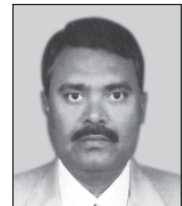




Bio-Medical Waste Management in Shiraz City of Iran

P. Lakbala and Dr. T. M. Mahesh



Abstract

This paper tries to document the practice of biomedical wastes (e.g. collection, storage, transportation and disposal) along with types and amount of wastes generated by hospitals and level of awareness and knowledge of workers/staff about bio-medical wastes. The results of a survey on medical wastes generation, and methods adopted in hospitals of Shiraz city of Iran for disposal and management of bio-medical wastes in the city are discussed.

1. INTRODUCTION

Hospital waste refers to all wastes, biological or non biological that is discarded and not intended for further use. Medical waste is a subset of hospital wastes and it refers to the materials generated as a result of diagnosis, treatment or immunization of patients and associated biomedical research (Rutala, 2005). Biomedical waste (BMW) is generated in hospitals, research institutions, health care teaching institutes, clinics, laboratories, blood banks, animal houses and veterinary institutes (Sharmam, 2002). Biomedical waste poses hazard due to two main reasons: the first is infectivity and the other toxicity. Like other industries and institutions, healthcare facilities generate various kinds of wastes as a result of a variety of medical treatments and research. In the past 10 years, due to the increased number and size of health care facilities, medical services, and use of medical disposable products, the generation rate of health care wastes has increased rapidly (Licset *et al*, 1993).

Improper medical waste management is alarming and it poses a serious threat to public health. Medical waste contains highly toxic metals, toxic chemicals, pathogenic viruses and bacteria (Chintis *et al*, 2004). This can lead to pathological dysfunction of the human body (Ray, 2005). Medical waste poses high risk to doctors, nurses, technicians, sweepers, hospital visitors and patients due to arbitrary management (Becher *et al*, 2002). Safe disposal and subsequent destruction of medical waste is the key step in the reduction of illness or injury through contact with this potentially hazardous material, and in the prevention of environmental contamination (Blenkham, 2006).

Until recently, medical waste management was not considered as an issue. In the 1980s and 1990s, concerns about exposure to human immunodeficiency

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virus (HIV) and hepatitis B virus (HBV) led to questions about potential risks inherent in medical wastes. Thus, hospital waste generation has become the prime concern due to its multidimensional ramifications as a risk factor to the health of patients, hospital staff and also extending beyond the boundaries of the medical establishment to the general population (Gordon *et al*, 2004).

The United Nations recommended appropriate procedures for collection and disposal of wastes to member countries and announced that every waste producing unit was responsible for the disposal of its own (Pruss *et al*, 1999). The WHO reveals that more than 50,000 people die every day from infectious diseases. One of the causes for increase in infectious diseases is improper waste management. HIV, hepatitis, tuberculosis, pneumonia, diarrhea diseases, tetanus, and whooping cough are the diseases spread through improper waste management.

Iran is located in the Middle East Asia and has a total population of about more than 70 million inhabitants. Shiraz, the largest city in the southern part of Iran and capital of the Fars province, serves as a referral center for about one quarter of Iran's medical cases. In Iran, as in many other developing countries, no proper and efficient rules have been legislated as yet and also there is no useful information about medical waste management. In this paper the results of a survey on medical wastes generation, and methods adopted in hospitals of Shiraz city of Iran for disposal and management of bio-medical wastes in the city are discussed.

2. METHODOLOGY AND DATA COLLECTION

The data were collected by using questionnaire from 9 hospitals: 4 government's teaching hospitals and 5 private hospitals. Questionnaires were used to survey the hospital wastes in terms of collection, transportation, segregation, treatment and disposal and to collect available information for analysis of the system. The sample survey was conducted in 4 teaching hospitals and 5 private hospitals of Shiraz city of Iran which are the medical referral centers in southern Iran.

The practice of waste segregation, the type of storage containers, the temporary storage area, collection procedures, on-site transport and treatment of wastes, off-site transport and disposal of hospital wastes were studied and the type of sewerage system used at hospitals was also assessed. The personnel involved with collection and disposal of wastes were also interviewed. All of the wastes generated in 9 hospitals (Table 1) were weighed during a week for each hospital in three shifts for a period of one and half month.

Interviews with the environmental health experts and members of infection control committee of hospitals, workers to weighing waste selected and after training them all segregated wastes according to infectious, non-infectious and

**Table1 Rate of Waste Generation and Hospital Services**

Hospital code	Number of bed	(day/bed/kg) generation rate teWas			
		-Non infectious	Infectious	Sharp	Total
A	412	3.81	6.21	0.12	10.14
B	166	.0.52	1.07	0.03	1.61
C	202	0.84	1.03	0.02	1.89
D	130	0.89	0.72	0.03	1.64
E	300	1.51	1.81	0.03	3.34
F	150	1.16	1.61	0.02	2.78
G	300	2.50	1.80	0.02	4.32
H	65	2.03	1.70	0.15	3.88
I	60	1.16	1.01	0.06	2.22

Source: Primary survey, 2008

sharps, were weighing and recorded for each ward of hospitals under the control of environmental health experts of hospitals and researcher.

Non-infectious and infectious and sharp wastes from out-patient and in-patient services in hospitals were collected separately and weighing with specific scales in front of waste storage room in each hospital was done. Each type of waste was recorded on special data form. Following these procedures, the wastes were transported to a special site for storage and final disposal. The data collected through the questionnaires and the quantities of infectious, non-infectious and sharp wastes were tabulated and analyzed in terms of kg / bed / day and kg / day. These data were used to determine the quantities of wastes generated by each ward of hospital. The data was tabulated, coded and analyzed by using SPSS 12 software and results are derived and interpreted.

3. MEDICAL WASTE MANAGEMENT IN SHIRAZ CITY

The mean, minimum and maximum of bed occupancy in teaching hospitals were 85 percent, 77 percent and 99 percent and in private hospitals it was 65 percent, 46 percent and 80 percent respectively.

3.1 Waste Segregation and Containers

Segregation of waste at source including radioactive, infectious, non-infectious and sharp waste with proper color coding were done in all hospitals and stored in separate containers. Anatomical parts of body if attached to bone were delivered to the custodian and buried according to religious rites but body parts not attached to a bone were considered to be infectious waste. Pharmaceutical waste and cans packed under pressure were disposed along with infectious waste in all hospitals. Liquid pharmaceutical waste was poured into the sewer.



All hospitals used yellow plastic bags and yellow plastic containers for infectious wastes. Out of 9 hospitals, 8 hospitals (88.9 percent) are using yellow safety boxes that made of resistant disposable plastic with cover and international label on it and one teaching hospital is using empty white drug container for sharps waste without any label. Nearby 88.9 percent hospitals choose white and 22.2 percent of hospitals choose white or black color plastic bags and blue or green container for non-infectious waste. It is observed that in all hospitals, suitable and adequate number of containers is used.

3.2 Hospital Waste Generation

The study revealed that the total amount of waste generation rate (Table 2) in all hospitals was 726.50 kg/day, which includes 309.9kg (45.1 percent) of non-

Table 2: Waste generation rate (kg/bed/day) in Shiraz hospitals

Hospital (day/bed/kg)	Mean waste generation rate			
	Non-infectious	Infectious	Sharp	Total
Government	1.52	2.25	0.049	3.82
Private	1.67	1.58	0.05	3.31
Total	1.60	1.9	0.05	3.54

Source: Primary survey, 2008

infectious waste 408.50kg (53.6 percent) infectious waste and 8.1kg (1.3 percent) sharp waste. And the average of waste generation rate in the hospitals was estimated to be 3.54kg/bed/day which included 1.60kg/bed/day non-infectious waste (general), 1.90kg/bed/day infectious waste and 0.05kg/bed/day sharp waste.

4. WASTE GENERATION RATES IN SELECTED HOSPITALS

4.1 Waste Collection Methods and Time Duration

The results revealed that in all hospitals, the wastes were collected at the end of each shift, and then collected wastes were transported to a temporary storage area by the hospital staff. The medical wastes were collected by trolley. One teaching hospital have shooting system that used only for some infectious and sharp waste, and all noninfectious wastes and other infectious waste such as pathological wastes and placenta and bloody infectious waste handling by trolley. The staff employed for handling the wastes in all hospitals used personal protective equipment included 11.1 percent trousers with gloves, 77.8 percent trousers with mask and gloves 11.1 percent trousers with boots and gloves. This study revealed that the workers used apron only sometimes for washing something in units.

4.2 Internal transportation

Appropriate containers (trolley) with color coding (yellow for infectious and green or blue for non-infectious waste) and capacity 220 liters that have cover were used in all hospitals. The end of each shift moving it outside of wards in



hospitals and cleaning staff knot bags and collected all bags that existed in different color containers (yellow for infectious, blue for non-infectious and yellow safety box or white empty drug box for sharps) manually and transported to the containers located outside of units and then moving these containers to storage room. It is observed that in some hospitals cleaning workers collected all infectious and non-infectious waste and closed the corner of wards before transporting wastes to containers outside wards, according to scientific standards, domestic waste mingled with infectious waste must be labeled as infectious (Department of Health, 1996).

4.3 Prophylactic Measures

The study revealed that 92.4 percent workers have taken vaccine of tetanus and hepatic B, and 7.6 percent have not taken vaccine, and 22.8 percent workers being needle sticks injuries while handling the waste, that it was in teaching hospitals were 31.3 percent and in private hospitals were 13.6 percent. It seems that proportion is less in private than government (training), probably because of lack of training to student and careless attitude of doctors, students and personnel in segregated wastes in government (teaching) hospitals. Of course the results revealed that personnel being needle stick injuries do not follow up for care by hospitals. Moreover accidents related to breaking or overturning of waste containers and splash of wastes in all hospitals were not recorded.

4.4 Temporary Storage Site

In this study we found that 88.9 percent of hospitals have temporary storage rooms and one teaching hospital had no storage area because this hospital wants to install new autoclave and storage room required for this instrument and all containers were in front of storage room in the yard of the hospital.

The infectious and non-infectious wastes were kept in separate containers and were not mixed in the hospital's temporary storage area. The study revealed that 59.3 percent of storage area was safe, 66.7 percent cleanable, 22.2 percent had sufficient space and 55.6 percent of storage area had separate location and 48.1 percent had good ventilation and 70.4 percent had sufficient lights. The storage time in these sites were between 12-24 hours, and it depended on when municipal workers coming to hospitals for off-site transportation of wastes.

4.5 Hospital Waste Treatment

In this study, one teaching hospital used incineration for almost sharps and placenta and waste of patients that have HIV, or Hepatitis. This incinerator worked only on nights, and it is placed in storage room. This hospital had



autoclave that was not working and that this hospital had problems with regard to temperature, height of the smoke stack and rate of smoke production, and some personnel in night shifts and workers had complained about smoke and bad smell due to incineration of wastes.

4.6 Off-site Waste Transportation

The off-site waste transportation from hospitals was done by Shiraz Municipality and the waste containers had 220 liters capacity, with cover that had tiers for moving and had special space for atomically carrying it by car. There are 3 specialized cars for carrying infectious wastes of all hospitals, clinics, health centers and laboratory in the city with white color and personnel for carrying infectious waste have protective clothes including boots, musk, gloves, uniform with white colure that carrying waste of hospital every day at 6 am to 6 p.m. It was observed by personnel of hospitals that car sometimes do not have very well isolation and water and blood flows from them during transportation. And some hospitals have complained about late coming of cars. Sharps and infectious waste were buried in the final disposal site in specific burial sites outside of the city. Non-infectious waste was treated and used as house garbage by municipality.

4.7 Treatment and Final Disposal of Waste

All hospitals disposed of their non-infectious wastes at the site of municipal garbage. And the infectious and sharp wastes were buried in pits and covered with clay and lime at specific landfills sites or burial site of the city.

Radioactive waste was collected and disposed off by the Atomic Energy Organization in all hospitals. Liquid pharmaceutical and liquid chemical waste was poured into the hospital sewer system in all hospitals.

4.8 Labor Safety and Training Programs

Training programs have been conducted by environmental health specialists and infectious control committee that works in hospitals. This study revealed that 49 percent personnel in hospitals have gone for annual training on BMW management, and 83.7 percent of cleaning workers have been training on BMW management and 16.3 percent have not been training on waste management, and that this percentage in government hospitals was higher than private hospitals. Meanwhile, 90.2 percent of workers in this study were aware of dangers associated with wastes, and 9.8 percent were not aware.

Cleaning workers were trained about medical waste management system in hospitals. The study revealed that there are no in-hospital training classes about management of hospital waste for doctors, students (in teaching hospitals) and the municipality workers also do not have training programs about dangerous bio-medical waste.



The personnel of municipality are not aware of dangerous of infectious wastes and it has been seen sometimes that these personnel were searching infectious wastes for empty bottles of serum, 27.2 percent of personnel have been seen scavenging and they are municipal workers in hospitals.

No references to waste management were available in the job descriptions of hospital staff, about hospital waste management and nearby 66.7 percent of hospital administrators revealed that hospital have BMW management team that consisted of environmental health experts and head of infectious control committee in hospital and cleaning workers.

Nearby 22.2 percent of managers who engaged BMW management responded that the hospital had no plan for waste minimization, reuse and recycling of waste and 66.7 percent of them responded that the hospital is trying to purchase products that are eco-friendly such as cellulose glasses for tea, and disposable cellulose plate for hot food and for another produces do not have any plan. Only 33.3 percent of hospital managers were satisfied with existing BMW management system in each hospital.

4.9 Hospital Waste Management Regulation

This study revealed that no definite plan or policy existed concerning the purchase of required equipments and facilities for the appropriate disposal of hospital wastes. No definite budget for BMW management system existed. This study revealed that no regulations for disposal of medical wastes of hospitals existed. All hospitals were interested in buying appropriate facilities required for safe disposal of the bio medical wastes. But specialized organizations in the Bio-Medical Waste Management should come forward to render services in the form of consultancy to different types of hospitals depends on requirements of each hospital in purchasing autoclave or incinerator etc. and safe handling of the equipment for safe disposal of bio medical wastes.

4.10 Sewage Treatment System

This study revealed that in 23.1 percent of hospitals, sewage was transported into absorbent wells and in 76.9 percent of hospitals the sewage was poured into the municipal sewer system without any treatment.

5. CONCLUSIONS

A lesser amount of bio-medical waste means a lesser burden on waste disposal work. Cost saving and efficient waste disposal system is necessary. Hence, health care providers should always try to reduce waste generation in day-to-day work in clinics or hospitals.

Lack of awareness, appropriate policies and laws, and apathy are responsible for improper management of medical wastes in Shiraz city. Existing medical waste management system currently serves only hospitals; clinic laboratory and



health centers do not cover 2,000 physicians in Shiraz city, and they dispose of infectious wastes like domestic wastes. We recommend that the following steps should be urgently taken:

- Certified education training programs are to be organized and offered to all hospital personnel;
- Proper and adequate waste management systems should be introduced and established in all health-care establishments to protect general health and the environmental;
- There should be standard norms of cleanliness and disposal of wastes with clear cut job descriptions for the concerned staff;
- Every health-care establishment should install an autoclave or a large incinerator that is equipped with smoke and emission control facility approved by environmental organization for safe and proper disposal of health-care wastes;
- There should be written instructions on health-care waste management at various places within the health-care establishments;
- Health-care waste management committee should be formed in each health-care establishment to look after routine cleanliness and proper disposal of health-care wastes;
- Mechanisms need to be evolved for training of patients and visitors at hospitals about waste management in hospitals;
- Pay more attention to segregation, collection, transportation and final disposal of infectious and other medical wastes, especially in teaching hospitals;
- The basic approach to medical waste management is to reduce the quantity of wastes at source as far as possible. Hospital wastes should be recycled whenever feasible with due regard to environmental aspects so that quantity of materials entering the waste system is reduced;
- Waste management requires a systems approach involving the handling, storage, transport, treatment and disposal of wastes by methods that at all stages minimize the risk to health and environment;
- All hospital personnel should be made aware of the potential risks of handling medical wastes. Hospital waste management cannot succeed without willing co-operation and participation of all categories of personnel; and
- The management with medical wastes requires knowledge in and cooperation of all persons concerned and must be supported by adequate provision of equipment and budget.

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