

# Management of Dental Amalgam Waste Produced in Private and Public Dental Practices in Two Cities of Morocco: Rabat and Kenitra

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## Abstract

**Background:** Dental amalgam has been the subject of several studies mainly on the emission of mercury vapor during its handling. The World Health Organization considers that the inhalation of mercury vapor can have adverse effects on the digestive, nervous, immune, pulmonary and renal levels. The aim of this study was to evaluate current practices in the management of dental amalgam waste produced at the level of dental practices in the cities of Rabat and Kenitra in Morocco.

**Methods:** A questionnaire has been established to assess the situation of mercury waste management in dental practices and to make these physicians aware of the importance of this management. This study was conducted for a period of three months from April 15 through July 15, 2017.

**Results:** Of the 172 questionnaires submitted to the dentists, 50 completed and usable questionnaires were retrieved. The response rate was 29%. The survey revealed that 68% (17) stated that their dental chair was not equipped with an amalgam separator, the spittoon being connected directly to the sewers. The average amount of dental amalgam used per dental office and per month was 5.6±17.33g. Among the dentists interviewed, 96% had no idea of the Minamata convention. 54% (27) still use dental amalgam. Of these, 42% (21) still throw this waste into public garbage cans.

**Conclusion:** Dentists share the overall responsibility for the reduction and elimination of toxic waste that can harm human health and the environment.

**Keywords:** Law 28-00; Minamata convention; Mercury waste management; Sorting

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## INTRODUCTION

Dental amalgam is used in the treatment of carious lesions. It is a mixture of mercury (generally 50% of the weight of the powder / liquid mixture) and a set of powdered metals (silver: 35%, tin: 9%, copper: 6%, and trace amounts of zinc) (1). Dental amalgam has been the subject of several studies, mainly on the emission of mercury vapors during its manipulation, the release of mercury into the oral cavity and the toxic effects on health and the environment. Thus, the WHO considers elemental mercury to be toxic to the central and peripheral nervous systems. Inhalation of mercury vapors may have adverse effects on the digestive, nervous, immune, pulmonary and renal levels, and may even be fatal. Inorganic mercury salts are corrosive to the skin, eyes and gastrointestinal tract, and may be toxic to the kidneys when ingested (2).

In the Moroccan Law 28-00, on waste management and disposal, Article 3, Paragraph 6 defines hazardous waste as: “*all forms of waste which by their nature are dangerous, toxic, reactive, explosive, flammable, biological or bacterial and constitute a danger to the ecological balance as fixed by international standards in this field or contained in additional annexes*” (3).

**The objective of this study** was to evaluate current practices in the management of amalgam waste produced by dental offices in order to sensitize healthcare professionals to the sorting of mercury waste.

## METHODS

This is a descriptive and analytical cross-sectional survey, which took place between April 15 and July 15, 2017. Dentists included were registered in the National Council of dentists in Morocco, installed in the private sector, before

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April 2017, as well as dentists practicing in the public sector of the cities of Rabat and Kénitra. A questionnaire was developed to assess the situation of mercury waste management in dental offices and to raise dentists' awareness of the importance of this management.

The sample calculated for our study was random and representative. The size used was determined at 172 professionals. The data collected were analyzed by the XL STAT software in the trial period offered by the company. The Chi-squared test was used to test the independence between two random variables.

## RESULTS

Among the 172 questionnaires submitted to dentists, only 50 well completed and usable questionnaires well recovered. The response rate was 29%.

Among the respondents to our questionnaire, 72% (36) worked in the private sector and 28% (14) worked in the public sector. Practitioners had more than 15 years' experience in 50% of cases (25 practitioners) and 10% (5 practitioners) had less than 5 years' experience (Table 1).

Regarding the architecture of the dental cabinets, 92% (46) of the dental offices are well ventilated and 8% (4) are not (Table 1).

The management of medical and pharmaceutical waste in dental offices is provided in 48% by the dentists' assistants, in 26% by the dentists assisted by their assistants. In 26% of

the dental offices, this responsibility is attributed to the housekeeper or the secretary (Table 1).

Only 52% (26) of dental office waste managers have received training in medical and pharmaceutical waste management, and 48% (24) have not received any training (Table 2).

The average amount of dental amalgam used per dental office per month is  $5.6 \pm 17.33$ g with a minimum quantity of 0g and a maximum quantity of 100g per dental office per month.

Of the respondents, 16% (8) reported that their dental chair was equipped with an **amalgam separator**, while the remaining 84% (42) did not use it, so the cuspidor was connected directly to the sewer (Table 2).

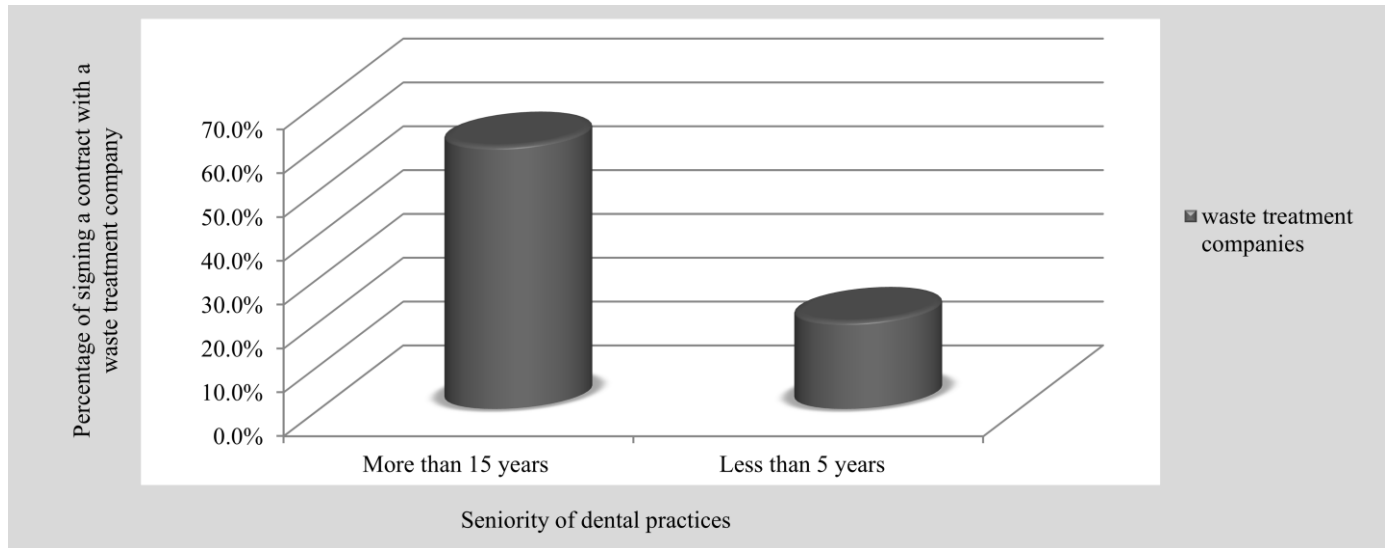
The Minamata Convention was known by 4% of the dentists who responded to our questionnaire, while 96% had

**Table 1. General characteristics of the studied sample, dental offices, Rabat-Kénitra, 2017**

| Characteristics                         | Dentists (n=50) |    |
|---|-----------------|----|
|   | No              | %  |
| <i>Sex</i>                              |                 |    |
| Male                                    | 25              | 50 |
| Female                                  | 25              | 50 |
| <i>Activity area</i>                    |                 |    |
| Private                                 | 36              | 72 |
| public                                  | 14              | 28 |
| <i>Experience years</i>                 |                 |    |
| More than 15                            | 25              | 50 |
| 10 - 15                                 | 10              | 20 |
| 5-10                                    | 10              | 20 |
| Less than 5                             | 5               | 10 |
| <i>Aeration of the dental office</i>    |                 |    |
| Yes                                     | 46              | 92 |
| No                                      | 4               | 8  |
| <i>Responsible for waste management</i> |                 |    |
| Dentists                                | 13              | 26 |
| Assistants                              | 24              | 48 |
| Secretaries                             | 5               | 10 |
| Housekeepers                            | 8               | 16 |

**Table 2. Knowledge and management methods of dental amalgam waste produced in dental practices, Rabat-Kénitra, 2017.**

| Characteristics   | Dentists (n=50) |    |
|---|-----------------|----|
|   | No              | %  |
| <i>Training in waste management</i>                     |                 |    |
| Yes   | 26              | 52 |
| No  | 24              | 48 |
| <i>Knowledge of the law 28-00</i>                       |                 |    |
| Having an idea  | 45              | 90 |
| Have no idea  | 5               | 10 |
| <i>Knowledge of the Minamata Convention</i>             |                 |    |
| Having an idea  | 2               | 4  |
| Have no idea  | 48              | 96 |
| <i>Reduced use of amalgam</i>                           |                 |    |
| Yes   | 48              | 96 |
| No  | 2               | 4  |
| <i>Equipment of armchairs by mercury separator</i>      |                 |    |
| Yes   | 8               | 16 |
| No  | 42              | 84 |
| <i>Disposal of amalgam waste</i>                        |                 |    |
| Do not use or handle amalgam                            | 23              | 46 |
| Public garbage  | 21              | 42 |
| Waste treatment company                                 | 5               | 10 |
| Other   | 1               | 2  |
| <i>Control of the Ministry of Health</i>                |                 |    |
| Yes   | 2               | 4  |
| No  | 48              | 96 |
| <i>Problems encountered when managing amalgam waste</i> |                 |    |
| Lack of waste management companies                      | 19              | 38 |
| No problem  | 19              | 38 |
| Additional expense                                      | 10              | 20 |
| Other   | 2               | 4  |



**Figure 1. Contract a waste treatment company according to the seniority of the dental practices, Rabat-Kenitra, 2017. There is a statistically significant difference between the seniority of dental practices, especially those older than 15 years, and the signing of a contract with a waste treatment company ( $p < 0.05$ ).**

having begun to reduce the purchase and use of mercury-based dental amalgam, compared with 4% (2) who continue to use amalgam without reduction (Table 2).

The survey found that 46% (23) of respondents no longer use dental amalgam to restore teeth, and they do not extract old dental amalgam, while 54% (27) still use dental amalgam. Of these, 42% (21) eliminate the waste from this restorative material in public garbage, 10% (5) report contracting with medical and pharmaceutical waste recovery companies, and 2% (1) used other means to get rid of the amalgam waste (Table 2).

Among the dentists questioned, 90% (45) had no idea about the Law 28-00 on waste management and disposal and 10% (5) knew about it. Furthermore, 96% (48) of the participants said that they had never been subject to the Ministry of Health control (Table 2).

We found that there is a very significant correlation between seniority of dental offices and the establishment of a contract with a waste treatment company ( $p = 0.008$ ) (Figure 1).

## DISCUSSION

Dental amalgam is a mixture of metals in powder and mercury. Thus, the waste produced during the sculpture of this material constitutes a non-negligible source of toxicity to the environment and, indirectly, constitutes a danger to public health. Therefore, the amalgam must be handled in good conditions and its waste must be properly disposed of.

During the placement and removal of dental amalgam restorations, a variety of waste products is generated:

- The elemental mercury vapor released by a dental amalgam alloy;
- Amalgam particles that have not been brought into contact with the patient;
- The particles that have come into contact with the patient's secretions;

- Amalgam sludge: fine particles present in the dental office waste water usually trapped in separators and vacuum filters.

Responsibility for medical and pharmaceutical waste management in dental offices studied is assumed by the housekeepers and the secretaries in 38%, which makes the situation worrying. Indeed, the management of amalgam waste containing mercury requires specialized training. However, only 52% of waste managers in dental offices have received training in waste management. These results remain very close to those of the United Arab Emirates where only 48.9% of waste managers have received specific training (4). This lack of training in medical and pharmaceutical waste management can have a negative impact on different stages of the waste management process.

The good practice of manipulating the amalgam begins by aeration of the cabinet.

Amalgam particles from excessive pulping produced during the carving and polishing of new amalgam restorations or the removal of old restorations should be collected in amalgam separators. Nevertheless, the use of this device does not seem to be widespread in the cities of Rabat and Kénitra because only 32% of the participants in our survey are equipped with an amalgam separator. This figure is much lower than in France where 98% of practitioners have this type of device in their practices according to the French Dental Association (ADF) in 2014 (5). This difference in attitude is explained by the application in France of the Order of 30 March 1998 which laying down the conditions under which amalgam waste must be disposed of (6).

A Canadian team confirmed in Ontario study that the use of amalgam separators by all dentists could reduce the amount of mercury entering wastewater to approximately 2.46 mg mercury per dentist per day instead of 170.72 mg of mercury per dentist per day without separator (7).

We noted that 42% of the dentists who responded to our survey threw the dental amalgam waste into the public garbage cans. This figure is higher than in India where 39% of the dentists dispose of dental amalgam waste in public waste (8). This difference in results makes the situation alarming in view of the large amount of toxic waste produced by dental offices, which is mixed with household waste, a situation that poses a great risk to humans and the environment.

The main cause of this situation is the legal vacuum and the lack of awareness of Law 28-00 on waste management and disposal. Our survey shows that only 10% of the dentists who responded to our questionnaire declare they are aware of this law. Toxicology regulation could be considered as a determinant of health, as policies introduced by regulatory toxicology agencies influence health services and are effective at the community level. These policies could be distributed differently among the subgroups of the populations in a systematic manner, which may be a source of inequality (9).

However, strengthening the control of the Ministry of Health would make it possible to verify the application of good medical and pharmaceutical waste management practices by dentists. And in order to activate an adequate toxicovigilance system, the Moroccan Ministry of Health has developed the poison control center called Poison Control and Pharmacovigilance Center of Morocco, which has a role in improving poisoning management and risk assessment through a set of indicators selected by the center (10).

On the other hand, 54% of the dentists who participated in our survey used dental amalgam to restore decayed teeth; these results are closer to those observed in Switzerland where 51.5% of the fillings repairs are performed with dental amalgam (11). Indeed, the increasing demand for cosmetic teeth by patients and their refusal to have amalgam fillings (sometimes even dentists use composites instead of amalgams), and the growing awareness of toxicity of amalgam are in favor of a change in practices.

Only 4% of the dentists who responded to our questionnaire reported awareness of the Minamata Convention, while 96% had no idea.

This Convention remains an adequate legal framework to protect human health and the environment at the global level from the toxic effects of mercury. Thus, the remarkable advances of this convention are considering the life cycle of mercury (from the mine to the storage), the progressive prohibition of the mining extraction and the prohibition of products and processes using mercury by 2020 (12). Although the use of dental amalgam is widespread, concerns have been raised about the human health and environmental damage caused by emissions and improper waste management. The Minamata Convention requires a voluntary elimination of the use of dental amalgam and a commitment to other measures (13).

There is a statistically significant difference between the seniority of dental practices, especially those older than 15 years, and the signing of a contract with a waste treatment company ( $p < 0.05$ ). This is because former dentists have more financial means to establish this type of contract compared to those with less than five years' experience.

## LIMITATIONS

The study has several limitations:

- Lack of time for most dentists, which prevents them from completing the questionnaire, which led us to raise their awareness and sometimes wait several hours to meet the doctor and explain the nature of the investigation and take the answers on the questionnaire,
- Failure to answer the questionnaires was one of the attitudes adopted by many dentists.

However, many practitioners have pointed out the importance of this study and they have indicated their encouragement at the end of the questionnaire.

## CONCLUSION

Dentists share global responsibility for the reduction and elimination of mercury waste that can harm human health and the environment. Dentistry faculties should integrate an awareness program into the initial curriculum and the Council of the College of Dentists would play an important role in the training of established dentists. It is time for the responsible authorities to mobilize for the implementation of the Law 28-00 on waste management and disposal.

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