

Architectural Evaluation of the Process of Disposing Bio-Medical Wastes in Khartoum’s Hospitals

*Tayseer Awad ELKareem Basbeer¹, Alia Taha Ali Taha²

Corresponding Author: TayseerAwadELKareem Basbeer

ABSTRACT

Biomedical waste is a serious problem face Sudanese in hospitals, because of its hazardous effects in the environment and human health (over view of town. Researchers must find technical solution to dispose. The objectives of this study. First to give the definition, categories of bio-medical wastes, Second the status of biomedical waste in hospitals and how hospital disposal the biomedical waste by each category, third this mainly to highlight the effects of biomedical waste in the urban scale. Last regulations and recommendations.

Key word: hospitals, biomedical waste, hazardous, Sudan, Khartoum, environment.

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I. INTRODUCTION

Bio-medical waste means any waste generated during diagnosis, treatment or immunization of human beings or animal .it includes syringes, live vaccines, laboratory samples, body parts, bodily fluids and waste, sharp needles, and lancets. Biomedical waste can be categorized based on the risk of causing injury and/or infection during handling and disposal. Wastes targeted for precautions during handling and disposal include sharps (needles or scalpel blades), pathological wastes (anatomical body parts, microbiology cultures and blood samples) and infectious wastes (items contaminated with body fluids and discharges such as dressing, catheters). Other wastes generated in healthcare settings include radioactive wastes, mercury containing instruments and polyvinyl chloride (PVC) plastics. WHO stated that 80% of hospital wastes are domestic, around 20% are biomedical 95% of them dangerous and 5% dangerous and. And state criteria's hospitals in develop countries the waste generation rate ranges between 2 and 2.5 kg per bed in day.

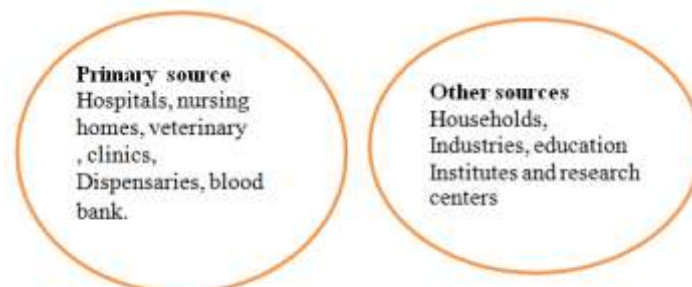
II. PAPER METHODOLOGY

This paper is to evaluate the status of biomedical waste disposing in Sudanese hospitals, for that first it explains and discusses the bio-medical wastes and the methodology\process of disposing bio-medical wastes, before making the evaluation study. The Khartoum city hospitals taking as case study, the methods of data collecting about them are: interviews, and site trips.

III. THE BIO-MEDICAL WASTES

3.1.1 Sources of Bio-Medical Waste:

One such waste is bio-medical waste generated primarily from health care establishments, including hospitals, nursing homes, veterinary hospitals, clinics and general practitioners, dispensaries, blood banks, animal houses and research institutes. The other sources of biomedical wastes are the: Households, Industries, education institutes and research centers, Blood banks and clinical laboratories, The sector generates all the types of waste listed under the bio-medical waste are shown in Figure. The other source of the sector generates all the types of waste listed under the bio-medical waste are shown in Figure (1).



Sources of Bio-Medical Waste

3.1.2 Categories of biomedical wastes and treatment.

Categories of biomedical wastes are given in Table 1.

Category	Source of waste	Treatment and Disposal
1	Human Anatomical Waste (human tissues, organs, body parts)	Incineration /deep burial
2	Animal Waste (animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals, colleges, discharge from hospitals, animal houses)	Incineration /deep burial
3	Microbiology & Biotechnology Waste (wastes from laboratory cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transfer of cultures)	Local autoclaving / microwaving incineration
4	Waste Sharps(needles, syringes, scalpels, blades, glass, etc. that may cause puncture and unused sharps)	Disinfection (chemical treatment /autoclaving/ microwaving and mutilation/ shredding
5	Discarded Medicines & Cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)	Incineration /destruction and drugs disposal in secured landfills
6	Soiled Waste (items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material contaminated with blood	Incineration autoclaving/ Microwaving
7	Solid Waste (wastes generated from disposable items other than waste sharps such as tabbing, catheters, intravenous sets etc.)	Disinfection by chemical treatment autoclaving/ microwaving and mutilation/ shredding”
8	Liquid Waste(waste generated from laboratory and washing, cleaning, housekeeping and disinfecting activities)	Disinfection by chemical treatment and discharge into drains
9	Incineration Ash (ash from incineration of any bio-medical waste)	Disposal in municipal landfill Chemical treatment and discharge into drains for liquids and secured landfill for solids.
10	Chemical Waste (chemicals used in production of biological, chemicals used in disinfection, as insecticides, etc.)	Disposal in municipal landfill Chemical treatment and discharge into drains for liquids and secured landfill for solids.

3. 1.3 Type of container and color-code for collection of bio-medical waste

Type of container and color-code for collection of bio-medical waste Table 2.

Category	Waste class	Type of container	Color
1.	Human anatomical waste	Plastic	Yellow
2.	Animal waste	Plastic	Yellow
3.	Microbiology and Biotechnology waste	Plastic	Yellow/Red
4.	Waste sharp	Plastic bag puncture proof containers	Blue/White Translucent
5.	Discarded medicines and Cytotoxic waste	Plastic bags	Black
6.	Solid (biomedical waste)	Plastic bags	Yellow
7.	Solid (plastic)	Plastic bag puncture proof containers	Blue/White Translucent
8.	Incineration waste	Plastic bag	Black
9.		Plastic bag	Black

(3.2)The methodology\process of disposing bio-medical wastes

3-2-1 sorting (segregation) and packing of the bio-medical wastes

The generator of the bio-medical wastes should segregate them from the non-hazardous wastes ,from the sources of their generation ,and the wastes generator should assumes the direct responsibility of the sorting (segregation)and packing in locations specially assigned to this purpose inside the health establishments and the medical departments as follows :

To collect the infectious bio-medical wastes in plastic bags marked with the yellow colour and labelled with the statement of hazardous bio-medical wastes is very clearly stated and to affix on them the logos of the hazardous bio-medical wastes and in conformity with the specifications.

- To collect the wastes of the sharp equipment in the puncture-resistant and leak-proof safety bins and to label them with the words of sharp wastes, and to put on them the logo of the hazardous wastes.
- To collect the wastes of the liquid chemical materials in thick, tightly shut and leak resistant yellow packages and marked with medicines-chemical wastes –and to be labelled with the logo of the hazardous bio-wastes.

3.2.2. Collection and transportation inside the health establishment.

- The collection and transportation of the medical wastes` bags and containers require the use of trolleys cars designed for this purpose, a trained staff to ensure the maximum degrees of safety during the process of collection and transportation inside the health establishment in order that the contents of the bags and containers will not scatter or leaks .
- Before the transportation of the bags and containers of the bio-medical wastes, they should be tightly shut and to ensure that the label of the data of the wastes is existing therein and marked with the logo of the hazardous bio-wastes.
- The wastes bags should not be filled with more than three quarters of their size, and they should not be pressed or compressed .They should not be pressed to the body, or to be held from the bottom at their carriage, rather they should be held from the upper part during their carriage.
- The wastes transportation cars –trolleys- which are assigned for this purpose ,should be covered and designed in a way which ensure their efficiency at the loading and discharge .They should also be strong and leak-resistant ,in addition to the easiness of their cleaning and disinfection(with disinfectants) .
- The medical wastes which are generated from the departments and rooms of infectious diseases and the isolation rooms and departments should be collected under the direct supervision of the one in charge of the Medical wastes management in the health establishment.
- The human, foetus and placental tissue sand organs should be separately collected and preserved in the morgue refrigerator or in a special refrigerator until they are disposed of through the burial.
- The animals cadavers and tissues should be separately collected and preserved in a refrigerator until they are processed and disposed ofThe trolley cars which are designed for the collection and transportation of the medical wastes should be daily collected and cleaned by a trained staff and supervision of the officer of the medical wastes in the health establishment, in a special site, provided that the residuals of the cleaning should be processed before their discharge or disposal.
- In case of the scatter or leakage of the medical wastes from the bags, containers or the transportation cars, then the scattered or leaked wastes should be considered as extremely hazardous wastes which entail the immediate dealing with them, and to take the disinfection and the safety procedures in the place where the leakage had occurred.
- The non-hazardous health case wastes should be collected in black bags and they should be dealt with in a completely separate manner from the medical wastes in all the stages (packing, collection, and transportation inside the establishment and the storage) for some time until their transportation to the places of final disposal.

3-2-3 the temporal storage inside the health establishment:

To provide a special site for storage inside the health establishment to be a centre for the assembly of the medical wastes.

3-2-4 Transportation of the medical wastes outside the site:

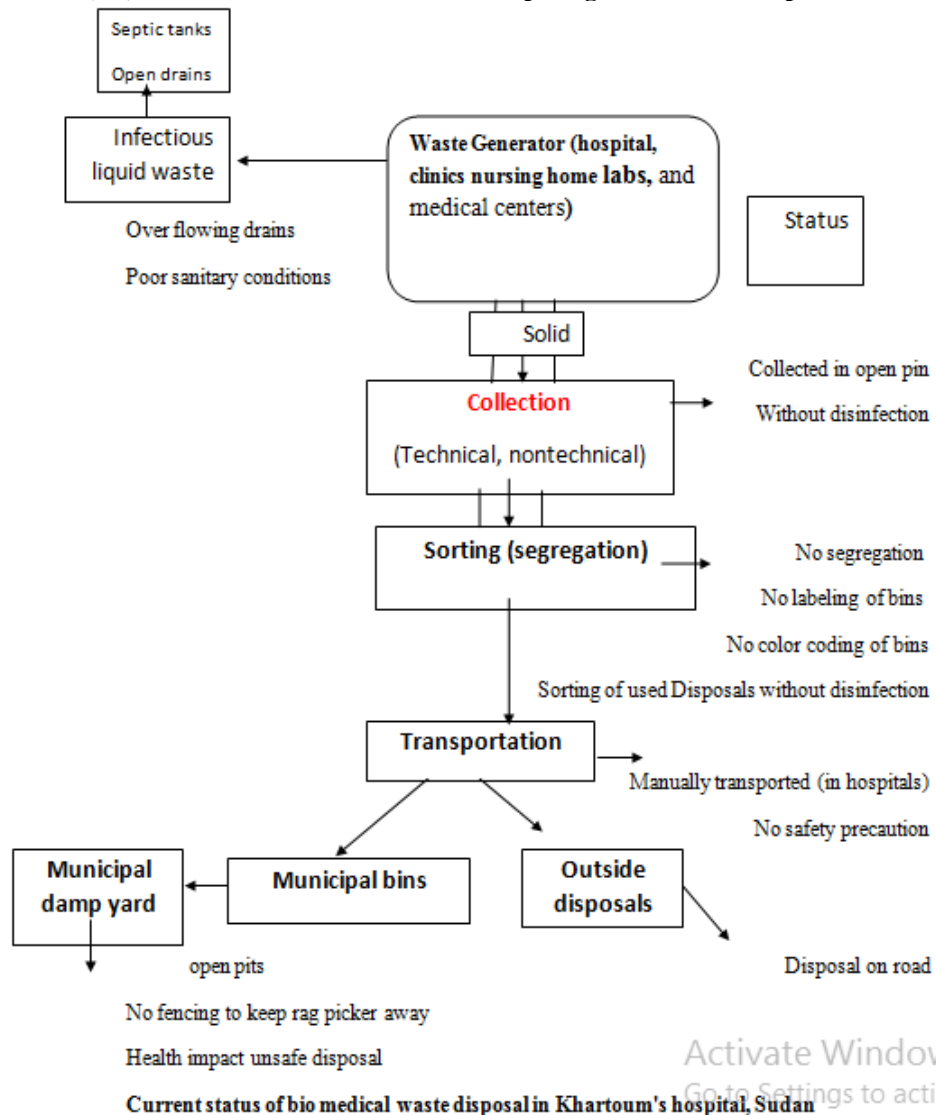
The medical wastes generator should abide with the implementation of the following procedures before loading the wastes outside the establishment:-

- Packing the medical wastes and putting the posters thereon in a proper manner.
- Non-delivery of any consignment of medical wastes except to an authorized person or establishment from the competent authorities for the transportation of the medical wastes.
- Non-delivery of any consignment of medical wastes for transportation outside the establishment without being accompanied with a transportation document.
- Non- delivery of any consignment of medical wastes to a treatment facility which do not possess an authorization from the competent authority.

The standards of the health landfill in the hospitals

- 1- The floors should be from metallic materials and very easy for cleaning and disinfection.
- 2- The walls should be cladding with plastic materials.
- 3- They should be connected with the sewerage of the hospital.
- 4- They should be of good ventilation and lighting, and air- conditioned.
- 5- They should be of tightly shut doors and a door for the wastes car and a door for the use of the hospital

(3.3)The status of biomedical waste disposing in Sudanese hospitals



Amount of wastes as per WHO standards

Table (1)

Amount of waste as per field survey

Table(2)

IV. CONCLUSION

The researcher undertook the study of a number of hospitals (general-teaching) , and she conducted a questionnaire on the officials of the management and the workers and she observed the following :

- 1- The field work (management and workers)
 - a) Lack of the continuous control of the wastes management process, and the complete lack of awareness of the service workers which led to the mixing of the medical wastes with the ordinary wastes.
 - b.The lack of sufficient equipment for protection and safety of the employees.
 - c.The non-use of the red and yellow bags for the medical wastes.

- d. The non-burning of the plates of the bacterial culture in the incinerator because they are manufactured from glass.
 - e. The number of the containers is very few, in such a manner that it is in commensurate with the size of the discarded wastes.
 - f. The sharp medical wastes were put in the safety bins.
 - g. The bad blood is exterminated through the burning in the incinerators, and in some hospitals it is burned inside the hospital.
 - h. Due to the increase of the price of the safety bin, it was substituted by the use of the drip cartoon or the jericans instead of it.
 - I. The wastes bags are transformed from the from the departments to the temporary landfill of the hospital by carrying them on hands by the cleaning workers.
 - j. Lack of rooms for the medical wastes with the required designing standards and specifications.
 - k. Lack of training or periodical vaccination for the workers.
- 2-Non-abidance by putting the sharp tools and needles in the safety bin in some times.

V. RECOMMENDATIONS:

5.1 The field work (management and workers).

The necessity of the creation of the job of the waste management officer in the hospitals and the greater health centres. he shall be responsible and assumes the follow-up of the method of collection, transportation and disposal of the wastes ,where the director of the health facility shall be directly affiliated to him , and he shall have direct contact with the heads of the departments ,the director of the personnel ,the financial department, and the service department ,and he shall directly oversee the female and male workers of cleaning and garbage collection .

The physicians and nurses should lessen as far as possible the use of the needles and syringes so as to reduce the risk of the medical remains.

The necessity of the training of the workers and those in charge of the medical wastes.

To provide the safety bins and the medical wastes bags .

5.2 The Ministry of Health:

- To establish a separate administration for the medical wastes in the Ministry of Health-Khartoum state so as to strengthen the role and prevention of the extent of the risk of the medical wastes.

- To recommend the adoption of the modern and applied environmental managerial methods in a place which suffers from the same environmental problems such as some of the developing states, and the enforcement of the environmental laws in this connection?

- To hold contests between the hospitals concerning the methods of the proper sorting, transportation and disposal of the medical wastes without problems.

- To lay down strict regulations and taking disciplinary procedures against whoever commit a mistake or to cause the subjection of the life of another person to the risk of infection due to the negligence and indifference in the dealing with the medical wastes .

To conduct further studies on the possibility of burial and disposal of the wastes, and the extent of their impact on the environment and the society.

- To conduct a study on the incinerators and their types and locations in Khartoum state, and the extent of their subjection to the safety and environment laws and regulations.

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Amount of wastes as per WHO standards															
Item	Hospital Name	State	Locality	No. of beds	Amount of wastes/bed/kg	Amount of medical wastes		Medical wastes 80% similar to the household wastes		Hazardous Medical wastes 20%		Hazardous medical 95% of the medical		Infectious and hazardous medical 5% of the medical	
						2.00	2.50								
1	Khartoum Teaching Hospital	Khartoum	Khartoum	1,000.00	2.00-2.50	2,000.00	2,500.00	1,600.00	2,000.00	400.00	500.00	380.00	475.00	20.00	25.00
2	Soba Teaching Hospital	Khartoum	Khartoum	403.00		806.00	1007.50	644.80	808.00	161.20	201.50	155.14	191.45	8.06	10.08
3	Bahri Teaching Hospital	Khartoum	Bahri	391.00		782.00	977.50	623.60	782.00	156.40	195.30	148.38	185.75	7.82	9.78
4	Omdurman Teaching Hospital	Khartoum	Omdurman	535.00		1,070.00	1,337.50	856.00	1,070.00	214.14	267.30	203.30	254.13	10.70	13.38
5	Mohamed El-Amin Hamed Hospital for Children, Omdurman	Khartoum	Omdurman	290.00		580.00	725.00	464.00	580.00	118.00	145.00	110.20	137.25	5.80	7.25
6	Obstetric and Midwifery Hospital	Khartoum	Omdurman	300.00		600.00	750.00	480.00	600.00	120.00	150.00	114.00	142.00	6.00	7.50
7	El-Baraka Hospital	Khartoum	Bahri	50.00		100.00	125.00	80.00	100.00	20.00	25.00	19.00	23.75	1.00	1.25
8	Best Care Hospital	Khartoum	Khartoum	82.00		164.00	205.00	131.20	164.00	32.80	41.00	31.16	38.95	1.64	2.05
9	National Center for Radiation Treatment and Nuclear Medicine	Khartoum	Khartoum	100.00		200.00	250.00	160.00	200.00	40.00	50.00	38.00	47.50	2.00	2.50
Total				2969.00		6,302.00	7,817.50	5,041.66	6,320.00	1,260.40	1,575.50	1,197.38	1,496.73	63.02	78.78

Amount of wastes as per WHO standards

Item	Hospital Name	State	Locality	No. of Beds	Amount of Med. Wastes/day/kg	Amount of wastes/bed/kg	Wastes 80% medical similar to household	Medical 20%	Hazardous medical 95% of the medical	Hazardous medical 5% of the medical
1	Khartoum Teaching Hospital	Khartoum	Khartoum	1000	3,000.00	3.00	2,400.00	600.00	570.00	30.00
2	Soba Teaching Hospital	Khartoum	Khartoum	403.00	600.00	1.49	480.00	120.00	114.00	6.00
3	Bahri Teaching Hospital	Khartoum	Bahri	391.00	1,100.00	2.81	880.00	220.00	209.00	11.00
4	Omdurman Teaching Hospital	Khartoum	Omdurman	535.00	1,500.00	2.80	1,200.00	300.00	285.00	15.00
5	Mohamed El-Amin Hamed Hospital for Children Omdurman	Khartoum	Omdurman	290.00	800.00	2.76	640.00	160.00	152.00	8.00
6	Obstetric and Wifery Hospital	Khartoum	Omdurman	300.00	900.00	3.00	720.00	180.00	171.00	9.00
7	El-Baraka Hospital	Khartoum	Bahri	50.00	140.00	2.80	112.00	28.00	26.60	1.40
8	Best Care Hospital	Khartoum	Khartoum	83.00	225.00	2.71	180.00	45.00	42.75	2.25
9	National Center for Radiation Treatment and Nuclear Medicine	Khartoum	Khartoum	100.00	280.00	2.80	224.00	56.00	53.20	2.80
Total				2969.00	8,545.00	24.18	6,836.00	1,709.00	1,623.55	85.45

Amount of waste as per field survey

*Tayseer Awad ELKareem Basbeer " Architectural Evaluation of the Process of Disposing Bio-Medical Wastes in Khartoum's Hospitals." International Journal of Computational Engineering Research (IJCER) 7.8 (2017): 01-06.