THE WASTE CRISIS IN LEBANON

HOSPITAL WASTE MANAGEMENT STATUS IN LEBANON (facts and effects)

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Overview

1- THE WASTE CRISIS IN LEBANON

The waste crisis in Lebanon is a constant problem. It's due to the combination of corruption, poor governance and weak infrastructure seen in many countries. The history of the waste management crisis in Lebanon goes back several decades, with a pattern of poor government planning; inadequate support to and monitoring of waste management in areas outside of Beirut and Mount Lebanon; overuse of open dumping and burning; and a lack of transparency.

2- HOSPITAL WASTE MANAGEMENT STATUS IN LEBANON

a- Introduction

The existing management of hospital waste in Lebanon currently poses both an environmental hazard as well as a public health risk. This is due mainly to lack of legislation, information and modern treatment and disposal facilities designed for this purpose.

Environmental deterioration has become among the most pressing public and official concerns worldwide, both in developing and developed countries. In Lebanon, the environmental problems especially the disposal of hazardous hospital waste is acute due to the effects of the long war and the lack of adequate environmental policies and services (Halbwacks, 1994). There is a growing awareness, on a world-wide scale, of the need to impose stricter controls on the disposal of waste generated by hospitals and other healthcare services. Hospital waste poses a serious public health problem.

b- **<u>Materials and Methods</u>**

The total area of Lebanon is 10,452 km2, divided into five administrative areas. More than 90% of the hospitals in Lebanon are operated by the private sector of which the Ministry of Health finances 70% of the patient treatments. The remaining 30% of patient treatment are financed through private insurance or by individual. Therefore, the Ministry of Health is the largest client of the private sector.

To get more data, it inquires more details about the hospital type, size, number of beds and number of admissions per year. To study segregation, collection, storage, treatment and disposal of hospital waste, i.e. all stages from the production until final treatment. The focus of this particular data collection is on hospital risk waste according to the World Health Organisation (WHO) classification, (Table 1) generated by private general hospitals, since the non-risk waste may be collected, transported and disposed in a similar way as municipal waste.

Table (1): Typical categories of healthcare risk wastes

Risk waste category	Description	Examples
Infectious waste	Waste suspected to contain pathogens	laboratory cultures; waste from isolation wards, tissues; materials or equipment in contact with infectious patients
Pathological waste	Human tissue or fluids	body parts; blood and other bodily fluids; human fetuses
Sharps	Sharp waste	needles; infusion sets; scalpels; knives; blades; broken glass
Pharmaceutical waste - including genotoxic waste	waste substances with genotoxic properties	expired or redundant pharmaceuticals; items contaminated or containing pharmaceuticals (bottles, boxes) waste containing cytotoxic drugs; waste containing genotoxic chemicals
Chemical waste	discarded chemical substances	laboratory reagents; film developer; expired or redundant disinfectants/solvents
Pressurized containers	empty/damaged gas cylinders, cartridges and aerosol cans	
Radioactive waste	waste containing radioactive substances	unused radiotherapy/lab research liquids; contaminated

		glassware, packages or absorbent paper; urine and excreta from patient treatment/testing with unsealed radionuclides sealed sources

However, full segregation is not practiced for all risk wastes; pharmaceutical products and containers, which if not returned to the manufacturers, are disposed through the municipal waste system. Where no-risk waste disposal facilities exist, segregation is not practiced and risk waste is disposed of with non-risk waste.

c- <u>Discussion</u>

The waste management situation in Lebanon is not famous at all. In fact, only few hospitals showed practice a good segregation at source. The majority of hospitals have their own system for collect and segregation of hospital waste. Almost all hospital surveyed in the country do not pre-treat hospital waste before disposal. Majority are still practicing open dumping or inadequate landfill and finally very few hospitals are seriously considering developing programs and plans of action for adequate healthcare waste management: Handling, storage, transportation, treatment, disposal and training. The total hospital waste stream can be broadly categorized into two waste types: non-risk waste and risk waste. It has been reported by the World Health Organisation (WHO) that 75-88% of waste from hospitals falls into the non-risk waste category (comparable to domestic garbage) which can be disposed of in the municipal waste management system. The remaining 12-25% of hospital waste is comprised of those components, which are potentially contaminated with material, which has infectious, chemical or radioactive properties (World Health Organisation, Copenhagen 1983).

These waste types are defined as risk waste and must be handled and disposed in such a manner as to minimise the potential for human exposure and cross-contamination. This data provided by hospitals about their waste generation may be inaccurate, which may affect the real value of hospital waste generation (Table 3). **Estimates of the generation of hospital risk waste should be based on bed numbers, bed occupancy, segregation and waste factors. These factors can be obtained from pre-published sources using data.**

Table (2): Estimated hospital waste generation

Region	Number of Hospital	Number of beds	Risk waste Total waste* (kg/occupied bed/day)		Proportion of risk waste (%)
Beirut	35				
Mont-Lebanon	16				
North	23				
South	28				
Bekaa	22				
Total	124				

* Total waste designated mixed risk and non-risk waste.

The average of risk waste generation is 1.04 kg/occupied bed/day.

The ratio of risk waste in (kg/occupied bed/day) is calculated by: Numerator / Denominator

Numerator: weight of risk wastes in kg in a duration of time.

Denominator: (percentage of occupancy in hospitals × total number of beds in hospitals × duration of time) + number of occupied isolated beds in a duration of time.

d- <u>Risk-Management Strategy</u>

The effective implementation of a risk-management strategy places a number of requirements on the hospitals generating the risk waste. We suggest that segregation at source, at the point of generation, is the only effective method of ensuring that risk and non-risk waste are kept separate and are appropriately handled and disposed. Segregation at source may reduce volume and cost. Packaging and labeling must be carried out at the point of origin; safe disposal and handling of sharps is more important than ever especially with the risk of disease transmission (Gwyther, 1990). It is an essential element of any infection control program (Palenick et al.,1993). Good sharp disposal practice is essential in preventing accidental inoculation with blood or body fluids (Legge, 1996; Kopfer et al.,1993). Each package must be labeled to allow the type of waste to be readily identified. Manual handling at all stages of the collection and transport process must be minimized as much as possible, to avoid direct contact between staff and the public and waste materials. Procedures for in-house waste packaging, labeling and handling should be provided and such procedures should be regulated across the entire country. One of today's major dilemmas in healthcare is the disposal of hospital waste.

None of the existing disposal practices in Lebanon adequately meet the necessary standards for the safe disposal of hospital waste and protection of the environment and public health. Therefore, it is recommended that these practices be discontinued as soon as possible. In recent years, techniques have been developed to reduce human exposure to the toxic and infectious components of hospital waste. There are many options available to replace the disposal methods currently in use in the country. **The most commonly used techniques include internal segregation, containment and incineration (Phillips, 1999).** The options included technologies such as gasification, steam sterilization or heat disinfection which can be used to process certain categories of clinical waste prior to landfill-all, have advantages and disadvantages (World Health Organization, Geneva 1992). The World Health Organization outlines the main advantages and disadvantages of the treatment and disposal options (Table 3). To select the most efficient treatment method of hospital waste, composition analysis is generally considered to be the fundamental information needed (Li, et al.,1993).

Table (3): Main advantages and disadvantages of some treatment and disposal option.

Treatment/disposal method	Advantages	Disadvantages
High temperature incineration	incineration Very high disinfection efficiency; Adequate for all infectious waste, and most of pharmaceutical and chemical waste.	Incineration temperature of 800?C; Destruction of cytotoxic; Relatively high costs of investment and operation.
Steam sterilization(Autoclaving)	Environmentally friendly; Relatively low investment and operation costs	many breakdowns and bad functioning; Operation requires qualified technicians; Inadequate for anatomic waste, pharmaceutical and chemical waste or waste not easily penetrable by steam.
Microwaving and Irradiation	Environmentally friendly. Good disinfection efficiency under appropriate operational conditions;	High investment and operation costs; Potential operation and maintenance problems
Chemical sterilization	Highly efficient disinfection; Good operating conditions; Costly if the chemical disinfectants are expensive	Requirements of highly qualified technicians for operation of the process; Use of hazardous substances which

		require comprehensive safety measures; Inadequate for pharmaceutical, chemical and some types of infectious waste.

A study regarding the characteristics of hospital waste should also be done. **To realize a sustainable development within hospitals, it is necessary that the need to maintain a balance between effective infection control and a good ecological environment is recognized and supported by healthcare workers and the hospital management** (Daschner and al., 1997). Adequate training for all staff involved in the waste management chain is fundamental for the safe operation of a risk waste management system within a hospital. If staff is alerted to the correct procedures and protective clothing and equipment is provided, potentially dangerous accidents can be prevented (Burns, 1991). Responsible persons for all aspects of the waste management system must be clearly identified and appropriately trained. **Finally, individual hospitals should prepare their own written policies and measures for waste handling, appropriate to their requirements.** We agree with all requirements of hospital staff regarding hospital waste collection and treatment system and propose the elaboration of a national program of sound healthcare waste management achievable through an action plan. Before implementing of this action plan, the country has to commit itself to developing a national policy, and designate responsibility to the appropriate government authority. The Ministry of Health or the Ministry of Environment will usually serve as the principal authority, and should work closely with other relevant ministries. Policy commitment should be reflected in appropriate budgetary allocations at different government levels. The proper management of hospital waste is largely dependent on good administration and organization inside hospital. These should be supported by adequate legislation and financing, as well as active participation of trained and informed staff.

3- THE IMPACT OF WASTE INCINERATION

Viruses like AIDS or hepatitis B are quickly destroyed once they leave the host organism. Without the presence of sharp objects, such as needles, these viruses are extremely unlikely to spread. Furthermore, pathological or infected waste amounts to only about 10% of total hospital waste.

While incineration is capable of destroying the bacteria and viruses, it forces on itself the additional burden of having to destroy the material on which the pathogens lie: paper, cardboard, plastic, glass and metal. It is in this process that acid gases are generated from the chlorinated organic plastics present (such as PVC), and toxic metals are liberated from the pigments and additives in the paper and plastic products as well as other miscellaneous items like batteries, discarded thermometers, etc. Highly toxic dioxins and furans are formed from any chlorine present in the waste.

Polyvinylchloride (PVC) plastics - the primary source of dioxins and furans - are replaceable by environmentally safe materials. Organochlorines – largely foreign to nature and in most cases difficult to degrade – are toxic and in many cases carcinogenic. They are the cause of many wildlife and human health problems such as reproductive problems, immune suppression and neurophysical diseases. Dioxin is the most toxic organochlorine. It is a global contaminant and humans are exposed to it through the food chain, particularly through dairy, eggs, fish and meat.

Incinerators are today being proposed as the environmentally acceptable solution to the waste crisis of so-called developing countries. Scientific research however proves this to be nothing but a myth. Waste incineration is actually a seriously polluting technology.

Incineration is always a simple redistribution of the toxic matter, even if PVC and other organochlorines were phased out. The “better” the incinerator gets at protecting the air from these pollutants the more toxic the ash becomes. Ironically, incinerators require landfills in the ground because of the ash they produce. This ash is scientifically regarded as "hazardous waste". Landfilling waste incinerator ash only transfers the problem and does not solve it at all. The toxic substances in landfills strike back in the form of leachate, a concentrated toxic fluid that will eventually leak from landfills into groundwater reservoirs. The best lining of “sanitary landfills”, such as high-density polyethylene (HDPE) plastic would crack after 10-20 years. **Landfills are ecological time bombs**.

In short: All incinerators give the illusion of “solving” a problem. But they create at least two new ones, toxic emissions in the atmosphere and toxic ash in the ground.

The negative trend today in developing countries is still to generate waste and build the technology to cope with the mountains of waste. Then the technology and laws are optimized so that the health hazard of the incineration technology is allegedly minimized. The developed, Western countries went this painful road by reacting to problems and trying to solve the symptoms. Mediterranean countries like Lebanon should learn from these mistakes.

Today, the Council for Development and Reconstruction (CDR) and the Ministry of Environment are pushing for the construction of a central hazardous hospital waste incinerator. It is must that the hospital owners should carefully consider the alternatives to incineration instead of blindly treading along the mistaken paths of the now-aware West.

Alternatives could be made more desirable for the hospitals with financial and fiscal incentives or rewards for using clean technologies, and with strict fiscal penalties for failing to meet environmental standards. So let's know more about Pyrolysis technology versus incinerators and autoclave as a clean technology.

4- The Impact of Autoclaving?

Autoclaving is a sterilization method that uses high-pressure steam. The autoclaving process works by the concept that the boiling point of water (or steam) increases when it is under pressure.
Items to be autoclaved are subjected to gradual temperature increases under high pressure until 121 °C is reached and then steamed for around 15–20 minutes.

The autoclave allows steam to flow around items in the chamber. The length of time and temperature necessary for sterilization depend on the items to be sterilized and whether they are wrapped or left directly exposed to the steam. Items should be separated to allow the steam to penetrate the load evenly. The steam can reach in small crevices and can kill all bacteria, viruses and bacterial spores. The simplest form of the autoclave is the pressure cooker types or laboratory bench autoclaves. The following is the detailed description of different components/ parts of an autoclave:

a- When to Autoclave

Autoclaves can be used to eliminate microorganisms, cure composites, vulcanize rubber, and for hydrothermal synthesis. Autoclaving is a very dependable method for the sterilization and decontamination of laboratory glassware, medical instruments and waste, reagents, and other media. Autoclaves can inactivate fungi, bacteria, spores, viruses and other microorganisms on surgical instruments such as scalpels, forceps, scissors and other metal items.

b- Why Autoclaving is Good for the Environment

Because autoclaving sterilizes without the use of reagents and allows for the re-use of lab equipment and supplies, it is environmentally friendly. It can be used to sterilize medical waste before disposal, eliminating environmental concerns regarding incinerators.

c- Precautions

Closures should be autoclaved separately or very loosely on top of container; otherwise a vacuum is created during cooling. Liners will get sucked into the container or bottles and caps can crack or warp. Expanding vapors during heating can also cause containers to crack or explode without sufficient ventilation.

This method of sterilization should not be used if the material to be sterilized can be damaged by heat or moisture. Plastic resins that cannot be autoclaved include PET, PETG, LDPE, and HDPE, PET, PETG.
Paper products like paper and some plastic resins cannot be autoclaved due to the moist heat.

5- <u>PYROLYSIS RECYCLING (FORTAN PLANT) AS AN ALTERNATIVE CLEAN TECHNOLOGY</u>

FORTAN pyrolysis plants are intended for pyrolysis recycling wastes such as: MSW, rubber wastes, waste plastics, used tires, wood waste, soil contaminated by oil sludge, bitumen, medical waste, etc.

Pyrolysis is a thermal decomposition of materials without access of air - destruction of normal structure of material by means of high temperature, without oxygen access.

Raw material (waste) is loaded into a container of heat-resistant material (retort). In this time there is air (and oxygen) in the retort. The retort lid is manufactured with a lock with special design, which provides a complete sealing of the space inside the retort and eliminate the possibility of smoke. The retort is placed into the pyrolysis module. Heating is provided through walls of the retort. Temperature is rising gradually. Process may be divided in three stages:

- Drying (up to 200 C)
- Pyrolysis (200-500 C)
- Calcination (500-600 C)

If there are liquids that have boiling point up to 200C (for instance, water, gasoline) it start boiling and vaporizing with rising temperature. First, water starts vaporizing at 100 C, vapor goes out the retort and with rising pressure (2-3 kPa) it takes air out the retort. This is drying process.

Over 200 C pyrolysis decomposition starts. Materials that are decomposed at 200-500 C: polymers, textile, rubber, oil products, organic materials (wood, leaves, food, etc.), etc. Material is heated above its decomposition temperature and chemical bonds break in its molecules. When all materials are decomposed, it is carbon residue left in the retort, temperature is 500-600 C and it is calcination. No vapor goes out the retort and we finish the process. Vapour-gas mixture goes out of the retort through the pipeline, cooled in heat-exchanger, vapour is condensed to the tank, gas goes further to separators to separate splashes of liquid.

a- <u>Structure of Fortan plant</u>

FORTAN plant consists of the following units: pyrolysis module, retorts, heat-exchanger, gas-liquid separators and tank. The pyrolysis module is vertical; the oven shaft is lined with heat-resistant concrete and high-temperature thermal insulation on the basis of ceramic fibre. The fire-bars and gas burner are installed in the bottom of the shaft. The intensification of burning and mixing of flue gases are achieved by air blowing. The retort with raw material is placed into the shaft of the oven through its opened top. Retort is a cylindrical container of heat-resistant steel, with a lid. Special shutter around the perimeter of contact surfaces of the retort and the oven ensures sealing of the internal space of the furnace. Heat-exchanger is intended for cooling and condensation of vapors of liquid pyrolysis products. The gas-vapour mixture comes to heat-exchanger from the retort. Condensed liquid is collected in the tank. Incondensable gas goes to separators where final cleaning of gas from liquid splashes is carried out. After gas goes to gas-burner.

The site for placement of FORTAN plants does not require long preparation and large-scale construction works. All connections in the plant are flange. When equipment is used in different places, the process of assembly-disassembly takes a minimum time.

The most effectively is to operate two and more pyrolysis ovens together with using of the abundant gas of the first oven to heat the second one. At each period of time the ovens are at different stages of the process. The shift of the process phase between two ovens is chosen in such a way so as the first oven passes the stage of maximum gassing at the time when the second oven has the greatest need in fuel. Thus there is no need for additional solid-fuel

- **b- Advantages of fortan pyrolysis plants**

- Processing of various carbon containing waste;
- Removable retorts;
- Indirect heating of the raw material;
- Environmental friendly processing;
- Easy maintainable;
- Work at almost any weather conditions 24 h/day, 365 days a year

- **c- Output of products of pyrolysis process**

Output of products of pyrolysis process depends on the composition and characteristics of the raw material used

- **d- Medical wastes**

- Pyrolysis oil 70%
- Pyrolysis gas 10%
- Carbon 20%

The emissions into the atmosphere are significantly reduced and thus there is no need in the gasholder for the temporary storage of the pyrolysis gas. The research department of TT Group is constantly working to solve new technological tasks, solutions of which we offer.

Pyrolysis has been successfully launched in many countries all over the world**: Russia, Turkey, Australia, Belarus, India, Argentina, Armenia, Bulgaria, Kyrgyzstan, Moldova, Transnistria, Turkmenistan, Ukraine, Czech Republic, South Africa, Republic of Panama, etc.**

The manufacturing of the equipment is certified according to the quality management system in accordance with the requirements of the international standard ISO 9001.

Sooner or later, we will have to recognise that the Earth has rights, too, to live without pollution. What mankind must know is that human beings cannot live without Mother Earth, but the planet can live without humans.

To keep our environment clean, safe, and healthy..think AWM

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