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RESEARCH ARTICLE

Assessment of hospital waste management constraints and related environmental issues in Faisalabad, Pakistan

Tahira Yasmeen[1*], Faisal Islam[1], Shahida Amin[1], Shafaqat Ali[1], Farhat Abbas[1], Razia Virk[2], Toseef Majid[1]

[1]Department of Environmental Sciences, Government College University, AllamaIqbal Road, Faisalabad, 38000, Pakistan.

[2]Departments of Bio Sciences, University of Wah, Quaid Avenue, WahCantt, Pakistan.

Manuscript Info *Abstract*

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Hospital waste is one of the biggest problems in developing countries as most of the generated waste is directly dumped along the municipal waste or burnt openly, thus polluting the environment. Unfortunately, scarce data is available on the amounts, characteristics and management of the various types of wastes that are continuously generated by healthcare units in Pakistan. In this study, primary data was collected through comprehensive surveys, including questionnaire form, personal observations, formal and informal meetings while secondary data was collected from hospital's records. Average waste generation rate was 1.12 kg day^{-1} bed^{-1} and nearly one sweeper for seven beds. The studied hospitals generate approximately 2.9 tons waste day^{-1} which contain 12% infectious waste. Heavy metal analysis of incinerator ash reveals that the Zn and Pb were high among other metals. The present study showed that hospitals in district Faisalabad do not have any effective hospital waste management policy.

Introduction

Healthcare system is a basic requirement for wellbeing of mankind and a civilized society cannot do well without this important and critical sector. A number of facilities are provided by the health care units but a wide range of health related outputs are also generated side by side that becomes waste after being used (Azagei et al., 2010). Medical wastes production has been tremendously increased in recent years due to the growing population, quantity, capacity building of health care facilities and use of disposable medical products (Mohee 2005). Medical waste play significant role in the intensification and transmission of disease (Tsakona et al., 2007; Chaerul et al., 2008). According to the WHO (2000) about 21 million hepatitis B, 260,000 HIV and 2 million HIV infections were reported all over the world due to use of contaminated syringes (Shinee et al., 2008). Moreover, about 4 million kids and 1.2 million adults die each year across the world due to waste born diseases (Akter 2000).Environmental nuisance may also arise due to foul odor, flies, cockroaches, rodents and vermin as well as contamination of underground water tables by untreated medical waste in landfills (Nemathaga et al., 2008). Failure to adopt minimal standards of hospital waste management not only curtailed the health of society but also enhanced workload of health care units. In developed countries, good legislation, best technologies and proper guidelines are provided stating different feasible ways from waste collection to its final safe disposal with minimal risk to environment and human health (Tudor et al., 2005). Where hazardous and non-hazardous medical wastes are handled and disposed off together with domestic wastes, thus posing massive health risks to the health of municipal workers directly as well as to the public and environment indirectly (Silva 2005). Generally, infectious health care waste generated by hospitals, do not implement presented legislation due to insufficient information and funds therefore incorporate medical waste management supported by adequate equipment and budget could greatly reduce financial stress and quantities of waste (Danchaivijitr 2005; Marinkovića 2008). Availability of reliable data and its analysis are the indispensable necessities for proper management of hospital wastes. Despite the existence of Pakistan Biosafety Rules 2005 (SRO 2005) neither proper hospital waste management systems have been developed in various health

institutions nor are the concerned health professionals aware of the situation resulting therein. Unfortunately, no appropriate investigations and statistical analyses have been conducted in this regard and no official data about medical waste is available so far in Pakistan. Gathering of information through proper research, statistical analysis of the data and establishment of database could help to plan and design suitable strategy for the management of medical wastes. In view of all above said, this investigation was done in Faisalabad as a first step of series to evaluate the hospital waste management practices in Pakistan.

Background information

Faisalabad is the is the third largest metropolis in Pakistan, the second largest in the northeast province of Punjab after Lahore, and a major industrial center in the heart of Pakistan. The city covers an area of approximately 1,280 km^2 with the population of about 4,177,246 inhabitants.

There are about 32 big hospitals working in district Faisalabad and divided into three major categories (I) government hospitals (II) trust hospitals, organized by NGOs and (III) private hospitals. Both general and medical waste is generated in different hospitals that are usually disposed off in the premises and causing environmental and health issues due to improper disposal and treatment of the waste, restrained with a variety of potential infectious and toxic material. Keeping in view the health problem caused by improper management of medical waste, the current study was designed to assess the hospital solid waste management practices in terms of types of waste and quantities of waste generated as well as waste handling, disposal and to recommend policy measures based on results of this study.

Methodology

The six busiest hospital of Faisalabad were surveyed conveniently covering three categories, e.g. government, trust and private hospitals. Two hospitals were selected randomly from each category. G1 hospital and G2 hospital from government sector, T1 hospital and T2 from Trust, P1 and P2 hospital from private sector were selected to assess the medical waste management system in Faisalabad.

Data Collection

The study was based on the review of available information on medical waste, on-site inspection of hospital premises and disposal sites that relates to their nature, impacts and management techniques. Self-administered questionnaire and a check-list were designed aiming to get proper information regarding waste collection from point of generation to proper disposal and to evaluate the exercised waste management practices. The study was carried out from January-August, 2011. Six parameters of waste management such as waste generation, segregation, sorting, handling, gathering, transportation and final disposal were focused in this study. Primary data was collected through interviews with authorities of the hospital, hospital staff and in-charge of waste management unit and compared with the suggested standard of the WHO for assessment of hospital waste management in this developing country (Pakistan). Personal observations of the worker in the waste management units of selected hospitals were recorded to check the compliance of all activities with recommended standards.

Sampling and analysis

In order to determine physical and chemical characteristics, the waste was separated into different categories in accordance with WHO guidelines (1978). All types of the wastes generated in selected 6 hospitals were weighed on a daily basis, during the study period (eight months). Different departments of each hospital including Operation Theatre, Emergency Center, Labour room, Pathology Laboratory, Radiology and different wards including Surgical, Medical, peads, Gynecology / Obstetrics were observed to collect data for the study. Ten beds each of the above said wards were marked and observed continuously during study period with three different colored covered bins for separate waste collection. Red bins were placed for non-sharp infectious waste including surgical dressing, cotton swabs, blood, body fluid, body parts, pus, sputum, culture of contagious agents and other contaminated waste. Yellow bins were placed for sharps including needles, subcutaneous needles, razorblade and other blades, knives, infusion set and broken glass and white bins for all the non- infectious waste, which includes paper, cigarette packets, cardboard, packing material, leftover food, fruit and garbage etc. Bins were laid by the side of each bed, lined with a polythene bag. The collected waste was weighed prior to its removal by the concerned staff. The weighing of waste was done twice a day i.e. in the morning and evening.

Personal visits to the hospitals were made regularly and waste management staff and sanitary workers were individually interviewed. Personal observations were also made about gathering, sorting, handling, transport and disposal of medical waste.15 workers and 15 paramedics' staffs were included for the survey and data collection. The information given in the questionnaire was counter checked.

Results and Discussion

Hospital capacity and occupancy rate

Medical establishments of district Faisalabad fall under trust, Government (public) and private sectors. All the public sector medical establishments belong to the Ministry of Health. Total number of beds, occupancy rate per hospital and average occupancy rate in the 6 hospitals of all three sectors are presented in Figs. 1, 2, 3 and 4. The highest number (1300) of beds with 100% occupancy rate was found in G1 hospital followed by G2 hospitals (700) with 93% occupancy rate, while the lowest number of beds (100) was recorded in P2 hospital with lowest occupancy rate (60%). T1 and T2 trust hospitals were found with comparable occupancy rate of 80% and 87%, respectively. The occupancy rate of our study was much higher than Askarian et al. (2004) study who found occupancy rate of 53% in his 4 month study in 15 hospitals of Iran.

Comparison of manpower involve in waste management

Although G1 hospital is bigger hospital then G2 hospital but there is no significant difference in staff strength involved in waste management between two hospitals. The relationship between workers of waste management team of all studied hospitals to the total bed capacity indicates that approximately 1 worker is available for the cleaning of 7 beds. In general, there is approximately 1 sweeper for 5 beds in G1 hospital while in G2 hospital approximately 1 sweeper is serving for 6 beds. On the other hand, in P2, P1, T2 and T1 hospital approximately 1 sweeper is for 10, 15, 13 and 12 beds, respectively.

Waste generation

Waste generation rate of each hospital was a little different from other hospital (Fig. 5). Average waste generation rate of various hospitals of district Faisalabad was 1.12 kg day^{-1} bed^{-1},which included 78% general or non-infectious waste and 12% infectious waste while composition of generated waste consist of plastic 55%, paper 5% , textile 10% and glass 30%. The observed values in this study are higher than the study done in Saudi Arabia Health Center in which waste generation rate of 0.8 kg day^{-1} bed^{-1} was recorded (Al-Zahrani et al., 2000). In contrast, waste generation rate in our study was much lower with 4.45 kg day^{-1} bed^{-1}in Iran (Askarian et al., 2004).The differences are probably due to socio-economic and cultural conditions, living standard of the patients, availability of temporary storage facilities and ways of waste categorizing and segregation system (Patwary et al., 2009).Farzadkia et al. (2009) also observed similar results with average waste generation rate of 2.5 to 3.01 kg bed $^{-1}$ day-^{1}, which included 85 to 90% of household waste and 10 to 15% of contagious waste. In the hospitals of Ulaanbaatar waste generation rate was found lower than other countries (Shinee et al., 2008). This result is contradictory to our study that may be due to the use of different safety measure in hospitals of other countries. However, the average waste generation rate (1.3 kg $patient^{-1}$ day^{-1}) as observed by Swalem et al. (2009) is in line to our study. The proportion of general to infectious waste in our study was different from WHO literature. The difference in waste production (by weight) was not only observed among different countries but also found in different hospitals within the country (Qdais et al., 2007). Waste generation rate in various hospitals depends upon a variety of factors such as types of health care services provided, number of beds, bed occupancy rate, viable social condition of the patients and the general condition of the region where the hospital is placed. In different regions of world, waste generation kg bed^{-1} day^{-1} was reported differently, like in Tanzania average waste production is 0.84 to 5.8 kg bed^{-1} day^{-1} (Mato and Kassenga 1997), Korea 0.14 to 0.49 kg bed^{-1} day^{-1} (Jang et al., 2006), Jordan 0.61 kg bed^{-1} day^{-1} (Abdulla et al., 2008). Turkey 2.11 to 3.83 kg bed^{-1} day^{-1} (Eker and Bilgili 2011), Bangladesh 0.25 kg bed^{-1} day^{-1} (Patwary et al., 2009a,b), Egypt 0.4 to 1.91 kg bed^{-1} day^{-1} (El-Salam 2010), Brazil 0.57 kg bed^{-1} day^{-1} (Silva et al., 2005), Greece 0.26 to 0.89 kg bed^{-1} day^{-1} (Karagiannidis et al., 2010) and South Africa 0.60 bed^{-1} day^{-1} (Nemathaga et al., 2008).

In our study, G1 hospital is one of the big hospitals (1300 beds) in district Faisalabad and generates large quantity of waste (1750 kg^{-1} day^{-1}) (Fig. 6). Number of beds in G2 hospital is about 1 times less than G1 hospital and waste generated by the G2 hospital (740 kg^{-1} day^{-1}) is greater than G1 hospital. P2 and P1 hospitals add much less waste however overall there was little difference between hospitals for per bed generation of medical waste. In general, public hospitals generate large amount of waste, trust hospitals generate medium and waste generation rate of private hospitals is much less than those of public and trust hospitals. Average waste generation per day per bed and total waste generated per day in studied hospitals is presented in Fig. 7 whereas, Table 1 represents waste generation rate in individual wards/operational units of the studied hospitals.

Waste Segregation

In order to formulate proper waste management schemes, it is necessary to have precise data on the medical waste generation rate (Yong et al., 2009). Separation of medical waste from general waste should be done at the point of waste production. During interview with the hospital staff it was revealed that separation of hospital wastes into contagious and non-contagious waste was not done according to reported rules/regulation and standards of WHO in all categories of hospital (Fig. 8). The hospitals do not properly label their infectious waste with symbol of bio-hazard. Some rules of waste segregation are followed by the G2, G1 and P1 hospital e.g. use of separate color

coded bins for infectious or non- infectious waste to some extent so the isolation of waste is conducted at the point of waste generation but afterwards all type of waste are deposited at the same place and transported out without distinction. Same was found in study of Bangladeshi and Egyptian hospitals where the segregation of non-infectious and infectious waste was done at the site of generation but during their disposal, all the infectious and non-infectious wastes were mixed together (Hassan et al., 2008; El-Salam 2010). A case study in China disclosed that about 73% of hospitals segregate its medical waste into different categories (Yong et al., 2009). In Pakistan, public sector hospitals deal with the common public and most of them are illiterate so they do not usually aware and bother to use different bins for different types of waste. However, comparatively, the hospital waste management system was much better among government hospitals in comparison to trust and private hospitals where color code system is not properly followed for different kinds of wastes. Abdullah et al. (2008) recorded similar findings regarding separation of various type of medical waste in the hospitals. Rao (2008) also reported that medical waste management was found better in government hospitals as compared to private hospitals.

Figure 1. Total numbers of beds in the studied hospitals

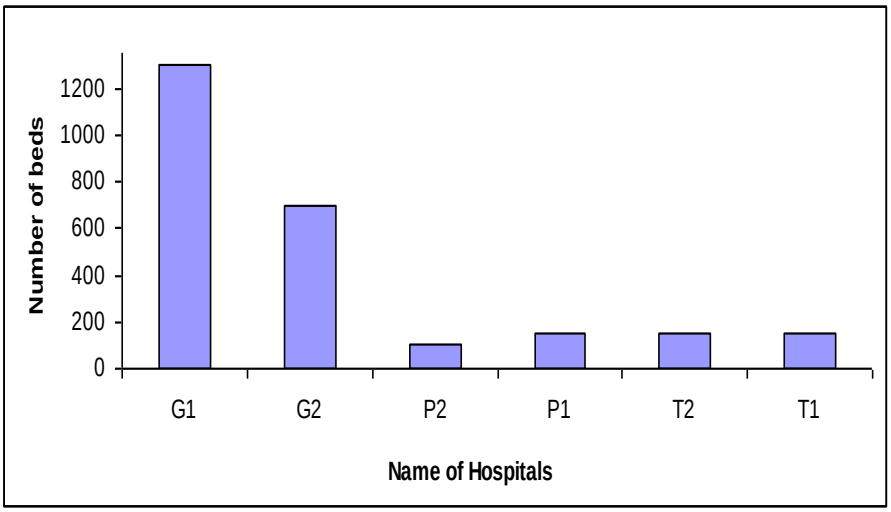


Figure 2.The occupancy rate (%) recorded during study period (Eight months) in all the hospitals

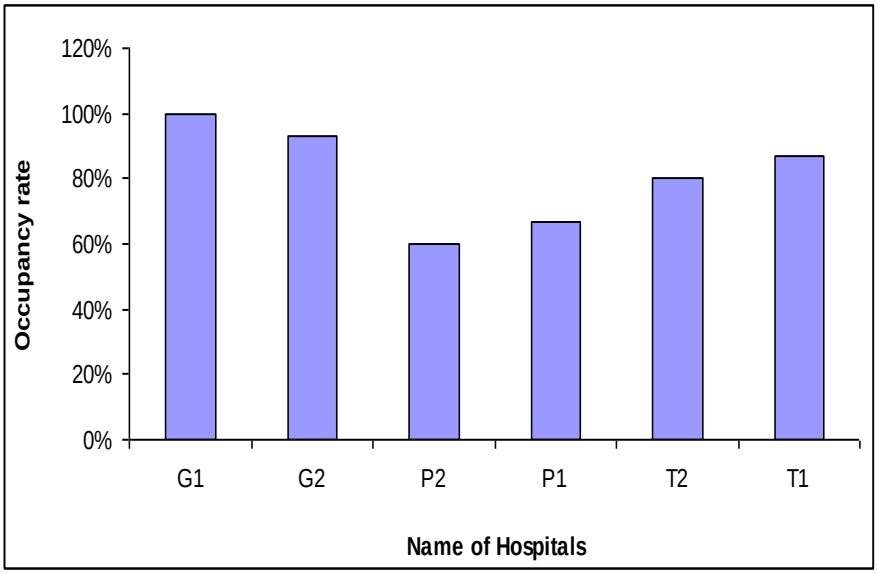


Figure 3.Variation of the average bed occupancy (%) in Faisalabad by month of the year 2011

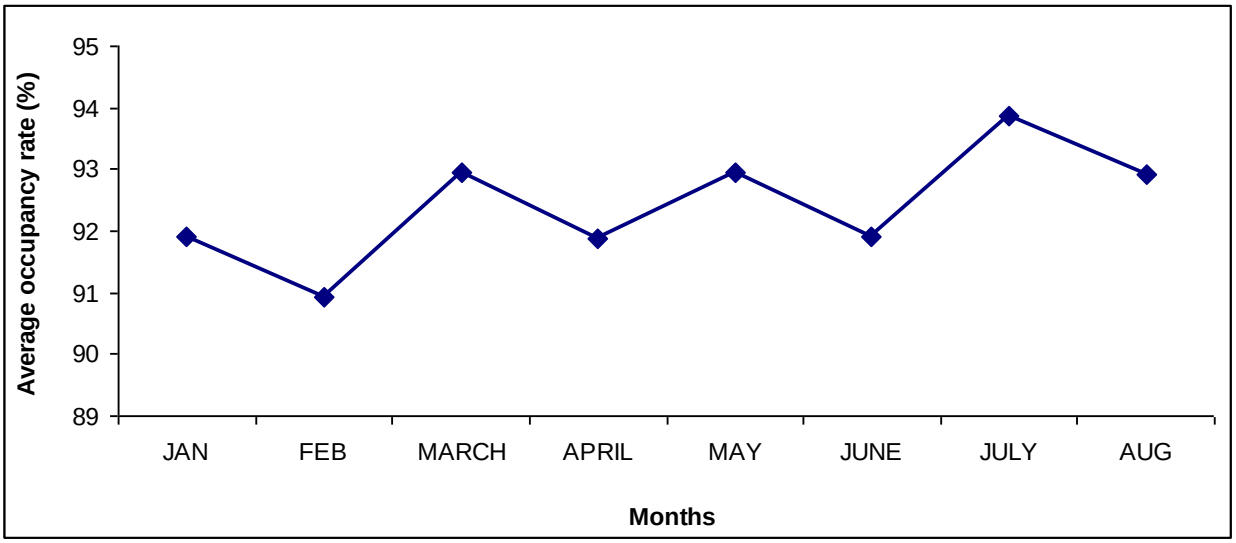


Figure 4.Percent occupancy rates in different wards of the studied hospitals

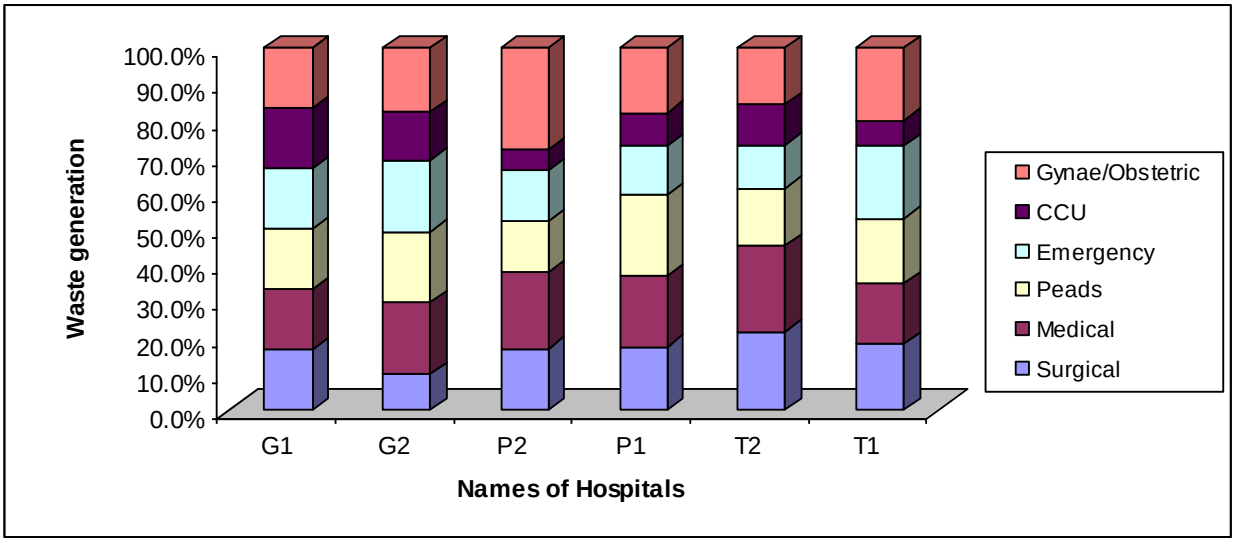


Figure 5.Average waste generation (kg day^{-1} bed^{-1}) in the studied hospitals

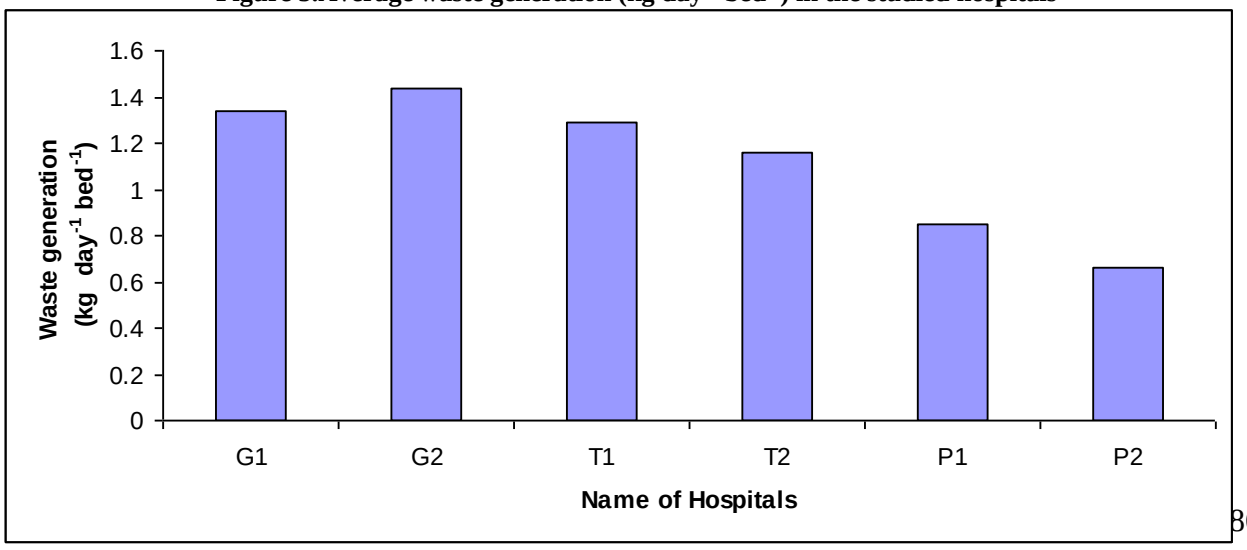


Figure 6. Total waste generation (kg day^{-1}) in the studied hospital

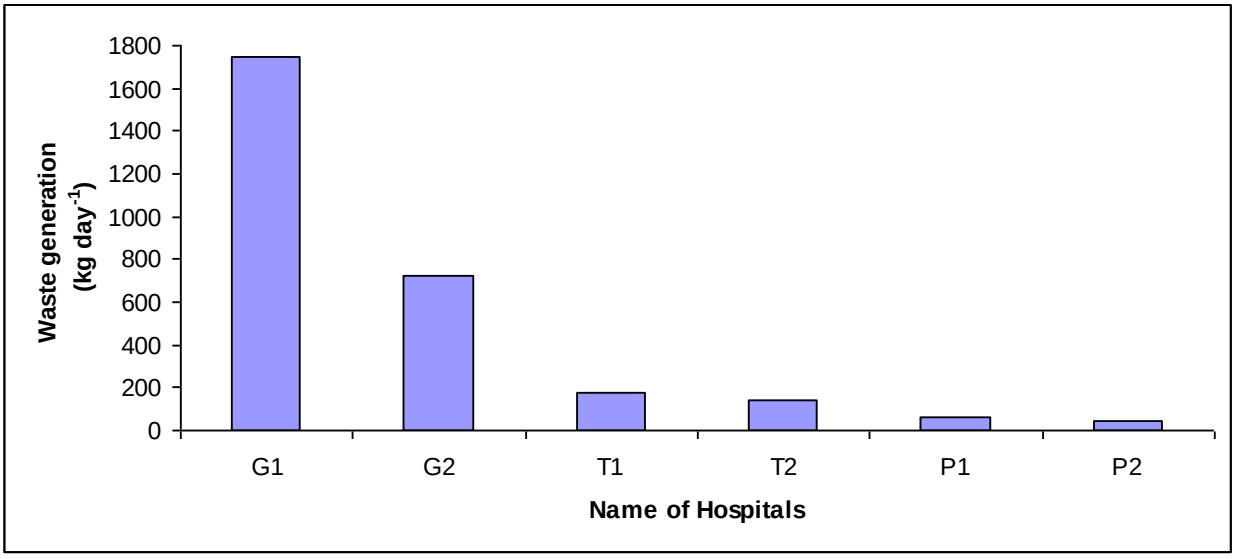


Figure 7. Pie charts showing the percentage composition (by wt.) of hospital solid waste generation (kg day^{-1} ward^{-1}) in the studied hospitals

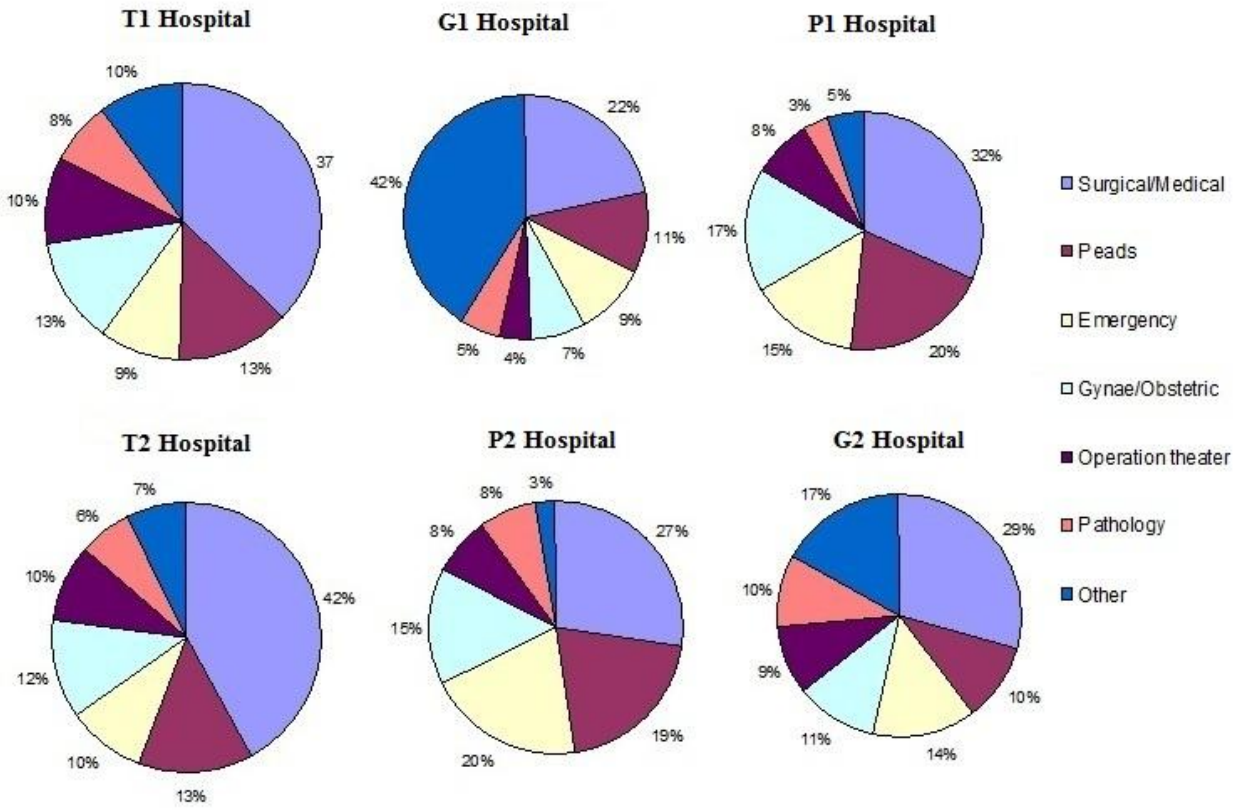


Figure 8. Percentage of different waste handling processes in the studied hospitals

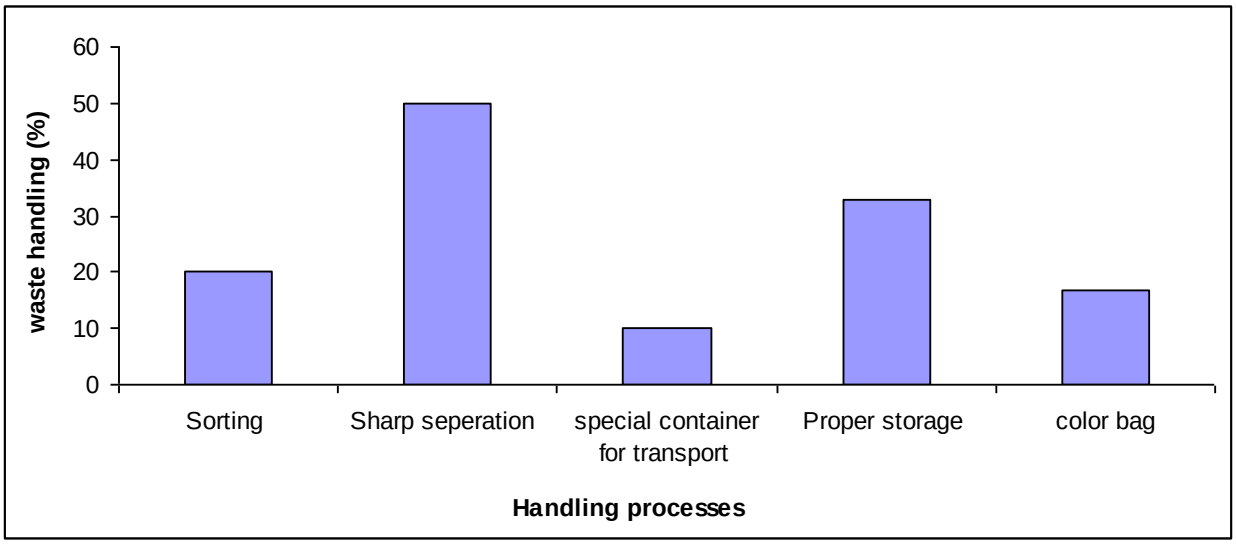


Figure 9. Trolleys in use for onsite waste transportation in G1 Hospital

Figure 10. Safety measure profile in the studied hospitals of Faisalabad

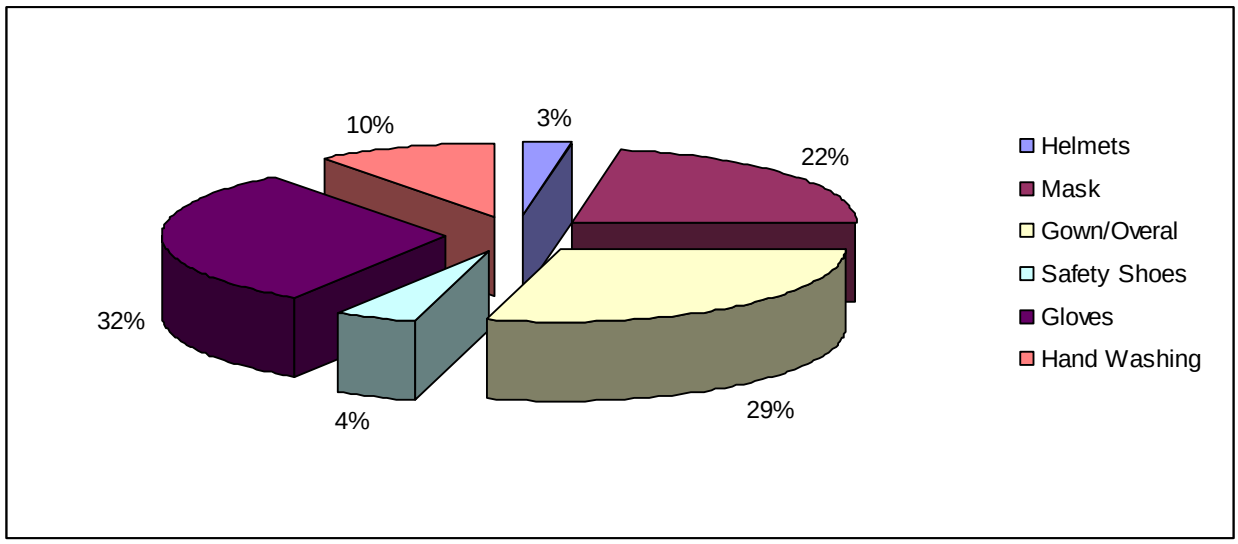
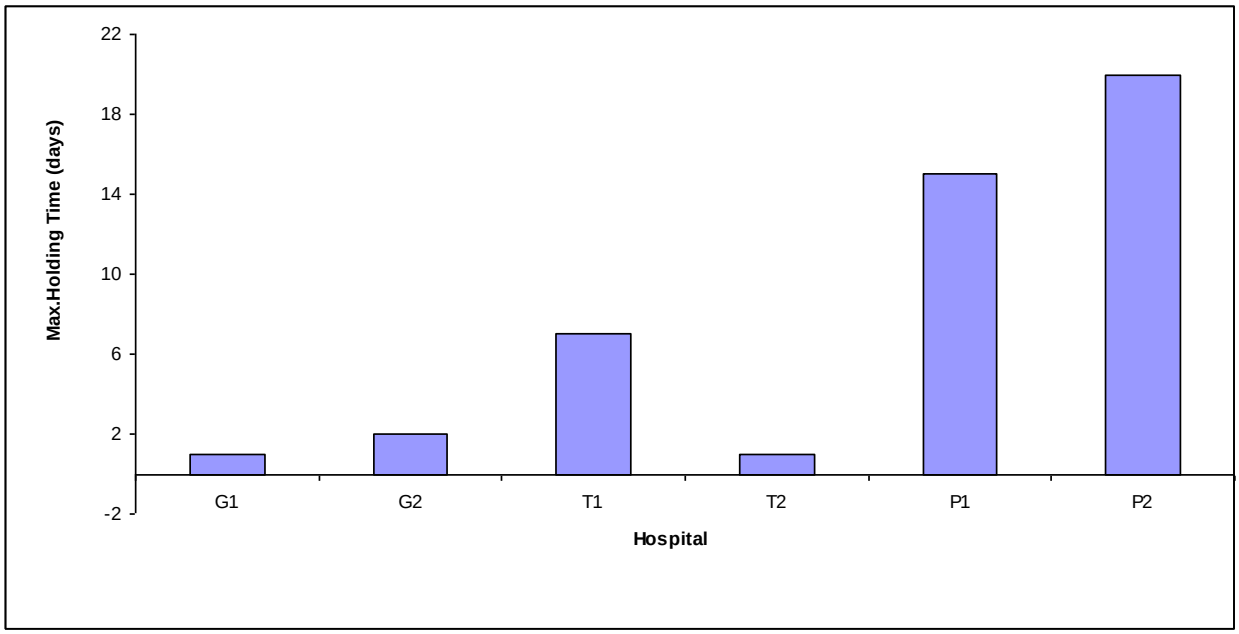


Figure 11. (a) Storage of hospital waste on road side (b) Collection unit of waste in G2 hospital

Figure 12. Maximum holding time (days) of waste before disposal



Medical waste handling, collection and temporary storage

Medical wastes generation as well as collection in the selected hospitals is on daily basis and the waste is transported from generation point to the temporary collection unit by hospital staff. In G1 and G2 hospitals, onsite transport of waste from the sites of production to the temporary collection unit is by wheeled trolleys (Fig. 9). These wheel trolleys are not cleaned properly which may cause infection as flies and other insect may contact with them. In trust hospitals (T1 and T2) and private hospitals (P1 and P2)onsite transportation of waste is carried out manually and no wheel trolleys or other carriers for use are available. Moreover, the hospitals do not maintain a record or register for medical waste disposal. The staff was not fully aware of risk and how to handle it. The working staff of all these hospitals for handling waste was not found properly dressed for personal protection and it seems that personal hygiene was compromised during handing of hospital waste. G1 and G2 hospitals only provide polythene gloves and over-coat/gown to their worker (Fig. 10). No training was given to the staff about proper hand washing and due to inadequate education; habit of hand washing after each waste handling was not adopted by the workers. Staff handling medical waste in all studied hospitals does not receive vaccine against hepatitis, tetanus and any other disease. Improper handling of waste bags was observed in all hospitals and hand washing after taking off gloves was negligible which show lack of awareness towards handing of infectious waste. Similar findings were reported by Danchaivijitr et al. (2005). Targeted awareness regarding hand wash practices is urgently needed and use of over-cot and facemasks for personal protection should be encouraged. Boudar et al. (2006) also observed that properly defined methods were not being used for various steps of waste management such as handling and disposal of their hospital wastes, starting from the workers responsible for waste gathering to those who transport the wastes at the disposal site. The same kinds of results were reported by other researcher Nasima et al. (2002). They found that hospital workers have no proper understanding of hospital waste management and do not perceive handling or disposal of medical waste as a risky work.

Therefore it is essential to understand that the deficiency of appropriate equipment for protection, deficient knowledge concerning the proper usage of tools and deficiency of relevant understanding of the workers can exposes workers to severe risks. G1 and G2 hospitals in this study, have poor sanitary momentary collection units at the backyard of the hospitals which is not properly constructed, secured and maintained. The contagious and non-infectious wastes are kept separate in hospital's own temporary collection unit. The wastes are kept in this temporary collection unit or neighboring area until the time of disposal and off-site transport. On the whole, three collection points for medical wastes are maintained in G1 hospital whereas; G2 hospital has maintained two points for medical waste storage (Fig. 11). One small room exists in T2 and T1 for storage of waste. In P1 and P2 hospital, no specific room was found for temporary storage. In P1 and P2 hospital waste is collected in outside the hospital in metal drums or in open place and the collection point of waste is not well secured and sanitized.Beforehand, this waste is gathered by municipal worker for disposal. The scavengers sort the bin to search the valuable things like syringes and other plastic waste. Later, after final disposal of waste in city dumping site, scavengers were again observed for sorting the things at dumping sites (Patwary et al., 2011). The situation of ineffective legislation and implementation of rules in Pakistan can be judged a report of leading TV channel, disclosing that in Lahore, Pakistan, two factories were sealed by authorities those were involve in the manufacturing of kids feeders, crockery and straws from recycling of Hospital waste (For video: http://www. facebook.com/ photo.php?v=10200094673
355611).

An astonishing fact emerged in this study was handling of pathological waste without the use of refrigerators. The pathological waste is stored in plastic bags and placed in the form of heap in storage room or in open area. The storage rooms are not at isolated area nor are they disinfected daily and poorly ventilated. According to WHO (2000), there should be special storage rooms in the isolated area of hospital where euro bins or four wheeled bins must be used to store hospital waste until its off site or on-site disposal. The survey analysis revealed that timing of temporary storage for waste was varying in different hospitals. The waste was being moved to municipals sites in 1 to 20 days. The maximum waste holding time was about 20 days by the P2 hospital and least time was about 1 day of G1 hospital (Fig. 12). While the implementation of hospital waste management rules of Pakistan (2005) was totally avoided, according to which the waste must not be stored for more than 24 hours.

Table 1 Medical waste generation (kg day^{-1}) in different operational units of studied hospital of Faisalabad

Operational Units	Public Sector		Private Sector		Trust Sector	
	G1	G2	P2	P1	T1	T2
Labour room	20	19	4	5	5	2
Lab	6	6	3	3	0.5	0.5
X- ray	5	4	1	1	1	0.5
Dispensary and Dressing room	7	7	0.5	1	0.5	0.5
OPD	4	4	1.5	1	1	0.5

Table 2 Categories of medical waste collected from tagged beds of the studied hospitals

Waste type	WHO standard Color Code	Examples
Infectious	Red	surgical dressing, cotton swabs, blood, body fluid, body parts, pus, sputum, culture of contagious agents and other contaminated waste
Non infectious	Blue	paper, cigarette packets, cardboard, packing material, leftover food, fruit and garbage
Sharp	Yellow safety box	needles, subcutaneous needles, razorblade and other blades, knives, infusion set, broken ampules and vials.

Table 3 Heavy metals in the incinerator ash of G1 and T2 hospitals

Sampling Month	Hospital	Cr (µg g^{-1})	Cu (µg g^{-1})	Pb (µg g^{-1})	Ni (µg g^{-1})	Zn (µg g^{-1})
March	G1	0.234	0.023	3.469	0.143	7.342
	T2	0.457	1.046	2.456	0.345	5.359
April	G1	0.527	10.056	2.453	0.493	2.466
	T2	0.762	9.231	3.634	1.356	8.462
May	G1	0.961	0.563	11.57	3.137	6.128
	T2	0.736	0.065	1.343	0.014	6.342
June	G1	0.455	1.238	6.366	0.564	3.472
	T2	0.332	0.5436	1.568	0.984	13.457
July	G1	0.328	0.451	1.452	0.034	5.341
	T2	0.865	6.640	2.578	2.736	2.346
August	G1	0.451	2.027	2.672	1.872	11.354
	T2	0.649	0.872	1.4467	0.567	9.522

Off-site Transport and disposal of Medical Waste

In Pakistan approximately 0.8 million tons of hospital waste is produce daily (Anonymous 2012). In Karachi only, 35 tons of hospital waste is dumped in municipals while many hospitals don't installed incinerators so, direct burning is the main process of disposal of medical waste (Anonymous 2011).

In our survey, no treatment before transportation of infectious waste was observed in all six hospitals. In G1 and T2 hospitals transportation of the medical waste is not done because these hospitals have their own incinerator for final disposal of waste. Moreover, G2, T1, and P1 hospitals transport their medical waste to G1 hospital for incineration. The maximum infectious waste holding time are shown in Fig 12. It was observed that increased waste holding time was because of expenses of transportation and operating cost of incinerator. Small size of pickups for transportation of hospital waste is usually used. The wastes are usually heaped and they fall off on the roads during transportation. The wastes are burdened directly into the wagons without putting them first into closed containers. The medical

waste has been loaded by hand and made contact with the floor, thereby increasing the danger of the waste handler being injected or cut by contaminated hard metals such as blades and needles (Tsakona et al., 2007). The same wagons were being used for non-infection waste disposal which must increase the contamination of non-infection waste with pathogenic substance, causing a serious health risk to the workers. Moreover, these wagons are not labeled with bio-hazardous symbols, not just fix for medical waste transportation, not properly cleaned and disinfected after transportation. Much of the waste fall on the road during transportation, this is hazardous for the public and environment. No off site transportation of medical waste was observed in P2 hospital where waste usually disposed of by burning. Blenkharn (2006) found collection of waste in areas those were easily available to the community and malfunction due to local individual carts was common. Many hospital waste carts and areas dedicated to their storage were in a bad condition of restore. Tsakona et al. (2007) also found same kind of unsuitable gathering and procedures for transport of contagious waste, which were extremely dangerous for the wellbeing of staff and patients. The present study showed that all the hospitals in district Faisalabad do not have any policy and plan for managing medical waste. Samwel et al. (2004) also found no clear laws and appropriate policies in Tanzania associated to medical waste management, compared to other countries. However, in developed countries the waste management system is much better than developing countries those are suffering from lack of budget, consciousness and economic crisis.

Heavy Metals in Hospital Incinerator Ash

The basic aim to note the parameter was the investigation of heavy metals concentration in incinerated waste of hospital. Heavy metals were found for all ash samples of selected hospitals. Zinc (Zn) and lead (Pb) were the dominant metals found among the samples while copper (Cu), nickel (Ni) and chromium (Cr) were not present at high concentration in ash, respectively (Table 3). The average concentration of Pb in ash samples ranges from 1.343 to 11.57 µg g-1 Moreover the concentration of Zn ranges in ash samples was 2.466 to 13.457 µg g-1 The presence of heavy metals in the hospital waste might be from the plastic accessories and lead batteries (Meyers et al. 1998). The pigmentation of plastic is due to the presence of different metals like Zn, Pb and Cr etc which are detrimental to health. The use of colored plastic in hospitals of Faisalabad is the main cause of the high concentration of above said metals (Aucott et al. 2006). High amount of lead in the ash of hospital G1 might be due to the high temperature of the incinerator as the Pb is volatile metal it may be vaporized in an environment at high temperature. This type of phenomena was also observed by the Racho & Jindal (2004). The incinerator ash is also dumped along the municipal waste (Ilyas 2011) as our survey revealed that worker thought that it is safe to dispose. But the metal contamination in ash may leach down in soil in rainy season (Chandler et al., 1997) and may enter in the water which led to the underground water contamination.

Conclusion

On the whole, all the hospitals do not fulfill the WHO recommended standards of waste management in each step right from collection to disposal. It is due to inadequate knowledge, equipment and improper training of hospital staff. The main problems of hospitals with respect to the management of medical waste include insufficient regulations and proper training on the different aspects of gathering, sorting, handling, transportation and disposal of waste, improper use of colored bags and lack of budget. Due to all these deficiencies the hospitals do not meet the WHO standards of waste management. We conclude that, there is an urgent need of devising effective waste management plan for all the hospitals in Faisalabad city. In addition, waste managingstaff of these hospitals must be given adequate equipment and budget to make them functional and efficient.

Recommendations

From above study we recommend the following key points with respect to the administration of hospital waste in Pakistan.

1) Before the implementation of waste management strategy the obligation must be given to the concerned governmental authorities. Ministry of Health along with the ministry of Environment, are the competent authorities those could cooperate with managements of governmental, non- governmental and private organization to ensure application of action plan.

2) For effective and sound management of infectious and non-infectious waste, it is necessary to collect information about the current status of hospitals in term of facilities provided by health care unit, beds capacity, occupancy rate, waste generation rate and its types, handling segregation transportation, disposal, manpower involve in waste management process, professional in waste management team, personal protective equipment and there usage. All

these collected information will help to develop state of the art plan. For the effective implementation of action plan legislative cover must be provided to the strategy.
3) Training about the use of personal protective equipment, waste collection and further processing must be given because in Pakistan these workers (Sweeper and cleaner) are mostly illiterate and have no idea about the nature of hazardous materials and their impact on health of society.
4) Periodic monitoring and assessment through independent investigating team must be done in order to implement the action plan properly.
5) For the treatment of hospital waste up to dated scientific methods must be adopted with the passage of time.

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