Global use of dental amalgam: the African perspective

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Introduction

In 1997, a consultative meeting reviewed and updated the 1995 WHO/FDI Consensus Statement on Dental Amalgam. The meeting made some useful recommendations on the use of the restorative materials[1]. The key issues highlighted on the presentation for Sub-Saharan Africa included:

i. Dental Amalgam is most extensively used for the repair of decayed posterior teeth.
ii. Neither the WHO/AFRO nor member states in the African Region had policies in place in respect to the use of dental amalgam.
iii. It questioned if there was any proposed action on policy development on the use of dental amalgam by WHO/AFRO.
iv. It recommended Research Studies into the local development of restorative methods and inexpensive biomaterials.
v. It also recommended Research projects on the assessment of the risks and benefits of using dental amalgam.

Ten years after the adoption of the resolutions, there have been changes in policies on the use of dental amalgam and other restorative materials globally, with more definite policies adopted by some countries in Europe and in other sections of the globe.
The situation report on these issues in Sub-Saharan Africa and particularly in Nigeria follows.

Situation report for Sub-Saharan Africa and Nigeria:

1. Dental Amalgam is most extensively used for the repair of decayed posterior
teeth.
In order to answer this question for Nigeria, a questionnaire survey was conducted among general dental practitioners in Nigeria. Contact details (e- mail addresses) obtained from an oral health care personnel directory was used to send the questionnaires, with a response rate of less than 5% in about 9 months. A better response was obtained by direct distribution of the questionnaires at the location of clinics and during seminars and workshops involving dental surgeons.
A total of 94 responses from dental surgeons in private, government and mission clinics located in 14 of the 37 states in Nigeria were obtained. Results of the information obtained relating to the use of amalgam and other restorative materials are shown in **(Figure 1 and 2).**
The findings are also supported by the sales record (obtained with the kind permission) of one of the major dental materials outlet in Nigeria **(Fig. 3).**
A comparison of the sales of different restorative materials in one major outlet in Nigeria shows a relatively higher amount of amalgam purchased in the last 3 years. Although there were no figures for sales in the years preceding 1997, it is noteworthy that the volume of resins-based restorative materials purchased in the last 3 years exceeded that of amalgam.

2. Neither the WHO/AFRO nor member states in the African Region has policies in place in respect to the use of dental amalgam.
In 1998, the WHO/AFRO developed a Regional Strategy for Oral Health in the African Region for the period between 1999 and 2008. The report did not propose any policy on the use of amalgam[2].
The National Oral Health Strategy for Nigeria does not include the development of a policy on the use of dental amalgam for the country[3].

3. Any proposed action on policy development on the use of dental amalgam by WHO/AFRO or the member countries?
A review of the WHO/AFRO Regional Oral Health Strategy did not indicate any clear proposal for an action on the development of a policy on the use of dental amalgam[2].
In Nigeria, there is no proposal for an action on the development of a policy on the use of dental amalgam[3].

4. Local development of restorative methods and inexpensive biomaterials.
The WHO/AFRO, through the Intercountry Centre for Oral Health (ICOH) for Africa, Jos, Nigeria has been conducting training/demonstration programmes, and sponsoring research studies in various areas of oral health, since its inception in 1988. In 2005, the centre was restructured following the signing of a new Memorandum of Understanding (MOU) and was renamed the Regional Centre for Oral Health Research and Training Initiatives (RCORTI) for Africa, in collaboration with the WHO/AFRO, with its research theme more emphasized.

Following this development, a Department of Dental Materials Research was created and new researchers employed to complement the workforce at the Centre.
The RCORTI's permanent site, which would incorporate a Research Complex, is presently under construction. The Centre would welcome collaboration with dental materials Research Units of Dental Schools, with the aim of realizing the objective of thelocal development of dental materials in the sub-region. (www.rcortiafro.org.).
In 1990, the Nigerian Government established the Raw Materials Research and Development Council with a mandate to "stimulate industrial growth through development, utilization of locally sourced raw materials and building technological capacity for processing same". As part of its modus operandi, it supports major R&D activities in research institutes, universities, polytechnics, private and public Research and Development (R&D)

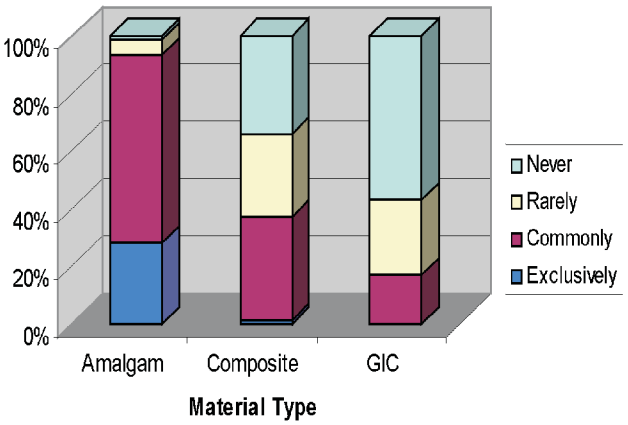

Figure 1: Use of Restorative materials for class I restorations

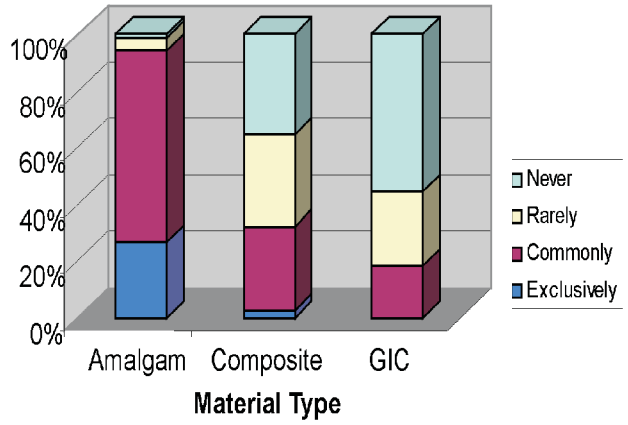

Figure 2: Use of Restorative materials for Class II Restorations

outfits. Its R&D themes, among many others, include Chemical and Pharmaceuticals; Base Metals, Iron and Steel; New and Advanced Materials which cover relevant areas of dental materials research. No dental school in Nigeria today has a dental materials research unit to complement the services of the RMRDC. (www.rmdc.org.ng).

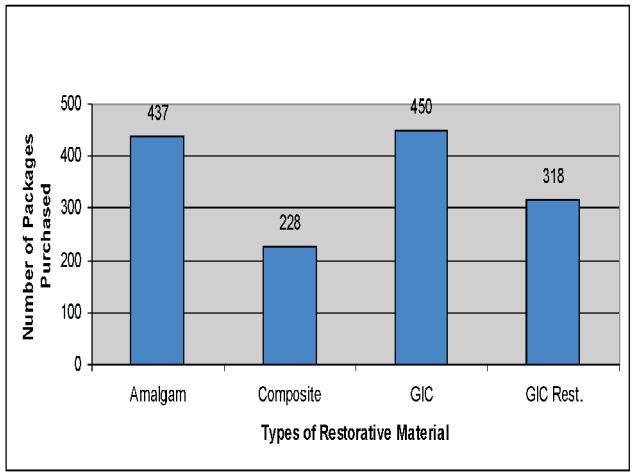

Figure 3: Volume of sales of different Restorative Material (2006-2008)

In view of the presence of such establishments in Nigeria, a search through the internet (PubMed, African Journals OnLine (AJOL), Journal of Raw Materials Research) showed that quite an extensive work has been carried out by researchers in other fields of science like engineering, biotechnology, with no research publications from researchers in our dental schools and oral health research institutions to date.

The reported research findings could serve as a baseline for further researches into the local development of restorative methods and materials by oral health professionals [4-14].

There is an urgent need for a re-awakening of interest in research among oral health professionals in our dental schools and oral health research institutes, with a greater level of collaboration between them and researchers in other fields of science in tertiary institutions and research institutes.

5. Recommendation for research projects on the assessment of the risks and benefits of using dental amalgam.

A search through indexed journals in the PubMed and the AJOL showed dearth of research publications from research projects on the assessment of the risks and benefits of the use of amalgam in the sub-region in the last 10 years.

The only reported publication highlighted the side-effects of amalgam and identified the absence of the means of treating amalgam waste as the basis for dentists to be involved in the fight against amalgam contamination [15].

The Amalgam Controversy: key issues to consider in Sub-Saharan Africa

There has been an increasing criticism for the continued use of amalgam in dentistry.

To address these concerns, "dental professionals should understand the impact of the various levels and types of mercury on the environment and human health" [16].

1. Mercury Toxicity and its Control

Although studies over the years have highlighted various routes of mercury contamination globally, there is no reported, quantifiable estimation of mercury emissions in the sub-region. However, different research publications have identified various routes of mercury contamination which could be readily related to the sub-region.

These include:

I. Allergic Skin reaction
ii. Discolouration of Jewelries
iii. Amalgam Snow
iv. Gingival Inflammation
v. Lichenoid reactions in the Oral Mucosa
vi. Tooth Discolouration
vii Gingival Discolouration (Tattooing).

- Industrial Emissions, from electric power plants, coal combustion and solid waste incineration [16-19];
- Gold Mining Activities [20];
- Natural Emissions from volcanoes [21]

- Herbal Remedies. All the samples of herbal remedies analyzed in a study in Nigeria showed elevated levels of heavy metals, including mercury [22]
- Dental Amalgam Use

Dental Amalgam Use

Neme et al[23] highlighted the following as factors which influence the release of mercury vapour from amalgam:- alloy morphology (admixed vs spherical), restorative design, and operator technique [23].

Reactions to dental amalgam observed by dentists (n=71) in the course of tooth restorations in Nigeria include:

I. Allergic Skin reaction
ii. Discolouration of Jewelries
iii. Amalgam Snow
iv. Gingival Inflammation
v. Lichenoid reactions in the Oral Mucosa
vi. Tooth Discolouration
vii. Gingival Discolouration (Tattooing)

Control of Industrial Emissions of Mercury

1. Coal Combustion
   - solvent adsorption
   - electrostatic precipitation
   - wet-flue gas desulphurization
   - activated carbon injection [18 24]
2. Solid Waste Incineration
   - injection of sodium tetrasulphate dissolved in NaOH solution [19]
3. Gold Mining
   - home-made retorts [20]
4. Electrochemical Technique
   - electro-oxidation [25]
5. Phytoextraction ([26,27]

Phytoextraction is the volatilization and extraction of mercury by Brassica juncea (Indian mustard) plants growing in mining pits. It has been shown to have relatively low risk on the population around the Tui mining sites in New Zealand. It is enhanced by the innoculation of plant growth promoting rhizobacteria.

Researches on rhizobacteria and acinetobacter spp (used for bioremediation of heavy metal contaminated soil) have been conducted in different African countries on their possible roles in hazardous waste treatment and in bioremediation of mercury-contaminated soil [5,8]

Control of mercury toxicity in the dental clinic could be at the operator, material, cavity design and the clinic levels. Reported recommendations for the control in the clinic include:

i. Maintenance of a proper mercury hygiene regimen
ii. Mandatory use of amalgam separators. Reported efficiency of = 96. 1% - 97% for amalgam particles >1.2μ [28, 29];
iii. Improved design of the discharge system;
iv. Sensible use of high pressure water cleaning;
v. Regular maintenance, including replacement of amalgam separators and filters at certain intervals;
vi. Outright ban of mercury use in dentistry
vii. Prevention of dental caries by fluoridation

2. Fluoridation for the prevention of dental caries.

Can we adopt the Norwegian Model described by Mjor & Eriksen[30]? What is the level of availability of a central pipe-

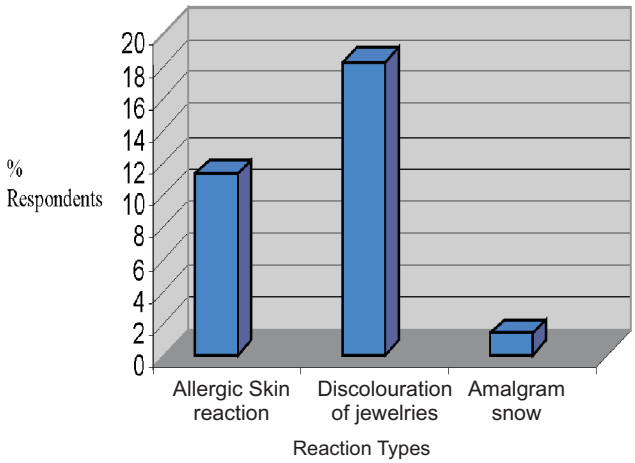

Figure 4: Observed reactions to mercury in dentists in Nigeria

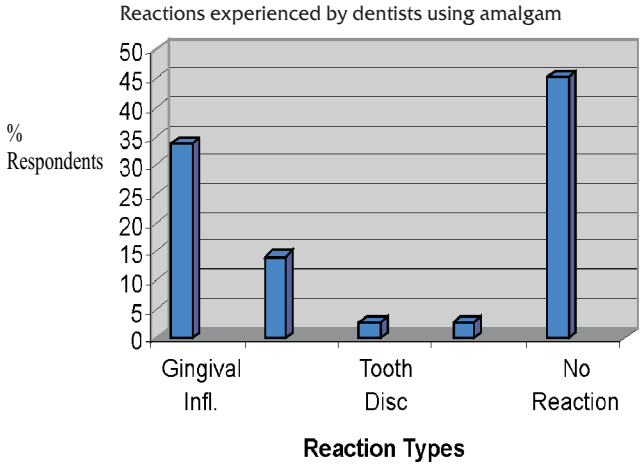

Figure 5. Observed reactions to mercury by dental patients in Nigeria

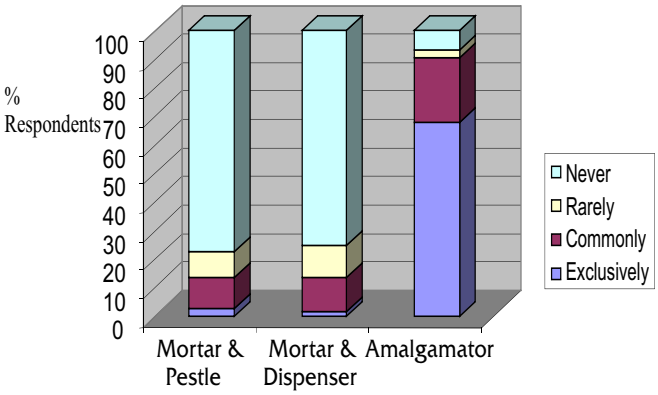

Figure 6. Levels of use of different amalgam mixing methods in dental practices in Nigeria

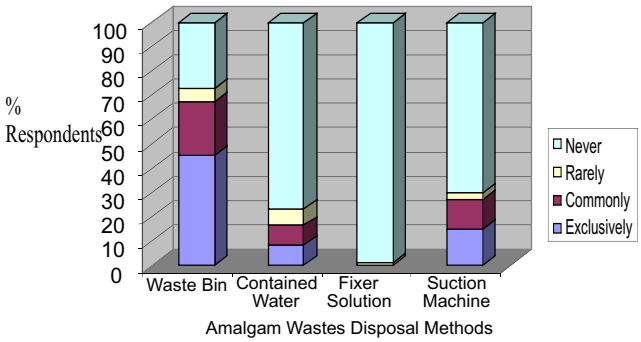

Figure 7. Levels of use of different amalgam waste disposal methods in dental practices in Nigeria

borne water supply in the countries in the sub-region? What would be the effect of the relatively high levels of fluoride in drinking water and dental fluorosis reported in some sections of the sub-region?

Akpata et al[31], in a study on fluoride, dental fluorosis and caries experience in Nigeria, reported the following :

i. Fluoride concentration was less than 0.6 ppm in most parts of Nigeria, and particularly low in the southern parts of the country with most states being less than 0.3 ppm".
ii. Where systemic fluoridation is indicated, other vehicles of fluoridation may have to be considered in view of the supply of pipe-borne drinking water to only a small segment of the population;
iii. A higher cariogenic challenge among the younger age group. They suggested that caries preventive and therapeutic services should be focused on this segment f the society.
iv. Fluoride concentration was quite high (>1.5ppm) in some parts of Nigeria, especially the North Central Zone. The provision of pipe-borne drinking water and the defluoridation of the drinking water at the water-works, were recommended.

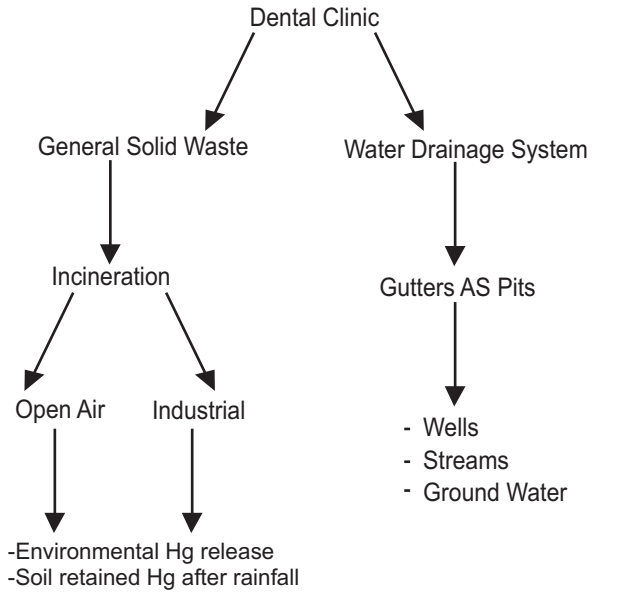

Figure 8: Pathway of Disposal

Local development of defluoridators for household and community use should be encouraged along the lines of reported models in Thailand, Tanzania, in regions with high levels of fluoride in the drinking water[32].

3. Health Policies of member countries and its disposition towards prevention and treatment of dental caries.

Mjor & Eriksen identified the following factors required for the success of a caries and restoration prevention programme: (i) fluoride; (ii) increased level of (dental) education; (iii) access to dental care, and (iv) enhanced living condition[30].

The possibility of attaining (ii) and (iii) depends largely on the health policy of the individual countries in the sub-region.

The National Health Insurance Scheme (NHIS) in Nigeria, which started in 2002, is presently limited to workers in the Federal (and some State) Civil Service and a few private establishments. Under the present scheme, dental services are exclusively fee-for service and restricted to "simple extractions and amalgam fillings" for a family of six, including four biological children under the age of 18 years[33].

A look into the situation in just one of the accredited NHIS dental service providers in
Northern Nigeria (all 36 patients seen under the NHIS in 8 months) showed that the situation could only get worse unless there is a major review of the current guidelines of the NHIS (Excerpts from a memorandum submitted to the NHIS Guidelines Review Committee 2008).

The recommended review of the guidelines to include resin-based tooth restorations and root canal treatments would give this scenario. The effect of a caries prevention programme, if adopted, would be phenomenal.

The availability of such a universal health insurance scheme, though not yet the ideal for oral health services, is a sound foundation for the implementation of a caries-prevention programme that would provide a long-term control of dental caries and a considerable reduction in the amount of amalgam waste generated in the dental clinics.

In order to achieve this, there is a need for dissemination of information on the development of dental public health in the Nigerian National Health Insurance Scheme or any such universal health systems in the other countries of the sub-region. This should deliberate on such themes as:

- Experience of dental personnel who have worked with such a universal health insurance system;
- Health promotion concepts;
- Oral health diseases prevention in communities, appropriate systems of universal health insurance, basic minimum package and clinical practice guidelines in dental service.

This would serve as a forum for obtaining good information towards developing the main methods of providing good preventive and therapeutic oral health services under the health insurance systems in the different countries in the sub-region. In Nigeria, the Chief Dental Surgeon of the Federation and the Nigerian Dental Association are encouraged to act quickly and decisively in view of the on-

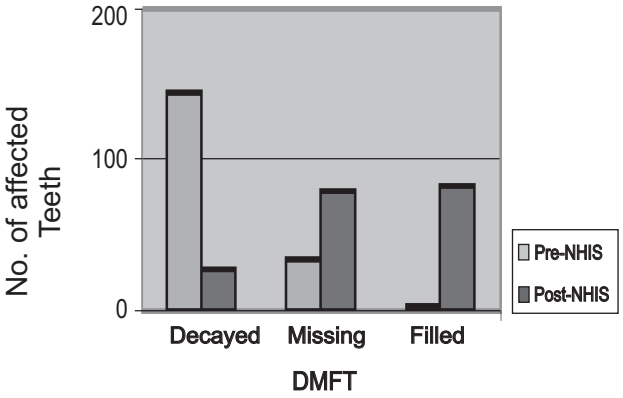

Figure 9. Caries Experience with present NHIS Treatment Protocol (n=36)

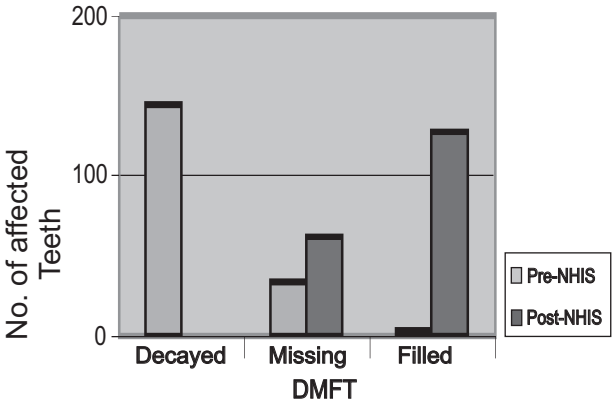

Figure 10. Projected Caries Experience with the Recommended NHIS Treatment Protocol

going review of the current guidelines of the National Health Insurance Scheme, which is aimed at the improvement of its services.

4. Technique sensitivity of other material options for treating dental caries and its anticipated effects.

Poor saliva control, among other reported factors, is a major cause of failure of resin-based restorations. A total of 73 dentists responded to the question on the type of saliva control measure used in their practice for restorative procedures.

Fifteen (16%) respondents used only one control measure, 14(14.9%) isolated restoration site using cotton rolls along with the direct use of spitton-bowl. Only one practitioner (1.1%) used the rubber dam along with a high volume suction.

The expected result would be a high failure rate of resin-based restorations.

Our role as dental practitioners in the African Sub-Region

Four main suggestions are presented:

1. Ensure the incorporation of the prevention of dental caries as a key strategy in the oral health policy of the governments in the sub-region.
2. Ensure the control of mercury toxicity in the clinic by the maintenance of a proper mercury hygiene regimen.
3. Use of alternative, less toxic restorative materials in the treatment of established cases of dental caries.
4. Support our governments in the development of policies on the control of mercury emissions and specifically, the control of mercury toxicity in dental clinics by encouraging the enactment of laws to regulate/address broad public safety concerns, especially in our situation, where there is no known existing law curtailing mercury toxicity.

If enacted, interpreted and implemented, these would have their ultimate impact on oral health and dental practice in Sub-Saharan Africa.

Summary

Amalgam use in Africa is gradually declining, with an increasing use of tooth-coloured restorative resins. The main threat to the continued use of amalgam in the sub-region remains the poor management of amalgam wastes in dental practices, absence of restrictive criteria in restoration placement.

* Poor saliva control remains a threat to the use of alternative resin-based restorative materials.
* Caries and restoration prevention is feasible in Nigeria and the sub-region. The adoption of universal health care systems by more countries in the sub-region is a sound foundation on which other supporting factors should be built.
* The patient must remain the centre of our health care system. Dental practitioners in the sub-region should develop a taste for excellence in service provision.

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