Upravljanje medicinskim otpadom

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Apstrakt: Upravljanje medicinskim otpadom je od velikog značaja za ljude i životnu sredinu. Neodgovorno upravljanje i klasifikovanje medicinskog otpada može dovesti do ugrožavanja životne sredine i prouzrokovati zdravstvene rizike kako kod zaposlenih, tako i kod pacijenata. Tradicionalno odlaganje otpada na deponije predstavlja najučestaliji oblik odlaganja otpada kod nas, iako autori vide najefikasnije rešenje u spaljivanju kao naprikladijem metodu ili integrisanom metodu hijerarhijskog upravljanja od faze nastanka do tretiranja otpada, što donosi ekonomsku prednost i smanjenje rizika potencijalnih šteta. Da bi se živelo u skladu sa okolinom, problem zbrinjavanja otpada se mora prepoznati kao jedan od važnih zadataka svih struktura koje učestvuju u njegovom stvaranju i zbrinjavanju.

Ključne reči: medicinski otpad, menadžment, upravljanje, zdravstvo, životna sredina.

Medical waste management

Abstract: Medical waste management is of great importance for people and the environment. Irresponsible management and classification of medical waste can lead to environmental hazards and cause health risks to both employees and patients. Traditional waste disposal on landfills are the most common form of waste disposal in our country, although the authors see the most efficient incineration solution as a more appropriate method or an integrated method of hierarchical management from the generation stage to waste treatment, which brings economic advantage and risk reduction potential damages. In order to live in harmony with the environment, the problem of waste disposal must be recognized as one of the important tasks of all structures involved in its creation and disposal.

Key words: medical waste, management, administration, health, environment

1. Introduction

The different types of global hazards facing the modern world can be divided into two basic ones: pollution and the creation of waste material that is released into the environment. At the same time, it means excessive consumption of natural resources that cannot be renewed. In modern society, almost everything, material, apparatus or object will become waste after a short or long time.

The increase in the quality of life, the development of technologies and the use of non-returnable packaging have caused the quantities of waste to increase day by day and threaten if they are not adequately disposed of. Their consequences are incalculable, which are slowly but surely endangering the conditions for a safe life. And while nature reuses its waste in the process of circulating matter and energy, man has created a series of synthetic materials that cannot be included in this process. They are accumulating, disturbing the balance in nature and becoming an economic, ecological and health problem of today, and they set the task of special care for waste in front of the society.

The amount of waste generated is related to the technological development and economic power of a country. Economically developed countries generate more waste, so today they face serious problems of waste disposal and management.

Developing countries generate smaller amounts of waste than developed countries, but they also have problems with harmful effects on human health and the environment because they do not have regulated waste collection and disposal systems.

The growth of living standard, the increase in the number of inhabitants, the development of technology, economic and non-economic activities and the use of non-returnable packaging have caused the amount of waste to increase day by day. In addition to municipal household waste, there are other human activities in which not only municipal but also various types of hazardous waste are generated.

2. Medical waste management

2.1. Hazardous waste

By place of origin, waste can be: municipal waste originating from households or similar in characteristics and content to household waste, technological or industrial waste generated in industry and crafts, packaging waste, construction waste generated by construction, maintenance and removal of buildings, and electrical or electronic waste. Special emphasis is placed on medical waste generated during the provision of health care or in scientific research. By properties, waste is divided into inert or non-hazardous and hazardous waste.

Hazardous waste began to be talked about more seriously in the late 1970's and early 1980's, following the events in the city of Love Canal in New York State. The city was built on a landfill for chemical and industrial waste, so the whole area was contaminated with more than 200 different chemicals, of which 10% were potentially mutagenic, teratogenic and carcinogenic.

The frequency of abortions or children born with chromosomal aberrations and a number of other diseases among citizens has warned the world that chemical waste should be treated as a separate category. In the early 1980s, hazardous waste was first officially defined in the United States. Hazardous waste is considered to be substances that have flammable, reactive, explosive or corrosive properties. (Jakšić et al., 2001)

Waste is also dangerous if it contains substances that are toxic (toxic) or infectious (infectious), carcinogenic, mutagenic and teratogenic. Hazardous waste can be in a solid state or in the form of a liquid, while toxic gases are classified as air pollution. However, hazardous waste is also considered to be substances that have the properties of releasing harmful gases by chemical or biological decomposition, ie in the processes of processing and disposal. Waste that can be classified as hazardous requires special methods of treatment and disposal, and this category of waste also includes waste in the provision of health care (McKay, 2002).

2.2. Medical waste

The generation of waste is a consequence of all human activities, including health. Waste generated during the provision of health care can be divided into two groups of waste, municipal and hazardous waste. Municipal waste contains: paper and cardboard packaging, glass, food scraps and other common waste generated in the administration, kitchens and laundries. Hazardous medical waste contains elements of chemical and biological danger, whether they are in solid, liquid or gaseous state (Alagoz and Kocasoy, 2008)

Its properties are: harmfulness, toxicity, carcinogenicity and infectivity, and that is why hazardous medical waste differs from municipal waste. The amount of hazardous waste compared to the total amount of waste generated in health care institutions is not large, but it certainly requires, like any other type of hazardous waste, special treatment.

It is an unacceptable, but realistic, fact that medical waste from health institutions (clinical and / or hospital centers, health centers and regional clinics) is transported without special markings by vehicles of the utility company with other municipal waste and disposed of at the city landfill without prior treatment. Needles and sharp objects that have been in contact with blood and body fluids are not separated in specially designed boxes for biorisk waste in some health care institutions (Jakšić et al., 2001).

2.2.1. Hazardous medical waste

According to the place of origin, within hazardous waste, we single out a group of hazardous medical waste. Medical or health waste is waste that is generated during the protection of human health. The largest producers of medical waste are large health care institutions, ie clinics, health centers, hospitals, diagnostic and research laboratories, morgues, autopsy centers and transfusion and dialysis centers. Smaller producers are smaller health units such as private specialist and dental clinics, acupuncture and chiropractic clinics, home care institutions for the disabled, addiction reduction centers for addicts and funeral services. (Jakšić et al., 2001). According to the Ordinance on medical waste management, medical waste is a special type of waste that is produced in health care institutions.

It is a heterogeneous mixture of municipal, infectious, pathological, pharmaceutical, and laboratory waste, disinfectants and packaging, as well as radioactive and hazardous chemical waste. Hazardous medical waste contains toxic, harmful, carcinogenic and infectious substances and according to its properties and place of origin is divided into: pathological waste, infectious waste, sharp objects, pharmaceutical waste, chemical waste, pressure vessels and radioactive waste.

2.2.2. Safety and health aspects related to medical waste

Medical waste does not account for a large part of the total environmental pollution, but it is potentially among the most dangerous types of waste, because it can lead to infections and poisoning. Pollution coming from health facilities can be very dangerous to the health and ecosystem in which that waste is stored. Inadequate management of hazardous medical waste, from handling within facilities providing medical and veterinary services to final disposal, poses a very high risk, both for the health of staff handling it, patients and the environment in general.

In the process of handling medical waste, medical and non-medical employees are exposed to the risk, primarily of injury, if the used sharp objects are not safely packed. The World Health Organization estimates that due to inadequate medical waste handling, about 20 million people worldwide are infected with hepatitis B, C and HIV each year.

Those who search for waste in containers and landfills are also exposed to this risk. The population can be exposed to the risk of medical waste in a direct and indirect way, through various routes of contamination: inhalation, penetration through the skin and ingestion. It is estimated that about 80% of waste produced in hospitals is actually infectious waste. Risks of hazardous medical waste are: infectious diseases (AIDS, viral hepatitis B and C, intestinal infections, respiratory infections, blood infections, and skin infections); effects of radioactive substances (carcinogenic, mutagenic, teratogenic, and reproductive health toxins); poisoning or intoxication.

All persons who may come into contact with medical waste are exposed to potential health risks, namely: medical and non-medical staff of health care institutions, patients inside and outside health care institutions and their visitors, employees of utility companies handling and transporting waste, employees at landfills, including those who search for waste, the population, and especially children if they play with objects that can be found in the waste outside of health care facilities (Hossain, et al., 2011)

The introduction and implementation of adequate procedures for minimizing the risk of medical waste primarily protects the health of the population and reduces the negative impact on the environment. The first step in the management system is to identify potential risks. Possible ways of transmitting the disease are: direct contact, contact with vectors (flies, insects, field mice, rats, dogs, cats), aerobic transmission, polluted water and polluted environment (Herceg and Lukić, 2009).

Table 2. Type of medical waste, mode of infection and diseases caused by inadequate medical waste management

TYPES OF WASTE	INFECTION TYPE	DISEASES
Feces	Fecal oral intestine, food, water, insects, dirty hands	Salmonellosis, shigelosis (dysentery), hepatitis A, enterocolitis (viral and bacterial), parasitic diseases
Sputum, dust	Respiratory - droplet, by inhalation	Tuberculosis (TB), viral and bacterial pneumonia
Blood, body fluids	Infusion systems, transfusion, injuries skin and mucous membranes, fresh contaminated waste	Human immunodeficiency virus (HIV), acquired immunodeficiency disease (AIDS), hepatitis VHB virus, VHC
PUS	Contact with food	Skin infections, alimentary toxico-infections
Genital secret	Contact with fresh contaminated waste	herpes genitalis, candidiasis, clamidiasis, AIDS
CSF	Syringes, needles, containers	Meningitis (viral and bacterial)
Urine	Contaminated objects, water, food	Urinary tract infections
Blades, needles	Injury, stab incidents	Hepatitis: VHB, VHC, HIV, AIDS, pyodermas
unprotected mixed medical waste	Vectors: flies, cockroaches, mice, rats, birds, stray dogs and cats	Intestinal infections, injuries and infections

2. 2.3. Packaging for hazardous medical waste

Disposal of medical waste begins in wards, clinics, institutes, laboratories, dispensaries, dressing rooms, surgical rooms and other parts of health care institutions. It is necessary to ensure sorting and separate collection at the place of origin. Waste is sorted and collected at the place of origin in packaging adapted to its properties, quantity, and method of storage, transportation and processing, in a way that protects the environment and those who professionally handle waste. General (inert, non-hazardous) medical waste that is similar to municipal waste is disposed of as municipal waste, because it does not pose a risk to health and the environment. Packaging, such as plastic bags, cardboard boxes, containers and containers, must be made in such a way that its characteristics (color, shape, size) enable and facilitate the classification of hazardous medical waste at the place of origin (Bdour et al., 2007). A Packaging for storage must be marked "hazardous medical waste", with an indication of the type of waste. The packaging has specific markings: red for infectious waste, red with a black band for pathological waste, yellow for chemical waste, green for pharmaceutical waste, and black and blue for municipal waste.

2.2.3. Technologies for hazardous medical waste disposal

Disposal of waste from health care institutions is a complex system that involves its classification at the place of origin, collection, transportation, storage and treatment. By its composition, inert medical waste does not pose a direct danger to the health of people who handle it during collection, primary and secondary storage, and final disposal. Still, it poses a big problem given its volume and quantity. The correct way of managing this type of waste implies its classification at the place of origin into specialized containers for paper, glass, metal, etc. (Dowell et al., 2001). Earlier analysis and research noted that 77.36% of waste from health facilities is disposed of in landfills. In that waste, municipal waste is represented with 62.78%. This type of waste would be adequately disposed of if it was separated from potentially infectious waste at the place of origin. Thus, there are hazardous types of waste from health institutions at local municipal landfills: medicines, disposable materials, sharp objects, substrates and biological materials, and others (Radenovic, 2008).

Unfortunately, the final destination of waste is not only landfills, but also rivers, groundwater and the sea, because 8.87% of the total amount of hazardous medical waste and various chemicals and even radioactive contrast agents are annually discharged into the sewage system from medical institutions. (Grabara and Dima, 2014).

Each health care institution should elaborate in detail the method of sorting medical waste: its initial storage, roads, methods, persons in charge and time plan for waste collection, as well as transport to the place of secondary storage, duration of secondary storage, keeping records of types and quantities of waste, and its marking (Grose et al., 2012).

Hazardous medical waste should undergo a pre-treatment procedure before final disposal. Medical waste should be stored secondarily in a separate, marked, fenced and covered area, provided only for that purpose, and which must be structurally adapted for easy cleaning and disinfection.

3. Medical waste management in Serbia

Following the principles of the overall waste management system, a medical waste management system is being developed, which is based on a hierarchical way of acting, from the control of the place of origin to the place of final disposal. Avoiding waste is definitely a priority. Since this is not always possible, the waste needs to be: sorted, properly pre-treated, and transported in a special way, finally processed and the remains properly disposed of (Ugrinov and Stojanov, 2011). The final treatment method must be the one that will produce the least risk to human health and the environment. The implementation of the overall waste management system enables the disposal of medical waste with less financial resources, because large quantities of medical waste could be disposed of within the technological and municipal waste. Waste from health care institutions should be sorted and collected at the place of origin in packaging adapted to its properties, quantity, method of storage, transport and processing, so as to protect employees in health care institutions, employees who manage waste, citizens and the environment. Highly infectious waste requires heat or chemical sterilization in the area where the waste is produced before it is mixed with other infectious waste.

Hazardous medical waste (blades, highly infectious waste, other and potentially infectious waste, pharmaceutical waste, genotoxic, amalgam waste from dental practice, hazardous chemical waste and other chemical waste) should be kept in boxes or packaging that clearly state the characteristics and features category of waste and which provide adequate protection for persons from health care institutions who come into contact when handling the specified packaging (Tamplin, 2005). Disinfectants should not be disposed of in a sanitary landfill and should be transported in the prescribed manner.

Before disposal, it should be treated with inertization, ie the waste is pressed and lime or cement is added to it. Disinfectants must not be encapsulated as they are corrosive. Encapsulation of waste involves sealing in metal or plastic containers, and plastic foam, bituminous sand, cement mortar and/or clay material are added to the waste (Tanaskovic, 2007). Medical waste generated in health care facilities is transported to a pre-determined location within the health care facility before disposal, transport or transfer to an authorized person for these activities. The place must be a closed room that meets the following conditions: to be under the supervision of a waste management officer, to be spacious enough to receive the maximum amount of waste of different categories that must be stored separately, to prevent physical access to unauthorized persons and pests and to have provided a suitable refrigerated waste compartment that requires storage in cold rooms.

The room or landfill must be equipped with fire extinguishers and inert absorbent material to localize any spilled liquids (chemicals). If the final treatment of medical waste is carried out by the health institution where the waste is generated, the treatment is carried out in accordance with the conditions of the environmental permit or waste management permit issued by the institution.

In order to avoid the risk of disease transmission from medical waste, precautionary measures should be established, as well as training or education of health and other personnel handling waste in the direction of: acquaintance with the rules of medical waste disposal, classification of waste according to source and method of sorting, waste sorting. the place of its origin, the use of protective equipment, the manner of closing the packaging (bags, bottles, containers) as soon as they are filled with waste, careful transport of medical waste to the disposal site, packaging that must be visibly marked and appropriate hand washing after contact with medical waste. (Rakočević, 2010)

Waste management in the Republic of Serbia is regulated by a large number of regulations that directly or indirectly regulate this area (Radenovic, 2008). The complexity and importance of regulating this

area indicates the fact that a set of laws in the field of protection has been adopted environments that are fully compliant with international regulations. Waste management is regulated by large number of regulations that directly or indirectly standardize this area:

1. Law on Ratification of the Basel Convention on the Transboundary Movement of Hazardous Wastes and Their Disposal (Officialist FRY, international agreements, no. 2/99)
2. Law on Environmental Protection (Official Gazette of the Republic of Serbia, No. 135/04)
3. Law on Waste Management (Official Gazette of RS No. 36/2009),
4. Law on Health Care (Official Gazette of the Republic of Serbia, No. 107/05)
5. Law on Protection of the Population from Infectious Diseases (Official Gazette of the Republic of Serbia, No. 125/04).
6. Law on Production and Trade of Toxic Substances (Official Gazette of the Republic of Serbia 101/05, other law).
7. Law on Medicinal Products and Medical Devices (Official Gazette of the Republic of Serbia, No. 84/04).
8. Law on Transport of Dangerous Goods (Official Gazette of the FRY 24/94, Official Gazette of Serbia and Montenegro 1/03 Constitutional Charter)
9. Law on Waste Management (Official Gazette of the Republic of Serbia, No. 25/96,)
10. Rulebook on the manner of handling waste that has the properties of hazardous substances (Official Gazette of the Republic of Serbia, No.
11. 12/95)
12. Ordinance on the conditions and manner of classification, packaging and storage of secondary raw materials (Official Gazette of the Republic
13. Serbia, no. 55/01)
14. Rulebook on the manner of destruction of drugs, auxiliary drugs and medical devices (Official Gazette of the FRY, no.
15. 16/94, 22/94, Official Gazette of Serbia and Montenegro 1/03 Constitutional Charter)

3. Conclusion

Medical waste, due to its composition and negative impact on the environment and human health, requires a team of experts who are trained to manage and steer that species waste. Furthermore, they should be responsible for transferring their knowledge to the staff of the institutions which medical waste produces. On the other hand, it is the institutions that produce it, and logically, they should be responsible for proper waste management.

In total environmental pollution, medical waste does not occupy a large part, but is potentially among the most dangerous types of waste, because it can lead to outbreaks of infection and poisoning. It is common for each country to dispose of medical waste with the help of domestic regulations. International legislation has provided a good basis for drafting domestic regulations that are not fully implemented in Serbia. Serbia does not pay enough attention to the issue of medical waste disposal.

The odds are that medical waste disposal will not get the connotation of an important topic in the near future for a long time, despite the extreme importance to take into account the significance of this issue before the consequences of its neglect begin to be felt. The opinion of the author of this paper is that the problem of medical waste disposal can be solved by adequate application legislation, as well as greater interest of the scientific and professional public, which can affect the awareness of citizens about the importance proper management of both other and medical waste streams.

4. Literature

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