

Legal Regulation and Critical Analysis for an Effectively Treatment of Pharmaceutical Waste

Merita Dauti, Edita Alili-Idrizi, Sihana Ahmeti-Lika, Ledjan Malaj

Abstract—The extermination and proper disposal of pharmaceutical wastes from expired and unused medications remains a disputable issue due to their specific nature and characteristics. Even though the hazards from these wastes are already well known in terms of environment and human health, people still treat them as usual wastes. At a national level, in many countries the management of pharmaceutical and medical wastes has been one of the main objectives in order to protect people's health and the environment. Even though many legal regulations exist in this respect, there has not been a single law that would clearly explain the procedures of returning medicines, ways of selection, treatment and extermination of pharmaceutical wastes. This paper aims at analyzing the practices of pharmaceutical waste management and treatment in some European countries as well as a review of the legislation and official guidelines in managing these kinds of wastes and protecting the environment and human health. A suitable treatment and management of expired medications and other similar wastes would be in the interest of public health in the first place, as well as in the interest of healthcare institutions and other bodies engaged in environment protection.

Keywords—Pharmaceutical waste, legal regulation, proper disposal, environment pollution.

I. INTRODUCTION

A clean and healthy environment is the focus of many activities organized worldwide, because it ensures a good public health and better life quality. Within the framework of these activities, special attention is devoted to the management of produced wastes from both households and other facilities.

A statistical analysis that was recently made in the 27 EU member states and some other non-EU members shows that the level of waste production has increased considerably. The statistical data show that the total production of wastes from households and industry in 2012 in these 27 members of the EU was 2,500 million tons. There was a considerable variation in the amount of waste generated in 2010 across those countries. Expressed in relation to population, Latvia generated the lowest level of waste per inhabitant (669 kg), just below Croatia (715 kg). A relatively low level of waste generated per inhabitant there was in the Former Yugoslav Republic of Macedonia (1113 kg). The highest share of EU-27 total being accounted for by Germany (14.5%), just ahead of France (14.2%) and somewhat further ahead of the United

Kingdom (10.4%) [1].

In many legal regulations of EU countries as well as in some other non-EU countries that aim EU membership, the main objective is reduction of waste production, and whenever this is impossible to do, a proper selection and disposal of those wastes should be done in order to minimize their impact on the environment.

Regulation 2150/2002 was adopted. This regulation aims at monitoring the implementation of waste policy and principles for a proper disposal of wastes. Since 2004, all EU member states have been obliged to report data on generation, recovery and disposal of waste every two years [2].

In this context, certain standards and criteria have been set for producers so that the production processes and the products themselves have as little influence as possible in the environment. These standards include ISO 14000 and ISO 14001 set by the International Organization for Standardization (ISO) located in Geneva, Switzerland.

Compared to the total amount of urban municipal waste, Health Care Waste (HCW) comprises a small fraction; however due to its potential danger for the health of the population, these kinds of wastes have remained in the center of attention of the public interest.

Health Care Waste includes all medical wastes that come from healthcare institutions, research centers and laboratories. Pharmaceuticals and chemicals comprise about 3% of the total amount of Health Care Waste [3]. Pharmaceutical waste includes expired, unused, split and contaminated pharmaceutical products, drugs, vaccines and sera that are no longer required and need to be disposed of appropriately [4].

Unwanted medications do not only derive from healthcare institutions but from households too. Special attention should be paid to this fact because the treatment of unwanted medicines as usual wastes can turn them into dangerous agents in terms of environment pollution. The presence of pharmaceuticals in environment, especially in water resources, has been confirmed by several reports [5]. Experience from EU Member States demonstrates that once HCW has been effectively treated it poses no greater hazard to the environment than municipal waste, if proper management practices are applied [6]. In the last 10 years, stricter emission standards for dioxins and furans in many countries have significantly reduced the release of these substances into the environment. In several European countries where tight emissions restriction was adopted in the late 1980s, dioxin and furan concentrations in many types of food (including mother's milk) have decreased sharply [3].

In attempts for minimizing the hazards and consequences

Merita Dauti, Edita Alili-Idrizi, Sihana Ahmeti-Lika are with Department of Pharmacy, Faculty of Medical Sciences, State University of Tetova, 1200 Tetovo, Republic of Macedonia (e-mail: merita_leka@yahoo.com, edita.alili7@gmail.com, sihana.ahmeti@hotmail.com).

Ledjan Malaj is with Faculty of Pharmacy, University of Medicine, Tirana, Albania (e-mail: ledjan.malaj@gmail.com).

caused by Health Care Waste, the EU has adopted Directive 2001/83/EC and then Directive 2004/27/EC, in which considerable improvements of environmental aspects in the existing legislation were made [7], [8]. The European Environment Agency (EEA) constantly reports on the situation with the environment and provides information on environmental policies in various different European countries. Currently, the EEA consists of 33 members.

In the context of controlling and disposing of dangerous wastes at a global level, in 1992 the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal came into force. The Convention has 181 Parties and aim to protect human health and the environment against the adverse effects resulting from the generation, management, trans-boundary movements and disposal of hazardous and other wastes. Each country that is a Party to the Convention is required to report information on the generation and movement of hazardous wastes. In the text of the Convention, Annex 8, wastes which may contain either inorganic or organic constituents are specified, including wastes from production, preparation and use of pharmaceutical products [9].

In the US guidelines on proper disposal of prescription drugs for the public are provided by the Food and Drug Administration (FDA). In these guidelines, instructions of how to handle properly unused medication in domestic conditions are given [10]. Another agency that also aims at informing the public about the way of treatment of pharmaceutical waste is the Environmental Protection Agency (EPA).

Despite the engagement of the above-mentioned institutions and the usage of greater and greater medications in healthcare, the numerous reports and studies show that many countries have not adopted the official states guidelines in terms of proper disposal of unused or expired medications. In many European countries, citizens are not well-informed on how they should react with unused pharmaceuticals in households. A considerable amount of unused pharmaceutical products is discharged through the sinks or as household waste. Although most European States provide special collection systems, the amounts collected differ widely [11].

Since its independence in 1991, Republic of Macedonia has made permanent attempts to meet the requirements which are needed for becoming a member of the EU. Currently, Macedonia has the status of a candidate country and a number of EU directives have already been adopted.

Health Care Waste Management (HCWM) is one of the most challenging sectors, and at the same time, one of the top priority sectors of the country.

The Government of Republic of Macedonia has adopted two framework legislative instruments for implementation of the basic principles for protection and care of the environment including waste management:

- Law on protection and promotion of the environment and nature in 1995 and
- Law on waste in 1998.

According to the Law on protection and promotion of the environment and nature, the Government defined the

hazardous waste in full compliance with the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal [6].

In 2002, taking into consideration the gaps of the existing relevant legislation compared to the EU requirements, the Government initiated the process of drafting new legislative instruments. A package of 3 legislative instruments was adopted by the Parliament in the period of 2004-2005, including: the new Law on the Environment, the new Law on Waste Management and the Law on the Protection of Nature [6]. Apart from the above-mentioned laws, a number of regulations have been adopted by relevant institutions. Formulation of policies, drafting and law enforcement in the area of the Health Care Waste Management is shared between several ministries: Ministry of Environment and Physical Planning, Ministry of Health and Ministry of Agriculture, Forestry and Water Economy. We should point out that most of regulations adopted by these institutions have been directly transferred from the EU directives. Because of the distribution of responsibilities and the lack of coordination among these institutions on one hand, and the weak capacity of these institutions on the other, a lack in monitoring, inspection, note taking and data reporting is evident.

In this respect, the aim of this study is by presenting the experiences from several EU countries in the management of pharmaceutical waste and by reviewing international legislation for this purpose, to reveal the gaps that exist in dealing with this serious problem.

II. MATERIALS AND METHODS

The study has been based on the availability of information from recent years about the management of solid wastes, and especially pharmaceutical wastes. During the collection of data, various different scientific papers, abstracts, technical reports and other studies related to the problem in question have been taken into consideration. The focus was on National Plans for Waste Management, Drug and Environmental regulation in some European countries as well as legal provisions and regulations that deal with proper disposal of unwanted medicines.

In collecting the necessary data, the official websites of governmental organizations such as World Health Organization (WHO), European Environment Agency (EEA), European Medicines Agency (EMA), and Environmental Protection Agency (EPA) have been used.

III. RESULTS

A. Definition and Classification of Health Care Waste

The clear definition of health care waste and the scope of legislation are most important for effective health care waste management.

Health-care waste includes all the wastes generated by medical activities. It embraces activities of diagnosis as well as preventive, curative and palliative treatments in the field of human and veterinary medicine. In other words, are considered as health-care waste all the wastes produced by a

medical institution (public or private), a medical research facility or a laboratory [12].

According to the Technical Guidelines on Environmentally Sound Management of Biomedical and Health-care waste provided by the Conference of the Parties to the Basel Convention on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal (December 2002), health-care waste are classified as follows:

TABLE I
CLASSIFICATION OF HEALTH CARE WASTE

HEALTH CARE WASTE
A: Non-Risk Health Care Waste
A1: Recyclable Waste
A2: Biodegradable Waste
A3: Other Non-Risk Waste
B: How Requiring Special Attention
B1: Human Anatomical Waste
B2: Sharps
B3: Pharmaceutical Waste:
B3.1: Non-Hazardous Waste
B3.2: Potentially Hazardous Waste
B3.3: Hazardous Waste
B4: Cyto-Toxic Pharmaceutical Waste
B5: Blood And Body Fluids
C: Infectious And Highly Infectious Waste
C1: Infectious Waste
C2: Highly Infectious Waste
D: Other Hazardous Waste
E: Radioactive Waste

As we can see from the chart, pharmaceutical wastes are divided into three classes:

- Non-hazardous pharmaceutical waste -this class includes pharmaceuticals such as chamomile tea or cough syrup that pose no hazard during collection, intermediate storage and waste management. They are not considered hazardous wastes and should be managed jointly with municipal waste.
- Potentially hazardous pharmaceutical waste -this class embraces pharmaceuticals that pose a potential hazard when used improperly by unauthorized persons. They are considered as hazardous wastes and their management must take place in an appropriate waste disposal facility.
- Hazardous pharmaceutical waste - comprises heavy metal containing and unidentifiable pharmaceuticals as well as heavy metal containing disinfectants, which owing to their composition require special management. They must be considered as hazardous wastes and their management must take place in an appropriate waste disposal facility.

Another category of pharmaceutical wastes that could attract the public's attention is:

- Cytotoxic pharmaceutical waste - are wastes that can arise by use (administration to patients), manufacture and preparation of pharmaceuticals with a cytotoxic (antineoplastic) effect. These chemical substances can be subdivided into six main groups: alkylated substances, antimetabolites, antibiotics, plant alkaloids, hormones, and others. A potential health risk to persons who handle cytotoxic pharmaceuticals results above all from the mutagenic, carcinogenic and teratogenic properties of

these substances. Consequently, these wastes pose a hazard, and the measures to be taken must also include those required by occupational health and safety provisions [13].

B. The Presence and Impact of Pharmaceuticals in the Environment

As a result of the increase of the pharmaceutical market in European countries, the impact of pharmaceutical substances in the environment has also increased. Data show that in Europe, France, Germany, and the United Kingdom account for 46% of the market volume in tones of active ingredients, followed by Spain, Russia and Italy. The market volume in tones of active ingredients by antibiotics is still growing. Turkey, France, and Russia have the highest antibiotics consumption, followed by Italy, Spain, Germany and the United Kingdom [14].

Taking into consideration recent reports on the presence of pharmaceutical substances in the environment, a possible method of reducing the hazards on the environment and human health would be raising the awareness of doctors so that they would not prescribe medications unless it is really necessary to do so. Good and permanent information by doctors of their patients on proper disposal of medications upon their prescription would raise the awareness of people about the dangers of pharmaceutical wastes on the environment. A decade ago, the European Environment Agency (EEA) identified the subject as an important emerging issue in its report "Environment in the European Union at the turn of the century". Since then more research and expert recommendation have underlined the need to tackle the release of pharmaceutical substances into the environment, primarily via wastewater [17]. A considerable amount of unused pharmaceutical products is discharged through the sinks or as household waste. This method of medication disposal results unsuccessful because the mixture with waters in canalizations creates very dangerous substances. Reports on medication remainders in landfills have also been numerous.

Over a 45-year period, researchers found high concentrations of antibiotics and barbiturates in a Danish landfill [16]. High concentration of antibiotics can produce alterations in microbial community structure and affect entire food chains [18]. Also one study in Germany showed that barbiturate concentrations were still found in the environment, even though their use had been virtually eliminated 30 years ago [15]. In an examination made by Stockholm Country Council of 159 drugs substances, only two found to be readily degradable; the others were persistent or lacked data about their degradability [22]. Other substances found in surface water throughout Europe include beta-blockers, antidepressants, antiepileptics, antineoplastics, diagnostic contrast media, synthetic musks, disinfectants, sunscreens, and nutritional supplements [18].

C.Managing Practices of Pharmaceutical Returns and Waste

The extermination of unused and expired medications still remains a huge problem. Even though numerous studies and reports on the impact of these wastes on the environment exist, we can still say that in many countries right information of the public in relation to the management and disposal of unused and expired medications is missing.

The age-old wisdom of flushing medication down the toilet (still recommended by many professionals), however, is probably the least desirable of all alternatives, which include disposal in household trash and community hazardous waste pickup programs [19].

The best form to prevent unintentional poisoning or abuses with substances from unused medications, is undoubtedly the returning of medications. Collection programs are being increasingly used in some European countries. Through these programs, proper disposal of medications is provided, thus eliminating the dangers to the environment and the community.

Article 127b of the European Union Directive 2004/27/EC required that "Member States shall ensure that appropriate collection systems are in place for medicinal products that are unused or have expired" [8]. In 2007, the European Federation of Pharmaceutical Industry Association (EFPIA) conducted a survey of the 27EU Member States and Norway to determine how these collection programs were being implemented [20]. Twenty of the 28 nations surveyed have established a pharmaceutical waste collection scheme, the majority of which (11) are pharmacy-based collection systems. It is worth mentioning that Sweden is one of the few countries which apart from the implementation of the collections programs and population realization, has also classified about 420 pharmaceutical substances that comprise 70% of pharmaceutical sales in Sweden. The report of the Swedish Medical Products Agency here includes substances which are provisionally classified as toxic/highly toxic and persistent from an ecological point of view [22]. Other European countries where collection programs are implemented include: Switzerland, Ireland, Luxemburg and France.

The collection programs on United States date back from 2004-2005. Many pharmacies in US take back unused and expired medications [21].

On a global level, other countries with good collection programs are Australia, Canada, Kuwait, etc.

D.Health Care Waste Management-General Practice in Republic of Macedonia

According to the data of the State Statistical Office, the total amount of collected municipal waste in the Republic of Macedonia in 2012 was 555 760 tones. Compared to 2011, the total amount of collected municipal waste increased by 1.02%. The highest amount of collected municipal waste was registered in the Skopje Region - 144 593 tones, or 26.0% of the total collected amount in the Republic of Macedonia.

The total amount of generated municipal waste in the Republic of Macedonia in 2012 was 786 909 tones. The

annual amount of generated municipal waste per person in 2012 was 382 kg per person, which is 7.0% higher than the same amount in 2011. The whole amount of collected municipal waste (100%) is disposed of in landfills, and no other operations for municipal waste treatment are performed [23].

As regards the production of Health Care Waste, the healthcare institutions are undoubtedly the biggest producers of such wastes. In the Republic of Macedonia these institutions belong to both the private and public sector, organized in three levels: primary, secondary and tertiary healthcare, with 497 beds in 100,000 inhabitants.

The Strategy for Waste Management of the Republic of Macedonia reports that the overall amount of wastes produced by healthcare institutions reaches 6,670 tons, of which hazardous waste takes up 15% of the total amount of Health Care Waste.

TABLE II
AMOUNT OF GENERATED WASTE FROM HEALTH CARE INSTITUTIONS

Section	Generated Waste/Tones	Non-Hazardous	Hazardous
Health Care Institutions	6670	5670	1000

Apart from healthcare institutions, producers of pharmaceutical preparations and products are also generators of Health Care Waste. According to the data by the State Statistical Office, in Republic of Macedonia the amount of generated waste from this section in 2010 was 1,247.23 tons, of which 1,236.90 tons were nonhazardous and 10.33 hazardous wastes [23].

TABLE III
AMOUNT OF GENERATED WASTE FROM MANUFACTURE

Section	Generated Waste/Tones	Non-Hazardous	Hazardous
Manufacture of Basic Pharmaceutical Products and Preparations	1247.23	1236.90	10.33

Around 1,200 t of hazardous waste from health institutions is relatively small amount of material in terms of economy of scale at any capacity treatment. But the country produce specific waste fractions that can pose a real risk to the environment and to human health, such as old drugs, pesticides and contaminated packaging across the country, selected old chemicals and laboratory chemicals residues and similar combustible hazardous materials [24]. Public Enterprise "Komunalna Higijena" is established and owned by the City of Skopje. The company deals with waste collection (mixed municipal waste and separate collection of medical waste in the urban area of Skopje. Among other communal services, they carry out street sweeping and maintenance of public hygiene. The company operates the "Drisla" Landfill (for disposal of mixed municipal waste) and the incinerator for health care waste, granted by the Department for International Development (DFID) of the British Government.

Existing medical waste incinerator in landfill "Drisla" has a capacity of 500 ton medical waste per year. It operates at a temperature of approximately 850°C and has a retention time

of less than two seconds. It also has equipment for purification of exhaust gases. As a result, the existing facility does not meet the legal requirements of the EU Directive on Incineration of Waste. Therefore the proposal is to build a new incinerator for medical waste that meets the requirements of the Waste Incineration Directive of the EU [25].

There are data on the amount of medical waste incinerated in the incinerator "Drisla" in years, from 2000 to 2010th. It shows a general upward trend, from 115 tons in 2000 to 444 tons in 2010, although the figure for 2009 higher, 499 tons. From this there arises the "Drisla" receives about 50% of medical waste in Macedonia, although concentrated waste from Skopje which has the largest concentration of health care institutions in the country. The data from landfill "Drisla" for the incinerated medical waste are presented in the following table

TABLE IV
INCINERATED HEALTH CARE WASTE FOR 2000-2012 YEARS

Year	Collected and Incinerated Health Care Waste in Tonnes
2000	114.90
2001	231.90
2002	248.60
2003	255.06
2004	322.67
2005	375.65
2006	327.00
2007	355.00
2008	358.85
2009	416.31
2010	458.43
2011	496.97
2012	501.25

The average increase in the period 2006 - 2009 was 5.2% per year. If medical waste continues to grow at a rate of 5.2% per year, the total amount of waste to be incinerated in 2025 would be 1123 tons. The figure below shows the increase in years of the medical waste in Macedonia.

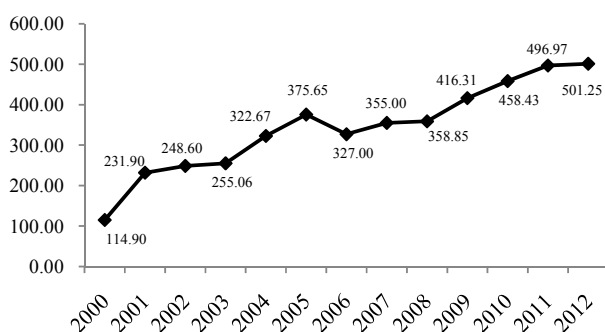


Fig. 1 Collected and incinerated Health Care Waste in tonnes

Health care waste is collected from Healthcare Institutions Located in the urban area of Skopje using two dedicated trucks for this purpose, each equipped with 5 m³ open

containers. The containers are colored yellow and are marked with text informing that medical waste is being transported.

The collection of medical waste by public institutions is an already regulated process. Private institutions still pose a problem; they produce considerable amounts of wastes, and even though they have contracts with collecting companies, the latter do not engage sufficiently in doing their job correctly. This makes it clear that these private healthcare institutions exterminate these wastes in other forms, or they dispose them of together with other municipal wastes.

The practice of returning programs is still unknown in Macedonia. The population is totally uninformed about the dangers that these wastes may cause. All wastes from unused and expired medications are treated as usual municipal wastes. There are no guidelines that would guide patients in terms of the proper disposal of medical wastes. Relevant institutions that deal with environment protection do not have any data about this problem.

E. Legal Regulation for Pharmaceutical Waste-Compliance with Environmental Regulation

In the overall legal regulations in the Republic of Macedonia, Pharmaceutical waste is hardly ever mentioned. These wastes are dealt with within the health Care Waste, divided into numerous articles from laws adopted by different institutions, without any special specifications.

The definition of Health Care Waste, where Pharmaceutical waste is also included, along with ways of managing, collecting, transporting, selecting and disposing are included in a fragmented way in the legal regulations in the Republic of Macedonia. Summarized altogether, they are as follows:

o Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal (OGRM 49/97)

The Parliament of Republic of Macedonia has adopted the Law on the ratification of the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal in 1997. The Basel Convention makes specific reference to the control of Health Care Waste like sharps, pathological infectious waste, hazardous chemical waste, and pharmaceutical waste in Annex 8:

- Clinical wastes from medical care in hospitals, medical centers, and clinics (Y1).
- Wastes from the production and preparation of pharmaceutical products (Y2).
- Waste pharmaceuticals, drugs, and medicines (Y3), and
- Waste from the production, formulation and use of biocides and phyto-pharmaceuticals

o Law on Environment (OGRM 53/05)

This law is in compliance with the International Plant Protection Convention (IPPC). The law is made by the template of western law where fundamental principles governing horizontal runs in one basic law. It is kind of general environmental law that covers common issues regulated by sectoral laws for individual environmental media, environment and waste management, such as laws on water,

waste management, for protection of nature and the quality of ambient air. The sub-chapter dealing with prevention of pollution includes the treatment of Health Care Waste, within the framework of hazardous wastes without any particular specifications. However, the law sets the basis for regulating other treatment types, e.g. sterilization in autoclaves requiring permits for processing, treatment and/or storage of waste

o Law on Waste Management (OGRM 68/04, 107/07, 102/08, 143/08, 124/10, 51/11, 123/12)

The Law on Waste Management defines all types of wastes according to the legislation of the European Union. In article 6, the HCW is defined as a “waste generated in medical and health institutions (dispensaries, hospitals, polyclinics and outpatient departments, dental clinics, veterinary stations), which originated as a product of used items and materials during diagnosing, medical treatment and prevention of diseases of in human and animals.”

In respect of this definition, the Government, introduced in the definition of the HCW also the waste of veterinary institutions but at the same time excludes the waste from scientific, developing and researching institutions.

The Law on Waste Management provides the legal base for further regulation by secondary legislation of the following issues:

- Separate handling of hazardous waste
- Mixing of hazardous waste
- Obligations to register and classify hazardous waste

The Law on Waste Management lists the HCW as one of the types of hazardous waste, thus in the Chapter for handling hazardous waste, Sub-chapter for handling specific types of hazardous waste (article 73) is prescribed that the HCW shall be handled in accordance with the provisions for handling hazardous waste. In this article the legal basis for two legislative instruments is set as follows:

- Detailed prescription of the manner of handling HCW, the labeling and forms related to HCW handling, as well as the types of HCW who’s processing shall be prohibited. A draft regulation is being produced recently in cooperation between the Ministry of Environment and Physical Planning and the Ministry of Health. The content of the draft regulation is briefly presented in later paragraphs.
- Regulation on Conditions for Handling Hazardous Waste and the Manner of Packaging and Labeling the Hazardous Waste. The Draft regulation is also further explained in terms of its coverage and compliance with the EU Directive on Hazardous waste [6].

o Law on Drugs and Medical Devices (OGRM 106/07,88/10,36/11,53/11,136/11,11/12)

This law regulates drugs and medical devices for use in human medicine, conditions and methods for ensuring their quality, safety and effectiveness, method and procedures for their production, testing, marketing sales, marketing, pricing, quality control, inspection and advertising supervision. Article 106 is defined as a “Waste of Drugs” and below are the

specifications for unused medication. Medication is considered defective if:

- shelf life has expired ;
- altered organoleptic characteristics (appearance, color, taste and smell) ;
- packaging is damaged;
- laboratory showed that the control is not in accordance with declared quality and withdrawn from use of any other reason.

The defective drug is considered waste and its circulation is prohibited. Pharmaceutical waste is disposed of in a manner which does not endanger the health of people and the environment. Costs associated with the disposal of drugs are covered by the owner of pharmaceutical waste.

o Law on Sanitary and Health Inspection (OGRM 71/06)

The Law on Sanitary and Health Inspection establishes competences and organization of the State Sanitary and Health Inspectorate. In this respect the appointment of sanitary and health inspectors, their mandate and the procedures for carrying out the inspection and control are stipulated in detail. The State Sanitary and Health Inspectorate are to carry out inspection and control over the laws and regulations in the area of sanitary-hygiene, epidemiologic and health protection, as well as health insurance. According to the Law on Waste management in the State Sanitary and Health Inspectorate cooperation with the State Environmental Inspectorate is responsible for the inspection of the Health Care Waste handling [6].

As can be seen from the description of the above-mentioned laws, the management of medical or pharmaceutical wastes, from the legislative point of view is very fragmented. There is no specification and a clear method of their disposal to be included in a single law. In order to supplement this gap, numerous regulations have been adopted. Some of them are as follows:

o Regulation on the Manner of Disposal of Drug Waste (OGRM106/07)

This regulation came into force in 2008. This regulation prescribes in detail the manner of disposal of drug waste. Under disposal of drug waste under this Regulation involves destruction of the drugs prescribed methods and translating them into substances that not are harmful to health, human life and environment. The destruction of the drugs used physical, chemical, physical and chemical other appropriate methods based on the achievements of modern science and technology, whose selection and application depend on physical-chemical and other properties of the drugs are destroyed, and comply with regulations for environmental protection. Drugs of this Rulebook with expired shelf life, kept by their owners in a separate room / or part of a room, until their surrender for destruction Drugs are stored in external contact packaging, with respect to the storage conditions specified by manufacturer. To approve the destruction of drugs by law cares Drug Agency, which later than 30 days from receipt of the request, issued written authorization for destruction.

o Regulation on the Manner of Handling HCW, Labelling and Forms for Handling HCW and on Types of HCW for which Processing is Prohibited

This Regulation establishes the manner of handling HCW, the manner of labeling and record keeping of handled HCW, as well as of all types of HCW whose processing is prohibited. The regulation has undergone several amendments due to the intensified cooperation among stakeholders Ministry of Environment and Physical Planning, Ministry of Health and the joining of these authorities by the third party-the Ministry of Agriculture, Forestry and Water Economy, being responsible for veterinary establishments.

The Regulation provides definitions on HCW in the Art. 3 in the following manner, (i) Pathological, (ii) Infectious, (iii) Sharps, (iii) Pharmaceutical, (iv) Chemical, (v) Genotoxic, (vi) Containers under pressure. The Genotoxic waste was included after a round of consultations with stakeholders. The Regulation defines the types of medical waste, how handling of medical waste shall be conducted, which includes segregation, identification, collection, packaging, labeling, transportation, processing and disposal.

Separation / segregation at source within the hospitals is intended to reduce health care wastes for treatment, as a result of the avoidance of its mixing with non-hazardous wastes. In Article 4, handling operations are listed as follows: HCW separation at source, separate collection, storage on-site, re-use, recycling, recovery, treatment, transport outside health care facilities and final disposal. In Article 5 separations at source, registration, labeling, packaging and record keeping are prescribed.

In addition, distinction between various HCW types upon labeling and packaging by use of different colors is defined as follows:

- red color for pathological (anatomic) waste
- yellow color for potentially infectious waste
- green color for pharmaceutical waste
- black or blue color for municipal or inert waste

Apart from the color of packaging appropriate labeling is being defined as well.

IV. CONCLUSION

The treatment of medical wastes poses a very specific problem. In all cases in the literature and numerous reports on different methods of disposal of these wastes and their negative impact, they are treated as part of the Health Care Waste. Even though they comprise a small fraction of the total amount of wastes produced within the Health Care Waste, they are spread all over the place and are on the hands of the general population. By not being aware about the consequences from these wastes, people treat them as usual wastes, unlike those managed by professionals, i.e. healthcare personnel. There is no a special law that would clearly define, classify and provide proper guidelines of disposal of medical wastes. In developed countries in the EU and the USA, this problem has been resolved within the framework of the adoption of programs for collecting and returning

pharmaceutical wastes. However, in other countries, such as Macedonia, this problem has not even been mentioned as such. What can be noticed in the treatment of this problem are the numerous gaps in legislation, the lack of coordination of competent institutions, as well as the total lack of information among the population in terms of the proper treatment of these wastes or the organization of programs for collecting and returning these wastes.

As regards the specifications of pharmaceutical waste and its impact on the environment, competent institutions such as the Ministry of Environment and Physical Planning and the Ministry of Health involve in the compilation of legal provisions and regulations. This implication of competences is expected to produce better outcomes; however, this is not the case.

In Macedonia, in the last decade there have been so many changes in the legislation in terms of the unification of that legislation with the European one that one may think that the issue of medical waste management is something that now belongs to the past. In fact, the problem still persists and has not been dealt with appropriately. The lack of coordination among relevant institutions causes lack of information about the management of pharmaceutical wastes. Total lack can be noticed in terms of the way of reporting data for recent years, as well as those for methods of proper disposal of medications by private healthcare institutions.

REFERENCES

- [1] Eurostat. Waste Generation, 2010 (kg per inhabitant). Available: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Waste_statistics
- [2] EU Waste Statistics Regulation (EC 2150/2002) 2004-06. Available: <http://publicdata.eu/dataset/eu-waste-statistics-regulation-ec-2150-2002-2004-06>
- [3] WHO, 2011. Waste from health-care activities. Fact sheet n°253. World Health Organization. Available: <http://www.who.int/mediacentre/factsheets/fs253/en/index.html>
- [4] WHO, 2009 How to Dispose Unused Medicines Available: <http://www.fda.gov/downloads/drugs/resourcesforyou/consumers/buyingusingmedicinesafely/understandingover-the-countermedicines/ucm107163.pdf>
- [5] US EPA (US Environmental Protection Agency), 2011. Pharmaceuticals and personal care products, relevant literature. Available: <http://www.epa.gov/ppcp/lit.html>
- [6] Basel Convention Regional Centre, Bratislava. Strategy on Biomedical (Healthcare) Waste Management. Former Yugoslav Republic of Macedonia. Skopje, January 2008,14-18
- [7] Directive 2001/83/EC of the European Parliament and of the Council of 6 November 2001 on the community code relating to medicinal products for human use. Official journal L- 311,28/11/2001, pp.66-128, article 127b
- [8] Directive 2004/27/EC of the European Parliament and of the Council of 31 March 2004 amending 2001/83/EC on the community code relating to medicinal products for human use. Official journal L- 136 30/4/2004, pp. 57, article 127b
- [9] Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and Their Disposal. Annex VIII; 72-79. Available: <http://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf>
- [10] US FDA, 2012. How to dispose of unused medicines. Food and Drug Administration. Available: <http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm101653.htm>
- [11] European Environmental Agency. Pharmaceuticals in the environment. EEA Technical report/No 1/2010, Copenhagen,2010
- [12] WHO Fact sheet n° 231, April 2002 (<http://www.who.int/mediacentre/factsheets/fs231/en/>)

- [13] Preparation of National Health-Care Waste Management Plans in Sub-Saharan Countries- Guidance Manual Secretariat of the Basel Convention and World Health Organization (http://www.basel.int/Portals/4/Basel%20Convention/docs/pub/techguid/gm_hc_sussahara_e.pdf)
- [14] Campagnolo, E. R.; Jonson, K. R.; Karpati, A.; Rubin, C. S.; Kolpin, D.W.; Meyer, M.T.; Esteban, J.E.; Currier, R.W.; Smith, K.; Thu, K.M., 2002 "Antimicrobial residues in animal waste and water resources proximal to large-scale swine and poultry feeding operations". *The science of the total environment*, 299:89-95
- [15] German Advisory Council on the Environment, 2007. Pharmaceuticals in Environment. Statement April 2007. No. 12. Available at: http://www.unweltrat.de/english/edownload/statemen/Stellung_Pharmaceuticals_in_the_Environment_2007_eng.pdf
- [16] Holm JV, Rügge K, Bjerg PL, Christensen TH. Occurrence and distribution of pharmaceutical organic compounds in the groundwater down gradient of a landfill (Grinsted, Denmark). *Environ Sci. Technol.* 1995; 29(5):1415-1420
- [17] Choi CO. Pollution in solution, drug-resistance DNA as the latest fresh water threat. *Scientific American*. Januari 2007:22-23.
- [18] Daughton CG, Ternes TA. Pharmaceuticals and personal care products in the environment: agents of subtle change? *Environ Health Perspect.* 1999; 107 Suppl. 6: 907-938.
- [19] Daughton CG. Cradle-to-Cradle Stewardship of Drugs for Minimizing Their Environmental Disposition While Promoting Human Health *Environ Health Perspect.* 2003; Vol.111, No. 5
- [20] Taylor D, Poulimare M. An initial survey of unused and expired medicine take back schemes in the European Union. Conference: pharmaceutical products in the environment : trends towards lowering occurrence and impact. KNAPPE International Conference, Nimes, France ;2008
- [21] Glassmeyer S.T *et al.* Disposal practices for unwanted residential medications in the United States. *Environment International.* 35 (2009) 566-572.
- [22] "Miljöpåverkan från läkemedels- och kosmetiska och hygieniska produkter". ("Environmental effects of pharmaceuticals as well as cosmetics and hygiene products", report by the Swedish MPA, 2004, contains a summary in English, www.lakemedelsverket.se)
- [23] Generated waste by section of economic activity. State Statistical Office of the Republic of Macedonia 2012, No : 5.1.12.17 (www.stat.gov.mk)
- [24] National Plan for Waste Management (2009-2015) of Republic of Macedonia (2009-2015), based on the National Strategy for Waste Management. Final draft document, October 2008
- [25] Feasibility study for landfill "Drisla", 2011282292/EVT/EES/1/C 5th August 2011