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Management of Medical Waste

by

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1. INTRODUCTION

Many countries in the Eastern Mediterranean Region (EMR) of the World Health Organization (WHO); especially those which are most urbanized and industrialized; have reported a gradual expansion and development of new public and private medical facilities, resulting in the increased production of medical wastes. These wastes are usually high infectious, radio-active, hazardous and require proper management and safer disposal methods. Inadequate storage, collection, treatment and inefficient disposal can give rise to the incidence of diseases such as AIDS and Hepatitis B as well as increased risks of health hazards to personnel handling such wastes.

Eventhough some countries have devised codes of practice and made recommendations for the handling and disposal of hospital and clinical wastes, they tend not to be enforced, resulting in many categories of clinical wastes being disposed of in landfill sites, without any special precautions or safety measures being taken. The purpose of this paper is to: (1) review the medical waste management situation in EMR; (2) present various categories of medical waste; and (3) suggest available medical waste management (handling, storage, transport and disposal) options suitable to EMR situation.

2. AN OVERVIEW OF MEDICAL WASTE MANAGEMENT SITUATION IN EMR COUNTRIES

Review of available data for 11 countries in EMR shows that:

- (a) very few countries have adequate information about the quantities or composition of their medical wastes (MW) (Table 1).
- (b) less than 50% have requirements or availability (Table 2) of:
 - Protective clothings for their personnel, handling such wastes
 - Colour coded bags or their usage
 - Interim waste storage facilities before transporting to disposal facilities
 - Disinfection or autoclave facilities for their disposables
 - Special handling facilities for radiological or radioactive waste
 - Special hazardous waste storage cans
 - Trained personnel or training programmes dealing with handling and management of medical and hazardous wastes, infection control and protection, hospital personnel and protection against medical waste hazards e.g. Hepatitis B, T.B., AIDS, Typhoid.

Table 1

Total Hospitals and Medical Waste Generation
in 11 Countries of the EMR

| Country | Hospital | | | Medical Waste | |
|----------------------------------|----------|-------|------------------------|----------------|----------|
| | Number | Beds | Bed Occupancy rate (%) | kg/occ.bed/day | Tons/day |
| Bahrain | 11 | 1653 | 80 | 3.8 | 5 |
| Iran | - | 89308 | - | 2.71 | 154 |
| Lebanon | 147 | 9271 | - | - | - |
| Oman | - | - | - | - | - |
| Palestinian Occupied Territories | 24 | 2826 | 75 | - | - |
| Pakistan | 791 | 78044 | 85 | - | - |
| Saudi Arabia | - | - | - | 1 | 41 |
| Sudan | 230 | 19556 | 60 | - | 200 |
| Tunisia | 154 | 15316 | - | - | - |
| United Arab Emirates | 44 | 5857 | - | - | 7 |
| Yemen | 74 | - | - | - | - |

Table 2

Medical Waste Collection and Storage Facilities
in the Hospitals in 11 EMR Countries

| Item | Facilities in Number of Countries (11) | | | |
|--|--|----------|------|------|
| | very good | moderate | fair | None |
| Availability and use of Protective Clothing for personnel | 5 | 1 | 1 | 4 |
| Medical Waste Segregation facilities | 1 | - | - | 10 |
| Disinfection or autoclave of disposable materials and cultures before disposal | 4 | - | - | 7 |
| Colour coded bags for waste storage and collection | 5 | - | - | 6 |
| Interim storage facilities before transporting to disposal facility | 2 | - | 1 | 8 |
| Special hazardous waste (radio-active) storage containers | 1 | - | - | 10 |
| Separate waste containers for non-clinical waste | 1 | - | - | 10 |
| Adequately trained personnel or training programmes | 3 | - | 1 | 7 |

(c) In terms of transportation and disposal facilities (Table 3):

- About 10% have special transport vehicles or adequate incineration facilities or proper regulations, standards or guidelines
- Majority are still practicing open-dumping or following inadequate landfilling procedures
- Only a small percentage of the countries is seriously considering developing programmes and plans of action dealing with the proper storage, transportation and disposal schemes

In view of the above, the medical waste management situation in EMR is very far from being satisfactory and therefore needs:

- Increased awareness of health hazards associated with contaminated or infectious medical wastes
- Adequate training of personnel and strengthened legislation
- Increased information, experience and data related to categories and sources of wastes
- Identification and adoption of appropriate, suitable, management options considering social, cultural and religious priorities of the EMR countries

3. MEDICAL WASTE CATEGORIES AND SOURCES

Hospitals and medical care centres produce two distinct categories of waste, clinical and non-clinical (general).

3.1 Clinical Waste

Clinical wastes can be classified into the following seven categories (Table 4)

- (1) Pathological waste. Included are all human tissue (whether infected or not) such as limbs, organs, fetuses, blood and other body fluids; animal carcasses and tissue from laboratories, together with all related swabs and dressings.
- (2) Infectious waste. This consists of soiled surgical dressings, swabs and other contaminated waste from treatment areas; material which has been in contact with persons or animals suffering from infectious diseases; cultures and stocks of infectious agents from laboratory work; dialysis equipment, apparatus and disposal gowns, aprons, gloves, towels, etc., from dialysis treatment areas; waste from patients in isolation wards; all other materials such as bed linen, etc., which may contain pathogens in sufficient concentration or quantity that exposure to it could result in disease.

Table 3

Medical Waste Transportation and Disposal Practices in 11 EMR Countries

| Item | Solid Waste disposal facilities in number of countries (11) | | | |
|---|---|-----------|---------------|----------|
| | current | | Underplanning | No plans |
| | Adequate | Not Adeq. | | |
| Open dumping and burning | - | 3 | - | - |
| Special vehicles for transporting waste | 1 | - | 1 | 9 |
| Proper co-disposal of municipal and medical waste | - | 2 | - | 5 |
| Special incineration facilities | 1 | 5 | 1 | 4 |
| Regulations, standards and Guidelines | 1 | 2 | 5 | 3 |
| Programmes for developing proper storage, transportation and disposal schemes | - | - | 2 | 9 |

Table 4: Categories of clinical waste produced by various types of health care service

| Source | Pathological | Radioactive | Chemical | Infection | Sharps | Pharmaceutical | Pressurized containers |
|-----------------------------|--------------|-------------|----------|-----------|--------|----------------|------------------------|
| Patient services medical | X | | X | X | X | X | X |
| Surgical | X | | X | X | X | X | X |
| Operating theatre | X | | X | X | X | X | X |
| Recovery & intensive care | X | | X | X | X | X | X |
| Isolation ward | X | | X | X | X | X | X |
| Dialysis unit | X | | X | X | X | X | |
| Oncology unit | X | | X | X | X | X | |
| Emergency | X | | X | X | X | X | X |
| Outpatient clinic | X | | X | X | X | X | |
| Autopsy room | X | | X | X | X | X | |
| Radiology | X | | X | X | X | X | |
| Laboratories biochemistry | X | X | X | X | X | | |
| Microbiology | X | X | X | X | X | | |
| Haematology | X | X | X | X | X | | |
| Research | X | X | X | X | X | | X |
| Pathology | X | X | X | X | X | | |
| Nuclear Medicine | X | X | X | X | X | | |
| Support services blood bank | X | X | X | X | X | | |
| Pharmacy | X | X | X | | X | | |
| Central sterile supply | | | X | | | X | X |
| Laundry | | | X | | | | |
| Kitchen | | X | | | | | |
| Engineering | | | | | | | X |
| Administration | | | | | | | |
| Public areas | | | X | X | X | | |
| Long term health care est'a | | | | | | X | X |

Source: World Health Organization (1985)

- (3) Sharps. This category includes needles, syringes, scalpels, blades, saws, nails, broken glass and any other items which could cut or puncture.
- (4) Pharmaceutical waste. This includes pharmaceutical products, drugs and chemicals which have been returned from wards, have been spilled or soiled, are out of date or contaminated, or are to be discarded for any reason.
- (5) Chemical waste. Examples are discarded solid, liquid or gaseous chemicals from laboratories or other sources such as diagnostic work, experimental work, cleaning, housekeeping and disinfection procedures. Chemical waste may be divided into two groups, hazardous and non-hazardous:
 - (a) Hazardous wastes can be sub-divided according to their properties, such as:
 - toxic
 - corrosive (acids below pH2 and alkalis above pH 12)
 - highly flammable (flash point below 21°C but below 50°C)
 - reactive (explosive, shock sensitive, water reactive, air reactive)
 - genotoxic (carcinogenic, mutagenic, teratogenic or otherwise capable of altering genetic material) for example, cytotoxic drugs
 - (b) Non-hazardous chemical wastes consist of chemicals other than those described above, such as sugars, amino acids and other organic and inorganic salts.
- (6) Aerosols and pressurized containers. Included are those used for treatment, instruction or demonstration purposes, those containing innocuous or inert gases and other containers which may explode if incinerated or punctured.
- (7) Radioactive wastes. These can be divided into two groups, those which are in "sealed" sources and those in "open" sources:
 - (a) "Sealed" sources are those in which the radioactive isotopes are sealed into the source for use as a component or an instrument isotope cannot be separated from the component and is usually of a much higher level of activity than "open" sources. Sealed sources are used, for example, in brachytherapy but do not routinely give rise to radioactive wastes. They are normally disposed of by returning them to the supplier for special handling procedures.
 - (b) "Open" sources are those in which the isotope itself is used, for example in vitro analysis of body tissue and fluid. Wastes generated by this type of treatment or use can be gaseous, liquid or solid, and are generally of low activity.

3.2 Non-clinical Waste

The non-clinical waste comes from the following sources:

- (1) Kitchen and canteen waste. These wastes are produced in the preparation and serving of food, including food packaging, waste and surplus food, cleaning materials etc.
- (2) Commercial and clerical waste. Included are office materials and equipment including timber, metal, paper and cardboard, wastewater and laundry waste.
- (3) Used disposable bed pan liners, urine containers, faeces, incontinence pads and stoma bags.
- (4) Noninfectious animal bedding
- (5) Other substances that do not pose a special handling problem or hazard to human health or the environment.

3.3 Waste Composition

The overall composition of clinical wastes is infinitely variable. Most volumes of clinical wastes will comprise some proportion of general wastes including unused disposable medical items, wrapping and other packaging materials and other items arising in clinical, laboratory, research or veterinary premises. Irrespective of the exact composition and proportions of individual items within clinical wastes, the inevitable wide variation in composition does not infer any decreased risk associated with its handling and ultimate disposal. Cross-contamination between items within clinical waste containers may freely occur thus rendering all items present potentially hazardous, irrespective of their seemingly innocuous nature.

4. HEALTH RISKS AND HAZARDS ASSOCIATED WITH MEDICAL WASTES

4.1 Inside the Medical Facilities

Personnel working in the clinics, wards and inside the medical facilities are exposed to some of the following risks:

- Personnel handling waste that contains blood-soaked objects from patients in dialysis units must be protected against the transmission of hepatitis B. Special arrangements are necessary for the isolation, separation, collection and disposal of this waste. In the case of patients whose diagnostic status is unclear, it would be appropriate to deal with waste in the same manner.
- Custodial personnel, maintenance staff and porters could be at risk from sharps in waste that contains syringes and needles, if these have not been kept separate and safely packaged for disposal.

- Personnel involved in the final disposal or incineration of waste may be exposed to risk from pathological waste that has not been kept sufficiently cool, especially if the wrapping or storage sacks are punctured or torn.
- Pharmacy personnel may be at risk from respiratory or dermal exposure to aerosols contaminated with pharmaceuticals or solvents.
- Custodial personnel could be exposed to risk on any premises where leaks or obstructions in drains result in the escape of gases or hazardous solvents that may be inhaled. Exposure to H₂S escaping from blocked sewers is a well known hazard.
- Personnel working in or visiting laboratories and rooms in clinical laboratories where pathogenic microorganisms, infectious agents or pathological materials are examined, handled or stored could be at great risk from wastes which may be generated there.

4.2 Outside the Medical Facility

In addition to health risk to patients and personnel, there is substantial impact of medical waste on the human health and the environment (risks of pollution of air, water and soil) outside the medical health care centres. Few examples are listed below:

- To safeguard against water pollution due to:
 - * on-site wastewater treatment
 - * sludge generation and management
 - * smell, odor and H₂S
- To safeguard against chemicals used for water and wastewater treatment
- Minimization of impacts of disinfectants and air sprays
- Minimization of emissions from incinerators

5. MEDICAL WASTE MANAGEMENT IN EMR COUNTRIES

An appropriate and integrated scheme for clinical wastes should consist of the following steps:

- Handling and segregation
- Storage
- Pre-Treatment
- Transport
- Disposal

5.1 Handling and Segregation

The waste from various wards and clinics should be segregated and transferred to appropriately marked or coded containers (Table 5) of suitable strength and durability in safe and convenient locations at the source of generation. A standard system of marking or identification of containers for different categories or waste should be adopted on a nationwide basis. The personnel handling such wastes must be wearing protective clothings such as gloves, overalls, masks, goggles and visors, if necessary.

5.2 Storage

Temperature and humidity seriously affect the bacterial growth and increasing risk of infection. Large hospitals and private clinics in some EMR countries have adequate air conditioning and humidity control facilities, thus minimizing adverse conditions and impacts on the degradation of the stored medical waste.

Several steps and procedures for storing wastes within medical facilities are presented below.

1. Soiled surgical dressings, swabs and other contaminated wastes from treatment areas should be placed in a suitable clinical waste storage bag (Table 5) or bin with suitable plastic liner bag at the point of generation.

Liner bags should be removed at least daily or when three quarters full. They should be securely fastened with adhesive plastic tape before removal and then deposited in a clinical waste storage bag. This bag should also be securely fastened with adhesive plastic tape when it is three quarters full or prior to daily collection. Contents should not be transferred loose from bag to bag.

2. All human tissue, limbs, placenta, etc. should be placed in a clinical waste bag and bin, where appropriate and disposed of by incineration, under supervision. On no account must human tissue be mixed with other waste for collection.
3. Syringes, needles and cartridges should be discarded intact, and should be placed in a suitable "sharps" container which, when full (or at maximum intervals not exceeding one week), should be sealed and placed into a clinical waste bag for storage prior to removal and disposal by incineration.
4. Surplus unused or partially used medicinal products should normally be returned to a responsible person at a hospital pharmacy.
5. Infected or contaminated laboratory animals carcasses should be incinerated. If an incinerator is not available, small carcasses should be wrapped in an expendable waterproof bag, closed with adhesive plastic tape, double wrapped in a clinical waste bag, placed in a suitable robust and leakproof container and taken to a point designated by the disposal authority.
6. Clinical waste which require incineration should be stored in readily identifiable containers (consistent with the recommended colour code).

Table 5

Recommended U.K. Colour Coding for Containers for Clinical Waste

| Colour of Bag | Type of Waste |
|--|---|
| Black | Normal household waste (not to be used to store or transport clinical waste) |
| Yellow | All waste destined for incineration |
| Yellow with a black band | Waste (e.g. home nursing waste) which preferably should be disposed of by incineration but may be disposed of by landfill when separate collection and disposal arrangements are made |
| Light blue or transparent with light blue inscriptions | Waste for autoclaving (or equivalent treatment) before ultimate disposal |

Note: The following colours are used widely in the U.K. National Health Service for linen containers:

Red (or white with red band) - for foul or infected linen
White (or clear plastic) - soiled lined

7. Clinical waste which require autoclaving (or equivalent treatment) before ultimate disposal should be stored in readily identified containers.
8. Radioactive waste should be properly labelled and can be stored to allow decay.

Pressurized containers such as aerosol cans must not be placed in waste disposal bags destined for incineration, but should be stored separately in containers which are marked with the words:

"Do not incinerate"
"Do not puncture"
"Keep out of direct sunlight"

5.3 Pre-Treatment

The medical waste should be segregated at source into the following categories:

- Non-hazardous chemical waste

- * Recyclable
- * Non-recyclable
- * Disposable

- Hazardous chemical waste

- * Recovery and reuse
- * Combustible waste
- * Reactive waste

Chemical treatment is usually regarded as a preliminary step prior to the final disposal.

Sterilization is required for certain categories of medical waste prior to disposal. Various methods utilized are as follows:

- Steam sterilization
- Microwave sterilization
- Thermal inactivation
- Gas-vapour sterilization
- Chemical disinfection
- Irradiation

5.4 Transport

The medical waste, transported in trolleys and carts, requires care in minimizing impact on the health and safety of staff, patients, visitors, waste disposal operatives and community at large. Wherever possible, special vehicles and containers should be used for the transport of infectious and pathological materials, so that it presents no danger to public. The waste should be collected and transported as frequently as possible during the day, at least twice/day.

5.5 Disposal

5.5.1 Incineration

Rotary Kiln incinerators have been quite successfully used for the incineration of clinical wastes, achieving good burn out characteristics, giving an ash which is sterile and virtually free of unburn and carbon. However improperly run and operated incinerators can result in significant air emissions thus violating air quality regulations.

Incineration may be appropriate for the following medical waste items:

- Human tissue, limbs, placentae, infected carcasses and dialysis wastes
- Sharps (except mercury-bearing wastes)
- All pathology wastes
- Small amounts of drugs, medicines and injectables
- Soiled surgical dressings, swabs and other contaminated wastes

5.5.2 Landfill

Due to the high cost of incineration and air pollution problems, there is a growing tendency for medical waste, especially non-clinical, to be disposed of by landfill. The following wastes are, usually, considered suitable for landfill disposal:

- Soiled surgical dressings, swabs and other contaminated wastes from treatment areas
- Properly packaged discarded syringes, needles, cartridges, and other sharp instruments
- Some pharmaceutical and chemical wastes provided they are compatible with the landfill environment
- Animal carcasses that have not been used in research
- Involving infectious materials
- Used but emptied disposable bedpan liners, urine-containers, stoma bags and used incontinence pads unless from high-risk areas
- Wastes derived from the surgeries of medical practitioners, dental surgeons and veterinary surgeons, and
- Wastes arising from home care patients except from high risk cases

Landfilling of medical wastes does not necessarily represent an inexpensive disposal option compared to on-site disposal because the costs of collecting and transporting these wastes to the landfill site must be taken into account.

5.5.3 Discharge to Sewers

The medical waste suitable for discharge directly to the sewer usually includes used bedpan liners, urine containers and stoma bags. However, caution must be exercised over disposal to sewer if the sewers are old or known to be fractured, since infectious material may leak from the sewer pipes and contaminate groundwater and/or surface water. This method should not be employed if the sewerage system is not connected to a sewage treatment works capable of rendering the infectious material harmless.

5.5.4 Radio-Active Waste Disposal

The radio-active wastes can be in the form of solid, liquid and gaseous forms. The main approaches to radio-active waste disposal are: (a) concentration and storage; (b) dilution and dispersal; and (c) incineration.

- (a) Concentration and storage is used principally for solid waste. The waste is compacted and retained at a permanent storage or burial site. This method of disposal is unnecessary for most health care establishments.
- (b) Dilution and dispersal is usually applied to liquid and gaseous waste. The waste can be diluted through discharge into the sewer system. Gaseous waste can likewise be diluted through dispersal in the atmosphere in a normally uninhabited area.
- (c) Incineration is a special application of both of these general methods. The ashes represent the concentration and the air effluent the dispersal.

By far the most widely used method for solid waste disposal is storage pending decay, followed by disposal in ordinary waste system. For example plastic bag stored in a large can or drum for a period one or two months will lose its radio-activity.

6. REFERENCES

- Managing Medical Wastes in Developing Countries: Report of a Consultation on Medical Wastes Management in Developing Countries, WHO, Geneva, September 1992, WHO/PEP/RUD/94.1, World Health Organization, Geneva, 1994.
- Health Care Waste Management Handbook - by T. Hall, Senior Associate, Environmental Technology Consultants Ltd., U.K., 1994.
- WHO/Eastern Mediterranean Region (EMR) Country Reports presented at the "UNEP/WHO Regional Workshop on Medical Waste Management in West Asia and EMR" Sharjah, U.A.E., March, 1994.