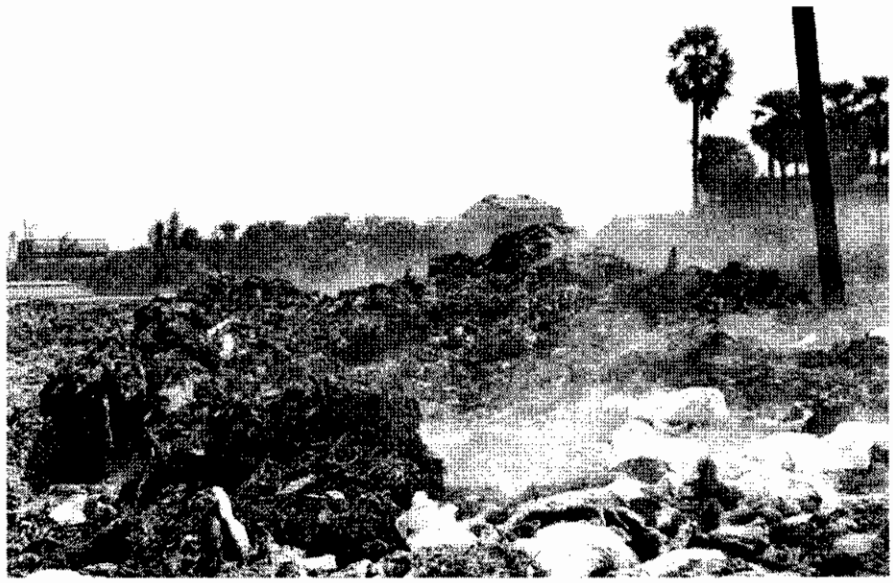

Figure 9 Burning of hospital waste at dumping site

Figure 10 Burning of hospital waste at dumping site

Figure 11 Open dumping of hospital wa ste at dumping site

Figure 12 Scavenging hospital waste at the dumping site

Figure 11 show that there is no proper check on the disposal of hospital waste. The waste is openly dumped at the dumping site, and the site is not properly designed even have no boundary wall. In such a case, there are increase chances of scavenging as shown in Figure 12, where this waste is collected and sold on low prices in local markets, where it is cleaned and made available for reuse.

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Table 9 Chi-Square Tests for association between the use of protective measures during segregation and handling of wastes and number of Hepatitis cases in hospitals' workers

Parameters	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	38.749[a]	1	.000		
Continuity Correction[b]	35.961	1	.000		
Likelihood Ratio	39.947	1	.000		
Fisher's Exact Test				<0.000	<0.000
Linear-by-Linear Association	38.332	1	.000		
N of Valid Cases[b]	99				

The association between the protective measures during segregation and handling of wastes and the health workers' infection with hepatitis was confirmed through statistical

analysis. The results showed that there exist significant correlation between protective measures and hepatitis infections as *P* value is less than 0.005 (Table 9).

Further, the results showed that significant association exists (*P* value <0.005) between the needle stick injuries occurred in healthcare workers and the number of staff infected with Hepatitis in both government and private sector hospitals (Table 10).

Table 10 Chi-Square Tests for association between needles stick injuries in staff and number of Hepatitis cases in hospitals' workers

Parameters	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	33.278[a]	1	.000		
Continuity Correction[b]	30.698	1	.000		
Likelihood Ratio	33.936	1	.000		
Fisher's Exact Test				<0.000	<0.000
Linear-by-Linear Association	32.920	1	.000		
N of Valid Cases[b]	99				

Table 11 Chi-Square Tests for association between vaccination given to staff and the number of workers infected with Hepatitis

Parameters	Value		Df	Asymp. Sig. (2-sided)
	GH	PH		
Pearson Chi-Square	95.246[a]	1.108E2[a]	4	<0.000
Likelihood Ratio	90.370	108.460	4	<0.000
N of Valid Cases	76	23		

Table 11 shows that significant association exists between the vaccination given to staff and the number of workers infected with Hepatitis in government as well as private sector hospitals (P <0.005).

4.2. Discussion

Many countries has established strict guidelines regarding managing the infectious waste in the medical settings including the World Health Organization. Since, the sharp wastes is also included in the category of infectious or risk wastes, so, the proper management of sharps waste is very important especially to control the blood borne diseases. The management of sharps waste includes placing the separate containers for sharps collection including syringes, using the puncture proof containers, avoiding overflow, and preventing sharps waste spreading inside and outside the hospital, and also proper disposal of sharps. Needle stick injuries is a serious problem among the healthcare staff and also to the general public as experienced by many healthcare workers in the present study and also reported from literature (Abu-Gad and Al-Turki, 2001; Memish et al., 2002).

The sharps should be immediately destroyed or disposed of after its use, which is not seen in any of the hospital at the study area. Syringes along with needle attached should be directly put into an approved sharps receptacle after its use, but normally, they are mixed with other wastes. Using proper containers and safety boxes for sharps can protects the healthcare workers, other staff dealing with waste and the transporters (Jagger et al., 2003).

The total waste including infectious and non-infectious waste generated in these selected healthcare facilities is approximately over 5000 kg per day, in which the quantity of sharps waste ranges between 115 to 215 kg per day. This huge amount of waste including sharps waste requires proper handling, treatment and disposal in order to protect the environment and also the general community, because if such amount of waste is improperly managed, it causes infections and diseases. As we noticed in the study area that about 630 to 1800 hepatitis patients in government hospitals and 30 to 150 patients in private hospitals were registered each month in these selected hospitals. Similarly, a little amount of HIV patients and patients involved in different diseases in both sector hospitals were registered each month. There should be several reasons for this infections and diseases, but when we observe

the present practices of waste handling, the probability is that a large number of such diseases may be linked with improper waste management, as seen at the study area. Both the infectious and non-infectious waste is still mixed with municipal waste. Some other studies are also reporting such problems. Carefree handling and disposal of medical waste impacts both directly and indirectly on staff, patients and the environment. This is because a hospital represents a unique environment, providing healthcare to patients and as a work environment for medical and other staff (Sobotova et al., 2003).

Segregation process is taking place in these hospitals, but there is no proper written instructions have been found and also segregation process is not done according to regulations. Although, labeling or color-coding has been seen about 92% in govt. hospitals and 65% in private hospitals, but only two types of plastic bags have been observed mostly, i.e., White and Black. The symbol of infectious or hazardous materials for segregated waste has not been seen anywhere. Segregation of waste is an important step in waste management. The other studies also shows that the most suitable mean of recognizing the categories of healthcare waste is the categorization of waste into color coded plastic bags or containers (Rao et al., 2004). The conditions of wearing protective clothing during segregation and handling of wastes were also not very well. About 74% of the staff in both the government and private sector hospitals are wearing any protective clothing like gloves and masks etc., but no protective boots, safety glasses, lab coat and heavy duty gloves have been observed anywhere in these hospitals. The percentage of needle stick injuries occurred in medical staff is 30% at both government and private sector hospitals. Nurses are mostly exposed to such injuries as compared to other staff. Many studies indicate that the highest rate of needle stick injuries occurs in nurses (Knight & Bodsworth, 1998), as a consequence of their direct contact of nurses with the patients. It is also noticed in the study area that the most number of affected persons due to needle stick or sharp injuries were nurses. The suitable way for the protection of medical staff from injuries is to insist on the proper sharps waste management

system and using proper protective clothing like lab coats, gloves, safety glasses, aprons, protective footwear and heavy duty gloves (CDC, 1998).

The improper sharps waste management is directly linked with the conduction of blood borne diseases like Hepatitis B (Carrilho et al., 2004), Hepatitis C (Alter, 1997) and HIV (Bell, 1997). Such problems are also reported from the study area, and about 37% of the staff in government hospitals and 30% of the staff in private hospitals was infected with Hepatitis (either B or C). Many studies are also reporting such problems, which make it necessary to take steps for protecting the medical staff and also the community (Jahan, 2005). Vaccination given to staff is also a step to protect the healthcare workers from such infections. When a person experience a needle stick injury used on an infected patient, they should be properly vaccinated. The status of vaccination given to staff is also not good in these hospitals. About 43% of the staff in govt. hospitals and 61% of the staff in private hospitals is vaccinated against Hepatitis. For the proper management of sharps waste, it is necessary to use separate waste bins for the collection of sharps waste. The percentage of using separate containers for sharps waste is 72% at government sector hospitals and 61% at private sector hospitals. Normally, both sector hospitals are also using single container for both the infectious and non-infectious wastes, as observed in many areas of these selected hospitals.

The waste is stored before final disposal inside the hospital premises at a storage area or site. The container used for the storage of all kinds of waste is plastic bags and plastic containers. About 83% of the government hospitals and 87% of the private hospitals are using plastic bags for the storage of wastes. The remaining 17% of the government hospitals and 13% of the private hospitals are using plastic puncture proof containers for the storage. Large drums are also used for the storage of wastes in some hospitals. The plastic bags, which are used for storage purpose is not puncture proof and leak proof. Such plastic bags can increases the chances of injuries and leakage and also the sharps will overflow inside and outside the hospital. The reason for using such plastic bags is that it is less costly and easily

available. In order to protect the hospital environment from infections, it is necessary to store the waste inside the hospitals for less duration. The WHO recommended the normal duration of storage of waste which is 24 hours in warm season, when refrigerator is not available and 48 hours in cool season (Manyele et al., 2010). But both sector hospitals are not following these criteria and store their wastes even up to 72 hours or more in some cases. No disinfectant, even the chlorine solution is used in the containers to decontaminate it. The containers are used again and again, but there is no proper treatment to clean it. The sanitary worker is responsible for the transportation of all kinds of wastes. The sanitary workers are also not well equipped during their transportation process. Although about 79% of the sanitary staff at government sector hospitals and 78% of the sanitary staff at private sector hospitals are using protective clothing, but here again they are using only gloves and masks, which cannot protects them from injuries. They are using the facility of wheel barrow for the transportation of wastes, but in some cases even hand transportation has been seen in some hospitals.

Sharps instruments are reused, so, they are sterilized before reuse. The type of sterilization done is autoclave and boiling. About 65% of the government sector hospitals and 61% of the private sector hospitals are using the option of autoclave for sterilization. The remaining 35% of the government hospitals and 39% of the private hospitals are using the option of boiling. But in some cases, no sterilization is done and the instruments are used again and again which can affect not only the patients but also the healthcare workers. The method used for the disposal of injections is open burning, using needle destroyer or syringe cutter, incineration and open dumping. The government sector hospitals are using the option of open burning (4%), incineration (26%), needle destroyer or syringe cutter (17%) and open dumping (53%), while the private sector hospitals are using the option of incineration (31%), needle destroyer or syringe cutter (17%) and open dumping (52%). The other sharps items are completely incinerated in an incinerator. Some of the hospitals have no air pollution

control devices installed at the incinerator. About 34% of the hospitals at government sector and 35% of the hospitals at private sector have no air pollution control devices. As a result emission occurs; this causes air pollution and can affect both the surrounding and the environment, and can cause health problems both in the medical staff and the people living near to the incinerator. The plastic attached to the injections and needles are synthetic compounds, and are present in the surroundings over an extended time period and leads to accumulation, because these are not easily biodegradable by the indigenous micro flora and fauna (Gidarakos et al., 2009). The purpose of treating and disposing the waste is the protection of public health by destroying or isolating the infectious healthcare waste from medical staff, general public, grazing animals and also from the disease vectors. Improper treatment of sharps waste and then improper disposal can results a risk to healthcare staff, the general public and the environmental pollution (Manyele et al., 2010). The ashes from the incinerator are also removed in an irregular manner. In some hospitals, the ashes after removal from the incinerator is placed inside the hospital premises or thrown at the dumping site, some hospitals are burying their ashes. In both the cases, there is a chance of water pollution in those areas where the water table is high. Significant associations exists between the workers infected with Hepatitis and the use of personal protective equipments in segregation and handling, needle stick injuries occurred in staff and also the vaccination given to staff, because in all these cases, the P value is less than 0.005, which shows a significant association in these variables.

Management of sharps waste is a serious problem in most of the hospitals in district Peshawar and rest of the Pakistan hospitals, because of its increasing quantity and continuous generation which is coupled with poor management. In the present study, beside these six healthcare facilities, private clinics, government dispensaries and government EPI center attached with mother healthcare center in different areas of district Peshawar were personally visited and data was collected regarding sharps waste. But the data collected is neither

analyzed nor included in results, because in these primary healthcare centers there is no segregation, handling, treatment and disposal. These primary healthcare units are simply sending their waste directly to the dumping site. Where the scavengers are already present for receiving such type of waste especially sharps like used syringes, and they receive the waste and sold it in local markets on low prices. These syringes are cleaned and make available for reuse. There is severe risk for infections and serious diseases like hepatitis and HIV from the improper waste management of these primary healthcare units. If such kind of waste is improperly handled, treated and disposed off, as observed in the majority of the primary, secondary and tertiary healthcare units in the study area, it can pose a great risk to staff and to the community. Government are required to take steps for its management in both public and private sector hospitals especially the primary healthcare units by making strict regulations regarding sharps waste and strictly enforce that regulations. There should be proper check on all these facilities by regularly inspecting these facilities. This requires a national strategy involving the concerned ministry, doctors association, nurses association, Non Governmental Organizations (NGOs) and other stakeholders. Further, creating national action plans, developing national healthcare waste management guidelines and building capacity at the national level are important activities which can help to minimize risks posed by healthcare waste to the environment and public. For this purpose, workshops and other training programs should be organized by the government for creating awareness in healthcare workers and the public.

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Our society is producing different kinds of waste, in which healthcare waste is one of the categories, which is considered as special waste because of its infectious or hazardous nature. Sharps waste comes in the category of infectious wastes of healthcare waste, and it has the highest potential of transmitting blood borne pathogens which causes blood borne diseases, in which the most significant are Hepatitis B (HBV), Hepatitis C (HCV) and even HIV, a disease which causes AIDS. Therefore, the sharps waste is recognized as a risk waste. Although, the quantity of sharps waste generated in the healthcare facilities is very small as compared to the other waste generated in these facilities, but it required more special attention in handling and treatment. Despite of their seriousness, sharps waste is still mixed and dumped with the general or municipal waste. The conditions of sharps waste management in developing countries like Pakistan is so severe as compared to other developed regions of the world. The developing nations have no exact data about the quantity of waste created in the medical services and also have no information regarding the nature of such waste produced within these medical facilities. Most of the hospitals are not keeping and maintaining a record of it. If in case, the record is found, then it is not up to date. Similarly, at the study area, it has been observed that the sharps waste management is unsatisfactory at both the public and private sector healthcare facilities, especially the primary healthcare facilities in district Peshawar. Both sector hospitals have poor practices regarding sharps waste management. There is no infection control committee or waste management team to conduct sharps waste management in an appropriate way. The persons who are involved in dealing the infectious waste are mostly uneducated and untrained. They have no proper knowledge of dealing with this waste and also these persons are unvaccinated too.

The status of segregation process regarding color-coding, tagging and separate containers placement for sharps segregation is inappropriate, because in many areas, both the infectious and non-infectious wastes are mixed together. The staff is not properly equipped when segregating and handling sharps waste, due to which needle stick injuries are occurring in the healthcare staff, which can cause blood borne diseases in these healthcare staff. Needle destroyer or syringe cutter is provided to the hospitals, but in many cases it is not properly used and syringes along with needles are thrown at dumping sites, where there are chances of scavenging and its reuse.

The sharps waste is interimly stored for a long period of time inside the hospitals. The containers used for sharps waste storage is normally plastic bags which can increase the chances of injuries in the staff dealing with such wastes, because the bags which are used are not puncture proof. The conditions of transportation of wastes are also not good and the person responsible for the transportation of wastes is normally a sanitary worker which is also not properly equipped with personal protective equipment during their transportation of wastes. The sanitary workers are also at risk of needle stick injuries during their transportation process.

Sharps instruments are reused and the sterilization is done for it, but in some cases no sterilization is done. In such cases, there are health risks to both the workers and the community. Syringes with or without needles are sent to the incinerator, as a result emissions occurs which can cause environmental pollution, because some hospitals have no air pollution control devices installed at the incinerator, and can effects the health of the workers and also the local community. The ashes from incinerator is openly dumped at the dumping sites, where there is chances of leachate into the ground water and causes water pollution, especially in those areas where the water table is high.

This study will be helpful for the medical staff in creating awareness in them in these selected healthcare facilities. They will be aware in the future of the risks associated with improper sharps waste management, and will protect themselves from sharp injuries by using proper personal protective equipments.

5.2. Recommendations

The following recommendations are presented for the better management of hospitals' sharp waste:

- The first step is to create awareness about the risk associated with medical waste especially the sharps in both the healthcare workers and the general public. The mass media can play a vital role in taking this step.
- Educated and trained staff should be hired for dealing with such waste. If it is not possible, then educate the present staff with proper training and should be keep updated from time to time.
- Waste should be properly segregated by using proper color-coding and tagging. And there should be separate waste bins for segregation of sharps wastes.
- Infectious and hazardous waste should be labeled with biological hazard symbol (Dashchner, 2000).
- Waste should be collected in good quality bags and containers, from which there is less chances of permeability or perforation and also should be easily handle and should be easily cleaned.
- Separate containers should be placed in each department for the collection of injections and other sharps, and the containers should be puncture proof.

- Wearing of complete personal protective equipments should be necessary during their segregation, handling and transportation of waste.
- Syringe cutter and needle destroyer should be properly and regularly used, if it worn out, then report to the senior and replace it with a new one.
- Reporting system of injuries must be established in every hospital. For this purpose, a proper occupational health department should be established which report the injuries, make recommendations and also create awareness about the risks associated with such injuries.
- Avoid the use of large containers for temporary storage of wastes.
- Wastes should be not stored for more than 24 hours at the storage site or store room.
- Secure and closed containers should be used for transportation.
- Use such facility for the transport of waste, which can be easily handled and can be easily moveable from one place to another or to the final disposal site.
- Try to avoid the disposal of syringes and other plastic materials in incinerator, in order to minimize emissions and air pollution and instead if possible and there is no risk to the health, these plastic materials needed to be recycled.
- For the disposal of sharps, it is necessary to establish sharps pit or the encapsulation of sharps should be done, which is a suitable and economical option for sharps waste.
- For the management of such waste, try to use those technology options which are environmentally and economically sustainable such as using autoclave disinfection, microwave disinfection, mechanical and chemical disinfections etc.

- For the elimination of the presence of pollutants like dioxins and other toxic gases, operate the incinerator at a high temperature (Pruss et al., 1999). Also installed the pollution control devices at the incinerator, in order to reduce air pollution.
- Those materials like pressurized containers and heavy metals like Lead and Mercury should not be incinerated which causes operational problems or produce toxic pollutants.

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