

## MANAGEMENT OF MEDICAL WASTE IN DENTAL PRACTICE: ASSESSMENT OF KNOWLEDGE, ATTITUDES AND PRACTICES OF EMPLOYEES

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**Abstract:** Medical waste represents a significant challenge in waste management due to its potential danger to human health and environmental protection. In dentistry, specific categories of medical waste are generated, which include infectious waste, sharp objects, as well as waste rich in toxic heavy metals such as mercury and lead. Inadequate management of this waste can result in serious health and environmental risks for health workers, as well as the general population and the environment. Considering the importance of proper and safe management of medical waste, the aim of the research is to assess the level of knowledge, attitudes and practice among employees in dental offices in Canton Sarajevo, including both the public and private sectors. The research was carried out through a descriptive-analytical cross-sectional study, with the application of an anonymous questionnaire structured in three segments: assessment of knowledge about the generation, types and relevant legislative regulation of medical waste, evaluation of attitudes towards medical waste management, and analysis of practice in management procedures. A total of 217 health professionals of various profiles were surveyed, including doctors of dentistry, specialists, dental nurses-technicians and dental technicians, whereby 168 respondents were employed in public and 49 in private dental practices. The results indicate the fact that the average level of knowledge of the respondents, both in public health institutions and in private practices, does not meet the defined criteria for a good level of knowledge (set at 75%). However, from the aspect of the average level (defined at 56.25%), the respondents showed satisfactory results. A similar tendency was observed in the practice of medical waste management, where the results in the public sector are somewhat more favourable compared to the private sector, although without a statistically significant difference. Attitudes towards waste management were also at an average level, but do not reach the level that would indicate good practice. Respondents from the private sector showed a slightly lower level of attitudes and practices compared to employees in public institutions. The analysis of demographic data showed statistically significant differences in the age of respondents depending on the employment sector, with professionals from the private sector being younger. Based on the results, we emphasise the need for continuous professional training and education of dental workers with aim to improve their knowledge, attitudes and practice in the field of safe medical waste management. The implementation of adequate protocols and standardized procedures can significantly contribute to reducing professional risks, preventing infections, and protecting the environment. This study represents a relevant contribution to the development of medical waste management policies and strategies in dentistry, emphasizing the need for a systemic approach in protecting the health of workers, patients and the community.

**Keywords:** medical waste, dental practices, KAP survey, waste management

### 1. INTRODUCTION

Waste generation is a result of human activities and occurs in all places where people live. medical waste is of particular importance, and that is the waste generated during the provision of various types of health services and in all places where these services are provided (Stanković et al., 2015). Medical waste can contain hazardous substances, so inappropriate medical waste management procedures can lead to a number of risks for healthcare workers and other personnel involved in waste disposal, as well as the whole environment (Holcer et al., 2015).

Waste generated during the provision of healthcare services is mostly non-hazardous, 75-90%, while the remaining 10-25% is qualified as hazardous waste. The category of hazardous waste includes: sharp, infectious, pathological, pharmaceutical, chemical and radioactive waste. Due to the importance of the proper disposal of medical waste, the obligations of waste management are divided into the obligations of producers of medical waste and the obligations of authorized legal or natural persons who take over medical waste, that is, who collect, process or export it. Management and disposal of medical waste should be carried out in such a way as to reduce the risk for the emergence and spread of infectious diseases and environmental pollution (Maha et al., 2015). Due to characteristics of medical waste, its management carries the risk of occupational exposure during the contact of healthcare workers or workers who manage the waste and their activities with contaminated material. The most common risks of professional exposure to medical waste during the provision of health services are injuries, that is, needle stinging incidents associated with the risk of acute or chronic diseases caused by the hepatitis B virus, hepatitis C virus and HIV. In order to prevent the occurrence of the mentioned diseases, continuous theoretical and practical education and training of the working staff is necessary. Education about the importance of immunization against viral hepatitis type B and tetanus, measures taken in case of injuries and procedures for reporting, immediate action and monitoring is of particular importance in education about preventive measures, (Holcer et al., 2015). Proper management of medical waste reduces health risks from the aforementioned blood-borne infections, but also from infections of the digestive tract, respiratory tract and skin. In addition, the risk of genetic damage is reduced, if it is waste containing radioactive substances, and of poisoning if it is medical waste containing chemicals (Rakić et al., 2016). Dental activity represents the organized provision of dental care through the work of dental workers within public healthcare institutions or private practices, and it is performed at the primary, secondary and tertiary levels (Parliament of the Federation of Bosnia and Herzegovina, 2012). Dental offices and clinics are considered places where smaller amounts of medical waste are generated compared to other places where health services are provided, but they are significant because, in addition to the waste that is the same as in other healthcare institutions, which is infectious, certain amounts of other hazardous waste are also generated that can harm health of people, but also have harmful influence on the environment as a whole. The waste generated in dentistry contains sharp objects, infectious waste and waste with a high content of heavy metals. Dental waste includes smear tests, swabs, glass, needles and other waste materials that are often contaminated with body fluids, blood and saliva, which make this waste infectious (Maha et al., 2015; Danaei et al., 2014). In the field of dentistry, mercury waste, waste from dental amalgam, lead, and silver-containing waste were often found and have severe risks for health and are also environmental hazards (Subramanian et al., 2021). Amalgam, or amalgam waste, is qualified as hazardous waste because more than 70% of its mass consists of mercury and silver. Improper collection and disposal of amalgam waste can lead to occupational exposure to mercury. If this waste is not properly managed, mercury and silver can accumulate and lead to environmental contamination from where they can reach the food chain and cause harmful effects on the health of people and other living beings. Amalgam mercury can cause nephrotoxic and neurotoxic effects in humans, as well as negative effects on the gastrointestinal, respiratory, immune and urinary systems. Lead from X-ray fixatives can also have harmful effects on human health and the environment as a whole. Because of all of the above mentioned, the identification of the amount and composition of medical waste in the dental industry is necessary in order to achieve an optimal way of management. Many studies have been conducted on this topic in various countries (Koolivand et al., 2015; Danaei et al., 2014). The management of waste generated in dental offices is a challenge faced by healthcare workers, but it is also one of the most important environmental problems. Management and disposal of biomedical waste should be done using safe as well as proper methods. These methods should be known as well as practiced by all healthcare professionals for reducing transmission of different infections and prevention of different types of health as well as environment-associated hazards (Mahajan et al., 2024). In addition, the manufacturing and discarding of medical and health care sector waste lead to increased levels of GHG emissions and pollution (Attrah et al., 2022). The aim of the research is to examine the knowledge, attitudes and practices of employees in public and private dental offices about the medical waste management process.

## **2. MATERIAL AND RESEARCH METHODS**

Respondents included in the research were health professionals employed in dental offices who have dental education and directly provide dental services, and who perform dental work in public health institutions and in private dental practice in the area of Sarajevo Canton, and they include: doctors of dentistry, doctors of dentistry-specialists, dental nurses and dental technicians. A total of 217 respondents were surveyed (168 respondents from public offices and 49 respondents from private practices). The research was conducted in 51 dental practices, of which 23 are public and 28 are private practices. The research included employees of dental offices in Sarajevo Canton who voluntarily agreed to the research. The research was conducted as a descriptive-analytical, cross-sectional study which included subjects who met the criteria for inclusion in the study. To collect data on the

knowledge, attitudes and practices of employees in dental offices, an anonymous survey method was used, which was carried out with the help of a modified survey questionnaire on the assessment of knowledge, attitudes and practices as an instrument. After the preparation of the questionnaire, the aim and methodology of the research were clearly presented to all respondents involved in the research. Their obligations during the research were explained in detail, and they were told that the obtained data would be used exclusively for scientific purposes. It was emphasized in the special note that the research is completely anonymous. The first part of the questionnaire contained questions related to the general characteristics of the respondents (age, gender, occupation, type of dental office). The questionnaire contained 34 questions, designed to obtain information on risk assessment in the process of medical waste management among healthcare workers in dental services. The questions were divided into three groups as follows: (a) Knowledge (K) about production, hazards and legislation on medical waste (16 questions), (b) Assessment of attitude/behaviour (A) towards medical waste (11 questions) and (c) assessment of Practice (P) during needle stick sting incidents (7 questions). Questions for assessing knowledge were multiple-choice questions in which only one answer was correct. Questions for assessing attitude and practice were presented in a positive or negative response format (Yes/No). Each correct answer carried 1 point. The KAP score of each respondent in the study was assessed with appropriate grades in each section of the modified questionnaire according to a scoring system in order to categorize the KAP of respondents who participated in the study as good, average or poor.

### 3. RESULTS

As part of the research, the knowledge, attitudes and practice were analysed in total of 217 respondents employed in public healthcare institutions (PHI) and private practices (PP). Most respondents were from the public sector, 168 respondents (77.42%), and 49 respondents (22.58%) were from private practice. This distribution indicates a greater representation of public health workers in the sample. When it comes to the gender structure of the respondents, the dominant group were females, 176 (81.11%), while males were represented by 41 participants (18.89%).

**Table 1. Age of the respondents**

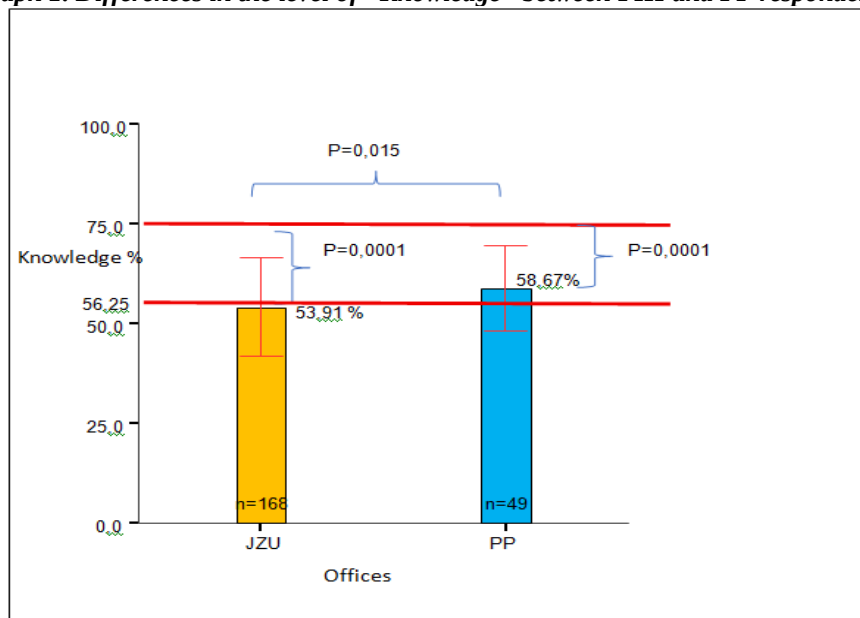
|                                               |               | N   | Mean  | Std. Deviation | Test  |
|-----------------------------------------------|---------------|-----|-------|----------------|-------|
| <b>Age of all respondents</b>                 |               | 217 | 43,94 | 9,9            |       |
| <b>Age in relation to gender</b>              | <b>Male</b>   | 41  | 40,22 | 8,88           | 0,07  |
|                                               | <b>Female</b> | 176 | 44,81 | 10,01          |       |
| <b>Age in relation to healthcare facility</b> | <b>PHI</b>    | 168 | 46,52 | 8,755          | 0,001 |
|                                               | <b>PP</b>     | 49  | 35,12 | 8,726          |       |

Source: Authors research

Table 1 shows the average age of all respondents included in the study (n = 217) and it was  $43.94 \pm 9.90$  years. The age ranged from 20 to 65 years, indicating the representation of respondents of different generations within the dental profession. Analysis of the age structure in relation to gender revealed a statistically significant difference ( $p = 0.007$ ). Male respondents were younger on average – their average age was  $40.22 \pm 8.80$  years, while female respondents had an average age of  $44.00 \pm 10.00$  years. Also, a significant difference in the age of respondents was established in relation to the type of healthcare activity (public versus private practice). Respondents employed in private practice (PP) were significantly younger compared to those employed in public healthcare institutions (PHI) ( $p = 0.001$ ). Namely, the average age in the group of subjects from PP was  $35.12 \pm 8.70$  years, while in the group from the PHI the average age was  $46.50 \pm 8.70$  years. A total of 51 health institutions were included in the research, of which 28 (54.9%) were private dental offices, while 23 (45.1%) belonged to public health institutions (PHI). The average value of knowledge among respondents from private practice (PP) was  $58.67 \pm 10.8\%$ , while the recorded average value among respondents from public health institutions (PHI) was  $53.91 \pm 12.2\%$ . In relation to the set threshold of 75%, which was defined as the limit for a good level of knowledge, both groups of respondents showed statistically significantly lower results ( $p = 0.0001$ ), which indicates that the average knowledge in both

categories does not reach a level that would be considered satisfactory. On the other hand, when they are compared with the threshold of 56.25%, which was marked as the limit for the average level of knowledge, it was determined by statistical analysis that neither PHI nor PP deviate significantly from that value.

**Graph 1. Differences in the level of "Knowledge" between PHI and PP respondents**

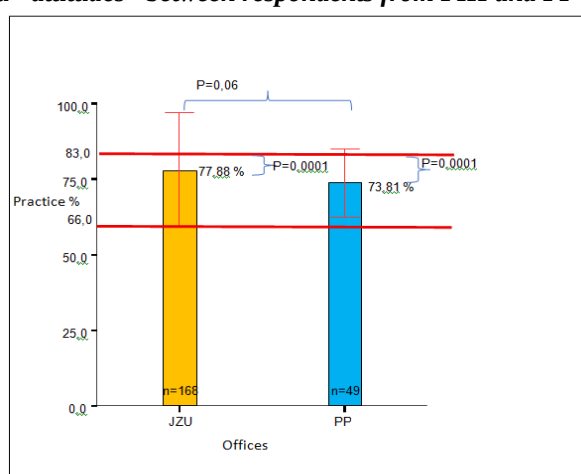
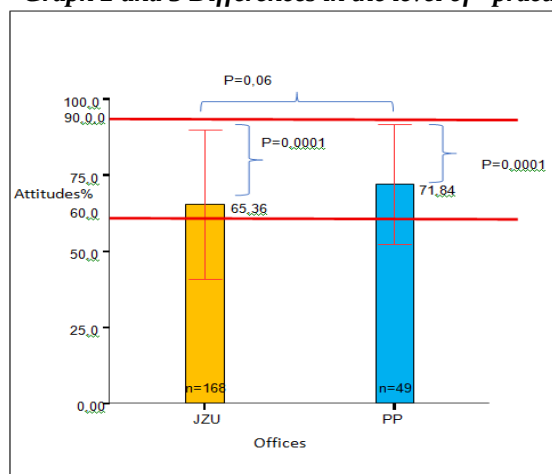


Source: Authors research

Differences in the level of "Practices" between respondents from PHI and PP are not statistically significant ( $p=0.06$ ), but are indicative because the p value approaches 0.05. In PP, the level of "Practice" is lower. The level of "Practice" in PP was  $73.8\pm\%$ , while the level of "Practice" in PHI was  $77.8\pm2\%$ . Both categories of respondents are significantly below the limit for good practice, which was set at 83% ( $p=0.0001$ ), that is, they do not deviate statistically significantly from the limit for average practice, which was 66.0%.

The differences in the level of "Attitudes" between respondents from PHI and PP are not statistically significant ( $p=0.06$ ), but they are indicative because the p value approaches 0.05. The level of "Attitudes" in PP is lower, and it is  $71.84\pm\%$ , while it is  $65.36\pm2\%$  in PHI. Both categories of respondents are significantly below the limit for good practice, which is set at 90% ( $p=0.0001$ ), but they do not deviate statistically significantly from the limit for average attitudes, which is 60%.

**Graph 2 and 3 Differences in the level of "practices" and "attitudes" between respondents from PHI and PP**



Source: Authors research

#### 4. DISCUSSION

The obtained results of this research are largely consistent with the results of a systematic review that indicates an insufficient level of knowledge and uneven practices in relation to medical waste management (BMW) among dentists. Tompe et al. (2020) point out that dentists in teaching institutions show a higher level of awareness and knowledge of Biomedical waste (BMW) management guidelines compared to private dentists, which is partially attributed to regular education in public institutions. In our research, both respondents from private practice (PP) and from public health institutions (PHI) showed knowledge values statistically significantly below the threshold for a good level (75%), although they approached the limit of average knowledge (56.25%). When it comes to practice, although the differences between PHI and PP were not statistically significant ( $p = 0.06$ ), the observed advantage in favour of PHI may point out to better institutional organization and availability of resources, which had also been noted in the systematic review. For example, Tompe et al. (2020) report low usage of amalgam separators in several regions, as well as inconsistent application of waste disposal rules in private practices. The attitudes of respondents from both groups also did not reach the threshold for a good level (90%), but they remained statistically within the framework of average values. It is interesting that respondents from PP showed slightly more positive attitudes compared to PHI, which is in accordance with the results of a systematic review that indicates the interest of private dentists for additional education when it is available (Tompe et al., 2020). These results further emphasize the need for targeted and continuous education of all healthcare workers, with a special focus on the private sector, in order to ensure a harmonized and efficient practice in the management of biomedical waste. The results of the study by Bansal et al. (2013) confirm the findings of our research on insufficient awareness and practice in biomedical waste management among dentists, especially in private practice. Similar indicators establish that a significant number of dentists are not aware of the basic categories of waste and the correct colour coding for its disposal, as well as improper practices such as disposal of needles and outdated medicines. These data additionally emphasize the need for improving education and stricter control of the application of the guidelines, which is in accordance with the findings of our research, and which show average values of knowledge and practice below a satisfactory level. The study by Naz et al. (2020) among private dentists in Karachi shows a high level of awareness of healthcare waste management and support for continuous education, which is in line with the positive attitudes we observed in our study. However, similar deficiencies in knowledge and practice, especially in private practices, indicate the need for additional educational programs and better monitoring of the application of guidelines. These findings confirm that awareness alone is not enough and that better implementation is necessary to achieve a satisfactory level of biomedical waste management. The results of the research carried out in Latur show that, although most dentists have basic knowledge about waste disposal, there is often lack of application in practice – one third of them dispose infected needles in the common waste (Pawar & Patil, 2017). A similar discrepancy between knowledge and behaviour was recorded in our research, which points out to the need for targeted education and more consistent control of the implementation of regulations.

#### 5. CONCLUSION

The results of the research indicate that the employees in dental offices, both in public and private sectors, have a satisfactory, but insufficiently developed level of knowledge, attitudes and practices regarding medical waste management. Demographic differences among the respondents were established, which can affect the approach and effectiveness of educational activities. Considering the specifics and dangers of medical waste in dentistry, it is necessary to improve continuous education and adherence to prescribed procedures, in order to reduce professional risks and protect the health of workers and the environment. The implementation of targeted training programs and the control of medical waste disposal procedures are key measures for the improvement of this field. Further research and evaluation of existing practices are necessary for efficient improvement of the waste management system in dental institutions.

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