



TECHNIUM
SOCIAL SCIENCES JOURNAL

Vol. 29, 2022

**A new decade
for social changes**

www.techniumscience.com

ISSN 2668-7798



9 772668 779000

Quantitative and environmental analysis of hospital waste management in southern Algeria

Youb Okkacha, Said Bouarfa, Khaouani Boumediane

Center for Scientific and Technical Research in the Dry Areas (CRSTRA) University Campus, BP 1682 - 07000 Biskra RP (Algeria).

Email: said_bouarfa_07@hotmail.com , okachayoub@gmail.com

Abstract. The economic and social development that Algeria has experienced in recent years has generated large quantities of waste, including special waste. Despite the efforts and the laws promulgated, their management and treatment are difficult. This article analyzes the state of hospital waste management in Algeria and particularly in the communes of the Laghouat wilaya located in the Algerian south. The evaluation of the associated socio-environmental impacts shows that the quantity of hospital waste produced in the Laghouat wilaya amounts to nearly 163 tons/year. The results indicate 151 tons/year of healthcare waste, 0.57 tons/year of expired drugs, 10 tons/year, 2256 liters/year of radiology liquids. The production of these harmful materials has become a source of problems, at the same time of insalubrity and public health. Indeed, the inadequacies in the management of these special residues contribute globally to a degradation of the quality of the environment and, more precisely, to visual and olfactory pollution and potential impacts on human health. Faced with this situation and to minimize environmental and health risks, this work proposes recommendations and modalities for better and more rigorous management of hospital waste to all actors concerned and through the various health institutions of the Laghouat wilaya.

Keywords. hospital waste, healthcare activity, risk, sustainable management, Laghouat, Algeria

1. Introduction

Hospitals and other health care facilities, laboratories and research centers, morgues and autopsy centers, research facilities and laboratories that test on animals, blood banks and blood collection services, and care facilities for the elderly are the major sources of healthcare waste [1], which is generally classified into two categories, infectious waste and medical waste [2]. These health care establishments generate an increasing quantity of waste, leading to particular constraints, particularly due to its infectious nature [3]. This waste is waste from diagnostic, monitoring, preventive, curative, or palliative treatment activities in human and veterinary medicine [4]. These wastes present an infectious risk [5]. They can also present chemical, toxic, or even radioactive risks [6]

Healthcare waste comprises sharp objects, blood, chemicals, pharmaceuticals, radioactive products, all placentas, and another human anatomical waste corresponding to human fragments [7]. Poor management of this waste exposes anyone who comes into contact with it to the risk

of infection, contamination by various viruses, and injury, in addition to the damage caused to the environment, notably by the contamination of soil, water resources, and air [8]. A significant part of this waste is deposited uncontrolled in internal “landfills” which generate gaseous emissions and leachates likely to induce environmental and health impacts [9]. Leachates, waste liquids discharged from hospital facilities, are vectors of pollution [10].

The average amount of hazardous waste per hospital bed per day is 0.5 kg in high-income countries and 0.2 kg in low-income countries [11]. However, hazardous and non-hazardous waste are rarely separated in low-income countries, and hazardous waste is much higher. To dispose of the medical waste, the producer can either use a collection service provider who will take charge of it and transport it, take the medical waste to a declared collection site, or make the medical waste commonplace through pre-treatment thorough disinfection of the waste [12]. The cost of managing this type of waste is four times higher than for household waste: one tonne of medical waste costs between 500 and 1000 euros, i.e., 3 to 5 times more than one tonne of household and similar waste (between 150 and 200 euros) [13].

2. Material and methods

2.1. Study Area

Algeria is located south of the Mediterranean Sea, in northwest Africa, and the center of the Maghreb region. It is the largest country in Africa in terms of surface area, with 2,381,740 km² (3% is arable land and 85% is desert) [14]. Laghouat is an Algerian wilaya with the same name as its chief town. Located in the center of the country, 400 km south of the capital Algiers (Figure 1), it covers an area of 25,000 km² (fig1). With a desert climate, it is a

pastoral region with the largest natural gas deposit in Africa, an estimated reserve of several billion cubic meters [15]. In 2010, the population count of the wilaya was 520,188 inhabitants, representing a density of 20 inhabitants per km² [16].

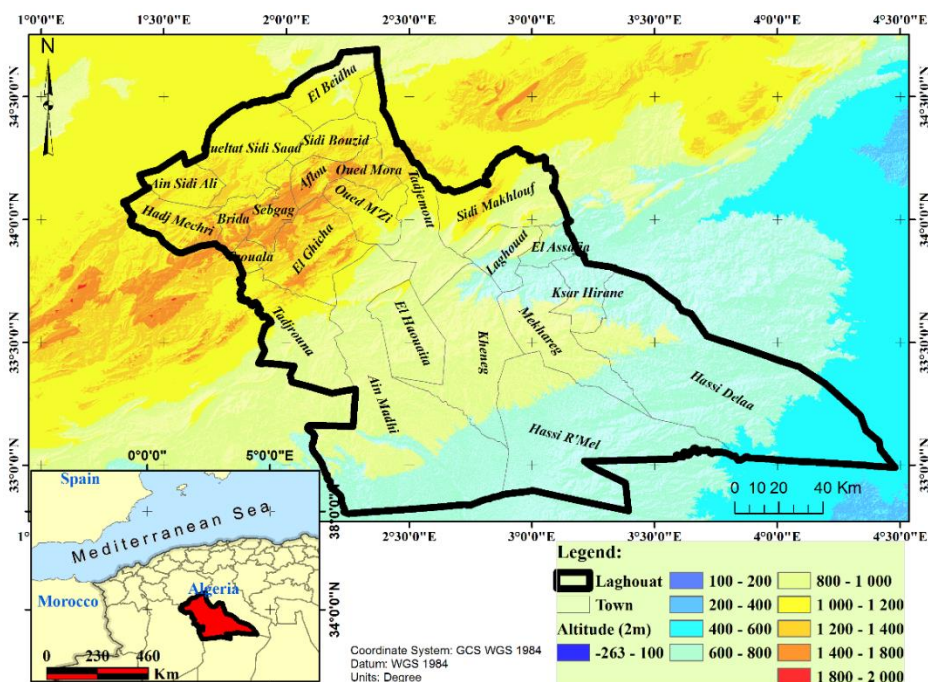


Figure 1: location of the of The Study area

2.2. Data collection and methodology

The health sector of the Laghouat wilaya is managed by a Directorate of Health and Population (Direction de la Santé et de la Population, DSP). There are 58 directorates in Algeria. The healthcare infrastructure (hospital establishments) of the Laghouat wilaya is classified into seven sectors (Table 1). It includes 2 Public hospitals (Etablissement public hospitalier EPHs) located in Laghouat and Aflou, 7 local public health facilities (Etablissements publics de santé de proximité, EPSPs), 29 polyclinics, 52 wards, 10 maternity wards, 89 pharmacies. The Laghouat wilaya has 2 hospitals with a total of 565 beds located in the two urban centers of Laghouat and Aflou, i.e., an average of 1.08 beds per 1,000 inhabitants, and 7 EPSPs located throughout the communes of Laghouat, Ksar Hirane, Hassi Delaa, Ain Madhi, Aflou, Gueltet Sidi Saad, and Brida (Figure 2).

The hospital waste generated by these sectors are classified into four categories:

- A: waste assimilated to the household wastes coming from the canteen, the administration, etc.
- B: waste specific to hospitals (anatomical) containing blood, secretions, or excretions
- C: contaminated waste (wastes from service of infections, dialysis, etc.)
- D: special and radioactive waste

The four categories are mentioned in the Algerian Executive Decree 03-478 of 8 December 2003, defining the modalities of health care waste management [17]. They are classified according to the Algerian executive decree 06- 104 of 28 February 2006, which sets the nomenclature of waste, including special hazardous waste , which can be divided into two types [18]. On the one hand, we can note the domestic and non-contaminated waste. On the other hand, we note the waste of care activities with infectious risks that must be eliminated under specific conditions. Therefore, it is important to emphasize the alarming nature of the dangers associated with the partial and very unorganized destruction of these two types of waste, despite the enormous efforts to improve sanitary infrastructure [19].

Table 1: Distribution of the healthcare infrastructure in Laghouat wilaya.

Sector	Commune	Polyclinics	Wards	Maternities	EPHs
Laghouat	Laghouat	6	4	1	1
	Sidi Makhoulouf	1	3	1	
	El Assafia	1	2		
	Kheneg		1		
Total / Laghouat Sector		8	10	2	1
Ksar El Hirane	Ksar El Hirane	1	2	1	
	Ben Nacer / Benchohra	1	2		
Total / Ksar El Hirane Sector		2	4	1	0
Hassi Dalaa	Hassi Delaa	1			
	Hassi R'Mel		3	1	
Total / Hassi Dalaa Sector		1	3	1	0
Ain Madhi	Ain Madhi	1		1	
	Tadjmout	1	1	1	
	El Houita		1		
	Oued M'Zi	1			
	Tadjrouna		1		
Total /Ain Madhi Sector		3	3	2	0

Aflou	Aflou	5	7	1	1
	Sidi Bouzid	1	2		
	Sebgag	1	3		
	Wadi Morra	1	3		
Total /Aflou Sector		8	15	1	1
Brida	Brida	1	3		
	Taouiala	1	2	1	
	El Ghicha	1	4	1	
	Hadj Mechri	1	5		
Total /Brida Sector		4	14	2	0
Gueltet Sidi Saad	Gueltet Sidi Saad	1	3	1	
	Ain Sidi Ali	1			
	Beidha	1			
Total /Sidi Saad Sector		3	3	1	0

3. Results and discussion

3.1. Quantitative study

The annual quantity of waste from health care activities distributed over the seven sectors according to the classification of the Public Health Establishment of the wilaya of Laghouat (Figure 3) exceeds 163 tons/year (Table 2), and the daily quantity is 447 kg/day (Table 3, Figure 4).

Table 2: Annual amount of waste in the health sector.

Sectors	Quantity (tons/year)
*Laghouat	80.5
*Ksar El Hirane	12
*Hassi Delaa	1.8
*Ain Madhi	3.2
*Aflou	27.5
*Brida	19
*Gueltet Sidi Saad	19
Total	163

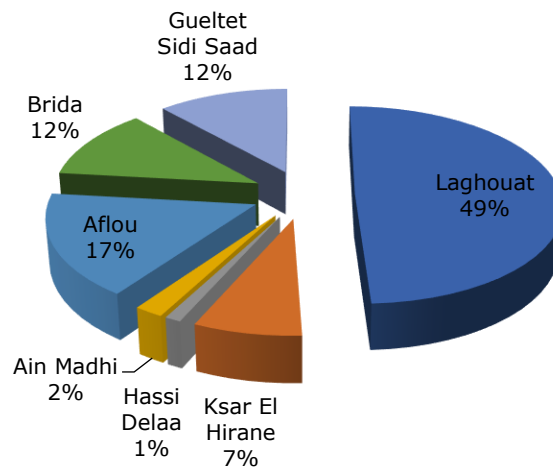


Figure 3: Annual waste amount/sector.

Table 3: Daily amount of waste in the health sector.

Sectors	Quantity (kg/day)
*Laghouat	220
*Ksar El Hirane	33
*Hassi Delaa	5
*Ain Madhi	9
*Aflou	75
*Brida	52
*Gueltet Sidi Saad	53
Total	447

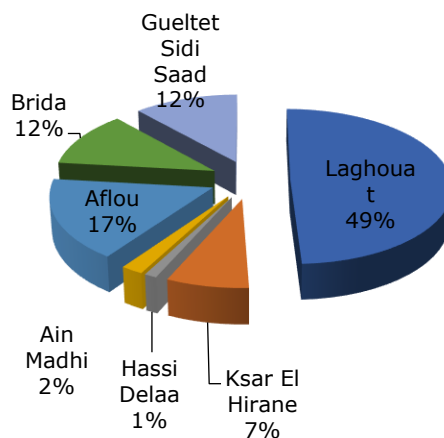


Figure 4: Amount of daily waste/sector.

Table 4: Global quantification of healthcare waste in the Laghouat wilaya.

Sector	Establishment	Health-care waste (tons/year)	Expired drugs (tons/year)	Placentas (tons/year)	Radiology fluids (liters/year)
* Laghouat sector	EPSP	40,15	0,15		576
	EPH	34,675	0,38	4,599	
* Sector Ksar El Hirane	EPSP	10,22		1,277	624
	EPH				
*Hassi Dalaa sector	EPSP	1,825			
	EPH				
*Ain Madhi sector	EPSP	3,285			
	EPH				
*Aflou sector	EPSP	21,9			
	EPH	2,425	0,04	2,555	624
*Brida sector	EPSP	18,25		0,51	144
	EPH				
*Sidi Saad sector	EPSP	18,25		0,511	288
	EPH				
Total		150,98	0,57	9,452	2256

3.2. Qualitative study

There is a lack of knowledge about appropriate packaging for hazardous waste collection in these health care facilities. Unsealed and vented bags, old buckets, recycling boxes, cardboard boxes, etc., can be found. Standardized materials do not exist in the departments. Sorting is not done at the source. Indeed, the first preventive gesture normally consists in putting sharp and prickly waste such as scalpels, mounted syringes, blood tubes, blood glucose clips, staples, etc. in single-use, sealed yellow containers bearing the universal pictogram (infectious risk). For soft waste such as compresses, cotton, gloves, masks, catheters, infusion bags, dressings, etc., they should be placed in rigid cardboard boxes, lined with plastic bags, and filled to prevent them from being opened. These containers should never be left on the floor. Storage, transportation, and disposal of this waste must be done according to standards.

3.3. Environmental management aspect

This study concerns the wilaya of Laghouat for a total of 189 hospitals. The report is damning: some hospitals have recourse to the single use (non-woven) of linen, especially in the operating room, thus increasing the risk of nosocomial infections. Disposable clothes are available on the Algerian market, but their price remains relatively high because of the 30% customs tax they are subject to. Storage facilities exist only in some hospitals. As for the mode of transport of this waste, the bags of waste are dragged by hand, transported in carts, tractors with trailers, wheelbarrows, etc., without any precautions being taken to protect the staff who seem to be unaware of the risk.

3.4. *Review of treatment aspects*

Of the 236 incinerators in hospitals nationwide, 64 incinerators are not functioning. An incentive tax for the removal of waste from health care activities has been introduced, amounting to 150 euros /ton of stored waste. The hospitals of Laghouat; the two EPHs Laghouat and Aflou, the two EPSPs of Ksar El Hirane and Ain Madhi; have the means of treatment of waste by incineration with an incineration capacity that varies according to the type of incinerator adopted for each sector: 112 kg /h for the sector of Laghouat, 5 kg /h for the sector of Hassi Dalaa, 76kg /h for the sector of Aflou, 52 kg/h for the sector of Brida, 52 kg /h for the sector of Gueltet Sidi Saad. The choice of incineration is in accordance with the Algerian legislation in force.

4. **Conclusions and recommendations**

A risk management program must be implemented immediately in all healthcare facilities to control the various risks induced by waste from health care activities and minimize the quantity at the source. The main risks induced by waste are characterized by the physical risk (in particular accidental cuts and pricks), the biological risk (infectious risk and risk of contamination), the chemical-toxic risk, the radioactive risk, the ecotoxic risk, and the risk of violation of the privacy of the patient or the nursing staff.

In light of the above observations made during the course of the research, a number of recommendations are made in the hope of improving medical waste management. Several recommendations could improve the operational efficiency of hospitals in medical waste management. It is important to periodically measure and quantify the amount of medical waste generated in each unit of the hospital to determine which unit or department generates the largest and smallest amount of waste. This may have implications for resource allocation in medical waste management.

In addition, proper segregation of infectious and non-infectious medical waste is necessary. It is necessary to provide plastic bags and solid plastic containers for infectious waste, such as empty antiseptic containers used in the hospital. Infectious waste bags and containers must be marked with the Biohazard symbol. A standardized system of red color-coded bags used for the segregation of hazardous waste should be used and strictly followed. Implementing segregation practices within the hospital will result in a clean waste stream that can be easily, safely, and cost-effectively managed.

Furthermore, it is important to have an effective sharps management system, including appropriate equipment and containers at all points of sharps generation, a secure accounting and collection system for transporting contaminated sharps for treatment and final disposal, and appropriate training of hospital staff in handling and management. Regular training and education of all workers, from physicians to laborers to waste management company employees, is also necessary to develop an awareness of health, safety, and environmental issues. It is important that workers know and understand the potential hazards of medical waste.

In addition, medical waste should be transported in suitable leakproof roll-off containers. The containers should be clearly identified and cleaned regularly. The waste should be transported in a special vehicle or in a special leakproof container with a lid. Finally, environmental health experts should be included in the infection control team and waste management experts. This will improve the ability and efficiency of the infection control team to conduct its operations.

References

- [1] A. P. Ananth, V. Prashanthini, and C. Visvanathan, "Healthcare waste management in Asia," *Waste management*, vol. 30, pp. 154-161, 2010.
- [2] M. M. Hasan and M. H. Rahman, "Assessment of healthcare waste management paradigms and its suitable treatment alternative: a case study," *Journal of environmental and public health*, vol. 2018, 2018.
- [3] C. Corvalan, E. Villalobos Prats, A. Sena, D. Campbell-Lendrum, J. Karliner, A. Risso, S. Wilburn, S. Slotterback, M. Rathi, and R. Stringer, "Towards Climate Resilient and Environmentally Sustainable Health Care Facilities," *International Journal of Environmental Research and Public Health*, vol. 17, p. 8849, 2020.
- [4] S. O. Abah and E. I. Ohimain, "Healthcare waste management in Nigeria: A case study," *Journal of Public health and Epidemiology*, vol. 3, pp. 99-110, 2011.
- [5] Y. A. Youb okkacha, Bouabdessalam Hassiba,, "Municipal waste management in the Algerian high plateaus," *Energy Procedia*, vol. 50, pp. 662-669, 2014.
- [6] M. R. Khan and Z. Raza, "Socio-economic impact of improper hospital waste management on waste disposal employees," *Pakistan Journal of Medical Research*, vol. 50, 2011.
- [7] M. Ali and C. Kuroiwa, "Status and challenges of hospital solid waste management: case studies from Thailand, Pakistan, and Mongolia," *Journal of Material Cycles and Waste Management*, vol. 11, pp. 251-257, 2009.
- [8] Y. o. Youb Abderrahmane, Bouabdessalam Hassiba,, "Sustainable solid waste management in the city of Mecheria (Western Algeria)," *Energy Procedia*, vol. 50, pp. 953-959, 2014.
- [9] S. R. Shrivastava, P. S. Shrivastava, and J. Ramasamy, "World Health Organization appeals to international stakeholders to streamline the mechanism for the management of health-care waste," *Sifa Medical Journal*, vol. 3, p. 58, 2016.
- [10] V. Di Bella, M. Ali, and M. Vaccari, "Constraints to healthcare waste treatment in low-income countries—a case study from Somaliland," *Waste management & research*, vol. 30, pp. 572-575, 2012.
- [11] W. Xing, W. Lu, Y. Zhao, X. Zhang, W. Deng, and T. H. Christensen, "Environmental impact assessment of leachate recirculation in landfill of municipal solid waste by comparing with evaporation and discharge (EASEWASTE)," *Waste management*, vol. 33, pp. 382-389, 2013.
- [12] M. K. Debere, K. A. Gelaye, A. G. Alamo, and Z. M. Trifa, "Assessment of the health care waste generation rates and its management system in hospitals of Addis Ababa, Ethiopia, 2011," *BMC Public Health*, vol. 13, pp. 1-9, 2013.
- [13] W. H. Organization, "Statistiques sanitaires mondiales 2012," 2012.
- [14] S. Bouarfa and S. A. Bellal, "Assessment of the Aeolian sand dynamics in the region of Ain Sefra (Western Algeria), using wind data and satellite imagery," *Arabian Journal of Geosciences*, vol. 11, pp. 1-16, 2018.
- [15] M. Laouadi, S. Tennah, N. Kafidi, N. Antoine-Moussiaux, and N. Moula, "A basic characterization of small-holders' goat production systems in Laghouat area, Algeria," *Pastoralism*, vol. 8, pp. 1-8, 2018.
- [16] Z. Houyou, C. L. Biolders, H. A. Benhorma, A. Dellal, and A. Boutemdjet, "Evidence of strong land degradation by wind erosion as a result of rainfed cropping in the Algerian steppe: a case study at Laghouat," *Land Degradation & Development*, vol. 27, pp. 1788-1796, 2016.

- [17] L. C. d. Gouvernement, "Décret n° 03/478 du 9 décembre 2003 définissant les modalités de gestion des déchets d'activités de soins," vol. 78, pp. 4-7, J. o. d. l. R. algérienne, Ed., ed: Journal officiel de la République algérienne, 2003, pp. 78, pp. 4-7.
- [18] L. C. d. Gouvernement, "Décret Exécutif n° 06/104 du 28 février 2006 fixant la nomenclature des déchets, y compris les déchets spéciaux dangereux," vol. 13, pp. 9, Journal Officiel de la République Algérienne (JORADP), Ed., ed. Journal Officiel de la République Algérienne (JORADP),, 2006, pp. 13, pp. 9.
- [19] S. Chattopadhyay, A. Dutta, and S. Ray, "Municipal solid waste management in Kolkata, India—A review," *Waste management*, vol. 29, pp. 1449-1458, 2009.