



“EU-HCWM”

Assessment and national report of Greece on the existing training provisions of professionals in the Healthcare Waste Management industry

REPORT: I



DEVELOPING AN EU STANDARDISED APPROACH TO VOCATIONAL QUALIFICATIONS IN HEALTHCARE WASTE

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CHAPTER 1 EXECUTIVE SUMMARY

The medical services had always as a primary target to address the health problems of patients and prevent potential health problems of citizens. But alongside to the awareness of societies in recent years in the fields of environmental protection and public health, management of waste arising from medical and hospital units has emerged as an extremely important issue.

In Greece more than 17,000 tonnes of infectious hospital waste are produced yearly; a significant part of it is still mismanaged. Only one off-site licensed incineration facility for hospital wastes is in operation, with the remaining of the market covered by various hydroclave and autoclave units, whereas problems are still generally encountered regarding waste segregation, collection, transportation and management, as well as often excessive entailed costs. Although there is a significant improvement in the separation and treatment of healthcare waste the last decade, nevertheless there are still everyday practices that include dumping the solid hospital waste into household disposal sites and landfills after sterilization, still largely without any preceding recycling and separation steps.

Towards this direction, the Greek State adopted in 2003 the 37591/2031/2003 Joint Ministerial Decision, which in combination with the other relative laws for the management of solid non-hazardous and hazardous waste, aimed to define the legal and regulatory framework for waste management of health care units. The Joint Ministerial Degree was amended in 2012 by JMD 146163/2012 (Official Gazette 1537/B/8-5-12) "Measures and Conditions for the management of Health Care Waste" incorporating all relevant E.U. Decisions and Directives.

The aim of the current report is to reflect the current situation on the management of hospital waste in Greece and to present an overview of the legal and regulatory framework as well as the training provisions in the sector.

CHAPTER 2 OVERVIEW OF THE HEALTH CARE SECTOR

2.1 Introduction

Healthcare establishments in Greece generate significant quantities of infectious wastes every day, a significant fraction of which is still not properly managed. Sound waste management and environmentally friendly practices have not been given the proper attention by the Hellenic National Health System historically and it was not before 2003 that the Joint Ministerial Decision 37591/ 2031/2003, titled “Measures and conditions for medical waste management by medical units” (Hellenic Official Gazette, 2003), was issued, addressing contemporary technical and other requirements. This was the major cross-cutting step to increase awareness, shape behaviour and promote schemes according to the real significance of sanitary medical waste treatment and disposal, as well as to allocate budgets for the real cost of waste management.

JMD 37591/2031/2003 was amended in 2012 by Joint Ministerial Decision 146163/2012 (Official Gazette 1537/B/8-5-12) “Measures and Conditions for the management of Health Care Waste” incorporating all relevant E.U. Decisions and Directives (especially Directive 2008/98 EC and Environmental Law 4042/2012) improving the existing legislation and attaining compliance through inspecting mechanisms. From the initial implementation of JMD 37591/2031/2003 a lot of efforts have been made by policy makers in Greece encouraging safe handling and disposal of hospital waste, in order to reduce health and safety risks for the healthcare workers, patients, waste collectors and the entire community.

Of the 333,155 tons of hazardous waste, produced yearly in Greece, 14,600 tones (4.4%) are generated by hospitals¹, with the biggest part of this quantity considered to be infectious. According to the Hellenic legislation, “infectious” waste is any waste that comes in contact with blood or body fluids, thus including all wastes that are either actually or potentially infectious. It is also according to the international state of the art that infectious wastes are considered infectious, as they may pose a risk to human health and the environment when improperly stored, transported, treated, disposed of, or otherwise managed (US Environmental Protection Agency, 1986).

Since the management of hospital wastes has become a subject of interest, hospital administrations are struggling with numerous problems, while trying to avoid past wrong practices, like disposing of, either part or all, hospital wastes, untreated and mixed with municipal waste (MSW), in landfills. During the past, there was also a wide use of hospital incinerators (without any energy recovery or gas cleaning) in the country, which although initially targeted the treatment of “infectious” wastes, however ended up with practically a much larger fraction of the generated hospital waste stream being improperly incinerated, without being properly segregated before². This was drastically changed after the aforementioned 2003 legislation, as hospital administrations were legally forced to shut down most of the incinerators operating in hospitals, in a rather short period of six months (i.e. until April 2004) from the above Decision entering into force.

¹ Hellenic Official Gazette, 2007

² Tsakona et al., 2007



These changes have resulted by today in a wide turn to steam sterilization technology offered by private companies. However, a fraction of hospital wastes is still disposed without any pre-treatment, due to the following facts³:

- sterilization is not applicable to some categories (e.g. cytotoxic, anatomic, pharmaceutical),
- proper incineration requires operator training and qualification, waste management plans, measuring and monitoring of pollutants and operating parameters, as well as sufficiently high temperatures for cytotoxic, chemical and pharmaceutical waste,
- general hospital infrastructure for infectious waste management in Greece is still far from perfect.

Today, there is a growing interest on the issue of proper and integrated treatment of infectious hospital waste in Greece and significant investments for the improvement of infrastructure are anticipated, given the vivid interest of both the public sector individual hospitals, as well as private companies to invest in treatment technologies, including thermal treatment technologies.

³ Próss et al., 1999

2.2 General description of the Health Care System in Greece

Healthcare wastes (HCW) are mainly produced by the activities of Healthcare facilities. They are also produced by certain other activities (tattoo workshops, elderly care units etc.) that produce hazardous waste with infectious properties regardless of quantity and which are not included in the list of Healthcare Units following, as defined at the National Legislation:

- Public Hospitals (PH)
- Private Clinics (PC)
- Health Centres (HC)
- Municipal Health Practises (MHP)
- Private entities providing health services (PE)
- Health service units of insurance organizations (IKA)
- Health service units of the armed forces - military hospitals (MH)
- Blood Donation Centers (BDC)
- Diagnostic and research laboratories (DRL)
- Microbiological Laboratories (ML)
- Dental Clinics (DC)
- Veterinary Clinics (VC)
- Veterinary diagnostic and research laboratories (VDRL)

The number of hospitals operating in Greece, according to the National Statistical Authority (2008-2009), is 332, with 55,830 beds, including military hospitals. Out of these, 140 are public hospitals, the vast majority of which (133 out of 140) are supervised by the Ministry of Health and Social Solidarity through Regional Authorities, which were initiated in 2001 to ensure effectiveness and proper organization of health institutions, as well as to coordinate actions and promote policies on health services at a regional level. 44 of these 133 public hospitals (i.e. 33.1%) are located in the region of Attica which includes the city of Athens – Piraeus and the wider area, serving a population of 4.088.447 inhabitants, with 15.217 inpatient beds, whereas for Thessaloniki and the region of Central Macedonia the number of public hospitals is 21 (i.e. 15.8%) serving a population of 1.944.793 inhabitants with 6.252 inpatient beds.

Total recorded Healthcare Units (HCU) per category and administrative region, are presented at Table 1, whereas the distribution of HCU to Greek administrative regions shown in the following Diagram1.

Table 1. Health Care Units per Administrative Region

PREFECTURE	Public Hospitals	Private Clinics	Health Centres	Municipal Health Practises	Private entities providing health services	Health service units of insurance organizations	Military hospitals	Diagnostic and research laboratories	Microbiological Laboratories	Dental Clinics	TOTAL
	PH	PC	HC	MHP	PE	IKA	MH	DRL	ML	DC	
East Macedonia Thrace	6	8	14	3	0	10	3	22	67	519	652
Central Macedonia	21	27	31	2	2	54	2	58	246	2504	2947
West Macedonia	6	6	6	1	0	5	1	4	13	243	285
Epirus	5	2	16	0	0	5	0	9	53	349	439
Thessaly	5	33	17	0	0	10	1	36	95	783	980
Stereia Ellada	8	5	14	0	0	18	0	22	49	459	575
Attica	44	63	14	21	3	91	7	313	555	6920	8031
West Greece	11	7	19	0	0	17	0	30	135	590	809
Peloponnesse	9	5	22	0	1	10	1	34	89	561	732
Ionian Islands	6	1	8	0	0	5	0	6	21	155	202
North Aegean	5	3	7	0	0	6	0	13	38	152	224
South Aegean	5	1	11	7	0	4	0	8	51	262	349
Crete	9	9	14	0	0	7	1	20	79	623	762
TOTAL	140	170	193	34	6	242	16	575	1491	14120	16987

Figure 1. Health Care Units distribution

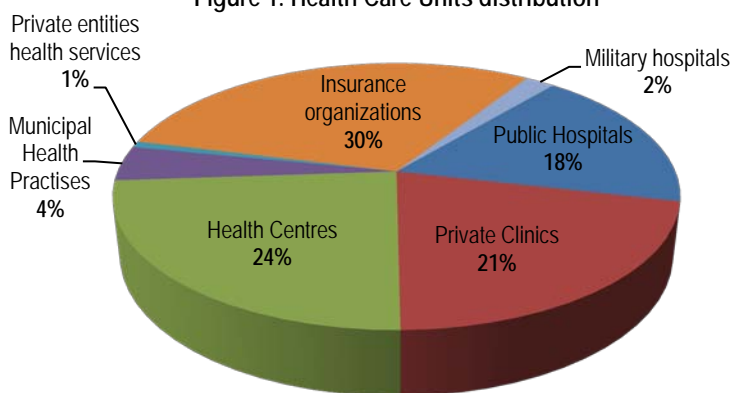


Figure 2. Health Care Units per Adiministrative Region

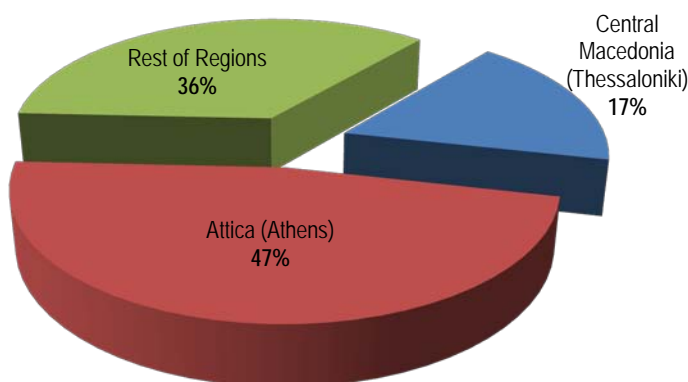
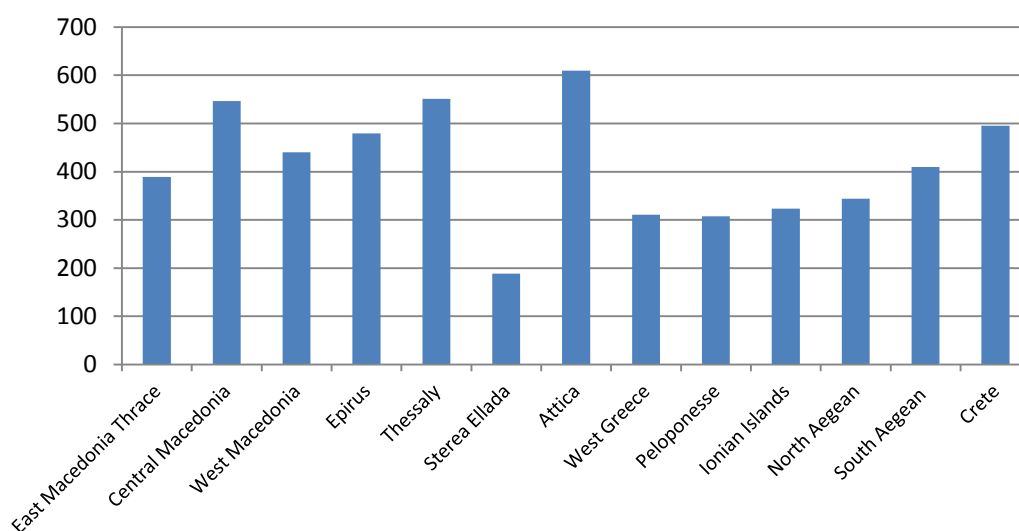


Table 2 shows the distribution of beds by type of Healthcare Unit and per Region⁴ (reference year 2008). The data refer only to private, public and military hospitals as well as private entities providing health services, which altogether concentrate the majority of the available beds.

Table 2. Inpatient beds per Health Care Unit type and Administrative Region

PREFECTURE	Public Hospitals	Private Clinics	Private entities providing health services	Military hospitals	TOTAL	PERCENTAGE	POPULATION	BEDS PER 100.000 INHABITANTS
	PH	PC	PE	MH				
East Macedonia Thrace	1875	452	0	35	2362	4,23	606.622	389
Central Macedonia	6252	3228	922	231	10633	19,05	1.944.793	547
West Macedonia	761	515	0	14	1290	2,31	293.172	440
Epirus	1672	30	0	0	1702	3,05	355.175	479
Thessaly	1846	2111	0	97	4054	7,26	735.885	551
Stereia Ellada	915	129	0	0	1044	1,87	554.426	188
Attica	15217	7451	615	1630	24913	44,62	4.088.447	609
West Greece	1991	313	0	0	2304	4,13	742.038	310
Peloponnesse	1643	90	60	25	1818	3,26	592.017	307
Ionian Islands	699	50	0	0	749	1,34	231.514	324
North Aegean	614	75	0	0	689	1,23	200.275	344
South Aegean	1151	107	0	0	1258	2,25	307.228	409
Crete	2391	477	0	146	3014	5,40	608.810	495
TOTAL	37.027	15.028	1.597	2.178	55.830	100,00	11.260.402	496

Figure 3. Inpatient Beds per 100.000 inhabitants and Administrative Region



⁴ Greek Statistical Authority

2.3 Statistical data on the Health Care Wastes produced in Greece

According to specific data collected from a statistic research⁵, the average production quantity of medical solid waste per day in Greece is nearly **6,5 kg/bed**, resulting in an average of **364 tn** of medical waste are produced every day in Greek healthcare centres (reference year 2008). The corresponding hazardous toxic and infectious wastes' quantity per year is over 17.000 tn⁶. An estimated **15%** of this quantity corresponds to infectious waste, while the remaining **85%** corresponds to waste with a municipal character. The distribution of medical waste production to administrative regions is depicted in the following Tables and Figures.

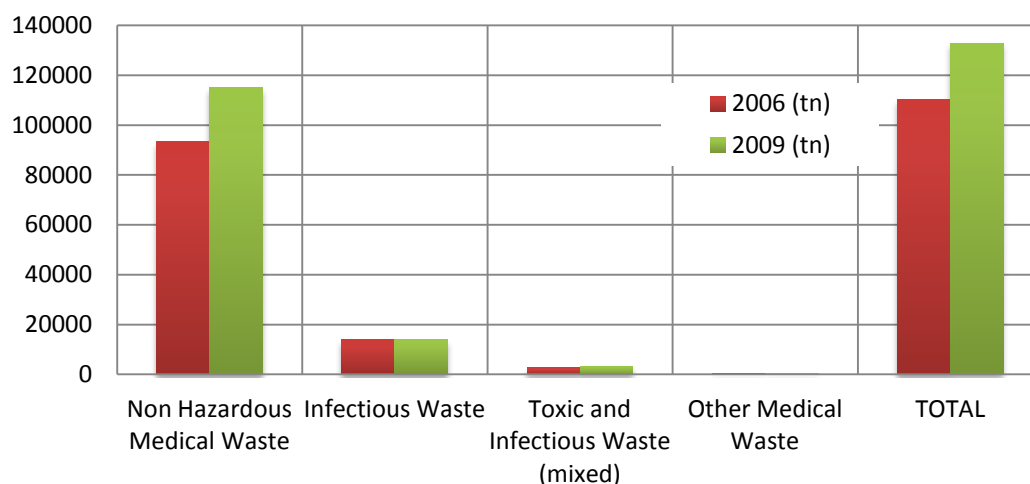
Table 3. Solid HC Waste production. Years 2006 and 2008

Year	Non Hazardous Medical Waste	Hazardous Waste		Other Medical Waste	Total
		Infectious Waste	Toxic and Infectious Waste (mixed)		
2006 (tn)	93.395	13.843	2.754	434	110.426
2008 (tn)	114.979	14.025	3.378	435	132.817

The reported amounts in Table 3 do not include the following:

- The quantities produced by veterinary clinics, veterinary diagnostics and research laboratories and blood donation centers.
- The quantities produced by primary health care units (nursing homes, rehabilitation centers, elderly houses etc.).

Figure 4. Solid HC Waste production in tons (2006 and 2008)



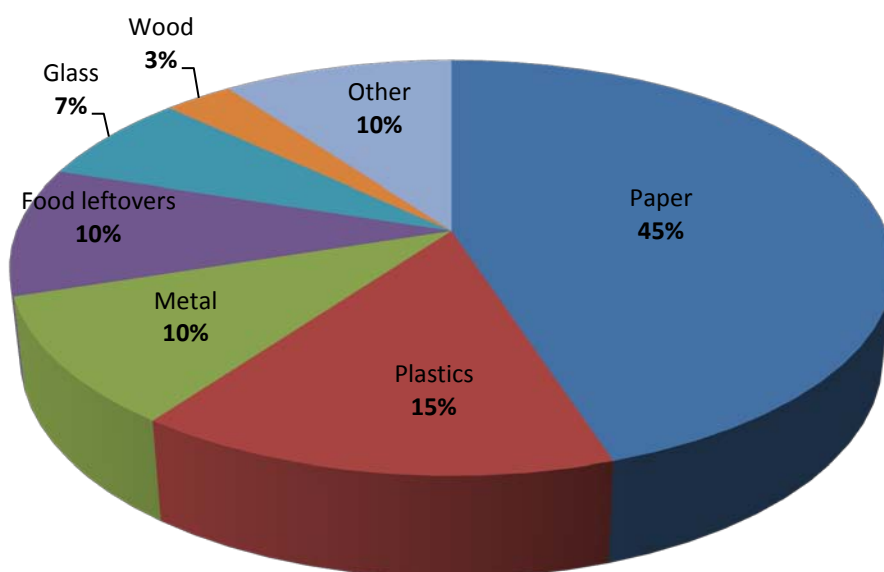
⁵ Ministry of Environment, Energy and Climatic Change – Department of Solid Waste Management. Hazardous Healthcare Waste Management National Plan. Protocol Number of Report: oik. 33312/4110/2014. Athens, 03/07/2012

⁶ ibid 5

Table 4. Solid HC Waste per type and Administrative Region (tons). Reference year 2008

PREFECTURE	Non Hazardous Medical Waste	Hazardous Waste		Other Special Medical Waste	TOTAL	PERCENTAGE
		Infectious Waste	Toxic and Infectious Waste (mixed)			
East Macedonia Thrace	5.112	639	162	19	5.932	4,47
Central Macedonia	20.633	2.589	607	63	23.892	17,99
West Macedonia	2.606	304	74	9	2.993	2,25
Epirus	3.938	523	154	15	4.630	3,49
Thessaly	7.845	858	200	31	8.934	6,73
Sterea Ellada	2.521	348	120	14	3.003	2,26
Attica	50.280	5.911	1.265	194	57.650	43,41
West Greece	5.253	687	202	23	6.165	4,64
Peloponnesse	4.171	565	179	19	4.934	3,71
Ionian Islands	1.719	228	66	9	2.022	1,52
North Aegean	1.599	212	65	7	1.883	1,42
South Aegean	2.821	366	98	6	3.291	2,48
Crete	6.481	795	186	26	7.488	5,64
TOTAL	114.979	14.025	3.378	435	132.817	100,00

Figure 5. Percentage composition of non hazardous hospital waste



The distribution of the hazardous HC fluids and waste waters per region, for reference year 2008, is shown in Table 5. As expected, the highest rates of hazardous wastewaters are produced in the region of Attica (47.2%), followed by the Region of Central Macedonia with (14.8%), Thessaly (6.7%) followed by the other regions. The aforementioned quantities do not include specific streams of fluids subject to special management regimes. In particular:

- Radioactive: Estimated quantity of radioactive waste: 0.26 tons/day and 1,36 m³/day of radioactive liquid wastes.
- Batteries (20 01 33 *): Estimated quantity of 0,38 tons/day.
- Gas containers (15 01 04): Estimated quantity of 0,16 tons/day.
- Ash and Slag (19 01 11 *) from small incineration plants within the health care units: Estimated quantity of 0,39 tons/day.
- HCM disposed of with household waste from home use (expired medicines etc.), the amount of which cannot be calculated.
- Animal by-products / Veterinary waste, the amount of which has not been registered.

**Table 5. Hazardous waste waters produced in Healthcare units per type and Administrative Region (lt/day).
Reference year 2008**

PREFECTURE	Hazardous Infectious Waste	Toxic and Infectious Waste (mixed)	Other Special Medical Waste	TOTAL	PERCENTAGE
East Macedonia Thrace	626	1.010	70	1.706	4,23
Central Macedonia	2.123	3.636	210	5.969	14,81
West Macedonia	197	419	27	643	1,60
Epirus	516	555	66	1.137	2,82
Thessaly	745	1.874	90	2.709	6,72
Stereia Ellada	402	816	50	1.268	3,15
Attica	6.527	11.971	503	19.001	47,15
West Greece	731	1.326	82	2.139	5,31
Peloponnesse	536	1.067	73	1.676	4,16
Ionian Islands	303	347	36	686	1,70
North Aegean	191	433	24	648	1,61
South Aegean	167	340	29	536	1,33
Crete	978	1.104	97	2.179	5,41
TOTAL	14.042	24.898	1.357	40.297	100,00

2.4 Legislation Applicable to HCWM

Medical Waste is the waste that originates from the operation of any sanitary unit (e.g. hospitals, clinics) and more specifically from public and private infirmaries, municipal surgeries, military hospitals, blood donation centers, diagnostic laboratories, microbiological laboratories, veterinary clinics and veterinary diagnostic laboratories, research centres and pharmaceutical plants. This group also includes dispersed sources of residues from home treatment (dialyses, administration of insulin, etc). Medical waste is in fact a varied mixture of different kinds of rubbish – from typically municipal ones (food, secondary raw materials, etc), through toxic chemicals (drugs, reagents, etc), to infectious ones (syringes, instruments, postsurgical waste). Numerous studies have shown that an estimated **75 – 90%** of waste originating within medical facilities has a municipal character. The remaining **10 – 25%** of waste (infectious, pathological, etc) is deemed to require special treatment. The reason is simple. Infectious medical waste is considered to be a special category of waste because of its high potential for contaminating the environment with pathogenic factors and bacteria and thus represents a higher risk to health. For example, contaminated needles and syringes represent a particular threat and may be scavenged from waste areas and dump sites and be reused. World Health Organization has estimated that, in 2000, injections with contaminated syringes caused 21 million hepatitis B virus (HBV) infections (32% of all new infections) and 2 million hepatitis C virus (HCV) infections (40% of all new infections)⁷.

Summarising, Medical Waste include the following:

- Body liquids or departments of human webs, that can contain infectious factors, such as:
 - ❖ Hepatitis A, B, C
 - ❖ Virus of AIDS
 - ❖ Viruses of haemorrhagic fevers
 - ❖ Micro-organisms of food infections (salmonella)
- Waste from diagnostic and research laboratories, which are sharp (used needles etc.) and may cause infections from wounds or pathogens (cultures of micro-organisms)
- Pharmaceutical and chemical waste with toxic, irritant or mutagenic action
- Radioactive waste such as medicine residues.

Legal Framework

Greece, as EU Member State has adapted its national legislation in the respective European and applies the required policy in the management of all waste including Healthcare waste.

In order to regulate the management of HCW, the country has put in force specialized legislation, already in the year 2003. In particular, for the management of medical waste from health care units, the Joint Ministerial Decision 37591/2031/2003 was introduced, establishing the terms and conditions for the management of HCW,

⁷ World Health Organization - WHO "Safe health-care waste management: Policy paper", Geneva, 2004.

including activities for the collection, transport, temporary storage, treatment and / or disposal thereof, and licenses necessary for the management of this type of waste. The JMD 146163/2012, which replaced the aforementioned JMD 37591/2031/2003, aims to improve the institutional framework and management of medical waste in full compliance with the EC Directive 2008/98 and the new Environmental Protection Law N.4042/2012.

The provisions of JMD 146163 / 2012 provide inter alia the following:

- The obligation of each health care unit that is subject to environmental licensing to establish "Internal Waste Management Regulations" countersigned by the competent Health Region. The regulation refers to the separation processes, collection, temporary storage, transport, treatment and disposal of HCW, with all the measures planned in each management stage.
- The terms, measures and conditions for the management of HCW the stages of separation, collection, transport, temporary storage, treatment (sterilization or incineration with appropriate technical and environmental standards respectively) and disposal.
- The competent authorities responsible for supervising the compliance of HCW management indebted to the provisions of the JMD.

Separation

The most important step in the management of HCW is the division into groups in a clear, understandable and easily way during the collection so that it is perceived by those responsible for waste management and to facilitate the collection and transportation.

Within the scope of JMD 146163 / 2012 the hazardous waste from Health Care Units are divided in to the following categories:

- Hazardous Waste purely infectious,
- Mixed Hazardous Wastes, with both infectious and toxic nature,
- Other Hazardous Wastes, purely toxic nature,

while simultaneously identified and the categories of Health Units that are required to manage their waste in accordance with the provisions of the above JMD.

Collection

Collection of HCW is in special containers or bags, depending on the method of disposal and its particular qualitative characteristics. Considering the treatment that will follow is the placement of waste in the corresponding color receptors, while for the sharps, rigid and resistant disposable packaging is foreseen

Transfer

The transfer of HCW within the health care unit, should be done with specific means and in compliance with the hygiene and safety rules of the Internal HCW Management Regulation.

Temporary storage

- Storage at appropriate places under temperature <math><50\text{ }^{\circ}\text{C}</math> and for a period of less than 5 days
- For quantities <math><500</math> liters for HCW of purely toxic character, caching is done within the facility of the hospital and for up to two (2) years, while all safety measures of the existing hazardous waste legislation are implemented.
- The storage can be up to 30 days at a temperature of less than $^{\circ}\text{C}$.

Transfer

The transport vehicle must be closed, sealed, with cooling capacity <math><80\text{ }^{\circ}\text{C}</math>, without compression mechanism. The waste is accompanied by a paper document identification, copies of which are held by the relevant departments.

Processing and disposal

The treatment to final disposal of HCW is done by the method of combustion, pyrolysis and/or for certain categories of waste with the method of sterilization and subsequent disposal together with household waste. The choice between these two alternatives is the result technical and logistics feasibility study.

2.5 Healthcare Waste Management

According to the existing legislation, the right way of managing Hazardous Medical Waste includes:

- Segregation and categorisation of the waste at the source (sanitary units).
- Incineration at high temperatures (>850°C).
- Sterilisation under specified conditions.
 - ❖ control of sterilization via biological indicators.
 - ❖ transport of sterilized waste to its final disposal area via specialized trucks and not via city waste trucks.

Hazardous Medical Waste is dangerous when the treatment methods used allow people or animals to come in direct or indirect (via food chain) contact with them. Such methods include:

- Mixture of Hazardous Medical Waste with municipal waste and transport by city trucks, or non-licensed transporters => uncontrollable final disposal in landfills
- Incineration without air pollution control => emissions of pollutants and heavy metals
- Storage or transport of Hazardous Medical Waste under conditions that encourage the multiplication of micro-organisms (no refrigeration)

The fact that the main method of treatment until 2003 was in situ was incineration resulted in increased incinerated quantities due to improper segregation of wastes. Inadequate compliance of hospital incinerators with hygienic standards was repeatedly reported, thus posing significant risks for the environment and the public health. The main reasons that were reported were:

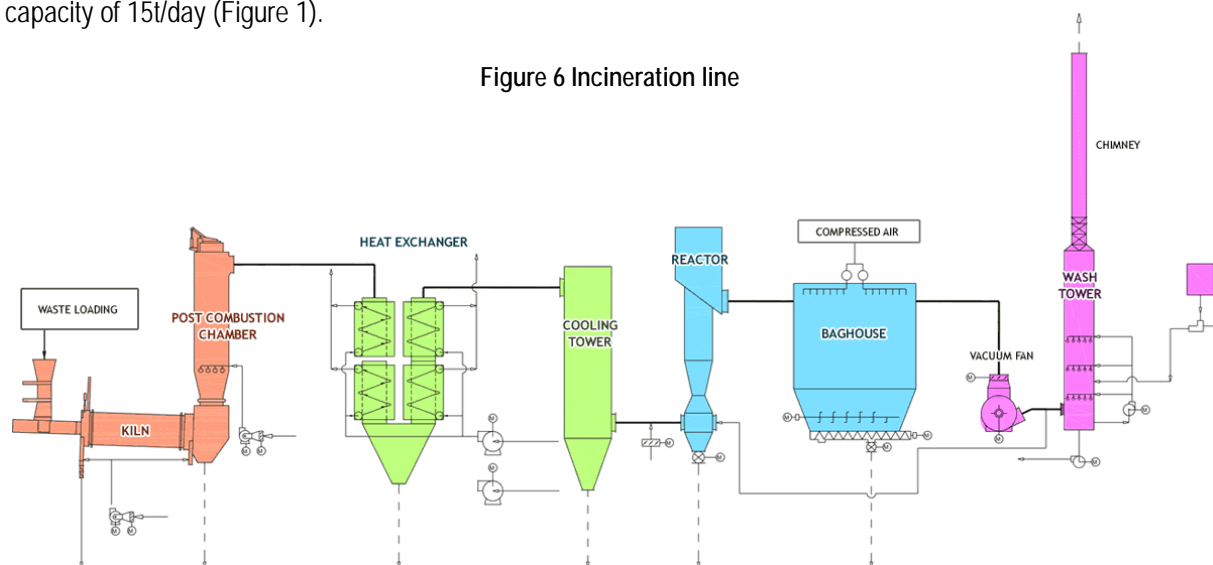
- Frequent overloads due to:
 - ❖ Bad segregation of wastes (as they often received much of the household-like fraction)
 - ❖ Servicing of other hospitals as well beyond covering own needs
- Hospitals served by other hospitals did not follow any requirements during waste transfer.
- No systematic maintenance.
- Frequent damages due to mishandlings in operation.
- Regular occurrence of significant financial costs, as a result of all the above.
- No flue-gas cleaning equipment.
- Absence of qualified personnel for their operation.
- No monitoring and recording equipment for emissions and operating parameters.
- No environmental, installation and operating permits by authorities whatsoever.

Quite obviously and naturally, all these facilities did not comply with the minimum standards of the relevant Joint Ministerial Decision 37591/ 2031/2003 (i.e.: minimum operational capacity of 100 kg/h and 16 h/day for 5 days a week operation). As a result, improper incinerator operation was associated with increased pollutant emissions whereas it often led to citizen protests against odours, gaseous pollutants, particles and overall environmental

degradation.

As a result of the 37591/2031/2003 Joint Ministerial Decision, there was a dramatic decrease in the number of operating hospital incinerators, since none of these was in compliance with most of the technical and other introduced requirements. The anticipated period for hospitals to make the necessary adjustments was rather short, namely six months (i.e. until April 2004) from the above Decision entering into force. This fact intensified illegalities during this transitional phase.

Today, in Greece, the only licensed plant for the treatment of Hazardous Medical Waste is the Incineration Plant of A.C.M.A.R. in the wider area of Athens (Attica), consisting of two independent lines of incineration with capacity of 15t/day (Figure 1).



It has a large-scale, double-chambered incinerator (rotary-kiln and post combustion chamber) in two parallel lines, with an overall capacity of 30 tonnes/ day and its reported investment costs amounted to 8.8 M€, with more than half of it spent on its flue-gas cleaning equipment⁸. There is an emission monitoring equipment and the bottom ash from the process is disposed at the adjacent sanitary landfill, whilst the fly ash is stored and shipped abroad for treatment, though the operators have plans to install a treatment facility for the fly ash. In addition, there is emission monitoring equipment, as well as an integrated service provision to the connected hospitals (both within and outside Attica), but the facility is still confronted with problems concerning cost-effectiveness of its operation, as it still does not operate in full capacity. Today, the facility operates with a capacity less than 6 tons/day, whilst the necessary capacity in order to cover its operating cost is estimated to be 13 tons/day (Aravosis et al., 2008). There have been some discussions with the hospitals and the regional authority of Central Macedonia, as the facility is servicing hospitals also half way between Attica and Thessaloniki, but logistics constraints still seem to dominate its possible extension in North Greece.

⁸ Aidonidou et al., 2003

In situ sterilization

Sterilization is generally accepted worldwide for treating infectious wastes⁹ (Próss et al., 1999) when they do not include micro organisms extremely dangerous for the humans (e.g. Ebola virus, Lassa virus, Hepatitis B, HIV, SARS); in this case, wastes should be pre-treated (e.g. autoclaved) and incinerated (Department of Health, 2006), a practice not yet anticipated by the Hellenic legislation.

The sterilized infectious wastes can then be disposed of in sanitary landfills, although in several countries such as Germany, a common practice is to incinerate them in Municipal Solid Waste incinerators (MSW), instead of dispose them of in landfills. Nevertheless, this safer practice cannot be adopted for the moment by Hellenic hospitals, due to the absence of MSW incinerators in Greece.

Shutting down in situ hospital incinerators led most of the Hellenic hospitals to the hands of hydroclave sterilization. It was estimated that 33% of all Hellenic hospitals use sterilization for their infectious wastes (Hellenic Official Gazette, 2007). Since the procedure of installing own devices and getting permits for their operation is very much time consuming, all sampled hospitals opted for and started employing even before 2002 companies providing hydroclave services via mobile units.

The hydroclave sterilization method applied by the company includes a double-wall circular vessel where shredding, continuous stirring and dehydrating of the wastes occur.

The sterilization process lasts about 30 min and the pressure and temperature remain just over 2 bars and 121 °C, respectively. The content, due to the continuous mixing, is exposed uniformly to the superheated steam, entering the double wall and the vessel.

Liquids and gases remain inside the vessel until the cycle is complete.

The sterilized liquids are forwarded to the sanitary sewer, while the heat of the wall results in total dehydration of the content. There are no harmful gas emissions. The evaluation of the efficiency of the treatment method is very important, as the treated infectious hospital wastes are disposed of finally in MSW landfills.

The resistance of various types of micro organisms (applied as biological indicators) to inactivation is used to provide documentation of how efficiently and effectively this treatment process is applied. The review of the test results on the effectiveness of sterilization, acquired by using *Stearothermophilus* spores as biological indicators, recorded by authorized hospital employees, showed that inactivation of wastes was successful in all hospital cases, during 2006.

An extensive review of hospital accounting documentation on the cost of sterilization showed that the charged fees were generally not proportional to the weight of the wastes or the distance of the hospital from the company's headquarters. Their variation range was between 0.52 and 1.76 €/kg and was reported to depend

⁹ Próss et al., 1999

mostly on individual agreements between the contractor and the administration of each hospital. It should also be noted that there are lately at least 2 reported attempts to set up a stationary hydroclave facility, one in north and one in central Greece, a fact that is also expected to increase the competition in the field, given that these applications were filed by different companies.

Regarding the management of the produced hazardous HCW, at present in the country operate the following units (Table 6):

- Two storage units of hazardous HCW.
- Five (5) sterilizing units, but without the proper spatial distribution.
- An incineration plant, in operation since 2002.

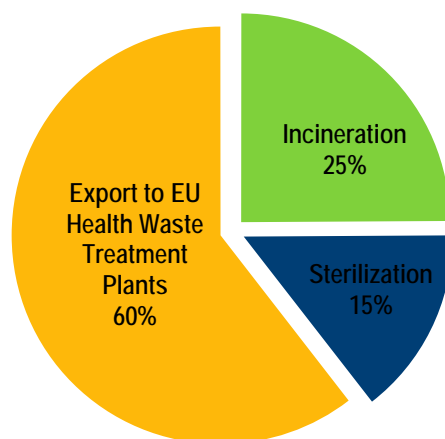
Table 6. Hazardous HCW Management plants and units

Unit	Location	Technology	Capacity
INCINERATOR SA	Athens	Incinerator	2 incinerator lines of capacity 15 tons/day each
STERIMED LTD	Thessaloniki Industrial Area	Sterilization	One sterilization kiln of total capacity of 9.600kg / day. A spare kiln of the same capacity
MEDICAL WASTE SA	Heraklion Industrial Area - Crete	Sterilization	Two ECODAS sterilization systems T1000 with a total capacity between 1.200 and 7.200 kg / day
APOSTIROISIS SA	Volos Industrial Area	Sterilization	Two ECODAS sterilization systems T2000 with a total capacity of 9.600 kg / day
HYDROCLAVE HELLAS	Larissa Industrial Area	Sterilization	Sterilization system HYDROCLAVE H-100 DUAL with a total capacity of 11.680 kg / day
ECOPRIME SOLUTIONS	Rhodes	Sterilization	Capacity 160 kgr/day

Table 7. Hazardous HCW Management per Administrative Region and Technology. Reference year 2008

PREFECTURE	Hazardous HCW	Incineration Treatment	Sterilization Treatment	Export to EU-HCW Treatment Plants	Percentage of HCW Incinerated	Percentage of HCW Sterilized	Percentage of HCW Exported
East Macedonia Thrace	801	0,00	278,60	522,40	0,00	34,78	65,22
Central Macedonia	3.196	0,20	1.275,20	1.920,60	0,01	39,90	60,09
West Macedonia	378	0,74	187,60	189,66	0,20	49,63	50,17
Epirus	677	23,98	0,00	653,02	3,54	0,00	96,46
Thessaly	1.058	556,32	10,40	491,28	52,58	0,98	46,43
Stereia Ellada	468	121	3,30	343,97	25,80	0,71	73,50
Attica	7.176	2.739	705,20	3.731,55	38,17	9,83	52,00
West Greece	889	339	0,00	549,69	38,17	0,00	61,83
Peloponnesse	744	145	0,00	599,01	19,49	0,00	80,51
Ionian Islands	294	36	4,10	253,43	12,40	1,39	86,20
North Aegean	277	44	11,50	221,61	15,84	4,15	80,00
South Aegean	464	0	36,30	427,70	0,00	7,82	92,18
Crete	981	329	26,00	625,63	33,57	2,65	63,77
TOTAL	17.403	4.335,25	2.538,20	10.530	24,91	14,58	60,50

Figure 7. Solid HC Waste Treatment - Greece (2008)



CHAPTER 3 SKILLS, COMPETENCES AND TRAINING OF INVOLVED PERSONNEL IN HEALTH CARE WASTE MANAGEMENT

3.1 National Qualification Framework – Nationally Accepted Qualifications for Waste Managers

The **National Organisation for the Certification of Qualifications and Vocational Guidance (EOPPEP)** is the Hellenic national authority that develops the regulatory framework for the certification of qualifications, i.e. the learning outcomes of non-formal education and informal learning, in response to labour market needs and priorities and in liaison with the accreditation of inputs, i.e. providers, trainers, occupational profiles and curricula standards. EOPPEP is also the statutory body for the development and implementation of the Hellenic Qualifications Framework (HQF) in correspondence with the European Qualifications Framework (EQF).

The Hellenic Qualifications Framework is planned to be developed in 4 stages. After a period of planning, public consultation, legal consolidation, and preparation, Hellas is now entering the 3rd phase, which is the Implementation Phase. This one consists the core phase of the HQF and it will be completed by engaging all stakeholders and the formation of the necessary Working Groups.

It is worthwhile mentioning that one of the main actions during the HQF implementation phase foresees the undertaking of pilot projects for the certification of specific continuing vocational training on “green” jobs and tourism sector and respective On-the-Job Training courses.

The National Centre for the Accreditation of Lifelong Learning Providers (EKEPIS) has issued until today two occupational profiles which include several Solid Waste Management training topics. These are:

1. The occupational profile for the **“Technician for the Management and Control of Environmental Protection Systems”**. As Technician for the Management and Control of Environmental Protection Systems is considered any employee of private and public Sector performing technical operation and maintenance works, supervising the operation and control of devices, instruments and machinery of Environmental Protection Systems, aiming to pollution prevention and control, minimizing risks, of any source threatening human health and safety during the operation and maintenance of the pre-mentioned systems. The job profile was developed by the joint collaboration of the following social partners and organisations:
 - Vocational Centre of Hellenic Workers’ Federation and of Hellenic Labor Institute,
 - Federation of Hellenic Industries,
 - Vocational Centre of the Hellenic Federation of Professionals and Traders,
 - National Federation of Hellenic Commerce

under the coordination of the Hellenic Foundation of Economic and Industrial Research and certified from the Ministry of Education, Lifelong Learning and Religious Affairs.

2. The occupational profile of the “Technician of Hazardous Waste Management (except radioactive waste)” was also developed but not certified. As Technician of Hazardous Waste Management (except radioactive waste) is considered any employee of private and public sector performing technical activities of mechanical equipment, operation, maintenance, surveillance and control at installations where hazardous waste is treated. This includes employees responsible for performing preventive and technical activities (collection, transport, storage, delivery, treatment and final disposal of hazardous waste) as well as those performing activities aiming to treat pollution caused by hazardous waste through cleansing and sanitation of the environment.

Additionally, during a Leonardo da Vinci project in 2006, the functional operations and the curriculum of the Technician on (Solid) Waste Treatment and Recycling was developed under the auspices of the General Secretariat of Lifelong Learning that belongs to the Ministry of Education, Lifelong Learning and Religious Affairs. Both functional operations and curriculum were not certified.

Based on the above mentioned it is resulting that none National Qualification Framework for Health Care Waste Management has been developed in Greece, so far.

3.2 National Occupational Standards for Healthcare Waste Managers

Healthcare establishments in Greece generate significant quantities of infectious wastes every day, a significant fraction of which is still not properly managed. Sound waste management and environmentally friendly practices have not been given the proper attention by the Hellenic National Health System historically and it was not before 2003 that a Joint Ministerial Decision (37591/2031), titled “Measures and conditions for medical waste management by medical units” (Hellenic Official Gazette, 2003), was issued, addressing contemporary technical and other requirements.

This was the major cross-cutting step to increase awareness, shape behaviour and promote schemes according to the real significance of sanitary healthcare waste treatment and disposal, as well as to allocate budgets for the real cost of waste management. Further steps are still necessary to improve the current legislation and to attain compliance through inspecting mechanisms, whereas more efforts should be made by policy makers in Greece to encourage safe handling and disposal of hospital waste, in order to reduce health and safety risks for the healthcare workers, patients, waste collectors and the entire community.

Since the management of hospital wastes has become a subject of interest, hospital administrations are struggling with numerous problems, while trying to avoid past wrong practices, like disposing of, either part or all, hospital wastes, untreated and mixed with municipal waste (MSW), in landfills.

These changes have resulted by today in a wide turn to steam sterilization technology offered by private companies. However, a fraction of healthcare wastes is still disposed without any pre-treatment, due to the following facts:



- sterilization is not applicable to some categories (e.g. cytotoxic, anatomic, pharmaceutical),
- proper incineration requires operator training and qualification, waste management plans, measuring and monitoring of pollutants and operating parameters, as well as sufficiently high temperatures for cytotoxic, chemical and pharmaceutical waste,
- general hospital infrastructure for infectious waste management in Greece is still far from perfect.

The adoption in 2012 of the Joint Ministerial Decision 37591/2031/2003 recast, (JMD 146163/2012) except of the harmonization of the Greek Legislation with EC Directive 2008/98 and the new Environmental Protection Law N.4042/2012, was a major breakthrough in terms of providing a training and operation framework for the personnel in health care units that are involved with the collection, temporary storage and monitoring of the HCW produced. Annex II refers in detail to the duties, responsibilities and obligations of the involved personnel as they should be included in the Internal Regulation of each Unit's HCW Management System. Although informative and mini training sessions have been organized by the Ministry of Health and the regional health care administrative authorities, in depth training and development of a structured qualifications' framework are still absent.

Today, there is a growing interest on the issue of proper and integrated treatment of infectious hospital waste in Greece and significant investments for the improvement of infrastructure are anticipated, given the vivid interest of both the public sector individual hospitals, as well as private companies to invest in treatment technologies, including thermal treatment technologies.

In this context, the growing needs for qualified Healthcare Waste Professionals and the technological advances implemented in the respective facilities, vocational training in the healthcare waste management sector, in Greece is still degraded.

CHAPTER 4 REMARKS – CONCLUSIONS

From the evaluation of the available data concerning HCW in connection with the applicable management methods adopted in Greece, derive the following conclusions:

- The annual quantity of solid HCW in the country (2008 data) is of the order of 17,400 tons, from which the Hazardous Infectious Waste amounted 14.025 tons, the mixed Toxic and Infectious Waste 3.378 tons while the Special Waste Streams amounted to 435 tons.
- The biggest amounts of solid HCW are produced by the public and private hospitals. Fairly large quantities produced by Health service units of insurance organizations and by military hospitals, despite their small number. The municipal health care stations / practises produce minimal waste as their activity is limited mainly to the prescription and supply of vaccines or injections. From the microbiological laboratories, due to their big number, significant quantities of HCW are produced, higher than those produced by diagnostic laboratories.
- In the total quantities of the HCW are not included the wastes deriving from veterinary clinics, veterinary diagnostic and research laboratories, blood donation centres, and primary health care facilities (nursing homes, rehabilitation centres, elderly houses etc.).
- The development of the HCW network management does not have the required spatial distribution. In many cases the waste transfer requires large distances, resulting in a significant increase in management costs.
- The main methods of HCW treatment, is incineration and sterilization. The quantities transported for incineration come from the mainland and mainly from the regions of Attica, Thessaly and Western Greece. The Region of Crete sent in 2008 for incineration about 33% of the generated hazardous waste and the quantities carried for incineration from the rest island country is very small, thus revealing the problem of waste transfer of by sea.
- Many of the HealthCare Units do not apply any treatment to the produced waste, but delivers them to licensed waste treatment companies to further process them. An important problem observed was the amounts of stored hazardous wastes, since it is impossible to estimate the quantities of the corresponding time storage space and the type of treatment that is ultimately applied.
- The management of mixed toxic and infectious waste as well as of other special medical waste in the country appears problematic since, until recently, the only existing incinerator in Attica, allowed incineration only of hazardous dangerous infectious waste and not of other categories of hazardous waste from HealthCare Units. Furthermore, it is not possible to dispose of hazardous waste in landfill plants in the country. Therefore, the only viable option was transporting them abroad.
- The temporary storage of waste is among the options of HCW management of several HealthCare Units. This results in waste quantities (particularly of Other Infectious Wastes) been stored at the premises of the HealthCare Units for long time periods without being sent for further treatment or disposal.
- Finally, the incineration of HCW produces ash (bottom ash and fly ash). According to the data of "INCINERATOR SA", only for 2007, the bottom ash produced by the HCW incineration processes equals to 3-



3.5 tonnes / day, while the fly ash was calculated to 1.5-2 tons / day. These quantities are transferred to properly licensed establishments abroad.

- Particularly important parameter for the effective implementation of the national Health Care Waste Management Plan, is the implementation of appropriate information and awareness-raising of all involved competent authorities, the staff of HealthCare units, legal entities and managers, the technical and scientific world, environmental agencies, organizations and citizens. Although training and especially for involved personnel in HealthCare Units is foreseen in the previous Joint Ministerial Decision 146163/2012, nevertheless no structured educational programme, approved either by the Ministry of Health or by the National Organisation for the Certification of Qualifications and Vocational Guidance, exists. Although the JMD defines in detail the duties and obligations of the personnel of HealthCare Units of the National Qualification Framework Health Care Waste Management has been developed in Greece, so far.

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