



**Ministry of Health
Directorate of Engineering & Maintenance**

Healthcare Waste Management In Kingdom of Bahrain

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الخلاصة

تعتبر نفايات الرعاية الصحية الخطرة من القضايا التي تحظى باهتمام العالم لما لها من آثار سلبية على سلامة المجتمع والبيئة. وتعد مملكة البحرين إحدى الدول التي تعمل على الحد من تلك الآثار من خلال تطبيق التشريعات الوطنية المتعلقة بالإدارة السليمة لنفايات الرعاية الصحية الخطرة في كافة منشآت الرعاية الصحية الحكومية والخاصة مثل القرار رقم (1) لسنة 2001 بشأن إدارة المخلفات الخطرة للرعاية الصحية الصادر من قبل الهيئة العامة لحماية الثروة البحرية والبيئية والحياة الفطرية. وبالرغم من الجهود المبذولة من قبل بعض المنشآت الصحية وذلك بهدف تحقيق إدارة ناجحة وسليمة لتلك النفايات الخطرة، إلا أن تلك الجهود لم ترق لمستوى الجهود الوطني الشامل والمتكامل لإدارة نفايات الرعاية الصحية الخطرة بدءاً من تولدها وحتى التخلص الآمن منها. ويرجع السبب في ذلك إلى تعدد المسؤولية بين الدوائر الرسمية والخاصة؛ فعملية جمع ونقل ومعالجة والتخلص من النفايات الصحية والتدريب والوعي لدى العاملين وأصحاب العلاقة بنفايات الرعاية الصحية الخطرة تتم وفق ضوابط داخلية مكتوبة أو مكتسبة.

وتنبثق أهمية هذه الورقة في توصيف إدارة نفايات الرعاية الصحية الخطرة بشكل مختصر، وتحديد نقاط الضعف والقوة والصعوبات التي تواجه تحقيق الإدارة المتكاملة لنفايات الرعاية الصحية الخطرة في البحرين. وتلخص هذه الورقة البيانات المتوفرة بهذا الشأن لعام 2008م، مع نتائج دراسة سابقة تم إجراءها من قبل الباحث في عام 2005 – 2006م من خلال استبيان تم توزيعه على بعض المنشآت الصحية، وتم استخدام برنامج الاحصاء (SPSS) لتحليل وتوصيف نتائج الاستبيان. وكما تم استخدام منهج تحليل عناصر القوة، والضعف، والفرص والتهديد (SWOT) كأحد أدوات الوصف للوضع الحالي لإدارة نفايات الرعاية الصحية الخطرة في مملكة البحرين، (Ref-1).

ويبلغ معدل تولد نفايات الرعاية الصحية الخطرة في مملكة البحرين 1.14 كجم/سرير/اليوم بالنسبة للمستشفيات، و 0.13 كجم/مريض/اليوم في مراكز الرعاية الصحية الأولية. أما بالنسبة للسكان فكان المعدل 1.45 كجم/نسمة/السنة. ولعل أبرز النتائج التي توصلت إليها الاستبانة هو أن المنشآت الحكومية أكبر مولد للنفايات الصحية الخطرة، حيث كانت نسبتها (93 %) من إجمالي نفايات الرعاية الصحية الخطرة لعام 2005م والبالغة 1,048 طن/السنة، وهي تمثل ما يقارب (0.1 %) من إجمالي النفايات الخطرة في مملكة البحرين. في حين أن عدد زيارات المرضى الذين ترددوا على المنشآت الصحية بلغ 4.5 مليون زيارة، مقارنة بعدد سكان البحرين البالغ 724 ألف نسمة (إحصائيات عام 2005م). وأن (53 %) من المنشآت الصحية تعتمد كلياً على شركات النظافة في جمع ونقل النفايات الصحية الخطرة، وأن غالبية المنشآت الصحية ليس لديها سجلات بهذا الشأن (65 %)، بالإضافة إلى أن (53.6 %) من المنشآت ليس لديها برامج للتدريب الخاصة بإدارة نفايات الرعاية الصحية الخطرة. هذا وبينت الدراسة أن (60 %) من المنشآت الصحية ليس لديها نظام داخلي للتدقيق بشأن إدارة هذه النفايات الخطرة. هذا وتوصلت الدراسة السابقة إلى أن كمية نفايات الرعاية

الصحية الخطرة سوف ترتفع بمعدل (6.7%) سنوياً، مما يعني زيادة معدل التولد اليومي لتلك النفائات الصحية من ثلاثة أطنان في عام 2005م إلى أكثر من 7.5 طن يومياً في عام 2020م، وارتفاع عدد المرضى إلى أكثر من 8 ملايين مريض لنفس الفترة. وتشير الاحصائيات الصحية لعام 2007م بأن عدد المرضى بلغ سكان البحرين بلغ اكثر من مليون نسمة حيث نصفهم من البحرينيين.

وتوصي الدراسة بإدخال مفهوم الإدارة الناجحة لنفائات الرعاية الصحية من ضمن المناهج في المؤسسات التعليمية الطبية، بالإضافة دعم التشريعات والأدوات الرقابية مع إيجاد آليات الدعم المادي لهذه الإدارة على المستوى الحكومي والخاص.

Abstract

Hazardous waste management has been identified as a priority environmental issue in many countries including Bahrain. The proper of healthcare waste management concerns members of the healthcare sector in order to protect occupational and public health and safeguard the environment. In order to integrated Healthcare Waste Management (HCWM) of both the public and private healthcare facilities in the Kingdom of Bahrain, it is necessary to understand the present situation. This paper based on the pervious study carried by the researcher on 2005 - 2006 and available data of 2008, and it is identify the weakness of the current practices of HCWM system including handling, storage, and transportation, in addition to measure level of awareness on the adverse health and environmental impacts of lack of such integrated management system. In addition, the paper depend on previous study done by the researcher through conducted a structured questionnaire. Data collected were analyzed using the statistical package SPSS, along with SWOT analysis to highlighted the strengths, weakness, opportunities and threats to achieved the successful HCW management.

Study results show the total generated Healthcare Waste (HCW) in Bahrain is 1,048 ton/yr (2.8 ton/day). The rate of healthcare waste generation is equal to 1.14 kg/patient/day for Inpatients, 0.13 kg/patient/day for outpatients, and 1.45 kg/yr. per capita. In addition, the study forecasts the number of patients to reach more than 8 million in 2020 generating nearly 7.5 ton/day of HCW at annual growth rate of 6.9 %. The most result can be highlighted were :

- The largest quantity of HCW (93 %) is generated from government healthcare facilities.
- Only 52 % of the surveyed facilities follow the national standards for HCWM.
- Most of the healthcare facilities responded do not keep records for their rate of generation of HCW (65 %).
- 53.6 % of the responded healthcare facilities do not offer any training programs for their employees on hazard HCWM.
- On their willingness to pay for proper HCW management, it was found that only 40 % of the responded facilities are willing to do so.

The study finally recommended enhancing the institutional and regulatory framework, building the institutional capacity of enforcement, using of market-based instruments such as user fees and the like. It was also recommended that future studies on alternative financing schemes including, for example, willingness to pay studies, be undertaken to secure sustainability of the HCW management system in Bahrain.

Key Words : Bahrain, Healthcare Waste, Waste Management, Quantity of Hazard Healthcare Waste, SOWT analysis, Environmental Awareness.

Hazard Healthcare Waste Management in Kingdom of Bahrain

1.0 Introduction :

Health enterprises like hospitals, clinics and other institutions, generate medical waste which known as " Healthcare Waste " include infectious and pathogenic materials, sharps, pharmaceuticals, chemical waste, etc. Healthcare hazardous waste with about 10 - 25% of the total waste generated within a healthcare establishment as defined by WHO, it is a relatively small waste group but, due to the risk created by this kind of waste it needs the most efforts. The complexity of infectious healthcare waste problems and the recent rise , reported globally, in the incidence of diseases such as AIDS, SARS and Hepatitis B open up greater risk of contamination through mishandling and unsafe disposal practices.

The healthcare hazardous waste logistic is different from the non-hazardous waste logistic, because the segregation, collection, transportation, interim storage, treatment and disposal must be carried out under the consideration of the hazards of the different waste groups. The hazardous waste logistic must follow special principles and requirements to minimize the risks generated by the waste groups for patients, visitors, staff and environment.

A well designed waste policy, a legislative framework, and plans for achieving local implementation throughout our beloved Kingdom for the safe and sustainable growth is essential. Change will be gradual and should be technically and financially sustainable in the long term. Hospitals and other health-care establishments have a duty of care for the environment and for public health, and have particular responsibilities in relation to the waste they generate. The onus is on such establishments to ensure that there are no adverse health and environmental consequences of their waste handling, treatment, and disposal activities.

The aim of this paper is to identify the strength and weakness of the current practices of HCWM system including handling, storage, and transportation, in addition to measure level of awareness on the adverse health and environmental impacts of lack of such integrated management system based on a surveyor conducted in 2005 - 2006 (Ref-1).

2.0 General Background Information

The Kingdom of Bahrain comprises an archipelago of thirty three low laying islands, with total area of about 685 sq km, situated in the Arabian Gulf between the Kingdom of Saudi Arabia to the West and the Qatar peninsula to the East. The largest island of the Kingdom of Bahrain is Bahrain. Bahrain island is connected to Saudi Arabia by a 25 km long causeway.

Bahrain's climate can be described as arid with irregular and light rainfall of about 77 mm per annum. The year may be divided into two main climatic periods with winter from December to March and summer from June to September. The summertime temperatures typically exceed 35 - 45 °C, while winter temperature range from 15 - 25 °C. The predominate wind direction is from North.

The population of Bahrain, according to the census taken in 2007 was above one million person, where 527,433 Bahrainis and 511,864 non Bahrainis, and the total in patients is 9,8970 and outpatient is 5,035,958 patient (Health Statistics, 2007). Where the total hazard healthcare waste generation in 2007 is 1,199 ton/year.

In 2002, the Kingdom of Bahrain has been divided to five Administrative Governors as follow :

- a) Capital Governor
- b) Muharraq Governor
- c) North Governor
- d) Midle Governor
- e) South Governor

3.0 Health Service Profile

Bahrain is one of the first country in the Gulf countries have developed the healthcare to the local citizen by opening a clinic in 1900. The health establishments has been gradually developed until in seventies of last century, the number of health facilities has been increased for both government and private sectors and now reached more than 429 of different activities and health support services such as hospitals, health centres, clinics, laboratories, pharmacies,.....etc.

The largest and most of middle health activities rolled by Ministry of Health (MoH), where the Salmaniya Medical Complex is a large self contained public hospital with some 1,000 beds . It is located in a commercial suburb of Manama, the capital city of Bahrain. A new hospital (King Hamad General Hospital) with 300-beds is currently under development in Muharraq island for a different area of Bahrain and will be operational from end-2010.

4.0 Healthcare Waste Management:

4.01 Healthcare Waste Management

It shall mean all the operations which occur to the waste from the generation time until being disposed of, including the collection, storage, transport and treatment operations in addition to the subsequent care to the disposal or burial locations of such waste.

The training and other management chain required such as auditing system is a part of the successful healthcare waste management, Fig. (1) show the chain of the HCW management.

4.02 Health-Care Waste:

Health-care waste includes all the waste generated by health-care establishments, research facilities and laboratories, including health-care waste generated at home (dialyses, insulin injections, etc.)

a) Regulated Healthcare Waste :

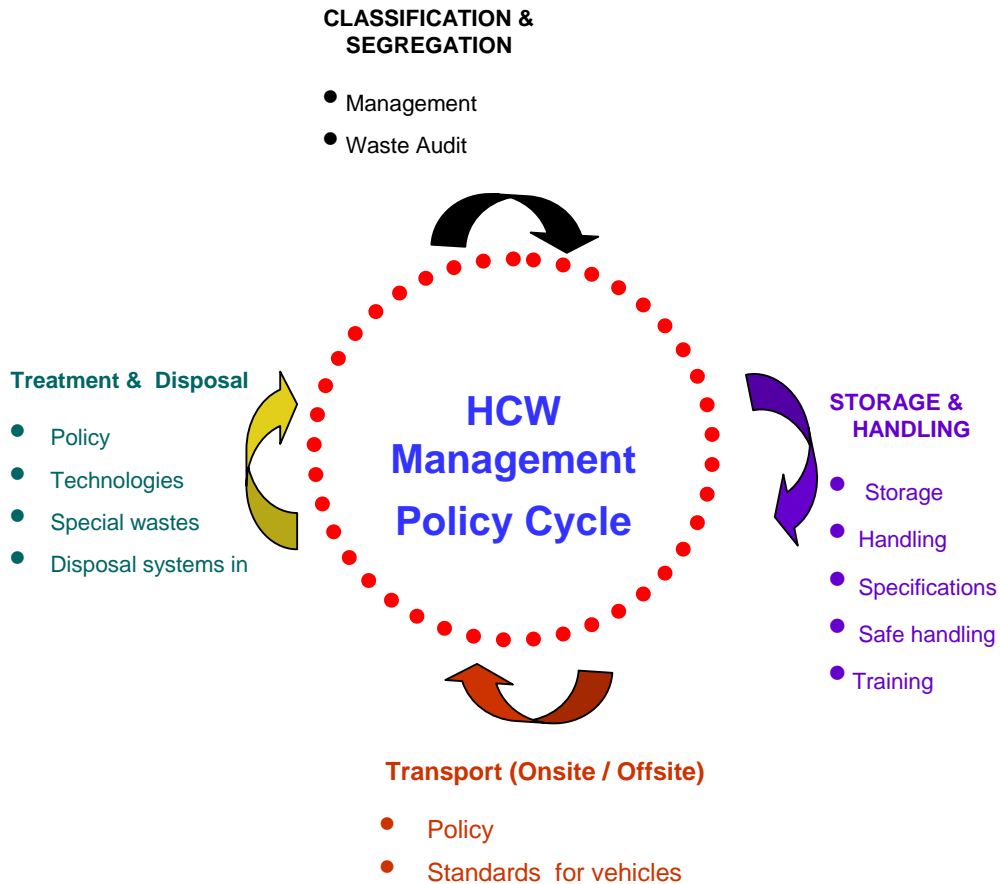
Waste from a medical facility or research laboratory which may be infectious, cytotoxic, radioactive, or may otherwise presents an actual or potential hazard to human health or the environment when improperly handled, transported , treated, or disposed of. It also include the expired drugs and medical supplies wastes.

The hazard wasted can be identified upon their properties such as :

- Infectious
- Toxic
- Corrosive
- Flammable
- Reactive
- Explosive
- Shock
- Sensitive
- Genotoxic

b) Unregulated Healthcare Waste:

All Healthcare Wastes which are not covered in the listing of regulated Healthcare Waste, and it is treated as municipality waste.



(each step requires specially developed individual policies and procedures)

Fig. (1) Healthcare Waste Policy Cycle

4.03 Categories of Hazard Healthcare Waste (HCW) :

The WHO has been categorized the healthcare waste as follow :

- a) Infectious waste (containing pathogens, excreta, etc.)
- b) Pathological waste (body parts, blood, foetuses, etc.)
- c) Sharps (needles, infusion sets, broken glass, etc.)
- d) Pharmaceutical waste (old medicines, etc.)
- e) Genotoxic waste (cytostatic drugs, etc.)
- f) Chemical waste (laboratory material, film developer, etc.)
- g) Heavy metal waste (batteries, thermometers, etc.)
- h) Pressurised containers (gas cartridges, etc.)
- i) Radioactive waste (waste from radiotherapy, etc.)

4.04 Classification & Colour Coding Of Hazard HCW

All government and some of private health facilities are following the Bahrain order No. (1) for 2001 in respect of hazard Healthcare Waste Management along with GCC standard (Ref-3) as listed in the following Table (1) :

Table (1) Healthcare Waste and Colour Coding

Types of Waste	Bag and Container colour
Generals waste	Black
Infectious waste	<ul style="list-style-type: none">• Yellow for all infectious waste• Red for human parts
Cytotoxic waste	Yellow
Chemical waste	Yellow (metal, leak proof, sealed container)
Radiological waste	Yellow
Expired medications	Yellow
Contaminated and unused sharps	Yellow sharps containers

4.05 Major sources of Healthcare Waste:

- Hospitals such as university, general, district,...etc.
- Health-care establishments, such as emergency services, healthcare centres, dialyses centres, fist-aid posts, transfusion centres,...etc.
- Laboratories and research centres such as medical laboratories, medical research centres.
- Animal research and testing.
- Blood banks and blood collection services.

4.06 Persons at Risk with Healthcare Waste:

- Medical doctors, nurses, health-care auxiliaries and hospital maintenance personnel
- Patients in health-care establishments or receiving home care
- Workers in support services allied to health-care establishments, such as laundries, waste handling and transportation
- Visitors to health-care establishments
- Workers in waste disposal facilities (such as transfer stations and landfills), including scavengers

5.0 Descriptive of HCW Management in Bahrain :

The current management and practice of hazard HCW in Kingdom of Bahrain for both government and private health facilities depend on their internal policies or field experiences. In general, most of the HCW in health facilities are collected from the generation patient areas such as treatment rooms, operation theatres, wards...etc in daily basis, except some of private sectors their HCW stay in premises for more than a day, then transported to the incinerator plant at Awali 15 km far away from centre of Bahrain capital " Manama ". However, treatment and disposed of HCW for some private health facilities are still unknown. In general, the classification, packing and handling of HCW of theses health facilities are not standardized due to absent of unique Bahrain Guideline of the said management.

Fig. (2) illustrated the HCW flow since generated till it treated and disposed, and Fig. (3) show the photographs of safe and wrong practice of existing HCW management in Bahrain.

Health Care Waste Management

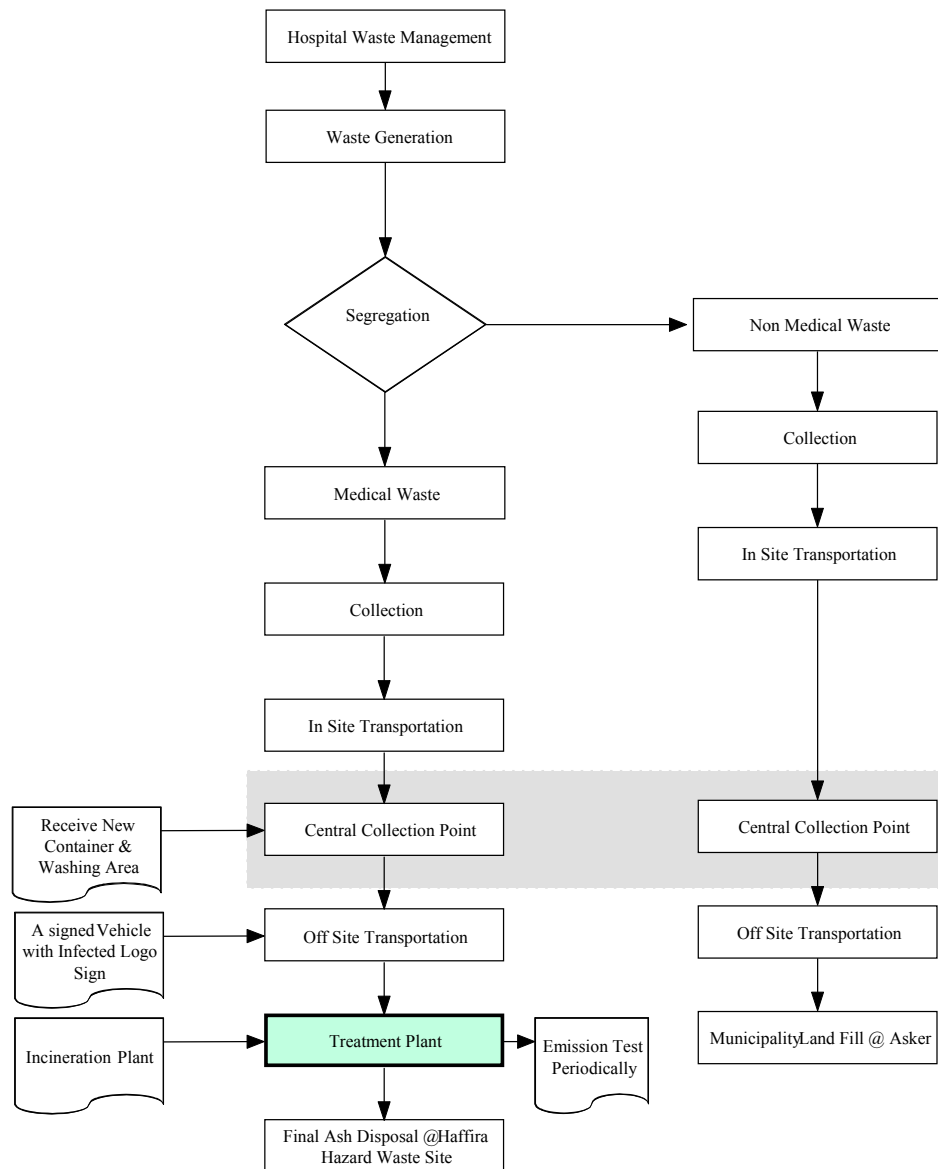


Fig. (2) hazard HCW Flow Chart for Most Health Facilities in Kingdom of Bahrain

Good Practices

Wrong Practices



i) Yellow container for sharp materials such as needles



ii) Hazard waste bag for packing non hazard health waste

a) Segregation Stage



i) Secured Storage room for Hazard waste



ii) Open area for storing Hazard waste

b) Collection & Storage Stage

Fig. (3) Safe & Wrong Practices of Hazard Healthcare Waste Management

Good Practices



i) Transportation with Delegated vehicle

Wrong Practices



ii) Normal vehicle for transportation hazard health care waste

c) Transportation Stage



i) New incineration plant comply to the environmental standards



ii) Damping hazard healthcare waste into municipality skip

d) Treatment & Disposal Stage

Cont. Fig. (3) Safe & Wrong Practices of Hazard Healthcare Waste Management

6.0 Generating Solid Waste Compared to Hazard HCW :

The quantity of hazard healthcare waste generated in Bahrain compared to the other municipality waste is small by 0.08 % of total Bahrain waste. Table (2) & (3) shows the type of waste compared to the hazard healthcare waste.

Table (2) : Type & Quantity of Waste Generated in Bahrain			
Year	Municipal Waste	Hazard Healthcare (HCW) Waste	(%) of HCW
2000	423,935	683	0.16
2001	515,428	725	0.14
2002	536,821	745	0.14
2003	659,846	784	0.12
2004	717,753	967	0.13
2005	1,034,921	1,049	0.10
2006	1,156,464	1,121	0.10
2007	1,091,948	1,199	0.11
2008	1,639,852	1,281	0.08

Table (3) : Type & Quantity of Waste Generated in Bahrain

No.	Type of Waste	Qty of Solid Waste (ton)	(%)
1	Domestic	529,755	31.96
2	Commercial	316,709	19.10
3	Construction	599,876	36.19
4	Industrial	110,470	6.66
5	Agricultures	67,841	4.09
6	Carcasses	15,201	0.92
7	Hazard Waste	16,626	1.00
8	Hazard Healthcare Waste	1,281	0.08
	Total	1,657,778	100.00

Fig. (4) show the government health facilities are the largest generator of hazard HCW by (93 %) compared to the private sector. And Salmaniya Medical Complex (SMC) (1000 beds) which is under the Ministry of Health umbrella generate alone 60 % of the total hazard health waste in Bahrain.

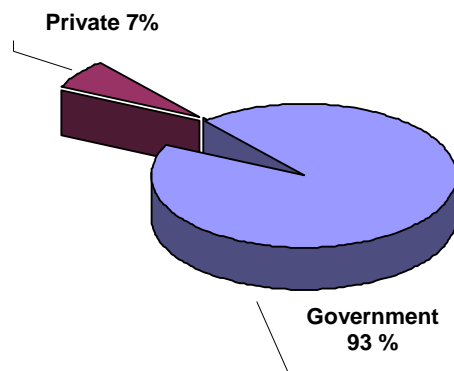


Fig. (4) % of HCW generation in Government & Private Health Sectors

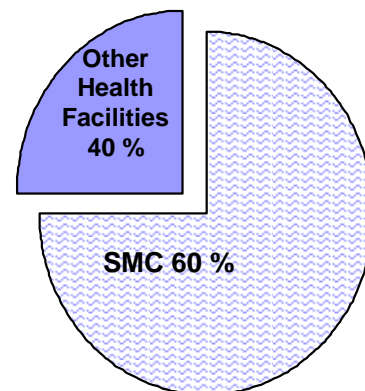


Fig. (5) SMC hospital is the largest generator of hazard HCW in Bahrain compared to other health facilities

7.0 Methodology

The study used a quantitative descriptive research design as it is an appropriate one to collect data base information for the current situation of hazard HCW management in Kingdom of Bahrain, and it has conducted in 2005 - 2006.

7.01 Sample Locations :

The sample of the study was divided in to two groups; one for the Administration and decision maker in the health facilities and the other for the employee of medical and allied health personnel in these facilities, as follow :

- a) Group (1) : From the total of 429 different health facilities of both government and private health sectors, the 120 of random samples were selected that represented 28 % of the total. The selection of the samples were based on their healthcare activities and quantity of HCW generation, and the response was 53 % out of 120 health facilities.
- b) Group (2) : 1000 of questionnaire forms have been distributed to the medical and support staff in the selected samples of Group (1). The purpose of this group of questionnaire to determine the employees' awareness regarding the management of hazard HCW nationally and internationally. Only 479 of questionnaire forms have been received (representing 48 % of total).

7.02 Questionnaire Preparation :

An HCW management questionnaires of both group (1) and (2) were prepared by the Surveyor and revised by Arabian Gulf University in cooperation with United Nation Environmental Programme (UNEP) in Bahrain regional office. The questionnaires was based on WHO model, and reformatted with modifications to compatible to the organisation of health facilities in the Kingdom of Bahrain.

The questionnaire has been distributed to the samples by either :

- a) Field visits to introduced the purpose of the survey and explain any queries raised by the health facility management board.
- b) Multi media such as telephone, faxes and internet (email).

7.03 Data Interpretation :

All of the data collected was statistically analyzed using the Statistical Package for the Social Sciences (SPSS ver. 13) to perform descriptive and inferential statistics. Descriptive statistics used a percentage to summarized the characteristics of the participated group.

7.04 The Results & Discussion

The results of the study framed in relation to three main categories:

- a) the sample general characteristics of HCW and related factors,
- c) the existing practice of HCW and disposal system, and
- d) staff awareness and training on HCW management.

7.04.1 General Characteristics

Study results show the total generated Healthcare Waste (HCW) in Bahrain was 1,048 ton/yr (2.8 ton/day) based on statistics 2005. The rate of hazard healthcare waste generation is equal to 1.14 kg/bed/day for Inpatients, and 0.13 kg/patient/day for Outpatients. These figures are relatively comparable to the international rates of 2 kg/bed/day for inpatients, and 0.1 kg/patient/day for visitors, (Ref-4). Per capita hazard healthcare waste generation was found to equal 1.45 kg/yr, compared to 0.4 - 5.5 kg/yr for high income countries.

Although the number of health premises in government sector (8 %) is less than the private (total of health facilities is 429). Where 35 of the facilities belong to government and 394 to private sector). From Fig. (6) it can be noticed the government health sector have the high percentage of the following :

- Generate 93 % (974 ton/yr) of total hazard HCW in Bahrain.
- Have more beds 86 % (1,741 beds of the total 2,033).
- 89 % of the patients in Bahrain (more than 4 million patients including in & out patients) visit and treated in the government facilities.

- The 69 % of manpower (medical staff such as Doctors, Nurses, Allied health, Technicians,...etc) in health facilities working in government sector.

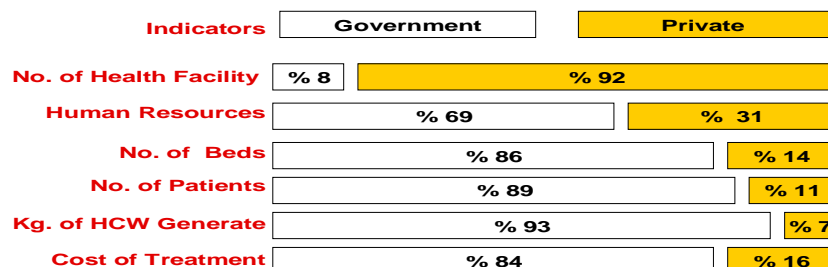


Fig. (6) % of Healthcare Activities regarding HCW Generation (2005)

Table (3) : Financial and Human Resources related to Hazard HCW in Bahrain (2005)

No	Factor	Health Sectors		Total
		Government	Private	
1 - Financial Resources	Budget for health sector - million in BD	103.1	N/A	103.1
	Expenditure for health sector - million in BD	138.1	N/A	138.1
	Quantity of HCW (kg/yr)	974,321.0	74,463.0	1,048,784
	Payment for treated HCW - BD.	194,864.20	37,231.5	232,095.70
2 - Human Resources	Expenditure for Cleaner - million in BD	2,287,687	N/A	2,287,687
	No. of Physicians	1,167	806	1,973
	No. of Dentists	111	184	295
	No. of Nurse	2,910	925	3,835
	No. of Allied Health	1,108	435	1,543
	Total Medical Manpower	5,296	2,350	7,646
3 - Patient	In - Patents	84,167	14,094	98,261
	Out - Patents	3,953,897	510,129	4,464,026
	Total of Patient	4,038,064	524,223	4,562,287
4 - Bed	No. of Beds	1,741	292	2,033

7.04.2 Existing Practices of Hazard HCW :

The intention of this stage of survey cover the generation of hazard HCW practice beginning from generation source in wards, treatment rooms,...etc. to final treatment and disposal of it, including segregation, handling, storage and transportation in & offsite the health facility.

a) Classification & Segregation Step

The study show the majority of health facilities are classified and segregated their HCW based on the hazard and non hazard waste (86 %), Fig. (7).

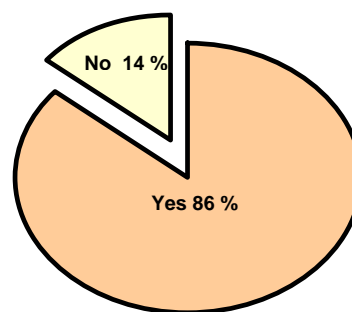


Fig. (7) Show the % of segregate healthcare waste at the source

The study show also the packing of HCW are not comply with colour coding based on waste type such as :

- 1) Only 43 % of health facilities using black plastic bags for non hazard HCW such as paper, kitchen refuse, ...etc., Fig (8).

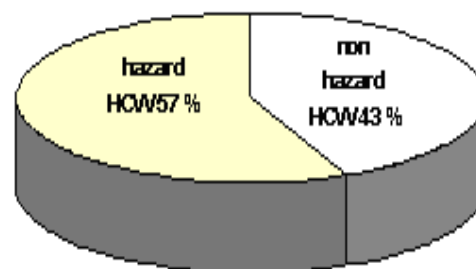


Fig.(8) Show the % of using black plastic bags

2) All infectious waste are packed in yellow plastic bags as should be. But some of health facilities using this type of bags for packing a sharps waste such as needles instead of hard yellow container (5 %), Fig. (9).

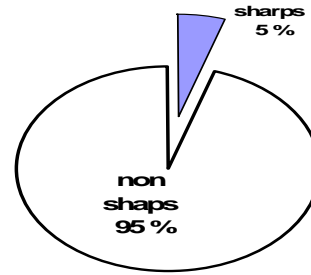


Fig. (9) Show the % of using yellow plastic bags

3) The red plastic bag used for packing the human parts such tissue, and 97 % of the health facilities are used it for the said purpose, Fig. (10).

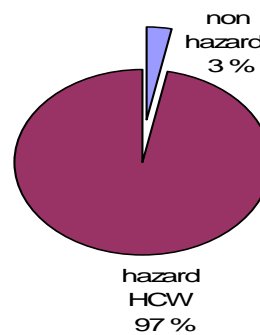


Fig. (10) Show the % of using red plastic bags

4) The yellow hard container used for packing the infectious sharp waste such as needles, sharp instrument,... etc. Only 46 % of health facilities were used the yellow container for sharp waste, Fig. (11).

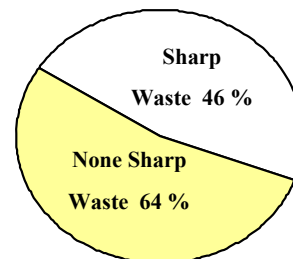


Fig. (11) Show the % of using the yellow hard container

b) Handling Step

It was found the most of the healthcare facilities (65 %) responded do not keep records for their generation of HCW, Fig. (12). The result also show the half of health facilities does not have clear information and instruction regarding the handling and storage of hazard HCW in their facilities, Fig. (13) .

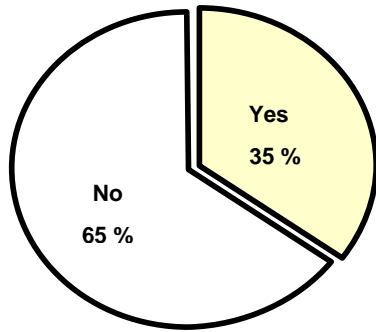


Fig. (12) show the % of Keeping records for hazard HCW at Facility

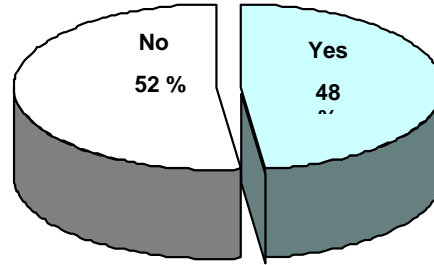


Fig. (13) show the % of available of HCW instructions in Facility

c) Storage Step

The study show half of the respondents answered have delegated room for storing the hazard HCW (60 %), Fig, (14). The most highlight point observed during the field visit as follow :

- Some health facilities using storage room of the hazard HCW for other purposed (44 %) such as storing drugs or stationery along with waste.
- 70 % of health facilities they cleaned and disinfected the storage room on regular basis.

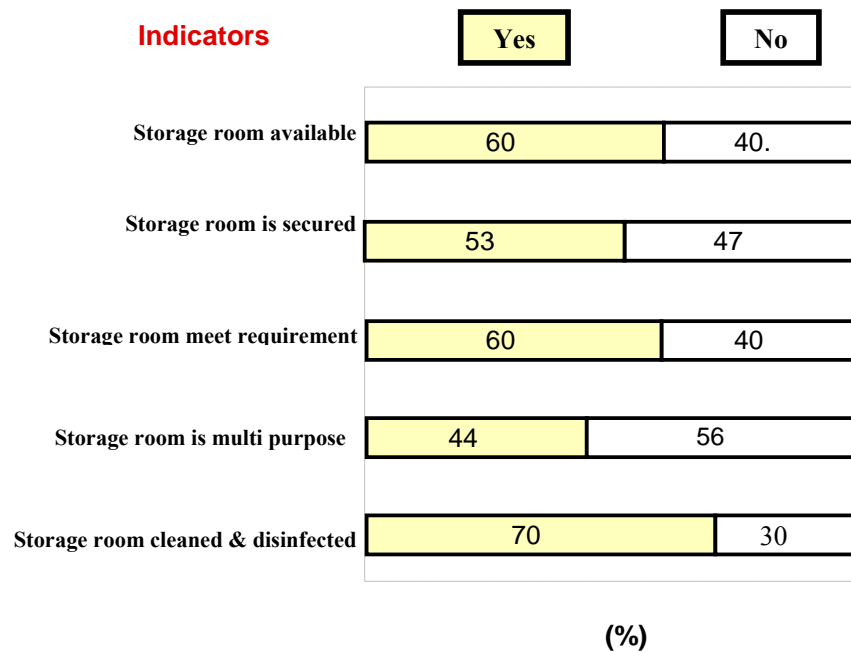


Fig. (14) Descriptive of storage room for hazard HCW

d) Transportation Step

Transportation step consist of Onsite and Offsite transportation, where Onsite transportation starting from generation sources of HCW at medical and treatment rooms towards to storage room/area. While the Offsite meaning mobilized the hazard HCW to outside health facility building then to treatment plant.

The result indicate the 53 % of health facilities carried their Onsite Transportation by Cleaner Company, and 21 % of them depend on the facility cleaner staff, Fig.(15). It has been observed also, the staff of Cleaner Company are always change between time to time in the in the health facility.

For Offsite Transportation, the result show 63 % of heath facilities depend on the private transporter, and other 21 % take off their hazard HCW by facility transportation, Fig (16).

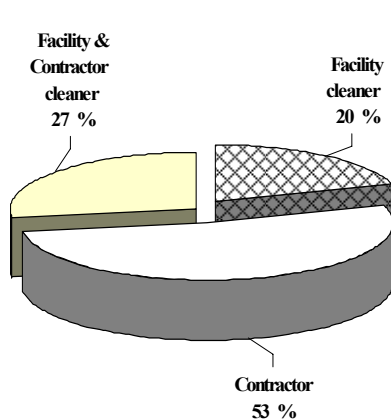


Fig. (15) % The responsibility of Onsite Transportation for HCW

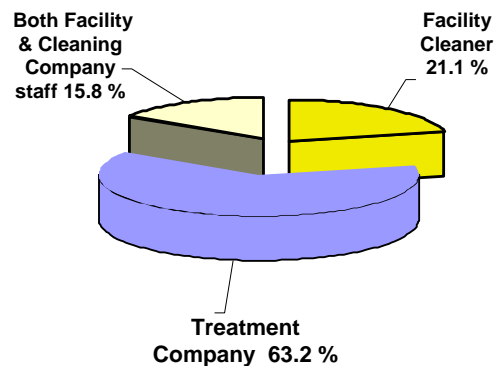


Fig. (16) % The responsibility of Offsite Transportation for HCW

In addition, 56 % of respondent answered their hazard and non hazard waste are transported (Onsite) from the source by individual trolleys, while 44 % of the other answered using same trolleys, Fig. (17).

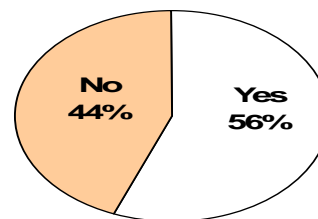


Fig. (17) Individual transportation for hazard & non hazard from the sources

The result also show the 61 % of health facilities did not have dedicated trolleys/containers for hazard HCW, and 53.7 % answered their trolleys doe not marked with hazard logo as awareness indication, Fig. (18).

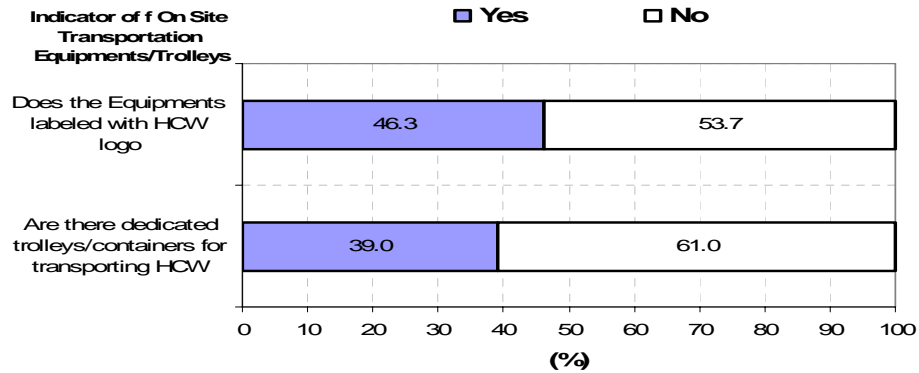


Fig. (18) Descriptive of Onsite Transportation Equipments

e) Treatment and Disposal Step

The study indicate there were six methods used to treat and disposed the hazard HCW, and the health facilities may used one or more of these methods for the said purpose as follow, Fig. (19) :

- The most method used was found incineration by 39.5 %.
- 6.8 % of solid hazard healthcare waste treated by autoclave, mainly for lab waste.
- Sewage network used to damp the liquid waste by 37.9 %.
- Some of health facility return back the hazard waste to the original supplier by 8 %, such as radio active waste.
- Other 7 % of health facility damped their waste to the municipality skip.
- Finally, 0.7% of health facility send their hazard waste to hazard landfill called "Hafira" which controlled by Environmental Affairs.

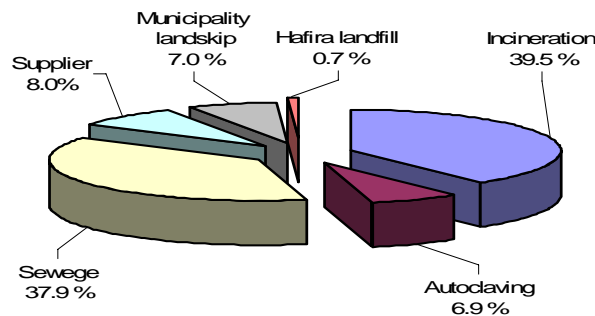


Fig. (19) Treatment & Disposal Methods for hazard HCW

7.04.3 Hazard Healthcare Waste Management Regulation :

a) Descriptive of Hazard HCW Management :

From Fig. (20), it can be noticed that 59 % of health facilities have instruction to deal with HCW, and most of them (60 %) did not have an auditing mechanism to ensure the HCW practice carried out as per the health facility instruction. The result also show 43% of HCW issues were discussed in regular facility management board.

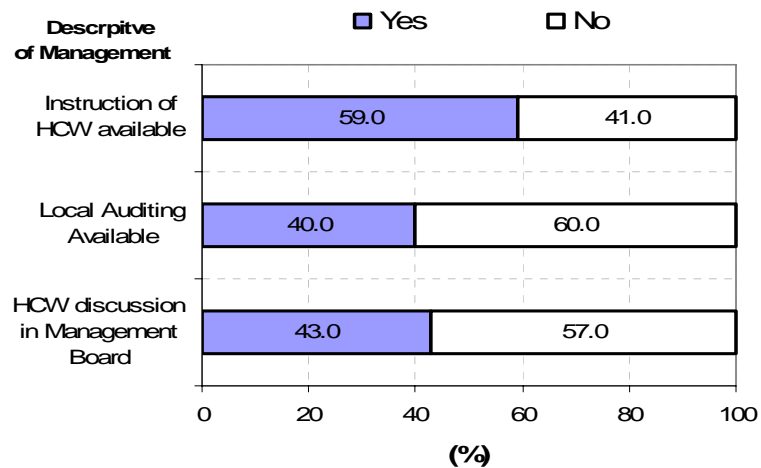


Fig. (20) Descriptive of HCW Management

b) Designation of Responsibilities :

The result show the responsibilities of Healthcare Waste Management in either in Government nor Private health sectors are nearly equal. Three parties in each health facility were shared the responsibility as indicated in the follow, Fig. (21) :

- First the Facility Administrators,
- Second, the Medical Supervisor, and
- The third lowest party is the Infection Control staff

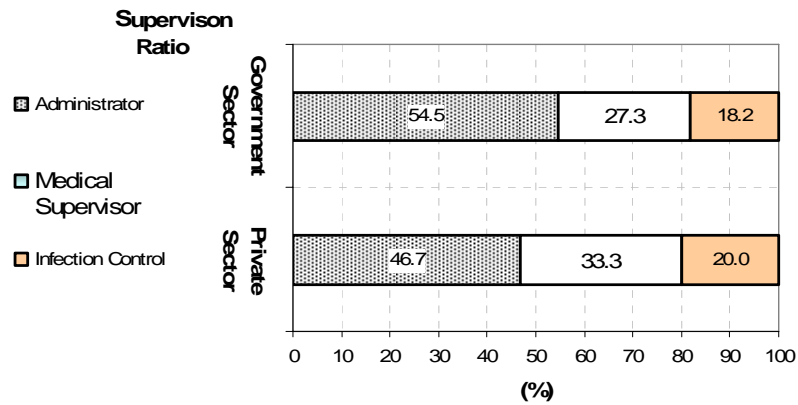


Fig. (21) % Descriptive of Designation of Responsibilities

c) Recording

The study show only 35 % of health facilities were records the quantity of hazard HCW, and 65 % of them were not, Fig. (22).

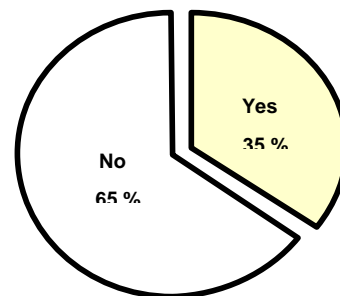


Fig. (22) Recording the Quantity of hazard HCW in the Facility

d) Willing to Pay for Treatment the HCW

The study show only 40 % of health facilities were willingness to pay for proper HCW final treatment and disposed, while 60 % of them were not, Fig. (23).

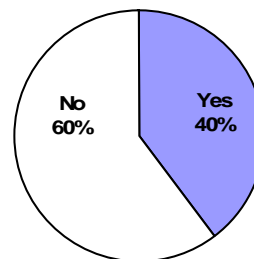


Fig. (23 Show the % of Health Facility willing to pay fees for final HCW treatment / dispose.

7.04.4 Staff Awareness and Training :

Raising awareness about the HCW management with training for medical and non medical staff is the health facility is an essential requirement to achieved the successful HCW management. However, training aims is must to create competent personnel and develop awareness amongst the workers and public with regards to all issues related to HCW management.

Out of 1000 distributed questionnaires, 479 (47.9%) were received, and 216 (45 %) of participates were nurses including allied health personnel. And 88 (18.4 %) were technicians, 83 (17.3 %) were cleaners , 76 (15.9 %) were administrative staff, and finally 16 (3.3 %) were physicians. However, the awareness marks of 479 respondent show their knowledge about HCW management are varied between unknown to excellent, as follow (F.g. 24):

- Only 18 % of participates answered their knowledge about HCW management is Excellent.
- The participates answered with scale of very good or good values are equal to 33 %.
- Other marks for weakness nor unknown scale were stand on 12 and 4 % respectively.

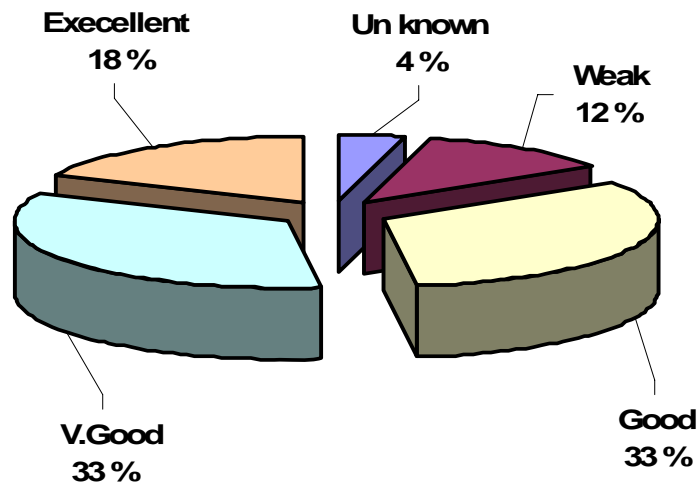


Fig. (24) % Awareness Ratio for Health Facility Workers

Fig.(25 show around 65 % of medical staff had a training on HCW practice, and more than 55 % of cleaners conducted training as well as.

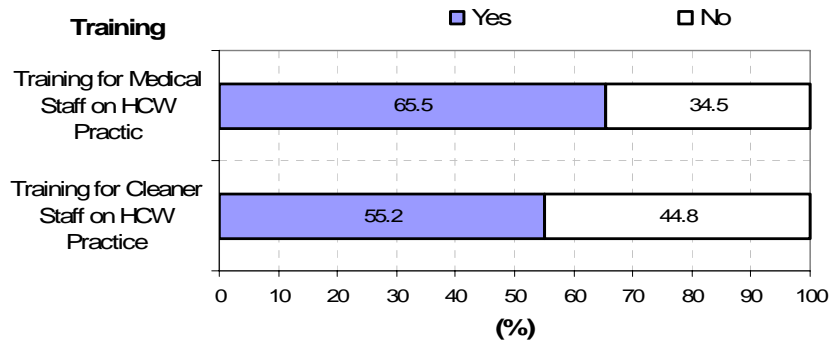


Fig. (25 Descriptive of Conducting Training for Medical and Cleaner Staff

7.04.5 Legal Framework of HCW Management :

More than three quarter of participant answers, show their HCW management policy based on the local and international standards of HCW management as follow, Fig. (26):

- 52.2 % of health facilities depended on Bahrain Ministerial Order no. 1 of 2001 with respect to Managing Waste Hazardous to Health Care, this ratio cover all government sector.
- 26.1 % of health facilities their HCW management based on international standards, such as ISO 14001, example the clinics of large industrial.
- However, 8.7 % used both Bahrain and International Standards, and it can be seen in were most heavy industrial clinics.
- Around quarter of health facilities (13 % as un known legal frame work) their HCW management practice based on the medical staff experience.

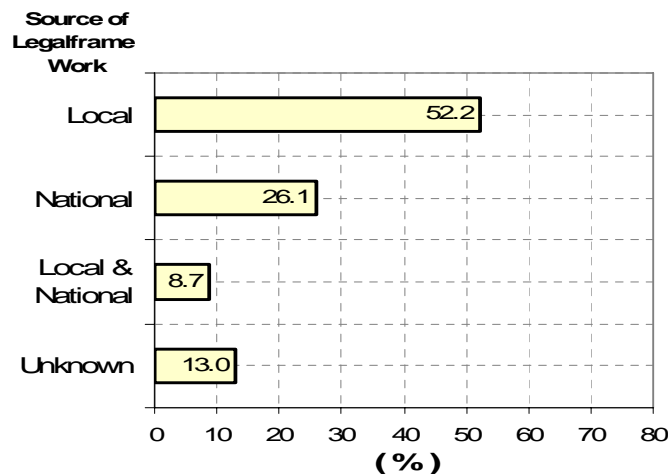


Fig. (26) Show the Legal Frame Work in (%) of HCW Management

7.04.6 Legal Forecasts Of Hazard HCW

As a result of Bahrain development in many activities including industrial, social and healthcare services along with the population growth, the quantity of healthcare waste is also gradually increased. In 2005, the population was 724 thousand person and the total patient reached to 4.5 million (including in and out patients) for both government and private sectors. Based on the following characteristics :

- Annual Growth for hazard HCW 7 %
- Per Inpatient 1.14 (kg/bed/day)
- Per Outpatient 0.13 (kg/visit/day)
- Per Capita 1.45 (kg/population/Yr)

The study forecasts the number of patients to reach more than 8 million in 2020 generating nearly 7.5 ton/day of HCW at annual growth rate of 6.9 %, Table (4).

Table (4) Forecasting of Generation hazard HCW , (Ref. 1)

Year	Population	Patient	Hazard HCW (Kg)
1997	594,137	3,268,143	669,615
1998	610,624	3,708,728	659,871
1999	628,088	3,651,094	650,128
2000	646,051	3,966,340	683,063
2001	654,619	4,004,230	725,224
2002	672,123	4,193,128	745,389
2003	689,418	4,369,431	783,535
2004	707,160	4,562,304	966,773
2005	724,645	4,562,287	1,048,784.00
2006	744,210	4,747,726	1,121,136.20
2007	1,039,297	4,940,790	1,198,494.60
2008	1,039,297	5,141,796	1,281,190.72
2009	1,098,537	5,351,079	1,369,592.88
2010	1,161,154	5,568,986	1,464,094.79
2011	1,227,339	5,795,880	1,565,117.33
2012	1,297,298	6,032,139	1,673,110.43
2013	1,371,244	6,278,159	1,788,555.05
2014	1,449,404	6,534,350	1,911,965.35
2015	1,532,021	6,801,143	2,043,890.96
2016	1,619,346	7,078,988	2,184,919.43
2017	1,711,648	7,368,352	2,335,678.87
2018	1,809,212	7,669,725	2,496,840.72
2019	1,912,337	7,983,618	2,669,122.73
2020	2,021,341	8,310,564	2,853,292.19

All statistics data base on actual value until 2008, and other is forecasting up to 2020, except :

- In 2007 the population has been adjusted to 1,039,297 for both Bahraini & non Bahraini, (Ref-2), and all population figures from 2008 up to 2020 is forecast.
- Total patients is 5,134,928 , where 98,970 for In patients and 5,035,958 for Outpatients including the government and private health sectors .

8.0 Opportunities for Improvement

The Strengths, Weakness, Opportunities, Threats (SWOT) analysis is a strategic planning use to evaluate existing practices of hazard HCW management include political commitment, presence of enabling legislative framework, potential availability of skilled human resources, and availability of a modern incineration facility. Points of weakness include weak institutional structure for HCWM, weak enforcement capacity of the existing regulations, lack of information, and low levels of awareness on HCWM. To achieved the successful of HCW management, a

several factors are affected to this management are summarized in the following Table (5).

The foundational principles for development the HCW management are :

- a) Regulations: This should include the development of draft standards and norms to facilitate the management of both solid and liquid HCW. Such regulations would cover:
 - Rules for separation and identification of waste
 - Rules for collection and transport of medical waste
 - Rules for registration of waste
 - Rules for treatment and disposal of waste
 - Requirements for administrative and financial mechanisms
- b) Guidelines: Guidelines to provide practical and technical advice for those who are required to implement the regulations should be drafted.
- c) Permits: As defined by the new legislation a system of permits for designated bodies for the collection, transportation and final disposal of HCW should be introduced.

9.0 Conclusion :

In order to continues improve the Healthcare Waste Management of Kingdom of Bahrain, and to ensure the health premises are following overall policy of the said subject, the paper highlights the following :

- Need to strengthening the entire HCW legal framework that includes a specific definition for HCW, a requirement for particular HCW management practices at all levels.
- Set up a Bahrain Guideline.
- Clear designation of responsibilities in each health facility along with.
- A delegation of responsibilities for implementing HCW legislation, and training requirements overall Bahrain Facilities by authority body such Ministry of Health.
- It also recommend the HCW management to be included in health educational institute programme.
- Continuous quality improvement to meet the latest international standards by steering committee involve government and private sectors.
- Encourage the investment in HCW management by private sectors.

Table (5) : Strengths, Weakness, Opportunities and Threats (SWOT) Analysis

	Factor	Strengths	Weakness	Opportunities	Threats
1	Healthcare Services	<ul style="list-style-type: none"> • Development growth • No. of health facility increased 	<ul style="list-style-type: none"> • Hazard healthcare waste increase 	<ul style="list-style-type: none"> • Minimized the waste in the generation sources 	<ul style="list-style-type: none"> • Daises
2	HCW Practices <ul style="list-style-type: none"> • Classification & Segregation • Collection & Handling • Storage • Transportation • Treatment & Disposal 	<ul style="list-style-type: none"> • Kk • Welling to improve • Frequently collected • Some storage comply with HCW requirement • Private involve 	<ul style="list-style-type: none"> • Absent of guidelines & instruction • Used un skilled worker & cleaner 	<ul style="list-style-type: none"> • Arise of training & awareness • Provide dedicated equipments/trolleys 	<ul style="list-style-type: none"> • Daises • Transportation & treatment cost is high
3	Management Factors <ul style="list-style-type: none"> • Financial • Administration • Technical & Operation • Training & Awareness 	<ul style="list-style-type: none"> • Income of HCW management • A skilled human resource • New treatment plant available 	<ul style="list-style-type: none"> • Absent of allocated budget • Absent of identified responsible person 	<ul style="list-style-type: none"> • Private investment • Gov. subsidies, no tax,..etc, • Educational in ** 	<ul style="list-style-type: none"> •
4	Legal Frame Work	<ul style="list-style-type: none"> • Bahrain Ministerial order no. 1 for 2001 	<ul style="list-style-type: none"> • Implementation mechanism is absent 	<ul style="list-style-type: none"> • Integrate the legal decree to suit Bahrain health facilities requirements. • To be identified the bodies responsible for HCWM 	<ul style="list-style-type: none"> • Occupational health against the worker & environment
5	Base Data & Information	<ul style="list-style-type: none"> • Welling to provide a data base 	<ul style="list-style-type: none"> • No records regarding HCW quantity • No reports of impacts & accident caused by HCW 	<ul style="list-style-type: none"> • Including with healthcare service statistics 	<ul style="list-style-type: none"> • No software / programme to entre the data

10.0 References :

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