A study of medical waste management reality in health institutions in Al-Diwaniyah Governorate - Iraq

Ahmed Mahmoud Falih¹, Mohammed K. Al kasser², Mukhtar Dhajir Abbas¹ and Hiba Abbas Ali²

¹Ministry of Environment, Directorate of Al-Qadisiyah. Email: gh585698@gmail.com
²University of Al-Qadisiyah, College of science. Email: mohammed.al-kasser@qu.edu.iq

Abstract:

The current study was conducted in Diwaniyah Governorate, Iraq (180 km south of Baghdad) to determine the effect of the wastes produced by health institutions on the environment and public health. The results showed that the amount of solid medical wastes generated from hospitals ranges between 3-3432 kg/day, and the treatment process is incinerators without any care taking to the health and environmental standards criteria. The study indicated that some hospitals do not contain waste treatment units for medical wastes. The medical wastes resulting from private clinics and laboratories are thrown with municipal waste without any sorting or treatment process. Liquid wastes from some government hospitals are thrown to the public sewage network without chemical treatment, while private hospitals lack wastewater treatment unit, and that's results from medical clinics and private laboratories are discharged either directly into the river's water through the rainwater network or by dumping it into the drainage using tank cars without any treatment. Thus, that most governmental and private health institutions do not have the ability to manage their medical wastes in an environmentally responsible manner and are not committed to the standards recommended by the Iraqi Ministry of Health and Environment in managing their medical wastes, which exposes workers in these health institutions, patients and the general public at risk in addition to the negative impacts on the environment and its living resources.

Key word: medical waste, waste management, health institutions, Diwaniyah Governorate Iraq

1. Introduction:

It is known that the healthcare process and medical treatment in many hospitals, clinics, laboratories and health care homes generate many types of liquid, solid and gaseous wastes in large quantities. Medical waste is considered a hazardous waste if it is not managed properly due to its negative impact on workers in health institutions, society and public health [1]. The lack of adequate awareness of the danger of medical waste and the misapplication of waste management systems correctly may lead to an increase in the difficulty and complexity of the task [2]. As a result of the spread of COVID-19 that has affected all of the world's population, hospitals, health care homes, clinics, laboratories, and pharmacies are producing more waste than usual, including chemicals, expired drug products, radioactive materials, glove masks, gowns, sharp tools contaminated with human blood, and protective equipment others may be infected with viruses and bacteria, also single-use plastics are now produced in large quantities, as these materials are toxic and
harmful in the environment due to their non-degradable or reusable nature, which negatively affects public health [3]. The random and uncontrolled burning of these wastes leads to the release of toxins into the environment, and this in turn leads to pollution of the soil, air and water sources, which increases their risk, and thus the secondary transmission of diseases to humans. Therefore, the sound management of waste is great importance through its role in protecting human health and the environment from hazardous chemicals and pollutants [4].

2. Methodology:

2.1. Study area: The current study was conducted in Diwaniyah, one of the central Euphrates provinces in Iraq (about 180 km south of Baghdad), located between latitudes 80399 and longitude 11398. Its total area is about 135.8 square kilometers, and its population is estimated at about one and a half million people [5]. The governorate contains 11 hospitals, 8 of them governmental and 3 of them belonging to the private sector, in addition to many governmental and private primary and specialized health care centers, and private doctors and nursing clinics.

2.2. Aim of the study: The study aim are determine the environmental reality of health institutions in the province of Diwaniyah as a model for the reality of health institutions operating in Iraq by identifying the methods of dealing with solid waste in terms of isolating regular and medical waste, and the nature of medical wastes disposal from health institutions and what are the methods used to treatment and dispose these wastes, as well as shedding light on the environmental problems faced by these institutions, whether in terms of treating the wastewater or in terms of the unavailable of such wastewater treatment units.

2.3. Data collection: Data were collected for the period from 1/2/2020 to 1/2/2021 and the information collected was based on visits and field surveys of health institutions in the governorate and the data included the following:

1. Determining the number of public and governmental health institutions (hospitals, health centers, doctor's clinics, nursing clinics, pharmacies).

2. Determine the amount of medical waste generated from hospitals and health institutions.

3. Determine the methods used in waste management and treatment.

4. Determining the efficiency of wastewater treatment plants for health institutions.

3. Results and discussion:

3.1. Health institutions in Al-Diwaniyah Governorate:

Table (1) shows the number of governmental and private hospitals, where the number of government health institutions is approximately (31), including (8) government hospitals, while the number of private hospitals is (3). The number of government health centers is (33) public health centers and (12) specialized health center. As for private clinics, private laboratories and pharmacies, they are scattered throughout the governorate and were counted personally. The study also showed that the total number of hospital beds in Diwaniyah governorate amounts to (1189) beds, ranging between (20-418) beds, depending on the type of hospital and the services it provides (figure 1) [6].
Table (1) number of health institutions in Diwaniyah Governorate.

| Health institutions              | Number |
|----------------------------------|--------|
| Governmental hospitals           | 8      |
| public hospitals                 | 3      |
| Government health centers        | 33     |
| Specialized health centers       | 12     |
| Medical Associate Clinics        | 70     |
| Doctors clinics                  | 200    |
| Private laboratories             | 185    |
| Pharmacies                       | 300    |

Figure (1) number of beds in hospitals in Diwaniyah Governorate.

3.2. Solid medical waste:

The results showed that the amount of solid medical waste produced from hospitals in Diwaniyah governorate ranges between 3-3432 kg/day (table 2, figure 2). The data indicated
that most governmental and private hospitals do not comply with what was stated in Article (2) of the Ministry of Health and Environment instructions for management of medical waste No. (1) of 2015, as most health institutions did not notice the presence of symbols on medical waste containers for the purpose of determining the type of waste and distinguishing it from other wastes.

Table (2) weight of wastes resulting daily from hospitals in Diwaniyah Governorate.

| Hospitals                          | Medical waste weight Kg/day |
|-----------------------------------|-----------------------------|
| Al-Diwaniyah Teaching Hospital    | 3432                        |
| Women's and Children's Hospital   | 80                          |
| Al-Hussein Hospital               | 10                          |
| Al Hamza Hospital                 | 1012                        |
| Afak Hospital                     | 200                         |
| Shamiya Hospital                  | 60                          |
| Al-Furat Al-Ahli middle Hospital  | 3                           |
| Al Shifa National Hospital        | 231                         |
| Diwaniyah National Hospital       | 206                         |

Figure (2) weight of wastes resulting daily from hospitals in Diwaniyah Governorate.

In addition to the fact that the type of bags used to collect waste is not in compliance with the conditions set forth in Appendix No. (3) to the above-mentioned instructions, as well as
the waste storage sites are also violating and unsafe (Figure 3), in addition to that, the method of transporting waste from the storage sites to the landfill is by car that is not dedicated to transporting medical waste. It is worth noting that the method of waste disposal is an old method and is not an environmentally friendly, as most health institutions burn their infectious and pathogenic medical waste in ways contrary to the required health and environmental requirements [7], as the incinerators located in a large section some of the health institutions are irregular incinerators whose temperature cannot be controlled in addition to the fact that their chimneys do not comply with the environmental requirements related to the installation of incinerators in health institutions. The data in the current study showed that some of the health institutions send their medical waste to other hospitals for the purpose of disposing them because does not contain specialized treatment units.

The field survey of the sites of these incinerators also indicated that they are located within residential areas and are surrounded by homes, educational institutions and commercial markets (Figure 4 and 5), and despite the Ministry of Health and Environment's keenness to protect surface and ground water and air and not harm any of them and the residential areas adjacent to the incinerator when choosing its location, we see that the Ministry did not mention the method that must be followed to achieve this, which requires amendment of the text for this, given that the solid and gas combustion products negatively affect human health and the surrounding environment [9].
Figure (4) shows the location of the Women's and Children's Hospital in Al-Diwaniyah Governorate

Figure (5) shows the location of Al-Diwaniyah Teaching Hospital in Al-Diwaniyah Governorate

This is what has been proven by various studies that indicated that the presence of incinerators may disrupt hormonal systems, affect immunity and the ability to have children, and cause cancers due to their exposure to various pollutants such as toxic particles, mercury, heavy metals, hydrogen chloride, volatile organic compounds, polycyclic aromatic hydrocarbons (PAHs), Polychlorinated bivinyls (PCBs), arsenic, nitrogen oxides, and greenhouse gases, in addition the burning of plastics increases the production of environmentally harmful pollutants and toxic equivalents dioxins and furans (TEDFs) [10]. The US Environmental Protection Agency (EPA) has indicated the presence of high levels of pollutants such as dioxins and furans in the environment resulting from healthcare incinerators [11], and the fine particles resulting from the incineration process can travel long distances before depositing and contaminating surface water, soil, plants and may be inhaled by humans, which causes various health effects [12].
The study also showed that private medical clinics and private laboratories are not restricted by the regulations and conditions issued by the Ministry of Health and Environment in managing their solid medical wastes, as these wastes are thrown directly with municipal waste without any sorting or treatment process (Figure 6), these wastes include growth media, sharp tools, tools and health contaminated materials, so that arrival these dangerous pollutants to municipal waste dumps.

![Figure (6) private medical clinics and private laboratories sold wastes.](image)

This type of waste is dangerous for people, because the probability to infection from a contaminated syringe as a result of throwing it with municipal wastes are 0.3 % for HIV, 1.8 % for hepatitis C and 30 % for hepatitis B [13], the infectious of hepatitis B or C can accure after one week when exposure to a drop of blood trapped in a medical syringe [14]. Other types of pathogenic bacteria such as *Pseudomonas aeruginosa* and *Acinetobacter baumannii* can be existed on devices such as syringes, blades, and others tools so the presence of such tools and materials contaminated with pathogens in municipal waste can cause serious injuries to individuals, especially those with weak immunity [15].

### 3.3. Liquid waste:

Liquid wastes of health institutions can be included wastewater, pharmaceutical wastes, radioactive liquid wastes, heavy metal residues and hazardous chemical liquids [16]. The results of the study showed that liquid wastes resulting from health institutions are discharge into the public sewage system, where these wastes are treated in a physical manner and biological only in some governmental institutions, while there are no treatment plants in private hospitals, but there are underground tanks that are emptied by tank cars and then
discharged into the drains. As for the medical clinics and private laboratories, they discharge their liquid waste without any treatment into the river directly through a rain water due to the connection of its streams with the rainwater network [6], which warns of dangerous consequences as a result of increased pollution in the river’s water and the spread of disease. As Al-Khalidi explained during his study of the Diwaniyah River that the water in which these wastes are thrown, the level of pollution in it is very high, which poses a great danger to the users of this water lead to the spread of diseases and negatively affect biological diversity in the water [17]. also effect on plants and animals by increasing disease-causing strains and reducing populations that contribute beneficial to the ecosystem[18].

The results showed that private pharmacies do not use a safe way to dispose of these materials, but rather they are thrown with other municipal waste, and the increases risk is the spread of many pharmacies and nursing clinics (doctor’s assistants) in residential neighborhoods, where pharmaceutical waste is disposed in residential corridors, with household waste uncontrolled, which poses a threat to the environment and public health. The disposal of pharmaceutical waste into the sewage network ultimately leads to its access to water sources, which directly affects the environment and the people who consume this water [16]. As it causes many diseases, genetic mutations, hormonal imbalances, heart problems, high blood pressure, diabetes, gastroenteritis, and neurobehavioral effects [19].

The treatment of pharmaceuticals liquid waste is one of the things that must be adhered to as the patients who undergo radiotherapy will secrete radioactive materials, especially Technetium-99m and iodine-131, which can be found in the environment. Also, the increased use of drugs ultimately leads to increased amounts of drug waste in sewage treatment plants, which are harmful to aquatic organisms, especially fish, and may end up in the soil through the use of sewage sludge [20]. Therefore, the liquid wastes of hospitals and medical institutions for treating cancerous tumors, like pharmaceutical products, medicines, waste and unhalogenated organic materials it should be treated and disposed in safe manner far away from domestic wastewater network [21].

In addition, antibiotic-resistant bacteria in hospital wastewater pose a major threat to public health and the environment as a result of the spread of resistance genes. As many of the resistance genes in bacteria spread widely around the world are mostly from hospitals, which is a health concern, many types of bacteria showed treatment failure among infected individuals because it have resistance genes [22].

4. Conclusions

The current study reached a set of facts, the most important of which are:

1. The method used to dispose of solid medical waste in government health institutions is by incineration only.

2. The incinerators located in some health institutions do not comply with the environmental requirements of their establishment, as they are located within
residential neighborhoods and shops. In addition, some hospitals do not contain special treatment units for treating solid waste, as they are sent to other hospitals.

3. Solid medical wastes generated from private clinics, private laboratories and pharmacies, are thrown directly with municipal waste.

4. The sorting process of solid waste in health institutions is not sound and does not take into account the conditions of the Ministry of Health and Environment.

5. The waste storage sites do not comply with the specifications contained in the instructions of the Ministry of Health and Environment, as they are open and unsafe, which facilitates the entry of those who abuse them.

6. The process of transporting medical waste from the storage site to the landfill is by a vehicle not intended for the transportation of medical waste.

7. Absence of clear signs and signals or color coding indicating the location or type of medical waste and how to deal with it.

8. Liquid wastes from hospitals are discharged into the public sewage network without chemical treatment or disinfection from pathogens. As for the wastewater from private hospitals, it is discharged into the drains without any treatment process, and the wastewater from private clinics and laboratories is discharged directly to the river without any treatment.

5. Recommendations:

1. Conducting studies to determine the type of chemical pollutants resulting from the disposal of medical waste, and the type of chemical pollutants and pathogens introduced with the wastewater.

2. Obliging health institutions to treat their liquid medical waste before throwing it to the river.

3. Obliging health institutions to conduct a sorting process for solid medical waste and manage it in a proper manner, in accordance with the instructions issued by the competent authorities.

4. Conducting training courses and awareness campaigns for workers in hazardous medical waste management.

5. Establishing deterrent laws for health institutions that violate the regulations and instructions for medical waste management.

6. References:

[1] Askarian, M., Mahmood, V., Gholamhosein, K., (2004): Results of a hospital waste in private hospitals in Fars Province, Iran. Waste Management 24, 347–352

[2] Www. Environment-agency.gov.uk.
[3] World Health Organization. Coronavirus disease (COVID-19) advice for the public. Geneva: World Health Organization; 2020 [cited 2020 3 March]. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public.

[4] Ayse Cebe, Sukru Dursun, Hysen Mankolli (2013): Hospital Solid Wastes and Its Effect on Environment. International Environmental Application and Science 8: 733-737.

[5] NCCI (2015): Qadissiya NCCI Governorate Profile. www.ncciraq.org

[6] Al Diwaniyah Environment Directorate - Urban Environment Division - Monthly reports on health institutions.

[7] Instructions for managing waste from medical care in health institutions issued by the Iraqi Ministry of Environment for the year 2012.

[8] Muhammad, Mukrian Aziz (2016): Civil Liability Caused by Medical Waste Master Thesis, Sulaymaniyah University - College of Law.

[9] Article (1) of the instructions for the management of waste left by medical care in health institutions issued by the Iraqi Ministry of Environment for the year 2012.

[10] Abor PA, Bouwer A. (2008) Medical waste management practices in a Southern African hospital. Int J Health Care Qual Assur; 21(4): 356-64.

[11] Ziraba, A.K.; Haregu, T.N.; Mberu, B. (2016) A review and framework for understanding the potential impact of poor solid waste management on health in developing countries. Arch. Public Health, 74, 55. [CrossRef] [PubMed]

[12] Watson, J.G., C.F. Rogers, and J.C. Chow. (1995): PM10 and PM2.5 Variations in Time and Space. Report No. 4204.1F. Prepared for TRC Environmental Corporation, Chapel Hill, N.C., by Desert Research Institute, Reno, NV.

[13] Batterman S. (2004): Assessment of Small-Scale Incinerators for Healthcare Waste. WHO, Geneva, 69 p.

[14] Thompson SC, Boughton CR, and Dore GJ. (2003): Blood-borne viruses and their survival in the environment: Is public concern about community needle stick exposures justified Australian and New Zealand Journal of Public Health 27(6): 602-607.

[15] Altaf A, Janjua NZ, Aamir JK, Mujeeb SA, and Samad L. (2004): An assessment of the quality of syringes in Pakistan. Study conducted by safe injection network, Karachi, Pakistan funded by World Health Organization, 30 p.

[16] Pruss, A., Giroult, E., Rushbrook, P. (1999): Safe management of wastes from healthcare activities! World Health Organization. Geneva, 3-4.

[17] Al-Kalidi ·Ahmed Mahmoud (2019): Limnological study of Al-Diwaniyah River Water – Iraq using some water quality index and wireless sensor network (WSN).
[18] Soge OO, Giardino MA, Ivanova IC, Pearson AL, Meschke JS, and Roberts MC. (2009): Low prevalence of antibiotic-resistant gram-negative bacteria isolated from rural south-western Ugandan groundwater. Water SA 35: 343–347.

[19] Salam Hussein Ewaid et al 2020 J. Phys.: Conf. Ser. 1664 012143.

[20] Ali Sharif & Muhammad Ashraf & Aftab Ahmed Anjum & Aqeel Javeed & Imran Altaf & Muhammad Furqan Akhtar & Mateen Abbas & Bushra Akhtar & Ammara Saleem (2015): Pharmaceutical wastewater being composite mixture of environmental pollutants may be associated with mutagenicity and genotoxicity, Environ Sci Pollut Res, DOI 10.1007/s11356-015-5478-3.

[21] ICRP, (2004): Release of patients after therapy with unsealed radionuclides. International Commission on Radiological Protection Ann. ICRP 34 (2), 1e79.

[22] EU, (2000): Commission Decision 2000/532/EC Replacing Decision 94/3/EC Establishing a List of Wastes Pursuant to Article 1(a) of Council Directive 75/442/EEC on Waste and Council Decision 94/904/EC Establishing a List of Hazardous Waste Pursuant to Article 1(4) of Council Directive 1/689/EEC on Hazardous Waste. European Union.

[23] Ahmed Sabah Al-Jasimee et al 2020 J. Phys.: Conf. Ser. 1664 012141.

[24] Odumosu BT, Adeniyi BA, and Chandra R. (2013): Analysis of integrons and associated gene cassettes in clinical isolates of multidrug resistant Pseudomonas aeruginosa from Southwest Nigeria. Annals of Clinical Microbiology and Antimicrobials 12: 29–36.