

Bio-Medical Waste Management and Analysis for Selected Hospitals in Southern and middle parts of Iraq

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Abstract

In terms of understanding the many types of waste and disposal options, this paper discusses how to handle medical waste. Over the past two decades, medical waste issues have become a problem with detrimental effects on environmental health. As a result, experts in public health and environmental issues started researching this phenomenon in all its manifestations. They tried to comprise it by putting in place different health controls and coming up with a cure. In addition to estimating the volume of solid medical waste produced in a few hospitals in the cities of Najaf and Basra, the research aims to provide a clear picture of the reality of biomedical waste management in Iraqi hospitals. Six sizable neighborhood hospitals with various specializations were selected to meet the study goals. For four months, waste (solid medical) was collected. The findings revealed that hospitals produced solid medical waste at an average rate of 0.42 to 3.90 kilograms per patient per day and that this rate was overall (1019 kg). Al-Sader Hospital had the highest proportion of waste output out of all the hospitals, reaching 34.15% when it was operating. In contrast, Al-Hakeem Hospital had the lowest percentage, just (6.67%) while operating. The most crucial management phase is storing, storing, and transporting hospital waste. It is necessary to understand why each sort of waste is handled in the way that it is. Consequently, it might be the outcomes in safe and effective medical waste management and the accomplishment of the requirements to safeguard society and the environment.

Keywords: Bio-Medical Waste, Hospitals, Solid waste, Disposal.

Introduction

Solid wastes also rise in proportion to population growth. In the end, waste pollution turns into a really significant problem for both the environment and general health. Medical waste is any waste created by a medical facility (private or public), a medical research facility, or a laboratory that is associated with providing health services¹. However, not all garbage generated by healthcare institutions may be categorized as medical waste. The majority (75 – 90%) of the garbage generated by medical establishments is either municipal waste or general waste. Municipal garbage management services often handle this trash. Medical waste, which makes up the remaining 10 – 25% of healthcare waste, may be very toxic and harmful to human health²⁻⁵. Medical wastes are divided into four categories: pharmaceutical wastes, radioactive wastes, hazardous wastes, and infectious wastes⁶. Infectious wastes includes bodily fluids, blood, swabs, cultures, gloves, and bandages. Hazardous wastes include sharps, equipment, and chemicals.

Health treatment is important to our safety and wellbeing, but medical waste is a serious issue for living nature and the human environment⁷. In certain nations, patient waste is becoming a major health

threat, and to reduce these hazards, a clinical management scheme must be introduced. Biomedical waste disposal has increasingly become a significant point of concern for hospitals and nursing facilities, as well as environmental and law enforcement authorities, the media, and the general public. Today, proper biomedical waste treatment has become a global humanitarian problem. While the dangers of weak medical waste management have ignited global concern, particularly in light of their far-reaching impact on human health and the climate, It is now generally accepted that the "Hospital waste" created during medical care has several negative and unhealthy impacts on the ecosystem, involving human beings. Clinical pollution represents a health concern to health-care staff, the general population, and the surrounding flora and fauna. Waste management problems in hospitals and healthcare facilities have been a rising point of concern. ⁸.

Biomedical waste (BMW)

It is a wider concept that applies to waste created or generated throughout human or animal study practices such as evaluation, care, or immunization, as well as waste produced or generated the processing or testing of biological or in health camps ^{8,9}.

Bio-Medical Waste produced by: Forensic Laboratories, Health Camps, Institute/Research Labs, Research/Educational, Clinical Establishment, Blood Banks/Blood Donation Camps, Pathological Laboratories, Dispensaries and Hospitals ¹⁰.

Specific to hospitals Bio-medical waste

It is characterized as waste that is polluted with patient body fluids and is produced during the diagnosis, care, or immunization of humans (including microbiological, disposables plastics, dressings, placenta, body parts and organs, ampoules, needles and syringes wastes) ¹¹.

The World Health Organization (WHO) reports that between 75% and 95% of biological waste is non-hazardous. Just 10% – 25% is dangerous, with about 10% being contagious as shown in Figure 1, with the other 5% being non-infectious still containing hazardous chemicals such as methyl chloride and formaldehyde as shown in Figure 2. The dangerous component of the waste poses a human, environmental, and/or microbiological danger to the general public and health-care personnel who are engaged in waste handling, storage, and disposal ^{11,12}.

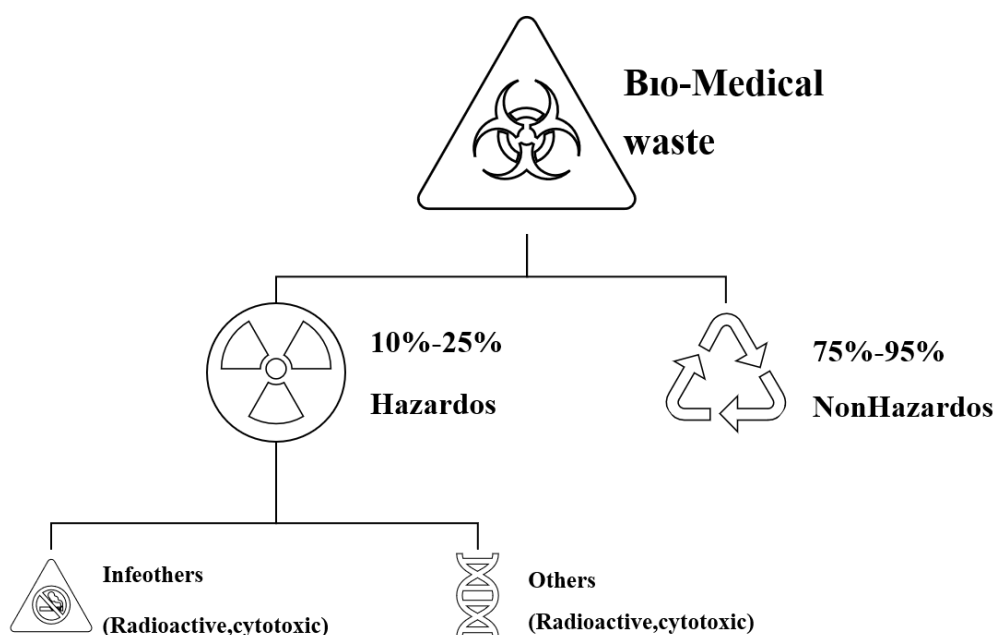


Figure 1: Bio-Medical waste ¹¹.

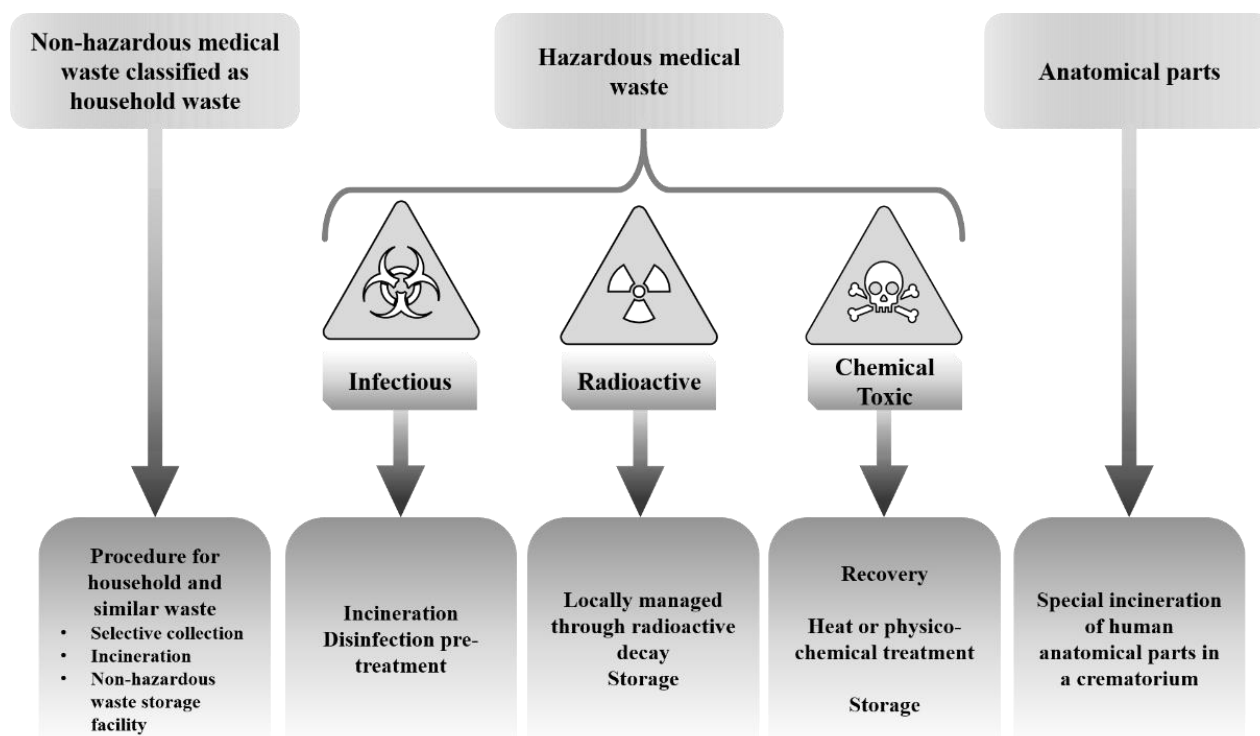


Figure 2: Non-hazardous and hazardous medical waste ^{11,12}.

Biomedical Waste Management Process

Hospital waste may be treated, transported, stored, separated, collected, and disposed of in a safe manner to avoid hospital infection ¹³.

Biomedical Waste Management Rule

It is a legal obligation to dispose of biomedical waste in a safe manner, table 2 shown the Types of biomedical waste, According to these laws, it is the obligation of the "occupier," that is, the individual who has authority over the organization or its premises, to take all appropriate measures to ensure that the waste produced is treated in a way that does not endanger human health or the environment, therefore it must be disposed of by a set of stages as in the Figure 3. ¹³.

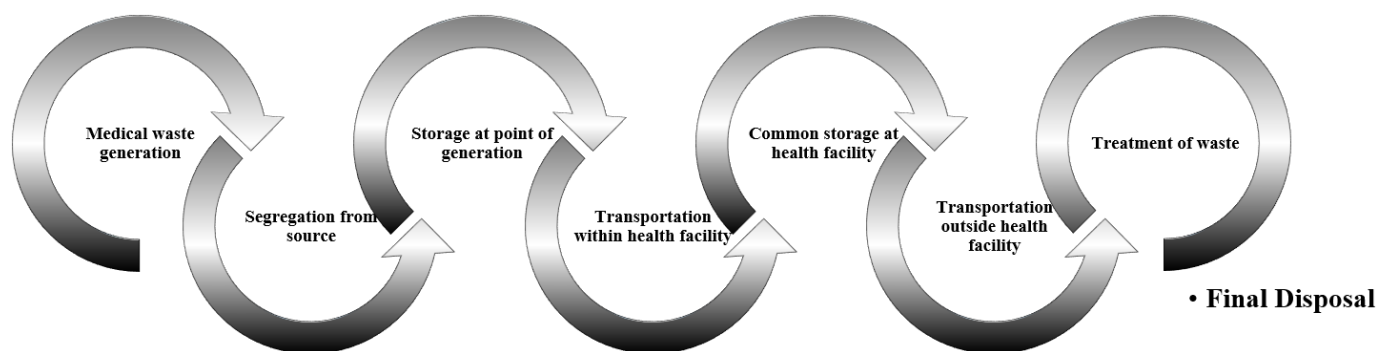


Figure 3: Process Flow Chart ¹⁴.

Table 1: Types of biomedical waste rule ¹⁵.

Waste Category	Kind of Waste	Disposal and remediation	Waste Category
Category No. 1	Human Anatomical Waste	Incineration /deep burial	Human Anatomical Waste (human tissues, organs, body parts)
Category No. 2	Animal Waste	Incineration /deep burial	Animal wastes includes animal tissue, organ, corpses, bleeding bits, fluid, semen, and laboratory animals used in testing, as well as waste caused by district clinics and colleges, discharged from hospital, and animal house.
Category No. 3	Biotechnology and Microbiology Waste	Local autoclaving/ microwaving/ incineration	Waste from Biotechnology and Microbiology, which include (lab cultures, stocks or samples of attenuated vaccines or microorganisms lives, animal and human cell culture utilized in researches and agents of infectious from researches and industrial labs, wastes from production of devices, dishes, toxins and biological utilized for transfer of cultures)
Category No. 4	Waste Sharps	Disinfections (chemical remediation/autoclaving/ micro waving and mutilation shredding	Sharps Wastes (glass, scalpels blades, syringes, needles, etc., which might be led to cuts and puncture. This involves both sharps' utilized and unutilized)
Category No. 5	Discarded Medicine and Cytotoxic drugs	Incineration / destruction and drugs disposal in secured landfills	Medicines that have been thrown out and cytotoxic products (wastes including discarded medicines, polluted and outdated)
Category No. 6	Soiled Waste	Incineration, autoclaving/microwaving	Disposal of Waste Material (Substances polluted with blood and fluids body involving line beddings, soiled dressing companies, dressings, cotton, other material polluted with blood)
Category No. 7	Solid Waste	Disinfections by chemical remediation autoclaving/microwaving and mutilation shredding	Solid Wastes (produced from disposable substances comparison with the sharps' waste including intravenous, catheters sets tubing, etc.)
Category No. 8	Liquid Waste	Disinfections by chemical remediation and discharge into drain	Liquid Wastes (produced from lab and disinfecting, housekeeping, cleaning and washing actions)
Category No. 9	Incineration Ash	Disposal in municipal landfill	Ash from incinerators (ash from wastes of biomedical incineration)
Category No. 10	Chemical Waste	Chemical remediation and discharge into drain for liquid and secured landfill for solids	Waste Chemicals (chemicals utilized in productions of chemicals, biological, utilized in ion of disinfect, as pesticides, etc.)

Research objective

1. Giving a clear picture of the reality of solid waste management in the studied hospitals.
2. Estimating the weight of waste presented by hospitals for use in the future planning process ¹⁶.

The study area

The study was conducted between a group of hospitals in the city of Najaf and the city of Basra by comparing the medical waste produced in each of the two cities, where the city of Najaf is characterized by religious tourism and has seasons characterized by tourists from their homes and abroad. Al-Najaf is a city in central Iraq about 160 km south of Baghdad. Its estimated population in 2018 was 1,471,592 people. It is the capital of Najaf Governorate. Location of Najaf within Iraq Coordinates: 32°00'00"N 44°20'00"E. Basra is a city in southern Iraq located on the Shatt al-Arab in the Arabian Peninsula. It had an estimated population of 2,908,491 million in 2018. Also, Basra is Iraq's main port. Located at Coordinates: 30°30'54"N 47°48'36"E as shown in Figure 4. As for Basra, it is a commercial and industrial city with international border outlets and a large number of local and foreign citizens ^{16,17}.

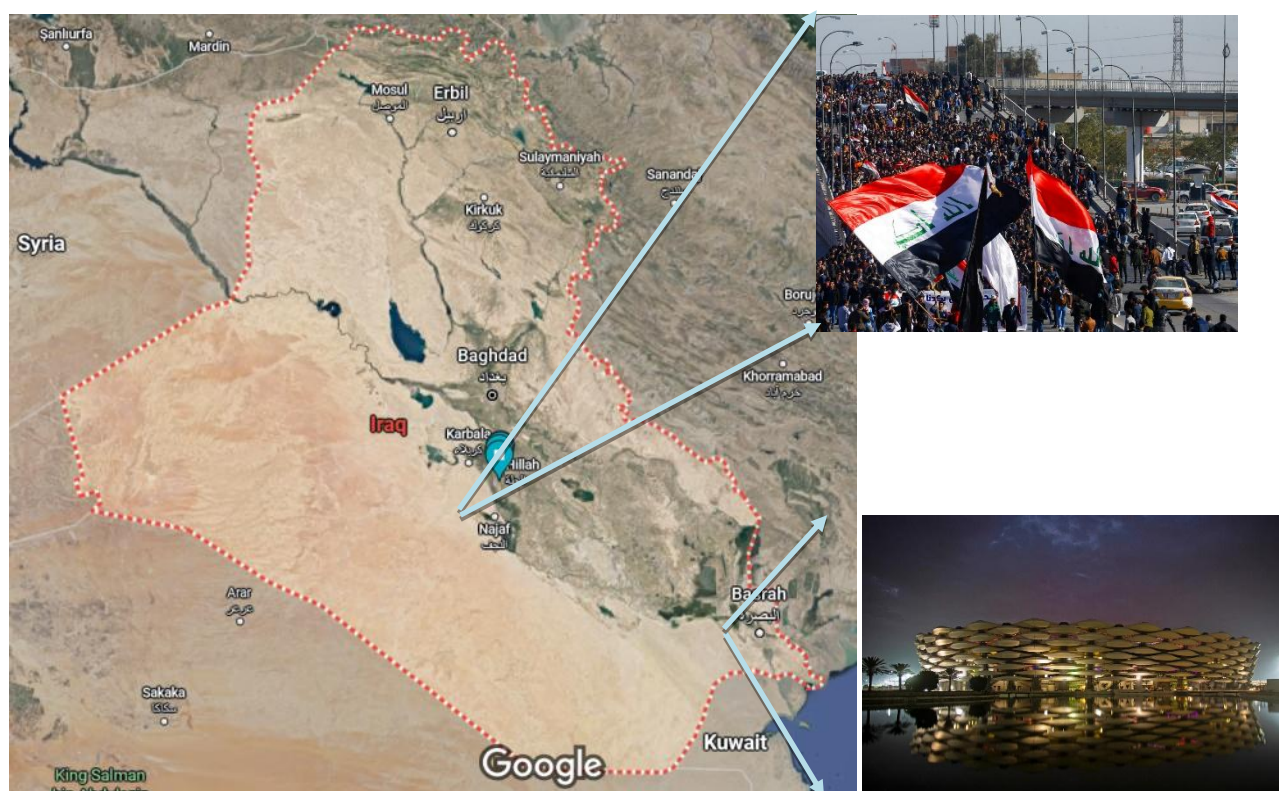


Figure 4. A map for the selected areas.

Experimental work

Najaf hospitals

The most important data were collected from selected hospitals in the city of Najaf daily for four months (August – November 2010); This data was for: number of patients and the amount of solid waste produced. These data collected from Najaf hospitals are summarized as shown in table 3, 4, 5 and 6. ¹⁷

Table 2: Information of studied hospitals in the city of Najaf ¹⁷.

Hospitals	Number of working staff	Capacity (patient)
Al- Sader Hospital	1283	505
Al- Hakeem Hospital	810	268
Al- Zahraa Hospital	721	319

Table 3: Quantity of solid medical waste in Al-Sader hospital ¹⁷.

No.	The month	Average Solid medical waste (kg/day)	Average No. of patients/day	Rate of Waste (Kg/patient/day)
1	August	360	66	5.45
2	September	325	79	4.11
3	October	345	128	2.69
4	November	363	86	4.22
Average		348	90	3.90

Table 4: Quantity of solid medical waste in Al-Hakeem hospital ¹⁷.

No.	The month	Average Solid medical waste (kg/day)	Average No. of patients/day	Rate of Waste (Kg/patient/day)
1	August	72	51	1.41
2	September	62	56	1.10
3	October	56	61	0.91
4	November	80	54	1.48
Average		68	56	1.22

Table 5: Quantity of solid medical waste in Al- Zahraa hospital ¹⁷.

No.	The month	Average Solid medical waste (kg/day)	Average No. of patients/day	Rate of Waste (Kg/patient/day)
1	August	189	143	1.32
2	September	129	122	1.05
3	October	168	194	0.86
4	November	196	175	1.12
Average		171	159	1.08

Basra hospitals

All laboratory waste is treated as medical waste, including pathological waste. The most important data were collected from selected hospitals in the city of Basra daily for four months (September- December 2009). This data was for: number of patients and the amount of solid medical waste produced ¹⁸.

Table 6: Information of studied hospitals in the city of Basra ¹⁸.

Hospitals	Number of working staff	Capacity (patient)
Basra General Hospital	1685	564
AL Fayhaa Hospital	912	424
General Ports Hospital	981	377

Table 7: Quantity of solid medical waste in Basra General Hospital ¹⁸.

No.	The month	Average Solid medical waste (kg/day)	Average No. of patients/day	Rate of Waste (kg/patient/day)
1	September	159	334	0.47
2	October	135	499	0.27
3	November	217	454	0.47
4	December	217	441	0.49
Average	/	182	432	0.42

Table 8: Quantity of solid medical waste in AL Fayhaa Hospital ¹⁸.

No.	The month	Average Solid medical waste (kg/day)	Average No. of (patients/day)	Rate of Waste (kg/patient/day)
1	September	132	118	1.11
2	October	130	150	0.86
3	November	155	150	1.03
4	December	124	122	1.01
Average	/	135	135	1.00

Table 9: Quantity of solid medical waste in General Ports Hospital ¹⁸.

No.	The month	Average Solid medical waste (kg/day)	Average No. of patients/day	Rate of Waste (kg/patient/day)
1	September	116	177	0.65
2	October	126	199	0.63
3	November	106	213	0.49
4	December	110	186	0.59
Average	/	115	194	0.59

Results and discussion

The amount of solid medical waste in Najaf hospitals for four months as shown in the fig.5 represent that the maximum quantity of solid waste in Al-Sader Hospital which reached to 363 kg/day in November while in Basra hospitals reached to 217 kg/day in general Basra hospitals in November and December as shown in Figure 6. Table 10 and **Chyba! Nenalezen zdroj odkazů.** 7. shows the quantities of waste produced by hospitals study in provinces Najaf and Basra. As the average amount of medical waste produced by these hospitals per day is 1019 kg and the rate of waste generation ranged between 0.42-3.90 Kg/patient/day. Al-Sader Hospital represents the largest percentage of waste production out of the total percentage, reaching 34.15% while it was, Al- Hakeem Hospital represents the lowest percentage of waste production out of the total percentage, reaching 6.67% while it was. The production of each of Najaf Hospital Al- Zahraa is, 16.78%. Production Basra Hospitals Basra General, AL Fayhaa, General Ports is 17.86%, 13.24%, 11.28%. Figure 8. shows the percentages of solid medical waste in hospitals.

Table 10: Quantity of solid medical waste in General Ports Hospital.

No.	Hospitals	Average Solid medical waste (kg/day)	Percentage of solid waste production (%)	Rate of Waste (kg/patient/day)
1	Al- Sader Hospital	348	34.15%	3.90
2	Al- Hakeem Hospital	68	6.67%	1.22
3	Al- Zahraa Hospital	171	16.78%	1.08
4	Basra General Hospital	182	17.86%	0.42
5	AL Fayhaa Hospital	135	13.24%	1.00
6	General Ports Hospital	115	11.28%	0.59
Total	/	1019	100%	/
Average	/	169.98	/	1.36

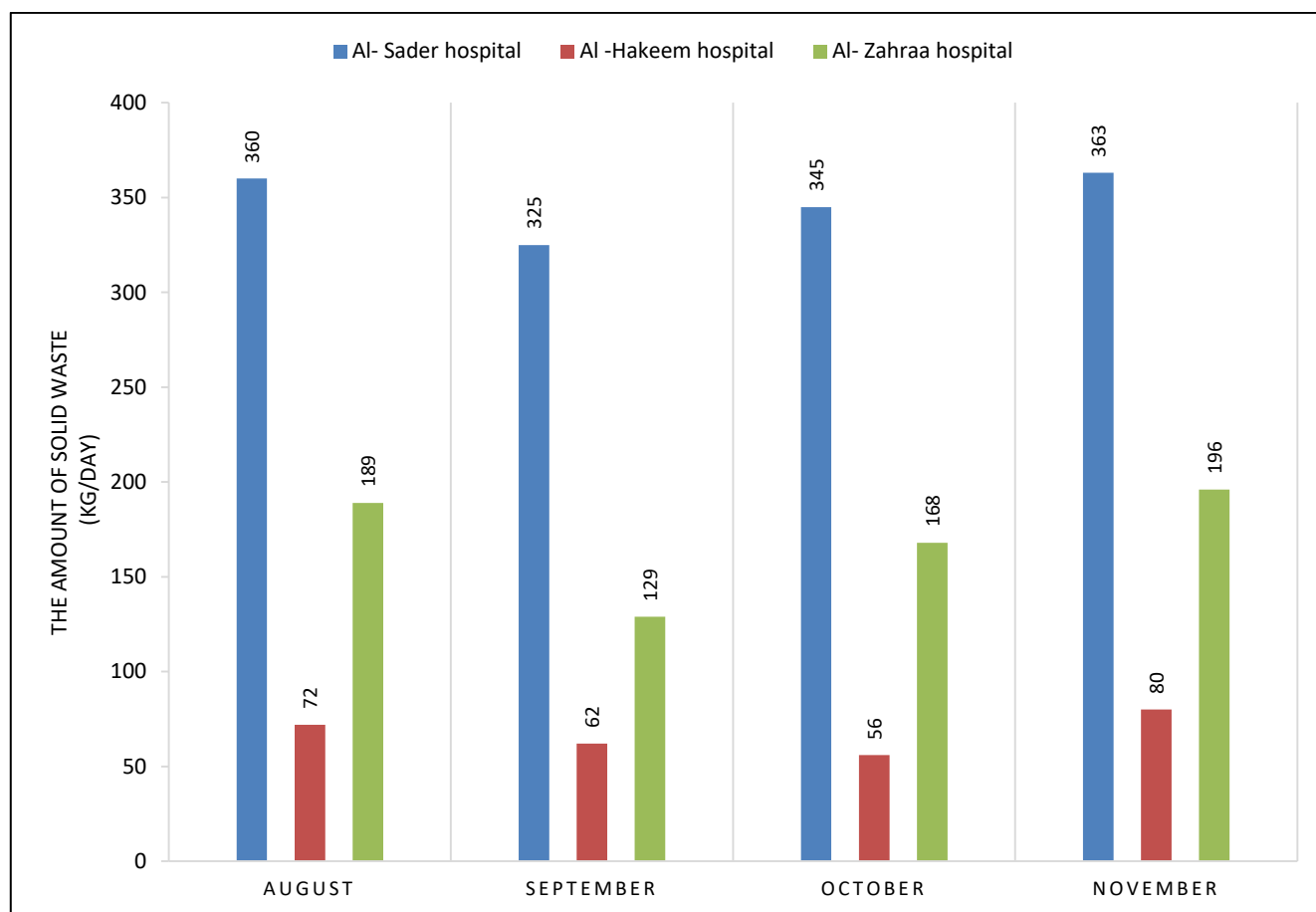


Figure 5. Solid medical waste in Najaf hospitals for four months.

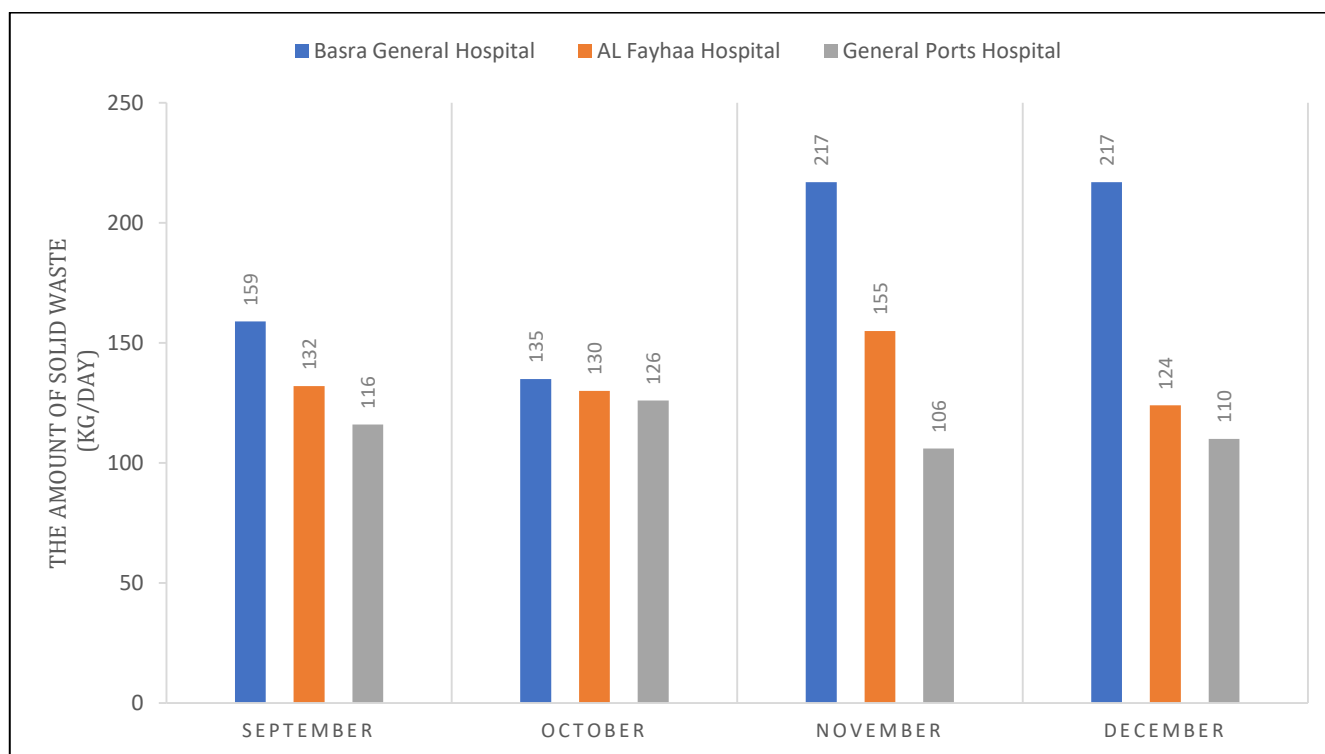


Figure 6: Solid medical waste in Basra hospitals for four months.

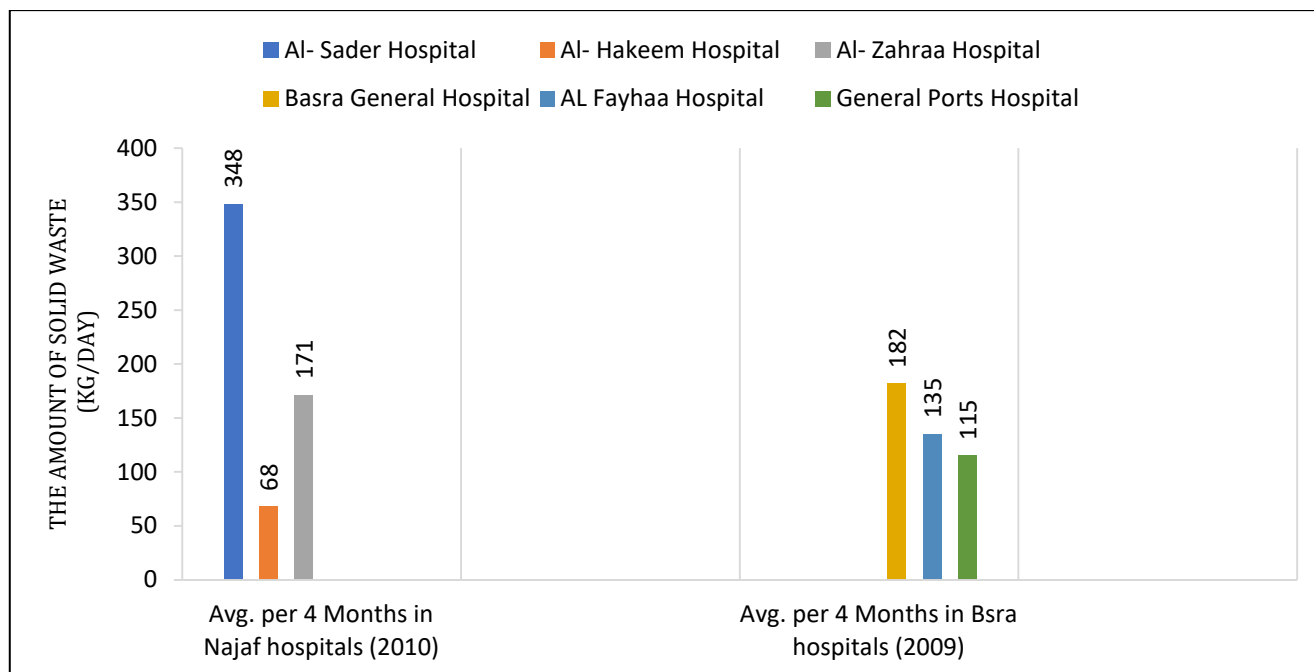


Figure 7: Solid medical waste in Najaf and Basra hospitals for four months.

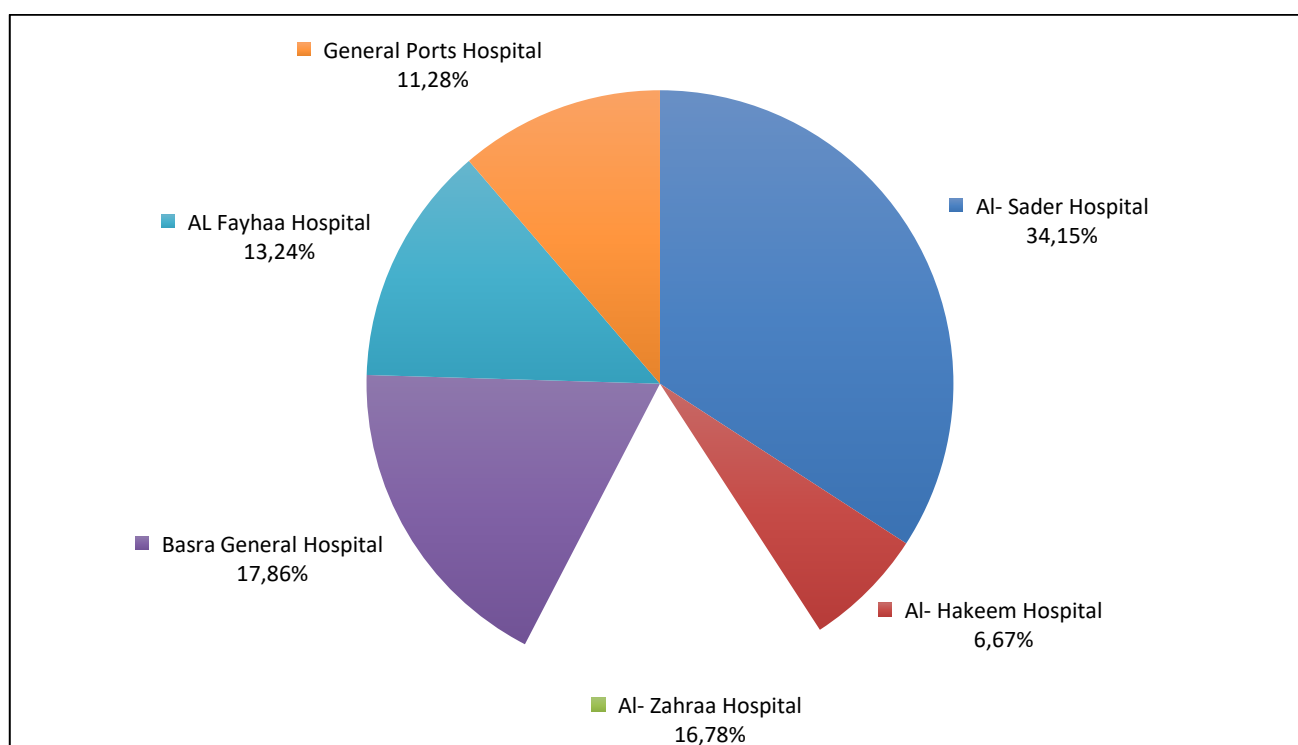


Figure 8: Percentage of solid medical waste production in hospitals (%).

Conclusion

Medical waste must be categorized depending on its source, type, and risk parameters related with its handling, storage, and final disposal. Separating waste at source is the main step, and decrease, recycling and reuse must be considered from an appropriate perspective. It is essential to think about innovative and radical measures to change the painful picture of civil disinterest on the part of hospitals and the slow implementation by the government of lowest rules, because waste production, especially biomedical waste, imposes an increase in indirect and direct costs in society. Thus, the challenge before us is the scientific management of the increasing amounts of biomedical waste that exceeds previous practices. For protecting the environment and the health of society, it should be educated ourselves on this significant problem not only for health institutions but also for the benefit of society.

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Nakládání s biomedicínským odpadem a analýza pro vybrané nemocnice v jižní a střední části Iráku

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Souhrn

Pokud jde o pochopení mnoha typů odpadu a možností jejich odstranění, tento dokument pojednává o tom, jak nakládat se zdravotnickým odpadem. Během posledních dvou desetiletí se problematika nemocničního odpadu stala problémem se škodlivými účinky na zdraví životního prostředí. V důsledku toho začali odborníci v oblasti veřejného zdraví a životního prostředí zkoumat tento fenomén ve všech jeho projevech. Snažili se to řešit tím, že zavedli různé zdravotní kontroly a přišli s projektem. Kromě odhadu objemu pevného lékařského odpadu produkovaného v několika nemocnicích ve městech Nadžaf a Basra je cílem výzkumu poskytnout jasný obraz o realitě nakládání s biomedicínským odpadem v iráckých nemocnicích.

Pro splnění cílů studie bylo vybráno šest velkých sousedních nemocnic s různými specializacemi. Po dobu čtyř měsíců se sbíral odpad (pevný zdravotnický). Zjištění odhalila, že nemocnice produkovaly pevný zdravotnický odpad v průměrné míře 0,42 až 3,90 kilogramů na pacienta a den a že tato míra byla celková (1019 kg). Nemocnice Al-Sader měla nejvyšší podíl na produkci odpadu ze všech nemocnic, když v době provozu dosáhla 34,15 %. Naproti tomu nemocnice Al-Hakeem měla za provozu nejnižší procento, právě (6,67 %). Nejdůležitější fází je třídění, skladování a přeprava nemocničního odpadu. Je nutné pochopit, proč se s každým druhem odpadu nakládá tak, jak má. Výsledkem může být bezpečné a efektivní nakládání se zdravotnickým odpadem a splnění požadavků na ochranu společnosti a životního prostředí.

Klíčová slova: Zdravotnický odpad, nemocnice, nebezpečný odpad, odstranění.