

TEXTILE-BASED MEDICAL WASTE GENERATED IN HOSPITALS

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Abstract

Medical textile is one of the important and growing segments of the textile industry which includes medical hygiene and healthcare textiles. Medical textiles are the products used for various purposes. To meet the specific need of the patients and are appropriate for any medical and surgical applications. As per the rise in demand of medical textiles waste generated is more in hospitals. Present study was planned to explore textile-based medical waste generated in hospitals of Kumaon region. Questionnaire cum interview schedule was formulated to collect information through survey method was used to collect the information from government, private and multispecialty hospitals of Udham Singh nagar and Nainital district regarding the use, care and disposal practice of medical textiles in Kumaon region. Total 60 hospitals were selected out of which 30 hospitals each were from Udham Singh Nagar and 30 from Nainital district. Thirty hospitals comprising of 5 government, 20 private and 5 multispecialty hospitals. The collected data was analyzed statistically using frequency, percentage, t- test, correlation and chi square test. It was seen from the study that some of the waste are generated daily based on the use of such textile based application and persons handling these waste used personal protective clothing while handling them.

Introduction

Advances in medical sector have promoted the use of medical textiles in the hospitals, due to which a rapid increase in the demand of medical textiles has been noted. Advancement in medical sector has increased the life expectancy due to which age related diseases have increased resulting in increased use of medical textiles. Despite of this, many diseases are appearing from time to time. Advancement in medical field is also helpful to cure patient having accident or some medical ailments. Innovative textile products give quick and effective treatment as well as comfort to the patients which have led to growth of medical textiles compared to few decades back.

Textile Institute (UK, 2002) defines medical textiles as “a general term which describes a textile structure which has been designed and produced for use in any of a variety of medical applications, including implantable applications”(Denton,2002).

The rise in the demand of the medical textile has also increased the amount of waste generated from the hospitals. There are two types of waste generated from health care units of hospitals, generally classified as infectious and non infectious. The waste under infectious category consists of bacteria and viruses, pathological waste consist of human fluid and tissues like blood. Whereas, pharmaceutical wastes consist of expired or unused medicines and vaccines; and sharps (this is the infectious and hazardous waste e.g. needles), chemical waste (this is the waste that consists of chemicals used in testing); genotoxic (the waste consists of carcinogenic properties); and radioactive waste (waste containing radioactive substances like unused liquid from radiotherapy). Whereas non infectious category consists of garbage and public waste. The untreated health care waste generated in hospital is disposed off and sometimes it gets mixed with non infectious hospital wastes or with general waste which when mixed together lead to environmental threat and health risk to public. Unpredictable transfer of untreated healthcare waste (untreated waste is a waste which is not disposed off and lead to infectious problem) is frequently the cause for the spread of few infectious diseases.

The purpose of hospital waste management is to manage the waste that is produced by the hospitals by use of various methods that control the spread of various diseases through hospital waste. Therefore, disposal practice of waste is an important practice to spare the doctors, medical care takers, technicians, housekeepers, sweepers, visitors in the hospital, patients, rag pickers and their relatives from risk of infectious diseases as persons who are directly exposed to waste are at more chance of infections due to improper administration of waste. Disposal practice will be followed based on type of waste generated.

Present study was conducted in Udham Singh Nagar and Nainital districts of Uttarakhand comprise of various government, private and multispeciality hospitals. These hospitals provide both indoor and casualty treatment in the hospitals. Studies related to textile-based medical waste generated in hospitals have not taken place in Uttarakhand. Thus, the present study was planned to explore the textile-based medical waste generated in the selected government, private and multispeciality hospitals in the Udham Singh Nagar and Nainital districts.

Materials and Methods

The study was conducted exclusively in hilly and plain areas of Uttarakhand. The locale included hospitals present in Nainital and Udham Singh Nagar districts. These two districts were selected as one of these districts (Udham Singh Nagar) is situated in plain area and has many hospitals compared to another area situated in hilly area of Kumaun region i.e. Nainital district. The stratified and random sampling technique was used for selection of hospitals. Fig 1 shows schematic representation of selection of locale and sample. Hospitals were categorized into three different types namely, government, private and multispeciality hospitals. Among 30 hospitals, 5 government, 20 private and 5 multispeciality hospitals were selected making total to 30 in each district thus total 60 hospitals were selected. The number of hospitals in each category was kept same in both the districts for comparison. All government hospitals were selected. Number of multispeciality hospitals were less compared to private hospitals so 5 multispeciality hospitals were selected and 20 private hospitals dealing with either maternity, orthopaedic, skin and cardiology treatment were selected in the category of private hospitals. The collection of data regarding the textile-based medical waste generated in hospitals was limited for the year 2018- 2019.

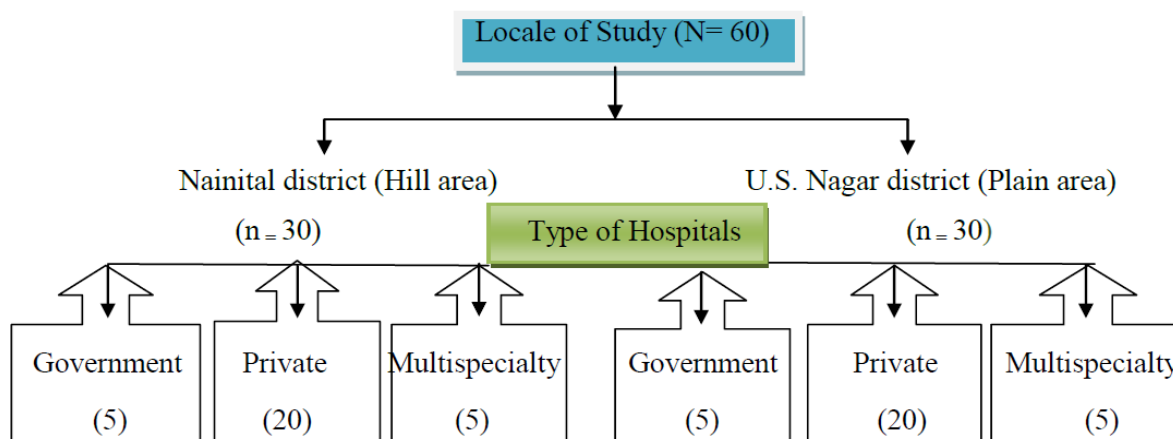


Fig1: Diagram showing selection of locale

The research was explanatory in nature which included interaction of the researcher with the respondent for collecting necessary information via questionnaire cum interview schedule (Veliveli, 2014). The survey method was the most suitable method for researcher for collection of data. The study was conducted to collect the information as per the objectives of the study. The tool used for collection of data was questionnaire cum interview schedule. Interview schedule is a method which basically centers on the data collection. A questionnaire can be defined as a set of printed or written questions with the choices in the possible answers, used for the survey. Under the present study, information was collected by the researcher by face to face interview method. The interview schedule was formulated and used as instrument for collecting data about use of medical textiles in different types of hospitals of Udham Singh Nagar and Nainital district of Uttarakhand. Interview schedule consisted of questions which guided the researcher. Interview schedule was formulated by the researcher with the help of subject matter specialist and was assessed by teaching staff Department of Clothing and Textiles, College of Home Science, G.B.P.U.A. & T., Pantnagar to check the clarity of the questions and corrections were made as per the suggestions. The questions comprised of two parts, i.e. general information and specific information. The survey method was used for data collection. Personal interview schedule was used as a instrument for collecting data from hospitals. Collected data analysis can be done through statistical tools. The information collected from each hospital was arranged and analyzed using appropriate statistical tests. Analysis was done using statistical measures like frequency, percentage, mean, t test and chi square.

Results and Discussion

Table 1 shows the textile waste generated in the hospitals of Udham Singh Nagar and Nainital districts. The waste generated in hospitals was collected and sorted based on the condition of textiles, it was either disposed off or laundered and reused. The textiles which were reused included bedsheets, blankets, towel, curtains, mattress cover etc.

Waste like gloves, caps, masks, urine bags, wipes, sutures, bandages, cotton and cotton gauze were generated in all hospitals irrespective of district as these are the basic necessities used in surgery or normal wound healing. These wastes were disposable and rest of wastes like bedsheet and curtains were reusable depending on condition of the material and they were disposed off when soiled heavily.

Towels as waste were generated in all the hospitals of both the districts. Maximum number of towel waste was generated in government and multispecialty hospitals (100 percent) except private hospital (55 percent) of Nainital district. Hospitals of Udham Singh Nagar district also generated towel waste. Maximum towel waste was generated by private and multispecialty hospitals (60 percent) followed by government hospitals (40 percent). Towels were used for wiping body of neonates and hands of the patients, doctors and workers in the hospitals.

Mattress cover as waste was generated in the hospitals of both the districts. Cent percent of government and multispecialty hospitals of Nainital district and multispecialty hospitals of Udham Singh Nagar district generated mattress cover as waste. It was reusable so after several uses, it was discarded when not in a condition to be used again. Whereas 50 percent of private hospitals situated in Nainital district and 60 percent of government hospitals and 80 percent of private hospitals of Udham Singh Nagar district generated mattress cover waste.

Absorbent pads were used for the personal hygiene purpose as they absorb urine, faeces, blood and mostly used by neonatal and elderly people care wards. This kind of waste was generated maximum by government (100 percent), private (85 percent) and multispecialty (60 percent) hospitals of Nainital district. It was noted that 40 percent of government, 70 percent of private and 80 percent of multispecialty hospitals of Udham Singh Nagar district generated absorbent pads waste. As they were provided whenever needed from *Jan Aushidhi Kendra*. Generally absorbent pad waste was found in maternity ward of hospitals.

Maximum amount of baby diapers disposable waste was generated by government and private hospitals (60 percent) and 20 percent by multispecialty hospitals of Udham Singh Nagar district. Whereas 40 percent of government and private hospitals of Nainital and 60 percent of multispecialty hospital district generated baby diapers waste. This waste was generated where neonatal care units were present in the hospital. Disposable diapers were used in maximum number of neonatal care units and rest were using cloth diaper for babies.

As per the Table, disposable gowns were not used in government hospitals of both the districts so no waste was generated due to disposable gowns. Ten percent of private hospitals of Udham Singh Nagar and 50 percent of private hospitals situated in Nainital district generated disposable gowns as waste because they were using disposable gowns. Use of disposable gown reduces risk of spread of infection as it is used only one time. Sixty percent of multispecialty hospitals of Udham Singh Nagar district and 40 percent hospitals in Nainital district generated disposable gown waste. The reason for not using disposable gown in government hospital and few of private and multispecialty hospitals may be due to lack of funds, They prefer to use cloth gown as it can be washed and used again.

Dead body sheets a sheet used to wrap around dead body not used frequently and used when somebody dies. At that moment, only sheets were used, so waste generated was also less as compared to other textiles. Government hospitals (40 percent), private (30 percent) and 20 percent of multispecialty hospitals of Udham Singh Nagar generated dead body sheets, 60 percent of government and multispecialty hospital and 15 percent of private hospital of Nainital district generated dead body sheet as waste. The frequency of generation of dead body sheet was very less.

Table 2 shows distribution of hospitals on the basis of frequency of waste generated in the hospitals. Maximum waste was generated daily. The waste generated daily in hospitals included gloves, caps, masks, urine bags, baby diapers, wipes, absorbent pads, cotton gauze and sutures in government, private and multispecialty hospitals of both the districts. It was also found that curtains, mattress cover, towels, bedsheets, disposable gowns, dead body sheet and bandages were used as per requirement and thus the waste generated was dependent upon its use only. Textile articles such as bedsheets, blankets, curtains, pillow covers, etc. are subjected to laundering and discarded when they are torn or heavily soiled. Whereas sutures, baby diapers, absorbent pads, and urine bag waste were generated daily depending on their use in the hospitals.

S. No.	Waste generated	Name of district					
		Udham Singh Nagar (n = 30)			Nainital (n = 30)		
		Government (n = 5)	Private (n = 20)	Multispecialty (n = 5)	Government (n = 5)	Private (n = 20)	Multispecialty (n = 5)
		Frequency (percentage)					
	Gloves	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
	Caps	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
	Mask	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
	Urine bag	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
	Disposable gown	0	2 (10)	3 (60)	0	6 (30)	5 (100)
	Dead body sheet	2 (40)	6 (30)	0	3 (60)	3 (15)	3 (60)
	Absorbent pads	5 (100)	17 (85)	5 (100)	5 (100)	19 (95)	3 (60)
	Baby diapers	3 (60)	12 (60)	1 (20)	2 (40)	7 (40)	3 (60)
	Wipes	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
	Sutures	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
	Bandages	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
	Bedsheet	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
	Towel	2 (40)	12 (60)	3 (60)	5 (100)	11 (55)	5 (100)
	Mattress cover	3 (60)	16 (80)	5 (100)	5 (100)	10 (50)	5 (100)
	Cotton	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
	Curtains	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
	Cotton gauze	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)

Table 2: Distribution of hospitals on the basis of frequency of waste generated in hospitals of Udham Singh Nagar and Nainital district (N = 60)

S. No.	Variables	Name of districts											
		Udham Singh Nagar (n = 30)						Nainital (n = 30)					
		Daily			Sometimes			Daily		Sometimes			
		Type of hospitals						Type of hospitals					
Gov.	Private	Multi	Gov.	Private	Multi	Gov.	Private	multi	Gov.	Private	Multi		
1.	Gloves	100	100	100	0	0	0	100	100	100	0	0	0
2.	Caps	100	100	100	0	0	0	100	100	100	0	0	0
3.	Masks	100	100	100	0	0	0	100	100	100	0	0	0
4.	Urine bags	60	0	0	40	100	100	60	90	80	40	10	20
5.	Disposable gown	0	0	60	0	10	0	0	10	0	0	45	40
6.	Dead body sheet	0	0	0	40	30	40	0	0	0	60	15	60
7.	Cotton gauze	100	100	100	0	0	0	0	100	80	0	0	0
8.	Absorbent pads	0	50	100	100	50	100	100	50	40	0	50	0
9	Baby diapers	60	60	20	0	0	0	40	40	60	0	0	0
10.	Wipes	100	100	100	0	0	0	100	100	100	0	0	0
11.	Sutures	100	100	100	0	0	0	100	100	80	0	0	0
12.	Bandages	100	0	0	0	100	100	100	10	80	0	90	20
13.	Bedsheets	60	40	60	40	60	40	0	0	0	100	100	100
14.	Towels	40	20	40	60	80	60	0	45	0	100	55	100
15.	Mattress cover	0	0	0	100	100	100	0	0	0	100	100	100
16.	Curtains	0	0	0	100	100	100	0	0	0	100	100	100
17.	Cotton gauze	100	100	100	0	0	0	100	100	100	0	0	0

Gov. = Government hospital, multi = Multispecialty hospital

Table 3 depicts the distribution of hospitals situated in Udham Singh Nagar according to the type of waste generated in different departments. As per the data shown in the Table, emergency, neonatal and inpatient departments of government hospitals generate infectious, pathological, sharps and pharmaceutical wastes except dialysis unit which generate infectious, sharp and chemical wastes. Waste generated from ICU unit and gynecology department was infectious, pathological and sharp waste was generated from OPD sharps, pharmaceutical and it was found that emergency, neonatal and inpatient department generate more amount waste.

Maximum number of departments i.e. emergency, ICU, cardiovascular, gynecology, IPD and OPD generate infectious, pathological and sharps and pharmaceutical waste where as none of the departments generated genotoxic waste due to non availability of oncology department in private hospitals of Udham Singh Nagar district. Whereas, chemical waste was generated from dialysis unit and radioactive waste was not generated by any of the departments

Table 3 also shows that in multispecialty hospitals, waste is generated. It was found that almost all the hospitals generate infectious, pathological, sharps and pharmaceutical wastes whereas genotoxic waste was generated by oncology department of only one hospital as department was found in only one multispecialty hospital. It was noted that chemical waste was generated from isolation, dialysis and surgical departments, whereas radioactive waste was generated from dialysis and surgical ICU departments.

No significant difference was found for infectious, sharps, pathological, pharmaceutical, genotoxic, chemical and radioactive wastes generated from various departments of government, private and multispecialty hospitals of Udham Singh Nagar district as shown by chi square test.

Table 3: Distribution of hospitals of Udham Singh Nagar according to type of waste generated in different departments (N = 30)

S. No.	Waste generated in departments	Type of hospitals																					
		Government							Private							Multispecialty							
		I	P	S	PH	G	C	R	I	P	S	PH	G	C	R	I	P	S	PH	G	C	R	
1.	Emergency	80	60	100	40	-	0	-	100	55	100	16	-	0	-	100	0	0	60	0	0	0	
2.	Isolation	60	40	60	40	-	0	-	10	10	10	10	-	0	-	40	0	40	0	0	40	0	
3.	Dialysis	0	0	0	0	-	0	-	0	0	10	0	-	10	-	20	0	20	20	0	0	0	
4.	I.C.U	40	0	40	0	-	0	-	60	0	60	60	-	0	-	100	100	100	100	0	0	100	
5.	Oncology	20	20	20	20	-	20	-	0	0	0	0	-	0	-	20	20	20	20	20	0	20	
6.	Neonatal	20	40	20	20	-	0	-	0	40	40	40	-	0	-	60	60	60	60	0	0	0	
7.	Cardiovascular	20	20	20	20	-	0	-	5	5	5	0	-	0	-	20	20	20	20	0	0	0	
8.	Gynecology	100	100	100	100	-	0	-	95	95	95	90	-	0	-	60	40	60	60	0	0	60	
9.	IPD	100	100	100	100	-	0	-	0	100	100	100	-	0	-	100	100	100	100	0	0	100	
10.	OPD	100	100	100	80	-	0	-	100	100	100	100	-	0	-	100	100	100	100	0	0	100	
11.	Surgical ICU	100	0	80	100	-	0	-	100	0	100	100	-	0	-	100	80	100	80	0	0	0	
		χ^2 cal															15.60	21.07	17.20	14.80	22.0	14.00	11.80
																	N.S	N.S	N.S	N.S	N.S	N.S	N.S

I = Infectious, P = Pathological, S = Sharps, PH = Pharmaceutical, G = Genotoxic, C = Chemical, R = Radioactive, N.S = Non-significant

Table 4 depicts the distribution of hospitals located in Nainital district according to type of waste generated in different departments. As per the data shown in the Table, most of the departments of government hospitals generated infectious, pathological, sharps and pharmaceutical waste. Whereas from ICU, infectious and sharp wastes were generated. Genotoxic wastes were generated from oncology department of government hospitals of Nainital district.

All the departments generated infectious, pathological, sharps and pharmaceutical wastes whereas none of the department generated genotoxic waste due to non availability of oncology department in private hospitals of Nainital district. Chemical waste was generated from dialysis unit. Genotoxic and radioactive waste was not generated in any of the departments.

This table also shows that multispecialty hospitals also generated waste and it was found that almost all the hospitals generate infectious, pathological, sharps and pharmaceutical waste. Genotoxic waste was the waste derived from drugs generally used in oncology unit that have high hazardous mutagenic or cytotoxic effect. Faeces, vomit, urine from patients treated with cytotoxic drugs are considered as genotoxic waste which was generated from oncology department of only one hospital as this department was found in only one multispecialty hospital. Chemical waste was generated from different departments like isolation, dialysis and surgical. The radioactive waste was generated from dialysis and surgical ICU departments.

No significant difference was found for infectious, sharps, pathological, pharmaceutical, genotoxic, chemical and radioactive wastes generated from various departments of government, private and multispecialty hospitals of Nainital district as shown by chi square test.

Table 5 shows results of distribution of hospitals based on PPE (personal protective equipment) used by hospital staff while collection, handling, segregation and disposal of biomedical waste. It was clear from the Table 5 that persons involved in handling and collection of medical waste used personnel protective equipments. These were used daily while collection, handling segregation and disposal of biomedical waste.

Table 4: Distribution of hospitals of Nainital district according to type of waste generated in different departments (N=30)

S.No.	Waste generated in departments	Type of hospitals																					
		Government							Private							Multispecialty							
		I	P	S	PH	G	C	R	I	P	S	PH	G	C	R	I	P	S	PH	G	C	R	
1.	Emergency	100	100	100	100	-	0	-	100	11	100	16	-	0	0	100	100	100	100	0	0	0	0
2.	Isolation	0	0	0	0	-	0	-	6	0	0	55	-	0	0	100	100	100	0	0	100	0	
3.	Dialysis	20	0	20	0	-	20	-	40	0	40	0	-	40	0	60	0	100	100	0	60	60	
4.	I.C.U	40	0	40	0	-	0	-	70	70	70	70	-	0	0	100	100	100	100	0	0	0	0
5.	Oncology	0	0	0	0	20	0	-	0	0	0	0	-	0	0	20	20	20	20	20	0	0	0
6.	Neonatal	60	60	60	60	-	0	-	60	60	60	0	-	0	0	20	20	20	20	0	0	0	0
7.	Cardiovascular	0	100	0	0	-	0	-	45	45	45	45	-	0	0	80	80	80	80	0	0	0	0
8.	Gynecology	100	100	100	0	-	0	-	85	85	85	85	-	0	0	100	100	100	100	0	0	0	0
9.	IPD	100	100	100	100	-	0	-	100	100	100	19	-	0	0	100	100	100	100	0	0	0	0
10.	OPD	100	0	100	100	-	100	-	100	100	100	20	-	0	100	100	100	100	100	0	0	0	0
11.	Surgical ICU	0	0	0	0	-	0	-	16	0	16	16	-	0	0	100	80	100	80	0	80	80	80
	χ^2 cal.															72.40	20.79	16.40	14.44	34.0	25.00	70.24	
																N.S	N.S	N.S	N.S	N.S	N.S	N.S	

I = Infectious, P = Pathological, S = Sharps, PH = Pharmaceutical, G = Genotoxic, C = Chemical, R = Radioactive, N.S = Non-significant

Table 5: Distribution of hospitals based on personal protection equipments used by hospital staff while collection, handling, segregation and disposal of biomedical waste

S. No.	Personal protective equipments	Name of Districts					
		Udham Singh Nagar (n = 30)			Nainital (n = 30)		
		Type of hospitals					
		Government	Private	Multispecialty	Government	Private	Multispecialty
		Frequency (percentage)					
1.	Aprons	5 (100)	15 (75)	3 (60)	5 (100)	16 (80)	4 (80)
2.	Cloth /disposable masks	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
3.	Waterproof gloves	5 (100)	20 (100)	5 (100)	5 (100)	20 (100)	5 (100)
4.	Gumboots	5 (100)	19 (95)	2 (40)	3 (60)	17 (85)	3 (60)
t cal					-1.00 N.S	-0.15 N.S	-0.56 N.S

N.S. = Non-significant

Table 5 shows that cent percent of the hospitals used masks and waterproof gloves in both the districts irrespective of type of hospitals. All the government hospitals located in Udham Singh Nagar provided aprons and gumboots to staff involved in collection, segregation and handling waste, followed by use of gumboots (95 percent) and aprons (75 percent) in private hospitals of Udham Singh Nagar. In sixty percent of multispecialty hospitals staff used aprons and in 40 percent of hospitals, staff used gumboots while handling of biomedical waste.

Cent percent of government hospital staff used aprons and 60 percent of workers used gumboots during handling waste in government hospitals of Nainital district. Gumboots were used 85 percent, aprons in 80 percent private hospitals in Nainital district. Eighty percent of hospitals provided aprons and gumboots (60 percent) to workers of multispecialty hospitals in Nainital district.

It can be concluded from the Table 5 that masks and gloves were used by workers of all the hospitals of both the districts. Therefore, it depicts that they are available in hospital stock and are provided daily. As per the biomedical waste management rules 2016, the staff handling biomedical waste should wear the personal protective equipment. It indicates that they were not using personal protective equipments as recommended in the rule.

No significant difference was obtained between government, private and multispecialty hospitals of Udham Singh Nagar and Nainital districts for use of personnel protective equipment while collection, handling, segregation and disposal of medical waste as observed by t-test. It means that hospitals staff of both district were using PPE in same proportion.

The result of present study is in accordance with study conducted by **Amin et al., 2013** in Peshawar. More personnel protective equipments were used in Kumaon region in comparison to hospitals of Peshawar, Pakistan.

Conclusion

It can be concluded from the study that waste like gloves caps, mask, urine bag, wipes, sutures, bandages, cotton and cotton gauze were generated in all hospitals irrespective of district as these are the basic necessity used in surgery or normal wound healing. The waste generated was disposable and rest waste like bed sheet and curtains were reusable depending on condition of the material and they were disposed off when soiled heavily. Sutures, baby diapers, absorbent pads, and urine bag waste was generated daily depends on the use. It was found that curtains, mattress cover, towels, bed sheets, disposable gown, dead body sheet and bandages were used as per requirement and thus the waste generated was sometimes. As they are subjected to laundering and discarded when they are torn and heavily soiled. All government, private and multispecialty hospital in both district generated infectious, pathological, sharps and pharmaceutical waste except genotoxic, chemical and radioactive waste in government and private hospital. The reason behind this may be the departments present in the hospital. Personal protective equipments were used by hospital staff while collection, handling, segregation and disposal of biomedical waste

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