

Evaluation of Radiographic Waste Management in Dental Clinics of Vadodara City

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Abstract: Background: Many Advanced Dental Radiographic imaging techniques are currently available to obtain images free of radiographic solutions like Radiovisiography. But still majority of dentists in India are dependent on conventional film based radiography due to high expenses. The aim of the study was to evaluate the management of radiographic wastes resulting from conventional intraoral radiography in dental clinics of Vadodara City. Material And Methods: Dentists registered with DCI & who are practicing in Vadodara city, were voluntary participants of the study. Each participant was asked to fill a questionnaire. The collected data was entered in the master chart & was subjected to statistical analysis. Result: Out of 376 dental clinics in the Vadodara city, only 182 are using conventional radiography and amongst them only 150 participants were willing to participate in the study. A total of 95.3% of the participants believed that radiographic waste materials could cause damage to the environment. Regarding the disposal of used fixer, developer solution; 86% affirmed that they threw the solution directly through the sink, 14% diluted it in water and threw it into the sink. Not a single participant is using specialized company for disposal of used processing solution. Considering the discarding of the packing of the radiographic films, 100% threw them into the garbage. Conclusion: The practicing dentists had knowledge about harmful effects of radiographic waste on environment but it did not reflect in their way of management. Their incorrect disposal & management are of great concern & the government agencies should supervise such actions to protect both the health & the environment. [Patel P Natl J Integr Res Med, 2020; 11(4):61-65]

Key Words: Developer, Fixer, Radiographic Waste Material, Dental Clinics

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Introduction: Health care establishments (together with dental clinics) are mainly concerned with providing high standard services to the community; this cannot be fully accomplished unless a proper biomedical waste handling policy that is consistent with the international regulations is strictly implemented¹.

Currently, the contamination of the environment has been a constant concern and this is not only more a desire of a small group of environmentalists but raises the global attention, even with the adoption of governmental policies. The pollution of rivers, lakes, coastal areas, and bays has resulted in environmental degradation due to the discard of increasing volumes of industrial and biomedical residues. The releasing of untreated sewage drastically increased in the last decades².

The discovery of X-rays has revolutionized the field of diagnostic and therapeutic medicine and, consequently, dentistry. Radiographies, now largely used by dentists for the diagnosis of pathologies in patients, have become a third eye for the dentist. Basically, the technique performed to obtain radiographic images involves exposure of radiographic films to X-rays, followed by their conventional/manual

processing, including film developing, washing, fixing, final washing and drying³.

The chemical residues presenting risks to either the human health or the environment should be submitted to specific final treatments when they do not undergo reutilization, recuperation, or recycling. The effluents coming from radiographic processing comprise solutions with high concentrations of silver and other chemical substances which are highly toxic to the environmental health. The best way to manage silver waste is through recovery and recycling⁴.

Additionally, a solid residue causing great concern is the lead found in the packing of the radiographic films. Although the lead foils themselves are relatively small, the cumulative waste produced can be considerable. Lead, like mercury and silver, is toxic and persists in the environment². Another common waste product in the dental office is unused films. This should also not be placed in the general waste. Unused films contain unreacted silver that can be toxic to the environment and also non-biodegradable plastic wrapper^{3,4,5}.

If these radiological wastes are discharged into a sewer system, hazardous liquid wastes can

potentially impact the waste water treatment plant and/or pass through the treatment plant into bays, oceans, rivers, or other receiving waters. Alternatively, if materials are disposed off in the trash, they may eventually contaminate the soil, ground water, creating public health problems³.

The current concern in altering the system of radiographic film processing by new products or less pollutant techniques may decrease the environmental contamination.⁶ However, little has been done still to minimize the environmental impacts caused by the radiographic films, developer, and fixer solutions and water which is used for rinsing the films. On the other hand, the proper treatment of the developer and fixer solutions may generate inputs and strengthen the economy by the possibility of being reused^{2,3,6}.

The technological advancements and the increasing investments in radiology has been addressed to improve the devices and to discover new ways to obtain images free of radiographic films & Solutions like radiovisiography. But still majority of dentists in developing nation like India are dependent on conventional film based radiography due to high cost factor. The need for the study is to evaluate the radiographic waste management in dental clinics of Vadodara city.

Objectives: (1)To evaluate the management of radiographic wastes resulting from conventional intraoral radiography in dental clinics of Vadodara City (2)To evaluate the management of residues resulting from radiographic processing in dental clinics of Vadodara City (3) To evaluate the management of solid radiographic wastes in dental clinics of Vadodara City.

Material & Methods: The present study was conducted amongst the Practicing Dentists of Vadodara city. The permission to undertake this study was obtained from Sumandeep Vidyapeeth Institutional Ethics Committee (SVIEC). The Source of data was Dentists owning or working in Dental clinics of Vadodara city. Their phone numbers were taken from IDA Vadodara Branch & Gujarat state dental directory. The questionnaire regarding radiologic waste management was adopted from the study conducted by Silva M et al (2102) after prior permission². The dentists of various dental clinics of Vadodara city were contacted over phone and

inquired about the type of radiography (conventional / digital), they were using in their clinics. The dentist of various dental clinics of Vadodara city who were using conventional radiographic technique & who gave the written consent were included in the study. The dentist of various dental clinics of Vadodara city who were using only digital radiography in their respective clinics, were excluded from the study.

The clinics in which conventional radiography technique is used was short listed and the investigator had taken appointment over phone with the dentists who were working in these clinics. As per the appointment, the participants were contacted and were explained about the study and written consent was taken. The questionnaire was given to assess the methods adapted for radiographic waste management. (Annexure no.1) Questionnaire took less than 10 min to answer. All the answers were kept confidential and were not depicted against their identity. The collected data was entered in the master chart prepared in micro-soft excel sheet 2007. The data was subjected to descriptive statistics.

Results: The present study was conducted amongst the Dentists registered with Dental Council of India & who are practicing in Vadodara city. From Table no. 1 it was clearly observed that out of 376 dental clinics in the Vadodara city, 182 (48.4%) were using conventional radiography and amongst them only 150 participants were willing to participate in the study. (Table no. 1)

Table No. 1: Demographics

Number Of Dentists Practicing In Vadodara	Number Of Dentists Using Conventional Radiography	Number Of Dentist Willing To Participate In The Present Study
376	182	150

Regarding the response to the Question no. 1 i.e. Do you believe that the fixer and developer solutions you use can damage the environment? Out of 150 participants 143 participants (95.3%) believe that fixer and developer solutions used in dental clinic can damage the environment and 07 participants (4.7%) said no for same. Regarding the response to the Question no. 2 & 3 i.e. How do you discard the fixer & developer solution in your office? Out of 150 participants 129 participants (86%) discard the fixer & developer

solution in the sink and 21 participants (14%) discard after diluting in water to the sink.

Participants were also inquired about how much developer and fixer solution do you discard per month (Question no. 4); Out of 150 participants 47 participants (31.3%) throw 100 ml or less in the sink, 44 participants (29.3%) throw 200 ml, 48 participants (32%) throw 01 liter and 11 participants (7.3%) throw more than 01 liter in the sink. (Table no. 2)

Table No. 2: The Response To Question No. 4

Question 4 response of participants	(a)	(b)	(c)	(d)
	47 (31.3%)	44 (29.3%)	48 (32%)	11 (7.3%)

The response to Question no. 5 i.e., How do you discard the water for film washing in your office? Out of 150 participants 102 participants (68%) throw in the sink and 48 participants (32%) Dilute in more water and throw in the sink. (Table no. 3)

Table No. 3: The Response To Question No. 5

Question 5 response of participants	(a)	(b)	(c)	(d)
	102 (68%)	48 (32%)	00	00

When the participants were asked regarding Question no. 6 i.e. How do you discard the packing of the films in your office; Out of 150 participants all 150 participants (100%) throw in garbage can.

Discussion: Health care establishments are mainly concerned with providing high standard services to the humanity; this cannot be fully accomplished unless an appropriate waste management guideline that is consistent with the global regulations is strictly executed². Dentist being a part of the health care society have moral and professional responsibility towards the dental as well as the general health of the patients they care. Health care centres, dental wings of medical institutes, Dental Council of India and Indian Dental Association should have national collaborative effort to minimize the effects of solid and liquid radiographic wastes to the minimum or nil, and to address these threats in comprehensive, effective ways. An environmentally responsible dental office can help in reinstating a healthier environment and can always make a difference^{13,14}. This suggests that most of the dentists in Vadodara city are

using Radiovisiography. Still conventional radiography is accountable because of its diagnostic accuracy of the image and the cost effectiveness. Regarding the first question- the fixer and developer solutions use can damage the environment, this present study shows that the dentist practicing in Vadodara city were aware about the harmful potential of the radiographic effluents and solid waste on the environment.

The fixer solution is a liquid which contains silver and requires a treatment prior to its discard; instead of only its dilution in water¹. There are several techniques to retrieve the silver within the fixer solution. Some of these methods are able to recover up to 99% of the metal⁴. Other than silver, the solution also contains certain chemicals which are pollutant to the environment. Regarding the discarding of fixer solution (Que. No. 2); 86% affirmed that they threw the solution directly through the sink & not a single participant is discarding through specialized company¹¹.

The developer solution should be neutralized prior to its discard because it has a pH around 11 to 12 (highly basic solution) and is also composed of aromatic phenolic compounds and amino acid salts. This solution should be treated before discarding in the sewage because it contains several harmful components or may form harmful byproducts in its reaction. These chemicals are hydroquinone, quinone, methol, sodium thiosulfate, sodium sulfite, elemental sulfur, acetic acid, sodium acetate, boric acid and silver, in the form of complex ions (S₂O₃⁻¹)⁵.

These are damaging to the environment and the polluted water has ill effects on health of animal kingdom, plants and human beings. Regarding the discarding of developer solution (Que. No. 3); not a single participant is using specialized company. The amount of developer and fixer solutions utilized in radiological centers varies according to the size of the health service unit and to the number of acquired images. Regarding the amount of developer and fixer solution discarded per month, all of them are discarding directly into the environment, which is not in agreement with the guidelines of the Indian Council on the Environment.

It is also known that great volumes of water used in the washing of the radiographs have been daily released in the sewage. The large amount of

radiographic water and their incorrect handling are of great concern, and the governmental agencies should supervise such actions to protect both the health and the environment. For the question No. 5 regarding the discard of the water result showed out of 150 participants 68% participants throw in the sink and 32% participants dilute it further and throw it in the sink. This water normally shows high levels of silver, well above the allowed value, which was similar to the results of other studies^{2,9,12}.

According to the technical guideline, the residues should be referred to landfills of Class I hazardous waste. The large amount of subjects discarding the film packing in the garbage may cause a serious environmental damage due to the presence of lead and also non biodegradable plastic. (Que. No. 6) According to the present study it was clearly observed that all practicing dentists of Vadodara city throw in garbage can and not using any specialized company.

Although individual dentists generate only small amounts of environmentally hazardous wastes, the accumulated waste produced by their profession may have a significant environmental impact, which in turn may pose risks to human health and other living organisms⁶. It is clear the need of greater attention by the public agencies, such as the environmental and sanitary surveillance, regarding to the residues of radiographic processing. These agencies should stimulate the silver retrieving from the fixer solution and the water used for film washing, therefore reducing the environmental damages and the costs and enabling the reutilization of this water in the process. Also, the agencies should require the treatment of the developer and fixer solutions in order to reach a less harmful way of discarding, aiming to reduce the impact on the public health and environment.

Our study result showed that though the dental practitioners in Vadodara city were aware of the harmful effect of radiographic waste, this was not reflecting in the way of Radiographic waste disposal. This was in accordance with the previous studies done by India and Brazil^{2,13}.

Although a service for the collection of this radiographic waste material is available, the dentists prefer to discard it in the common garbage. As many of the practicing dentists are usually depended on the attenders and the non-

clinic staff of the clinic for waste disposal, they may be unaware about the proper disposal methods for radiographic waste. As a group, we dentist should responsibly act to minimize the harmful environmental impact of the dental radiographic waste. Health care educational program and training should be conducted by the educational institutes and government agency to impart knowledge.

Conclusion: The findings of this study suggest that though the practicing dentist of Vadodara city had knowledge about harmful effects of radiographic waste on environment, it did not reflect in their way of radiographic waste management. Many of the practicing dentist of the Vadodara city are depended on the attenders and the non- clinic staff of the clinic, they are unaware about the disposal of the radiographic waste. Hence the radiographic waste is not getting disposed in a scientific way. Due to this the environment is getting polluted. The large amount of radiographic solutions and their incorrect management are of great concern, and the governmental agencies should supervise such actions to protect both the health and the environment.

References:

1. Hashim R, Mahrouq R, Hadi N. Evaluation of dental waste management in the emirate of Ajman, United Arab emirates. *Int Dent Med Res* 2011; 4: (2),64-69.
2. Silva M, Santos-Neto O, Moraes J, José B. Evaluation of radiographic waste management in dental offices and radiology clinics of São Luís (MA) *Journal: RSBO Revista Sul-Brasileira de Odontologia* 2012; 9(3): 260-265.
3. Jyothirmai K, Neha M, Mahalakshmi M. Management of Dental Radiographic Waste: A Review. *International J Medical Dentistry* 2014;4(3):206-209.
4. Hiltz M. The environmental impact of dentistry. *J Can Dent Assoc.* 2007; 73(1):59-62.
5. Grigoletto JC, Santos CB, Albertin LB, Takayanagui AMM. Radiographic processing effluents management status in healthcare centers. *Radiol Bras.* 2011; 44(5):301-7.
6. Grigoletto JC, Segura-Muñoz SI, BarbosaJunior F, Sanches SM, Takayanagui AM. Silver discharged in effluents from image-processing services: a risk to human and environmental health. *Biol Trace Elem Res.* 2011; 144(1-3):316-26.

7. Kizlary E, Losifidis N, Voudrias E, Panagiotakopoulos Composition and production rate of dental solid waste in Xanthi, Greece: variability among dentist groups. *Waste Management*. 2005;25(6):582-91.
8. Kontogianni S, Xirogiannopoulou A, Karagiannidis A. Investigating solid waste production and associated management practices in private dental units. *Waste Management*. 2008;28(8):1441-8.
9. Goshima T, Hori K, Yamamoto A. Recovery of silver from radiographic fixer. *Oral Surg Oral Med Oral Pathol*. 1994;77(6):684-8.
10. World Health Organization (2004). *Review of Health Impacts from Microbiological Hazards in Health – Care Wastes*, Geneva, Switzerland, 2004.
11. Govt. of India, Ministry of Environment and Forests Gazette notification No 460 dated July 27, New Delhi: 1998: 10-20.
12. Darwish IA, Al-Khatib IA. Evaluation of dental waste management of two cities in Palestine, *Eastern Mediterranean Health Journal*, 2006; 12: 217-222.
13. Atesgaoglu A, Omurlu H, Ozcagli E, Sardas S, Ertas N. Mercury exposure in dental practice. *Operative Dentistry*, 2006; 31: 666669.
14. Khandelwal V, Khandelwal S, Thakur J. Health care waste disposal among private dentist in an Indian city: it's time to act. *Int J Infect Control* 2013.
15. Rudraswamy S, Sampath N, Doggalli N. Staff's attitude regarding hospital waste management in the dental college hospitals of Bangalore city, India. *Indian J Occup Environ Med* 2012;16:75-8.

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