

**EVALUATION OF MANAGEMENT SYSTEM OF MEDICAL AND BIOMEDICAL WASTES AT
WAD MEDANI TOWN, SUDAN**

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ABSTRACT

This study was conducted at Wad Medani Town, Gezira state , Sudan to evaluate quantitatively and qualitatively the medical and biomedical waste (MBMW) generated by the Healthcare Establishments (HCEs).The study was conducted by the inventory of all HCEs by category, followed by site visits, developing a questionnaire, determining the sample size, quantifying the (MBMW) and analyzing the collected data. The study showed that, there was no appropriate technical management system for the management of MBMW at Wad Medani town. The waste managed as domestic waste, all mixed together, collected, handled, stored, transported and finally, disposed of. The results showed that, the total amount of non-health risk solid waste (NHRSW) generated per day was 399.59 Kg (92% of these wastes were produced by Wad Medani Teaching Hospital. While the total average amount of Health Risk Solid Waste (HRSW) generated per day was 265kg.The total amount of Health Risk Liquid Waste (HRLW) generated per day was 148 litre (93% arising from Wad Medani Teaching Hospital . The study recommended that, it is very important to establish an adequate management system for (MBMW) in all (HCEs) in Wad Medani town, accompanied with appropriate management planning copes with existing economics, social and environmental conditions.The importance of training, awareness and education of all medical staff , workers and for those who deal with and come in contact with (MBMW) on **how** to deal with them to protect their health and safety.

Keywords: Medical and biomedical wastes, health risk solid waste, health risk liquid waste, disposal , environment

الخلاصة :

لقد اجريت هذه الدراسة بمدينة ود مدني ولاية الجزيرة بغرض تقييم المخلفات الطبية الناتجة من المؤسسات الطبية المختلفة بالولاية كما ونوعاً إضافة لمعرفة النظام المتبع لإدارة هذه المخلفات . بعد حصر وتطبيق المنشآت الطبية والإحيائية تمت زيارة هذه المنشآت ومن ثم تحديد حجم عينة الدراسة (46 منشأة من جملة 158 منشأة) . تم إجراء المسح الميداني وجمع المعلومات المطلوبة باستخدام الاستبيان كما تم تحديد كميات ونوعية المخلفات الطبية المنتجة . ولقد أظهرت نتائج الدراسة أن كمية المخلفات الصلبة غير الخطرة المنتجة يومياً تقدر بحوالي 399.58 كيلوجراماً (91.8% تنتج من مستشفى ود مدني التعليمي) ، وكمية المخلفات الصلبة الخطرة بحوالي 265.05 كيلوجراماً/اليوم (91% تنتج بواسطة مستشفى ود مدني التعليمي) . وبلغ إنتاج المخلفات السائلة الخطرة 148.08 لتر/اليوم (93.7% تنتج بواسطة مستشفى ود مدني التعليمي) . أوضحت الدراسة أن كل أنواع المخلفات الطبية الصلبة يتم جمعها ونقلها وترحيلها مع المخلفات الصلبة الأخرى بواسطة العمال والنساء ويتم التخلص منها في مكب القمامة بصورة غير صحية مما يشكل خطراً علي العاملين في هذا المجال . كما أوضحت الدراسة عدم وجود قوانين وسياسات فعالة لإدارة المخلفات الطبية بمدينة ود مدني . وأوصت الدراسة بضرورة إنشاء نظام إداري مناسب للإدارة السليمة للمخلفات الطبية بالمدينة مع ضرورة سن القوانين والتشريعات الخاصة بذلك وضرورة الاهتمام بتدريب وتوعية كل من يتعامل مع هذه المخلفات الطبية حفاظاً علي صحتهم وسلامتهم .

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INTRODUCTION

Medical and Biomedical Waste (MBMW) is the waste resulting from the health care (HC) activities. WHO (1999) defined the healthcare waste (HCW) as; " the waste includes all the waste generated by healthcare establishments (HCEs), research facilities, and laboratories in addition , it includes the waste originating from " minor" or " scattered " sources such as that produced in the course of HC under taken in the home such as dialysis , insulin injection ,..etc.HC activities lead to production of waste , which is considered to be a reservoir of potentially harmful organisms that may lead to adverse health effects . Most of this waste is not more dangerous than regular household waste .

However , some types of HCW present a higher risk to health . These include IW (15% to 25% of total HCW) among which SHW(Sharp Waste) (1%) , body parts waste (1%) chemical and pharmaceutical waste (3%) and radioactive and cytotoxic waste or broken thermometers less than 1%. (WHO,2000and 2005).

The HCW can cause immediate short-term public health problems , as well as long-term environmental pollution , if not properly managed .MBMW has now come to be recognized as a priority problem in the Sudan due to increasing demand for medical and biomedical health services, which include the MBMW production . In spite of that, few studies were conducted on MBMW. These studies were restricted to Khartoum and Gezira States and they showed that, there were no effective management plans and systems for MBMW in the Sudan .In Wad Medani town, there are different HCEs providing HC services to the public . These are 17 hospitals with different bed capacity between 50-250 bed, 26 primary HC centers , 71 diagnostic, 61 pharmacies, 131 private clinics,3 polyclinics, and 9 drug companies (WHO ,2005) .

The increasing demand for medical and biomedical health services in Wad Medani town accompanied by increasing of medical and biomedical waste production which endanger the health of patients, visitors , environment and the community particularly there is no a sanitary management system implemented in a correct scientific ways for medical and biomedical waste in Wad Medani . A

about,250 tons of garbage is generated per day in Wad Medani town, about 2 tons of which are generated by WMTH. The waste generated by OHCEs (Other Health Care) in Wad Medani town was not known quantitatively and qualitatively . All MBMW generated by HCWs in Wad Medani town managed as domestic waste (Bashir,H,2005; personal communication).The absence of effective local ordinances , regulation and guidelines developed around management practice for medical and biomedical waste by responsible government institutions in Wad Medani town brought out the need for careful planning and management system govern by stiff regulations and guidelines particularly in the limited resource availability available for HCEs .

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Objectives of the Study

a. General objective:

To develop a simple appropriate technology for MBMW management system which ensure safety of patients, employees and visitors from hazards of MBMW and commitment for protection of the environment and the community.

b-Specific objectives :

1. To evaluate the management system of MBMW applied .
2. To identify, categorize and quantify the MBMW produced .
- 3.To develop a simple appropriate management system for MBMW in Wad Medani town .
- 4.To develop a simple technology for MBMW management system suited to environmental conditions of the study groups .

MATERIALS AND MEHTODS

The study area

This study was conducted during the period from August 2004-August 2007 at Wad Medani town, Gezira State , Central, Sudan.

Survey Methods:

Before undertaking the survey , clean and unambiguous definition had been decided upon regarding the classification of HCW in order to be able to determine the quantities of hazardous .HCW depending on what is considered as hazardous and what is considered non-hazardous .

For conducting this survey , four major steps were listed; these were :

1. Inventor of all the HCEs per category at Wad Medani town and site visits .
2. Developing a questionnaire .
3. Developing the sample size and how to be selected for the study .
4. Conducting the suvery through the following steps:-
 - a. Completing the questionnaire .
 - b. Quantifying of HCW.

Inventory all HCEs per category at Wad Mdani town and site visits:

Based on the meetings with the departments of preventive Medicine, Environmental Health and Statistics at Ministry of Health (MoH), Gezira State, the potential generators at Wad Medani town were identified, The medical care services are provided to the population through 307 HCEs (Ahmed H. Seed , 2003; Table 1) These were , Wad Medani teaching hospital (WMTH) which consists of fourteen specialized units and hospital , three non governmental hospital , 26 health centers (22 public and 4 private) , 71 private medical laboratories 61 pharmacies , and two medical institutions . However , the potential generators of

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MBMW are 180 (Table 2), including the hospital and the specialized sections of WMTH (Biostatistics administration,2005).

Table (1): Presents the types and number of HCEs at Greatest Wad Medani locality during the period of the study.

Types of Establishment	Number
Governmental Hospital	1
Non - Governmental Hospital	3
Governmental health Centers	22
Non - Governmental Hospital Centers	4
Private Clinics	131
Clinical Laboratories	71
Polyclinic	3
Pharmacies	61
Medical Institutions	2
Drug Companies	9
Total	307

Source: seed H .A (2003)

Table (2): Presents potential MBMW generators at Wad Medani town during the period of the study.

Types of Generators		Number
Hospital	Governmental	14
	Private	3
Health Centers	Governmental	22
	Private	4
Private Medical Laboratories		71
Polyclinic		3
Pharmacy		61
Medical Institutions		2
Total		180

Biostatistics administration (2005)

Visits were conducted to the institutions and administrations concerned with

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HCWM in order to get acquainted with the existing situation of HCWM at Wad Medani town ; these institutions and administrations include the following:-

i- The preventive Medicine , Environmental health , and pharmaceutical Administrations at MoH, Administrations of health Affairs at wad Medani teaching hospital (WMTH). The visits were conducted to elicit :

1. The activities practiced to collect, handle , store , transport , treat and dispose of MW.
2. The laws and regulation issued and applied to control HCWM .
3. Surveys and studies conducted in the field of HCWM at Wad Medani town , and
4. Difficulties and constrains regarding efficient management MW (Medical Waste).

ii- Environmental health administration at south Medani locality to collect information about municipal SW management ; their types quantities , methods of collection and transportation, treatment and disposal .

iii- Dumping area of SW to identify the methods of discharging .

iv- The Federal MoH at Khartoum to examine the national laws and regulations applied to manage and control of the MBMW in the Sudan .

Developing the questionnaire

A questionnaire was prepared to be completed by all group sample of the HCEs . The questionnaire contained the following information :

1. Type of HCEs hospital , health centers, clinical laboratories, pharmacies , poly clinics and medical institution (medical lab . of faculty of medicine and institute of nuclear medicine) .
2. Number of in-patients and out- patients of the HCE/ day , and the number of HCE beds .
3. Type , components and quantities of MW generated
4. What happened between segregation (if any) and , final disposal of MW produced ? what are the principle problems and difficulties ?
5. their qualifications , level of education , training , and job description.
6. The availability of legislation and general policy applied for HCWM and control at the HCE .

Step III: Determination of the sample and methods of selection among the study populations

Due to the heterogeneity and the similarity of HC activities and health services introduce to the people , the HCEs at wad Medani town were grouped into two groups :

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Group 1: Wad Medani teaching hospital (WMTH) , which consists off Medicine , Orthopedic , ENT, Chest unit , X-ray Unit , operation Unit Autopsy Unit, Blood Bank , Renal dialysis Unit, Obs and Gyne , pediatric , Surgical wards, and first Class Wards.

Group 2: The other healthcare establishment (OHCE_s) include private hospital , polyclinics, public , and private health center private clinical laboratories , pharmacies , and medical institution (medical lab. Of Faculty of medicine and Institute of Nuclear Medicine) .

Out of the total number of HCE_s (307) at wad Medani town , there were 180 HCE_s that produce MW, which represents the total size of the study group, including the specialized hospital and unit of WMTH. The rest one (127 HCE_s) were not generate hazardous MW . Each HCE of the study group represent an entity in the study and, has an equal chance as other entities to be represented in the sample size of the study .

Certain aspects had been taken into consideration for selection of the sample size e.g. the objective of the study , difficulty of waste segregation for weighting at arising cost , time , and the degree of accuracy required for the results, the size of the study group , and the variation between the HCE_s that constitute the stud group .

All sections and unit of WMTH (total population) , were taken as a part of the sample because this hospital is considered to be the basis of the study , and also all non-government hospitals , polyclinics and Medicine Institutes were also taken as total population because they were small in number . The rest of the sample had been taken from the OHCEs according to the following equation (Kush, 1965) :

$$n = \frac{Z \times sd}{e} = \frac{ZP(1-p)}{e}$$

Where :

N: Population Size

n : Sample size

Z: 1.96 (constant)

SD = Standard deviation

E= error percent = (0.05

According to the above formula , the total sample size from the rest HCE_s was defined by 46 HCE_s . The sample size of each category of the rest HCE_s was calculated as following (Table 3) :

No. of HCE_s category $\xrightarrow{\hspace{10em}}$ $\times 46$ (total No. of sample size)

Total NO. of the rest HCE_s

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Table (3): Presents distribution of sample’s size for the rest HCE_s during the period of the study.

Establishment	Number	%	Sample size
Health centers	26	16.5	7
Pharmacies	61	38.6	18
Private clinical Labs	71	44.9	21
Total	158	100	46

SD=± 23.6

The sample size

The unit of the sample size (n) from each population (N) of HCE_s was selected by using systematic random sampling method where each population group listed in serial number starting from 001. Then the desired sampling intervals (K) was determined:-

$$K=N/n.$$

The workers population consists of four main groups physicians, nurses and sisters, technical workers and cleaners. 10% of each group had been selected by using systematic random sample.

Conducting the survey

1. Filling the questionnaire

The questionnaires were filled through direct interview with the medical and medical supports workers (physicians, nurses, sisters, pharmacists, technicians, health workers and cleaners).

2. Quantification of HCW

Soild wastes (SW)

The study applied a method adopted by Basle Convention and the WHO, in which the weight of each type of waste arised from each building unit was estimated in each filled container. Then, multiplied with the intervals number of discharging per day.

For the sharp waste (SHW), the total number of each type produced per day was calculated at each building unit. Then, each type was weighed by using sensitive balance with sensitivity +0.0001.

Liquid Wastes (LW)

The volume of liquid waste produced per day was estimated through discussion with the medical and paramedical staff directly related with production.

The total sewage water produced was estimated by calculating the amount of waste water pumped from the storage well by a tanker per day.

3. The data analysis

The collected data by the questionnaires were incorporated into different databases. The databases were prepared using Excel program. A simple statistical calculations were carried out:

$$Y = \frac{\sum_{i=1}^n y_i}{n}$$

Where:

n is the number of healthcare sections surveyed/category.

Y_i is the daily production of the waste in each sample in Kg/bed/day.

The total production of hazardous and non-hazardous medical waste produced/day were calculated.

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Results and Discussion

Table (4) shows the types and amount of the solid wastes and the liquid wastes generated by each section of Wad Medani Teaching Hospital (WMTH) per day. This table illustrated that, the non-hazardous risk solid waste (NHRSW) generated per day by each section of WMTH was greater than the hazardous risk solid waste (HRSW) generated per day by each of these sections.

The Obs and Gyne generated the highest amount and percentage of the General solid Waste (GSW) (112.47 Kg/day; 30.7%), pathological 17 Kg/day (78.5%), infectious solid 57 Kg/day (28.2%), and pharmaceutical waste 3.5 kg/day (32.9%) comparing with other sections.

The highest amount and percentage of the chemical liquid waste produced/day were produced from Orthopedic section 6.7 L (49.7%), and the highest infectious liquid waste arising from Renal dialysis section was 63.4%. For the sharp waste (SHW), the highest amount and percentage of disposable syringes and lancets generated/day were arising from the Blood Bank section 1.5 Kg (22.3%). While the highest amount and percentage of cannula and platelets were arising from the Pediatric Hospital 0.24Kg (69%) and operation section 0.02Kg (47%) consequently.

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Table (4). Presents the type of wastes and the average amounts(Kg/L) produced/day at WMTH section during the period of the study.

Hospital	Type of Waste													
	GSW	PW	RW	GW	IW	SHW	Average amounts/d						Pharma ceutical	
	S	S	S	S	Liq	S	Liq	Syr	Lancet	Cannula	Slide	platelet	S&C	liq
Medicine	70.25	0.00	0	0	0.25	38.7	2.53	1.12	0.01	0.02	0	0.00	1.25	0.00
I. care	4.52	0.00	0	0	0.00	1.5	1.38	0.22	0.00	0.02	0	0.00	0.25	0.00
Orthopedic	17.10	3.00	0	0	6.70	25.0	1.75	0.40	0.00	0.01	0	0.01	1.25	0.00
E.N.T	15.06	0.15	0	0	0.00	6.0	0.75	0.26	0.00	0.01	0	0.00	0.50	0.00
Chest	10.71	0.00	0	0	0.00	3.0	0.50	0.11	0.00	0.00	0	0.00	1.10	0.00
Surgry	50.34	0.00	0	0	0.00	30.2	1.50	0.56	0.00	0.01	0	0.00	0.80	0.00
xRay	2.00	0.00	0	0	5.00	0.0	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
Operation	1.50	1.50	0	0	0.00	12.5	12.00	0.34	0.00	0.00	0	0.03	0.00	0.00
First class section	20.00	0.00	0	0	0.00	1.5	0.00	0.11	0.00	0.00	0	0.00	0.75	0.00
Obs/Gyne	112.47	17.00	0	0	0.04	57.0	18.00	1.46	0.01	0.02	0	0.01	3.50	0.00
Autopsy	5.00	0.00	0	0	0.00	0.5	0.70	0.05	0.00	0.03	0	0.00	0.00	0.00
Blood Bank	3.70	0.00	0	0	0.00	0.00	4.20	1.46	0.04	0.00	0	0.00	0.25	0.00
Renal Dialysis	7.00	0.00	0	0	0.00	3.00	80.00	0.07	0.00	0.00	0	0.00	0.00	0.00
Pediatric	47.18	0.00	0	0	1.50	22.98	2.00	0.39	0.01	0.24	0	0.00	1.00	0.00
Total	366.83	21.65	0	0	13.49	202.03	125.31	6.55	0.07	0.35	0	0.05	10.65	0.00

Average 26.20 1.55 0 0 0.96 14.43 8.95 0.47 0.00 0.02 0 0.00 0.76 0.00
 SD± 32.68 4.53 0 0 2.13 17.79 21.09 0.51 0.01 0.06 0 0.01 00.92 000

S = Solid Liq = Liquid Syr. = Syringes GSW: General Solid Waste , Pw: Pathological Waste , GW: Genotoxic Wste , IW: Infectios Waste

Table (5). Presents the average of wastes type (Kg/L) produced/day/HC unit of the category of OHCEs during the period of the study.

Hospital of OHCEs	Type of Waste													
	GSW	PW	RW	GW	IW	SHW	Average amounts/d						Pharma ceutical	
	S	S	S	S	Liq	S	Liq	Syr	Lancet	Cannula	Slide	platelet	S&C	liq
Private hospital and polyclinics	2.88	0.06	0.00	0.00	0.05	0.66	0.03	0.05	0.001	0.003	0.0	0.0005	0.29	0.00
Private laboratories	0.07	0.00	0.00	0.00	0.01	0.03	0.05	0.03	0.003	0.0	0.002	0.00	0.00	0.00
Health centers	0.49	0.00	0.00	0.00	0.01	0.20	0.03	0.05	0.003	0.0008	0.00	0.00	0.20	0.00
Pharmacies	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Faculty of Medicines lab	3.00	0.30	0.00	0.00	0.05	0.23	0.74	0.80	0.004	0.00	0.02	0.004	0.00	0.04
Institute of nuclear medicine	1.75	0.00	0.25	0.00	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Average 1.37 0.06 0.04 0.00 0.02 0.31 0.14 0.16 0.001 0.0006 0.003 0.0008 0.08 0.01
 SD± 1.37 0.12 0.01 0.00 0.02 0.32 0.29 0.32 0.001 0.001 0.008 0.002 0.13 0.02

S = Solid Liq = Liquid Syr. = Syringes

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Table (6).Presents the amount of wastes type (Kg/L) produced/d/ category of OHCEs during the period of the study.

Hospital	Type of Waste													
	GSW	PW	RW	GW		IW		SHW					Pharma ceutical	
	Average amounts/d													
	S	S	S	S	Liq	S	Liq	Syr	Lancet	Cannula	Slide	platelet	S&C	liq
Private & polyclinics	11.50	0.25	0.0	0.0	0.21	2.70	0.13	0.22	0.00	0.01	0.00	0.0	1.15	0.00
Private laboratories	4.70	0.00	0.0	0.0	0.89	1.83	3.80	2.41	0.19	0.00	0.05	0.0	0.00	0.00
Health centers	10.60	0.00	0.0	0.0	0.23	5.07	0.73	1.32	0.08	0.02	0.00	0.0	5.25	0.00
Pharmacies	1.20	0.00	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.80	2.50
Medical lab	3.00	0.30	0.0	0.0	0.05	0.23	0.74	0.80	0.00	0.00	0.02	0.0	0.00	0.00
INMO	1.75	0.00	0.25	0.0	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00
Total	32.75	0.55	0.25	0.0	0.38	10.58	5.40	4.74	0.27	0.03	0.07	0.0	7.20	2.50

Average 5.46 0.09 0.04 0.0 0.23 1.76 0.90 0.79 0.05 0.01 0.01 0.0 1.20 0.42
 SD± 4.50 0.14 0.10 0.0 0.34 1.19 1.46 0.95 0.08 0.10 0.05 0.0 2.04 1.02

S = Solid Liq = Liquid Syr. = Syringes

Tables (5 and 6) categorized the Occupational Health and safety association (OSHA) into six categories, and shows the types and average amounts of waste generated by each Healthcare establishment of each category. The table shows that, the medical laboratory of the Faculty of Medicine U of G produced the largest average amount of the general solid wastes 3Kg/day the pathological waste 0.3Kg/day and infectious liquid waste 0.74L/day compared with the other Healthcare Establishment of each category.

For the pharmaceutical solid and creamy waste, the largest amount generated/day were produced from private hospitals and polyclinics 0.3kg/day. While the largest amount of pharmaceutical liquid waste was produced from the pharmacies 41L/day.

For the sharp waste, the largest amount of disposable syringes, lancets, slides and platelets generated /day were from the medical laboratory of the faculty of Medicine U of G 0.8 Kg, 0.004 Kg, 0.004 Kg, following the same order.

CONCLUSION

The HCWM was in bad shape in Wad Medani town . The applied HCWM systems at all HCEs were unhygienic, unsafe and unreliable . The general awareness on the issues related to HCWM was very much lacking for both the generator HCEs as well as the waste handlers as observed during the survey . The MW was being dumped and mixed together. It is collected, transported and disposed in similar manner as the general municipal SW ; only a very a small portion of MW was segregated at the point of generation and disposed by burning

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only at the yard of the HCEs . All HCEs at Wad Medani town require HCWM system approaches in collection, handling, storage, transportation, treatment and disposal of their waste by the methods that at all stages minimize the risk of public health and to the environment. A need exists for further study must be conducted for assessment of the nature of the risk posed by MW and method for proper handling and management by HC workers other worker at risk and the general public .Studies are required at each HCE in Wad Medani town to establish a data base , information and statistic on HCW sources , generation , collection , transportation , treatment and disposal . To reach this level actual measurements and proper recording are required, from which, the components, compositions and quantities needed to be assessed and confirmed. This will form the basis of planning , designing and implementation of HCWM systems at HCEs .Depending on the objectives of the study and in light of the implementation the study concluded that ; requirement for HCWM acceptable the environment of medical institution in Wed Medani town can be divided into four steps in the following order : avoidance of waste where it is produced ; reduction of waste amount by segregation collection ; optimal reuse of waste produced by recycling ; and disposal of residual amounts of HRSW waste with the minimum risk to human and environment .

RECOMMENDATIONS

The following key recommendations are met simply as guidelines to stimulate better and more specific management system and applicable technology for HCWM management action program at MoH level and then at the level of individual HCE in Wed Medani town .

Based on the objectives and the results obtained the study recommended the following:

- 1-** Establishing a unit in Environmental health Section in MoH for MBMW management control in HCEs in Wed Medani town with the following responsibilities:
 - a – Creating and developing waste management plans and polices, ensuring compliance with applicable laws and regulation .
 - b- Controlling and monitoring of all MBMW activities HCEs .
 - c- Selection system , equipment and material for handling, treatment and final disposal of all type of HCW with coordination with administrative , medical directors and the operation of HCEs .
- 2-** Establishing of a simple applicable management system for MBMW in each hospital and poly clinic in Wad Medani town.
- 3-** Establishing of applicable technology for MBMW management in Wad Medani town This suggested to be consists of :

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- a. Institute a technical segregation system for MBMW at each HCE .
 - b. Provision of environmentally sound and cost effective treatment and disposal technical systems for MBMW .
 - c- Provide secure technical collection/handling , transportation and storage processes .
 - e- Development of awareness and protective measures for HCEs staff and the environment.
- 4- Develop an infrastructure for safe treatment and disposal of municipal solid and liquid wastes such as development of sanitary landfill , sewage treatment plant and sanitary incinerators .
- 5- Further studies on calculation of financial resources required to establish efficient applicable technology for MBMW management both at HCEs level and also at Wad Medani town level .
- 6- Update, activate and enforce the laws and regulations concern the MBMW .

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