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## Original Research Article

## Mercury poisoning within the dental clinic Myth or reality in Côte d'Ivoire

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## ABSTRACT

**Background :** The amalgam, a material that has been used for more than 150 years for posterior teeth restoration, has been controversial because of the poisoning risk related to its mercury-content. Its manipulation exposes the practitioner and his staff members to chronic mercury poisoning, which causes some pathologies. It is, therefore, less often used or even abandoned in developed countries. However, in Côte d'Ivoire, it remains the material of choice for posterior restorations for its mechanical properties and relatively low cost.

**Aim:** This study aimed to analyze mercury vapor levels measurement within dental clinics.

**Materials and Methods:** The study involved forty-six dental clinics in the district of Abidjan using exclusively or not the amalgam. A spectrophotometer, Lumex, was used to measure mercury vapor at two levels (garbage cans and ambient air) at the opening of dental offices' doors. Ten measurements equally spaced by ten seconds were done for each level. The data were analyzed using the SPSS and the Student test as a statistical test.

**Results:** Very high levels of mercury vapors have been recorded in 3/4 of dental clinics using exclusively or not the amalgam compared to the WHO threshold value (999ng/m<sup>3</sup>), whatever the measured level.

**Conclusion:** Mercury poisoning remains a reality within dental clinics in Abidjan.

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## 1. Introduction

Dental amalgam is the oldest direct posterior restorative material used in dentistry.<sup>1</sup> In the sub-Saharan region, the still high prevalence of the carious disease, the cost of the material along along the low refund rate for restorations, always justifies its indication. And yet, current therapeutic concepts focusing on dental tissue-preserving led to its abandoning or even its ban from Scandinavian countries, several years ago.<sup>2,3</sup>

Besides, once used to be acclaimed for its mechanical properties, amalgam is the subject of various controversial issues, particularly because of its toxicity related to its mercury-content.<sup>4-6</sup> It has been shown, nowadays, that mercury-content blood rates are particularly high in persons

handling mercury-content devices.<sup>7,8</sup> Among them are dental surgeons and their staff who are exposed to poisoning risk due to their circumscribed activity in an enclosed space which is the dental clinic. This toxicity is initiated primarily by contact (touching materials, deposition of the material on integuments) or by inhalation.<sup>9</sup> According to the United States Environmental Protection Agency (US-EPA) and the World Health Organization (WHO), the lowest standard amount of mercury vapor tolerated in an enclosed environment is 999 ng/m<sup>3</sup>.<sup>10</sup> Beyond that, the immune, brain and neurological systems can be affected.<sup>9,11,12</sup>

In Côte d'Ivoire, the amalgam use reduction remains linked to the patient financial possibilities or his/her aesthetic demand.<sup>13</sup> There's no data on usage conditions of dental amalgam and the medical staff risk exposure to mercury is unknown. This study aimed to measure mercury vapor levels within dental clinics based on the WHO

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threshold value.

**2. Materials and Methods**

It is a three-month (from February 2017 to April 2017) descriptive, prospective study. One hundred letters were sent to heads of public and private dental clinics, randomly chosen in each municipality of the District of Abidjan. Only clinics of those who responded favorably were selected for the study and were subject to monitoring. They were divided according to their exclusive use or not of amalgam. A spectrophotometer (Lumex® A 915, St. Petersburg, Russia) was used to measure mercury vapors. After calibrating the device to atmospheric conditions, a single operator took measurements at two levels at the opening of dental offices: garbage cans, amalgam residues receptacles, (0.5m from the floor) and just above the dental chair (1.5m from the floor), considered as ambient air. In each level, ten measurements equally spaced by ten seconds were recorded and the average was calculated. The data were analyzed using the SPSS and the Student test was used as a statistical test.

**3. Results**

Measurements were taken from forty-six clinics in the district of Abidjan.

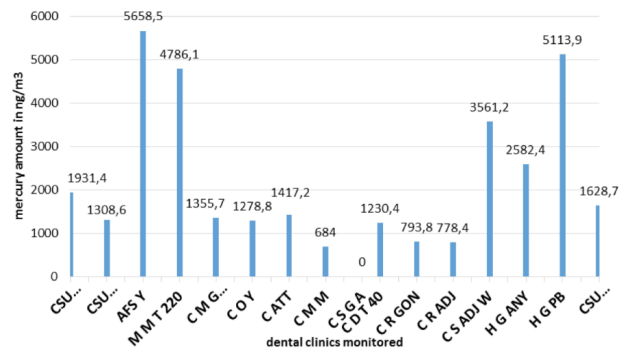
Significant and persistent mercury vapor levels were measured at both sites (garbage cans and ambient air) except for one practice (Figures 2, 3, 4 and 5).



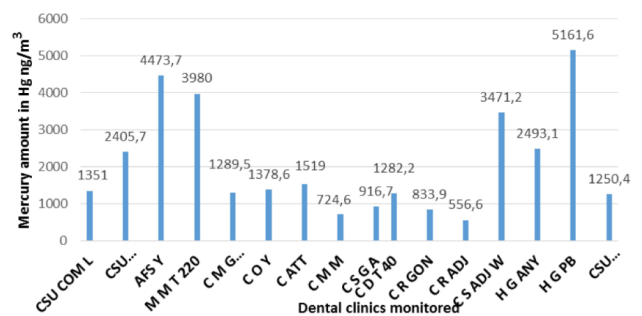
**Fig. 1:** LUMEX front and side view (LUMEX® RA-915 +#747 manufactured in St. Petersburg - Russia)

**4. Discussion**

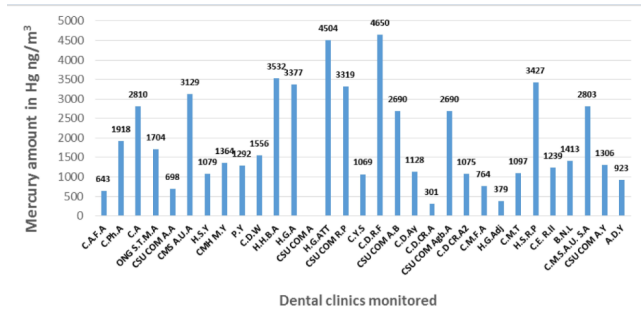
Previous works have proven the accuracy of the Lumex® spectrophotometer for measuring emissions of a physical element.<sup>14,15</sup> It is an atomic absorption multifunctional portable device. The one that was used for our study is the property of the "zero mercury working group" NGO. The device's sensitivity and selectivity properties make it possible to measure the mercury vapor in the ambient air. A



**Fig. 2:** Garbage cans measurements from dental clinics using exclusively amalgam



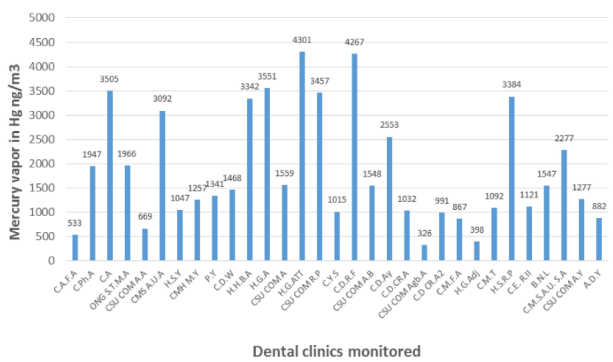
**Fig. 3:** Ambient air measurements from dental clinics using amalgam only.



**Fig. 4:** Garbage cans measurements from dental clinics using both amalgam and alternative materials.

single trained operator conducted the monitoring. The forty-six clinics surveyed are those whose official practitioners have agreed to participate in the study.

Amalgam, although it was stigmatizing because of the mercury toxicity, is still widely used in some clinics setting; a reason why this study was carried out to urge practitioners to be precautionary regarding risks involved in handling this material. Other studies have identified these monitoring sites (garbage cans and ambient air) as mercury vapor concentration areas.<sup>11,16,17</sup>



**Fig. 5:** Ambient air measurements from dental clinics using both amalgam and alternative materials.

The operator's prior training to handle the spectrophotometer has minimized the biases and contributed to the objectivity of the data collected.

The results showed high levels of mercury vapor compared to the threshold value (999 ng/m<sup>3</sup>) at the opening of practices. Using exclusively the amalgam or alternating with other materials involves permanent emissions of mercury vapor within dental clinics. These high vapor values are due to several reasons:

The lack of proper ventilation in clinics: in Côte d'Ivoire, these rooms are equipped with air conditioning or fan because of climatic conditions characterized by high ambient temperatures. This requires closed enclosures during patient care. Lack of proper air vent or ventilation at the opening and closing of the clinic would potentiate the storage of mercury vapor as mentioned in several studies.<sup>7,8,16,18</sup> A "background pollution" was noted according to the clinic's crannies and peaks of pollution in the air during the filling, removal and polishing of the dental amalgam.<sup>11</sup> This background pollution leads to direct poisoning of the medical staff every day. Previous work has shown that these "concentration or storage" sites for mercury vapor are most likely located in garbage cans, around the amalgamator, in the spittoon of the chair and just above the armchair by both the patient and the practitioner.<sup>11,16</sup> Our study also confirms it. The zero value was found in the garbage can of one of these clinics because it was brand new and had not yet been in contact with amalgam waste.

The form of amalgam used: two clinics out of the forty-six have used the bulk form (powder and liquid to mix) and the other forty-four clinics pre-dosed capsules. The bulk form is very polluting because it requires powder/liquid handling.<sup>1</sup> In this form of amalgam, the dose allows an excess of mercury to persist after crushing. Spinning is necessary to remove the excess fluid for better use of the material in the mouth.<sup>1</sup> Indeed, the amalgam must be well-trodden to restore the anatomical shape of the tooth but also to allow the smoothing of the reconstituted walls and avoid

the rapid formation of biofilm concerning restoration.

Pre-dosed capsules produce less and less pollution. But it is their management after the removal of the crushed amalgam that is problematic. Stored either in a leaking container or an open waste garbage can, mercury vapors are always released during the practitioner's activity.<sup>1,4</sup> Through this study, it was noted material residues and empty capsules in garbage cans sometimes opened and not emptied since the previous day.

Small areas of some clinics would favor this concentration of mercury vapor with excessive use of amalgam without proper ventilation of the room.

The use of carbon filter masks is recommended when handling amalgam to avoid inhalation of mercury vapor.<sup>1,9,11</sup> However, practitioners have indicated not having these masks. Thus, practitioners, their staff members and patients inhale mercury vapors during handling of the material and would then be exposed to various pathologies related to chronic mercury poisoning.<sup>14,16,17,19,20</sup>

Besides, this mercury vapor pollution can extend beyond the dental clinic with risks of pollution of the environment.<sup>12</sup> Indeed, in Côte d'Ivoire, due to the lack of amalgam separator in clinics and garbage sorting, contents of garbage cans are dumped in domestic garbage and then in the public dump of Abidjan, close to residences. When this discharge is full, the waste is incinerated which exposes surrounding populations to the risk of inhalation and poisoning.

## 5. Conclusion

Mercury poisoning in the dental clinic is a reality because its values are significantly higher than the daily standard recommended by the WHO. The use of amalgam in dental clinics, whether exclusively or not, directly exposes the dentist, his medical staff and patients to the risk of mercury chronic poisoning. If its use is still essential in our job, ADA and WHO's recommendations must be applied rigorously.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

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