

Knowledge and Practices for Hazardous Waste Management among Dental Health Care Workers in India

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Abstract:

Aim: To determine the knowledge of dental professionals in India regarding the management of hazardous dental waste and actual practices followed by them.

Material and method: A descriptive cross sectional study was conducted as a survey of Indian dental professionals. A self-administered questionnaire was designed to determine the knowledge and practices on hazardous dental waste and knowledge and practice of safety measures against cross-infection. This questionnaire was e-mailed to the seven hundred fifty dentists randomly selected from list of Indian dental association. Overall response rate was 67.92% (n=494). Obtained response for each question from participated dentist was calculated in percentage.

Result: Calculated data showed that there was very high discrepancy between knowledge and practice of dental professionals regarding hazardous waste management.

Conclusion: Majority of dentists practice improper waste disposal. Proper supervision and education should be done at all stages for proper management of hazardous waste. Practitioners should be retrained time to time for new technologies of proper waste disposal.

Keywords: Amalgam; Dental professionals; Fixer; Hazardous waste; Infection; Segregation.

Introduction:

During the past two decades the world experienced a dramatic increase in the amount of hazardous waste generated. As a result, this period also witnessed a vigorous drive for sustainable development and increased awareness and concern for the environment.¹ The United Nations Environment Program (UNEP) argues in their International Sourcebook on Environmentally Sound Technologies for Municipal Solid Waste Management that among these wastes, Biomedical waste is one of the most problematic types.² The developing world such as India has had to grapple with managing this type of waste against the backdrop of competing priorities such as the HIV/AIDS pandemic. Incidentally, it is also the developing world that has been affected the most by the pandemic. As a result of the high HIV/AIDS prevalence in this part of the world, there has been a considerable rise in hospital admissions and a high morbidity among the general population.

The term *biomedical waste* has been defined as "any waste that is generated during the diagnosis, treatment, or immunization of human beings or animals, or in the research activities pertaining to or in the production or testing of biological."^{3, 4} According to the World Health Organization (WHO) between 10% and 25% of biomedical waste generated is regarded hazardous due to its composition. The remaining 75% to 90% poses no risk of infection transmission, as it is comparable to domestic waste.⁵

Hazardous wastes are generated in dental offices as a result of treatment processes and other activities in dental care establishments. Hazardous wastes in dental offices can be categorized as infectious waste (used cotton and gauze pieces etc.), sharps (infected needles etc.), lead containing waste (lead aprons, lead foil packets, mercury waste (such as squeezed mercury, amalgam scrap), and chemical waste (such as lead film developers and fixers, disinfectants etc.). Waste water from dental offices typically contains high concentrations of metals such as mercury, silver, copper, tin, and zinc.⁶ Hazardous healthcare waste is deleterious to people and the environment, and unlike the non-hazardous healthcare waste, has to be treated in a special way. There are regional guidelines on this subject. Proper management of healthcare waste begins directly at the collection sites where hazardous is segregated from non-hazardous waste into specific colour-coded containers and sent to the final treatment site. Among dental offices, awareness of dentist and dental assistant is crucial for its proper management. They need to segregate the waste, store it in the correct bins at the point of generation and sent it to final treatment site. In order for them to fulfil this function efficiently, it is important that they have knowledge about the importance of segregation and how to distinguish the different containers and bins for the various types of health care waste.

Previous studies indicated that there is a divergence in knowledge and practices followed by dentists for management of hazardous waste of dental offices.^{7, 8} Adequate knowledge about the health hazard, proper technique and methods of handling the waste and practice of safety measures can go a long way toward the safe disposal of hazardous dental waste and protect the community from various adverse effects of the hazardous waste. With this background, this study was conducted with the main objective of assessing knowledge, attitude, and practices of dentists in India regarding the management of hazardous dental waste.

Methodology:

The presented study was a descriptive cross sectional study conducted as a survey of dentists whether working in government or private sector in India. Approval was granted by King George research ethical committee for conducting the study. A self-administered questionnaire was designed to record age, sex, type of practice, years of practice, additional training, knowledge and practices on hazardous dental waste and knowledge and practice of safety measures against cross-infection. The study population included dentists to whom email address is present in Indian dental association. No information was available about the knowledge of dentists regarding management of hazardous waste. From each state on India, dentists were selected randomly from the list. A self-administered questionnaire was e-mailed to the seven hundred fifty dentists. Overall response rate was 67.92% (n=494). Identity of the respondents was kept confidential.

Questionnaire data was entered into a computer and analyzed by statistical software (SPSS 12.0 for Windows, SPSS Inc., Chicago, USA). The accuracy of input data was verified by entering it twice with subsequent comparison of two data sets. No discrepancies were found in the data.

Results:

A total of 750 questionnaires were distributed. Returns were 494 questionnaires with 55% males and 45% females. 42% respondent worked in government and private hospitals while the rest were engaged in private practice. Only 48.7% respondents were aware of the existence of guidelines of waste management.

Mercury and Amalgam

In our study, 30% of the respondents used amalgamator to mix amalgam, 58% mixed manually, whereas 12% were not using amalgam at all. 36% used pre-encapsulated amalgam and 60% placed bulk mercury in the amalgamator. In this

survey, 7% were disposing mercury into the drain, 32% into the dustbin, and 49% were storing the excess mercury in glycerin and water.

60% respondents were manipulating amalgam with ungloved hands. 69% did not use rubber dam while placing or removing amalgam restorations and 26% did not use high-vacuum suction while handling amalgam in mouth. 36% dentists were using cotton to hold excess Hg spilled on the floor, and 42% used stiff paper to pick it. 47% dentists were aware of amalgam separators and only 10% participants had separator installed at their workplace.

On the hazardous effects of amalgam, 82% respondents indicated that amalgam is toxic if disposed improperly however only 10.7% indicated pollution as a consequence of improper disposal of amalgam. 77% did not know the hazardous effect of improper disposal of amalgam. 25% said they did not know how to dispose off amalgam. In general there was a discrepancy between knowledge and practice for disposal of amalgam. 30% of the respondents indicated that amalgam should be managed by under water storage. 50% actually stored excess amalgam under water. Other methods included general waste (17.5%), sodium thiosulfate (7.5%) and sewage (5%). 12.5% did not indicate how they disposed of waste amalgam (Figure1).

Developer, Fixer and Lead Foils

In this survey, it was found that 55% dentists were using conventional radiography, and 32% were using both conventional and digital. 45% of the dentists using conventional technique were discarding lead foils into the general garbage and 32% were collecting them in a separate container. 54% percent of dentists in our survey recommended that silver is collected from fixer and stored in separate container to dispose to certified company although in practice, only 3% followed. 11% were draining the fixer into the drain, 34% were draining the waste developer into the drain, and 42% were in practice that spent developer and fixer solutions are mixed and flushed into the drain (Figure2).

Body Waste

All the respondents knew the risk of cross-infection with improper disposal of bloody waste. However there was a discrepancy between knowledge and practice. Though, 76.2% indicated that incineration was the recommended method of disposal. Only 56.1% incinerated these materials. 7.1% did not know the recommended method of disposal. 31.7% respondents practised burning to dispose these waste (Figure3).

Sharps

Only 35.5% of the respondents indicated that sharps could be hazardous if improperly managed. 64.3% indicated that cross-infection was a possible risk of improper management of sharps. 71% respondents indicated that incineration was the recommended method of managing sharps. However, only 61% respondents incinerated sharps. 19.5% disposed of sharps in a sharp container while 4.9% disposed them with general waste.

Protective wears

82.9% of the respondents indicated incineration as the recommend means of managing waste wear. However, only 65.1% respondents indicated incinerating protective wear while 18% burnt their waste.

Pathological Wastes

82% respondents said that cross-infection can be a consequence of improper management of pathological waste. About half of the respondents incinerated their pathological waste. More than a quarter of the respondents, 28.6% disposed off pathological waste as general waste (Figure4).

Expired Drugs

Only 26.7% of the respondents indicating that expired drugs could end up in the wrong hands. About half 56.1% of the respondents incinerated expired drugs while 12.2% burnt the expired drugs (Figure5 and 6).

Disinfectants

In this survey, 66% of the participants were using disinfectants for cold sterilization, out of which 72% were flushing them into drain.

Table 1: Knowledge on recommend method and actual practices of amalgam disposal among respondents

	Recommended management %		Actual practiced management %
Under Water	30	Under water	50
Under sodium thiosulfate	12.5	Under sodium thiosulfate	7.5
Under developer	2.5	Under water	2.5
Burn/incinerate	5	Burn/incinerate	5
Special waste disposal site	25	Special waste disposal site	0
Sewage	0	Sewage	5
General waste	0	General waste	17.5
Did not know	25	Did not respond	12.5

Table2: Knowledge on recommend method and actual practices of developer and fixer disposal among respondents

	Recommended management %		Actual practice management %
Silver collected from fixer and stored in separate container but developer flushed in drain	54	Silver collected from fixer and stored in separate container but developer flushed in drain	3
Fixer and developer mixed and flushed in drain	25	Fixer and developer mixed and flushed in drain	42
Fixer can be flushed in drain	4	Fixer is flushed in drain	11
Developer can be flushed in drain	17	Developer is flushed in drain	34

Table 3: Practice of Waste Disposal Methods

	Recommended management %		Actual practice management %
Incineration	76.2	Incineration	56.1
Sterilization	4.8	Sterilization	2.4
Burn	7.1	Burn	31.7
Sewage	4.8	Sewage	26.4
Did not know	7.1	Did not know	4.9

Table 4: Disposal of Pathological Waste

	Recommended management %		Actual practice management %
Incineration	57.1	Incineration	52.4
Burn	16.7	Burn	7.1
General Waste container	9.5	General waste container	28.6
Disinfect	4.8	Disinfect	7.1
Bury	2.4	Bury	4.8

Table 5: Hazards and disposal of Expired drugs

Hazards	%		Recommended practice %
Pollution	15.6	Incineration	56.2
Toxic/allergen	33.3	Burn	12.2
Poison	15.6	General waste	7.3
Picked up and ingested by people	26.7	Back to pharmacy	2.4
Donot know	8.9	Bury	4.9
		Donot know	17

Discussion:

Dentists have social responsibility to maintain clean environment and should establish proper means of dental waste disposal from dental clinics. In the present study, about half of the respondents were not aware of existence of guidelines. This could be due to lack of education and training at the dental schools regarding handling and management of dental waste and lack of initiative taken by the dentists on acquiring new knowledge after training. Only 63.5% respondents indicated that it was important to follow set guidelines on management of hazardous dental waste. Recommendations should be made to the dental professionals to alter behaviour; real improvement was unlikely without changes to legislation and social policy.⁸

As American Dental Association (ADA) guidelines for proper disposal of amalgam waste,^{9, 10, and 11} amalgam should be stored separately in different containers labelled with a "biohazard" symbol. Chair side traps and vacuum pump filters should be used to remove the amalgam particles from the wastewater stream. However, some amalgam particles still enter into the sewer system. Amalgam separators should be used to remove amalgam waste particles completely in dental office discharge.^{12, 13} Mercury and silver present in amalgam wastes should be recovered through a distillation process and sent for recycling.

In addition to dental amalgam, the most common source of regulated heavy metals in dental office is lead from lead foil and lead shields.¹⁶ Lead cannot be placed in the regular solid waste containers nor can it be disposed of down the drain; it must be managed as either recyclable metal or hazardous waste. Lead foils should be collected in separate container and given back to the manufacturer or waste vendor for recycling. X-ray photo chemicals (developer, fixer, and cleaning solutions) also contain heavy metals. The used fixer should be collected separately in a labelled plastic container. Silver from

used fixer is a valuable source and should be recycled. Waste developer can be flushed into the drain because the hydroquinone is consumed during processing and becomes nonhazardous.

The sharps (needles, scalpel blades) are that category of waste that needs maximum precaution and care. The needles should be destroyed by needle destroyers or by using syringe melting and disposal system. The mutilated sharps should be placed in puncture proof sharp container containing 1% NaOCl for disinfection. Once the container is three-fourth filled, it should be given to waste handlers and sent for shredding, encapsulation, and disposal in landfills by common treatment facility. In sharps management 71.4% of respondents indicated knowing that incineration was the appropriate means of managing sharps as per the set guidelines but only 61% actually incinerated the sharps, 4.9% indicated disposing sharps in the general waste this difference could be due to cost and access to incineration facilities. In the current study, 76.2% of respondents indicated that according to set guidelines bloody wastes should be incinerated however only 56.1% of respondents actually incinerated the bloody waste while 24.4% disposed bloody waste into general waste This figure is much lower than compared to that in a study done in New Zealand where 56.4% of the dentists disposed off bloody swabs with general waste.¹⁰ This difference could be due to the fact that some of the practitioners interviewed in the current study were mainly from the urban centre and major hospitals in country, which has their own incinerators. However the disposal of bloody waste was still poor.⁷

Another hazardous waste is chemicals, disinfecting agents.⁹ Dental offices use a variety of chemicals for sterilization, disinfecting, and cleaning. Several of these products may contain active chemical ingredients (e.g., formaldehyde), that may be classified as hazardous. Local municipality should be consulted, before discharging chemicals into the sewer

system, if pH of chemical is less than 2 and higher than 12, if it contains higher concentration of formaldehyde or ignitable substances like (alcohols, ether, acetone, xylol, chloroform). It should be remembered that waste water eventually is reused as local drinking water.

Pharmaceutical waste that includes expired drugs should also be disposed off properly. Such waste is considered to be hazardous non-infectious waste. Either it should be returned to manufacturer or collected in a separate black bag and given to waste Collection Company, where they are either buried in deep landfills or incinerated.^{9,14}

Conclusion:

Most dentists are aware of the hazardous effect due to improper disposal of dental waste. Majority still practice improper waste disposal. There is need to retrain the practitioners on the importance and new technologies of proper waste disposal. Regular monitoring and training is required at all levels for management of hazardous dental wastes. Waste management program should be a part of academic curriculum and continuing dental education..

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