



Review Article

ENVIRONMENTAL AWARENESS AND HEALTH RISKS IN MEDICAL WASTE MANAGEMENT: A STUDY OF DENTAL CLINICS IN MISRATA.

By

Salem S. Elwahaishi¹, Aldukali A. Alkeskas², Abdallah A. Elmaheshi³

1,2. Department of Therapeutic Nutrition, Faculty of Health Sciences, Misurata University, Libya 3- Faculty of Medical Technology, Misrata, Libya

ABSTRACT

Dental clinics generate various types of medical waste, including solid, liquid, gaseous, and radioactive materials, originating from diverse sources and treatment processes. This study evaluates dentists' awareness of medical waste management practices, including waste segregation, associated risks, and occupational safety measures like immunization, disinfection, and sterilization.. Ninety-four private dental practitioners in Misrata participated in this study through a self-administered questionnaire. The methods used included a combination of quantitative analysis and descriptive statistics to assess awareness and practices. Data were analyzed using SPSS software. The results revealed that 55.3% of practitioners lacked knowledge about medical waste management. Alarmingly, 69.1% admitted to disposing of chemical waste via the city's sewer system. Notably, 51.1% of practitioners continued to use amalgam in their clinics despite its environmental hazards. The study revealed that a significant number of practitioners lack familiarity with the policies and guidelines for the management, segregation, and risks of medical waste within the city. This deficiency is largely attributed to a lack of vocational training. Therefore, it is essential to educate dental practitioners on proper waste management practices and procedures to address this issue.

KEY WORDS: Environmental awareness, medical waste management, dental clinics, Misrata, health risks

INTRODUCTION

Improper management of medical waste poses severe environmental and health risks, contaminating soil, water, and air. Infectious waste, such as contaminated sharps or pathological materials, carries an immediate risk of disease transmission, while chemical and pharmaceutical waste can disrupt aquatic ecosystems and contribute to antibiotic resistance. Incineration of medical waste without proper pollution controls exacerbates the issue by releasing toxic pollutants like dioxins and furans (1,2). The rapid growth in healthcare services has led to

increased medical waste generation, particularly in dental clinics, which frequently use materials containing heavy metals such as mercury, lead, and silver. Mercury from dental amalgam, a potent neurotoxin, can bioaccumulate in aquatic food chains, posing risks to biodiversity and human health. Lead and silver, commonly found in dental X-ray fixer solutions, present additional environmental hazards (3-6). Among these, dental clinics are notable contributors, primarily due to their utilization of materials containing heavy metals and other hazardous chemicals. Dental clinics are unique

among healthcare facilities due to their frequent use of materials containing heavy metals such as mercury, lead, and silver. Amalgam, a commonly used dental filling material, is a significant source of mercury in wastewater. Mercury, even in trace amounts, is a potent neurotoxin that can bioaccumulate in aquatic food chains, ultimately impacting human health and biodiversity (5). Lead and silver, often found in dental X-ray fixer solutions and other materials, pose additional environmental risks. Lead exposure can cause neurological and developmental impairments, while silver, though less toxic, can disrupt microbial ecosystems in water bodies (6). Effective management requires robust strategies that integrate policy enforcement, technological innovation, and public awareness. In dental clinics, the implementation of amalgam separators and proper waste segregation practices can significantly reduce the discharge of heavy metals. Moreover, the adoption of environmentally friendly dental materials and the promotion of sustainable practices can minimize environmental footprints. Regulatory frameworks, such as the Minamata Convention on Mercury, play a critical role in curbing mercury pollution globally and underscore the importance of local compliance and enforcement (7). Raising awareness among healthcare professionals and the public is equally crucial. Educational initiatives can foster a deeper understanding of the environmental impacts of medical waste and encourage behavioral changes toward sustainable waste management. Through collaborative efforts involving policymakers, healthcare providers, and the community, the risks associated

with medical waste and heavy metals can be mitigated, ensuring a healthier environment for future generations (8). This study highlighted the extent of dentists' awareness of the effects of medical waste on their health and the health of medical staff working in dental clinics and knowledge of the negative effects of materials used in dental clinics.

METHODS

A cross-sectional study was conducted among 94 private dental practitioners in Misrata who consented to participate. Data were collected using a structured, self-administered questionnaire comprising 70 closed-ended questions designed to assess environmental awareness and practices related to medical waste and heavy metals in wastewater. The questionnaire's validity was ensured through rigorous pretesting and expert review, focusing on face, content, construct, and criterion validity CMAJ. Data were analyzed using SPSS software.

RESULTS AND DISCUSSIONS

The study revealed that, 52 dentists (55.3%) lack sufficient knowledge about medical waste management, also 39 (41.5%) of respondents reported that their healthcare institutions do not provide training for personnel handling medical waste. Additionally, the results revealed that 52 (55%) of participants were unaware of the meaning of the colors used for sorting medical waste (Table 1).

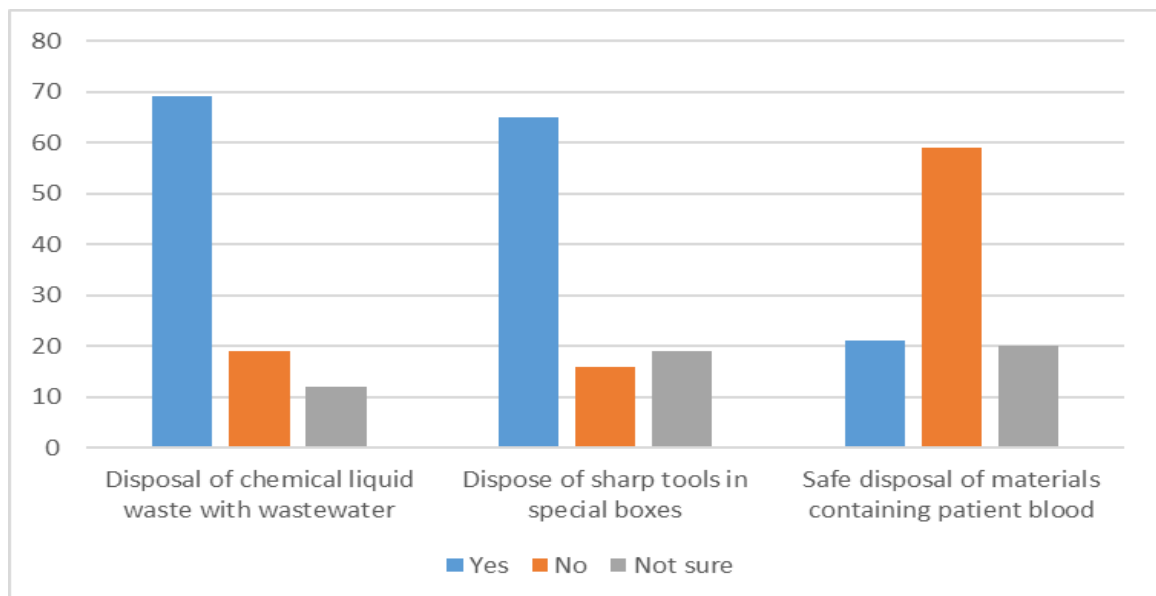
The findings highlight significant gaps in knowledge and practices regarding medical waste management among healthcare professionals. It might be due to inadequate education on the topic during their studies.

Table 1: Shows dentists awareness of medical waste management rules.

Title	No.	%
lack sufficient knowledge	52	55.3
training for personnel handling	39	41.5
Coulor coding	52	55

Also, these results highlight the need for improved education and training to ensure proper waste segregation and management practices. Similar issues have been observed by Janakiram (2008): 16.9% lacked knowledge of medical waste management. And Singh and Kumari (2014) found that only 30.6% of dentists in India were aware of relevant biomedical waste laws, while Sudhakar and Chandrashekar (2008) found limited awareness (57%) of biomedical waste management laws in Indian cities.

Regarding the management of waste materials and used tools, 69% of doctors dispose of chemical liquid waste into the sewage system, indicates a widespread practice that may harm the environment and public health. This highlights a need for better waste management training and infrastructure. While 65% of dentists properly dispose of needles and sharp tools in safety containers, however, there is room for improvement, as improper disposal poses a significant risk to sanitation workers and others. Nevertheless, 59% of dentists discard blood-contaminated materials, such as cotton and gauze, in regular garbage, raising concerns about improper waste management practices, this practice increases the risk of disease transmission and contamination, requiring urgent awareness and stricter enforcement of biomedical waste disposal regulations (Figure 1).

**Figure 1: shows dentists awareness of the rules for sorting medical waste.**

Similarly, previous studies highlight significant challenges in healthcare

waste management. Study by Al-Thabit found that liquid waste containing

remnants of amalgam fillings and dental radiology [9]. Liquids are often discharged directly into the general sewage system without treatment. This is likely due to the lack of a dedicated sewage system for clinic waste.

It was reported Janakiram, C that 64.3% of healthcare facilities did not segregate waste before disposal, and 47.6% of their waste was handed over to street garbage collectors [10]. This issue appears to stem from the absence of specialized entities for collecting and managing healthcare waste, exacerbating the risks of environmental contamination and public health hazards. The bar chart in figure 2 reveals notable trends in dental practice waste management. It shows that 69% of doctors use dental amalgam in their

clinics, likely due to its superior strength, durability, and affordability, which make it a preferred choice for many patients.

Conversely, 65% of dentists fail to properly manage used X-ray films, disposing of them with regular waste, highlighting a lack of awareness or resources for handling such materials responsibly. On a positive note, 59% of dentists prioritize safety concerning needles and sharp tools, demonstrating awareness of the risks associated with these items and taking steps to prevent injury.

These findings underscore the need for targeted interventions to improve waste segregation and disposal practices in dental clinic.

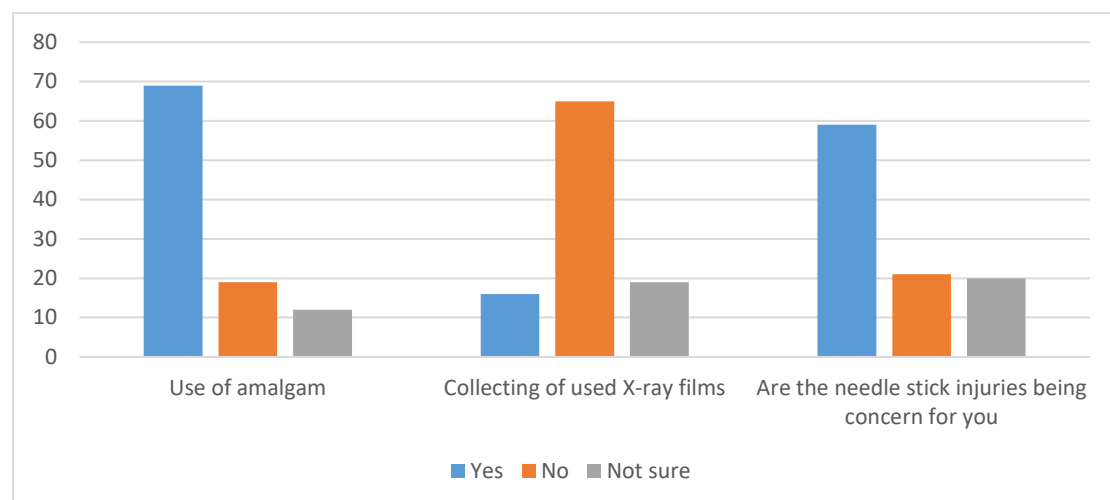


Figure 2: shows dentists' awareness of the danger of medical waste.

Study by Al-Khatib IA et al found that mercury, found in dental amalgam, is one of the most problematic hazardous wastes [11]. The findings revealed that there is no proper separation of dental waste by classification as demanded by the WHO, while Ramesh, N. et al reported that 57.3% of doctors used dental amalgam, with 42.67% refraining from its use [12]. This

reflects varied preferences for amalgam based on factors such as cost and safety concerns.

In terms of occupational hazards, 84% of respondents regarded needle-stick injuries or sharp instrument injuries as a significant concern, likely due to their frequent exposure in clinical settings.

Waste disposal practices remain a challenge. Other study by Ramesh, N. et

al reported that 68.1% of doctors disposed of X-ray films in shared containers, an unsafe practice due to the presence of lead, which poses severe risks to nervous system development and function [13]. In contrast, Singh RD et al noted that only 15.6% of dentists stored used X-ray films separately, reflecting limited adherence to recommended disposal guidelines [14].

The study reveals varying levels of awareness and practices regarding sterilization methods. As shown in figure 3, the 50% usage of chemical sterilization methods is comparable to findings by Janakiram (2008), who reported a similar preference for chemical sterilization among dental practitioners, often attributed to its cost-effectiveness and convenience.

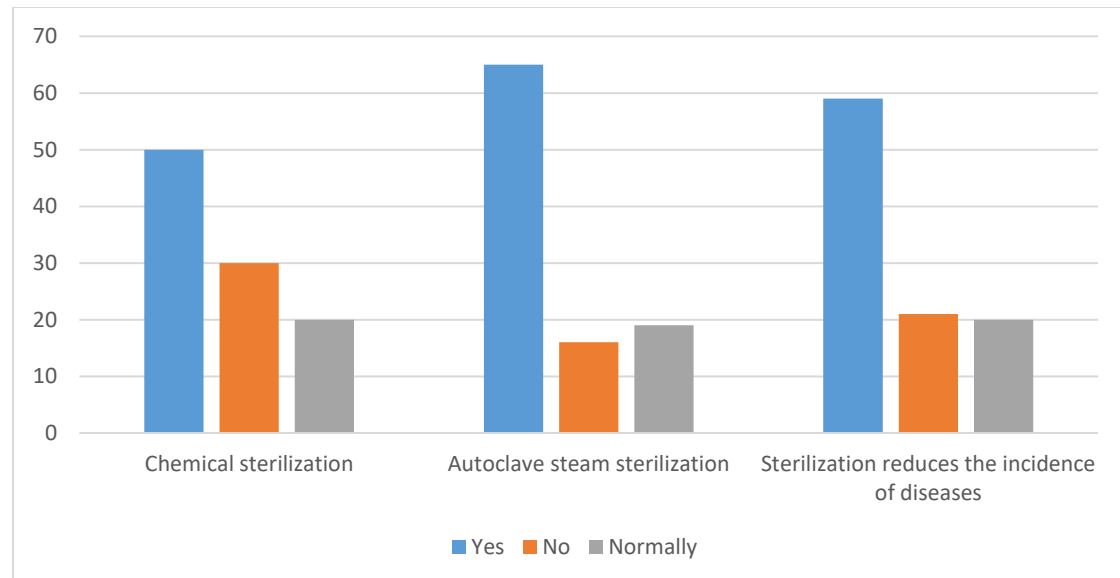


Figure 3: shows the awareness of disinfection and sterilization processes among dentists.

However, the 20% of respondents disfavoring chemical sterilization aligns with Al-Thabit, A., who noted concerns regarding the inconsistent effectiveness of chemical methods and the potential for occupational exposure to harmful chemicals.

The 65% reliance on autoclaving observed in this study is slightly higher than the 58.3% adoption rate reported by Ramandeep S. et al reflecting a gradual increase in the recognition of autoclaving as the gold standard for sterilization [15]. Nevertheless, the 19% of participants not preferring autoclaving echoes findings from Ramesh, N et al where cost, maintenance, and lack of access to

autoclave machines were cited as barriers, especially in smaller or resource-limited clinics [12].

The 59% acknowledgment of sterilization's importance in reducing disease transmission is consistent with the study by Mulay MV et al which found a similar proportion of respondents emphasizing sterilization's critical role in infection control [16]. However, gaps in adherence to proper sterilization practices, as identified in the current study, mirror the findings of Sudhakar and Chandrashekar who highlighted a lack of structured training programs and limited awareness as significant challenges in ensuring consistent compliance [17].

CONCLUSION

This study reveals significant deficiencies in the knowledge and practices of dental practitioners in Misrata regarding medical waste management. Insufficient vocational training and lack of resources are major contributing factors. Addressing these gaps through targeted educational programs, stricter enforcement of regulations, and improved waste disposal infrastructure can substantially mitigate health and environmental risks

RECOMMENDATIONS:

1-Training Programs: Implement educational initiatives for healthcare providers on the environmental and health hazards of improper waste disposal. Further research could explore the efficacy of various training methods, such as workshops, e-learning modules, and continuous professional development courses.

2-Strict Regulations and Monitoring: Enforcing proper biomedical waste management practices through regular audits and penalties for non-compliance.

3-Accessible Disposal Facilities: Providing clinics and dental offices with easy access to appropriate waste disposal systems.

4-Establishing accessible sterilization infrastructure and addressing barriers through policy initiatives could lead to better implementation of effective sterilization methods across healthcare facilities.

REFERENCES

1. Alam, P., & Ahmade, K. (2013). Impact of solid waste on health and the environment. *International Journal of Sustainable Development and Green Economics*, 2(1), 165-168.

2. World Health Organization (WHO). (2024). Health-care waste. Retrieved from (<https://www.who.int/news-room/fact-sheets/detail/health-care-waste>), viewed on 07 January 2024.

3. Karawad, L. Elwahaishi, S and Altabet A. (2017). Needlestick and Sharps Injuries Among Nurses and Laboratory Technicians at Misrata Hospitals. *The First Annual Conference on Theories and Applications of Basic and Biosciences*.

4. Salem S. Elwahaish, Waraida S. Al-Suwaihli , Altaher I. Altabet and Iman M. Sweab .(2024). Evaluation of the management of medical waste resulting from wet cupping therapy within health. *Sebha University Journal of Medical Sciences*.19 no. 1-6

5. Clarkson, T. W., & Magos, L. (2006). The toxicology of mercury and its chemical compounds. *Critical Reviews in Toxicology*, 36(8), 609-662.

6. Kummerer, K., et al. (2000). Pharmaceuticals in the environment: Sources, fate, effects, and risks. Springer-Verlag. Retrieved from (<https://www.webpages.uidaho.edu/fish511/Readings/Readings%202010/Pharmaceuticals.pdf>), viewed on January 2024.

7. United Nations Environment Programme (UNEP). (2013). Minamata Convention on Mercury. Retrieved from (<https://www.unep.org/globalmercurypartnership/resources/policy-and-strategy/minamata-convention-mercury>). viewed on January 2024.

8. Hossein Nematollahi, Reza Ghasemzadeh, Maryam Tuysserkani, Mohamadmahdi Aziminezhad, Maryam Pazoki. (2024). Comparative life cycle assessment of hospital waste management scenarios in Isfahan, Iran: Evaluating environmental impacts and strategies for improved healthcare

- sustainability. *Results in Engineering* 24. 1-19
9. Al-Thabit, A. (2004). Study on chemical sterilization methods in dental practices.
10. Janakiram, C. (2008). Dental health care waste disposal among private dental practices in Bangalore City, India. *Int Dent J.* 58(1):51-
11. Al-Khatib IA, Monou M, Mosleh SA, Al-Subu MM, Kassinos D. Dental solid and hazardous waste management and safety practices in developing countries: Nablus district, Palestine. *Waste Manag Res.*;28(5):436-44
12. Ramesh, N., Ramesh, S., & Krishnan, S. (2019). Management and Disposal of Mercury and Amalgam in the Dental Clinics of South India: A Cross-Sectional Study. *J Pharm Bioallied Sci*;11, 151-155
13. Ramesh, N., Kulkarni R D, Ajantha G S. (2007). Biomedical Waste Management. *J Oral Maxillofac*, 11, 5-9
14. Singh RD, Jurel SK, Tripathi S, Agrawal KK, Kumari R. (2014). Mercury and other biomedical waste management practices among dental practitioners in India. *Biomed Res Int.*
15. Ramandeep S Narang, Adesh Manchanda, Simarpreet Singh, Nitin Verma,(2012). Awareness of Biomedical Waste Management Among Dental. *OHDM - Vol. 11 - No. 4*
16. Mulay MV, Naik SD, Wyawahare AS, Mahajan SM, Kulkarni SS. (2024). Awareness and monitoring of infection control practices among healthcare workers in three primary health centers in India. *GMS Hyg Infect Control.* 5;19
17. Sudhakar and Chandrashekar. (2008). Dental health care waste disposal among private dental practices in Bangalore City, India. *Wiley* 58, 51-54