

COMPOSITION AND PRODUCTION RATE OF DENTAL SOLID WASTE IN NORTH-WEST IRAN

Balarak D,¹ Modrek MJ,² Ebrahimi M³

1. Assistant Professor, Department of Environmental Health, Health Promotion Research Center, School of Public Health, Zahedan University of Medical Sciences, Zahedan, Iran.

2. Department of Parasitology, Infectious Diseases Research Center, Zahedan University of Medical Sciences, Zahedan, Iran.

3. MSc Student of Environmental Engineering, Department of Environmental Health Engineering, Tabriz University of Medical Sciences, Tabriz, Iran.

ABSTRACT

Aim: Today, one of the most important environmental issues is dental solid wastes that because of the presence of hazardous, toxic and pathogen agents have special importance. In this study, solid waste produced in Tabriz- Iran general dental offices was studied.

Materials & Method: There were 440 dentists in the Prefecture of Tabriz. Only 320 dentists agreed to participate in this study. From each office 3 samples were analyzed at the end of successive working days (Monday, Tuesday and Wednesday). Samples were manually sorted into different 22 components and by means of laboratory scale were measured. Then, measured components were classified on the basis of characteristic and hazardous potential as well as material type. Total annual waste produced in dental offices in Tabriz is 70848 kg.

Results: Production percentages of infectious, domestic type and non-infectious wastes were 11.7%, 79.4% and 7.9%, respectively.

Conclusion: For the proper management of dental waste, it is suggested that in addition to educating dentists in waste reduction, separation and recycling inside the offices, each section of dental waste be managed separately and according to related criteria.

Key words: Dental solid waste, Infectious waste, domestic waste, Toxic waste.

Introduction

Hazardous waste management is a current 'hot' issue in Iran. Healthcare waste (HCW) is an extremely hazardous category as it poses health and environmental hazards due to one or more of the following characteristics.¹ They contain infectious agents, sharps, hazardous chemicals, or pharmaceuticals; or they are genotoxic or radioactive.² Dental solid waste consists of three main categories: Infectious Waste, Non-Infectious Waste and Domestic type Waste.³ This classification was used in the present study because of its simplicity and applicability, although the definition of infectious waste is not very clear among the dental community.⁴ Infectious waste contains materials contaminated with blood or other infectious fluids of the mouth, sharps and amalgam.⁵ The infectious waste is classified as hazardous.⁴ The safe management of such waste is necessary to avoid environmental and public health problems, especially related to transmission of infectious diseases, such as HIV infection and hepatitis.⁶ Sharps comprise a subgroup of infectious waste and require special handling, because they may cause injury and transmit diseases, especially to waste collection, treatment, and disposal personnel. Amalgam waste contains 49% mercury and is also classified as hazardous.⁷ The amalgam waste originates from the material used by dentists in tooth fillings.⁸ This is an approximately 1:1 mixture of metallic mercury and a powdered alloy consisting of Ag, Sn, Cu, Zn and probably other metals as well.⁹ This material has been used for more than 150 years, without obvious negative effects on human health.¹⁰ In fact, the dental society has long recognized the advantages of using amalgam for improving the mouth health of dental patients.¹¹ In many countries, a typical practice is to dump the majority of dental solid waste into household disposal sites and landfills without any recycling or separation processes.¹² Since some components in dental waste are hazardous, this

practice creates a potential risk to human health and the environment.¹³ In many countries, dental waste is regulated under medical waste control laws.¹¹ Even though hazardous waste represents a small proportion of total dental solid waste, there is still a risk for cross infection and potential environment dangers that can result from mismanagement.¹⁴ Dentistry is a part of healthcare services and dental waste (DW) management is a sector that needs to be organized basically from scratch in Iran; therefore, a thorough investigation of the composition and characteristics of dental solid waste is critical for the appropriate management of healthcare waste.¹⁵ The aim of this study was to determine the composition of dental waste from dental health services in Tabriz.

Materials and Method

Waste collection took place for 30 working days. At the time this work was conducted (2012), there were 440 dentists in the Prefecture of Tabriz. Only 320 dentists agreed to participate in this study.

Waste separation

The present study had been performed by census, in a way that the daily produced wastes of the dental centers were collected and separated. Also according to the recommendation of WHO and put them in special colored containers. The generated wastes on three consecutive days (Monday, Tuesday and Wednesday) of the middle of the week were examined. Following collection; the waste was transferred to the facilities of the Laboratory of Solid and Hazardous Waste Management of the Department of Environmental Engineering of Democritus University of Tabriz. There, the waste was manually separated and was weighed. Laboratory personnel involved in waste separation took all necessary measures for their safety and hygiene, such as use of protective gloves, masks, glasses, head cover, forceps and white laboratory uniform. during

the manual separation of dental solid waste, Components of such, Paper originating from paper towels used by dental patients and for packaging of dental products, Plastic-coated paper originating from towels used by dental patients and for packaging used in sterilizing dental tools, plastic originating from plastic glasses and packaging of dental products, Latex gloves used by dentists in dental practice, polyvinyl chloride (PVC) gloves used by dentists who are allergic to latex, tube accessories of saliva ejectors, containing metal coated with plastic, used anesthetic cartridges, disposable syringes and needles, wax, dental impression materials including silicones, acrylics and mercaptans, alginate, gypsum, extracted teeth, blood-contaminated cotton and gauzes, dental tools, such as surgical blades, mirror handles, broken forceps, etc. dental microtools, such as burs and endodontic and smoothing microtools (broaches and files), amalgam from old fillings or excess amalgam from the filling, carving and polishing, used plastic capsules containing amalgam residues not used in the filling process, used partial dentures from removable appliances, bridges from fixed prosthodontics, lead shields from X-ray film packets, domestic-type waste containing food waste, newspapers, magazines, packaging materials, flowers, etc.⁴ Based on the above components, the classification of dental solid waste, presented in Figure 1.

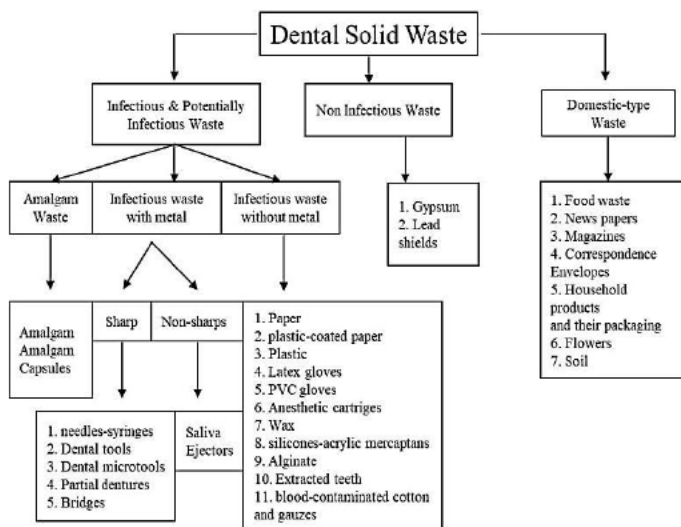


Figure 1: Classification of dental solid waste

In this study, the dental solid wastes generated had been determined per capita of the wastes as kilogram for each dentistry unit. A Typical scale had been used for weighing the wastes. After three times of weighing them, the average of the weights was calculated. The data were analyzed by SPSS Version 18. To analyze the data, parametric tests of one-way variance analysis and Kruskal-Wallis test were used. In this study, the dental solid waters generated had been determined per capita of the waters as kilogram for each dentistry unit.

Results

A total of 196.8 kg dental solid waste was collected during the study each day and was separated. Based on the results

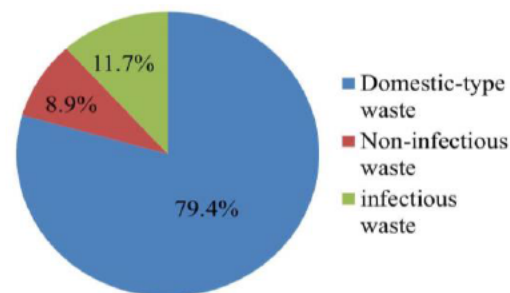
from the 320 private dental practices selected, the production rate of dental solid waste was 615 g/practice/day. Dental solid waste was classified in three main categories:

- 1) Infectious and potentially infectious waste, accounting for 11.7% by weight.
- 2) Non-infectious waste, accounting for 8.9% by weight.
- 3) Domestic-type waste, accounting for 79.4% by weight.

The results are presented in Table 1 and Graph. 2.

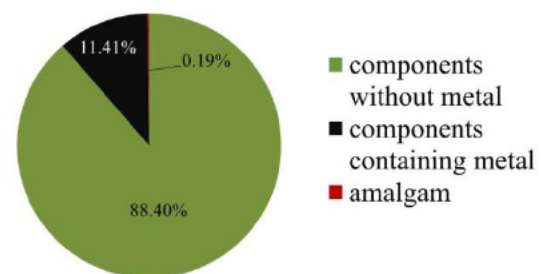
Waste category	Average total daily production (kg/d)	Production rate (g/practice/d)
Infectious and potentially infectious waste	23.03	71.95
Non-infectious waste	17.52	54.73
Domestic-type waste	156.25	488.31
Dental solid waste (total)	196.8	615

Table 1: Dental solid waste production for the dental practices selected



Graph 1: Classification of dental solid waste for the dental practices selected.

The category of infectious waste includes components containing metal (11.41%), components without metal (88.40%), and amalgam waste (0.019%). Amalgam is an infectious or a potentially infectious waste containing mercury. The results are presented in Graph 2.



Graph 2: Classification of Infectious and potentially infectious waste

The production rate of the infectious waste was 71.95 g/practice/day. This number includes the production rates of sharps (18.2 g/practice/day), non-sharps (81.8). A more detailed classification is presented in Table 2.

Waste Category		Percent	Production rate (g/dental practice/day)	
Infectious waste with metal 11.41%	Sharp 9.8%	Bridges	0.95	0.67
		Dental microtools	2.2	1.55
		Needles-Syringes	0.65	0.45
		Dental tools	4.8	3.39
		Partial dentures	1.2	0.85
	Non-sharp	1.61	1.15	
Infectious waste without metal 88.40%	Paper	30.7	19.52	
	Plastic-coated paper	20.08	12.77	
	Plastic	13.11	8.33	
	Latex gloves	11.2	7.12	
	PVC gloves	2.6	1.65	
	Anesthetic cartridges	1.2	0.76	
	Wax	3.4	2.16	
	Silicones-acrylic mercaptans	0.65	0.41	
	Alginate	2.4	1.52	
	Extracted teeth	0.96	0.61	
	Blood-contaminated cotton and gauzes	2.2	1.4	

Table 2: Classification of infectious and potentially infectious dental solid waste for the dental practices selected

Discussion

As it was observed, the total amount of dental waste generated in Tabriz is equal 5904 kg/month which is equivalent to 70848 kg/year. In the study was conducted in Hamadan, The total amount of dental waste generated was equal to 24 tons.³ Waste generated from Tabriz dental centers is more than 70 tons in each year. Although this amount is small in compared with municipal waste produced in Tabriz, however the proper management will need to perform due to special features and potential hazards in this waste. For proper management of waste generated, perform waste reduction, separation, recycling and reuse programs as much as possible is necessary.¹⁶ For dental waste in Tabriz not observe any of the following actions, that it indicates poor dental waste management.

There are poor dental waste management in Hamadan and Shahrood too, and Reduce generated, separation and recycling programs is not done.^{3,7} Waste reduction programs are practicable by reduce the use of disposable materials and the use of materials and products with less hazardous potential and the smaller packaging.¹⁷ The most important work for optimal management of dental waste is prevention of mixing all waste components together.⁶ In this study, the amount of waste components were classified into 22 categories and it's consistent with several studies in this field.⁵ As was observed, the main dental waste is household section that accounts 59.3% of total waste generated. In a similar study conducted in Greece; while most of the waste generated is related to household section, the most of the waste generated was infectious section that which constitutes 94% of total waste generated and Share

of a household and non-infectious waste was 6%.⁵ The major differences in the rate of dental solid waste produced in Iran and Greece related to this point that in Greece, often studied dentistry was performed therapeutic and restorative services; so most of the waste generated was infectious.⁵

While in this study, experimental dentists has been studied and in this part the amount of recycled components such as paper, cardboard, plastic, nylon, glass and Etc. is more. These results are consistent with a study conducted in Brazil.¹⁸ Also the difference in these two studies related to recycling operations that is done in household section in Brazil and form 40% of total dental waste generated;¹⁸ whereas the recovery operation is not performed in Iran and household section is about 20-30% further. In this study, Infectious waste comprises about 11.7% by weight of the dental waste. Despite it is a small part of total dental waste generated, but the main concern is with this section; because if we don't have properly managed, may cause the release of pathogens in the environment. These wastes should be collected separately and sterilized or autoclaved before disposal.⁴ In Turkey's by isolation and sterile gloves used by dentists, the volume of potentially infectious waste was reduced about 35%.² These results are fully consistent with the studies conducted in Iran;³ although it has many different by studies abroad.¹² These differences are because in these countries household waste is recycled but no recycling operations are performing in Iran and it's mixed by infectious and non-infectious wastes.⁵ Compounds of this type of waste are different and each management approach should be based on these characteristics.¹ Because household waste has recyclable materials such as paper, carton, plastic, cardboard, glass and etc. collection and disposal of mixed waste isn't principle; while it can be collection and disposal with municipal solid waste.³ In some classification for dental waste, infectious waste classified separately from toxins and drugs waste. But in some source because both sections are part of the hazardous wastes, they are placed in a group.¹⁹ In Brazil, dental waste is regulated under medical waste control laws. Even though hazardous waste represents a small proportion of total dental solid waste, there is still a risk for cross infection and potential environment dangers that can result from mismanagement.¹³ Poor management and lack of recycling programs has led to mixed disposal of hazardous and toxic materials by another waste generated.⁹ Safety Box for separate collection and disposal of sharp objects used in often centers rarely; this is consistent with Studies conducted in Iran, while all these things are to be followed in other countries such as Brazil, Turkey and Greece.^{2,5,18}

References

1. Pruss A, Giroult E, Rushbrook P. Safe management of wastes from health-care activities. World Healthcare Organization, Geneva, Switzerland. 1999.
2. Ozbek M, Sanin FD. A study of dental solid waste produced in a school of dentistry in turkey. Waste Manag 2004;24(4):339-45.

3. Kulivand A, Nabizadeh R, Joneidy A, Younesian M, Omrany G. Quantity and quality analysis and management of solid waste produced in dentistry laboratories and practical dentist offices in hamedan, Iranian Journal of Health & Environmental. 2009;2(1):36-46.
4. Kontogianni S, Xirogiannopoulou A, Karagiannidis A. Investigating solid waste production and associated management practices in private dental units. *Waste Manag* 2008;28(8):1441-8.
5. Kizlary E, Iosifidis N, Voudrias E, Panagiotakopoulos D. Composition and production rate of dental solid waste in Xanthi, Greece: variability among dentist groups. *Waste Manag* 2005;25(6):582–91.
6. Hiltz M. The environmental impact of dentistry. *J Can Dent Assoc* 2007;73(1):59-62.
7. Ghanbarian M, Khosravi A, Ghanbarian M, Ghanbarian M. Evaluation of Quantity and Quality of Dental Solid Waste. *Knowledge & Health*. 2011;6(2):42-6.
8. Diaz LF, Eggerth LL, Enkhtsetseg Sh, Savage GM. Characteristics of healthcare wastes. *Waste Manag* 2008;28(7):1219- 26.
9. Farmer GM, Stankiewicz N, Michael B, Wojcik A, Lim Y, Ivkovic D *et al*. Audit of waste collected over one week from ten dental practices. A pilot study. *Aust Dent J* 1997;42(2):114–7.
10. Bazrafshan E, Mostafapoor FK. Survey of medical waste characterization and management in Iran: a case study of Sistan and Baluchestan province. *Waste Manag Res* 2010;20(4):442- 450.
11. Al-Omari MA, Al-Dwairi ZN. Compliance with infection control programs in private dental clinics in Jordan. *J Dent Edu* 2005;69(6):693-701.
12. Treasure ET, Treasure P. An investigation of the disposal of hazardous waste from New Zealand dental practices. *Community Dent Oral Epidemiol* 1997;25(4):328-331.
13. Nazar MW, Pordeus IA, Werneck MA. Dental waste management in municipal health clinics in Belo Horizonte, Brazil. *Rev Panam Salud Publica* 2005;17(4):237-42.
14. Grega M, Buckingham P, Evans J. Hazardous waste management. 2nd ed. New York: McGraw Hill Press; 2001.158-161.
15. Amouei A, Miranzadeh MB, Asgharnia H, Fallah H, Mohammadi A. Study of quality and quantity of clinical laboratories solid wastes in north of Iran. *J Applied Technol Environ Sanitation* 2012;2(4):185-90.
16. Shinee E, Gombojav E, Nishimura A, Hamajima N, Ito K. Health care waste management in the capital city of Mongolia. *Waste Manag* 2008;28(2):435- 41.
17. Taghipour H, Mosaferi M. Characterization of medical waste from hospitals in Tabriz, Iran. *Sci Total Environ* 2009;407(5):1527- 35.
18. Vieira CD, de Carvalho MA, de Menezes Cussiol NA, Alvarez-Leite ME, Dos Santos SG, da Fonseca Goms RM, *et al*. Composition analysis of dental solid waste in Brazil. *Waste Manag* 2009;29(4):1388–91.
19. Nasrollahi M, Zazouli MA, Balarak D, Moradi Golrokhi M. Quantity and Quality Analysis and Management of Dental Solid Waste Produced in Private Office in Urmia. *J Dent Sch* 2015;33(4):262-268.

Corresponding Author

Dr. Mohammad Jafari Modrek

Department of Parasitology,
Infectious Diseases Research Center,
Zahedan University of Medical Sciences,
Zahedan, IRAN

Email Id: - mohammadjafarimodrek@gmail.com