The Problem of Medical Waste Management in Algerian Healthcare Institutions

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Abstract :
Medical waste constitutes one of the most critical environmental and health challenges facing healthcare institutions due to its hazardous nature and its direct impact on humans and the environment. This research aims to examine the reality of medical waste management in Algerian healthcare institutions by analyzing the adopted mechanisms of collection, transportation, and treatment. It also seeks to explore future prospects for improving this management by proposing practical and organizational solutions that align with international standards and the requirements of sustainable development. This work emphasizes the importance of developing an integrated framework that balances health and environmental considerations in an effective manner.

Keywords: : problematic ;Sustainable Management ;Medical Waste ;Healthcare Institutions.

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Introduction:

The environment is one of the prominent issues that occupies the entire world, due to its significance; it is the vessel in which humans live and the sole factor for the existence of life on Earth. Without it, life cannot exist. However, today the environment faces numerous problems, including pollution, global warming, desertification, and the increasing volume of waste in its various forms, among others, which threaten human life and pose a danger to living organisms in general. Therefore, it has become a concern for researchers, scientists, and various organizations to think about the trajectory it will take in the future. Preserving natural resources and meeting the requirements of human life, such as water, food, and healthcare, in addition to ensuring the safety of air, water, and soil, is essential. ... among the serious pollutants affecting both human health and the environment due to the technological and economic development occurring today, as well as population growth. The issue of waste in all its forms (solid, liquid) is continuously increasing, particularly medical waste, which is produced in large quantities in various healthcare institutions and is often disposed of in chaotic ways. This has made it one of the greatest challenges facing the environment on one hand and healthcare institutions on the other, due to the severe consequences it entails. Since the environment is considered the foundation of sustainable development, it is essential to understand the level of awareness regarding sustainable health development and the goal of providing a healthy and clean living environment. Therefore, mechanisms and methods for managing and treating medical waste must be established. This is what we have attempted to address in this research paper by posing the following main question:

What is the current state of medical waste management in Algerian healthcare institutions?

Under this, the following questions arise:

Is there a management system for medical waste in healthcare institutions?

What mechanisms and methods are used for managing medical waste in healthcare institutions?

What are the obstacles that hinder the efficient and effective management of medical waste in healthcare institutions?

Importance of the study:

The importance of the study is highlighted by the significance of the topic itself. Managing medical waste in the healthcare environment and attempting to control it is a very important subject that should be emphasized and given considerable attention, especially in light of the advancements in the medical sector and the risks associated with handling it, as it carries diseases, infections, viruses, etc., all of which pose a danger to human health and contribute to environmental pollution.

Objectives of the Study:

- To shed light on the reality of medical waste management within healthcare institutions.
- To analyze the risks resulting from medical waste, both to humans and the environment.
- To propose sustainable management mechanisms for medical waste that contribute to reducing harm and protecting public health and the environment.
- To enhance awareness of the importance of proper medical waste management, both at the individual and institutional levels, by promoting a culture of prevention.
- To diagnose negative points and weaknesses in the methods of managing and handling medical waste in healthcare institutions.
- To open avenues for research into future challenges related to medical waste, especially in light of rapid health, technological, and environmental transformations.

1- Definition of the basic concepts of the study:

1-1 Concept of the problem:

_ Procedurally:

It is a central question from which the research starts to diagnose an existing flaw or difficulty in the reality of managing medical waste within healthcare institutions. It is expressed through the formulation of a main question that reflects the existence of an actual problem and directs the study towards analyzing the causes and identifying possible ways to improve and develop the situation.

1-2 Concept of sustainable management:

_ Procedurally:

Sustainable management of medical waste is the set of policies, practices, and techniques adopted in the collection, transportation, and treatment of this waste, ensuring the reduction of its health and environmental risks while preserving resources.

1-3 Concept of Medical Waste:

- Definition:

- The World Health Organization defines it as: "waste produced by facilities that provide various healthcare services, laboratories, pharmaceutical production centers, pharmaceutical preparations and vaccines, veterinary treatment centers, research institutions, and home care (Ali Zahran, Abu Al-Judail, 2004,pp 23-25)."
- "Medical waste is everything that results from medical activities and can potentially lead to environmental pollution or harm the health of living beings" (Wahba and Abassi, 2006 ,p66).

- Procedurally:

It encompasses all waste generated from medical and therapeutic activities within healthcare institutions that require special treatment methods due to their potential hazards to health and the environment. This waste includes sharp materials, biological and chemical substances, medications, etc., and is handled according to specific procedures for collection, transportation, processing, and final disposal.

1-4 Concept of the Healthcare Institution:

- Terminologically:

- The Algerian legislator defines it in Article One of Executive Decree No. 07-140 dated May 19, 2007, which establishes the organization and operation of public healthcare institutions and public community health institutions as: "A public institution of an administrative nature that enjoys legal personality and financial independence and is placed under the authority of the governor" (Official Gazette, 2007).

- According to the World Health Organization, it is: "An essential part of a social medical organization whose function is to provide comprehensive healthcare to the population, both curative and preventive, extending its outpatient services to homes, and also serving as a center for training the health workforce and conducting social and biological research" (Ghazi, 1999 ,p. 6).

Operationally:

It is a healthcare unit that provides diagnostic, treatment, and follow-up services to patients and operates according to a defined administrative structure, which includes medical and administrative departments that work to provide care for patients, receive them, and ensure health and environmental safety, including the management of medical waste.

2- Types of Medical Waste

The types and classifications of medical waste vary according to their danger and nature. Perhaps the most prominent types of medical waste are:

- **Sharp medical waste:** This type of waste is considered dangerous due to its harmful nature and directly includes needles, scalpels, and blades used in operating rooms and healthcare settings.

- **Waste generated from the pathology department:** This waste typically includes human living tissues or body organs and fluids, in addition to corpses and others.

- **Infectious waste:** This type of waste is contaminated with pathogens or body fluids such as blood, and includes remnants of laboratory samples, medical swabs, and animals infected with diseases in research centers, among others.

- **Radioactive waste:** This waste is often produced from the radiation therapy of patients and contains hazardous radioactive elements.

- **Toxic and harmful cell waste:** This type of waste includes treatments that affect the body's cells, such as chemotherapy for cancer cells.

- Pharmaceutical waste: This includes preparations and medications that were used during treatment or expired before use.

- Chemical waste: Such as tools used in sterilization and health tools like mercury thermometers.

3- Stages of Medical Waste Management:

3-1 Sources of Medical Waste Production:

The sources of medical waste production are diverse and include medical facilities, treatment rooms, research centers, etc. They can be categorized into:

- Primary Sources: These include hospitals, emergency services, clinics, private health facilities, health centers specializing in vaccinations and immunizations, maternity centers, delivery clinics, dialysis units, diabetes care services, medical laboratories, etc.

- Secondary Sources: These consist of independent medical practices using medical examination tools, small dental clinics, home healthcare, mental health clinics, beauty and tattoo centers, acupuncture services, burial services, rehabilitation centers for the disabled and individuals with special needs.

3-2 Collection of Medical Waste:

Medical waste is collected periodically and appropriately, or as needed, at least once a day. It is important to emphasize that the use of hand carts should not be encouraged, as it can lead to spills, posing a risk to human health and the environment. The recommended practice for transporting waste within hospitals (Othigo, 2014) is to use designated carts, ensuring that separate carts are used for infectious waste.

To organize the collection and transportation of medical waste, a number of health regulations and international organizations have established a set of standards that must be adhered to during the collection and transportation of medical waste within the healthcare facility, which we summarize as follows**:**

- Education and training must be provided for all waste transport workers, including how to safely handle leaking or broken waste containers.
- Health workers must wear appropriate personal protective equipment when collecting waste.
- Alternative bags or containers must be provided to replace the full ones.
- Waste bags should be collected after filling them to three-quarters full by tying the neck with self-sealing plastic ties.
- Sharp waste must be collected when the containers are filled to the designated fill line or three-quarters full if there is no designated line.
- Infectious waste bags must be labeled with the date, type of waste, and point of generation to allow for tracking until disposal.
- Ensure that waste bags arrive closed and intact at the end of the transport process.
- Designated routes should be used to prevent exposure to staff and patients and to reduce the passage of loaded carts through patient care and other clean areas.
- Different types of waste must be transported separately.
- Patients and other clean areas should be respected.
- Different types of waste must be transported separately in carts designated for each type.
- Waste bins should be equipped with handles for ease of handling and collection.
- The size of medical waste bins should be appropriate for easy carrying, lifting, and emptying.
- Medical waste should be transported from its generation points to the central storage room within the healthcare facility at regular and appropriate intervals.
- Medical waste within the healthcare facility should be collected and transported using designated carts or containers (sealed).

To facilitate the safe disposal of medical waste, it should be collected in bags of different colors as follows:

Yellow bags: Many types of medical waste are placed in yellow bags, primarily; infectious and contaminated waste, chemicals, any waste related to medical laboratories, as well as expired medications. These are collected according to their type, either in plastic bags, plastic containers, or bins, all of which are yellow, indicating how to handle them safely.

Red bags: Contaminated medical waste made from recyclable materials is collected in these bags for sterilization and then recycled appropriately.

White or transparent bags: Sharp instruments are disposed of in these white bags, often placed inside special containers with a hole for disposing of sharp instruments. These instruments are then shredded as they can cause injuries to those handling them, posing risks. After shredding with special machines, they are sterilized and disposed of.

Blue bags: All medical laboratory glassware and instruments are placed in these blue bags. These waste items may be categorized with sharp waste since they can also be sharp in one way or another, but it is preferable to separate them because they do not necessarily carry the same level of contamination and danger as those instruments and may require simpler sterilization processes.

3-3 Transporting medical waste:

Medical waste is transported outside the healthcare facility by designated personnel who have special protective equipment to avoid any risk of infection.

4- Health and Environmental Risks of Medical Waste:

4-1 On Human Health:

Medical waste poses a serious threat to human health, especially when poorly managed or lacking safety measures during collection, transportation, and storage. This waste, containing toxic materials, germs, and viruses, can lead to the transmission of infectious and dangerous diseases, such as viral hepatitis, which spreads easily through unsterilized medical instruments like needles. Additionally, it can cause skin diseases and fungal infections resulting from direct contact with contaminated medical tools, dressings, and more. The effects are not limited to patients alone; they also encompass healthcare workers, sanitation workers, and users, who are among the most vulnerable groups to these dangers. In the absence of adequate protective measures and safety equipment, the likelihood of infection increases, especially given the rising prevalence of this type of waste being discarded into the environment without treatment. The risks do not stop there, as this waste can lead to psychological disorders due to inhaling vapors and toxic gases emitted from chemical waste, as well as burns and skin injuries caused by radioactive waste. Sharp waste, such as used needles, is among the most dangerous types of waste, as studies have shown that exposure to a single contaminated needle stick from a used needle on an infected patient carries a 30% risk of contracting hepatitis virus, with a 1.8% chance of acquiring acquired immunodeficiency syndrome (AIDS).

4-2 On the Environment:

The impact of medical waste is not limited to human health alone; it also poses a real threat to the environment. Improper disposal methods can lead to environmental pollution. When disposing of medical waste, it is essential to keep it away from water sources. If incineration is chosen, proper burning methods must be employed to prevent the release of toxic gases, such as chlorine and others, which are considered carcinogenic to humans and cause serious environmental disturbances.

These emissions contribute to air, water, and soil pollution, exacerbating the greenhouse effect, while also harming surrounding ecosystems by affecting microorganisms, plants, and animals. This makes the environment vulnerable to degradation in the future and puts its fate at risk unless sustainable and effective management mechanisms are adopted to treat this waste and mitigate its escalating impacts.

5- Methods of Disposing of Medical Waste:

5-1 Incineration: This method relies on converting all waste made of combustible materials into ash by using high temperatures under suitable conditions. Medical waste can be disposed of in this way either within the same medical facility or externally. This method is the most common due to its high effectiveness in eliminating all traces of medical waste, destroying the germs associated with it, and reducing its size and weight. It is important to note that this technique requires careful environmental monitoring, as well as the operation of incinerators by qualified technicians who are trained to handle this method and are aware of the dangers posed by the pollutants generated by incineration.

5-2 Autoclave Sterilization Systems: This method relies on the power of heat generated by saturated steam, combined with sufficient pressure to ensure the destruction of microorganisms in the waste, thus eliminating its danger. However, a drawback of this method is that it is not suitable for treating tissue pieces and waste used in chemical therapies.

5-3 Radiation or Microwave Treatment Systems: This method involves first spraying the waste with water, then exposing it to microwaves within a closed system. This process heats the water and waste to a sterilization temperature, thanks to the heat generated by microwave radiation.

5-4 Chemical Treatment Systems: This method involves shredding the waste using a special cutting device and spraying it with a chemical for a sufficient period to ensure the destruction of microorganisms, followed by drying.

-According to the World Health Organization:

Healthcare activities protect health, restore it, and save lives. But what about the waste and by-products they generate?

Eighty-five percent of the total amount of waste resulting from healthcare activities is general non-hazardous waste similar to household waste. The remaining 15% is considered hazardous materials that may be infectious, toxic, carcinogenic, flammable, corrosive, reactive, explosive, or radioactive.

Measures to ensure the safe and environmentally sound management of radioactive waste can help prevent the harmful health and environmental effects caused by this waste, including its potential chemical or biological hazards.

6-Examples of Medical Waste Legislation Worldwide

6-1United Kingdom

In Britain, medical waste and its handling are highly regulated. The applicable legislation includes the Environmental Protection Act 1990 (Part II), the Waste Management Licensing Regulations 1994, the Hazardous Waste (England and Wales) Regulations 2005, as well as specific waste regulations in Scotland.

6-2United States of America

In the United States, medical waste is typically categorized as biohazardous waste. In 1988, the U.S. federal government enacted the Medical Waste Tracking Act, which established standards for governmental regulation of medical waste. Following the expiration of the 1991 Act, states were given the responsibility to regulate laws concerning the disposal of medical waste.

6-3India

The Medical Waste Management Act in India, enacted in 1998, along with subsequent amendments, was introduced to regulate the management of medical waste. Each Pollution Control Board in every city is responsible for the implementation and enforcement of this new legislation.

There are numerous methods for disposing of waste in India, but most are harmful rather than beneficial. If bodily fluids are present in the waste, they need to be incinerated or treated with sterilization devices. Although this is the correct approach, most healthcare institutions fail to comply with the laws and regulations.

In India, the Bio-Medical Waste (Management and Handling) Rules have been in effect since 1998, and many healthcare institutions have been found to incorrectly segregate waste.

6-4Algeria

Like other countries around the world, Algeria is obligated to protect the environment. Consequently, several legislations concerning environmental protection have been issued, ranging from the Environmental Protection Law of 1983 to the Waste Management Law of 2001, among other decrees. Waste is considered one of the most significant threats to the environment, with hazardous waste being particularly dangerous.

In therapeutic activities, or what is referred to as medical waste, the Algerian legislator has organized methods for managing and disposing of it. According to Law No. 01-19 concerning the management, control, and removal of waste, this text is the first specific law regarding all types of waste, including medical treatment waste, which is defined broadly as "all waste resulting from examination, monitoring, preventive or therapeutic activities in the field of human and veterinary medicine."

Referring to Article 18 of Chapter Two of this text, we find that the legislator classified medical treatment waste as special waste, defined in Article 05, which includes hazardous special waste. This classification requires that medical treatment waste be managed specifically, with its disposal being the responsibility of the

producing institutions. The disposal process must be conducted in a manner that avoids harming public health or the environment.

According to Executive Decree No. 03-47 concerning the management of medical waste, the sustainable management system for medical waste aims to protect the environment in Algeria. It encompasses various techniques and methods that establish environmental quality standards used by the sustainable management system for medical waste.

7- Principles of sustainable management of medical waste:

- Principle of non-degradation of natural resources: This is stipulated in Article Two of Law No. 10-03 concerning the environment in its second paragraph, which states that the principle of non-degradation of natural resources requires preventing harm to natural resources such as water, air, land, and the subsurface.

The land, which is considered an integral part of the development process in all cases, should not be taken in isolation when achieving sustainable development.

- Principle of Substitution:

This involves replacing a hazardous and environmentally harmful activity with a less harmful one, chosen despite its higher cost.

- Polluter Pays Principle:

According to this principle, every person whose activity causes or may cause environmental harm bears all the costs of remedying that harm.

- Source Reduction Principle:

This principle aims to minimize waste to the lowest possible level by legally prioritizing waste prevention over any other solution whenever feasible.

- Waste Valorization Principle:

This involves recycling waste for reuse by transforming it into new goods and materials.

- Principle of Disposal of Non-Valorizable Waste:

According to Article 02 of Law 01-19, the management, monitoring, and disposal of waste are based on the following principles: organizing the sorting, collection, transportation, and treatment of waste.

- Valorization of waste through reuse or obtaining energy from rational waste treatment.

Informing and raising awareness among citizens about the dangers resulting from waste and its effects on health and the environment, as well as the measures taken to prevent these dangers and mitigate or compensate for them.

8- Sustainable management system for medical waste

The structure of the sustainable management system for waste depends on defining the tasks and responsibilities assigned to the parties involved in the system, as well as outlining its methodology and determining the management plan in official documents, which is linked to its completion by monitoring the work carried out by a responsible entity.

- Tasks and responsibilities of members of the sustainable medical waste management system:

The primary responsible person authorized to make decisions and manage waste is the director of the health facility, regardless of their title. Their responsibilities include ensuring the implementation of the waste management plan and overseeing the establishment of a contingency plan for potential emergencies.

Sufficient resources must be allocated to ensure the application of their plans and to adapt to any changes in circumstances as needed. The plan is prepared in writing by specialists, clearly defining the responsibilities of each member to facilitate proper oversight and accurate execution of the plan.

In the absence of any core team member, a direct substitute must be appointed, with temporary responsibility confirmed by an oath.

Additionally, the daily execution and ongoing monitoring of the waste management system is overseen by a responsible manager who maintains direct contact with individuals in healthcare institutions. This facilitates their task and fosters relationships with officials from other departments, as they are considered responsible after the director of the institution.

Methodology for the Sustainable Management of Medical Waste System:

The sustainable management of waste is carried out in collaboration with the responsible person and their committee, which is formed in accordance with the legislation. It begins with an analysis of the waste situation within the facility.

9- Examples of the reality of medical waste management in some public health institutions: from the Wilaya of Annaba

-Abu Bakr Al-Razi Hospital:

The management of medical waste is conducted in a manner that violates the agreed-upon standards, as medical waste is not collected and sorted properly. Instead, it is gathered randomly in bags (needles, medications, dressings, laboratory waste, etc.) and either discarded or transported to be incinerated within the hospital.

- Ibn Sina Hospital:

Ibn Sina Hospital lacks a precise sorting system for managing medical waste. The hospital building itself suffers from fragility (worn-out ceilings, leaking water pipes, etc.), not to mention departments that lack systematic protocols, such as the absence of protective equipment for workers and a shortage of necessary tools, leading to the improper disposal of waste. Consequently, medical waste is collected, transported, and discarded, but there is no designated area for it.

- Ibn Rushd Hospital:

Medical waste is not sorted; rather, it is collected and disposed of in a chaotic manner, and sometimes it is incinerated. The main problems facing Algerian healthcare institutions in managing medical waste include:

- The absence of a specific policy for managing and disposing of medical waste.
- Lack of oversight in enforcing regulations.
- Insufficient financial and human resources contributing to the medical waste management process.

Conclusion:

Despite the classification of medical waste as hazardous waste and the enactment of punitive laws by the Algerian state, the management of this waste

remains one of the most significant challenges facing our public healthcare institutions. Through the current study and after presenting some examples of medical waste management in certain healthcare institutions in the city of Annaba, the following conclusions can be drawn:

- There is a lack of attention to medical waste management by the officials of healthcare institutions.
- There is a failure to adhere to the standards for collecting this waste in colored bags, as well as random disposal methods for medical waste, with no assignment of specialized personnel and specific locations for its destruction according to the standards of the World Health Organization.
- The main reason is poor management and the absence of an effective strategy to address medical waste and attempt to dispose of it, which has led to severe problems for the health of citizens (users of healthcare institutions and visitors), as well as the danger it poses to the environment, which serves as a living habitat for organisms that have been significantly affected by air, soil, and water pollution, exacerbating the suffering from various diseases.

In light of the above, we can offer some suggestions to mitigate the negative effects of this hazardous waste:

- Public authorities should take necessary measures with an effective strategy to address this deteriorating situation.
- Strict enforcement of laws related to medical waste management by healthcare institution officials and penalizing violators.
- Adherence to the standards of the World Health Organization at various stages of medical waste management (collection, transportation, and disposal methods).
- Establishing a well-structured program for managing this waste while involving all stakeholders in this matter (institutions).

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