38TH INTERNATIONAL CONFERENCE ON ORGANIZATIONAL SCIENCE DEVELOPMENT: ECOSYSTEM OF ORGANIZATIONS IN THE DIGITAL AGE
UNIVERSITY OF MARIBOR PRESS: CONFERENCE PROCEEDINGS
P. Šprajc et al. (ed.)

University of Maribor Press

Students' Perceptions of Medical Waste Management in Serbia

KRISTINA STANOJEVIĆ, NATAŠA PETROVIĆ, MARKO ĆIROVIĆ & JELENA ANDREJA RADAKOVIĆ

Abstract Medical waste and associated negative environmental and health effects are becoming an important concern that demands the collective action from all the spheres of the society. This is way medical waste and medical waste management are more and more present as a research topic in scientific sphere as well. This paper tries to examine attitudes and knowledge undergraduate students of University of Belgrade - Faculty of Organizational Science, enrolled in Environmental Quality System course have on medical waste, medical waste treatment, regulation and health care institution practices and compares their beliefs to the factuality of the issue as an insight to how the two differ. The aim of the research is discovering how much has to be done in order to converge the two in order to increase the awareness on the necessity to deal with an issue of a rising medical waste concerns.

Keywords: • medical waste • medical waste management • students' perceprtion of medical waste management • Serbia •

CORRESPONDING AUTHOR: Kristina Stanojević, PhD student, University of Belgrade, Faculty of Organizational Science, Jove Ilica 154, 11040 Belgrade, Serbia, e-mail: kristina.stanojevic@fon.bg.ac.rs

DOI https://doi.org/10.18690/978-961-286-250-3.74 ISBN 978-961-286-250-3
Available at: http://press.um.si.

1 Introduction

During the past two decades, problem of medical waste has come to light as one of the most important phenomena that have played a clear negative impact to population health and environment (Al-Habash & Al-Zu'bi, 2012; Mihailović, Žarkić-Joksimović, Petrović, Makajić-Nikolić, & Radaković, 2017). When it comes to medical waste it should be pointed out that in literature and in practice next to the term "medical waste" terms that are used as synonyms include: hospital waste and health care waste (Komilis, 2016).

Due to the negative impact of such waste, the question of its disposal and management is gaining in importance around the world, and the question of resolving its proper transportation, treatment and disposal (Cheng, et al., 2009; Bokhoree, Beeharry, Makoondlall-Chadee, Doobah & Soomary, 2014). For these reasons, hospitals, clinics, medical and other health care insitutions must be on the alert in situations when they are dealing with medical waste (Luis, 2014).

Hazards that this waste carries consist of the possibill injuries arising from dealing with this wasste, endagering the most medical personnel but other persons handling medical waste, but also the whole population that may directly or indirectly come into contact with this waste (Birchard, 2002; Mohee, 2005; Windfeld & Brooks, 2015). It should be highlighted that threat arises for transmission of diseases such as typhoid, cholera, AIDS, hepatitis B and C, which drastically increased in the case of medical waste is not properly treated and destroyed. It should also be noted that even in cases of an adequate management of medical waste can lead to the risk of this waste (Baveja, Muralidhar & Aggarwal, 2000; Almuneef & Memish, 2003; Mohee, 2005; Insa, 2010). Therefore, the process of medical waste management has to be done in the safest way for the environment and humans (Zhang, Wu, Tian & Wang, 2016; Rajora, Xaxa & Mehta, 2012; Chen & Zhang, 2008).

It is worth noting that there is no universally accepted definition of medical waste. The reason for this lies in the diversity of defining medical waste, which is determined by various laws and regulations, and therefore the case that in different countries and organizations this term does not always mean the same thing (Komilis, Fouki & Papadopoulos, 2012; Windfeld & Brooks, 2015; Stanojević, Petrović, Drakulić, & Ćirović, 2017). Thus, for example. The World

Health Organization (WHO, 2017) is defined as a medical waste "waste resulting in the provision of health care services, which includes a variety of materials, of used needles and syringes, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials" a Department of Health Service (2004) as "all medical, liquid or gaseous wastes which are generated from healthcare facilities, medical laboratories, research centers, pharmaceutical and veterinary factories, veterinary clinics, home nursing institutions; human and animal remnants, body fluids; blood and derivatives, human excreta, contaminated clothing, wipes, injectors, contaminated sharp tools, expired medicines and chemicals".

This waste is waste water in the catalog under index number 18 (SEPA, 2010). Medical waste can be divided into two basic categories of hazardous and non-hazardous (infectious) waste that makes 10 to 25% of the entire medical waste (Voudrias & Graikos, 2014; Maamari, Brandam, Lteif & Salameh, 2015; Taghipour & Mosaferi, 2009).

2 Medical Waste Management

Waste management implies the implementation of legal measures in the context of separation, collection, transport, treatment, reuse and final disposal into the environment, and monitoring these activities. It must be done in a way that does not endanger the health and lives of people and the environment and to control and mitigation measures (International Committee of the Red Cross, 2011). Waste should be collected daily and from all points of origin, bags must be sealed and marked according to the type of waste, a full bag to be replaced now empty. By checking the packaging (and indications of the date and type of waste) can be seen from any department of the waste comes in the case of a fault which improves waste management system quarters (Brannen et al, 2000).

The medical waste management process implies:

- development of special management plans, records, measures and conditions of protection;
- making procedures;
- training programs for employees;
- cost estimates;
- the process of collecting, sorting, packaging and marking;

- transport;
- storage and
- treatment of medical waste.

Also, the tendency must be directed towards reducing the amount of generated medical waste at the site of production. This reduction in the most effective way can be achieved by separating solid waste from hazardous medical waste. Integrating the waste reduction concept together with procurement procedures and training of medical personnel, including doctors, nurses and laboratory technicians, can in the future be helpful in the safe management of medical waste. If training is provided for staff whose duties involve the handling of various medical waste and materials, healthcare professionals can contribute to reducing the impact of medical waste on human health and the environment, and it should be emphasized that adequate management of medical waste primarily requires compliance with regulations and procedures that are defined within the laws and plans of a particular institution of the institution that creates medical waste.

Accreditation of health institutions of primary, secondary and tertiary health care is in progress in Serbia. To that end, it is necessary to adopt and accept certain procedures that all employees have to apply, and for the successful inclusion of medical waste management programs, it requires significant cooperation from all and commitment to the view and time and resources (Dutta, 2002).

3 Methodology

Given the need to evaluate students' present knowledge, awareness and practice regarding medical waste and medical waste management in the aim of developing curriculum of the course, we conducted a study of 42 undergraduate students of University of Belgrade - Faculty of Organizational Science, enrolled in Environmental Quality System course. The authors of the paper conducted their research bearing in mind that overall knowledge and awareness level regarding medical waste management in Serbia is inadequate and poor, and that students should acquire the knowledge about this crucial environmental issue when they study topics like waste and waste management. The latter was done most diligently because safe and effective management of medical waste is not only a legal necessity but also a social responsibility (Kapoor, Nirola, Kapoor, & Gambhir, 2014). It should also be noted that the need to introduce education in

the field of medical waste management within ecological subjects is crucial, bearing in mind that Serbia belongs to developing countries where medical waste has not received the necessary attention and is often disposed with domestic and communal waste.

The course selected for this research is an obligatory course in the last year of undergraduate studies. The course classes consisted of two hours of lectures and two hours of exercises each week for a period of a 14-week semester. The course has sections on ecology, environmental degradation, environmental mediums, environmental issues and protection, integrated environmental management, eco management systems, ISO 14000, sustainable development and practices of sustainability.

Our research presented in the paper was performed based on the students attending the winter semester of the 2017/2018 academic year. The survey was conducted at the University of Belgrade - Faculty of Organizational Sciences. In the survey 42 students participated (31 females and 11 males). Students completed the survey and results for each student were calculated.

For the purposes of the research, students' perceptions of medical waste management in Serbia used the questionnaire of the authors Al-Habash and Al-Zu'bipitnik (2012). In order to obtain more precise answers, the validity of this questionnaire was checked through an interview with the expert in charge of special waste streams at the Ministry of Environmental Protection of Serbia, which gave the correct answers to the questions in the questionnaire. This research was carried out by mixing interview and questionnaire methods because questionnaires and interviews are often used together in a mixed method for the study of different educational assessments (e.g., Brookhart & Durkin, 2003; Lai & Waltman, 2008; Harris & Brown, 2010). The reason for this is the fact that this combination of testing methods allows the collection of "more in-depth insights on participant attitudes, thoughts, and actions" (Kendall, 2008).

The questionnaire of the conducted research has a total of 44 questions. The first seven questions were of a general nature and concerned basic demographic data. From the eighth question to the sixteenth, the respondents answered questions related to their knowledge of the concept of medical waste, medical waste management, as well as legal regulations and regulations that exist in this area of

Serbia. The opinion and knowledge of students regarding the practices of the medical waste management system in health institutions were also examined. From the nineteenth to the forty-fourth questions, the students gave their opinion on the current situation regarding the separation, collection, transport and treatment of medical waste in health institutions in Serbia.

The statistical software package SPSS 24 was used in this paper. In order to analyze the obtained data, descriptive statistics were used.

4 Results and Discussion

Of the total of 42 students, the survey was filled by 42 students, or all 100 percent. The demographic characteristics of the students studied are as follows:

- Structure by sex:
  - 31 respondents (73.81 percent) are female,
  - 11 respondents (26.19 percent) are male.
- Pre-completed secondary school:
  - About 4 year high school - 30 respondents (28.57 percent),
  - Secondary vocational school - 12 respondents (28.27 percent).

Further, the following results were obtained:

- 5 respondents (11.9 percent) are voluntary blood donors.
- A total of 15 respondents (35.71 percent) either stayed in the hospital as a patient or were visiting someone.
- All respondents are familiar with the concept of medical waste (100 percent), but well defined only slightly more than half of the students surveyed - 24 (57.24 percent).
- The vast majority of respondents - 39 (92.86 percent) know that there is a category of hazardous medical waste, but only 11 of them (26.19 percent) know and define it.
- Even 40 respondents (95.24 percent) know what medical waste management is, but only 5 of them (11.9 percent) know and correctly define it.
- All respondents, 42 (100 percent) think that there should be a separate law on medical waste.

- 29 respondents (69.05 percent) think that in Serbia there is a law that relates to medical waste, however, in Serbia there is still no law dealing with medical waste, but only the Ordinance on the management of medical waste.
- All respondents (100 percent) did not know which legislation relates to the management of medical waste.

Table 1 provides an overview of percentage of correct and incorrect answers on the questions. What can be concluded is that the examined students show insufficient knowledge of proper medical waste management practices and necessary for his care, and that they need knowledge in these areas.

Table 1: Frequencie of incorrect and correct answers of respondents

Order	Question/statement	Incorrect[%]	Correct[%]
1.	Medical waste is separated from the other waste	26.19	73.81
2.	Infectious waste is separated from the rest of medical waste	30.95	69.05
3.	Waste containing human organs, tissues and body fluids is separeted from the rest of the medical waste	21.43	78.57
4.	Pharmaceutical waste is being separated from the rest of medical waste	14.28	85.72
5.	Sharp waste is separated from the rest of medical waste	4.76	95.24
6.	Medical waste in hospitals is being classified according to its toxicity	95.24	4.76
7.	Highly infectious medical waste is classified as hazardous waste	61.9	38.1
8.	Medical waste is being collected from health facilities on a daily basis	95.24	4.76
9.	During the collection, medical waste is separated from other municipal waste in health care institutions	9.52	90.48
10.	Medical waste is collected separately from health facilities	9.52	90.48
11.	Hospitals have specialized storage facilities for medical waste	11.90	88.10
12.	In hospitals there are designated places for temporary storage of medical waste in each department	4.76	95.24
13.	In hospitals there are containers designed to transport medical waste	95.24	4.76
14.	Medical waste is taken separately for further treatment or storage	9.52	90.48
15.	Hospitals are "resolved" of medical waste by being driven by City Communal Service vehicles	88.1	11.9
16.	Highly infectious medical waste is treated in hospitals prior to storage	21.43	78.57
17.	Sharp waste is being sterilized in hospitals prior to storage	4.76	95.24
18.	Blood and contaminated liquids are disinfected prior to storage	11.90	88.10
19.	Medical waste is returned to the supplier for further processing	11.90	88.10
20.	Hospitals are "resolved" of medical waste by burying it at specific locations	9.52	90.48
21.	In hospitals there are incinerators for medical waste	11.90	88.10
22.	Hospitals are developing plans for managing medical waste	4.76	95.24
23.	In hospitals there are specialized units dealing with	4.76	95.24

	medical waste management		
24.	Hospitals have their own training on the treatment of medical waste for medical staff	4.76	95.24
25.	Hospitals have their own training for the treatment of medical waste for non-medical staff	57.14	42.86

5 Conclusions

Medical waste is increasing the involvement of competent authorities, but also the WHO, UN and EPA that give this problem a global character and point to the importance of its prompt solution and the inclusion of all stakeholders. Raising the awareness of the population is only the first step towards achieving the desired status. Insufficient knowledge of the students surveyed shows that additional efforts must be made to overcome possible obstacles to achieving a better quality of the environment, a brighter future for the coming generations, and the realization of the interests of all of us.

The importance of adequate management of medical waste and minimization of the risks, minimizes the possibilities for reducing the quality of the environment, as well as the spread and transmission of various diseases. The increasing concern of states and institutions to address this problem implies strict procedures that are prescribed for the proper management of medical waste. Medical waste from the place of origin to its destruction or disposal requires special attention from both the staff in the healthcare institutions and all other participants involved in the medical waste management process until it is destroyed.

Possible directions for further research should be based on examining the general public's views on the concept of medical waste and its management.

References

Al-Habash, M., & Al-Zu'bi, A. (2012). Efficiency and Effectiveness of Medical Waste Management Performance, Health Sector and its Impact on Environment in Jordan Applied Study. *World Applied Sciences Journal*, 19(6), 880-893.

Almuneef, M., & Memish, Z. A. (2003). Effective medical waste management: it can be done. *American Journal of Infection Control*, 31(3), 188-192.

Baveja, G., Muralidhar, S., & Aggarwal, P. (2000). Hospital waste management–an overview. *Hospital today*, 5(9), 485-486.

Birchard, K. (2002). Out of sight, out of mind… the medical waste problem. *The lancet*, 359(9300), 56.

Bokhoree, C., Beeharry, Y., Makoondlall-Chadee, T., Doobah, T., Soomary, N. (2014). Assessment of environmental and health risks associated with the management of medical waste in Mauritius. *APCBEE Procedia*, 9, 36-41.

Çalıs, S., & Arkan, B. (2014). The Views of the Nursing Students about the Medical Wastes and their Effects on the Environmental and Human Health. P*rocedia-Social and Behavioral Sciences*, 116, 1472-1476.

Chartier, Y. (Ed.). (2014). *Safe management of wastes from health-care activities*. World Health Organization.

Chen L., & Zhang J. (2008). Environmental impact and prevention measures of medical waste in Wenchuan earthquake relief. *Agro-Environment & Development*, 25(4), 41–42.

Cheng, Y. W., Sung, F. C., Yang, Y., Lo, Y. H., Chung, Y. T., & Li, K. C. (2009). Medical waste production at hospitals and associated factors. *Waste management*, 29(1), 440-444.

Department of Health Service (2004). *Medical Waste Management*. Management Act.

Dutta, S. (2002). *Environmental Treatment Technologies for Hazardous and Medical Wastes – Remedial Scope and Efficacy*. Tata Mcgraw-Hill Publishing Company.

Harris, L. R., & Brown, G. T. (2010). Mixing interview and questionnaire methods: Practical problems in aligning data, 15(1), 1-19.

Insa, E., Zamorano, M., & Lopez, R. (2010). Critical review of medical waste legislation in Spain. *Resources, Conservation and Recycling*, 54(12), 1048-1059.

International Committee of the Red Cross (2011). *Medical Waste Management*. International Committee of the Red Cross; Geneva.

Kapoor, D., Nirola, A., Kapoor, V., & Gambhir, R. S. (2014). Knowledge and awareness regarding biomedical waste management in dental teaching institutions in India - A systematic review. *Journal of clinical and experimental dentistry*, 6(4), e419.

Komilis, D. P. (2016). Issues on medical waste management research. *Waste management*, (48), 1-2.

Komilis, D., Fouki, A., & Papadopoulos, D. (2012). Hazardous medical waste generation rates of different categories of health-care facilities. *Waste management*, 32(7), 1434-1441.

Luis R.G. *Managing Human Reroutes*. 5th edition, 2014.

Maamari, O., Brandam, C., Lteif, R., & Salameh, D. (2015). Health Care Waste generation rates and patterns: The case of Lebanon. *Waste management*, 43, 550-554.

Mihailović, O., Žarkić-Joksimović, N., Petrović, N., Makajić-Nikolić, D., & Radaković, J.A. (2017, September). Economic and environmental effectiveness of infectious medical waste disposal system: A case study of the tertiary health-care institution. In G. Ćirović (Ed.), *Proceedings of XLIV Symposium on operational research International Regional Symposium*, Visoka građevinsko-geodetska škola, Zlatibor, (pp. 35-40), Planeta print: Beograd.

Ministarstvo zaštite životne sredine – Agencija za zaštitu životne sredine – SEPA. (2010). Katalog otpada – Uputstvo za određivanje indeksnog broja. Retrieved from http://www.sepa.gov.rs/download/Otpad/UputstvoKatalogOtpada.pdf. (In Serbian)

Ministarstvo zdravlja Republike Srbije – MZRS. (2008). Nacionalni vodič za bezbedno upravljanje medicinskim otpadom. Retrieved from http://www.komorabiohemsrbije.org.rs/pdf/vodic_medicinski_otpad,.pdf. (In Serbian)

Mohee, R. (2005). Medical wastes characterisation in healthcare institutions in Mauritius. *Waste management,* 25(6), 575-581.

Rajor, A., Xaxa, M., & Mehta, R. (2012). An overview on characterization, utilization and leachate analysis of biomedical waste incinerator ash. *Journal of Environmental Management*, 108, 36-41.

Sl. Glasnik RS, br. 78/2010 (2010). Pravilnik o upravljanju medicinskim otpadom. Retrieved from http://www.paragraf.rs/propisi/pravilnik_o_upravljanju_medicinskim_otpadom.html. (In Serbian)

Stanojević, K., Petrović, N., Drakulić, M., & Ćirović, M. (2017). Attitudes about Medical Waste Management in Serbia: A Case Study. In D. Vasiljević and L. Đorđević (Eds.), *Zbornik radova-XI Skup privrednika i naučnika SPIN'17: ŠTEDLJIVO (LEAN) UPRAVLJANJE RESURSIMA U PRIVREDI REPUBLIKE SRBIJE* (pp. 286-292). Fakultet organizacionih nauka: Beograd. (In Serbian)

Taghipour, H., & Mosaferi, M. (2009). Characterization of medical waste from hospitals in Tabriz, Iran. *Science of the total environment*, 407(5), 1527-1535.

Voudrias, E., & Graikos, A. (2014). Infectious medical waste management system at the regional level. *Journal of Hazardous, Toxic, and Radioactive Waste*, 18(4), 04014020.

Waste Management Strategy (WMS). (2009). Waste Management Strategy for the Period 2010-2019, Government of the Republic of Serbia. Retrieved from http://www.gs.gov.rs/english/strategije-vs. (in Serbian)

Windfeld, E. S., & Brooks, M. S. L. (2015). Medical waste management - A review. *Journal of Environmental Management*, 163, 98-108.

World Health Organization – WHO. (2018). Health-care waste. Retrieved from http://www.who.int/topics/medical_waste/en/.

Zhang, L., Wu, L., Tian, F., & Wang, Z. (2016). Retrospection-Simulation-Revision: Approach to the Analysis of the Composition and Characteristics of Medical Waste at a Disaster Relief Site. *PLoS One*, 11(7), e0159261.