



## BEST MANAGEMENT PRACTICES FOR DENTAL WASTE ENTERING WASTEWATER STREAM : ASSESSMENT OF AWARENESS AMONGST DENTAL PROFESSIONALS.

### Dental Science

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### ABSTRACT

**Context:** A significant component of the dental waste generated from dental office enters waste water stream. This may adversely affect environment, human health, other life forms, even after a sophisticated treatment for decontamination. All dental professionals therefore, should follow "best management practices" in the handling and disposal of waste to reduce potential environmental effects

**Methodology:** Dental professionals with minimum of six months of work experience responded to a self-administered questionnaire regarding awareness of best management practices for dental waste water. Questionnaire was divided into different subcategories of waste entering water stream. A scoring pattern was instituted for ease of analysis.

**Results and conclusions:** It was found that the disposal of all categories of waste into the water stream was not very well known by the professionals. Knowledge in category of x-ray photochemicals and amalgam waste needed improvement. And, training had a significant impact on the scores of the individuals.

### KEYWORDS

Dental waste, Waste water, Biomedical waste.

### INTRODUCTION

A significant component of the dental waste generated in dental office enters the waste water stream. The waste water stream from dental offices and hospitals is gaining attention of the environmentalists owing to its potential contamination with several hazardous pollutants. A major concern however, is the release of mercury as dental amalgam waste component. Many other heavy metals such as lead, chromium, beryllium and nickel, etc. also contribute to the hazardous nature of the effluent from the dental office. Besides heavy metal waste, large amount of chemical waste in the form of X-ray photochemicals, cleaners, disinfectants and sterilants also fall in the category of hazardous waste that enter the waste water stream from any dental care setting. The Dental Waste Water (DWW) may also include the liquid waste generated from cleaning and washing of spills of disinfectants, mercury, radiographic fixers and developers, etc.

The DWW with significant hazardous pollutants may adversely affect environment, human health, other life forms, even after going through a sophisticated and complete treatment for decontamination. All dental professionals therefore, should follow the "best management practices" in the handling and disposal of waste to eliminate or reduce potential environmental effects.

Best management practices apply to a variety of hazardous wastes. They are designed to provide guidelines to practitioners to limit the occupational and environmental hazards of a particular substance [1]. Awareness at the level of source elimination/reduction for potentially hazardous wastes entering water stream, is required to reduce the quantitative and economic burden of waste water treatment. The present study was therefore, planned to assess this knowledge of the dental professionals and contribute in the future planning and policy making for dental waste water management.

### METHODOLOGY:

The present study was conducted in the city of Lucknow, Uttar Pradesh. A total of 350 Dental professionals were included from in and around Lucknow city. Dental professionals with a minimum of six months of work experience were included. Informed consent was taken from all individuals.

A self-administered questionnaire, composed of 74 items, based on awareness of best management practices for the waste entering the water stream from any dental care setup was prepared. Each question was closed ended with a Yes/No/Don't know response pattern. The questions were framed to assess basic knowledge of disposing different categories of waste generated into water stream. Questions were also framed to assess awareness of source reduction of hazardous waste entering the waste water stream. Other aspects explored in the questionnaire were: knowledge of recovery/recycling options from the segregated waste destined to enter water stream and knowledge of replacement alternatives for hazardous categories of waste that can

enter the effluent from any dental setup. Information related to previous training/education in the subject and demographics was also sought from the participants.

The questionnaire was prepared in English language. It was pretested and modified in a pilot study including 30 independent set of participants. It was sent to the participants by e-mail or in some cases as a hard copy.

On the basis of responses each participant was given a score. The questionnaire was divided into different subcategories of waste entering the water stream from any dental care setting. Both overall scores and individual scores for different categories of waste for all participants were calculated.

### RESULTS:

The overall response rate of participants was 60%. The responses of the participants were categorized into scores according to the percentage of correct answers given by them. The scoring pattern is represented in Table I.

**Table I: Showing Scoring criteria.**

SCORE	PERCENTAGE OF CORRECT RESPONSES
A	More than 80%
B	(60-80)%
C	(40-60)%
D	Less than 40%

The overall scores obtained by the participants of the study are presented in table II.

**Table II: Showing overall scores of participants**

SCORE OBTAINED	PERCENTAGE OF PARTICIPANTS
A	32%
B	46%
C	17%
D	05%

Scores were also given to all participants in different subcategories. The subcategories of questionnaire were:

1. Chemical waste: included x ray photo chemicals, formalin waste, sterilants and cleaners
2. Dental amalgam waste
3. Other Heavy metal waste
4. Pharmaceutical waste
5. Solid waste

The scores of participants in different categories are presented in Table III.

**Table III: Scores of participants in different subcategories**

Category of waste	Percentage of participants under different scores			
	SCORE A	SCORE B	SCORE C	SCORE D
1. Chemical waste	31	51	15	03
2. Dental amalgam waste	14	59	24	03
3. Other Heavy metal waste	12	64	21	03
4. Pharmaceutical waste	64	26	8	02
5. Solid waste	65	35	-	-

The scores of participants in different sub categories of chemical waste are presented in Table IV.

**Table IV: Scores of participants in different subcategories of chemical waste.**

Category of waste	Percentage of participants under different scores			
	SCORE A	SCORE B	SCORE C	SCORE D
X-ray photo chemicals	23	48	17	12
Formalin	20	68	10	02
Sterilants and cleaners etc.	28	57	12	03

The participants with history of previous training had higher overall scores. The difference in average scores between trained and non-trained groups were statistically significant ( $p < 0.05$ ) (Table V).

**Table V: Difference in scores between trained and non-trained groups**

OVERALL SCORE		P-value
Mean percentage of TRAINED INDIVIDUALS	Mean percentage of NON-TRAINED INDIVIDUALS	
74% correct answers	47% correct answers	$< 0.05^*$

\* = significant

**DISCUSSION:**

The methodology of the study incorporated a structured questionnaire with closed ended questions. ‘Questionnaires’ offer the advantage of collecting data from a large number of respondents relatively quickly and inexpensively. One associated disadvantage is the ‘recall bias’ [2]. In the present study, it was ensured that there were no questions which required remembering backwards in time, so that risk of ‘recall bias’ was minimized.

The ‘Don’t know’ category was included in response for every question except those related to previous training because the response categories limited to Yes/No may again produce a bias. [2].

The various sub-sections within the questionnaire employed in the present study, however, have remained a part of knowledge assessment studies earlier. This was mainly applicable for amalgam and other heavy metal waste. Studies by Chala et al [3], Al Shatrat SM et al [4], Sharma et al [5], Narang et al [6] and many others have previously assessed knowledge of dental professionals regarding disposal of amalgam waste, photographic waste, etc. but the solid components of waste have always been the focus.

Various categories and sub categories of components of waste entering water stream were addressed in the questionnaire. A significant number of questions were related to disposal of amalgam waste as, concerns over the persistence and effects of mercury in the environment, particularly in wastewater, have increased significantly over the past decade.

The potential safety of amalgam as a direct restorative material has also been questioned because of leakage of elements such as mercury, copper, tin, and silver [7]. Adegdembo et al [8] found that about 60% of the waste generated during the removal of amalgams escaped the primary and secondary solids collectors and was released into wastewater. Therefore, if not captured and removed at the dental office, mercury-containing amalgam enters the environment anyhow. Therefore, considering the potential concerns of dental amalgam waste, all the best management practices for its disposal were addressed in the questionnaire.

Apart from mercury, other amalgam constituents (e.g. Ag, Sn, Cu, and Zn) in dental clinics’ wastewater have not been much reported in the literature. The study by Shraim et al [9] evaluated the concentrations of mercury and other metals in the wastewater of some dental clinics. They found values much higher than the local permissible limits.

The questionnaire in the present study also incorporated questions relating to disposal of bulk blood and suctioned fluids, which may be disposed of into the sewer, but with care to avoid splashing.

In addition to dental amalgam, other sources of heavy metals in the dental clinic were given due weightage in the heavy metal waste category. The most common source of regulated heavy metals in the office is lead from lead foil and lead shields. Lead cannot be placed in the regular solid waste containers nor can it be disposed off down the drain. It needs to be managed as either recyclable metal or a hazardous waste. Other metal sources include nickel and chromium from stainless steel orthodontic wires and crowns, and beryllium and nickel from crowns. These materials also should not be discharged into the sanitary sewer system. Elemental nickel, chromium in stainless steel and other heavy metals should be recycled as scrap metal. Elemental metals other than lead or mercury can be disposed of as solid waste, as long as it is not fine powder

X-ray photochemicals also contain heavy metals. Developer solutions are typically not hazardous waste because of their low silver content. Waste developer should not be mixed with used fixer, which is likely to be hazardous. Unused developer typically cannot go down the drain because it contains 1 to 5% hydroquinone. Used fixer is a hazardous waste because of its high silver content (the regulatory level is 5 mg/l silver, used fixer typically contains 3,000 to 8,000 mg/l of silver) and cannot be severed or disposed of as common solid waste. Some cleaners for x-ray developer systems contain chromium (or ‘chromate’) and are hazardous waste when discarded. Considering the potential hazardous nature, a separate sub-category of questions related to x-ray photo-chemicals was included in the ‘Heavy metal’ category.

The dental professionals also need to be aware of the availability and usage of Spill kits. Washings from spills also cannot be disposed of via the storm water drainage system.

Dental practices use disinfectants or line cleaners to flush dental unit wastewater lines for minimizing odour, removal of solid waste particles and biofilms. Published reports have demonstrated that these preparations, especially those containing chlorine, release more mercury from amalgam than the deionized water control [10, 11]. These issues were hence, addressed and awareness of the dental professionals was assessed.

Disposal of formalin solutions and waste glutaraldehyde were given a significant weightage in the questionnaire as specific practises are needed for its proper disposal into water stream.

Besides, sewerage is also not a suitable disposal method for solid clinical and related wastes, pharmaceuticals including cytotoxics, or radioactive wastes. Hence, knowledge in these categories of waste was also explored.

The results of the study indicated that ‘B’ score was the most common score observed in all categories of waste under the present study including overall scores. Only for formalin and pharmaceutical category ‘A’ score was predominant. This indicates reasonably good knowledge of professionals in these categories. The possible reason might be the level of acquaintance with products under these categories as gained through personal and professional experience.

The range of Score D was between 0-3 percent in all categories except for x-ray photochemicals. Score D was observed in 12% individuals for this subcategory. It indicates the low level of awareness of possible complications and hazards of radiographic waste.

Score A was least frequently observed in heavy metal waste category including dental amalgam subcategory. This was a little surprising as potential hazards of dental amalgam are expected to be known widely, owing to its popularity as the restorative material of choice over decades.

The higher scores in all categories were found to correlate to the history of previous training on all or some categories. A reference to the 'don't know' response needs a special mention. The inclusion of this alternative for each item of questionnaire highlighted the 'lack of knowledge' aspect of the respondents [2]. This option was seen as a common response by those who had no history of previous training. It helped in avoiding false positive or false negative responses to an extent.

#### **CONCLUSION:**

An overall assessment of the study indicated that:

- The disposal of all categories of waste into the water stream was not very well known by the professionals.
- Knowledge in category of x-ray photochemicals and amalgam waste needed improvement.
- Training had a significant impact on the scores of the individuals.

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