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Assessment of Waste Generation Rate in Teaching Hospitals of Metropolitan City of Pakistan

Samita Arub [a*], Sajid Rashid Ahmad [a], Sana Ashraf [b], Zahra Majid [a], Sadia Rahat [a], Rehan Iftikhar Paracha [c]

[a] *College of Earth and Environmental Sciences, Quaid-e-Azam Campus, University of the Punjab, Lahore, Pakistan.*

[b] *Lahore College for Women University, Lahore, Pakistan.*

[c] *Lahore Waste Management Company 4th floor Shaheen Complex, Egerton Rd, Garhi Shahu, Lahore, Punjab, Pakistan.*

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Abstract

Hospital waste management is of vital significance owing to its contagious and hazardous nature as it can produce detrimental effects for both humans and the environment. This work aimed to examine types of waste with respect to waste generation rate in multiple teaching hospitals of metropolitan Lahore. A structured questionnaire survey, site visits, interviews and meetings were conducted in seventeen teaching hospitals. The results have shown that total hospitals average waste, infectious, non-infectious and waste generation rate in Lahore teaching hospitals were 38978 kg/day, 10789 kg/day, 28189 kg/day and 3.7 kg/bed/day, respectively. It is concluded that maximum waste generated in Mayo hospital, Jinnah hospital, Services hospital and Lahore general hospital was 16%, 12%, 12% and 10%, respectively, as per maximum patient's visits. Positive liner correlation was between number of beds (P=0.917), number of accidents and emergency patients (P=0.75), infectious waste (P=0.998) and (P=1) with total waste. A straight line of linear regression was between (0.9966) infectious waste and (0.9995) general waste with average waste. Although, waste collection practices in these teaching hospitals were observed satisfactory but required training of doctors, nurses and hospital paramedical staff regarding infectious and general waste segregation. It is suggested that hospital staff, waste management and waste collection workers and respective waste management companies should be well trained and aware regarding infectious and non-infectious waste segregation, handling and disposing off procedures.

Keywords: Teaching Hospitals; Infectious and Non-infectious Waste; Waste Generation; Incineration; Waste Disposal.

1. Introduction

From last some decades, hospital waste management and disposal have become big issue globally. It is difficult to follow scientific and safe methods without disturbing environment. To maintain a sustainable safe environment, it is need of hour to emphasis on problem of hazardous hospital waste generation, waste segregation, waste collection and safe waste disposal approaches [1]. In general, hospital waste is a mixture of general waste, testing lab waste, medicinal chemicals, polymer or metallic vessels and pathological waste [2, 3]. Medicinal waste, contiguous waste and residential waste are main categories of hospital waste. Medicinal waste is stated as refuse generated during patient check-up, treatment and vaccination. Contiguous waste is specified as the part of waste relating to patients with transferable disease. Many time medicinal wastes are presumed as contiguous waste, as both are gathered collectively. Heterogeneous hospital waste is considered to be contiguous waste [4]. These contiguous wastes are the reason of various illnesses like cholera, plague, tuberculosis, ADIS (HIV), hepatitis and diphtheria [5].

* Corresponding author: samitaarub@yahoo.com

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Various types of dangerous and non-dangerous hospital wastes consist of pathological, sharps, medicinal, nontoxic, chemical, radioactive, food scrap, empty containers and packages [6]. Infective waste has numerous categories for example human tissues and body parts, animal carcasses, syringes, blades, saws, drugs, vomits, urine, chemicals and fluid from laboratories that is the big source of HIV, Hepatitis B and C viral infections. Needle and sharp items infected with human blood spread these viruses commonly. Many other diseases that could be spread by interaction with hospital waste that is urinary tract infections, respiratory tract infections, wound infections, bacteremia and skin infections [7].

According to World Health Organization (WHO), used infected syringes are the prime source of two-million HIV patients and twenty-one million hepatitis patients throughout the world. This hazardous and non-hazardous waste consists of microbial germs that have a potential to become threat for people, workers and environmental health [5].

Numerous studies have been conducted to highlight the medical waste issues regarding its segregation at source point, collection on scientific bases, handling, and for its proper safe disposal in Poland, Canada, China as infectious waste directly endangers human being health and environment [8–10].

A study conducted in Korea about hospital waste management practices has reported that incineration of infectious waste is by far the most suitable method for waste management. However, it is linked with the risk of air pollution. Toxic air pollutants are not only a threat for biological species of the area but also for humans too as per the nature of polyvinyl chloride (PVC) products. So, waste reduction at source point, recycling and installation of toxic air pollution controllers are advised by authorities in Korea [11,12].

In Pakistan, according to the Hospital Waste Management Rules 2005, an Executive District Officer Health (EDO-H) is the responsible of environment and hospital waste management practices specially supervision and execution. In hospital facility level designated Waste Management Officer is responsible for implementation. According to a survey that was conducted in different districts of the provinces, 38% healthcare facilities is manage its waste under the supervision of committees headed by medical superintendent (MS) and selected waste management officer. While in 62% small healthcare or hospitals head nurse manages the hospital waste with the help of sanitary staff. Survey showed that one third out of visited facilities implemented on plans according to standards regarding waste collection, transportation and dispose-off, while one third implemented minimal plan according to standards while remaining had no plan [13]. Various studies conducted in Pakistan showed that approximately 2 kg/bed/day waste is generated in which 0.1-0.5 is considered as harmful waste. About 4-2000 kg/day waste is produced by different health related institutes out of which 75%-95% is non-infectious generated by hospital surroundings, organizational and managerial activities, while 10-25% is infectious waste and requires careful disposal [7]. Farooq and fellows research in 2017 showed better waste management situation in tertiary care hospitals Lahore. Waste collection and separation was done on source point. Waste transported through open trolley on-site and waste was stored in designated area. The study was concluded that majority of hospitals were working by following protocols but failure was in waste transportation in some hospitals [14]. WHO published a report in 2019 showing HIV outbreak in Larkana, Sindh Province, Pakistan. The report showed an alarming rate of 751 people infected with HIV positive. The reasons traced for this outbreak were the use of infected syringes, un-tested blood transfusion, improper hospital waste management and respective faulty governance in the area [15].

Toheed and fellows previously studied hospital waste management system in five teaching hospitals of Lahore city in 2012-2013. Waste segregation, on-site and off-site waste storage and transportation were not according to WHO recommendations and not followed laws as well as Pakistan Government regulations [16]. Toheed and fellows study did not show the comprehensive current condition of hospital waste management system. Present study covers seventeen teaching hospitals of Lahore city and results interpreted through statistical analysis. Magnin GPS Explorist 600 unit is used to prepare location map and to show infectious and non-infectious waste data.

In order to understand hospital waste management system and improve a management approach, it is necessary to study and analyze current practices in teaching hospitals. Therefore, in this study, types of waste were examined with respect to waste generation rate in multiple teaching hospitals in metropolitan, Lahore. A cross sectional study was conducted. Structured questionnaire data was interpreted through statistical analysis and pined out waste values on map.

2. Materials and Methods

2.1. Study Area

Lahore is the 2nd largest city of Pakistan and 1st biggest city of Punjab province. Geographically Lahore is situated in 31° 13' and 31° 43' N latitude and 74° 0' and 74° 39.5' E longitude [17]. According to 2017 census, population of Lahore is 11.126,285 [18]. There are many government, semi government, private and trust hospitals in Lahore. In order to know the hospital waste type and waste generation, seventeen Teaching hospitals were studied. All teaching hospitals were attached by Ministry of Health and Medical Education Department. Total infectious and non-infectious

waste generated in these teaching hospitals, was stated as hospital waste. Location map of the study area is shown in Figure 1.

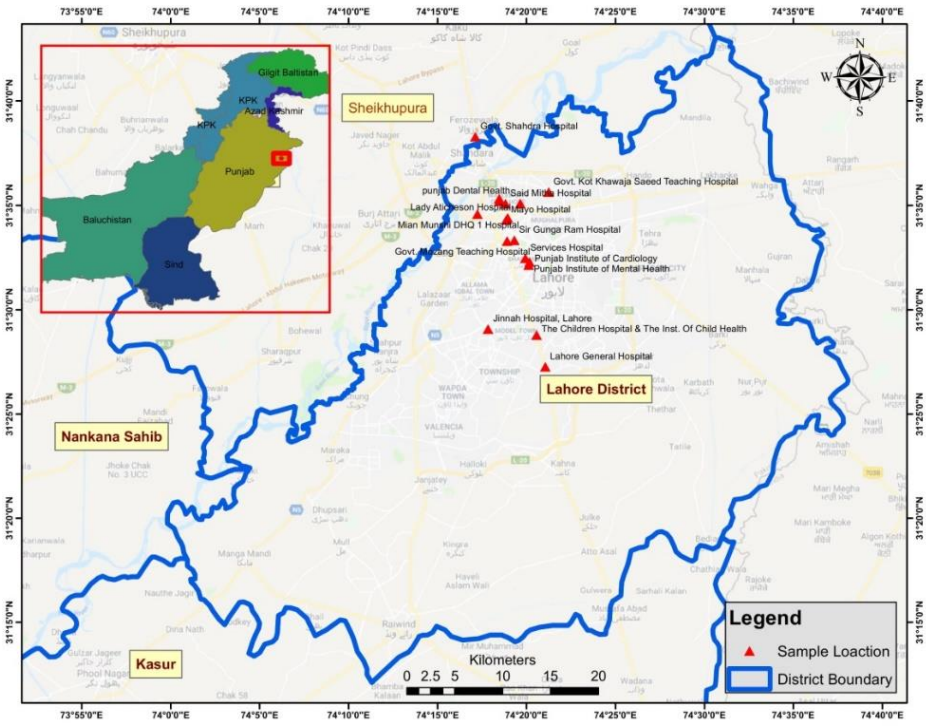

Figure 1. Location map of study area

2.2. Methodology

Infectious and non-infectious waste data were collected through questionnaire by visiting teaching hospitals of Lahore. Purpose of teaching hospitals visits was to get field observation and interviewed primarily. Collected data was cross checked through field observation. One-o-one interviews were conducted. To fill the designed questionnaire, information of waste types and quantity was collected from hospital waste collector staff, management staff, superintendents, doctors and nurses.

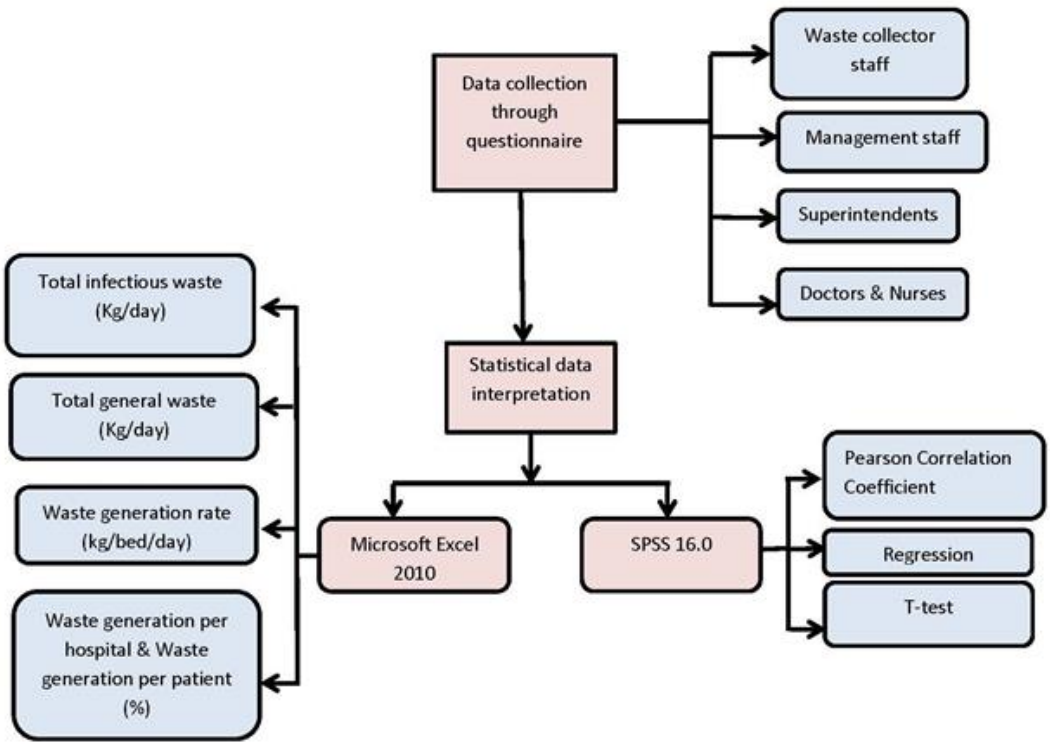

Figure 2. Research Framework

Quantity of hospital waste to be generated depends upon several factors such as size of hospital, healthcare type, occupancy rate of hospital beds, facilities, location and services provided by hospitals [19]. The designed questionnaire was clearly written. The data gathered from teaching hospitals include the following information:

- Number of beds in teaching hospitals;
- Outdoor patients visited per day;
- Indoor patients visited per day;
- Infectious waste (kg/day) of accidental and emergency patients;
- Outdoor patient's infectious waste (kg/day);
- Admitted/hospitalized patients infectious waste (kg/bed/day);
- General waste (kg/day).

The designed questionnaire was given to interviewees before interview for clarity in answers. The infectious waste observations were taken by visiting the selected teaching hospitals waste generating, waste collection and authorized waste stored points. Observations were also taken trough checking waste points and through monitoring. Outdoor doctors consulting rooms, operation theaters, laboratories, pharmacies, waste collection points and waste storage rooms were the waste checking point in selected hospitals. The study time duration was 3 days per hospital. Teaching hospital waste was monitored every day from generation source to storage point and till to incinerator plant where infectious waste finally incinerate. The purpose of the waste monitoring and observation was to ensure that the infectious waste was collected, handled, transported and disposed-off by following to SOPs.

Number of patients visited and admitted, and waste generated was monitored and recorded on record sheet per day. Collected data was tally with the hospital noted record too for the consistency and to avoid the ambiguity. Each hospital location coordinates were pinned out by using a Magnin GPS Explorist 600 unit.

2.3. Statistical Analysis

Data collected and filled questionnaires were used for calculating total infectious waste (kg/day), total general waste (kg/day), total waste generation rate (kg/bed/day), waste generation per hospital (%), and infectious waste per patient (%) through Microsoft Excel 2010. SPSS 16.0 were used for statistical (Pearson correlation coefficient, regression and t-test) data analysis.

3. Results

3.1. Total Waste Generation Rate

Seventeen teaching hospitals were surveyed and their infectious and non-infectious waste types and generation rates were measured. The teaching hospitals beds range from 30-2081, while total 11910447 numbers of out-patients and in- patients were visited per day. Teaching hospitals are normally general-purpose hospitals which facilitate all kind of patients, while few special kinds of diseases are handled in special-purpose hospitals like Punjab Institute of Cardiology, Punjab Institute of Mental Health, Punjab Dental Health and The Children Hospital & the Inst. of Child Health.

Total waste generation rate in these teaching hospitals were little different from each other depend on patients handling capacity and facilities provide in these hospitals. Total waste generated in these teaching hospitals was 38978 kg/day as shown in Table 1. Total waste generated rate was 3.7 Kg/bed/day.

Table 1. Waste generation rate in selected teaching hospitals of lahore

Sr. No.	Name of Teaching Hospitals	Beds	OPD[1] Visits p.a[3]	A&E[2] patients p.a	@kg/b/d 2.07	Infectious 25%	OPD kg/p 0.075	Infectious 80%	A&E kg/p 2.07	Infectious 25%	General Waste 75%	Total Waste kg/day	Kg/bed/day
1	Jinnah Hospital, Lahore	1500	787,410	269,145	3,105	776	162	129	1,526	382	3506	4793	3.1953333
2	Mian Munshi DHQ 1 Hospital	149	473,474	287,991	308	77	97	78	1,633	408	1476	2039	13.684564
3	Lady Aticheson Hospital	200	142,000	29,037	414	104	29	23	165	41	440	608	3.04
4	Mayo Hospital	2081	1,120,000	333,090	4,308	1,077	230	184	1,889	472	4694	6427	3.088419
5	Services Hospital	1196	1,520,638	329,274	2,476	619	312	250	1,867	467	3320	4656	3.8929766
6	Sir Gunga Ram Hospital	862	611,770	188,880	1,784	446	126	101	1,071	268	2167	2982	3.4593968
7	Punjab Institute of Cardiology	347	251,224	70,709	718	180	52	41	401	100	850	1171	3.3746398
8	The Children Hospital & The Inst. Of Child Health	684	550,000	0	1,416	354	113	90	0	0	1085	1529	2.2353801
9	Lahore General Hospital	1000	891,288	311,023	2,070	518	183	147	1,764	441	2912	4018	4.018
10	Govt. Shahdra Hospital	300	418,167	255,157	621	155	86	69	1,447	362	1568	2154	7.18
11	Govt. Muhammad Nawaz Shareef Hospital	200	845,075	128,682	414	104	174	139	730	182	893	1318	6.59
12	Lady Willingdon Hospital	235	79,908	15,497	486	122	16	13	88	22	434	591	2.5148936
13	Said Mitha Hospital	100	399,558	91,505	207	52	82	66	519	130	561	809	8.09
14	Govt. Kot Khawaja Saeed Teaching Hospital	150	473,474	287,991	311	78	97	78	1,633	408	1477	2041	13.606667
15	Govt. Mozang Teaching Hospital	100	399,558	91,505	207	52	82	66	519	130	561	809	8.09
16	Punjab Institute of Mental Health	1400	129,000	3,417	2,898	725	27	21	19	5	2193	2944	2.1028571
17	Punjab Dental Health	30	125,000	0	62	16	26	21	0	0	52	89	2.9666667
	Total	**10,534**	**9,217,544**	**2,692,903**	**21,805**	**5455**	**1894**	**1516**	**15,271**	**3818**	**28189**	**38978**	**91.129793**
				Total						**Infectious Waste**		**10,789**	
				Total						**General Waste**		**28,189**	

3.2. Infectious and Non-infectious Waste Generation Rate

Total infectious and non-infectious wastes generated in teaching hospitals of research area were 10789 kg/day and 28189 kg/day, respectively. Percentage of total infectious and non-infectious wastes generated in teaching hospitals of research area has shown in Figure 3.

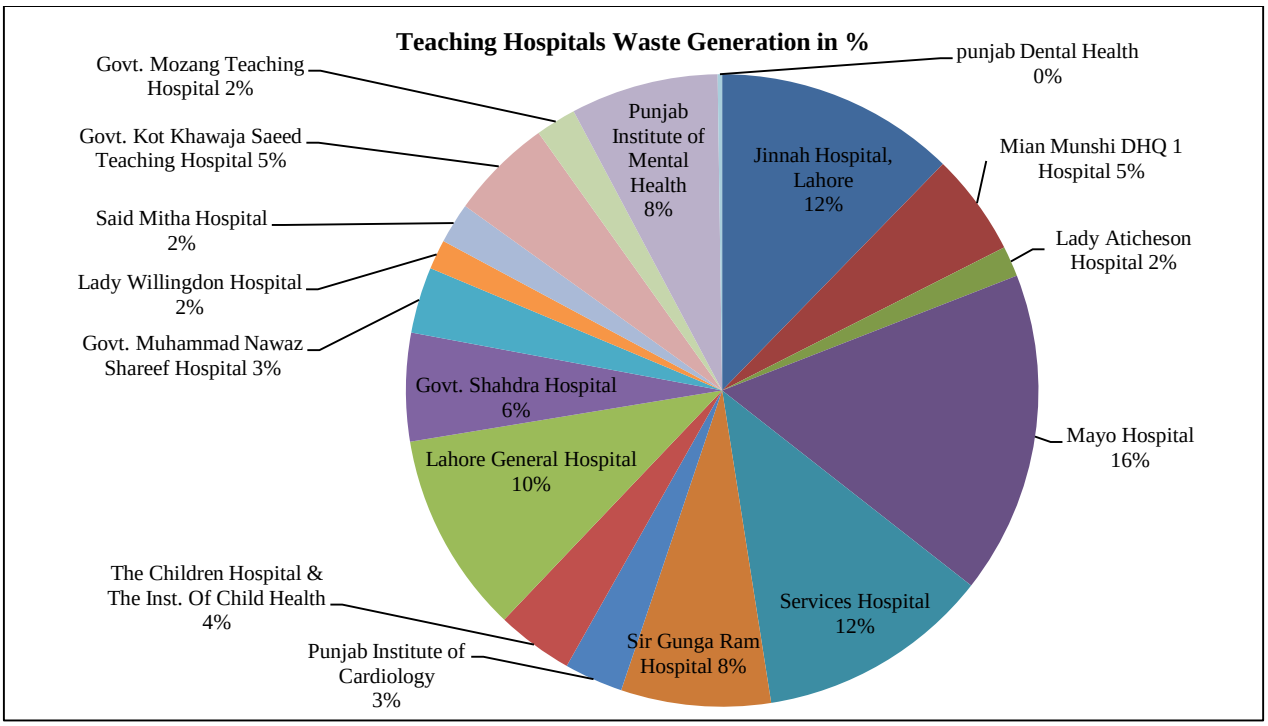

Figure 3. Percentage of waste generation in selected teaching hospitals of Lahore

Jinnah hospital generated total infectious and non-infectious waste 4793 kg/day (12%) with 3.2 kg/bed/day rate. Mian Munshi DHQ 1 hospital generated total waste 2039 kg/day (5%) with 13.7 kg/bed/day rate. Lady Aticheson hospital generated total waste 208 kg/day (2%) with 3 kg/bed/day rate. Mayo hospital generated total waste 6427 kg/day (16%) with 3.09 kg/bed/day rate. Services hospital generated total waste 4656 kg/day (12%) with 3.9 kg/bed/day rate. Sir Gunga Ram hospital generated total waste 2982 kg/day (8%) with 3.5 kg/bed/day rate. Punjab Institute of Cardiology generated total waste 1171kg/day (3%) with 3.4 kg/bed/day rate. The Children hospital generated total waste 1529 kg/day (4%) with 2.2 kg/bed/day rate. Lahore General Hospital generated total waste 4018 kg/day (10%) with 4 kg/bed/day rate. Government Shahdra hospital generated total waste 2154 kg/day (6%) with 7.1 kg/bed/day rate. Govt. Muhammad Nawaz Shareef hospital generated total waste 1318 kg/day (3%) with 6.5 kg/bed/day rate. Lady Willingdon hospital generated total waste 591 kg/day (2%) with 2.5 kg/bed/day rate. Said Mitha hospital generated total waste 809 kg/day (2%) with 2.09 kg/bed/day rate. Govt. Kot Khawaja Saeed teaching hospital generated total waste 2041 kg/day (5%) with 13.6 kg/bed/day rate. Govt. Mozang Teaching hospital generated total waste 809 kg/day (2%) with 2.09 kg/bed/day rate. Punjab Institute of Mental Health generated total waste 2944 kg/day (8%) with 2.1 kg/bed/day rate. Punjab Dental Health generated total waste 89 kg/day (0.2%) with 2.9 kg/bed/day rate. Figures 4a and 4b show the concentration of infectious and non-infectious wastes of studied hospitals.

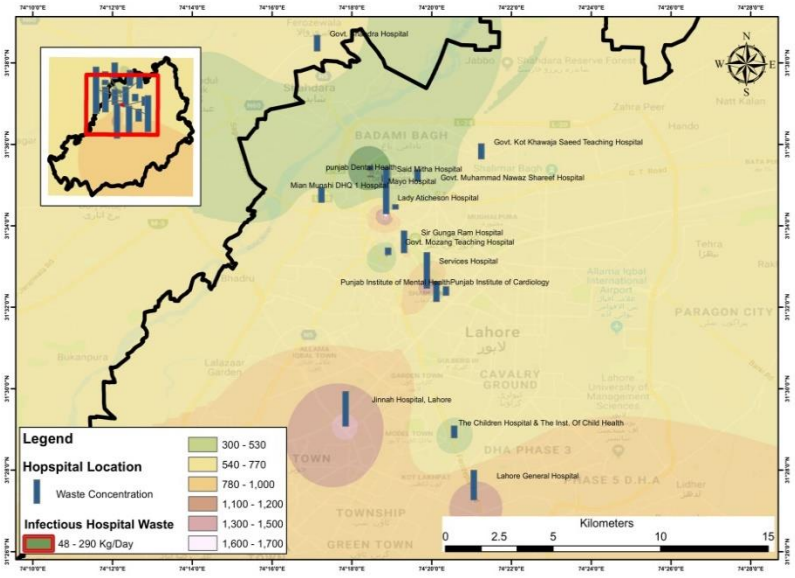

Figure 4(a). Concentration of infectious waste in study area hospitals

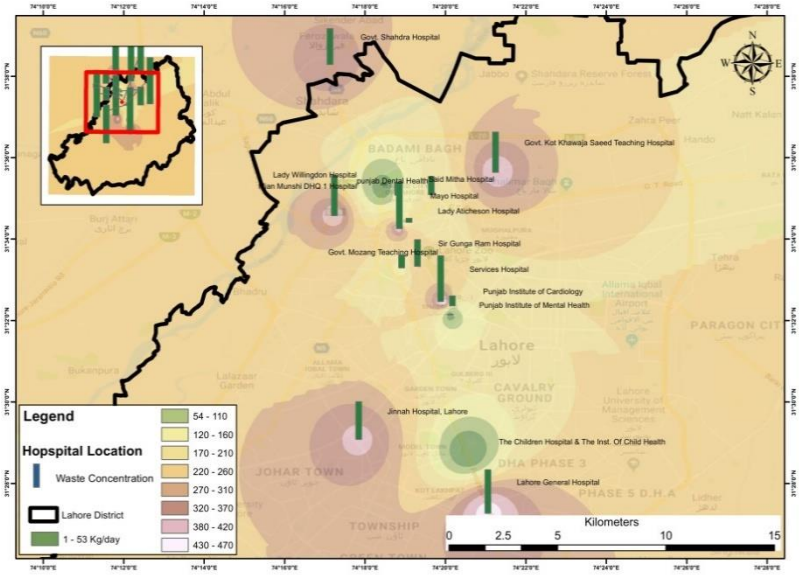

Figure 4(b). Concentration of non-infectious waste study area hospitals

3.3. Percentage of Infectious Waste and Total Patient Visited Hospital

Figure 5 shows relationship between visited patients and infectious waste generating percentage in teaching hospitals. Approximately 15% patients visited Services hospital while 12% infectious waste generated per day. 12% patients visited Mayo while infectious waste generated 16% which is the biggest value of generation of infectious waste. Punjab Dental Health visited 1% patients and infectious waste generated 0.3% of total waste.

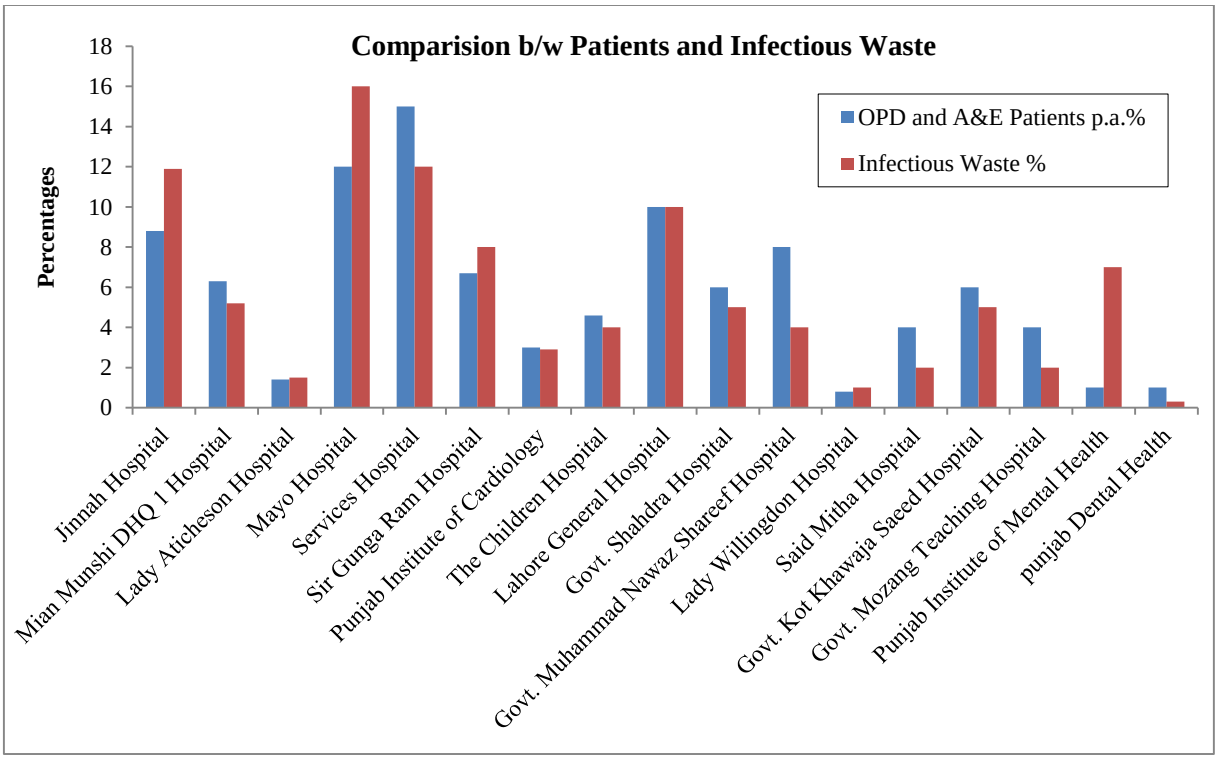

Figure 5. Relationship in total patients and total infectious waste percentage

3.4. Percentage of Infectious Waste in the Total Hospital Waste Management System

Results have shown that in the studied hospitals, infectious waste was generated by 27% in Jinnah hospital, 28% in Mian Munshi, 38% in Lady Aticheson, 27% in Mayo hospital, 29% in Services, 27% in Sir Gunga Ram, 27% in Punjab Institute of Cardiology, 29% in The Children Hospital, 28% in Lahore General Hospital, 27% in Govt. Shahdra, 32% in Nawaz Shareef, 27% in Lady Willingdon, 30% in Said Mitha, 28% in Kot Khawaja Saeed, 31% in Mozang hospital, 26% in Mental Health, and 42% in Dental hospital as given Figure 6.

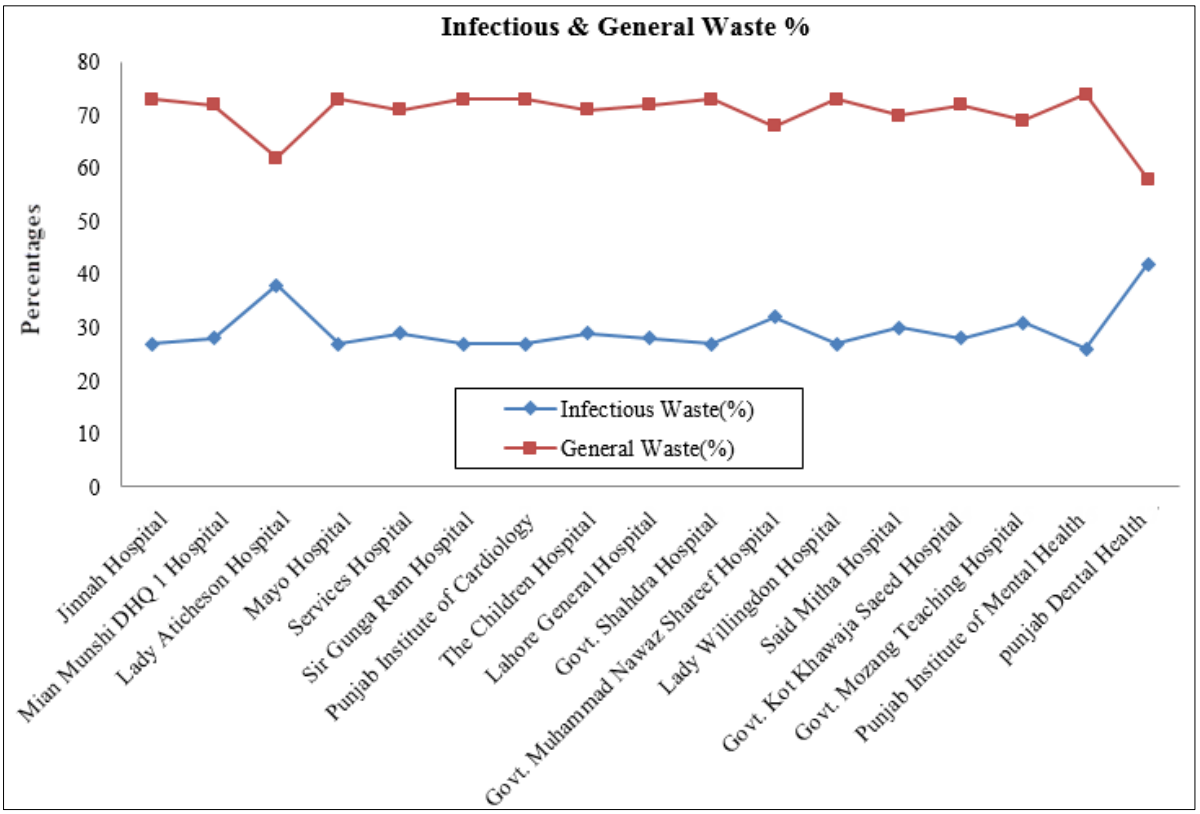

Figure 6. Percentage of infectious waste

3.5. Statistical Analysis of Hospital Waste

Statistical Pearson correlation coefficient in Table 2 indicates that only number of outdoor patients shows (P=0.044) no linear correlation with total waste. There is perfect positive liner correlation between number of beds (P=0.917), number of accidents and emergency patients (P=0.75), infectious waste (P=0.998) and (P=1) with total waste. While in liner regression, there is a straight line between (0.9966) infectious waste and (0.9995) general waste with average waste. There is no pattern in (0.8409) number of beds, (0.5944) number of outdoor patient and (0.5619) number of accidental and emergency patients with average waste.

Table 2. Statistical Characteristics of the Relationships between Total Wastes and Other Parameters

	Pearson Correlation Coefficient (r)	Simple Linear Regression (R^2)	t	Sig.
Number of beds	0.917	0.8409	4.149	0.001
Number of Outdoor Patients	0.044	0.5944	5.544	0
Number of A&E Patient	0.75	0.5619	5.035	0
Infectious Waste	0.998	0.9966	5.452	0
General Waste	1	0.9995	5.251	0

3.6. Infectious Waste Treatment

Two incinerators were present for teaching and public hospitals to incinerate the infectious waste with 3000kg/day capacity. One was working privately having 4000 kg/day capacity. The cost of incineration is PKR 80/kg.

4. Discussion

Metropolitan city Lahore Teaching Hospitals are working under Government sector. All Lahore teaching hospitals belong to ministry of Health. Its waste management governs (Lahore Waste Management Company (LWMC) that is a Semi Government department works under supervision of provincial Environmental protection department.

This study describes the waste types and generation rate. This statistics may be used as reference for controlling bodies and hospitals waste manager for better planning and improvement in any hospital infectious waste. This study may help the waste planners for waste treatment and its safe disposal.

Teaching hospital waste generation rate was totally varied from each other. The recorded values were very high than the studies have done in various other countries. Outside Pakistan, several studies have focused on the hospital waste management such as the India and Jordan where waste generation rate ranged between 0.5-2.0 and 0.52.2 kg/bed/day, respectively. Saudi Arabia and Kuwait have waste generation rates ranged from 0.03 to 3.78 and from 3.65 to 5.4 kg/bed/day, respectively. Moreover, in European hospitals, the generation rates of medical waste were 3.9 kg/bed/day in Norway, 4.4 kg/bed/day in Spain, 3.3 kg/bed/day in United Kingdoms and 2.5 kg/bed/day in France [20]. Similarly, the average waste generation rate of hospitals (2.79-3.86 kg/bed/day) in Taiwan was much high as compared to Poland (2.6 kg/bed/day), Japan (0.25 kg/bed/day) and Korea (0.48 kg/bed/day) [11, 21, 22]. This may be due to various factors as numerous studies have been conducted to find the factors that affect average waste production per day in hospitals and clinics [23–25].

During the research, it was observed that infectious waste generation rate was high with increasing the number of patients visited teaching hospitals. Present study demonstrates that waste generation in teaching hospitals of Mayo hospital, Jinnah hospital, Services hospitals and Lahore General hospital were comparatively high than other studied teaching hospitals. The variability of hospital waste generation can be indicative the fact, that total beds, or other factors may affect for example number of outpatient, inpatient, and patients came due to accidents or in emergency. Lab facilities, surgeries performed per day, number of departments, wards and hospital type may also be the reasons of maximum waste generation in these hospitals. Ceraro and Belgiorno (2015) has documented that hospital waste generation rate in different countries depends on several factors like provision of hospital services, disposable or hospital reusable instruments quantity, and laws, regulations and policies enforced there [26].

In the present study, waste is divided in to two parts; infectious and general waste according to Hospital waste Management Rules, 2005 Pakistan. Approximately in all teaching hospitals, the proportion of infectious to general waste was very high than WHO recommendation. According to WHO, the waste generated by hospitals and healthcare are general waste, estimated 75-90% (85%) while remaining 10-25% is hazardous and 10% waste is hazardous infectious. High rate of infectious waste might be due to different factors for instance improper infectious waste segregation, less training programs and lack of planning. Infectious waste treatment and disposal cost significantly can be reduced by implementing the educational programs and proper planning of waste minimization [27]. To enhance segregation efficiency and reduce inappropriate use of containers, the containers should be placed at proper place and labeled carefully [28]. A study was conducted in Greece in which nurses were approached specially for waste segregation, waste minimization price and pollution avoidance planning and execution process. Results showed that nurses were already well aware about waste segregation but facing hurdle in waste minimization during their duty [29]. Niamul Bari and fellows conducted research in 2019, to evaluate information about the practices related to waste segregation. In many hospitals collection of wastes in Rajshahi City from source of generation is not properly performed and not used colour containers as well [30].

Moreover, regression analysis, pearson correlation coefficient and t-test statistics were used for better understanding. There is perfect positive liner correlation between number of beds, number of accidents and emergency patients, and infectious waste with total waste. Only number of outdoor patients has no linear correlation with total waste. Sanida *et al.* (2010) used these statistical analyses to evaluate relationship of number of beds, out-patient, accidents and emergency patients, infectious and general waste with total waste. In addition, Eslami *et al.* (2017) used Pearson correlation coefficient and concluded that there was significance difference among private and governmental hospitals, with reference of infectious and sharp waste generation rates (P=0.027). Significant differences between specialized and general hospitals were also showed in group of non-hazardous waste (P=0.039), infectious waste (P=0.001) and total waste generation rate (P=0.02). To obtain accuracy in researches results, various hospital infectious and noninfectious studies were concluded with statistical analysis [31, 32].

Similarly, regression analysis results have shown that there are straight fit lines of general and infectious wastes with total waste as shown in Figure 7. It has direct positive relationship. Number of beds, number of outpatient and number of accidents and emergency patient's results are scattered as shown in Figure 7. These results show no patterns and have weak linear relationship.

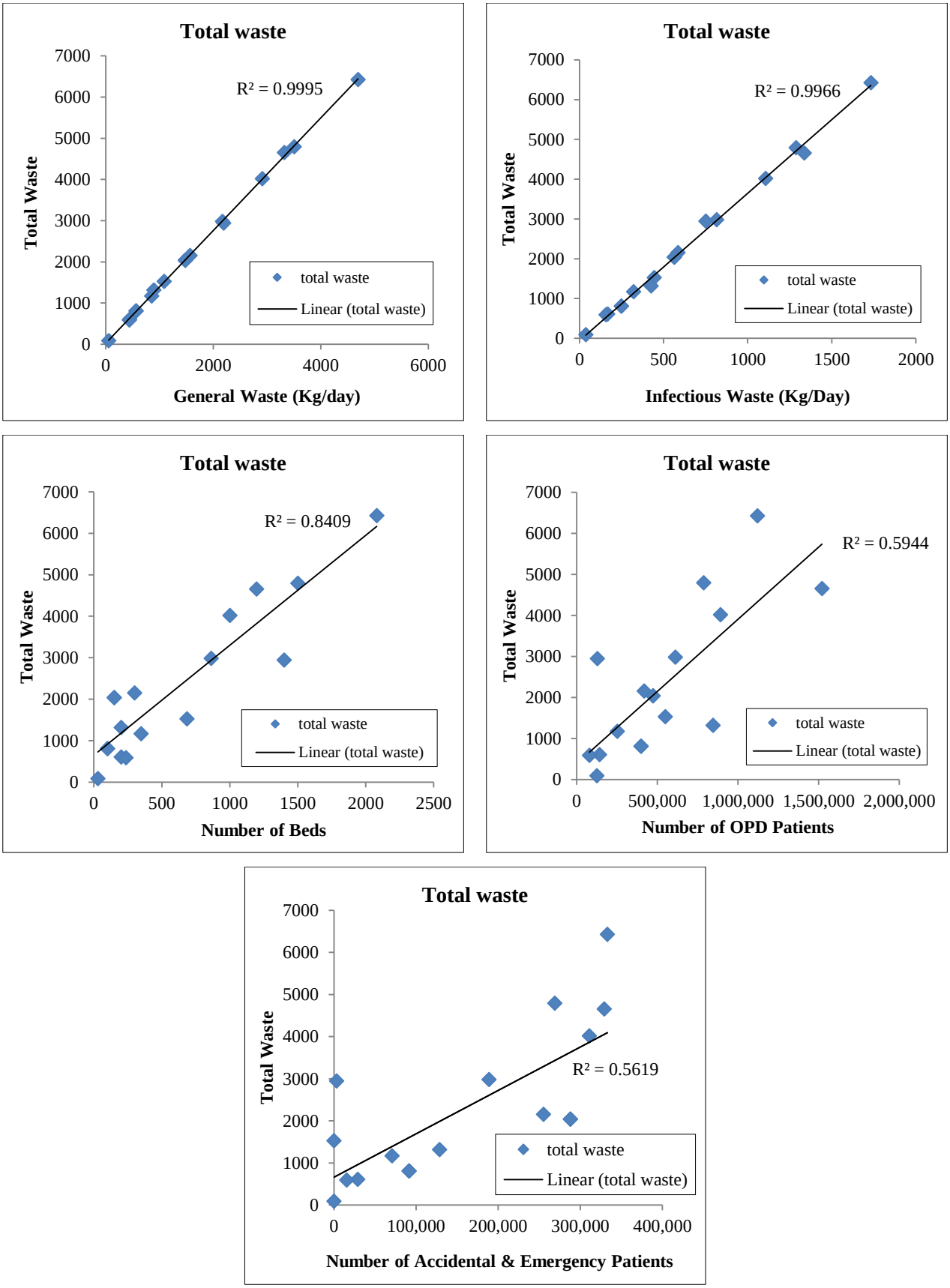

Figure 7. Scatter plot of total waste (kg/day) vs. number of beds, number of OPD patient, number of A&E patients, infectious and general waste

Issam A Al-Khitab conducted a research for secure outcome of waste management plan. For the estimating the general waste, total hazardous waste and daily total waste of hospital, multiple-variable regression model set was used. The purpose of the regression model used was that it may help in planning of waste management and to satisfy the

increasing waste treatment and disposal demand of hospitals [33]. Similarly a study was conducted at Upazila level Bangladesh in 2014 to identify the generation of hospital waste from the medical services. Where the amount of hospital waste was positive correlated with the number of occupied beds (R^2 =0.898) and with the number of patients (R^2 =0.785) [34]. Moreover, a study was done by Mohee about healthcare institution Mauritius in 2004, which revealed the exercise of regression relationship between number of beds and amount of hazardous waste. The R^2 value was 0.9551.The results y=0.0006 where y was the hazardous waste amount per bed per day. While x-0.19 was obtained, x was used for number of occupied bed. Author concluded that this equation is applicable for large hospitals [35].

The waste generator entities are responsible for ensuring proper waste disposal. In the present research the teaching hospitals have proper waste management plans and team. Practices regarding infectious waste disposal or incineration were quite good according to the waste management plan and were similar in all the hospitals. The wastes of 165 hospitals are brought at this incinerator for disposal from in and outside of Lahore [36]. An investigation was done by Abdullah and fellows in north Jordan in 2007. The purpose of the investigation was to know the level of segregation, treatment and disposal option in selected hospitals. The results reported similarly like current study regarding segregation in which infectious hospital waste was done improperly. While for infectious waste treatment condition was so poor. Incinerators were used only for 48% infectious waste. None incinerator working was met with Ministry of health regulations. Their 57% liquid waste was thrown in municipal drain while left liquid waste was collected in septic tanks [37]. Yong and fellows conducted a research in China, Nanjing in 2009 and, concluded that only incineration technology was being used by waste disposal companies [38]. Dioxin and furans are released from hospital waste incinerators due to polyvinyl chloride (PVC) plastic and affect human reproduction, development and immune system function, also cause cancer and environmental impacts. In spite with strict environmental laws and regulations lot of criticisms have been received. Responsible authorities should pay attention on this issue because of criticism by public and researchers [12, 38, 39].

According to the Hospital Waste Management Rules (2005), under the provision of Pakistan Environmental Protection Act (1997), each hospital is the responsible for its proper waste management (segregation, handling, storage and transportation) till its final disposal [40]. These guidelines are applicable to all hospitals, clinics, dispensaries, maternity centers, dental clinics, pathological laboratories, blood banks, nursing homes, research institutes and other health care facilities [6]. Similarly a research was conducted by Goren in 2011 in Turkey, where to avoid the danger of medicinal waste to workers and people, Medical Waste Control Regulation were used to express waste management system. To minimize the environmental pollution sterilization plant extension was under consideration [41]. Proper awareness and knowledge has become essential requirement for proper hospital waste management [42].

5. Conclusion

The aim of this study was to examine types of waste with respect to waste generation rate in multiple teaching hospitals in metropolitan Lahore. The research was conducted to quantify the waste generated from different hospitals. The total hospital's average waste, infectious, non-infectious and waste generation rate in surveyed teaching hospitals were 38978 kg/day, 10789 kg/day, 28189 kg/day and 3.7 kg/bed/day, respectively. Amount of general and infectious waste are high with the number of patients visit to the hospital. It can be due to the various factors including the facilities and services that are provided by the hospitals. Percentage of infectious waste is far high in 42% in Dental hospital, 38% in Lady Aticheson, 32% in Nawaz Shareef, 31% in Mozang hospital, and 30% in Said Mitha than WHO guidelines. Others remaining hospitals infectious waste values were between 26-30% that values are also so high. High percentages can be the reason of improper segregation. All collected data have shown that nearly all hospitals do not segregate their infectious waste accurately. In all studied teaching and public hospitals, infectious wastes is being collected and transported to incinerator plant and being incinerated there regularly according to the laws and regulations.

It was observed that public teaching hospitals are working and providing better practices and services under supervision of government following the national laws and regulations for hospital waste management. It is suggested that periodic education and training programs should be conducted by government for workers related to infectious and non-infectious hospital wastes segregation and also pay attention on release of hazardous gases from incinerators.

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7. Conflicts of Interest

The authors declare no conflict of interest.

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