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**DARU Journal of Pharmaceutical Sciences**

e-ISSN 2008-2231

DARU J Pharm Sci  
DOI 10.1007/s40199-018-0212-6



DARU Journal of  
Pharmaceutical  
Sciences



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# Replacing dental amalgam by mercury-free restorative materials; it's time to take action

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Received: 26 July 2018 / Accepted: 10 August 2018  
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## Dear editor-in-chief

In the recent years, the risk benefit of the use of amalgam in dentistry has been criticized. In 2014, in an article written by Maqbool et al. [1], the dental amalgam was introduced as a threat to society and the authors called policy makers in the health and environmental sectors to pay attention to the extent of the risk. They asked to re-evaluate and revise official permission to use of amalgam in dentistry. At the moment in 2018, we see that some countries are phasing down the use of amalgam.

This filling material is being used in dentistry for more than 150 years due to its ease of application, durability and low cost [2]. The toxicity of dental amalgam for patients has been a matter of controversy. In a review by Rathore et al., in 2012 it has been shown that amalgam restorations slightly raise the exposure of patients to the mercury but has no practical or clinical significance [2]. The World Health Organization (WHO) stated that even the small amounts of mercury might be capable of causing severe health and environmental problems, and it is a threat to the development of the child in utero and early in life [3]. Therefore, it seems reasonable to restrict the use of amalgam at least for the sensitive group like pregnant/breastfeeding women and children. The main concern in this regard is the disposal of amalgam waste, which usually is being disposed in the sewer at the end of clinical procedure, and also seeped out into the environment from the corpse after the death. It has been indicated that some microorganisms in the soil or water can transform mercury to its highly toxic form, methyl mercury, leading to the accumulation of mercury in the food chain and eventually reaching the general population [4].

Although dentistry may not be the first main use of mercury, the United Nations Environment Program (UNEP) Global Mercury Assessment 2013 revealed that dental amalgam mercury accounts for 21% of global mercury consumption in products [5]. Considering the fact that this toxic element, which has been considered by WHO as one of the top ten chemicals of major public health concerns [3], does not degrade in the environment; the more dental amalgam use accounts for the more accumulation of mercury in the environment [5]. It has been illustrated that due to the high solubility of mercury, it is capable of transporting to its target organs after being absorbed in the lung [6]. It has been revealed that mercury compounds have detrimental effects on gene expression changes of glucose homeostasis, which leads to insulin resistance and hyperglycemia [7], while the result of a review showed that more studies are required to investigate the toxic effects of low levels of mercury exposure on human [8]. At 2013, the Minamata Convention on Mercury was adopted aiming at protecting human health and the environment from detrimental effects of mercury (<http://www.mercuryconvention.org/Convention/Text/tabid/3426/language/en-US/Default.aspx>). Taking practical steps towards phasing down the amalgam use, some countries have banned the use of amalgam dental material. Norway was the first country that banned the use of mercury in all products in 2008 including dental amalgam, followed by Sweden and Denmark (<http://holisticdentistry.ie/blog-Banning-amalgam-Countries-and-treaties-leading-the-way.html>). On July 1, 2018 European Union banned the use of dental amalgam for children under 15 and for pregnant/nursing women (<https://articles.mercola.com/sites/articles/archive/2016/12/27/european-union-bans-amalgam-fillings.aspx>). Although the Minamata Convention has been signed by 128 countries, unfortunately majority of those countries have taken no practical steps in this regard. The best strategy for phasing down amalgam use is to prevent dental caries and promote public oral health knowledge. WHO stated that phasing down of amalgam use may cause more challenges in low- and middle-income countries. This might be due to lack of dental personnel, limited

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financial resources and high prevalence of dental caries [9]. These countries are encouraged to establish public oral health programs.

### Summary of world status

Oral health services are very limited in African region leading to poor dental hygiene and high prevalence of tooth caries. Because of severe dental carious lesions, amalgam is still highly indicated [9]. In the South-East Asia region, tooth caries are a public health problem. The use of amalgam is still common in dental schools; however, there is more emphasis on tooth-colored restorative materials that lead to decrease of amalgam use. The cost of amalgam restorations is lower than composite resins in this region. Local manufacturing of tooth-colored restorative materials in Indonesia has both reduced costs and improved access [9]. Many chief dental officers in European region believe that the complete ban on amalgam could be problematic in countries with low resources. In Norway, since 2008 there has been a complete ban on the use of amalgam. During the past decade Sweden has gone through “phasing out policy” leading to decline amalgam use. In Denmark “phasing-down policy” in the use of amalgam in children has been performed. Data showed that 5% of tooth restorations are amalgam in Finland, while the number is less than 10% in Netherlands [9]. There is a significant burden of dental caries in the Eastern Mediterranean region. Dental amalgam restorations are being used in government clinics more commonly in comparison with private clinics. In Jordan, 90% of amalgam fillings are being performed in government clinics while the percentage in Kuwait has been decreased to 50% [9]. Local manufacturing of dental amalgam has led to the long history of amalgam use in China. In the Western Pacific region, the

amalgam restoration material is most commonly used in Hong Kong, particularly in government clinics. The most trend to decline amalgam use has been reported in Xian and Shanxi provinces. Mongolia has the least amount of amalgam use in this region, which has been reported as 10% of dental restorations. The amount in Singapore and Vietnam is 20%, in the case of Malaysia is 50% in private clinics and in the Philippines is 70% [9]. In general, the use of amalgam is decreasing in this region and tooth-colored materials are becoming more popular. Varieties of associations in the region of the Americas, including the American Dental Association (ADA) and the US Food and Drug Administration (FDA) have made debate regarding the advantages and disadvantage of amalgam since 70 years ago. In 2009 the FDA declared the final regulation, in which classified amalgam as the same as other restorative materials [9]. Composite resin restorations are more expensive compared with amalgam in the US and insurance does not cover tooth-colored materials [9]. Access to oral health care is still a challenge in Canada. In general, the use of amalgam is decreasing in Canada aimed at tooth preservation. There is a ban on mercury-containing products in this country; however, dental amalgam and lamps have been exempted based on the need [9]. There is a high burden of dental caries in Latin American countries. Amalgam is the main restorative material for posterior teeth. Decreasing the cost of other restorative materials is crucial in this region [9].

Hence, dental amalgam is used in all regions and almost all countries, thereby the global ban on amalgam would be problematic for public health, but the phase-down strategy should be programmed quickly [3]. The Minamata Convention has been signed by Iran (<http://www.mercuryconvention.org/Countries/Parties/tabid/3428/language/en-US/Default.aspx#decl-IR>) on 16/06/

**Table 1** Best management practices for dental offices using amalgam adapted from World Health Organization documents [9] with permission (license code: 263328)

DO	DON'T
Do use pre-capsulated alloys and stock a variety of capsule sizes	<i>Don't</i> use bulk mercury
Do recycle used disposable amalgam capsules	<i>Don't</i> put used disposable amalgam capsules in biohazard containers, infectious waste containers or regular garbage
Do salvage, store and recycle non-contact amalgam (scrap amalgam)	<i>Don't</i> put non-contact amalgam waste in biohazard containers, infectious waste containers or regular garbage
Do salvage (contact) amalgam pieces from restorations after removal and recycle the amalgam waste	<i>Don't</i> put contact amalgam waste in biohazard containers, infectious waste containers or regular garbage
Do use chair-side traps, vacuum pump filters and amalgam separators to retain amalgam and recycle their contents	<i>Don't</i> rinse devices containing amalgam over drains or sinks
Do recycle teeth that contain amalgam restoration. (Note: Ask your recycler whether or not extracted teeth with amalgam restorations require disinfection)	<i>Don't</i> dispose of extracted teeth that contain amalgam restorations in biohazard containers, infectious waste containers, sharps containers or regular garbage
Do manage amalgam waste through recycling as much as possible	<i>Don't</i> flush amalgam waste down the drain or toilet
Do use line cleaners that minimize dissolution of amalgam	<i>Don't</i> use bleach or chorine-containing cleaners to flush wastewater lines

2017 and it is now time to take an action in Iran too. Considering the large population of Iran and the common use of dental amalgam by dentists, it sounds very critical to phase down the dental amalgam use in Iran.

### Alternatives to dental amalgam restorations

Mercury-free dental restorative materials including composite, glass ionomers, ceramic and composites are well known as an alternative to amalgam and are being used in most countries. These alternative materials are more widely available in higher income countries. Various factors affect the choice of restorative materials, including size and site of the cavity, patient preference, cost, technology and environmental factors [9]. Dentists in low- and middle-income countries should be acknowledged regarding the detrimental effects of amalgam to the environment and also in dental schools the most emphasis should be put on mercury-free restorative materials. Norway as the first country which banned the use of amalgam, a survey was carried out by the Norwegian Dental Association (NTF) one year later to evaluate the dentists' satisfaction with alternative restorative materials. The results showed that among various alternative materials dentists prefer composites for mesial-occlusal-distal (MOD) cavities [10]. The majority of dentists reported secondary caries as the main cause of replacement of class II composite restorations in premolars and molars, followed by lost restoration and allergic reactions respectively. It is notable that majority of practitioners reported the main significant factors for the longevity of class II composite restorations as follows: moisture control, high caries activity, poor oral hygiene and poor matrix technique, respectively. And the type of composite has been reported as the least significant factor for the longevity of composite restorations [10]. In addition, the Norwegian dentists believed that moisture control is the most important factor to achieve successful composite restorations and disagreed with the point that composite is not suitable for molars and that composite is only suitable in small cavities [10].

### Best management practices (BMP) for amalgam waste

Considering the fact that a complete ban on amalgam use is not possible at this stage, it is necessary for all dental personnel be aware of how the amalgam waste should be handled and disposed. BMP are series of amalgam waste handling and disposal practices aimed at decreasing environmental detrimental effects of amalgam [9]. BMP for dental offices using amalgam has been shown in Table 1.

### Compliance with ethical standards

**Conflict of interest** The author declares that there is no conflict of interest.

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