Management of solid waste in two hospitals in Baghdad-Iraq

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Abstract. This study was conducted to examine medical waste management practices in two governmental hospitals in Baghdad, which disposed of its medical waste by incineration. Simple observational, cross-sectional study was conducted as a case study approach of Baghdad Educational Hospital and Sheikh Zayed General Hospital, for the period from 28 Oct. 2018 to 5 May 2019. The data were collected through a pre-designed questionnaire with a checklist. The study showed that segregation of the medical waste into hazardous and nonhazardous waste was done in both the hospitals. For nonhazardous waste, disposal through Municipal Corporation was conducted, while all other kind of medical wastes were burnt. Hospital waste segregation, collection, transportation & disposal practices were not in accordance with standard guidelines of the developed countries. A majority of medical solid waste in both the hospitals under study was mismanaged. The workers handling the transport, segregation, and disposal of waste were provided with gloves and masks along with other special equipment like leg protectors, boots and aprons. No color coded practices were observed in both hospitals. The janitors and sanitary staff were immunized against common communicable diseases. Our recommendation for further studies is to find alternatives and appropriate technologies for disposal of medical solid waste in Baghdad hospitals.

Key word
Infectious waste, medical waste, incinerators, solid waste incineration

1. Introduction
Medical waste is a special group of waste because it creates possible environment hazards, typically including many infectious materials as sharps, human tissues or carcasses and other infectious materials [1]. World Health Organization states that "85% of hospital wastes are actually non-hazardous, whereas 10% are infections and 5% are non-infectious but they are included in hazardous wastes". This variety is reliant on the whole amount of waste produced [2]. Despite the fact that medical waste management differs from one hospital to another; the challenges are alike for all healthcare units and at all steps of management, including segregation, collection, and storage, transport, treatment and disposal [1]. The aim of our study is to examine medical waste management practices in two governmental hospitals in Baghdad (Baghdad Educational Hospital and Sheikh Zayed General Hospital), which dispose its medical waste by incineration.

2. Research Methodology
The present study relied on the conventional method in conducting scientific research, which includes:
A. Review of the references related to the subject of research in two ways:
i. The use the available literature of interest in scientific libraries.
ii. The use of technological information and information survey with the help of the information network to obtain the recent research and related articles (approved sites).

B. Field investigation through observation to apply the legislation (local or international regulation) regarding the problem of research concerning medical waste at the site of the study (Baghdad Educational Hospital and Sheikh Zayed General Hospital) during field visits.

C. Using the various methods of communication used in verification and access to results in two ways:
   i. Direct personal connects with the administrators of the environmental management system at the site of the study in each hospital.
   ii. Field visits to the site for the study of the on-site treatment and disposal of medical waste by incinerator unit.

D. Discuss the scientific results and its relationship to the integrated environmental management system.

3. Period of Research
The project started on 28 Oct. 2018 and ended on 5 May 2019.

4. Data Collection Tool
Structured questionnaire with check list and photos were used as a tool to collect the data.

5. Study Location
The research was carried out to examine medical waste management and focused on incineration practice as treatment and disposal method in two hospitals:

   A. Baghdad Educational Hospital
It is one of the seven largest hospitals belonging to the Directorate of Medicine City (Madenet AL-Tib) in Baghdad. It is a government hospital. The hospital provides diagnostic, therapeutic, medical, surgical and educational services in various branches of medicine. It has a capacity of 1000 beds. Its staff includes (189) specialist doctors in all branches and (302) post graduate physicians. The solid medical waste is collected for the purpose of incinerating from 7 hospitals and 11 specialized centers in addition to the Higher Institute of Occupational Health and Nursing School [3].

   B. Sheikh Zayed General Hospital
Formerly known as Al-Haidari Hospital, it was renamed the Olympic Hospital where it was associated with the Iraqi Olympic Committee. In 2003, the hospital was disengaged from the Olympic Committee and linked to the Ministry of Health and changed its name from the Olympic Hospital to Sheikh Zayed Hospital because of the UAE government's support for the development of the hospital. Currently the hospital specializes in the surgery of neural tumors. It is a government hospital belonging to Rusafa Health Directorate, with a capacity of 1000 beds. Its staff includes 28 physician of Orthopedic Surgeons, 17 Ophthalmologists, 26 Cardiologists, 55 radiologist and sonar, 67 dermatologist and surgeons. The solid medical waste is collected for the purpose of incinerating from all the departments of the hospital [3].

6. Results
The real situation of the solid medical waste management was compared with international standards for both hospitals under study, Baghdad Educational Hospital (BEH), and Sheikh Zayed General Hospital (SZGH). Table (1) shows the results.
Table 1. Comparison between real situation and international standard of solid waste management at studied hospitals.

| Item | International standards\(^{4}\) | Real Situation |
|------|----------------------------------|----------------|
|      |                                  | BEH            | SZGH           |
| 1    | Minimization (Recycling)         |                |                |
|      | -Product recycling               | -No recycling or composting | -No recycling or composting |
|      | -Sorting principle               | -Available     | - Available    |
|      | -Segregation [Appendix A (Table A-1)] | - colored coding applied only as follow: -yellow for operation and laboratories, while sharp materials and needles by Sharps container -Household refuse, in black bags. | - same as BEH |
| 2    | Collection and storage           |                |                |
|      | - Handling of bags: Bags and containers are two-thirds full and should be locked. - Waste must be collected regularly at least once a day. Containers may be labeled - Must be collected and stocked up separately. - The employees must be informed to collect yellow bags and sharps containers. They must wear gloves. - A specific area must be designated for storing medical waste. | - The bags are filled up completely. - Waste is collected daily, but it is unlabeled. - Sorted not as recommended. - The employees are informed and wear gloves. - There are closed areas but not sufficient for all wastes. |
|      |                                  | - The bags are filled up completely. | - Waste is collected daily, but it is unlabeled. - Sorted not as recommended. - The employees are informed and wear gloves. - There are an open area for all wastes. |
| 3    | Transport                        |                |                |
|      | - Means of transportation of waste must be reserved for that purpose. - Manual handling of waste bags should be minimized. | - Not sufficient - Manual handling of waste bags. | - Not available. - Manual handling of waste bags. |
| 4    | Treatment and Disposal of Medical Waste |                |                |
|      | - Shredding (i. The plastic and sharps should be shredded. ii. Needle destroyers used for discarding needles iii. used only for categories No.4 and7). Appendix A (Table A-2) | - Ceased. | - Not available |
|      | - Medical incinerators i. Used for category No. 1,2,5,6. Appendix A (Table A-2) ii. Must be controlled. | | i. Used for all kind of categories even for needles. ii. Applied by chemical method. |
|      |                                  | | i. Used for all kind of categories even for needles. ii. prolonging the chimney of the incinerator. |
The study showed that segregation into risk and non-risk waste was done in both hospitals. For non-risk waste, disposal through Municipal Corporation was conducted, while all other kinds of medical wastes were burnt. Hospital waste segregation, collection, transportation & disposal practices were not in accordance with standard guidelines as that of the developed countries. A majority of the medical solid waste in both the hospitals under study was mismanaged.

The workers handling the transport, segregation, and disposal of waste were provided with gloves and masks with other special equipment like leg protectors, boots and aprons. No color-coded practices were observed in both hospitals. The janitors and sanitary staff were immunized against common communicable diseases.

7. Discussion
The results of the study showed that the management of health waste was not at the required level, despite the process of sorting medical waste, but all the wastes were collected in yellow bags without attention to the international classifications in this regard. This may be due to the fact that the sorting process for hazardous waste is all yellow so all the waste is burned without regard to the classification that prevents the burning of plastic waste, injections and needles. Non-hazardous waste is collected in black bags and collected for disposal as municipal waste.

The results of the study showed that the incinerators at the Baghdad Teaching Hospital are burning all the waste, although the shredders are ceased and the bags are filled without attention to leaving one third of the bags empty. It is noteworthy that plastic bags of light thickness can be punctured by the needles when kept inside them. Although the medical waste is not recommended to be stored for long periods of 72 hours, especially during the summer, but we found piles of waste in open areas, in addition to the closed area next to the incinerator.

Our study also found inaccuracy of the answer by the medical staff responsible for the management of medical waste than what actually exists in the hospital. The incinerators do not provide a comprehensive solution for medical waste, but rather transform the waste into a new type of pollution, such as air and soil pollution. Unless the incinerator is controlled, the process of prolonging the chimney of the incinerator is not a cure for the problem but an export of contaminants to make it spread over long distances. The location of the incinerator, especially in the Sheikh Zayed General Hospital is in the middle of a residential area.

8. Conclusion
Medical solid wastes may be posing a major impact on human health and environment. In Baghdad, the practice of appropriate medical solid waste management is inadequate and there is not enough information on medical waste management technologies and impacts.

Hospital waste segregation, collection, transportation & disposal practices were not in accordance with standard guidelines as that of developed countries. A majority of the medical solid waste in both the hospitals under study was mismanaged.

9. Recommendations
Some recommendations are as follows:
   i. Find alternatives and appropriate technologies for disposal of medical solid waste in Baghdad hospitals.
   ii. We need more information on the level of awareness of health care workers about the risks they face by dealing with medical waste.
iii. Careful assessment of training programs in neighboring countries and how they can be implemented in Baghdad.

References
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Appendix (A)

Table (A-1): Coding Recommendations\(^{(4)}\).

| Color coding | Type of container | Waste categories |
|--------------|-------------------|------------------|
| Yellow       | Plastic bags      | Cat 1 Human anatomical waste  
Cat 2 Animal Waste  
Cat 3 Microbiological Waste  
Cat 9 Solid Waste |
| Red          | Disinfected container plastic bags | Cat 3 Microbiological Waste  
Cat 6 Soiled Dressing |
| Blue/white   | Plastic bags, puncture proof containers | Cat 4 Waste sharp  
Cat 7 Plastic disposable |
| Black        | Do                | Cat 5 Discarded medicine  
Cat 9 Incineration ash  
Cat 10 Chemical Waste |

Table (A-2): Categories of Medical Waste\(^{(4)}\).

| Option       | Waste Category                                                                                                                                                                                                 | Treatment and Disposal                                           |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Category No. 1 | Human Anatomical Waste (human tissues, organs, body parts)                                                                                                                                                    | Incineration/deep burial                                        |
| Category No. 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                                        |
| Category No. 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 infectious agents from research and industrial laboratories, wastes from production toxins, dishes and devices used for transfer of cultures) | Local autoclaving/microwave/incineration                         |
| Category No. 4 | Waste sharps (needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)                                                                  | Disinfection (chemical treatment / autoclaving / microwaving and mutilation/shredding) |
| Category No. 5 | Discarded Medicines and Cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)                                                                                               | Incineration/destruction and drugs disposal in secured landfills |
| Category No. 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                            |
| Category No. 7 | Solid Waste (wastes generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets etc)                                                                            | Disinfection by chemical treatment/autoclaving/microwaving and mutilation/shredding |
| Category No. 8 | Liquid Waste (waste generated from laboratory and washing, cleaning, housekeeping and disinfecting activities)                                                                                             | Disinfection by chemical treatment and discharge into drains    |
| Category No. 9 | Incineration Ash (ash from incineration of any medical waste)                                                                                                                                              | Disposal in municipal landfill                                  |
| Category No.10 | Chemical Waste (chemicals used in production of biological, chemicals used in disinfection, as insecticides, etc.)                                                                                          | Chemical discharge into drains for liquids and secured landfill for solids |
# Appendix (B)

| Photo (B-1) | Photo (B-2) | Photo (B-3) |
|-------------|-------------|-------------|
| Gabage bags are stacked inside the closed area next to incinerator. | A pile of yellow bags filled with solid medical waste is stacked abroad in vicinity of the incineration. | Incineration of solid medical waste. |

Baghdad Educational Hospital