Destination of Hospitals Wastes: Design Factors

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ABSTRACT

Wastes -- originating from several activities of human life – are of various types. Among these are Hospital Wastes (HW) that is generated from medical facilities and practices. Wastes accumulation causes negative effects on human health and his environment. Since cities and other forms of human settlements can be considered as a product of human design and planning in conjunction with urban sprawl, pollution, and social and health problems; rational design and planning that can contribute to Hospitals Wastes Management (HWM) may help in improving human conditions and reach a safer environment.

The process of HWM consists of several phases, a) internal circulation of wastes, b) treatment of wastes, and c) destination of wastes. Several factors can be of consideration, among which are architectural design and planning. This paper studies the third phase of HWM process, destination of HW, including design and planning factors of the sites serving as destinations. Destinations of HW in Egypt are addressed, as well.

KEYWORDS:

Architectural Design, Health Care Facilities Design, Wastes Management, Medical Wastes Management, Hazardous Materials and Hazardous Wastes Management, Environmental Control, Medical Wastes Destination, Wastes in Egypt, Medical Wastes in Egypt, Medical Wastes Destination in Egypt.

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INTRODUCTION

Wastes originated from several activities of human life comprise various types, including Hospital Wastes (HW) generated from medical facilities and practices. As a result, accumulation of wastes cause negative effects on human health and his environment. Improvement of everyday life conditions, including the physical environment, social, and economic ones, can help avoid a large proportion of diseases and accidents [WHO, 1999a, WHO, 1999b, ERF, 1988a, Traverse, 1991, Woodside, 1993, and Kelly et al., 1993]. Since cities and other forms of human settlements can be a product of human design and planning in conjunction with urban sprawl, pollution, and social and health problems, rational design and planning contributing to Hospitals Wastes Management (HWM) may help improving human conditions and reaching a safer environment.

The process of HWM contains three phases: internal circulation of wastes, treatment of wastes, and destination of wastes. HWM can be influenced by several factors, among which is architectural design and planning.

This paper may consider the third phase of HWM process, destination of HW, including design and planning considerations of sites serving as destinations. Destinations of HW situation in Egypt may be addressed, as well. However, the first and second phases of HWM process to be of consideration in other papers by Nada, M.S.

1. HOSPITALS WASTES

Hospitals wastes are those resulted from various activities of hospitals including diagnosis, treatment, immunization, and research. As of El-Shiekh [2001], SAIC [2001a], Hasan [2001], Abo El-Ata [2001a], WHO [2000], Prüss et al. [1999a],

wastes resulted from hospitals consists of solid wastes and water wastes, 15% of HW are harmful (10% infectious wastes and 5% non-infectious but harmful). Hospitals classification, sources of HW, and classification of HW are considered below.

1.1 Hospitals Classification

Hospitals can be considered as the main source of health care wastes generation, in respect to quantities and types. Hospitals are divided into two categories as follows:

- General hospitals, which provide a wide range of medical services, accordingly, those hospitals have a variety of wastes sources and types.
- Specialist hospitals, which include hospitals with different branches and specializations, such as pediatric hospitals, etc.

1.2 Sources of Hospital Wastes

HW differs according to hospitals types (education, central, etc.) and according to the amount of wastes produced. HW sources include: [El-Shiekh, 2001]

- In-patient wastes (such as ordinary household wastes, treatment procedures waste, etc.).
- Out-patient clinics (similar to in-patient wards ones).
- Emergency and operation departments (similar to the mentioned previously, besides, body organs and tissues, sharps, etc.).
- Laboratories (dyes, packaging materials, sharps, remains of samples, etc.).
- Pharmacies (pharmaceutical products wastes such as drugs, drug residuals, and therapeutic chemical).
- Dialysis (sharps, ordinary household wastes, etc.).
- Radiology (wastes contaminated with radionuclides generated from therapeutic procedures and others).

- Other sources such as laundry, sterilization department, kitchen, etc.

1.3 Classification of Hospital Wastes

HW have several classifications, among these is the following one:

- General waste (non-infectious and non-harmful one).
- Pathological waste (that is sectioned from a body).
- Radioactive waste (solids, liquids, and gaseous waste contaminated with radionuclides).
- Chemical waste (that is explosive, flammable, toxic, corrosive, irritable, reactive, carcinogenic, etc.).
- Infectious waste (contains pathogenic micro-organisms, such as waste that contain blood and urine).
- Sharps (that can cause both direct pricking and cutting injury, and potentially infectious).
- Pharmaceutical waste (such as expired drugs or contaminated ones).
- Pressurized containers.

2. RISKS OF HOSPITALS WASTES

Several research works have been conducted trying to study the relation between infectious HW and various diseases. According to El-Shiekh [2001], Prüss et al. [1999b], and WHO [2001], there is a close relationship between infectious HW and infectious rates of some diseases such as hepatitis viruses B and C. Particularly, infectious via sharps contaminated with a patient blood. In addition, wastes can be explosive, flammable, and radioactive, which require a safe way for disposal, as unsafe disposal may expose, not only, man to a great risk, but also, air, water and soil.

3. OBJECTIVE OF HOSPITALS WASTES MANAGEMENT

The main objective of following guiding procedures for the safe hospitals wastes management, whether these wastes are hazardous or not, is to reduce the risk of pollution resulted from such wastes. And, to avoid health risks originated from the exposure of hospitals workers to HW. As of Lotfi [2001], Prüss et al. [1999c], and Prüss et al. [1999f], environmental protection for both of hospitals users and surroundings should be provided. This could be achieved via adapting convenient atmosphere for HMM, starting by internal circulation phase (including segregation and transportation of wastes), passing by treatment of wastes, and ending by final disposal of waste.

4. HOSPITALS WASTES CYCLE

Hospitals wastes cycle may be represented according to the following sequence, and as shown in Figure (1): (a) waste generation, (b) waste segregation with the consideration of segregation at source, (c) waste collection using tools of collection such as nurse trolley, shown in Figure (2), and rack, shown in Figure (3); and (d) packaging, (e) internal transportation of wastes (inside the hospital), (f) intermediate storage of wastes (temporary), then, (g) treatment and/or disposal of wastes.

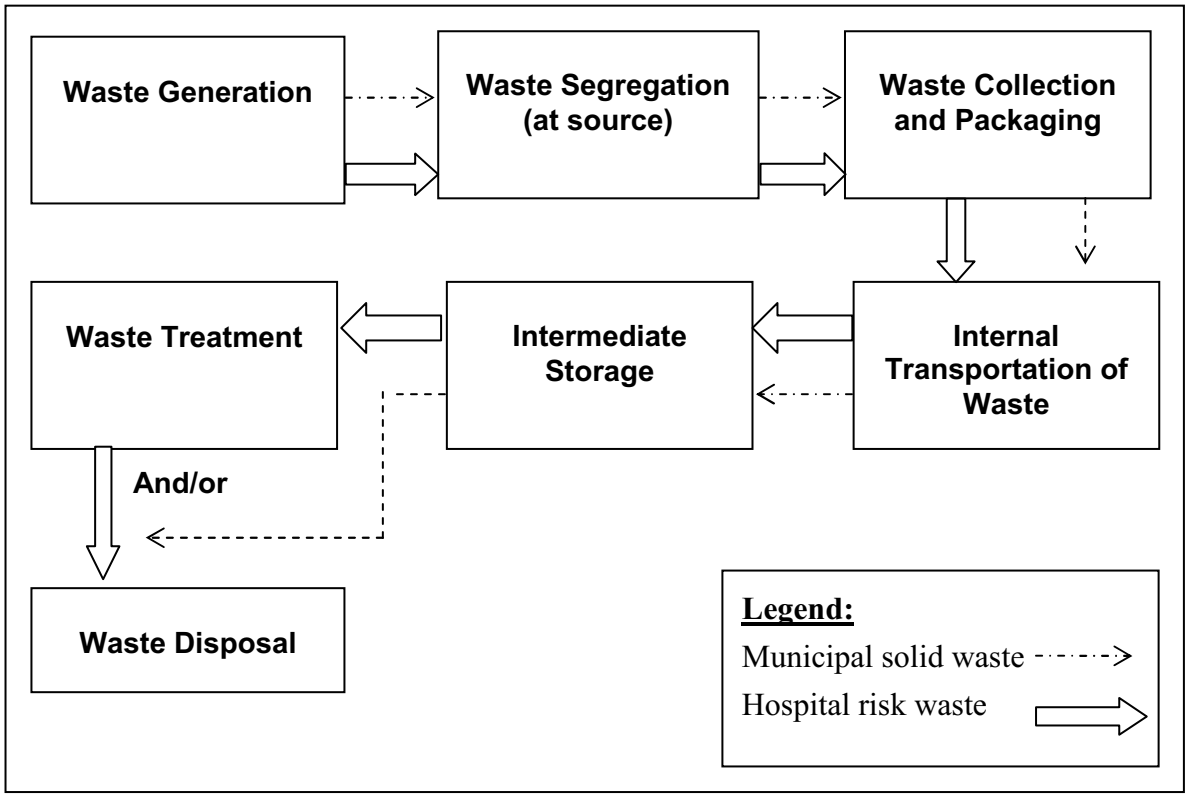

Fig. (1): Hospitals Wastes Cycle

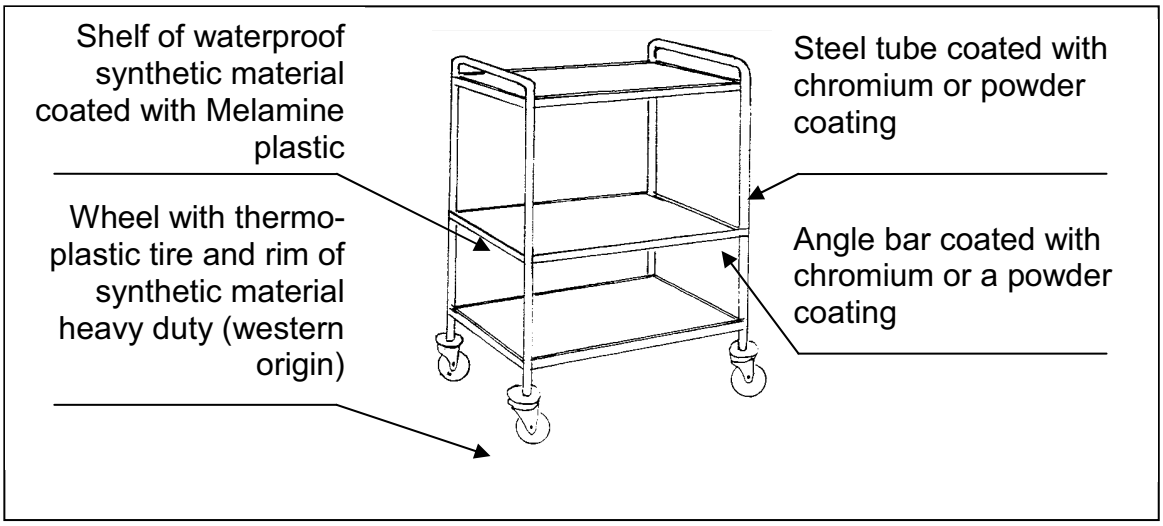

Fig. (2): Nurse Trolley for Waste Collection
[Carl Bro International /a|s, 1996a]

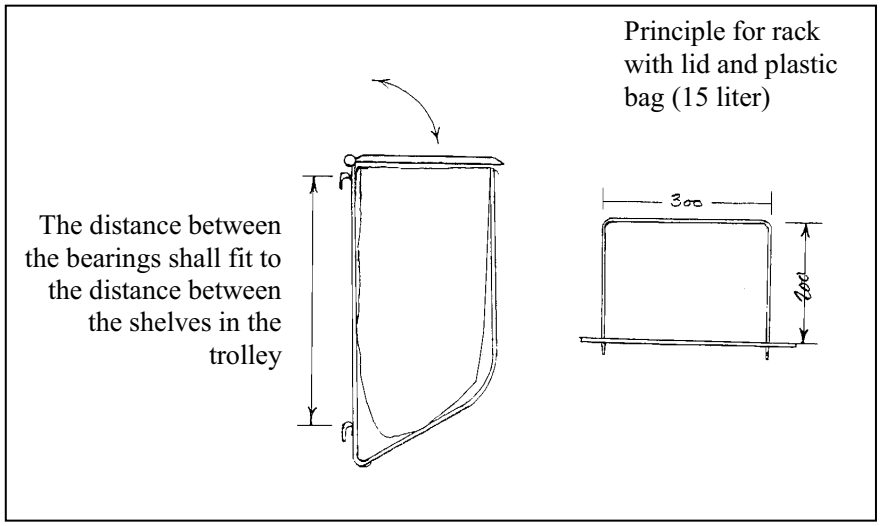

Fig. (3): Rack for Waste Collection [Carl Bro International /a|s, 1996a]

5. DESTINATION OF HOSPITALS WASTES

Solid municipal hospital waste, in addition to, the residues of incineration process should be disposed safely in healthy dump sites. Figure (4) shows one example for a dump site in Pennsylvania, USA. According to Lotfi [2001], Abo El-Ata [2001a], Prüss et al. [1999e], MOHP et al. [2000] and Abo El-Ata [2001b], destination of HW involves several considerations including transportation of waste and healthy destination of waste. The following sections address these considerations, passing by the advantages and disadvantages of direct dumping of HW.


Fig. (4): An Example for a dump site in Pennsylvania, USA [Zero Waste, 2003]

5.1 Transportation of HW Outside of the Facility

HW may be conveyed outside of the hospitals in cases such as: transportation of hazardous HW for treatment outside of the hospital, if this hospital (where the waste is generated) does not house a suitable mechanism for treatment; transportation of waste incineration residues and other remains of waste treatment; and/or transportation of solid municipal waste.

Moreover, HW reach the collection station, finally, where it is transported to either treatment facilities in other health care institutions (or treatment facility outside of the hospital zone), or final disposal of waste sites, which are preferred to the designed is such a way to receive hazardous HW and chemical waste.

Residues of waste incineration and solid municipal waste can, also, be disposed in an ordinary dump site designed for ordinary waste (including municipal waste) disposal. While, hospitals in remote areas or away from waste treatment facilities and waste disposal sites, should provide the suitable treatment mechanism, internally. In such a case, necessary precautions and procedures for a convenient and a safe, occupationally and environmentally, should be followed, similarly, for a safe disposal of waste.

5.2 Healthy Destination for Hospital Wastes

The process of disposal of waste containing organic substances may result in digestion of micro-organisms, in presence or absence of air, due to the availability of the organic substance and liquids within waste. This digestion process occurs over months and years depending on temperature and availability of air and water. Bad smells can spread out of untreated waste disposal. Besides, its health and safety negative impacts, because of the possible risk of infectious diseases that can affect dump site workers and people dealing with waste. In addition, infectious

waste remains a source of a great risk for long periods, as different types of bacteria, viruses, and micro-organisms have the ability to stand destruction, especially, if the dump site is poorly designed and/or incorrectly operated.
Consequently, direct dumping for hazardous HW is not recommended, generally. So, it is preferred to go with direct dumping in special, temporarily, and exceptional cases, and with care. Hazardous HW dumping, whether treated or not, may consider the precautions addressed later in this paper. HW that is previously, pressed or treated with sterilization can be disposed the same way as municipal waste.

5.3 Advantages and Disadvantages of Direct Dumping of Hospital Wastes

Flexible capacity of sites and sites construction and operation phases do not need high costs are two main advantages of direct dumping of HW. While, the disadvantages include: the risk of spread of infection, waste disinfection is not available, waste volume is not reduced, and needs proper operation with daily covering of waste and prohibiting open incineration of waste in the site.

6. SITUATION OF HOSPITAL WASTES DESTINATION IN EGYPT

One may recognize many negatives while considering the situation of HW destination in Egypt. These negatives resulted from the absence of correct concepts and proper systems, for the know how of waste handling and disposal, as workers and authorized personnel dealing with waste are, insufficiently, aware of these concepts and systems. This can be observed in several hospitals, as waste is collected in inconvenient containers and inconvenient spaces, besides, waste transportation is conducted manually and incorrectly.

In addition, there is no clear and precise administrative and financial framework for waste disposal. And, waste, with its various types and origins, is handled without differentiation or segregation. While, waste disposal is an important issue that need cooperation of many institutions and agencies to put it in a proper situation, which may be suitable for the economic and health conditions in Egypt.

Moreover, in Egypt, as hazardous HW is classified among hazardous waste, needed regulations and procedures for transportation of hazardous waste should be followed while dealing with hazardous HW.

7. SUGGESTED PLAN FOR HOSPITALS WASTES MANAGEMENT IN EGYPT

Despite the difficulties facing a proper conduct of HWM, rational planning may help overcome these difficulties. According to Hussein [2001] and Abo El-Ata [2001b], the Ministry of Health in Egypt has conducted several plans, programs, and activities for safe HWM. A proposed plan for HWM in Egypt may be considered in this section. The plan aims to establish sustainable HWM covering the hospitals all over Egypt with the segregation of HW from ordinary municipal waste, and establishing techniques for treatment and final disposal of waste. This can be achieved within the plan framework that consider establishing environmentally and economically sustainable HWM, which cover various facilities in Egypt.

The plan tries to: work on prohibiting random waste disposal and open incineration of HW, and replacing it by treatment techniques safe, on the environment and human health; limit health risks resulted from unsafe disposal of HW, whether occupational health risks or health risks on inhabitants of the surroundings; work on developing existing waste incineration systems to function properly; encourage establishing plants and networks for central treatment outside residential areas;

work on increasing national awareness and developing capabilities of workers in HWM filed; encourage institutions participate in establishing systems for waste management on the scale of districts, which can solve problems of waste disposal for small institutions; and support the private sector contribute in activities of waste transportation and treatment.

This plan can be divided into several phase, with respect to a short term phase the following may be considered: establishing systems for waste handling and segregation inside hospitals, training workers to deal properly with waste, and providing the needed equipment and tools; repairing, mentioning, and developing existing treatment systems, establishing networks of institutions so as those do not have in house treatment facilities can benefit from others having these facilities; cooperation of local units to prepare plans for governorates, bill of quantities for the private sector, etc. for HW only or within a framework with ordinary solid municipal waste; cooperation of local units and the Egyptian Environmental Affairs Agency (EEAA) to select the convenient sites for central treatment and safe disposal; institutional and manpower development to comply with HWM system on its different levels; and waste can be treated with any environmentally complying system that is approved by concerned authorities.

The medium term phase may focus on more costly and time consuming activities, such as: further decentralization of responsibilities; providing more treatment facilities; and adjust existing legislation. While the long term phase can focus on following up activities and fill in gaps activities, in case other phases have been successful, such as: making sure that the guidelines and standards are followed; and more treatment facilities are functioning properly.

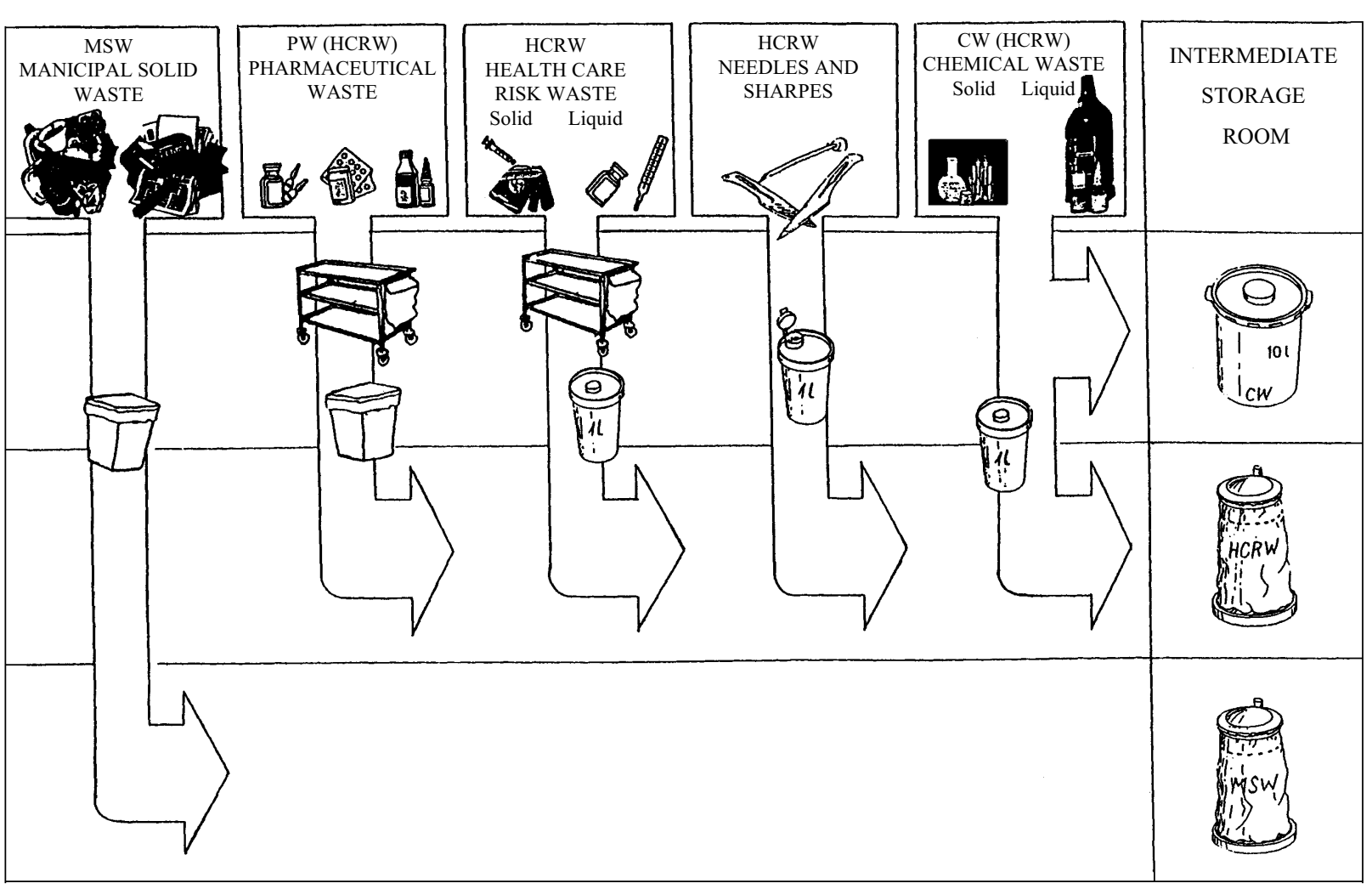

Fig. (5): Health Care Waste [Carl Bro International /a|s, 1996b]

8. PROPOSED GUIDELINES FOR HOSPITAL WASTE DESTINATION

HW destination is preceded by several phases, starting by waste collection in suitable containers with plastic bags, having colors specific for different waste types (black for non-hazardous and red for hazardous waste), waste transportation to collection stations with suitable location and area, then final disposal. According to Hasan [2001], Prüss et al. [1999d], SAIC [2001b], MOHP et al. [2000] and ERF [1999b], HW final destination (at the end of HWM process) depends on the segregation done in the hospital departments as some are recycled and others go directly to incineration, while most of waste disposed similar to that of the ordinary way. This final destination phase is considered in this section with respect to the guidelines and precautions, which are proposed for HW destination.

8.1 Hospital Wastes Prevention, Reuse, and Recycling

Handling HW problem may be via people, who create HW, realization to their daily routine, item by item, and deciding their actual needs and why they use one product instead of another. Moreover, waste management may be improved by:

- Minimizing red bag locations, to help ensuring that only hazardous waste is discarded into the containers, accordingly, can reductions.
- Collecting hazardous waste including sharps in reusable containers.
- Reducing on-site autoclaving, as minimizing red bag locations and initiating reusable containers may reduce demand for autoclaving and encourage using central autoclaving.
- Increasing control over hazardous waste and low level radioactive waste, e.g. by track purchase, use, and disposal of products with hazardous constituents.
- Developing segregation of materials for recycling, particularly at source.

- Reducing waste generation, by material balance, use of alternatives that can reduce waste production, final disposal of hazardous HW, etc.
- Using alternatives to hazardous materials, such as the use of electronic devices instead of mercury.
- Reusing and recycling of HW, however, it is necessary to study its feasibility in light of its benefit, quantity of waste, and used techniques.
- Reconsidering waste as a potential mean of national income instead of a source of pollution, by reusing, recycling, etc.

8.2 Suggested Precautions for Hazardous Hospital Waste Dumping

As mentioned previously, dumping of hazardous HW treated or not should consider the precautions that can be summarized as follows:

- Direct dumping for HW should be limited and in special cases, such as small amounts generated from small institutions in remote areas and lack the presence of advanced treatment techniques.
- Placing untreated HW in closed bags or containers that can endure degradation factors.
- HW disposal should be in holes, specifically assigned for HW disposal, within dumping site. Figure (6) shows a possible way for lining a dump site.

Fig. (6): A Dump Site Liner [Zero Waste, 2003]

- Avoiding direct contact of humans or animals to HW by:
    - Surrounding the dumping site by a fence and working on spreading waste over increasing areas.
    - Prohibiting waste segregation in the dump site and dealing with the contents of the site.
    - Working on covering the waste layers, directly and immediately after dumping, by layers of sand and dust.
- Working on preventing the ground water from the risk of leachate (fluid from the waste flowing via the soil down to ground water), this can be through selecting the dumping site away from sources of water.
- Working on preventing the waste from the risk of rain, flooding, and strong wind.

CONCLUSION

Accumulation of wastes originated from human life activities, including hospital wastes (HW), may cause negative effects on human health and his environment. As various forms of human settlements such as cities can be a product of human design and planning together with urban sprawl, pollution, and social and health problems, rational design and planning contributing to hospitals wastes management (HWM) can help improving human conditions and environment.

This paper addresses the destination of HW as one of HWM phases, comprising: involved risks of HW as a close relationship between infectious HW and infectious rates of some diseases such as hepatitis viruses B and C can be recognized, HW cycle including waste generation, segregation, transportation, storage, then, treatment and/or disposal, and destination of HW considering transportation of HW

outside of the facility, healthy destination for HW, and direct dumping of HW advantages and disadvantages.

Moreover, this paper considers HW destination in Egypt situation as it involves several negatives results from various factors such as the absence of correct concepts and proper systems. In addition, the paper addresses suggested plan for HWM in Egypt, which aims establishing sustainable HWM covering the hospitals all over Egypt segregating HW from ordinary municipal waste and tries improving HWM situation. This plan can be divided into several phases including a short term phase and a medium term one, which may focus on more costly and time consuming activities. Besides, the paper includes proposed guidelines for HW destination comprising: HW prevention, reuse, and recycling considerations; and suggested precautions for hazardous HW dumping.

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التخلص من مخلفات المستشفيات:
عوامل تصميميه

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ملخص

تضم المخلفات الناتجة من مختلف أنشطة حياة الإنسان أنواع متعددة. وتعد مخلفات المستشفيات المتولدة من المنشآت والممارسات الطبية أهم هذه الأنواع. نتيجة لذلك، فان تراكم المخلفات يؤثر سلبياً على حياة الإنسان وبيئته. وباعتبار المدن والمستعمرات البشرية الأخرى هي نتيجة لتصميمات وتخطيط الإنسان، بالاتحاد مع الزحف العمراني، والتلوث، والمشاكل الاجتماعية والصحية، فإن التصميم والتخطيط الرشيد المساهم في إدارة مخلفات المستشفيات، قد يساعد في تحسين أحوال الإنسان وفي الوصول إلى بيئة أكثر أمناً.

تتكون عملية إدارة مخلفات المستشفيات من مراحل عديدة: أ) الحركة الداخلية للمخلفات، ب) معالجة المخلفات، ج) والتخلص من المخلفات. يعتبر هذا البحث محاولة للتعرض للمرحلة الثالثة من منظومة إدارة مخلفات المستشفيات: وهي التخلص من المخلفات، بما في ذلك العوامل التصميميه والتخطيطية للمواقع التي تختص بدفن المخلفات والتخلص النهائي منها. ذلك بالإضافة إلى التعرض إلى وضع التخلص من مخلفات المستشفيات في مصر.

Arabic Abstract

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