

MEDICAL SOLID WASTE GENERATION AND ASSOCIATED HEALTH PROBLEMS IN BAHAWALPUR CITY OF SOUTHERN PUNJAB, PAKISTAN

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ABSTRACT

Introduction: Management of medical waste generated during the course of health care activities is the worldwide growing problem. This micro-level research explores the kinds of medical solid waste generated and associated health issues in Bahawalpur City. Several health risks are associated with improper medical waste disposal. In Bahawalpur City rules and regulations about the waste disposal are hardly followed and it is difficult to find precise recorded information regarding hospital waste management.

Objectives: The main objective of the study was to estimate the amount of different types of medical waste generated by various sources and associated health problems in Bahawalpur City. It also looked into the health risks and diseases caused by improper waste disposal in the city.

Material and methods: Both primary and secondary data are used for this cross sectional study. For the collection of primary data, 34 hospitals (29 Private and 5 Government) of Bahawalpur City were selected. Field survey was conducted through questionnaire containing 34 queries. The responses of doctors and other concerned people about the medical solid waste generation and associated health problems were noted. The collected data was processed using various geographic techniques to summarize the results and reach the conclusion.

Results: It was found that government hospitals are major source of waste generation in Bahawalpur. The residents are suffering from many health problems originating due to the improper management of hospital waste. Results demonstrate that hospital waste is seriously infectious and dangerous for human health as it may cause several diseases like hepatitis B and C, HIV, skin allergies, T.B and cancer. Most of the inhabitants of study area and workers are directly affected primarily because of unawareness.

Conclusion: The study revealed that foremost reasons for increasing health problems associated with medical waste are improper disposal, lack of knowledge about hospital waste management rules and regulation, unawareness and non-cooperative attitude of management staff, and financial constraints for the purchase of modern waste disposal equipments. Study suggests that awareness and training programs are required to be arranged after short intervals. Above all, rules and regulations about waste disposal should be strictly followed.

KEYWORDS: Bahawalpur, diseases, hospitals, health problems, medical solid waste, management practices.

1. INTRODUCTION

In the modern world, hospitals and clinics have become an essential component of societies where patients come and their diseases are cured. Since the earlier times, the hospitals are established for the treatment of sick persons but they also generate several kinds of harmful materials known as medical waste. Medical waste mainly consists on the waste produced by hospitals, laboratories and research amenities. It also comprises on the waste generated by small or dispersed sources. For instance, it is generated during the course of health care undertaken in the home dialysis, insulin injection, etc. It is now a well-established fact that proper and safe disposal of medical waste is becoming a big issue specifically in less developed areas like Bahawalpur. Many adverse effects of medical waste, generated during the patients care, on the environment and human health have been documented. Several studies, hitherto, have been conducted on medical waste generation, its management practices and associated health issues in different parts of the world (e. g. Cheng et al., 2008; Moreira & Gunther, 2013; Munir et al., 2014; Subramani et al. 2014; Sartaj & Arabgol 2014; Ali et al., 2015; Eslami & Nowrouz, 2017; Mmereki et al., 2017; Niyongabo et al., 2019; Chauhan 2020). A number of studies have exposed various hazardous aspects of the medical waste generated by various point sources and disposed-off improperly and asserted that some of the waste types are highly dangerous for the environment and human health (Caniato et al., 2015; Ghasemi & Yusuff, 2016; Olufunsho et al., 2016; Minoglou et al., Gerassimidou & Komilis, 2017; Udofia et al., 2017; Doylo et al., 2018; Yazie et al., 2019; Manzoor & Sharma, 2019; Tebeje & Chufa, 2019). In recent time, due to unprecedented population growth and rapid urban expansion, number of hospitals and clinics specifically in private sector has increased several folds in Bahawalpur City of southern Punjab. Many patients, not only from surrounding areas but from other parts of the country too, are treated here. As a result, increase in hospital waste has become a potential health hazard. It affects not only the health care workers, but its sphere of influence includes the common masses and flora and fauna of the area also. If cared and managed improperly, hospitals may become a hub center for the growth of several kinds of infectious diseases, transfusion transmitted diseases, rising incidence of hepatitis B, and HIV etc. Incessantly increasing land and water pollution also leads to the increased possibility of catching many kinds of serious diseases. The waste generated by any hospital or health care facilities consist of general waste like wrapping material, eatables, paper wrapper etc. which are extremely dangerous. Similar waste in valid medications include cytotoxic drugs, soiled dressing, swabs, cotton with body and blood and body fluid,

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dissected body organs and tissues, disposable syringes, intravenous fluid bottles, catheters, gloves, injection vials, needles, blades, scalpels etc. Waste is produced from the diagnostic, handling or vaccination of individuals, animals or in investigation actions affecting the production of testing of living individuals (Baveja, 2000). Medical waste is categorized in to different types such as infectious, non-infectious, pathological, pharmaceutical, genotoxic, chemical, high content of heavy metal, radioactive etc. (Table 1).

In the practice of healthcare provision, waste is produced including sharps, body and other infectious materials (Baveja, 2000). About 20% hospital waste is recognized as possibly infectious (Rutala, 1998). In Dhaka city total waste production is 3500 mt/day and merely 5.7 % waste is generated by hospitals (Asaduzzaman & Hye, 1997). Hospital wastes produced in the city of Dhaka, Bangladesh about 200 mt/day and approximately 20% is infectious (Chowdhury, 1999). Contacts to infectious hospital waste can be the consequences in injury or epidemics. Hospital waste is infectious in nature. It comprises transferable, transmitted and hazardous waste which holds toxic infectious chemicals, pharmaceuticals, radioactive and it also contains sharps (Ekhaise & Omavwoya, 2008). As a result of improper handling, hospital waste becomes the cause of diseases including hepatitis B and C, skin diseases, diarrhea, dysentery, tuberculosis malaria skin allergy etc. (Akter et al., 2002). Doctors, nurses, paramedical staff, cleaning staff, hospital safeguarding personnel, patients getting cure, visitors to the hospital, support service personnel, kids while they playing on roads or waste dumping areas common people all these individuals are surely harmed by hospital waste at the consequence of improper waste disposal. People who treating patients producing waste by their activities, persons who gather, segregate, grip, wrap up, accumulate, transport and dispose of the waste material mostly infected by these activities. Hepatitis B and C, blood borne diseases, aids, tuberculosis and cholera are the major transmitted diseases and having cross infectious nature for handlers. Injury by sharps, contact with blood and body fluids are harmful for human eyes as well as creating threat of skin diseases.

In sum, medical centers are the places established for facilitating and caring of the inhabitants. These are indeed, wellbeing establishments that offer patients care facilities. Hospitals and health centers have to provide services to preserve community's health. The hospitals work for individuals directly by offering patients care and services and indirectly by safeguarding a clean and safe environment to their employees and the society (Patil & Pokhrel 2005). Thus, they must not be turned in to the irritating and disturbing element for the society. This study is aimed at to investigate medical waste generation and associated health issues in Bahawalpur City. It also points out the sources that generate medical

waste during the health care activities including hospitals, clinics, blood banks, pathological diagnostic laboratories etc.

1.1 The study area

The study area, Bahawalpur City spanning over an area of about 237.2 sq km is located on the southeastern side of Sutlej River on northern fringe of Cholistan desert. Geographically the city is located at 71°-41'-1" East longitude and 29°-23'-44" North latitude (Khan et al. 2020). Presently, it contains a population of 762,111 persons and with a population density of 3,213 persons per square km ranks as the 12th biggest city of Pakistan (GoP, 2017). It was established in 1847 and presently serves as tehsil, district and divisional headquarter. The city has two parts namely Bahawalpur City and Bahawalpur Cantonment area. It is accredited as one of the fastest growing cities of Pakistan. Beside fast natural increase in city's population, continuously increasing rural to urban migration has put immense stress on its resources including health facilities.

1.2 Classifying medical waste

Several comprehensive classifications of hospital or medical waste are already in existence. For instance, medical waste can be divided into infectious, hazardous, radioactive and general types. Another classification divides hospital waste into two types namely infectious or hazardous waste and non-infectious or non-hazardous waste. For this study, however, following classification of WHO with some modifications has been followed and hospital waste has been classified into ten categories namely infectious, pathological and anatomical, pharmaceutical, chemical, high content of heavy metals, pressurized containers, sharps, highly infectious, genotoxic, radioactive waste (Table 1).

Table: 1: Classification and brief description of medical wastes

Sr. No.	Type of waste	Description/characteristics of wastes
1	Infectious	Waste like urine, blood and other body discharge, lungs discharge and etc
2	Non-Infectious (General)	Cafeteria, billing, administration, cashier, rest rooms hostels, residential areas, pantries in wards, stores, etc.
3	Pathological	It consists of human body parts, organs, tissues, and body fluid, blood etc., anatomical waste material is partially the part of pathological waste and also contains identifiable body parts, although they are harmful or not.
4	Sharp	Sharp waste having curves, sharp edges or

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		projections it becomes the cause of cutting or penetrating the skin of workers and common inhabitants, needles, broken bottles, injections and all these substances are included in sharps and should be collect in separate containers and disposed carefully.
5	Genotoxic	Genotoxic waste is consists on cytostatic drugs, vomit, and urine as the result of patients cured with cytostatic drugs, chemicals and radioactive waste materials.
6	Pharmaceutical	This type of waste consists of all types of drugs and the apparatus used to mix cytotoxic drugs, drugs that used in chemotherapy for cancer treatment, cytotoxic waste material. Also contains discarded materials like connection tubes, bottles, vials, expired unused vaccines, splits unclean pharmaceutical drugs and vaccines and etc.
7	Chemical	This type of waste includes solid liquid and gaseous material which is produced by vacuuming procedures and disinfectant processes. Chemical waste must be collected, stored and treated separately because chemical waste material is corrosive, toxic and hazardous.
8	High content of heavy metal	High content of heavy metal includes blood pressure gauges, mercury thermometer these are electronic sensing equipment.
9	Pressurized waste	Pressurized waste contains compressed gas cylinders, aerosol cans and disposable compressed gas containers.
10	Radioactive waste	Radioactive waste possibly solid, liquid and gaseous. Radioactive waste generated by chemotherapy and by operating different body parts, body fluids and tissues.

2. MATERIAL AND METHODS

Both primary and secondary data has been used for this cross sectional study. Secondary data was obtained from official reports, journals and other publications. Primary data was collected through field survey using questionnaire method and interviewing the concerned people. The responses of doctors and other concerned people about the medical solid waste generation and associated health problems were noted. The questionnaire consisting of 34 queries contained mostly closed ended

multiple choice questions arranged in a sequence according to rank order scale. The respondents were asked to choose one of the given options.

Table 2: List of surveyed hospitals/clinics in Bahawalpur City

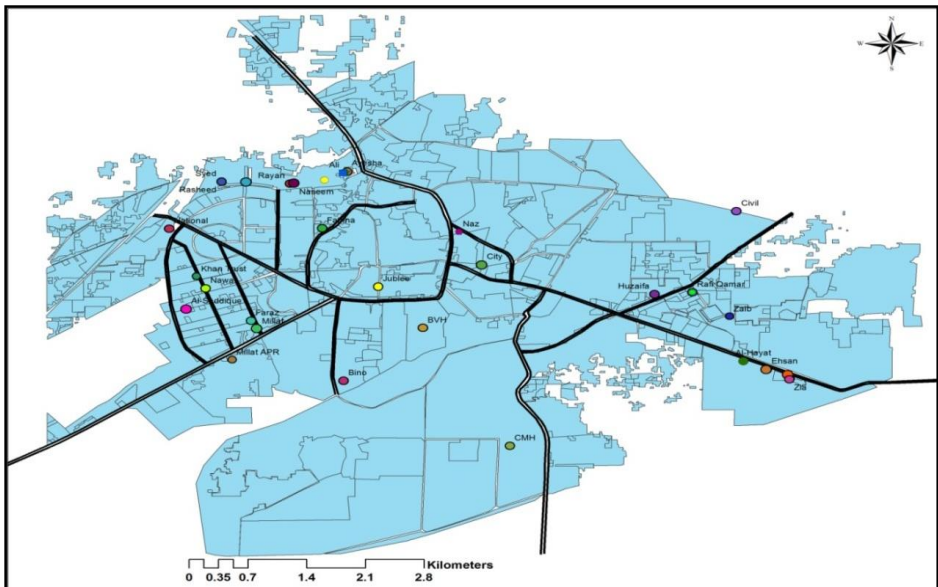
Hospital Name	Location Area	Ownership Status	Hospital Kind	Start Year
Naseem Zahra	MTC	Private	Special	2012
Rayan	MTC	Private	Special	2012
Rehman	MTC	Private	Special	2002
Faraz	MTA	Private	Special	2005
Ali	MTC	Private	Special	2007
Al-rehman	MTC	Private	Special	2009
Aeysha	MTC	Private	Clinical	2008
Fatima	MTC	Private	General	2012
Bahawalpur	MTC	Private	Special	2000
Aliza	MTC	Private	General	2007
National Orthopedic	IA	Private	General	1990
Syed clinic	Shahdrah	Private	Clinical	2010
Khan Eye	MTA	Private	Special	2012
Millat	MTA	Private	Clinical	2001
Nawal	MTA	Private	Special	2005
Al-Saddique	MTA	Private	Special	2011
Rasheed	MTB	Private	Special	1999
CMH	BC	Govt.	General	1960
Beno	DMR	Govt.	Special	2000
Zia	HPR	Private	General	1994
Azlan	HPR	Private	General	2012
Al-Hyat	HPR	Private	General	1998
Rafi Qamar	RQR	Private	General	1973
Serwar Shahaid	HPR	Private	General	1993
Ehsan Ahmed	HPR	Private	General	1982
Zaib	ST	Private	General	1995
Shahid	ST	Private	General	1997
Huzaifa	APR	Private	General	2009
Millat	APR	Private	General	1992
BVH	CR	Govt.	General	1906
City	UC	Private	General	1993
Naz	UC	Private	General	1995
Civil	JWR	Govt.	General	2013
Jublee	CFK	Govt.	General	1906

Source: Data recorded during field survey by authors.

Note: MTC= Model Town-C, MTA= Model Town-A, IA= Industrial Area, MTB= Model Town-B, BC= Bahawalpur Cantt, DMR= Dubai Mehal Road, HPR= Hasilpur Road, RQR= Rafi Qamar Road, ST= Satellite Town, APR= Ahmedpur Road, MC=Circular Road, UC= University Chowk, JWR= Jhangiwala Road, CFK = Cha Fathe Khan

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However, for the convenience of respondents to express merely personal view, some open ended questions were also used regarding the hospital wastes in terms of collection, transportation, segregation, treatment, disposal and overall management system. The questionnaires were filled by interviewing the concerned stakeholders of 34 hospitals (29 Private and 5 Government) located at different places of Bahawalpur City (Table 2 & Map 1). At first step, a list of all intended hospitals of Bahawalpur City was prepared along with their contact phone numbers. For the collection of information about the type and amount medical waste, visits of the individual hospitals and clinics were arranged. For the collection of data about the spread of diseases by different types of medical waste, at least one doctor from each hospital was specifically interviewed and specific questions were asked. Field observations were also recorded during the field visits. At the end collected data and concerned information were integrated to draw and summarize the results and to reach the conclusion. The data was processed using various geographic techniques and computer software. At the end, bases on results and conclusion, some suggestions have also been put-forth to minimize the harmful effects of hospital waste on human health.



Map 1: Location of hospitals in Bahawalpur City

Source: Processed by authors from Bahawalpur Outline Development Plan

3. RESULTS AND DISCUSSION

3.1 Medical waste generation and associated health problems

As population of an area increases the need of hospitals is also increased. With the increase in number of patients, the amount of waste generated by hospitals is also increased. Health risks are directly proportional to the amount of medical waste released by hospitals and clinics. Hospital waste is very hazardous and has toxic pathogens which have very dangerous impact on human health. The improper waste management in Bahawalpur City is causing several health related issues. The concerned hospital staff often throws medical waste on public places, on roadside or in open containers which may harm the surrounding environment and spread diseases. The common people do not have sufficient knowledge to cure themselves and most of them are unaware of the hazardous intensity of hospital waste. More often all kinds of waste is dumped in same container which is potentially dangerous, not only for humans but for other living organisms also. It was noticed that in study area laypersons, workers, sweepers and rag pickers do not know how to handle this waste in proper and safe manner. That is why they easily become victim of harmful effects of waste and suffer from different kinds of diseases. Probably, due to such reasons, the number of hepatitis patients in the study area is continuously on the rise. Although, there are several causes of the spread of different diseases, such as use of contaminated water, polluted environment, mosquitoes, flies, poisonous smoke, unhygienic food, germ-infested fertilizers and so on, but medical waste is the chief cause of spread of different diseases in Bahawalpur City. Several diseases like hepatitis A, B, C, aids, asthma, skin allergy, cancer, headache etc. are very common nowadays. During the survey, concerned doctors opined that most of the virus-related and bacteriological diseases are spreading due to inappropriate disposal of hospital waste. Studies have proved that spread of diseases is directly related to the amount of hospital waste generated during different health cure activities (Dhote 2016). Toxic impact of hospital waste materials has already been confirmed (Dhote 2016). For instance, when the infectious waste is mixed with general or non-infectious waste then all waste becomes hazardous and may cause different type of diseases.

Table 3: Types and amount of hospital waste produced per day in Bahawalpur City

Waste types	Private hospital	Government hospital	Total
	Waste amount (Kg/day)	Waste amount (Kg/day)	Waste amount (Kg/day)
Infectious	30	69	99

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Non-Infectious	34	100	134
Pathological	49	92	141
Sharp	57	88	145
Genotoxic	21	35	56
Pharmaceutical	24	87	111
Chemical	38	154	192
High Content of Heavy Metal	49	172	221
General	76	153	229
Total	378	950	1328

Source: Field survey by authors

Hospital waste contains different body parts and body fluids like vomits which have very irritating smell and may become the chief cause of headache, vomiting, different type of allergies etc. Dumping sites of waste are the basic birth place for flies and mosquitoes. Flies and mosquitoes spread the diseases like diarrhea, malaria, dengue etc. Sharp wastes like needles and knife are tremendously dangerous and have lethal effects on human health. Harmful viruses injected in the body through a cut or rapture and penetrate in the skin by needle sticks or sharps accidentally. Similarly genotoxic, pharmaceutical, pressurized waste causes the different types of cancer, skin diseases, asthma and blood born diseases. The hazardous intensity of medical waste is further increased when it is mixed with domestic waste. In Bahawalpur, this kind of waste has seriously harmed the human health due to two main reasons, the lack of awareness and inadequate disposal of waste. If the two basic types of waste, infectious and non-infectious, are not segregated, the entire volume of waste becomes infectious. The commonly practiced methods of waste disposal are landfills, burning, deep burial, incinerators, chemical treatment and discharge into drains which may harm environment, workers health, land, water, sanitation and so on. Insufficient and inadequate treatments of hospital waste create severe health problems and also have dangerous impacts on environment.

The amount of hazardous medical waste generated by 34 surveyed hospitals in Bahawalpur City is approximately 1328 kg per day. Surveyed 29 private and 5 government hospitals produce variable amounts of different kinds of wastes. The concentration of patients in government hospitals is high as compared to private hospitals. Government hospitals are producing a large amount of waste while private hospitals are less waste producing establishments. Both different types of hospitals are producing almost 99 kg infectious, 134 kg non-infectious, 141 kg pathological, 145 kg sharps, 56 kg genotoxic, 111 kg pharmaceutical, 192 kg chemical, 221 kg

high content of heavy metal and 229 kg of general waste every day (Table 3). Based on the amount of waste generated, surveyed hospitals have been categorized into low, medium and high waste generating points (Table 4). Most of the waste is not properly disposed off by the concerned staff. They routinely throw it along roadsides or dump in containers. Most of the hospitals are located in densely populated residential where hospital waste is mixed with general domestic waste. During field visits, it was noticed that in such areas kids easily become the victims as they play with waste materials like bottles, plastics etc. No waste segregation measures are opted by hospital waste management staff to separate the hazardous waste from general waste. Lack of safety measures increases the hazardous effect of waste and becomes the root cause of blowout of different diseases.

Table 4: Types and amount of medical waste generated in Bahawalpur City

Waste type	Categories and amount of waste in kilograms generated per day in Bahawalpur City		
	Low	Medium	High
Pathological waste	1-50	51-100	101-150
Pharmaceutical waste	1-40	41-80	81-120
Sharp waste	1-45	46-90	91-135
Chemical waste	1-70	71-140	141-210
Genotoxic waste	1-20	21-40	41-60

Source: Field survey by authors.

3.2 Types of waste and associated diseases

As in Bahawalpur City no appropriate scientific method of medical waste disposal is in practice and there is no proper place of disposal, hospital waste is turning into a hazardous issue. Its damaging impact on human health and environment has been witnessed by the concerned stakeholders. Almost 100% of the 34 interviewed doctors and management staff working in the hospitals opined that the incidence of diseases spread has increased over time mainly due to the improper disposal of hazardous medical waste. Table 5 shows the results of interview about the diseases caused by different types of medical wastes. According to doctor's opinion working in Bahawalpur pathological waste may cause hepatitis, aids, rabies, cholera, asthma and blood diseases. Pharmaceutical waste can cause hepatitis, aids, skin allergy and TB. The main diseases associated with sharp waste are hepatitis, aids, skin allergy and other skin diseases. Chemical waste can cause allergy, skin infection, cancer etc. Exposure to genotoxic waste can cause cancer, reproductive diseases, hepatitis, HIV and syphilis etc.

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Table 5: Opinion of doctors about diseases caused by different types of waste

Type of waste	Diseases caused	Number of respondents	Percentage
Pathological waste	Hepatitis	21	61.8
	Aids	04	11.8
	Rabies	02	5.9
	Cholera	02	5.9
	Asthma	03	8.8
	Blood diseases	02	5.8
Pharmaceutical waste	Hepatitis	07	20.6
	Aids	21	61.9
	Skin allergy	02	5.9
	TB	04	11.8
Sharp waste	Hepatitis	07	20.7
	Aids	20	58.8
	Skin allergy	02	5.9
	Skin diseases	05	14.6
Chemical waste	Allergy	05	14.7
	Skin infection	20	58.8
	Cancer	09	26.5
Genotoxic waste	Cancer	05	14.7
	Reproductive diseases	15	44.1
	Hepatitis	09	26.5
	HIV	01	2.9
	Syphilis	04	11.8

Source: Field survey by authors (N=34)

3.2.1 Diseases caused by pathological waste

Pathological waste mainly includes human body parts, organs, tissues and body fluids. This type of waste is extremely hazardous and poisonous and has direct effect on human health. Table 5 tells the opinion of doctors about the chances of disease spread from this kind of waste. About 61.8% of them opined that this type of waste is main cause of spreading hepatitis, 11.8% opined aids, 5.9% opined rabies, 5.9% opined cholera, 8.8 % opined asthma, and 5.8 % opined blood borne diseases in study area (Fig 1). These are specific diseases which spread as a result of inappropriate disposal of pathological waste.

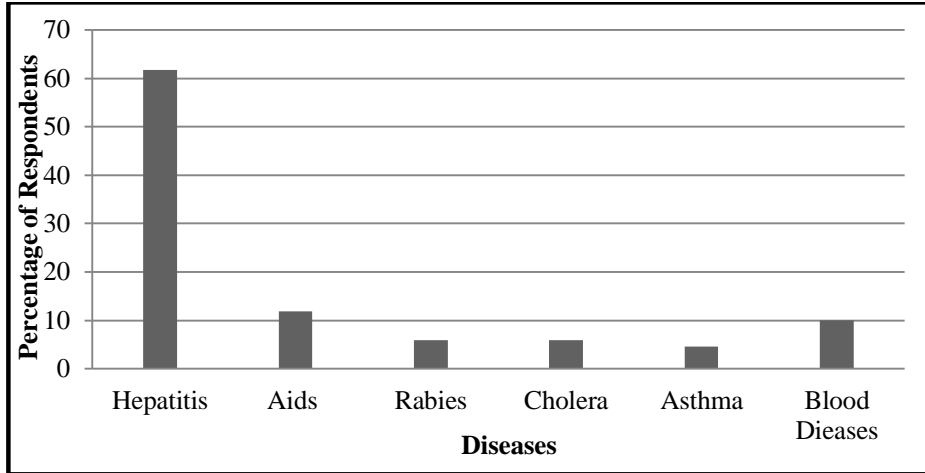
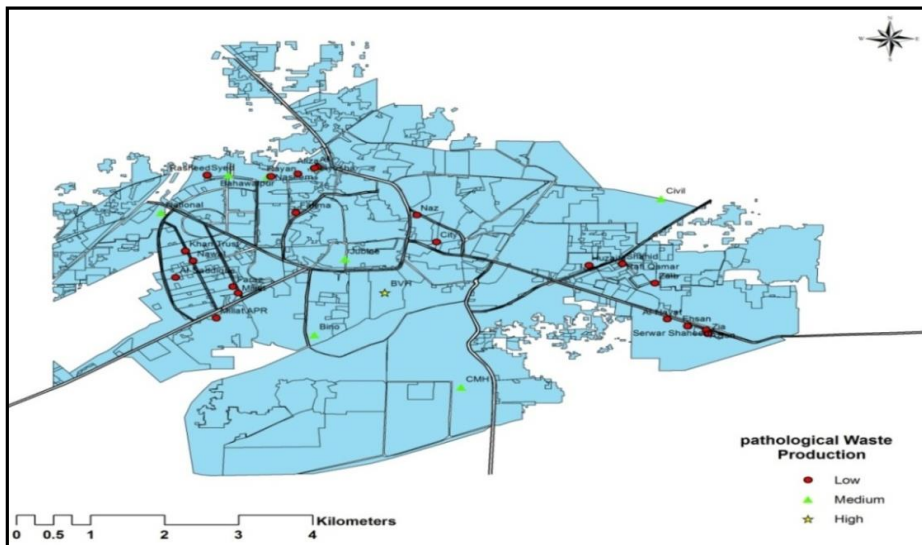


Fig 1: Diseases caused by pathological waste



Map 2: Location of pathological waste producing hospitals and clinics in Bahawalpur City

Source: Processed by authors from Bahawalpur Outline Development Plan

Table 4 shows the range of intervals for low, medium and high amount of waste producing categories of medical waste. Approximately 141 kg pathological waste is produced by enlisted hospitals and clinics in Bahawalpur City every day. As compared to other types of waste, pathological waste is more hazardous and highly infectious. Map 2 shows that the hospitals in Model Town-A, Commercial Area of Satellite Town,

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and some hospitals in Model Town-C are generating very low amount of pathological waste. While some hospitals in Model Town-C, CMH, Bino,

Jubilee and Civil Hospital fall in medium category of pathological waste generation. Major source of pathological waste generation in study area is Bahawalpur Victoria Hospital (BVH). Improper disposal of this kind of waste may cause issues like hepatitis, aids, rabies, cholera, asthma and blood diseases. From interviewed sample it was confirmed that pathological waste is the main cause of hepatitis spread in Bahawalpur (Fig 1).

3.2.2 Diseases caused by pharmaceutical waste

Pharmaceutical waste is poisonous, genotoxic and reactive. Even though present in minor amount, it originates great intoxication. Due to the improper disposal of pharmaceutical waste, numerous diseases may generate but some specific diseases associated with this kind of waste are hepatitis, aids, skin allergy and TB (Table 5 & Fig 2). According to the opinion of 61.9% doctors, this kind of waste is the main cause of spreading aids, 20.6% opined about hepatitis, 11.8% about T.B and 5.9% opined about the spread of skin allergy in study area.

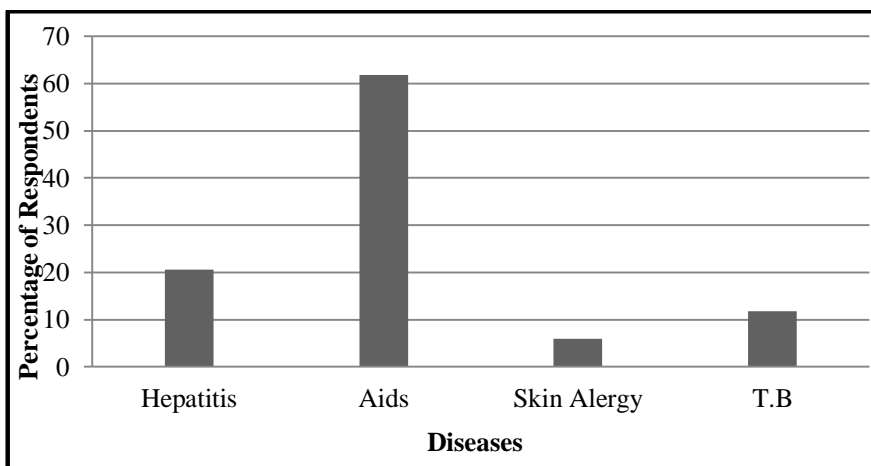
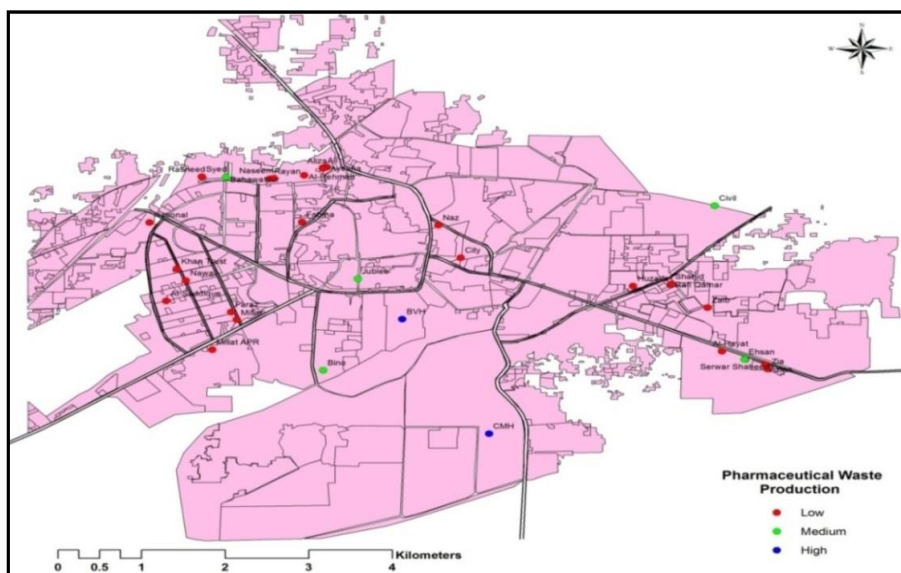


Fig 2: Diseases caused by pharmaceutical waste

Table 4 shows the range of intervals for the low, medium and high amount of generation of this kind of waste. According to survey results, approximately 111 kg pharmaceutical waste is produced in Bahawalpur City per day. The low amount of pharmaceutical waste is generated by private hospitals in Bahawalpur city which are located in Model Town A, B, C, Industrial area, Commercial Area of Satellite Town. Medium amount is generated by Jubilee hospital located in city core, Bino Hospital located on Noor Mehal Road, Civil Hospital located at Jhangiwalla road. CMH and BVH

are the major sources of pharmaceutical waste in study area which producing high amount of pharmaceutical waste on daily basis (Map 3).



Map 3: Location of pharmaceutical waste producing hospitals and clinics in Bahawalpur

Source: Processed by authors from Bahawalpur Outline Development Plan

3.2.3 Diseases caused by sharp waste

Pathogens contained in infectious and sharp waste might pass in the human body through a rupture or a cut in the skin. In study area all the doctors stated that sharps are the highly dangerous category of hospital waste. Sharps have more infectious and harmful impact on human health. Most commonly the victims are the workers, rag pickers and the sweepers who handle the waste at the point of generation. Most of the doctors (58.8%) viewed during the interviews that this kind of waste may cause aids, 20.7 % opine about hepatitis, 5.9% about skin allergy and 14.6% opined about the spread of other skin diseases (Table 5 & Fig 3). This kind of waste is one the main causes of the spread of aids just because of the inappropriate way of disposal.

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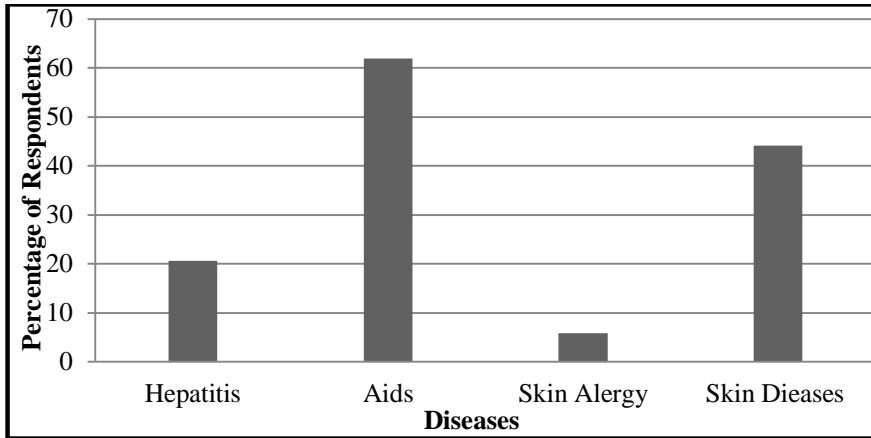
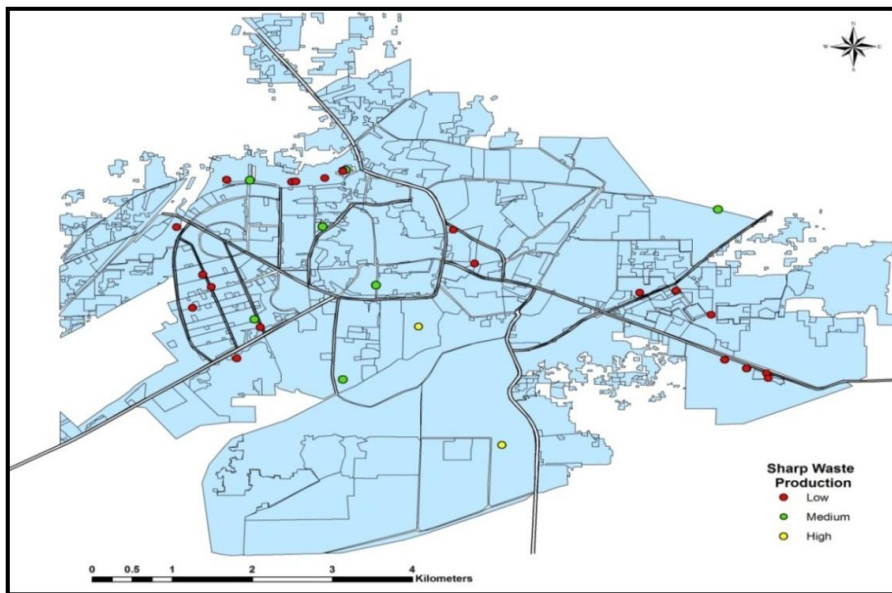


Figure 3: Diseases caused by sharp waste



Map 4: Location of sharp waste producing hospitals and clinics in Bahawalpur City

Source: Processed by authors from Bahawalpur Outline Development Plan

Table 4 shows the range intervals for the low, medium and high amount of the sharp waste generation categories. Approximately 145 kg sharp waste is produced in Bahawalpur City per day. Government hospitals are the main and private hospitals are minor source of the production of this kind of waste. Private hospitals generate relatively less amount of sharp waste as compared to government hospitals. Most of the private hospitals

located in Model Town A, B, C, Commercial Area of Satellite Town fall in low waste generation categories of this kind of waste. Major source is

again BVH and rest of the hospitals fall in medium category of waste generation (Map 4).

3.2.4 Diseases caused by chemical waste

During diagnosis process and treatment of various diseases, different chemicals are being used. These chemicals also have many side effects on patients as well as on the persons who are working with them. These chemicals also include different type of gaseous materials, drugs and other chemicals which have very poisonous and toxic impact on human health. Chemical waste substances may cause skin diseases, allergies and cancer (Table 5). During survey 58.8% doctors viewed that this kind waste is one of the major causes of spreading skin infections, 26.5% opined about cancer and 14.7% told about causing allergy (Fig 4). Again improper disposal of chemical waste material is the problematic.

Table 4 indicates the range intervals for low, medium and high amount of waste production categories for this kind of waste materials. Approximately 192 kg chemical waste is produced in Bahawalpur City per day. Most of the private hospitals in study area are producing comparatively low amount of chemical waste. Two private and three government hospitals are producing medium amount of chemical waste. Only BVH is the major source which is generating high amount of chemical waste (Map 5).

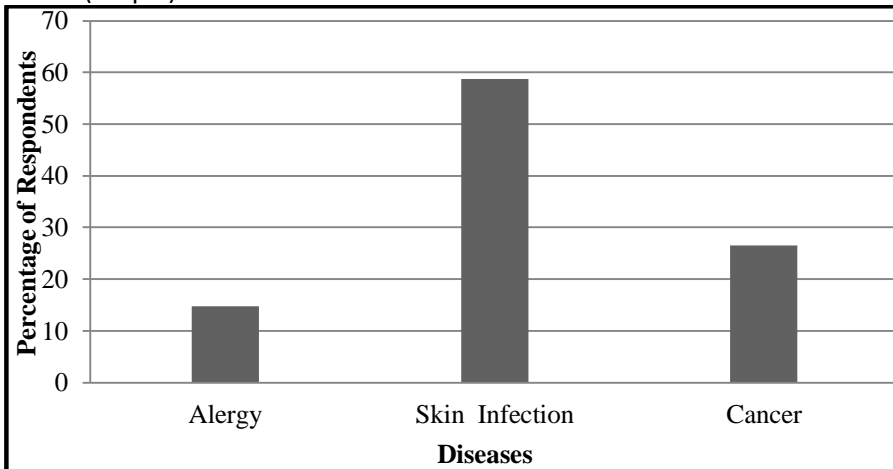
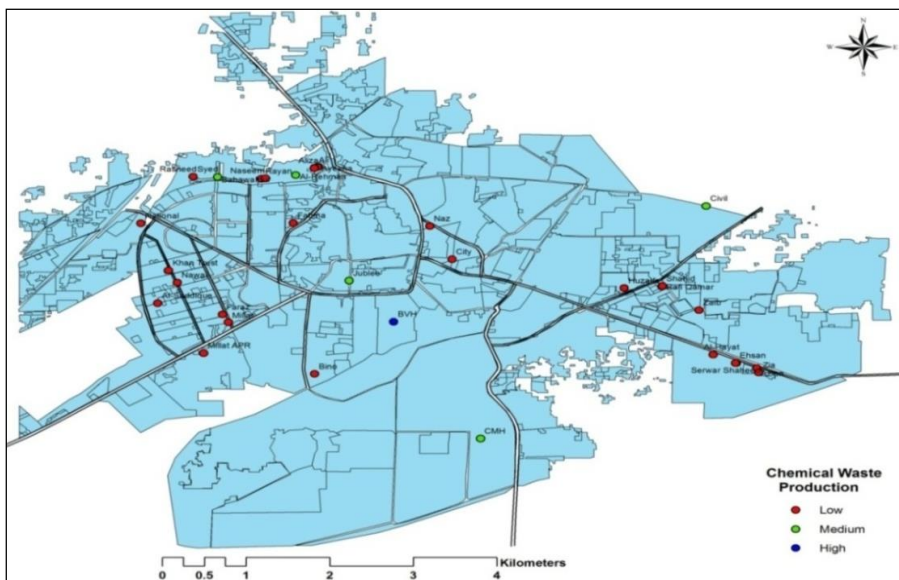


Figure 4: Diseases caused by chemical waste

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Map 5: Location of chemical waste producing hospitals and clinics in Bahawalpur City

Source: Processed by authors from Bahawalpur Outline Development Plan

3.2.5 Diseases caused by genotoxic waste

Genotoxic waste includes waste drugs and chemicals. According to the doctors genotoxic waste may cause reproductive diseases, cancer, hepatitis, HIV and syphilis (Table 5). Survey results show that 44.1% doctors were of the view that this kind of waste may cause reproductive diseases, 26.5% opined about the spread of hepatitis, 14.7% about cancer, 11.8% about syphilis and 2.9% opined about the spread of HIV (Figure 5). Table 4 indicates the range intervals for low, medium and high amount of waste production categories for genotoxic waste materials produced in Bahawalpur City per day. Again most of the private hospitals are the small sources of genotoxic waste materials generation and fall at the low level in the ranking (Table 3). Two private and four government hospitals are at medium level in study area. While the major source of genotoxic waste is BVH (Map 6).

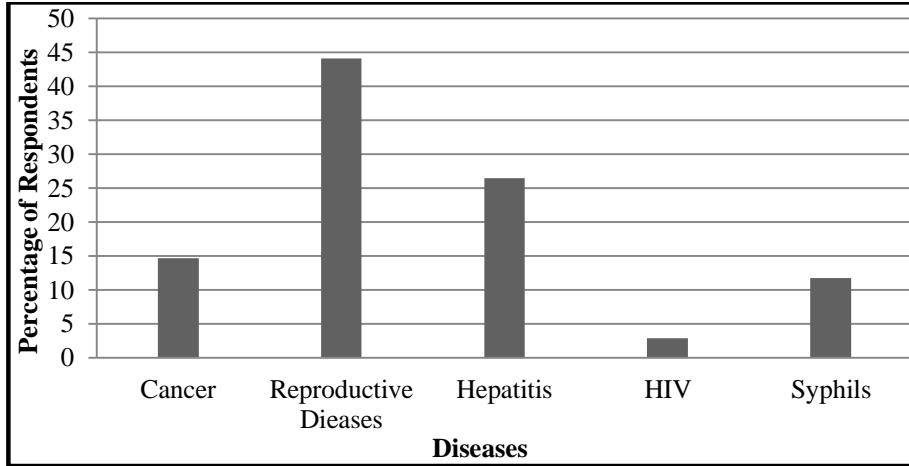
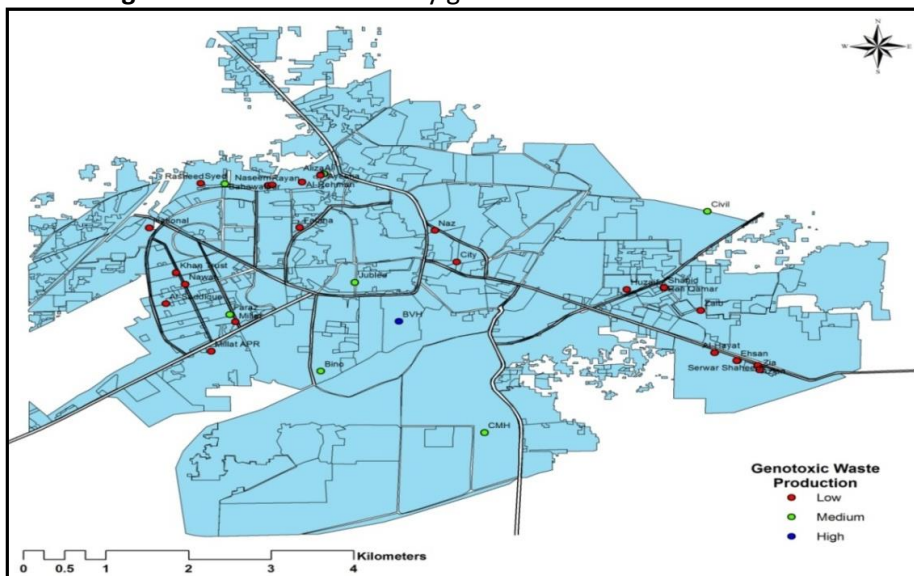


Figure 5: Diseases caused by genotoxic waste



Map 6: Location of genotoxic waste producing hospitals and clinics in Bahawalpur City

Source: Processed by authors from Bahawalpur Outline Development Plan

The production of hospital waste in Bahawalpur has been growing in amount and variety due to increase in the number of patients and the extensive approval of single use disposable objects. In the past, hospital waste was routinely mixed with domestic waste and landfill method was used for disposal. Although advanced scientific methods of medical waste disposal are used in the developed countries but in Pakistan in general and in Bahawalpur City in particular, no appropriate method is in practice for the treatment of hazardous waste. Use of advance equipment is lacking

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due to financial constraints and affordability factor. In Bahawalpur City hospital management staff use different disposal methods i.e. they just throw the hazardous waste on the roadside along the hospital or they throw the waste in government containers without taking precautionary measures of its adverse effects. They also place a container on the road outside the hospital and just dump their waste material in it. In some cases, TMA collect the waste from hospitals and after that what they do, no one knows. Inadequate waste disposal and treatment leave an adverse impact on the health of the inhabitants of Bahawalpur City. Handlers are least concerned about the adverse effects of hospital waste on the human health. Resultantly, with the passage of time, improper management of hazardous waste is turning into a big threat for the entire society.

4. CONCLUSION AND SUGGESTIONS

4.1 Conclusion

The study concludes that foremost reasons for increasing health problems associated with medical waste are improper disposal, lack of knowledge about hospital waste management rules and regulation, unawareness and non-cooperative attitude of management staff, and financial constraints for the purchase of modern waste disposal equipments. Overall population, number of patients and number of hospitals and clinics has increased tremendously over last few decades in Bahawalpur City. Medical waste in solid or liquid form is generated during the testing, treatment and vaccination of patients. In Bahawalpur City both government, as well as private hospitals are producing different kinds of medical wastes. Improper and non-scientific disposal of these wastes is raising several environmental and health issues in the area. Improper handling of medical waste is causing easy spread of several diseases such as hepatitis B and C, HIV, skin diseases, diarrhea, headache, cancer, TB etc. The number of patients of such diseases is on the rise over time. In Bahawalpur City hospital waste is not properly dealt, no rules, regulations and proper way of disposal are in practice. Study revealed that in most of the health centres hardly any treatment plant and technical machinery or equipment is available for proper handling of hospital waste. The attitude of most of the management staff of hospitals about the hazardous intensity of medical waste is found lenient. They just throw the waste outside the hospital along roadsides or in containers placed along roadsides. Open dumping of waste along roadsides is creating serious threat for humans. If same trends continue, the situation may become more alarming for the health of city inhabitants. It is thus an important need of the time that an economical and modern scientific waste handling scheme must be implemented for Bahawalpur City. In addition, the quantity of waste production should be

reduced through awareness and education of all inhabitants as well as of medical workers.

4.2 Suggestions

Based on the findings and conclusion of the study following suggestions are set forth;

1. Following the maxims 'Health is Wealth' and 'Health for all' modern scientific medical waste disposal methods must be established in all government and private hospitals. Continually, medical waste should be destroyed closer to the point of use without any delay. Landfill method is very common in Bahawalpur which is not safe. Several approved methods are available to destroy medical waste. For example, infectious waste can be safely destroyed by incineration or autoclaving methods.
2. Health ministry and other concerned departments should arrange awareness programs specifically for the hospital staff and city residents about the hazardous intensity of hospital waste. Hospital authorities should conduct training programs for their doctors and staff such as ward boys, nurses, workers and sweepers as well.
3. Hospital management authorities must convey the complete design of act in respect to storage, segregation, collection and transportation of waste materials from all the points of waste generation in the hospitals.
4. The hospital staff must be responsible and trained enough in disposing of the waste materials properly.
5. Hospital staff members who are responsible of handling hazardous waste should wear protective clothing and other items such as eye protective glasses, gloves, face covering masks etc. All such items must be provided them by hospital authorities.

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