

EVALUATION OF ENVIRONMENTAL AND HEALTH RISKS RELATED WITH THE MANAGEMENT OF MEDICAL WASTE IN AL NAJAF CITY

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Abstract

Healthcare activities naturally lead to by-products, such as hazardous waste materials. These waste materials comprise various materials, such as used needles, syringes, solid dressing, body parts, diagnostic samples, blood chemicals, pharmaceuticals and so on. When these infectious waste materials are exposed to the public, serious health problems may arise, especially for those collecting waste, hospital patients as well as healthcare workers. Ineffective disposal of such waste could also harm the environment, an example of which is poorly designed incinerators which could potentially generate much hazardous pollutants. The present study investigates the potential risks arising from medical waste management in the city of Al Najaf, Iraq. Two medical institutions (one public and the other private) have been analysed in the study. The management of medical waste by the institution authorities have been observed, with the findings demonstrating that both manage medical waste in different ways. There was simply not enough data regarding medical waste management technology, along with its impact on public health and environment. Furthermore, the toxicity associated with medical waste in cases of mishandling could lead to degradation of the environment. Moreover, there was a lack of waste burning by incinerators in Al-Sader hospital as well as wastes produced by other private hospitals. Mishandling and disposal of medical waste in the hospitals studied may lead to environmental hazards. Lastly, the author has recommended practices to enhance suitable management of medical waste to the two medical institutions studied.

Keywords: Environment, Hazardous waste, Medical waste.

1. Introduction

Hazardous waste (HW) is generated by various medical facilities, such as hospitals, veterinary facilities and dental offices. In order to spread infection, waste must possess pathogenic agents in large enough quantities to lead to infection. A vulnerable individual host must make contact with the infectious agent. Furthermore, there must exist a portal of entry through which a sufficient number of organisms must be deposited to infect the host. Solid waste arising from diagnosis, treatment, and clinical as well as pharmaceutical studies are referred to as clinical waste [1].

Medical waste (MW) is unique, in relation to other waste types, due to its great potential to infect and cause injury to hosts. Mishandling disposal actions in health care establishments, may perhaps lead to risks posed for persons as well as the ecosystem due to the highly hazardous and infectious nature of such waste [2]. Various studies have attempted to contrast and categorize the hazards posed by hospital wastes on both groundwater and surface water resources. The effects of hospital waste dumpsite were also investigated with regards to water quality of chosen boreholes near hospitals [3]. Generally, waste refers to a substance (whether in solid, liquid or gas state) which does not have any immediate utilization and is disposed of permanently. Hazardous waste may exhibit various unwanted traits, such as flammability, reactivity, explosivity, corrosiveness, radioactivity, infection, irritation, sensitization or bio-accumulative [4].

Previously, waste generated at hospitals was gathered with domestic wastes, being hauled to ordinary solid waste dumping sites [5]. Medical waste comprises materials having microbiological cultures, Similar to office and domestic sector, medical process produce other types of waste, such as paper and plastic which do not pose direct hazards to human health. Medical waste which are sharp, such as needles, syringes, scalpels and so on, may even harm human beings non-infectiously [6].

The World Health Organization (WHO) has categorized medical waste in various categories. First, infectious agents comprising pathogens which are found in great concentrations to expose victims to diseases. Wastes in this category range from lab and surgical operations. Second, sharps such as spent needles, glasses, blades, and syringes. Third, pathological wastes such as various parts of body, bloods and fluids of body. Fourth, pharmaceutical wastes from drugs, or any polluted chemicals. Fifth, chemical wastes, which may be a by-product of diagnosis or cleaning materials. Sixth, radioactive waste, which may be contaminated with radioactive substances as a by-product of diagnosis or treatment procedures. Seventh, pressurized containers, such as gas cylinders. Eighth, substances containing a high heavy metal content, such as broken mercury thermometers. Medical waste naturally tend to be infectious, pathological sharp [7].

Health care (HC) is a necessity for sustaining human existence. However, bio-medical waste produced by medical facilities could be hazardous, toxic and lethal, due to their highly hazardous nature in transmitting diseases. Hazardous and toxic waste comprising materials which are radio-active, bio-medical, and infectious effects are highly hazardous if not properly handled and disposed. Such waste should not be mixed with conventional municipal waste [8]. The essential requirement for appropriate hospital waste management is crucial to quality assurance. In spite of major hospitals and healthcare institutions exercising poor

waste management practices and systems, many healthcare institutions even discard medical wastes in municipal garbage sites. Such medical waste, ranging from disposable syringes, catheters, IV sets and tubing and plastics, is sorted manually by rack pickers on a scheduled basis. Open dumping with exposed borders leads to a leak of waste and emissions to the environment, where they are circulated by air, superficially or groundwater flows, damaging the environment. Of particular risk are human beings and animals who come into contact with the medical waste sites. Thus, it stands to reason that such hazardous wastes be managed efficiently to preserve both human health and the environment. Malpractice of waste management is an immediate cause of environmental pollution, unpleasant smells, nurture and dissemination of insects, rodents and other such creatures. These factors may also bolster the spread of disease, such as typhoid, hepatitis, cholera and AIDS, when the individual hosts come into contact with syringes and needles which may be contaminated [9].

Healthcare waste (HCW) may be categorized according to the source, type and risk factors associated with handling, storage and finally disposal. Various studies have investigated the healthcare waste generation from various types of healthcare facilities [10]. Globally, the healthcare sector is advancing at a rapid rate in contrast to other economic sectors. Nevertheless, a fraction of waste generated at such institutions has not involved the same attention as compared with other types of wastes, in particular for developing nations. This occurs in spite of the fact that healthcare wastes are regarded as hazardous waste as they pose serious and direct harm to human health [11]. HCW further poses harm to a nation's economy as well [12].

Institutions produce various types of wastes. Households produce small quantities of waste, compared to hospitals which produce large quantities of waste (more than 100 kg per month or may be more) [13].

Thus, the present study focuses on assessing the potential health risks and environmental issues related with management of the medical waste in Al Najaf city. Healthcare services in Al Najaf city are distributed by governmental hospitals and a private hospital scattered within Iraq. The objectives of the study are to collect data of medical wastes management (MWM) (collection, treatment and disposal practices), as well as to evaluate the real and actual status of medical waste management within the city. Furthermore, it is sought to identify the potential effects that medical waste pose towards human health and the environment. Relevant recommendations will also be made to enhance the medical waste management in Al Najaf City, Iraq.

2. Techniques Used in the Management of Medical Waste (MW)

Various methods have been implemented to reduce hazards of medical waste, detailed in the following sections:

2.1. Separating different categories of medical wastes

MW separation is a technique which sorts through pathological, infectious wastes and sharps found in containers. Such waste containers are categorized and labelled according to water-tightness and biohazard potential for various types of medical waste, sorted by uniform color.

Medical waste segregation and labelling include separation into various categories and numerous coloured bags utilized [14]. To exemplify this practice, infectious medical waste may be disposed by the process of burial landfilling or via incineration. Such wastes are contained in yellow coloured plastic bags. Apart from this, red containers are used to sort wastes treated by microwave or autoclave.

2.2. Segregation

Segregation is another effective method, as it is feasible for preventing mixing among hazardous and non-hazardous wastes. This particular method decreases waste volume and toxicity. Moreover, transportation of such wastes are simplified by the segregation technique. Medical waste segregation varies according to composition, quantity and final disposal method [7].

2.3. Disinfection process

To appropriately decrease toxicity levels of medical waste, disinfection by chemicals are often employed. With regards to solid waste, disinfection is feasible only if waste materials are first shredded. Disinfectants themselves could be hazardous in some scenarios, and is thus not recommended to treat pharmaceutical, chemical and other infectious waste [7].

2.4. Incineration

Burning wastes by incinerators refers to the method of eliminating waste by a high temperatures; this is typically carried out in furnaces. This method burns hazardous materials, thereby decreasing mass and waste volume, converting it into harmless ash. Incineration is a feasible method for wastes containing 60% combustible materials. It is further feasible for pathological and infectious waste as well as sharps [15]. Wastes volume will reduce between 50 to 400 times the original volumes [16]. Incineration poses a significant advantage to decrease waste volume; however it also has limitations, including generation of gases, relative high costs, as well as contaminations hazard. Incinerating of hospital wastes generates more dioxins and toxic gases than regular municipality incinerators [17].

2.5. Disinfection by plasma and emerging technology

Disinfection method is achieved via the Plasma process, which utilizes a plasma generator (using air for combustion) to produce low temperature plasmas. This method reduces the emission of harmful dioxins and NOX. Another benefit of this method is its low energy consumption in comparison to other combustion processes [16]. Novel technology for hazardous medical waste management converts hazardous medical waste (HMW) to ordinary municipal solid waste (MSW). The technique includes shredding and best grinding of bags contained infectious medical waste via blades with sharp cutters [18].

3. Methodology

The public healthcare sector in Al Najaf city is available free to the public. The Ministry of Health and Ministry of Municipality oversee healthcare waste management. Fourteen regional hospitals in the city offer a various medical

services. Furthermore, 55 Community Health Centres. The private healthcare system in the city further comprises three private hospitals with some clinics.

Unique public hospital and private hospital in the city have been investigated in the current study. The methodology was followed in this manner because data regarding medical waste is not easily accessible. Chosen hospitals are considered among the largest and the oldest medical establishments, comprising various departments from wards, laboratories, x-ray department, maternity ward, and even incinerators to final dispose of generated medical waste. The chosen hospitals were visited to collect the data for analysis. In particular, the incinerators of the public hospital was also visited. Various departments were investigating, including the waste management methods employed, the data of which was collected appropriately.

4. Results and Discussion

4.1. Medical waste management at the public hospital

Al Sader public hospital was investigated in the present study. MW generated within the region from community health clinics and private hospitals are all managed by this hospital. The hospital possesses around 505 beds and two incinerators for disposing of hazardous wastes. It was noted that approximately between 1.074 to 3.844 kg/bed/day [19].

Investigating the hospitals showed that the interior transport of collected waste is conducted via many trolleys. Proper trolleys and clear colour coded bags for waste carriage were not available at the public sector hospitals.

Furthermore, operators for medical wastes transportation were exposed to very hot, noisy, smelly and ergonomically ill-designed working conditions. Wastes were also stored for multiple days, a practice which is not recommended according to studies. The storage time for waste kept should not be exceed 48 hours [20].

It was also noted that staff did not appropriately handle medical waste management effectively. Many of the staff were not aware of safety procedures for biohazards, due to lack of training. Such issues could easily be remedied by designating a budget for training staff who directly handle medical waste. The level of education of relevant staff will surely enhance proper medical waste management. This requires strong policies passed by management within respective organizations.

Generally, waste management policies of the hospital studied did not comply with the standards. As a result, scavengers who could carry and transport waste could easily spread diseases and jeopardize health of community members in the vicinity. Thus, the hospitals investigated did not possess an appropriate solution for proper waste disposal, such as a lack of incinerators. This leads to open dumping of medical waste, such as human organ waste, into community disposal sites.

Observations showed that the poor management of medical waste led to open dumping in public sites, risking exposure to be collected and transported by scavengers who may transmit the disease and endanger the environment. General waste is produced from the various activities in the hospitals, such as from food preparation, laundry facilities, administrative departments, housekeeping and so

on. General waste on hospital was determined from all waste disposed in black plastic bags and dumped to municipal waste landfill.

In the present study, pharmaceutical waste, from antibiotics, other drugs, heavy metals (e.g., mercury), phenols, and other such chemicals commonly used in hospital laboratories were found to be disposed into general sewers used by the public. Such released chemicals disrupt natural ecosystems, relaying toxicity into plants [21]. Hazardous waste was also found disposed in city bus bins as well as landfill sites. It is particularly dangerous to dispose such waste in landfill sites as it could seep into groundwater in cases of low-lying areas vulnerable to flood. Especially during rainy season, medical waste was found to infiltrate waters used for everyday washing and household works in agricultural locales.

Incineration was the most popular method for treatment at Al-Sader hospital. Al-Sader hospital contains two incinerators, the capacity of first incinerator is (250 kg) and the capacity of the second is (50 kg). After the separation of medical solids waste from public waste, the waste was burned in the incinerator with a temperature of (1000-1300) °C for hazardous waste, and a temperature (800-1000) °C for non-hazardous waste. After incineration, the waste is treated either with a water way as in gas incinerator or with cooling by air as in kerosene incinerator.

Comparison between two incinerators illustrates the capacity in selected hospital with the amount of medical solid waste produced by the same hospital contrasted with the wastes generated by other private hospitals per day. It was noted that there was a deficit in the possibility of burning all the waste in Al-Sader incinerators. Another limitation with the incinerators is that the incinerators with low temperature (less than 800 °C) leads to the emission of toxic fumes, the most important and most serious of which is dioxin which is produced when burning waste containing chlorine compounds. Dioxin is a group of compounds possessing harmful effects on health and some of which may be fatal even with low concentrations.

Nevertheless, management was not responsive in inquiring about the operation and maintenance of the incinerator. Despite medical wastes being crucial to ensuring general health of the public, mismanagement surely leads to hazards endangering public health. Furthermore, the environment is also damaged not only due to dangerous gas emissions from the waste incinerator, but also due to ash resulting from burning was disposed by landfill in the soil, leading to contamination of the soil and groundwater

4.2. Management of medical waste at the private clinic

Al Ameer private hospital was also investigated in the study. It is one of the major hospitals in Al Najaf City, possessing around 35 beds. Waste generated in the vicinity arises from various activities, varying by department. Hazardous wastes were transported to be burned at Al Sader Hospital (a public hospital), while other wastes are transported by municipal tractors. Waste materials, from plastic, paper, and food processing wastes, are inserted into plastic bags and collected in medium moving containers, after which they are gathered in a particular zone outside of the hospital. Interior transportation of waste is conducted using many trolleys. No proper trolleys and color-coded bags were found to be available for waste transport in the hospital.

Throughout the visit, the sewage discharged into the city sewerage system was observed. Solid waste were gathered in plastic bags and removed at irregular intervals by the municipal tractors. Liquid waste generated by hospital laboratories were found to be disposed into general sewers used by the public.

It was observed that segregation methods were not practiced appropriately, as staffs were not fully knowledgeable regarding proper segregation techniques during collection. Fundamentally, the staff lacked efficient infection control principles and segregation task resulted from a deficiency of training programs.

From observations, it was noted that the general waste were mixed and dumped together with household and municipal solid waste.

Furthermore, suitable trolleys and perfect colour coded bags for waste transport were found to be missing at studied private hospital. The private hospital studied did not have specific vehicles for hauling waste.

5. Conclusion

In conclusion, proper collection and segregation of medical waste are crucial to preserve human health and the environment. Not enough data exists regarding medical waste management technology as well as its effect on public health and environment. Malpractice with regards to medical waste disposal and management is also insufficient. Improper management of various medical waste may cause a negative problems to the health of staff and patients. MW are also highly hazardous, putting the public in risk of fatal diseases. Medical waste toxicity may be causing the environmental degradation. Unavailability of trolleys and a clear colour coded bags for waste transport in both public and private sector hospitals were also found to be missing. It was also found that the incinerators in Al-Sader hospital were not able to burn all the waste and medical waste generated. The disadvantages of burning process in Al Sader hospital influenced the smoke generation and pollution risks regarding human health and environment, which could potentially disrupt the balance of prevailing ecosystem. With regards to practices of open dumping of wastes, emissions directly harm the environment, thereby leading to rising contaminations carried via air circulation, superficial and ground water flows. Consequently, health risks arise, particularly for workers and animals in direct contact with the site.

6. Recommendations

The authors recommend the following practices for medical institutions in Al Najaf city with regards to MWM for preservation of the environment and public health. First, the amount of medical waste should be measured and quantified by units of medical institutions on a regular basis to gauge waste generated. Second, the city of Al Najaf's medical institutions should convene to adopt guiding policies regarding product purchases and waste reduction. Third, a Sharps Management System should be initiated within medical institutions. Due to the importance of sorting through equipment and containers in sharp-generating points, hospital staff should be appropriately trained regarding appropriate handling and managing of sharps. Fourth, there should be awareness programs for staff regarding how medical waste interacts with public health, safety and the environment. Fifth, hospitals must put into action medical waste management policies, ensuring proper disposal of medical wastes separated from other types of non-hazardous waste. It is recommended to carry this

process out in multidisciplinary teams with specialists from the environmental health field. Sixth, governments should put into action policies and regulations which would aid medical waste management initiatives. Seventh, The Ministry of Health together with the Ministry of Environment should convene with private hospitals and clinics, investing and incentivizing eco-friendly and cost-effective medical waste management technology. Eighth, staff should utilize personal protective equipment (PPE) within relevant work areas. Ninth and last of all, medical waste treatment facilities, from autoclaves to incinerators, should only be operated under the supervision of relevant experts of the respective equipment.

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Abbreviations

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| HC | Health Care |
| HCW | Health Care Waste |
| HMW | Hazardous Medical Waste |
| HW | Hazardous Waste |
| MSW | Municipal Solid Waste |
| MW | Medical Waste |
| MWM | Medical Wastes Management |
| WHO | World Health Organization |

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