

# ASSESSMENT OF HOSPITAL WASTE MANAGEMENT SYSTEM AND GENERATION RATES AT SMBBMU HOSPITAL LARKANA

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## ABSTRACT

The rationale of this study was to assess the hospital waste management system at different medical wards and to determine the total daily waste generation rates at Shaheed Mohatrama Benazir Bhutto Medical University (SMBBMU) Hospital Larkana. For that purpose a detailed survey of hospital was conducted through a questionnaire, and personal interviews from selected staff and public. The acquired data was documented for waste generation, segregation, collection procedures, type of containers and storage, onsite and off-site transport, treatment of hospital waste and final disposal options. The number of beds, bed occupancy rate and number of operations performed during the year 2011 were also recorded. It was found that the average generation rate of hospital and infectious waste was about 1.072 and 0.453 kg/bed/day respectively. The maximum amount of infectious waste was recorded in Surgical-III ward with 49% and minimum amount was reported in ENT with 26% of the total hospital waste. It was discovered from the study that the existing hospital waste management system was lower than standards. The poor waste management system in the hospital was mainly due to ineffective segregation, collection, storage and dumping of waste. In addition, lack of training and protective equipment for sanitary staff, scarcity of funds and indefinite policy of waste treatment were also the main causes of inappropriate waste management. It was concluded from the study that clear lines of responsibilities and proper management system could be supportive for up-gradation of public health as well as hygienic conditions in the hospital.

*Keywords: Hospital waste, infectious waste, non-infectious waste, waste management system, management practices*

## 1. INTRODUCTION

The waste generated from hospitals is now acknowledged as a serious issue. It may have harmful effects either on the environment or on human beings through direct or indirect contact [1]. In developed countries, the various technologies and ways are performed for collection, storage, transport, and safe and secure disposal of hospital waste [2]. However, in developing countries, hospital waste has not received sufficient attention. Therefore, hazardous hospital waste is still handled and disposed off together with domestic wastes, thus creating a great health risk to municipal workers, the public, and the environment [3]. No doubt, the society is continuously trying to improve the health standards by establishing medical institutions [4]. These institutes can play a significant role to restore the community health by means of modern technologies. Medical institutes or establishments include hospitals, clinics, medical centers, private practices, home health care, blood banks, veterinary offices, research and clinical laboratories, and all licensed and unlicensed medical facilities [5]. In spite of the consideration given to hospital waste by the general public and relevant government bodies, the terms like health facility waste, hospital waste, medical waste, regulated medical waste, and infectious waste remain

inadequately defined. No standard definition is universally accepted for these terminologies. Therefore, these terms are used synonymously.

Hospital waste is a solid or semi-solid waste produced in human health treatment giving facilities in the course of diagnosis or treatment of humans or animals. It includes pathogenic (infectious) and non pathogenic waste such as hazardous wastes, sharps, chemicals, pharmaceuticals, radioactive wastes, pressurized containers or cylinders. Non-infectious waste from healthcare settings may be regarded as similar to household waste and can be disposed off in a similar manner like municipal waste [6]. Infectious waste is one of the subset of hospital waste, that is able to transmit an infectious disease [7]. Infectious waste can also be further subdivided into various types such as micro-organisms, pathological tissue, blood product, animal body, surgery, laboratory, dialysis waste, isolation waste, blood contaminated, and fluid contaminated [8]. Infectious waste has to be managed in the proper way in order to minimize risk to the public health and environment.

The composition of hospital waste varies by the area, type and scale of medical facilities, clinic specialty and practice procedures [9]. The waste generation rates may

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range from 0.25-7.0 kg/bed/day in seven European countries and the United States [10], 0.4-5.5 kg/patient/day in 12 developing and developed countries [11], and 0.11-3.9 kg/bed/day at hospitals of Japan, Turkey, US, Canada, India, Thailand, and Bangladesh [12]. In Jordan, public hospitals had a higher average waste production rate (6.10 kg/patient/day or 3.41 kg/bed/day) than private hospitals (4.02 kg/patient/day or 1.88 kg/bed/day) [13]. Unfortunately, the information on hospital waste generation rates and management system is quite rare in Pakistan except a few advanced hospitals. The amount of hospital waste and the risks to waste handlers can be reduced effectively with proper waste handling, segregation and resource recycling [14]. However, many factors influence the hospital waste management system and often linked to one another, which require a comprehensive study to determine the influence of each factor in the system. An in depth survey on the hospital waste generation methods can be informative and beneficial for planning and enhancement of waste management system. This study investigated the generation rates of hospital waste in Shaheed Mohatrama Benazir Bhutto Medical University (SMBBMU) Teaching Hospital Larkana. The findings of this study could be useful for authorities to improve the methods of collection, handling and disposing off hospital waste. Consequently, it will also support to decrease the quantity of infectious waste by means of categorization and separation methods of waste at the source.

## **2. MATERIALS AND METHODS**

### **2.1. Study Area**

Larkana is fourth largest city of Sindh province. It is located in the north-western part of Sindh. It lies on 27°33' N Latitude and 68°12' E Longitude. Shaheed Mohtarma Benazir Bhutto Medical University (SMBBMU) has started functioning at Chandka Medical College on 12th April 2008. SMBBMU Hospital comprises four separate wings, namely Chandka Teaching Block, City Block, Paeds Block and Sheikh Zaid Women Hospital. SMBBMU is the leading referral medical center in northern part of Sindh and neighboring areas of Balochistan Province. However, till today no environment friendly waste management strategy had been incorporated in the hospital [15].

### **2.2. Data Collection and Analysis**

A study was conducted to collect the data regarding the number of wards, units, beds and patients. The collection of hospital waste samples and quantitative analysis were conducted in 2011. Initially, a trial collection exercise of one week was adopted before initiation of the regular collection program. The purpose of this trial exercise was to identify the main waste types and characteristics,

determine their respective quantities and plan the regular collection and segregation of waste. In all cases, waste collection and measurement took place for six working weeks, one week per month in the two collection periods. Different color coded waste containers, plastic polyethylene bags, an electronic balance, calculator and recording forms were used for waste handling and recording. The color coded waste containers were labeled with the international sign of hospital waste. Their capacity was about 03 liters. The containers were washed and reused every single day. Plastic polyethylene bags were purchased from a local market and were used for waste dumping after weighing. The plastic bags were suitable for preventing liquid leakage and leachate of hospital waste. An electronic balance with accuracy up to a tenth of a gram was used for weighing purpose. Daily waste recording forms were used for computational work and documentation of generated waste.

Collection containers were kept at suitable locations in each ward, laboratory and department of the hospital. Hospital personnel were supervised that the waste is to be dropped in the proper color coded containers. All wastes dropped in containers were weighed on a daily basis. The information regarding number of patients, occupied beds as well as medical examinations were recorded in computerized Microsoft excel spreadsheets. Furthermore, a survey was carried out through questionnaire, personal interviews of staff and patients, observations, and official record of the hospital for assessment of existing hospital waste management system for validation of public views and visual observations. The responses and documentations received from survey were reviewed for completeness and consistency before statistical analyses. The hospital waste was separated into different categories such as paper, textiles, plastic, glass, food residues, rubber and metal for determination of their type and weight percentage. Moreover, the waste generation rate was computed by dividing the total weight of waste (in kg) generated per day with the number of beds in the hospital (the empty bed was not count in the calculation) expressed as kg/bed/day or dividing the total weight of waste (in kg) generated per day with number of patients attended daily in the hospital (inpatient and outpatients) expressed as kg/patient/day [16].

### **2.3. Existing Hospital Waste Management System at SMBBMU Hospital**

The existing waste management system at SMBBMU Hospital was comprised of five elements namely generation, onsite handling, storage and processing, collection, transport and disposal. Generation type was consisted of both infectious and non-infectious wastes. Hospital waste generated close to the bedside usually thrown into the small waste bins with no lid or cover,

which produced unhygienic environment near the bed. Hospital waste was neither segregated nor it was color coded for separation of different types of wastes. All types of waste were stored in the containers whether it was infectious or non-infectious. The municipal workers handling the waste normally empties the smaller containers into the larger ones placed in the corridors. No suitable isolated storage area was designated in the hospital. Protective devices were also not given to the waste handling staff for safety. The sanitary staff was just handling the waste as normal domestic waste. The generated hospital waste was usually collected in open trolleys and waste bins. This practice is supposed to create health hazards as the vectors in the air came into the contact with the contaminated waste that later on became source of disease for public and employees of the hospital. Furthermore, the waste collected was transferred from inside of the hospital either on shoulders or by means of manual carts, with the possibility of infectious waste dropping on walking ways. No municipal container was placed in the front road of SMBBMU city hospital.

The waste placed in municipal containers contained the waste of SMBBMU as well as other adjoining areas. The waste from the containers was regularly picked up and shifted by the municipal authorities to the final destination, which was an open dump site. Consequently, the hospital waste mixed up with municipal waste at the final disposal site. The scavengers were also seen outside the hospital and municipal dumping area, searching for recyclable materials. The recyclable materials especially syringes returned to the market somehow after being washed. Such syringes contained pathogens, leads to very harmful consequences if used to patients. Although, Government of Sindh provided an incinerator for treatment of SMBBMU Hospital waste, but it was not operating due to unavailability of gas connection and other allied facilities.

### 3. RESULTS AND DISCUSSIONS

The capacity and cause of hospital waste created in the wards was evaluated by means of Statistical Package for the Social Sciences (SPSS) software. It was found that the average generation rate of hospital waste was 1.072 kg/bed/day and infectious waste was 0.453 kg/bed/day. The highest amount of infectious waste was generated in Surgical-III ward with 49%, Urology 44%, Medical-I 41% of total hospital waste. Minimum amount of infectious waste was reported in ENT with 26% and Gynecology I-II 29% of the total generated waste.

Outdoor patients per day, bed strength, average bed occupancy rates and total number of operations performed during the year 2011 are shown in Figures 1 to 4. There were a total of sixteen number Outdoor Patients

Department (OPD) sections in the hospital as shown in Figure 1. The hospital provided free of cost facilities to all patients. The number of OPD patients sometimes crossed beyond 3500 daily. However, the average number of OPD patients per day for the year 2011 stood at 3040. The average maximum number of patients per day in OPD was recorded in Pediatrics Medicine with 350 and the minimum patients were reported in Neuro Surgery with 50. The number of patients was 300 each in General Medicine and Gwynne Obis. A total of 250 patients were came for diagnosis and treatment purpose in General Surgery, Cardiology and Urology, whereas 200 patients came for consultation in EYE and Orthopedics, 150 in ENT, Dental and Chest and 140 in Dermatology.

Moreover, there were about 25 different wards and units in SMBBMU Hospital. The bed strength of different wards and units is graphically shown in Figure 2. The total number of beds in the hospital was stood at 1356. Out of these beds 725 were reserved for male and 631 for female patients. The total maximum number of bed strength for male and female was 200 in Pediatrics Medicine and in Gynecology wards respectively. The maximum number of male bed strength was in Pediatrics Medicine with 165 beds and female bed strength Gynecology Unit I&II with 200 beds respectively. The second maximum number of beds strength for male was in Medicine Unit-II with 60 beds. The second and third maximum beds strength for female was found in Pediatrics Medicine with 35 beds and Medicine Unit-II and Eye wards with 30 beds respectively. The minimum number of beds for both male and female were in critical care unit (CCU) with two beds only. The second and third minimum number of beds strength for male as well as female was noted in Peng ward and Dermatology with four and five beds and three and five beds respectively.

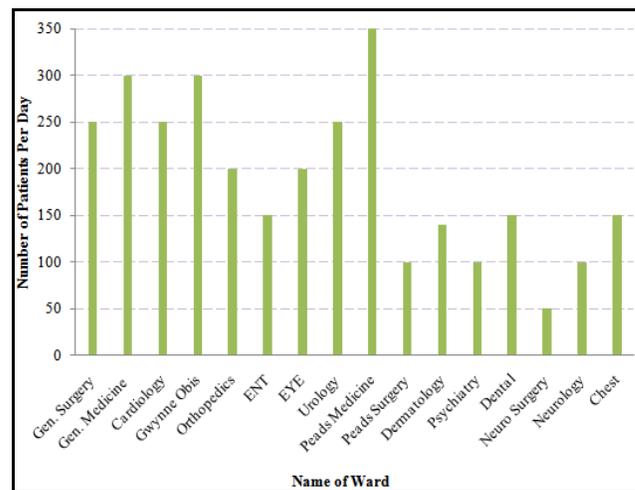


Figure 1. Ward-wise Number of Outdoor Patients at SMBBMU Hospital in 2011

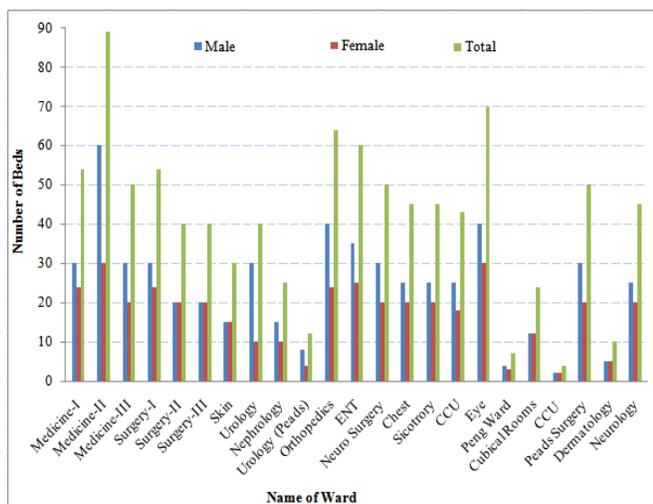


Figure 2. Ward/Unit-wise Bed Strength of SMBBMU Hospital in 2011

The average bed occupancy for the Year 2011 in SMBBMU Hospital is demonstrated in Figure 3. The total numbers of occupied beds were found to be 728 (54% of the total beds) out of 1356. The maximum beds occupancy was noted in Medicine Unit-I with 94.4% and the minimum was found in Pediatrics Medicine ward with 19%. Second and third most occupied beds were noted in Urology with 80% and Surgical-III with 78%. Similarly, second and third least occupied beds were found in Surgery Unit-II with 28% and Gynecology Unit I&II with 35%. In addition, the total number of major and minor operations performed during the year 2011 was 57681 with a monthly average of 4804 operations as shown in Figure 4. The average monthly maximum operations were made in the month of September with 5707 and minimum operations in the month of May with 3478.

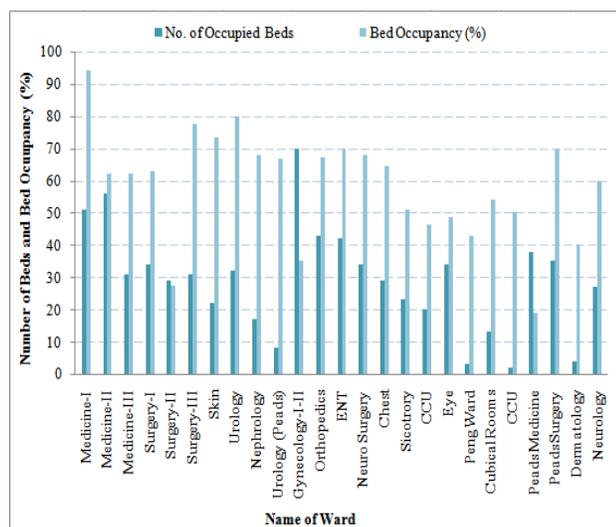


Figure 3. Ward/Unit-wise Bed Numbers and Average Bed Occupancy of SMBBMU Hospital in 2011

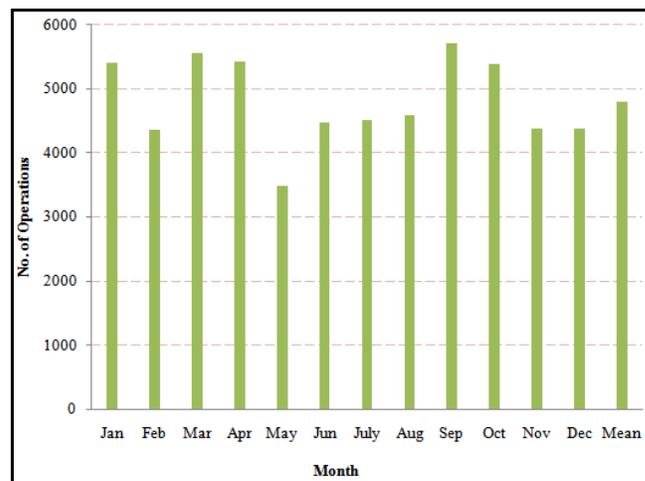


Figure 4. Number of Major and Minor Operations Performed at SMBBMU Hospital in 2011

The total generated waste was determined by examining the bed strengths on daily basis during study period. The total weight of hospital waste during study period was found to be 781 kg and the infectious waste were 330.4 kg as shown in Table 1. The component of infectious waste in the wards, OPD, X-Rays, Radiology and Research Lab was around 37 % of the total generated waste. The share of infectious waste from the total generated waste was found to be 100% in operation theaters, blood bank and pathological laboratories. Because the waste generated by such wards and units is considered to be pathogenic.

Table 1. Weight of Generated Hospital Waste and Infectious Waste

Sr. No.	Name of Ward and Unit	Total Waste (kg)	Infectious Waste (kg)
01	Wards	661.2	248.7
02	OPD, X-Rays, Radiology and Research Lab	53.8	20.3
03	Operation Theaters	24.2	24.2
04	Blood Bank & Pathology lab	16.0	16.0
05	Plastic drips/vials/ampoules	25.8	21.2
<b>Total</b>		<b>781.0</b>	<b>330.4</b>

#### 4. PROPOSED MANAGEMENT SYSTEM FOR HOSPITAL WASTE

The prevailing situation in the investigated hospitals was not attractive. It was observed that hospital waste was not properly managed. The infectious waste was generated from the hospital was composed of blood as well as blood soaked substances, body parts, body fluids, bandages, glucose bags, syringes etc. The generated hospital waste was treated as ordinary domestic municipal waste and

dumped off in vacant areas of city. The scavengers were found as main collectors at the curbside and at the final disposal points. The collected reusable waste materials were marketed by the scavengers to fulfill their economic needs. However, such activities could pose serious threats due to possible chance of contracting and spreading infectious diseases.

#### 4.1. Proposed Management Plan

The SMBBMUH is biggest hospital in the northern part of Sindh with more than 25 various wards. The SMBBMUH has 1356 beds with a bed occupancy rate of about 54%. Therefore, a strategy of total quality management (TQM) was proposed to be adopted to reduce generation of waste in the SMBBMUH. This perception was first adopted in industrial sites. It is a valuable tool and is able to enhance and improve the health and hygienic conditions in the hospitals [17]. This approach could be applied by using the acronym FOCUSPDCA which is explained as under:

F = Find a process for improvement

O = Organizing trained team for the process

C = Clarify and simplify the process

U= Understand sources of variation

S = Select the improvement

P = Plan the improvement

D = Doing the improvement

C = Check and study the outcomes

A = Act to achieve the gains

The waste management plan must be composed of different members headed by Medical Superintendent. The members includes Heads of every department, Infection Control Officer, Chief pharmacist, Radiation Officer, Senior Nursing Officer, Hospital manager, Health and safety Engineer, Financial Controller and waste management Officer. These officials should be responsible to ensure the implementation of waste management plan by relevant staff.

#### 4.2. Strategy for Storage, Handling and Disposal of Waste

An implementation approach was formulated for handling, storage and final disposal of hospital waste. This approach includes waste handling method, color coding, design and placement of containers and time table of waste collection. Waste handling method consists of different measures like, trained staff to put the waste into color coded bins. Sanitary staff must wear gloves and masks while handling the waste and also wear complete protective clothing when required. The waste containers

must be replaced when full and immediately place a new container when transporting the previous container. Color coded containers facilitates the waste generators to differentiate infectious and non-infectious waste. It is recommended that infectious waste and sharps must be placed in yellow color, and non-infectious waste in black color containers. Furthermore, infectious waste must be placed in closed pedal type containers and sharps in strong puncture proof containers. The design of containers may vary from one type of waste to other type. However, it is proposed that the containers for sharps and non-infectious type wastes should be approximately 1.5'x1.5'dia x 2'deep in size. However, the carrying capacity for sharp containers should be one kilogram and the pedal type containers should be of 10 kilograms. The pedal type containers should be placed according to the ward-wise bed occupancy rates for collection of infectious waste. It was also suggested that the hospital waste must be collected two times per day, the first one at 08:00 am and the last one around 08:00 pm. The infectious waste collected from hospital must be stored in biohazard room and it should be transported early in the morning towards treatment facilities. Non-infectious waste may be sent to the municipal containers for final disposal.

#### 5. CONCLUSIONS AND RECOMMENDATIONS

Surveys are the valuable quality improvement tools in all hospitals for enhancement of public health and protection of environment. It was revealed from the survey that the hospital waste not properly managed as per standards. The infectious and non-infectious waste was collected, transported and disposed off along with municipal waste. The waste containers were neither clean nor disinfected after use. The sanitary staff was not properly trained to handle the hazardous waste. The collected waste was carried away in open containers on hand carts and sometimes on shoulders to its final disposal points. No proper waste management plan was available and implemented. The study revealed that the average generation rate of hospital waste was 1.072 kg/ bed/day and the infectious waste was 0.453 kg/bed/day (42% of the total hospital waste). The highest amount of infectious waste was generated in Surgical-III ward with 49% and the minimum quantity was noted in ENT with 26% of the total generated waste. An effective medical waste management program was found to be indispensable in all levels of hospital units. The authors suggest the following measures to get meaningful outcomes:

- a) Different types of color coded containers should be used for infectious and non-infectious waste.
- b) The waste bins should be properly placed, handled, timely collected and transported.

- c) Protective clothing and materials as well as training should be given to the sanitary staff.
- d) Need of public awareness.
- e) Proposed management plan should be implemented with true spirit to reduce the chance of spreading infectious diseases.

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