

Healthcare Waste: Evaluation of its Generation Rate and Management Practices in Tertiary Care Hospitals of Lahore

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ABSTRACT

Objective: --To appraise the healthcare waste generation rate in tertiary care hospitals of Lahore and waste management practices in these hospitals.

Study Design: It was hospital based cross-sectional study.

Place and Duration of Study: The study was conducted from 16th June to 03rd July, 2009 in Gulab Devi Hospital, Services Hospital and Jinnah Hospital. For the purpose of determining special waste (pathological and radioactive waste) generation rate and its disposal, INMOL and Central Pathology Laboratory of Punjab Institute of Cardiology, Lahore were included in the study.

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Subjects and Methods: The study population comprised Nurses, Sanitary Staff and Sweepers performing duties in the wards of respondent hospitals in connection with the management of healthcare waste. A nurse, charge nurse, nursing assistant, sanitary incharge, sanitary worker and sweeper was the sampling unit. Multistage sampling technique was employed for selecting 05 (03 general and 02 specialized) tertiary care hospitals in Lahore, 05 wards from each hospital –and- 05

respondents from each ward. As such, 75 respondents were recruited for this study. Predesigned and pretested questionnaire was got filled, which contained questions about waste generation and management practices and knowledge in accordance with the Hospital Waste Management Rules-2005. Sole reliance was not placed on the information furnished by the respondents. They were interviewed with some leading questions to elicit actual and factual responses. Data was manually sorted out and analyzed with the help of calculator (fx-82TL).

Results: Average healthcare waste generation rate in the hospitals of Lahore has been estimated at 2.20 kg per bed per day. 65% respondents were found immunized against Hepatitis-B, out of which a number of sanitary workers / sweepers who were most involved in healthcare waste handling was far lesser than nurses. None of the respondents indulged in healthcare waste handling was wearing protective clothing. As regards most of the healthcare waste management practices, there was absolute gap between theory and practice.

Conclusion: Healthcare waste management is a community problem. Hospital Waste Management Rules-2005 are in force, but the hospital waste management practices have not been / are not being given due importance in Pakistan.

Key Words: Disposal of waste, Healthcare (HC) waste, HC waste generation rate, HC waste management, identification of waste, non-risk HC waste, risk HC waste, segregation of waste.

NB: Hospital Waste, Healthcare Waste, Medical Waste, Clinical Waste –and- Biomedical Waste are synonymous and interchangeably used terms.

INTRODUCTION:

Hospital Waste Management Rules-2005 include in the term “hospital” a clinic, laboratory, dispensary, pharmacy, nursing home, health unit, maternity center, blood bank, autopsy centre, mortuary, research institute and veterinary institutions, including any other facility involved in healthcare and biomedical activities –and- **hospital waste** includes both risk and non-risk entities generated in a hospital [1]. **World Health Organization** defines the term **healthcare waste** as the total waste stream from a healthcare establishment, research facilities, laboratories, and emergency relief donations. HCW includes several different waste streams, some of which require more stringent care and disposal [2].

Biomedical or healthcare wastes are the wastes arising from diagnosis, monitoring and preventive or curative or palliative activities in the field of veterinary and human medicine. Healthcare waste is also generated due to immunization of human beings or animals, in research pertaining thereto or in the production or testing of biologicals [3,4,5].

Healthcare waste can be broadly categorized into two groups (1) **General, Communal or Non-Risk Healthcare Waste** –and- (2) **Special or Risk Healthcare Waste**. About **85 [75 to 90]** percent of a hospital’s waste is **general refuse**, called **communal or non risk or non hazardous healthcare waste**, while the remaining **15 [10 to 25]** percent is contaminated with infectious agents (e.g. microbiological cultures, blood and blood products, body fluids, isolation waste from patients with communicable diseases, pathological specimens and sharps). Such sort of waste is called **special or risk or hazardous healthcare waste** [2,4,6].

According to World Health Organization, approximately 85% of hospital wastes are actually non-hazardous, 10% are infectious and around 5% are non-infectious but hazardous. In **USA**, about **15%** and in India around **25% (15.35%)** of hospital waste is regarded as infectious. In **Pakistan**, about **20%** of hospital waste is found to be potentially infectious or hazardous [5].

The quantity of waste produced per day per bed differs greatly from hospital to hospital, and from one country to another, and above all, depends on the attitude of the hospital [6]. This differs not only from country to country

but also within the country. In middle and low income countries, healthcare waste generated is lower than in high income countries [4].

Studies in Pakistan show that **around 250,000 tonnes** of medical waste is **annually** produced from all sorts of healthcare facilities in the country [7,8]. **In large hospitals, 0.5-2.0 kg waste is generated per bed per day**. Of this, **0.1-0.5 kg can be categorized as risk waste**. If this waste is not properly managed and disposed off, it can result in injury by contaminated sharps and infection with HBV, HCV & HIV. Improper disposal practices encourage illegal reuse of discarded syringes, IV tubes, blood bags and other equipment which is not designed for either sterilization or reuse [9,10]. **Appropriate management of healthcare waste** is thus a crucial component of environmental health protection and it should become an integral feature of healthcare services. Healthcare waste management means management of waste produced in healthcare facilities by using such techniques which will help to check the spread of diseases through various steps [3,11]. **Mismanagement** of healthcare waste poses risk to people and the environment. Healthcare workers, patients, waste handlers, waste pickers and the general public are exposed to health risks from infectious waste (particularly sharps), chemicals & other special HCW [2].

METHODOLOGY:

It was hospital based descriptive cross sectional study, in which extant data was also used. study was conducted from 16th June to 03rd July, 2009 in tertiary care hospitals of Lahore selected for the purpose. Study population comprised nurses, paramedical, sanitary staff and sweepers performing duties in the wards of respondent hospitals in connection with management of healthcare waste.

A nurse, charge nurse, nursing assistant, sanitary incharge, sanitary worker, sweeper was the sampling unit. *Multistage sampling technique* was employed. *In first stage*, list of hospitals in Lahore was obtained from the Punjab Health Department. Of twelve (12) tertiary care hospitals in public sector and eight (08) in private sector (including trust hospitals), 03 general tertiary care and 02 specialized hospitals were selected through convenient sampling techniques. *In second stage*, five wards from each of three hospitals

were randomly selected. *In third stage*, five respondent nurses and sanitary workers from each ward were selected by simple random sampling through lottery method. As such a sample size of *seventy five (75)* respondents was attained.

The study was conducted mainly in Gulab Devi Hospital, Services Hospital, Jinnah hospital. Additionally, Punjab Institute of Cardiology (PIC) and institute of nuclear Medicine and oncology (INMOL) were also visited for the purpose of conducting exploratory study and collecting extant data regarding management of special healthcare waste (radioactive and pathological). Tertiary care hospitals containing more than 200 beds, nursing staff, sanitary staff & sweepers, involved in the management of waste at various sources in respondent hospitals were included in the study, whereas doctors and unwilling ones were excluded.

The data was collected by getting the pre-designed and pretested questionnaire filled. The questionnaire contained questions about waste management practices and knowledge, some whereof were leading ones –and- were deliberately incorporated in the questionnaire to make the respondents furnish actual and true information.

The respondents involved in the management of healthcare waste were also interviewed with some leading questions for the purpose of eliciting actual and factual responses instead of solely relying upon theoretical information gleaned through questionnaires, because while interviewing them, it transpired that they had not furnished true account of waste generation in the questionnaires. Further, to do away with this anomaly, secondary data from waste registers maintained by Head Nurses of each ward was collected and following procedure was adopted to calculate per bed per day waste generation (in kg) in each ward:

- The record of previous 07 days risk waste generated in each ward of respondent hospitals was extracted from the waste registers maintained by the Head Nurse of the concerned ward.
- It is pertinent to mention that the Head Nurses in Services and Jinnah Hospitals do not maintain the record of non-risk waste, which as per guidelines and literature constitutes approximately 80% of total waste. In Gulab Devi Hospital, in

some wards Head Nurses were maintaining the record of both risk as well as non risk categories and in other wards only risk waste record was available. As such, to calculate the weight of waste generated (in kg) per bed per day, the weight of calculated average risk healthcare waste multiplied by 05 (80:20 rule) and then divided by the total number of beds in each ward visited. This yielded average weight of total waste: risk and non-risk generated per bed per day in kilogram.

- The waste data, so obtained, for each ward was summed up and divided by total number of wards in each respondent hospital concerned to calculate waste generation (kg) per bed per day by that hospital.

All questionnaires were minutely examined and mistakes and omissions were rectified. Then the data was manually sorted out for each question and analyzed with the help of calculator (fx – 82TL). Healthcare waste generated in kilogram per bed per day by each hospital was calculated as per procedure elaborated above. The study sample was distributed according to the educational level – training- waste management practices – frequency of waste collection from the wards – and- its transportation to central storage facilities in different respondent hospitals.

RESULTS:

Appraisal of Health Care Waste Generation Rate

Table-1 illustrates data on waste generation at various sources in three (03) respondent hospitals and results calculated there from. **The average health care waste generation rate in these hospitals has been estimated at 2.20kg per bed per day [Range=1.43-2.80kg per bed per day]. In Gulab Devi Hospital, the total waste generation varied from 1.00 – 3.60kg (average = 2.38kg) per bed per day. In public sector hospitals: Services and Jinnah, the rate of waste generation ranged between 1.5-5.0kg (average = 2.8kg) per bed per day –and- 1.1-1.7kg (average = 1.43kg) per bed per day respectively. However, health care waste generation rate was higher in Services Hospital and lesser in Jinnah Hospital with Gulab Devi Hospital falling between these two.**

Appraisal of Health Care Waste Management Practices

Table-2 (a, b, c) depicts the level of education and training imparted to those involved in healthcare waste management process from all three hospitals. **36% (27)** staff in all three (03) hospitals was illiterate and **09% (07)** had received formal school education only – whereas- **35% (26)** was matriculate and only

20% (15) had received education upto college level. Sweepers / Sanitary workers were amongst the illiterate and ward boys amongst pre-matric. **35% (26)** nurses were matriculate, *whereas 19% (14)* had BSc qualification to their credit. In the study population, illiterate and pre-matric were more in Gulab Devi and Services Hospital than in Jinnah Hospital.

Table-1: Healthcare Waste Generation Rate

Name of Ward –Unit-Block or Department	Waste Generation Rate (Kg per bed per day)		
	Gulab Devi Hospital	Services Hospital	Jinnah Hospital
Chest Emergency & ICU	3.60	--	--
Private Cottages	2.50	--	--
Various Medical Units	1.31	--	--
Post Operative Ward	2.00	--	--
Dr. Amir-ud-Din Ward	1.00	--	--
Medical Specialist Wards	--	3.65	--
Government Officers Block	--	2.25	--
Medical Emergency Ward	--	1.50	--
Surgical Emergency Ward	--	1.50	--
NOT Emergency Ward	--	5.00	--
Gynae & Obs Unit-I	--	--	1.40
Gynae & Obs Unit-II	--	--	1.70
Pediatrics Ward	--	--	1.09
Oncology Ward	--	--	1.50
Radiotherapy Unit	Discussed separately under special waste		
Waste Generation Range	1.00-3.60	1.5 – 5.00	1.1 – 1.70
Average Waste Generation Rate	2.38	2.80	1.43
Total Waste Generation Range	1.43 – 2.80 kg per bed per day		
Total Average Waste Generation Rate	2.20 kg per bed per day		

Table-2

Hospitals Parameters	Gulab Devi Hospital	Services Hospital	Jinnah Hospital	Total
(a) Educational Level of Respondents				
Illiterate	09 (36%)	09 (36%)	09 (36%)	27 (36%)
Pre-Matric	01 (04%)	06 (24%)	00 (00%)	07 (09%)
Matric	09 (36%)	06 (24%)	11 (44%)	26 (35%)
College Level	06 (24%)	04 (16%)	05 (20%)	15 (20%)
(b) Training on Healthcare Waste Management				
Received	07 (28%)	25 (100%)	25 (100%)	57 (76%)
Not Received	18 (72%)	00 (00%)	00 (00%)	18 (24%)
(c) Training to New Entrants				
Given	06 (24%)	25 (100%)	25 (100%)	56 (75%)
Not Given	19 (76%)	00 (00%)	00 (00%)	19 (25%)

Table-3 shows the level of immunization of respondents (healthcare waste management staff) –and- use of protective clothing, use of separate puncture proof containers and hand washing practices by them after handling healthcare waste in all three hospitals. **65% (49)** were found immunized against Hepatitis-

B. Most of the staff which was not vaccinated against Hepatitis-B were sweepers and others. As regards the use of protective clothing, **100% (75)** respondents claimed that they use the same and wash hands before & after handling waste.

Table-3

Hospitals Parameters	Gulab Devi Hospital		Services Hospital		Jinnah Hospital		Total	
(a) Level of Hygiene, Safety and Protection of Respondents								
	Yes	No	Yes	No	Yes	No	Yes	No
Immunization	20 (80%)	05 (20%)	14 (56%)	11 (44%)	15 (60%)	10 (40%)	49 (65%)	26 (35%)
Use of Protective Clothing	25 (100%)	00 (00%)	25 (100%)	00 (00%)	25 (100%)	00 (00%)	75 (100%)	00 (00%)
Use of Puncture Proof Containers	25 (100%)	00 (00%)	25 (100%)	00 (00%)	25 (100%)	00 (00%)	75 (100%)	00 (00%)
Hand Washing	25 (100%)	00 (00%)	25 (100%)	00 (00%)	25 (100%)	00 (00%)	75 (100%)	00 (00%)
(b) Segregation & Identification of Healthcare Waste								
Segregation	21 (84%)	04 (16%)	25 (100%)	00 (00%)	25 (100%)	00 (00%)	71 (95%)	04 (05%)
Destruction of Needles etc.	25 (100%)	00 (00%)	25 (100%)	00 (00%)	25 (100%)	00 (00%)	75 (100%)	00 (00%)
Identification (use of color coded containers)	25 (100%)	00 (00%)	25 (100%)	00 (00%)	25 (100%)	00 (00%)	75 (100%)	00 (00%)

Table 3 (b) shows the extent of segregation of the waste into risk and non-risk components, destruction of needles, syringes, IV sets etc. – and- use of color coded plastic bags and containers for its identification at the point of generation / collection in the respondent hospitals. **95% (71)** respondent nurses,

Table-4 (a) illustrates that in these hospitals, the frequency of collection of healthcare waste was in accordance with the guidelines and laid down procedure i.e. at least once daily. However, in Jinnah Hospital and some wards of other hospitals, particularly emergency

sweepers and sanitary staff: **84% (21)** in Gulab Devi Hospital, **100% (50)** in Services and Jinnah hospital claimed at source segregation of healthcare waste into its risk and non-risk of components. **100% (75)** claimed the destruction of needles, syringes, IV tubes and infusion bags.

wards, the frequency of collection was more than once, even thrice daily. It

was observed that in most of the wards, the sweepers and sanitary staff collected the waste stored in yellow bags and containers at source and transported it to central storage area.

Table-4

Hospitals Parameters	Gulab Devi Hospital	Services Hospital	Jinnah Hospital	Total
(a) Frequency of Risk Waste Removal / Collection Per Day				
Once	08 (32%)	12 (48%)	00 (00%)	20 (27%)
Twice	17 (68%)	02 (08%)	00 (00%)	19 (25%)
Thrice	00 (00%)	11 (44%)	25 (100%)	36 (48%)

(b) Mode of Transportation of Risk Health Care Waste				
Wheeled Trolley	16 (64%)	07 (28%)	25 (100%)	48 (64%)
Cart	00 (00%)	00 (00%)	00 (00%)	00 (00%)
By Hand	09 (36%)	18 (72%)	00 (00%)	27 (36%)

Table-4 (b) depicts that **64% (48)** respondent sweepers [**64% (16)** in Gulab Devi Hospital, **28% (7)** in Services Hospital and **100% (25)** in Jinnah Hospital] were using wheeled trolleys for the transportation of waste stored in primary bags and containers at the point of generation to the central storage depots.

Appraisal of Management of Special Waste (Pathological and Radioactive)

Segregation, identification, collection, transportation and handling of **radioactive waste** in INMOL and Jinnah Hospital were satisfactory. In INMOL, yearly generation of risk healthcare waste (nuclear medical waste, radio-immuno assay-1 waste and radio-pharmaceutical waste) is 190 to 200 kg and that of non-risk component is 750 to 900 kg. In Jinnah Hospital, the accumulation and disposal limits of radioactive waste were as per law / guideline set by Atomic Energy Commission. The Commission has issued mandatory authorization certificate to the hospital in this context. Management of **pathological waste** from the laboratories of Jinnah and Services Hospital was unsatisfactory, unhygienic and can be declared as unacceptable. However, histopathology section was running satisfactorily in both hospitals. The hazardous waste management in the central laboratory of Punjab Institute of Cardiology was found satisfactory.

DISCUSSION

The quantity of waste produced per bed per day differs greatly from one hospital to another, from one country to another [6], and even within the country [4]. Above all, the waste generation rate depends upon the attitude of the hospitals [6]. In middle and low income countries, the healthcare waste generated is lower than in high income countries [4].

In Pakistan, the waste generation rate has been estimated at **0.5-2kg per bed per day** [10,12]. Some studies in Karachi, Lahore, Kasur, Rawalpindi, Islamabad and Peshawar districts of Pakistan show an average

production of healthcare waste to be 1.5kg per bed per day [11]. If the said figures about waste generation rate are compared with the results of various studies conducted in Pakistan, the waste generation rate estimated through this study (**2.20kg per bed per day**) was higher than that determined earlier (**1.5kg per bed per day**). Such variation may be due to increasing use of disposable items. It may be an outcome of overestimated extant data obtained from waste record maintained at various sources of respondent hospitals. Another plausible reason for this variation may be non-inclusion of primary and secondary healthcare facilities in this study, because the use of disposable items in primary and secondary healthcare facilities is quite lesser than that in tertiary healthcare institutions.

However, rate of healthcare waste generation assessed through this study was lower than that estimated by developed nations including USA, but higher than India. **In USA**, it is 07kg per bed per day. **In UK**, it is 02.05kg per bed per day –whereas- the same **in Western European countries** is 03-06kg per bed per day and **in India**, it ranges between **01-02kg** per bed per day [11].

Practices whatsoever depend upon compatible education and training, which in turn are complimentary. Education without training is ridiculous, whereas training without education is superfluous. All employees in hospital handling and managing clinical waste need to be trained in safe procedures to minimize risks to human health and must be able to deal with spillages, accidents and other emergencies [13].

Hospital Management is under obligation to keep in place an immunization program for the staff coming in contact with risk waste [9]. Hepatitis-B and Tetanus immunization should be considered for all staff at risk from handling risk healthcare waste [13]. Nurses, albeit least involved in handling healthcare waste than sweepers etc. were amongst the majority having been vaccinated. Such sort of discrimination meted out by the employer

hospitals needs to be rectified and all those indulged in healthcare waste management must be treated at par. However, in Gulab Devi Hospital, most of the sanitary staff & sweepers were vaccinated against Hepatitis-B. Hospital management is also legally obliged to provide their employees protective clothing [13], which comprises face masks, heavy duty disposable gloves, aprons, industrial boots and leg protectors. Basic personal hygiene is important for reducing the risk from handling medical waste. Conventional washing facilities must be made available for the staff and personal hygiene should be included in the training programs [9]. Despite the claim of 100% respondents regarding the use of protective clothing, all the articles of protective clothing have not been seen in use even by a single respondent. Some were without any article, some wearing caps, some gloves and some masks. None of them was encountered as wearing leg protectors or shoes or apron or all articles, which is contrary to the guidelines incorporated in numerous laws, regulations or rules, both local or international. The sorrow state of affairs that literature does speak on waste management practices (segregation, collection, storage, transportation and disposal, but does not contain or contains a little bit about the safety and protection of staff involved in such practices. Even in Pakistan, Environmental Protection Act 1997 and Hospital Waste Management Rules-2005 made there under are silent about personal safety, protection and hygiene.

Hospital management must provide separate puncture proof containers for syringes, needles, broken glasses and other sharp objects to prevent accidental injuries to those handling them [1,6,9,12], because transmission of diseases (Hepatitis-B, C and HIV, in particular) generally occurs through injuries from contaminated sharps [2,12]. Segregation of healthcare waste into risk and non risk entities at the point of generation –and- its identification is the key to its minimization and effective management [6,10,11,12]. The waste sorted into color coded plastic bags or containers: yellow bag for risk waste, yellow container for sharps and white bag for non risk waste [3,6,9,10,12,14].

Rule-14 (d) (ii) of Hospital Waste Management Rules-2005 strictly prohibits the involvement of sanitary staff and sweepers in

waste segregation process [1]. This rule provides for the handling of waste bags and containers only by the sweepers and sanitary staff in a correct manner. But in all respondent hospitals, it was observed that the sweepers and sanitary staff were more and more involved in segregation of waste than nurses who are meant for at source waste segregation into risk and non risk categories as per rule. The staff (nurses, sweepers and sanitary workers) was not handling the waste in a disciplined manner, except in some wards in Jinnah Hospital. This culminated in poor segregation of waste into different categories. At times, risk & non-risk wastes were found being mixed up in some units.

As per Hospital Waste Management Rules-2005, waste needs to be collected at least once daily in accordance with the schedule specified in waste management plan. The removed yellow waste bags and containers need to be replaced with new ones of same type [1]. In Jinnah Hospital and some wards of other hospitals, particularly emergency wards, the frequency of collection was more than once, even thrice daily. As depicted in Table-4, the information furnished by the respondents with respect to 100% use of wheeled trolleys in Jinnah Hospital was also exaggerated one. Indeed, sweepers and sanitary staff from wards were found collecting waste from bags and containers in big pails (drums) with about 50 litre capacity. These pails were then transported on trolleys or shoulders or heads of the sweepers from the wards to the central storage facilities. Some sweepers were found carrying yellow bags and containers in their hands to waste storage area. *Neither* they were taking any precaution to protect them and general public, *nor* were employer hospitals paying any heed to the safety of these workers and system. Last, but not least, two sweepers in Services Hospital, when surreptitiously chased, threw the risk waste along the hind wall of Emergency Ward.

CONCLUSION:

Healthcare waste management, of risk waste in particular, is a community problem, the consequences whereof are many and varied. Increasing rate of waste generation, its unscrupulous segregation and improper disposal call for halting and reversal of upward trends of overall mismanagement. Hospital Waste Management Rules-2005 are in force,

but the hospital waste management practices have not been / are not being given due importance in Pakistan. Merely having a squad of sweepers, who keep the hospital clean, but scavenge recyclable and reusable hazardous items like syringes (though common, but not observed in this study) –and- dump the waste just across the walls is certainly not an answer to the problem.

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