

Medical Waste Management in Libya Northeastern Region Hospitals as a Case Study

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Abstract: *Medical waste management is an important public health concern worldwide. One of the first critical steps in the process of developing a reliable waste management plan requires a comprehensive understanding of the quantities and qualities of the wastes that needs to be managed.*

In Libya, as in many developing countries, little data is available concerning generation rates, handling and disposal of medical waste. This fact hinders the development and implementation of medical waste management schemes. The aim of this study is to survey an appraisal of the current situation regarding hospital waste management in Libya. Procedures, techniques, methods of handling, and disposal of waste are presented, as well as the amounts and compositions of hospital waste. This work was conducted in the form of a case study. Eight government hospitals in three cities, Benghazi, AL Bayda, and Tobruk, all located in the northeastern part of Libya, were selected for investigation. The investigation showed that the hospitals surveyed had neither guidelines for separated collection and classification, nor methods for storage and disposal of generated waste. This deficiency indicates the need for an adequate hospital waste management strategy to improve and control the existing situation. The average medical waste generation rate was found to be 1.45 kg/patient/day, comprised of 70% general healthcare waste (non-risk) and 30% hazardous waste. The average general waste composition was: 38% organic, 20% plastics, and 20% paper. Sharps and pathological elements comprised 27% of the hazardous waste component. The study recommended the need for an adequate medical waste management strategy to improve and control existing situation to recognize early deleterious effects on health and environment systems.

Keywords: Libya; medical waste; waste management; disposal; hospitals.

1. Introduction

Medical waste is an issue of growing concern since it is a source for contamination and pollution, capable of causing dis-eases and illness either through direct contact or indirectly by contamination of soil, ground water, surface water and air. The health care establishments are an integral part of the life support system. Improper disposal of waste generated from such establishments can have direct and indirect health impacts as well as posing a potential threat to the surrounding environment, people handling it and the public in general. There is an urgent need to improve upon the medical waste management practices in the country based on systematic and scientific planning of medical waste management [1]. Medical waste can be classified into two major groups: general and hazardous waste. Between 75% and 90% of the waste produced by healthcare is non-risk or general health-care waste that is comparable to domestic waste. Since general waste is not regulated or defined as hazardous or potentially dangerous waste, it requires no special handling, treatment or disposal as such and it should be dealt with via municipal waste disposal mechanisms. The remaining 10 –25% of health-care waste is regarded as hazardous or special waste, according to World Health Organization (WHO) and US Environmental

Protection Agency (EPA) definitions [2, 3]. Medical waste is defined as any solid wastes that is generated by medical treatment facilities and laboratory facilities operating in a hospital setting and is considered to be potentially hazardous to health. The waste includes animal carcasses, human body and animal parts, excretion and secretion from humans or animals, discarded plastic materials contaminated with blood, culture and stocks of infectious agents, discarded medical equipment, and other waste mixed with infectious agents [4]. There is growing awareness worldwide of the need to impose stricter controls on the handling and disposal of wastes generated by health care facilities. In developed countries, legislation and good practice guidelines define medical wastes and state the various possible ways for collection, transport, storage and disposal of such wastes [5].

The composition of medical wastes varies by the area, type and scale of medical facilities, clinic specialty and practice procedure. Domestic and sharp waste was estimated 1.3 to 1.85 kg/bed/ day in Libya. Infectious - hazardous - sharp and domestic waste was estimated 29.44% – 70.11% and food waste (30.89%) and the specific weight was estimated 99.58 kg m⁻³ in Benghazi, Libya [6]. Typical Composition and Characteristics of Infectious Waste are shown in Table 1. Medical wastes management has moved progressively and guidelines or standard procedures have been promoted at international levels, such as, US, Korea, Japan, UK and UN [7]. Table 2, indicates the amount and type of medical waste generated in some countries worldwide.

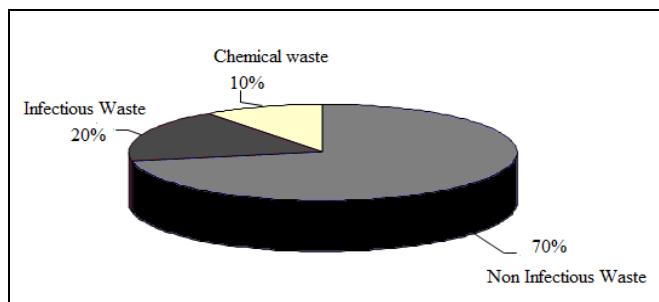


Fig. 1: General composition of medical waste

TABLE I: Typical Composition and Characteristics of Infectious Waste

Particulars	Percent
Composition:	
Celluloid Material (paper& Cloth)	50 – 70%
Plastics	20 – 60%
Glassware	10 – 20%
Liquids	1 – 10%
Type Characteristics:	
Moisture	8.5 – 1.7% by weight
Incombustibles	8% by weight
Heating Value	7,500 BTU/lb

TABLE II: Medical waste generation rates in different countries (Hamoda *et al.* 2005)

Country	Generation rate (kg/bed/day)
United State of America	7.0 – 10.0
European Union	3.0 – 6.0
Middle East	1.3 – 3.0
Latin American	1.0 – 4.5
India	1.0 – 2.0
Libya	1.30 – 1.85
Tanzania	1.8 – 2.0
Egypt	0.7-1.7

The difference of medical waste generation from country to another may be due to living habitudes and standards, availability of treatment facilities and also ways to categorizing wastes. Marincovic *et al.* (2008) reported that the medical waste generation rate depends on the size and the type of the medical institution, but also that it differs from country to country based on the level of economic development [23]. Furthermore, the use of disposable instruments and packaging materials rather than the use of reusable items in the healthcare centers in developed countries has increased the amount waste generation.

TABLE III: Methods employed for disposal of medical waste in the various countries

Country	General methods employed for disposal of Medical Waste	References
Bangladesh	Dumping	Hassan <i>et al.</i> (2011)
Greece	Recycling-Reuse, Combustion, Landfill	Tsakona <i>et al.</i> (2007)
Libya	Dumping, Incineration	Sawalem <i>et al.</i> (2009)
Malaysia	Landfill, Incineration, Recycling	Hossain <i>et al.</i> (2011)
Mongolia	Open dumping or open burning, Incineration, Autoclaving.	Shinee <i>et al.</i> (2008)
India	Landfill, Incineration, Autoclaving, Recycling.	Yashasvi <i>et al.</i> (2012)
Iran	Landfill, Incineration, Sewers	M.H.Dehghani (2008)

In developing and transitional countries like Libya, health-care waste has not received enough attention in recent decades. In many of these countries, medical waste is still handled and disposed of together with domestic waste, creating great health risks to health-care stuff, municipal workers, the public, and the environment. Most of the cities in Libya dispose of domestic and health-care wastes together in municipal dumpsites or in poorly designed landfills, or they use on-site incinerators to treat waste that poses operational and maintenance problems [14]. The study on the amount and type of solid wastes generated by health-treatment centers, weight mean of the total wastes, infectious, and general wastes for each people is one of the most important steps to reduce environmental and health problems and the cost of hospital waste management. The purposes of the present study are examining the amount and type of solid wastes generated in the some hospitals in the northeastern part of Libya, and estimating the annual amount of medical wastes generated and evacuated into environmental receiver resources

1.1 Review of Hospital Waste Management Practices in Libya

According to a report released by the Libyan Ministry of Health (February 2009), Libya had 96 hospitals with 20,289 beds, 25 specialized units with 5,970 beds, 1,355 primary health centers, 37 polyclinics and 17 quarantine units .

According to recent studies (Sawalem et al., 2009) of 14 health care facilities (10 hospitals, 2 clinics and 2 rural health centers) surveyed it was found that:

- 1– An average of 1.3 kg/patient/day of waste is generated in health care facilities. Hospital average higher levels of waste generation although all were below 1.5 kg/patient/day. These values are at the lower end of the values that WHO estimates for the hospital waste generation, but are consistent with other hospital generation values found in the region;
- 2–On average, 72% of hospital waste is classified as health care general waste whose composition is: Organics: 38%, plastics: 24%, paper: 20% (including cardboard), textiles: 9%, glass: 8%, metal: 1%.
- 3–The high volume of plastics is associated with the high usage of disposable items (e.g. packaging, bottles, bags used for food) used by the hospitals;
- 4–28% of hospital waste is classified as health care hazardous waste whose composition is: pathological waste 21% sharps 5%, other hazardous wastes 74%;
- 5–Sharps were typically disposed of in plastic containers. Operating theatre wastes are placed in bags, collected and then incinerated. Other solid wastes (HC general waste and other HC hazardous waste) are typically collected in black bags and placed into open containers for collection;
- 6–Although several hospitals visited were reported to be equipped with an incinerator, only two incinerators were operational. However, the design and operational performance of these incinerators does not fulfill operational criteria;

- 7–All solid wastes are collected by the municipality and disposed of to open dumps;
- 8–The use of protective equipment was observed at some hospitals, while was missing in others. Typically neither the hospital staff responsible for managing waste (including supervisory staff and workers) nor the medical staff were aware of the potential dangers associated with hospital waste and were not trained on hospital waste management ;
- 9–No waste management procedures /frameworks were reported, except for two hospitals two where basic protocols for waste segregation were in place. No written waste management policies, protocols, training programs, waste collection/handling procedures, or other management tools are commonly available at the hospitals.

2. Materials and Methods

This study was performed from December 2013 to April 2014, in eight government hospitals located in three major cities in Libya, Benghazi, AL Bayda, and Tobruk, all located in the northeastern part of Libya, Fig.2. The study was performed in two ways first for determined the waste generation rates and waste characterization, the second is to assessment the waste management practices in study hospitals. For the first task, the collection of hospital waste samples and analysis were carried out with standard methods. The waste characterization study was carried out in accordance with the latest WHO guidelines.[2]. All of the wastes generated in eight hospitals were segregated and weighed during a period of five months, manually.



Fig. 2: Study area for hospitals in Benghazi, Bayda and Tobruk cities

The quantity and composition of the wastes were determined at each hospital. Along with the interviews, the physical compositions of wastes in hospitals were determined. Before segregation, wastes were sprayed by disinfectant solution (0.5% sodium hypochlorite). Masks and large forceps were used when dividing waste into several types. During separation, each type of medical waste was discarded into bags.

General and medical wastes from outpatient and inpatient services were collected separately. The medical wastes were previously sorted into various components such as serum, syringe and needle (in safety boxes), etc. Then, wastes were transported to a special site for storage and final disposal.

The second task for actual practices for medical waste management was assessed using a form which was designed according to WHO criteria for collection of medical waste [2]. The form contained 25 items in 5 categories similar to those of the form for assessing the knowledge and practices of waste workers. All waste observations were made through direct site inspections to check the agreement between the interview data and the actual practices.

3. Results and Discussions

3.1 Quantity of Wastes Generated:

Results from the survey for waste generation rates and waste characteristics found that the average generation rate of the medical waste at the eight hospitals was 1.45 kg/patient/day, as presented in Table 4. The highest generation rate of 1.85 kg/patient/day was found in the Benghazi Medical Center, followed by 1.6 kg/patient/day in the Hawari Hospital. The lowest rates were found in the AL Bayda and Tobruk hospitals 1.3 and 1.2 kg/patient/day respectively. The medical waste from each hospital was analyzed for composition, the results indicate that the waste comprised of 38% organics, 20% for paper and plastic, glass 8.2%, 7.3% textile, liquids 2.2%, sharps 1.2% and 3.1% for others.(Fig.3). Quantities of each hospital wastes were presented in terms of kg/day for a total amount of waste generation. The data are presented in Table.4.

TABLE IV: Medical waste generation rates for hospitals in study area

Hospital Name	Avg. Generated Waste (kg/d)	Generation Rate (kg/patient .d)
Benghazi Medical Center (BMC)	1100	1.85
Hawari Hospital	714	1.60
Benghazi Children Hospital (BCH)	560	1.50
AL Jala Hospital	748	1.30
7th October Hospital	490	1.40
AL Jamhuria Hospital	628	1.50
AL Bayda Hospital	360	1.30
Tobruk Medical Center	272	1.20

† BMC: Benghazi Medical Center – BCH: Benghazi Children Hospital

The percentages of medical waste composition (non-infected waste) in Benghazi city hospitals (Benghazi Medical Center, Hawari Hospital, AL Jalal Hospital, AL Jamhuria Hospital and Benghazi Children Hospital) are shown in Fig.4

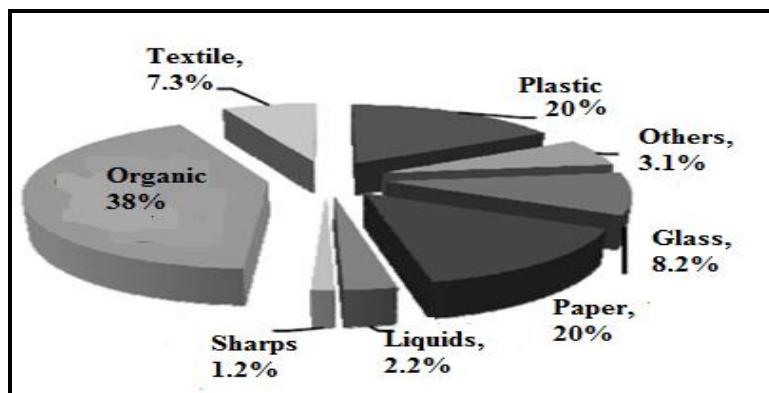


Fig. 3: Medical waste composition in studied hospitals as (mass %)

One important component of a waste characterization program involves the determination of the composition of the wastes. A sound understanding of the contents of the waste stream is helpful in the development of realistic waste reduction and recycling programs. According to the survey, it was found that around 69.5% of medical wastes were general wastes similar in properties to municipal wastes. The remaining 30.5% was infectious and hazardous wastes.

3.2 Waste Management Practices:

Results from the survey for the waste workers knowledge about dealing with medical waste. It was noted from Table 5, that 8% of workers in hospitals were able to identify the types of medical waste they were collecting. Few of the hospitals workers 17% and considered it necessary to sort medical waste. Only 9% of the workers in the hospitals could understand the reasons behind sorting medical

waste. Consequently 1% of the hospitals workers knew the adequate quantities for packing medical waste. Concerning risks that workers could be exposed to during handling medical waste, 53% of hospitals workers seemed to be aware of these. Regarding knowledge of adequate disposal procedures of liquid waste, expired blood units, human tissue remains and expired medicines, the percentages were 10%, 4.0%, 5.0% and 3.0% respectively for hospitals workers. The percentages of workers who believed that throwing expired blood units, human tissue remains and expired medicines into the normal domestic rubbish collection was an adequate disposal procedure were 55%, 17% and 64% respectively for hospitals.

Workers are required to wear appropriate uniforms and protective equipment when collecting medical waste. It is important for workers to know and understand the potential risks associate with medical wastes, and the importance of consistent use of personnel protection [11]. In addition, only three hospitals (37.5%) had suitable sanitized their temporary storage areas. According to Pruss et al.(1999), the temporary storage location, storage containers and storage management have a direct impact on the resulting environmental and the health risks at the hospitals, which must be well sanitized, secured for access only to authorized personnel [16].

TABLE V: Waste-workers knowledge about dealing with medical waste

Item	Number of interviews 92 (%)
Able to identify nature of medical waste	8
Identifies need to sort medical waste during collection	17
Know reasons behind sorting medical wastes	9
Know adequate quantities for packing medical waste	1
Aware of risks in dealing with medical wastes	53
Knows adequate disposal procedures of liquid waste	10
Knows adequate disposal procedures of expired blood units and by-products waste.	4
Knows adequate disposal procedures of human tissue remains.	5
Knows adequate disposal procedures of expired medicines	3
Believes throwing blood waste in domestic waste is an adequate disposal procedure.	55
Believes throwing of human tissue remains in domestic waste is an adequate disposal procedure.	17
Believes throwing expired medicines in domestic waste is an adequate disposal procedure.	64

Table 6 illustrates the self-reported knowledge and practices of hospital administrators in relation to medical waste. Only 38% of administrators in hospitals confirmed the importance of having specialized waste workers available. Personal safety tools were provided to waste workers by 45% of hospitals, and their use was monitored in 85%. All hospitals (98%) claimed to be raising awareness of workers about dealing with medical waste. Only 30% of the government hospitals and two-thirds of the private hospitals supervised their workers during waste collection.

TABLE.VI: Administrators self-reported knowledge and practices about dealing with medical waste in hospitals

Item	Number of interviews 25 (%)
Knows importance of availability of specialized supervisors and waste-workers.	38
Provide personal protection tools for workers.	45
Train workers in dealing with medical waste.	85
Workers supervised during waste collection.	30
Raise workers awareness about knowing and dealing with medical waste.	97
Department responsible for waste available within hospital management.	12
Collect waste 3 or more times per day.	96

4. Conclusions

There was poor awareness about medical waste risks and safe handling procedures among hospital administrators, and most hospitals were not differentiating between domestic and medical waste. Budgets were not allocated for waste management purposes, which caused shortages in waste facilities handling equipment and supplies and absence of training programmes for staff, resulting in poor knowledge and practices of waste-workers, a high rate of injuries and possible exposure of staff and visitors to hazardous waste. Nearly all hospitals in the study area were poorly done for medical waste management. From this study it can be said that there is an urgent need for raising awareness and education on medical waste issues. Proper waste management strategy is needed to ensure health and environmental safety.

5. References

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