Lessons from Countries Phasing Down Dental Amalgam Use

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Overall supervision

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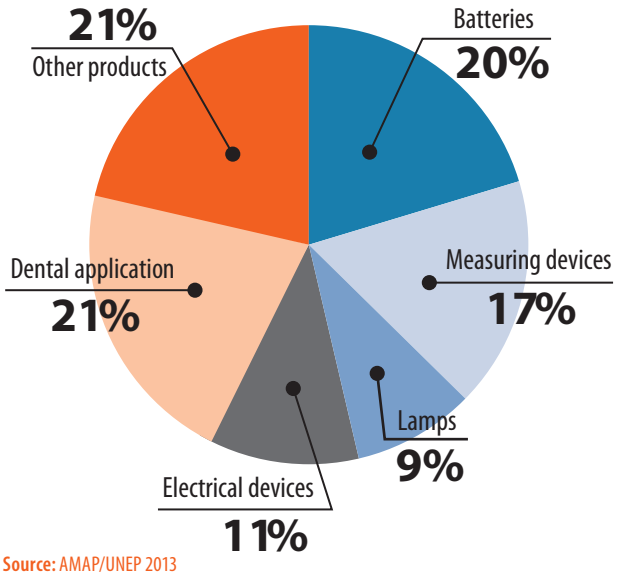
LESSONS FROM COUNTRIES PHASING DOWN DENTAL AMALGAM USE

Introduction

Dentistry may not be the first use of mercury that comes to mind when considering this heavy metal. Nevertheless the United Nations Environment Programme (UNEP) Global Mercury Assessment 2013 revealed that mercury in dental use accounted globally for 270-341 metric tons in 2010 (AMAP/UNEP 2013). This represents some 10% of global mercury consumption overall, and over 20% of global mercury consumption in products, as Figure 1 below demonstrates.

Figure 1: Mercury consumption in products, by product category (2010)



Source: AMAP/UNEP 2013

Due to growing concern regarding impacts of mercury on the environment, governments decided to negotiate a legally binding instrument on mercury, and the text of the Minamata Convention on Mercury was completed and adopted in 2013.

One of the key provisions of the Minamata Convention is the requirement for countries to phase down their use of dental amalgam. Based on official country responses to a UNEP survey questionnaire, this report presents a range of measures already taken by some countries in pursuit of their objectives to phase down or entirely eliminate the use of dental amalgam. It is intended that these examples may inspire and instruct other countries' efforts to implement this provision of the Minamata Convention.

Objectives

Among other significant applications of mercury, dental amalgam has attracted increased interest (WHO, 2011). Like other mercury uses, since mercury does not degrade in the environment, dental amalgam further contributes to the accumulation of mercury in the global environment, as described previously.

The Minamata Convention on Mercury, adopted in October 2013, has the objective to protect human health and the environment from anthropogenic emissions and releases of mercury. The Convention requires Parties to phase down amalgam use, taking at least two of the nine steps outlined in the Convention's Annex A, Part II (see "Time to act now!" section below). It is intended that coordinated implementation of the provisions of the Convention will lead to an overall reduction in mercury levels in the environment over time. However, the World Health Organization has noted that some low- and middle-income countries may face particular challenges in encouraging the use of mercury-free dental restorative materials. They may need external assistance and additional time to adopt the most appropriate mercury-free alternatives (WHO, 2011).

In order to assist countries in the phase-down process, the UNEP Chemicals and Waste Branch commissioned the Mercury Policy Project, a project of the Tides Center, to develop this brochure based on specific steps taken and methods used by countries that have already significantly reduced or eliminated the use of dental amalgam. UNEP's mandate to the Mercury Policy Project (MPP) included:

1. Identifying countries that have significantly reduced the use of dental amalgam. The identification process is described in the "Methodology" section below.
2. Developing a survey questionnaire, which benefited from questions formulated in a European Commission report (DG ENV 2012).
3. Collecting responses to the survey questionnaire from targeted countries, which were augmented with interviews, country reports and articles. Most of the responding countries completed a majority of the survey questionnaire.
4. Preparing this brochure – based on the responses to the survey questionnaire, interviews, country reports and scientific articles – which was to include reported trends, variations and commonalities as well as the main obstacles to reducing amalgam use, and how those obstacles were overcome.

Methology

The selection of countries to be surveyed was based on the findings of two reports: "Future Use of Materials for Dental Restoration" (WHO 2011), and the "Study on the potential for reducing mercury pollution from dental amalgam and batteries" (DG ENV 2012). These reports identified countries whose dental amalgam use appeared to have been significantly reduced or eliminated. MPP assisted UNEP in developing a survey questionnaire, which also benefited from review and input by officials from Sweden and the World Health Organization. The survey questionnaire sought information on a range of issues related to dental amalgam and alternative dental restoration materials, including national strategies and policies, issues of dental waste management and mercury releases, regulatory and voluntary initiatives, awareness raising, programs to prevent dental caries, potential impacts of reducing the use of dental amalgam, etc.

After final review, the survey questionnaire was sent out to the countries identified in the above mentioned reports; officials in Bulgaria, Denmark, Finland, Hungary, Japan, Netherlands, Norway, Singapore, Sweden and Switzerland generously responded. This report is, therefore, largely based on responses submitted by higher income countries, which have tended to take the lead in implementing policies to reduce amalgam use. Nevertheless their experiences are equally valuable for developing countries that choose to move in the same direction.

Unless otherwise noted, information on phase-down measures reported in this brochure was obtained directly from the government officials listed in the acknowledgements in response to the survey questionnaire, or was received in follow-up communications or related research. The figures and tables not obtained from the countries surveyed are sourced with the corresponding graphic.

Dental amalgam and alternatives

Dental amalgam fillings

Dental restoration is a common technique to treat dental caries. Left untreated, dental caries often leads to severe pain or discomfort, eventually requiring the removal of affected teeth. Dental amalgam is a widely employed restorative material that contains approximately 50% mercury (WHO 2011). This material has been employed for more than 150 years for dental care, in hundreds of millions of patients around the world (CDA 2006). For example, based on estimates for the European Union, approximately 370 million restorations were carried out in 2010, of which 125 million were done with amalgam (DG ENV 2012). Since amalgam fillings remain so common in so many countries, significantly phasing down the use of mercury in dentistry will require a range of measures adapted to each country's circumstances.

In the meantime, the life-cycle of mercury used in dental amalgam needs to be more widely understood and acknowledged in order to achieve an effective reduction in mercury releases to the environment. The main pathways of mercury in dentistry through the world economy and environment include:

- Producing mercury from sources such as mines and recycling;
- Storing, selling and shipping elemental mercury worldwide;
- Manufacturing and selling amalgam products to the dental trade;
- Placing and removing amalgam fillings in dental practices;
- Disposing, recycling or storing amalgam products and wastes; and
- The final fate of any amalgam fillings in the deceased via burial or cremation.

Figure 2 shows the various pathways for mercury emissions and releases following the placement or removal of amalgam fillings at the dental clinic. Mercury pollution may occur during any of these stages: during production of amalgam capsules; during preparation, placement and removal of dental restorations; when dental amalgam residues are discharged into wastewater (e.g. at the clinic or via normal human waste at home), discarded into solid, medical or hazardous waste, or otherwise disposed of; through disposal or land application of municipal sewage sludge that is contaminated with mercury from amalgam; and from amalgam fillings in the deceased, especially when the remains are cremated.

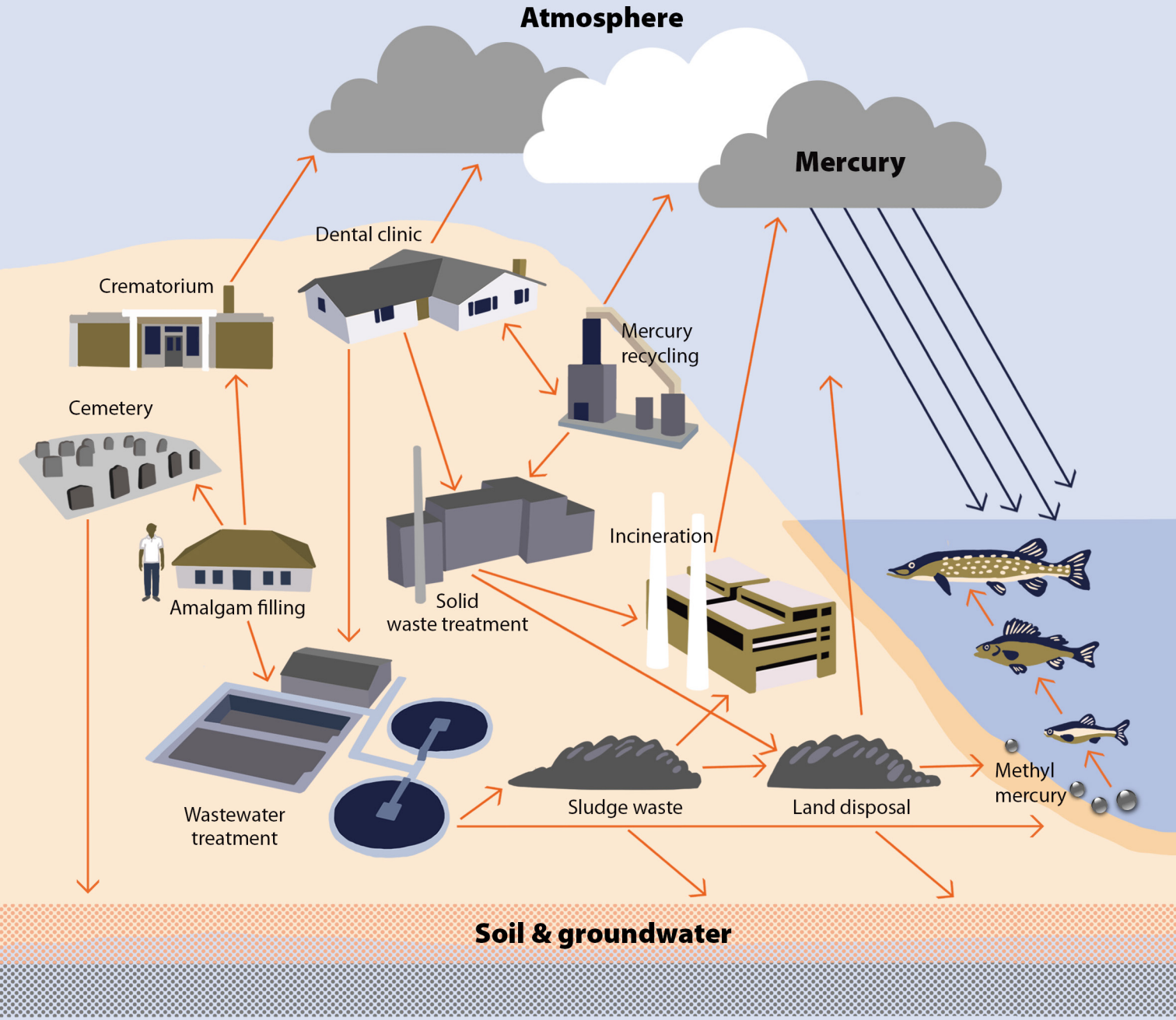


Figure 2: Mercury releases to the environment from dental care

Source: Concorde 2007

Because the removal and replacement of old amalgam is not a 'closed system,' the mercury wastes and releases generated by dentistry are difficult to monitor and control. The majority of dental mercury (about two-thirds) is eventually released to the environment as indicated in Table 1.

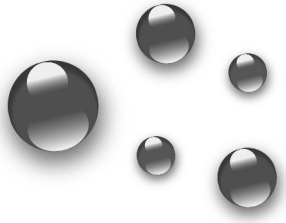


Table 1: Mercury used in dentistry - pathways to the environment

Global releases/ pathways	Mercury (metric tons/year)
Atmosphere	50-70
Surface water	35-45
Groundwater	20-25
Soil	75-100
Recycling of dental amalgam	40-50
Sequestered, secure disposal	40-50
Total	**260-340**

Sources: Maxson 2009, as cited in WHO 2011 and AMAP/UNEP 2013

Alternatives to dental amalgam fillings

Composite, glass ionomer, compomer and ceramic are materials that are commonly used as alternatives to amalgam (WHO 2011). These filling materials are now familiar in most countries and have been employed for decades in many (SCENIHR 2008).

Currently mercury-free filling alternatives are more prevalent in higher income countries, where the materials and related dental equipment are more readily available, where there are more dentists trained to use them, and where more patients are willing to pay a higher price for mercury-free fillings. Although the 2011 World Health Organization report confirmed that "recent data suggest that RBCs [resin-based composites] perform equally well" as amalgam, nevertheless the WHO recommended that research and development of high quality alternative materials should be further pursued (WHO, 2011) and the use of such materials should be further encouraged in public health care globally in parallel to the phasing-down of dental amalgam.

Amalgam phase-down measures

Experiences of countries phasing down dental amalgam

Despite the broad challenges inherent in reducing amalgam use in dentistry, some countries have already considerably restricted or banned its use. While every country needs to develop an approach that is appropriate to its own circumstances, the various measures described below may provide inspiration to other governments taking steps to phase down the use of amalgam in their own populations.

As cited in the country responses to the survey questionnaire, the main factors that have contributed to a decline in amalgam use include national and/or individual environmental concerns, patient and professional preferences to avoid mercury, patient preferences for tooth-colored fillings, professional preferences to favor viable techniques that preserve as much of the natural tooth structure as possible, etc. Moreover, oral health and dental hygiene programs that reduce the overall incidence of dental caries have also contributed to a decline in the need for dental restorations – both amalgam and non-amalgam (WHO 2011).

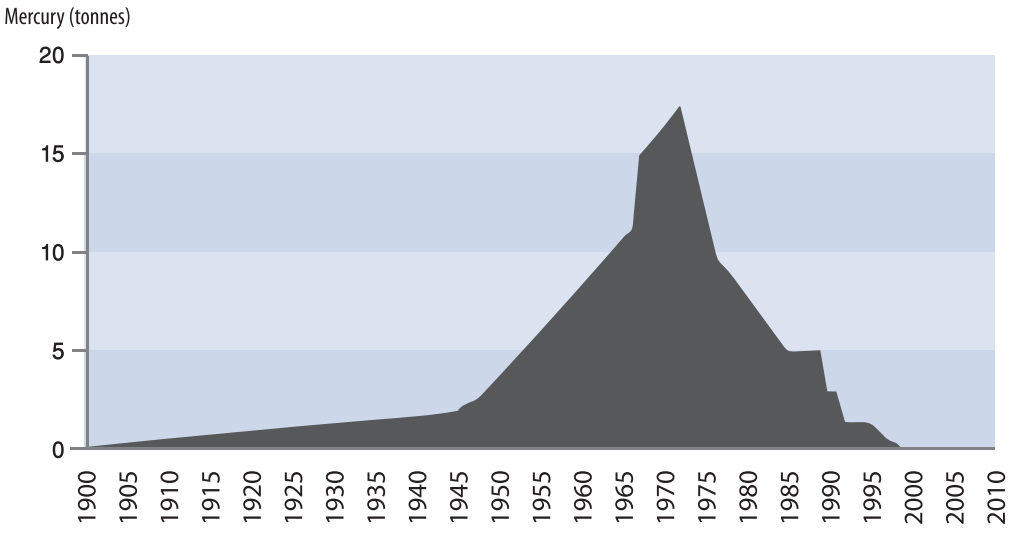
The experiences of various countries that responded to the survey questionnaire are summarized below.

Sweden – During the 1980s an intense debate was raised in the Swedish media by patient groups concerned about the health effects of amalgam in Sweden. Environmental concerns were also increasingly noted. Various expert groups and investigations were convened, and in 1991 the National Board of Health and Welfare investigated the preconditions for eliminating the use of dental amalgam (KemI 2005).

In 1995 there was a voluntary agreement between the state and county councils to put an end to amalgam use in dental restorations for children and young people. However, by 1997 the voluntary measures had not achieved the objective that had been established. In 1999 the Swedish Parliament decided that patients should no longer be reimbursed for the cost of amalgam fillings under the national healthcare system. As a result, the cost to patients for amalgam became comparable to the cost for composites (KemI 2005). Figure 3 reflects the decline in amalgam use in Sweden since the 1970s.

Since 2009 there has been a general ban on mercury in Sweden that includes dental amalgam. Meanwhile the cost of mercury-free restorations has continued to decline with new technologies, and with further training and experience of dental practitioners.

Figure 3: Mercury used annually in dentistry in Sweden



Sources: DG ENV 2012, p. 59 (with permission)

Norway **–** Interest in reducing amalgam use in Norway emerged during the 1980s as part of a broader policy to limit all releases of mercury, and also due to health concerns raised in the media by a patient association. In 1991, Norway issued guidelines that the use of amalgam should be limited due to environmental impacts. Stronger guidelines were issued in 2003, requiring materials other than amalgam to be considered as the first choice in tooth fillings. Since 2008 Norway has had a general ban on mercury products. This included a ban on amalgam, with an exemption period – now expired – for special cases. Amalgam use has been eliminated since 2011.

Denmark **–** The sale of mercury has been forbidden in Denmark since 1994, but an exemption was initially granted for mercury in dental amalgam. A subsequent "Recommendation" of the Danish health authority stipulated that from 1999 amalgam fillings should not be placed in front teeth or "milk teeth," nor should it be generally used for dental care of children. The health authority recommended that mercury-free alternatives should be the first choice for new fillings, except where: 1) it is not possible to keep the area dry; 2) it is difficult to access the cavity; 3) there is a particularly large cavity; or 4) the distance to the proximate tooth is too great. By 2013 amalgam was used in only 5% of restorations.

Finland **–** After consultation with an expert group in 1993, Finland issued the following recommendations: the use of amalgam should be reduced for environmental reasons and amalgam should be used only when other dental filling materials cannot be used. Since 1994 Finland's national guidelines stipulated that amalgam should not be used in restorations. The use of amalgam has declined significantly, recently accounting for no more than 3% of dental restorations.

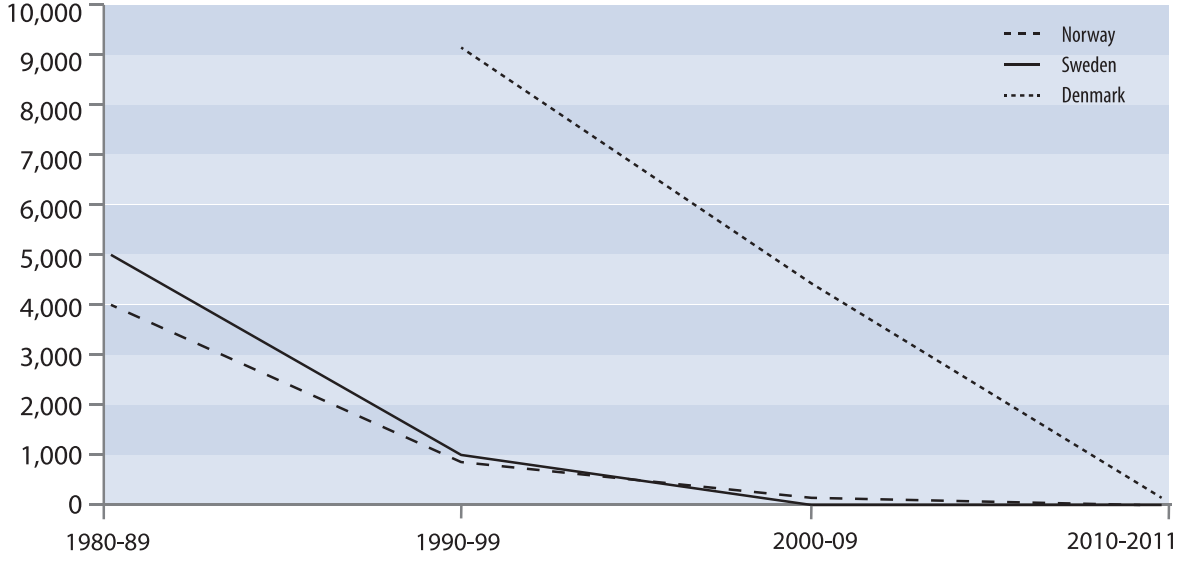
Netherlands **–** In the Netherlands a major shift away from amalgam took place in the 1990s after consultation with the dental sector, which eventually embraced the use of mercury-free dental restorations. Consequently, the average use of amalgam in the 2000s was around 7% of all dental restorative fillings, dropping to less than 1% by 2011.

Japan **–** Since the 1980s Japan has moved almost completely away from amalgam for aesthetic and environmental reasons. Amalgam has been replaced by composite resin, glass ionomer and gold/silver/palladium alloy. Amalgam was used in approximately 11% of all dental restorations in the 1980s, declining to less than 4% in the 1990s. In 2010 only 20 kg of mercury were used in dentistry.

Hungary and Singapore **–** In 2012 amalgam was reportedly used in only around 12% of all fillings placed in Hungary. Singapore reported that amalgam was used in about 16% of all dental restorations in 2012.

Three of the countries registering the most marked decline in the use of mercury in dentistry in recent decades are highlighted in Figure 4.

Figure 4: Mercury use (kg) in dentistry by country, 1980-2011



Source: Survey questionnaire responses from government officials in Norway, Sweden and Denmark

Lessons from successful amalgam phase down approaches

Countries that have successfully phased down dental amalgam have used similar approaches to achieve their goal. Their approaches include a number of measures that ultimately resulted in a smooth transition to greatly reduced amalgam use. Those examples may be combined to provide a general framework that other countries may use to address this issue, with more specific measures depending on their economic, cultural and social environment.

There are two main approaches to reducing mercury releases from dentistry:

- First, there is the pollution management approach which aims to reduce the environmental impact of mercury releases by using appropriate waste management measures, amalgam preparation procedures and air treatment systems, for instance.
- Second, there is the need for source reduction measures in the form of appropriate policies or regulations to reduce the use of mercury in society.

These two approaches need to be implemented in parallel, including a phase down in the use of amalgam, in order to most effectively reduce the environmental impact. The following part of the brochure discusses the different measures that may be taken to keep dental mercury out of the environment.

Limiting mercury releases to the environment

There are a range of measures that countries may take to greatly limit dental mercury releases to the environment. First, an accurate inventory of amalgam use is very useful to estimate the quantity of mercury used by the dental sector. This may be done by:

- Requesting or requiring amalgam manufacturers, distributors and/or importers to supply data;
- Examining the country's amalgam supply-demand chain and costs;
- Assessing the number of dentists in the country and determining average amalgam use; and
- Tracking imports of encapsulated dental amalgam and elemental mercury imported for use in dental restorations.

Table 2: Indicative annual cost (in USD) of amalgam separators by size of dental office

Type of cost	Small (1-4 chairs)	Medium (5-12 chairs)	Large (>12 chairs)
Purchase	228-1,370	760-2,510	2,850-10,000
Installation	114-228	143-297	228-1,140
Maintenance	0-228	0-228	0-228
Replacement	57-856	86-856	571-2,400
Estimated annual cost	211-1,073	293-1,110	1,990-4,630

Source: US EPA 2008 (Note that these costs are likely somewhat greater at present than they were in 2008)

This data establishes a baseline from which to gauge the subsequent phase down progress of a country, it facilitates setting a reduction target, and it sheds light on any mechanisms at the national level that could present problems or opportunities.

During the phase down, it is also important to limit any mercury releases to the environment, to the extent possible. This may be achieved with a waste management scheme that isolates amalgam scrap, capsules, or removed amalgam, and where possible (see discussion of waste management costs below), treats this solid waste in an appropriate manner. "Best management practices" for dental clinics also include the use of amalgam separators as the most effective method to minimize the amount of mercury released into wastewater. Depending on the size of the dental office and the number of separators required, the annual cost of amalgam separators (purchase, installation, maintenance) may vary between 60 USD and 270 USD per chair as shown in Table 2.

More recent information indicates that the recovered mercury also needs proper handling and disposal, for which the additional cost could range between 95 USD and 750 USD per year, depending upon the size of the dental clinic and other local circumstances.

Such costs may take some time to recover, especially for dentists in low- and middle-income countries, and should be considered in that context. Furthermore, if amalgam is not widely used in a given low- or middle-income country, limited resources may be more effectively used to phase down the ongoing amalgam use, rather than for amalgam related waste management. Separators potentially have a high degree of mercury removal (98.7% on average, according to a recent US EPA report) and can significantly reduce contamination of the wastewater stream. However, adequate attention has to be given to regular removal of the collected mercury and maintenance of the separator because improper use or poor maintenance will decrease its efficiency. Finally, the recovered mercury wastes need to be sent to appropriate treatment facilities to minimize any releases into the environment. This last requirement may be problematic in countries where there is limited infrastructure to properly manage and dispose of hazardous waste.

Table 3: National requirements for separators and best management practices

Country	Separators, BMPs required, new clinics	Separators, BMPs required, existing clinics	Separators, maintenance required	Separators, maintenance documented	Periodic inspection
Finland	X	X	X		
Japan					X
Hungary			X		X
Denmark	X	X	X	X	X
Switzerland	X	X	X	X	X
Sweden	X	X	X	X	X
Norway	X	X	X	X	X
Netherlands	X	X		X	X

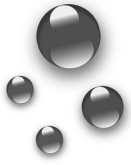
Sources: Survey questionnaire responses from Finland, Japan, Hungary, Denmark, Switzerland, Sweden, Norway and the Netherlands

As presented in Table 3, surveyed countries used a combination of regulations, guidance, and inspections to promote best management practices (BMPs), including the installation and proper maintenance of amalgam separators in dental clinics to ensure proper recovery of mercury. Alternatively, in countries where enforcement measures may be more difficult to implement, it may be preferable to focus primarily on annual reporting from dental clinics.

Also key to maintaining a safe working environment is attention to good mercury handling practices. Rather than mixing amalgam directly from elemental mercury, the use of pre-portioned capsules is strongly recommended since it guarantees proper composition of the dental filling material, ensures optimal quality and reduces haphazard releases and the chance of coming into contact with toxic materials. Where amalgam is mixed by hand, mercury releases are more significant and spills are more likely, resulting in even higher mercury releases and exposures to workers and patients.

Countries also report that crematoria are among their largest sources of mercury emissions to the atmosphere. Mercury emissions are projected to become even larger in the EU (OSPAR 2011) and the USA due to the significant increase in cremations and in the number of amalgams in the deceased – at least until a larger percentage of the deceased have fewer amalgam fillings. Figure 5 shows the projected rise in the incidence of cremation in the EU and the USA, which is believed to also reflect the global trend.

As illustrated below in Table 4, installing pollution control devices on crematoria is by far the most costly mercury emissions abatement measure. Consequently, it is much more cost-effective to eliminate the need for such pollution control devices over time by phasing down the use of amalgam fillings.



Despite the high cost, installation of pollution control devices on crematoria is playing an increasing role in reducing mercury emissions to air, particularly in the EU. Countries indicate that 44% to 100% of their crematoriums have installed mercury control equipment.

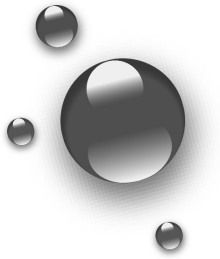
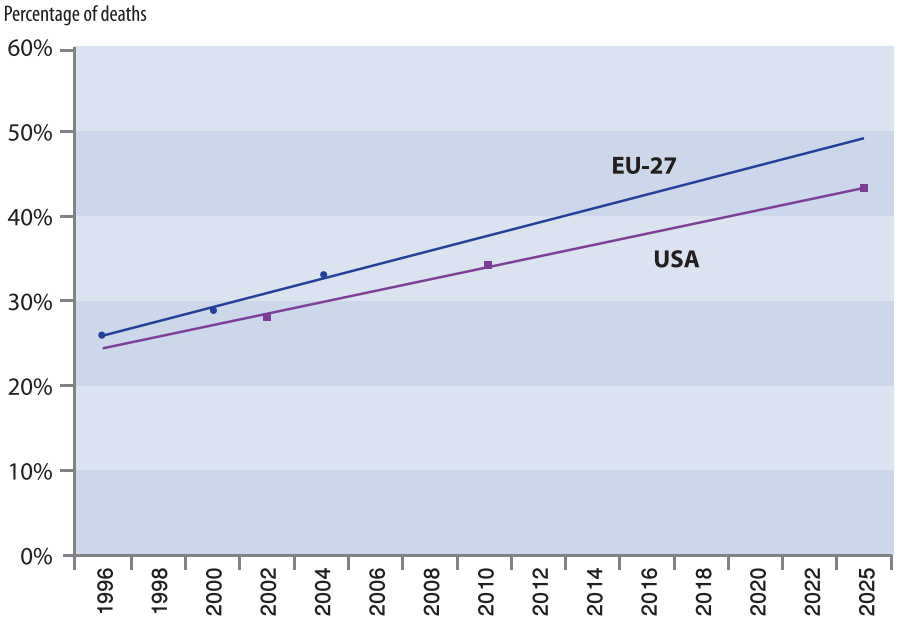


Figure 5: Cremation trends in the EU-27 and U.S.



Sources: CSGB 2004; Reindl 2007

Other challenges faced by governments include the increased cost of managing and disposing of sewage sludge contaminated by dental mercury released to wastewater – a problem highlighted by several countries responding to the survey questionnaire.

Table 4: Country statistics on controlling mercury releases from cremation

Country	% units with mercury controls	Requirements and/ or date required	Cremations per year	Installation costs per crematorium
Sweden	64% (2009)	95% removal rate required at large units	70,000 (82% at facilities with mercury removal)	Around 100,000 USD, 10% cost for mercury contaminant removal
Switzerland			20,000 (2011)	Ranges from 1,000,000 USD to 1,500,000 USD
Finland		23% of units by 2015-2016		
Norway	62.5% (2012)	Large crematories (>200 cremations-/yr.) regulated in 2007	15,544 (2012) 37% at facilities with mercury removal	Investment cost mercury filter (144,000 USD)
Denmark		2011		
Netherlands	>90%	Requirements on large units first: smaller ones required by 2012	75,000 (2008) 55.8% at facilities with mercury removal	Costs for installing devices for 50 crematoria estimated at 32 million USD

Sources: Survey questionnaire responses from Sweden, Switzerland, Finland, Norway, Denmark and the Netherlands

Involvement of the dental sector

Dentists and, in particular, their dental associations will also need to be consulted at an early stage and throughout the phase down process. It is important to understand their concerns regarding a phase down of amalgam use as well as to explain to them their country's obligations under the Minamata Convention.

When planning the amalgam phase down, Nordic countries experienced some initial resistance from the dental industry sector (DG ENV 2012). As surveyed countries reported, these challenges included the fact that some dentists:

- Were not aware of the environmental impacts of mercury from amalgam, and the social benefits of reducing mercury emissions (DG ENV 2012).
- Were initially reluctant to invest in new equipment required to reduce mercury pollution or to support mercury-free fillings (Klif 2011).
- Were not initially convinced of the durability of alternative filling materials (Klif 2011).
- Demonstrated varying levels of skill in applying mercury-free techniques.

The survey questionnaires returned by countries showed that during the phase down of amalgam use the committed involvement of the dental sector is necessary in order to achieve an efficient transition to alternatives.

- In Denmark, there were some initial objections from dentists. Subsequently, dental associations were directly consulted and then actively participated in the development of the health authority's 1999 policy to allow amalgam only in special cases.
- In Norway, the opinions of dentists changed over time. At first "emotions were high", but dental practitioners accepted the principles developed through the consultative process of the Norwegian authorities. This included many consultations with stakeholders, a national hearing, and vetting the proposed regulation through the World Trade Organization and EU notifications (VACMP 2004).
- In Sweden, dentists' attitudes changed gradually as government agencies held a variety of consultations with different stakeholders, including circulating a questionnaire on the impact of amalgam reduction, meetings with the affected parties to discuss specific problem areas, two study visits concerning amalgam, and the opportunity to comment on a draft report (KemI 2004, 2005).
- In Finland, the authorities worked with an expert group in the 1990s to prepare recommendations to reduce amalgam use, which declined significantly after the recommendations were introduced.
- In the Netherlands, a stepwise approach for eliminating the use of amalgam was employed after involving as many stakeholders as possible.

Other challenges have been overcome in close cooperation with dental schools. Countries can play a key role in supporting the reduced use of amalgam by encouraging dental schools to:

- develop curricula training dental students to use mercury-free alternatives;
- provide continuing education for dentists who are currently practicing; and
- educate current and future dentists about amalgam's impacts on the environment.

Dental schools may accomplish this by prioritizing knowledge about and proficiency in the use of alternatives to amalgam. For example:

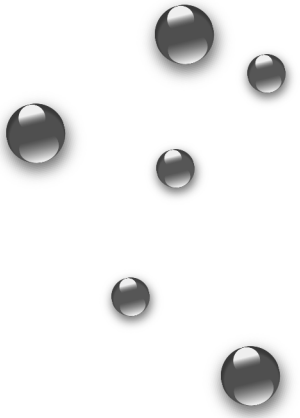
- In Sweden amalgam placement was not taught for several years prior to its ban. To reduce spills and exposure, mercury hygiene was emphasized along with the shift to pre-encapsulated amalgam. Dental schools have since demonstrated the efficacy of mercury-free alternatives and also can provide information on best management practices and amalgam separators as a number of countries do.
- In Denmark dental schools are actively collaborating in amalgam phase down efforts. Use of mercury-free alternatives is a part of dental schools' obligatory training.
- In the Netherlands the dental schools stopped teaching the placement of amalgam between 1995 and 2005, on a voluntary basis.
- In Japan dental amalgam is no longer emphasized in the educational system.

Public awareness of mercury in dentistry

In the higher income countries surveyed, there is general public awareness concerning the environmental and health issues associated with mercury. However, a surprising number of people are not aware that amalgam contains about 50% mercury. Some people are misled by terms commonly used to describe amalgam (for example, a "silver" filling in English, or "plombage" in French, from the French word for "lead"). Raising public awareness is an important factor that countries should consider because many people are not aware of the pros and cons of different dental restorations:

- In Norway, the government adopted measures to present information on alternative dental restorative materials in a balanced manner (UNEP 2010). As a result, the move away from amalgam started even "before the general ban on mercury in products was introduced" (Klif 2012).
- In Denmark, dentists were required to inform patients about the different dental restoration materials. Now "patients ask for alternatives due to public awareness."
- In Sweden, the government attributes "high awareness of the environmental and health risks of mercury among patients" as one of the "most important explanations" for that country's ability to virtually eliminate amalgam use (KemI 2011).

The acceptance, performance and use of mercury-free dental restorative materials have grown markedly in the countries surveyed, among others. Reasons for reduced use of amalgam as cited in responses to the survey questionnaire included the general desire to preserve as much of the tooth structure as possible, the general preference for tooth colored fillings, the awareness of environmental and other concerns associated with releases of mercury from dentistry, etc. Governments that actively promoted reductions in amalgam use observed more rapid progress toward phase down. Likewise, in the course of phasing down dental amalgam, countries noted that initial investments were required to train dentists and purchase equipment, but these were neither significant nor lasting barriers to the process of phasing down amalgam use.



Modify or strengthen legislation and regulation

Avoiding the use of amalgam for women and children

Countries wishing to phase down amalgam use may consider adapting their legislation to both set an objective and to achieve it. For example, Norway and Sweden introduced step-by-step legislation that allowed time for the industry and for dentists to adapt to the new restrictions or guidelines. The process started with a recommendation against the use of amalgam for vulnerable populations such as children and pregnant women. Governments could also recommend mercury-free fillings instead of amalgam as a first choice (SCENIHR 2015).

Following the lead of Norway and Sweden, some other European countries (Denmark, France, Germany) are following a similar precautionary approach by strictly limiting the use of amalgam in pregnant women and in the "milk teeth" of children. Dental amalgam use in Swedish children was reduced from 30% of restorations in 1991 to 1.5% in 1995, and subsequently Sweden adopted a ban on amalgam fillings for all young persons. In Norway amalgam use in children was reduced by 90% between 1995 and 2002. Amalgam use in Danish children was restricted in 2003.

Norway began a process to phase down amalgam use in the late 1990s. They first issued guidelines that amalgam should be avoided in pregnant women, and subsequently included children in the guidelines.

In the Netherlands, amalgam use has declined significantly in children and adults after it was discouraged in children. Other countries have had similar experiences, according to the responses to the survey questionnaire:

- In Finland, national guidelines recommend that amalgam should not be used in pregnant women and children.
- In Singapore, amalgam use in children has dropped from 50% of restorations in 2000-2009 to 20% in 2010-2011.
- In Hungary, amalgam use in children was reduced to 14% in 2011.

Substituting less hazardous chemical substances

Some countries also adhere to a policy of substituting less hazardous chemical substances. This approach states that when chemical substances with elevated health or environmental risks are in use, an assessment should be made (VACMP 2004). If less hazardous alternatives exist, they should be used in order to reduce the health or environmental risks (NBH 1999). For example, in Switzerland the 1989 Swiss Ordinance on Risk Reduction related to chemical products stated that amalgam may not be used if a mercury-free alternative can be applied in its place.

Table 5: National dental insurance schemes

Country	Covered population	Type of insurance scheme
Japan	Universal entitlement	The statutory health insurance coverage guarantees dental care. Recipients typically pay 30% of the cost, while those 70 years and older pay 10%. Routine dental examinations are provided for infants, children and adolescents as part of public health and school health programmes, and most municipalities subsidise these costs for infants and children.
Switzerland	Special scheme for dental care	Basic health insurance is mandatory for all persons, although dental care is not included in the basic healthcare scheme. Under a separate scheme, dental treatment is fully covered for children 18 and under.
Denmark	Universal entitlement	Dental care for children, adolescents, nursing home residents and disabled people is publicly financed. Dental care for adults is largely private with support from public health insurance; patients have to cover 70% of costs.
Finland	Universal entitlement	Patients contribute 20% of costs on average of both amalgam and non-amalgam fillings.
Singapore		Government subsidies are available for dental restoration materials.
Sweden	Universal entitlement	Dental treatment for children is fully covered, and for adults 50% of the treatment cost is covered. Amalgam fillings are not covered at all (KemI 2011).
Norway	Children, seniors and others.	Dental care is fully covered for children up to age 18. Amalgam fillings are not permitted.
Netherlands	Universal entitlement	Children are publicly insured until age 18. Adults can purchase insurance and be partly reimbursed for any type of filling.

Sources: Questionnaire responses from Japan, Switzerland, Denmark, Finland, Singapore, Sweden, Norway and the Netherlands; and Nomura (2008)

Better balanced dental insurance schemes

Some countries have found that addressing imbalances in insurance schemes can be a very important measure for phasing down amalgam use (KemI 2004, 2005). As Table 5 above shows, countries vary substantially in their systems of publicly financed insurance coverage or reimbursement schemes for dental restorations.

The responses to the survey questionnaire confirm previous findings that traditional health insurance schemes often contain an inherent financial incentive in favor of amalgam (Concorde 2007; WHO 2011). Therefore, where appropriate, countries should examine how national insurance practices may be revised to help phase down amalgam use. Likewise, third-party payment systems for dental care can also be adapted so as to help phase down amalgam use.

Sweden lists its "decision to stop financial support for amalgam fillings from the national dental insurance service" as among the "most important explanations" for ending the use of amalgam (KemI 2011). The result was that the cost to the patient of an amalgam filling became as high as, or even higher than, the cost of a composite restoration. When insurance coverage for amalgam was eliminated, its use dropped substantially.

Improve public health, promote oral health and prevent disease

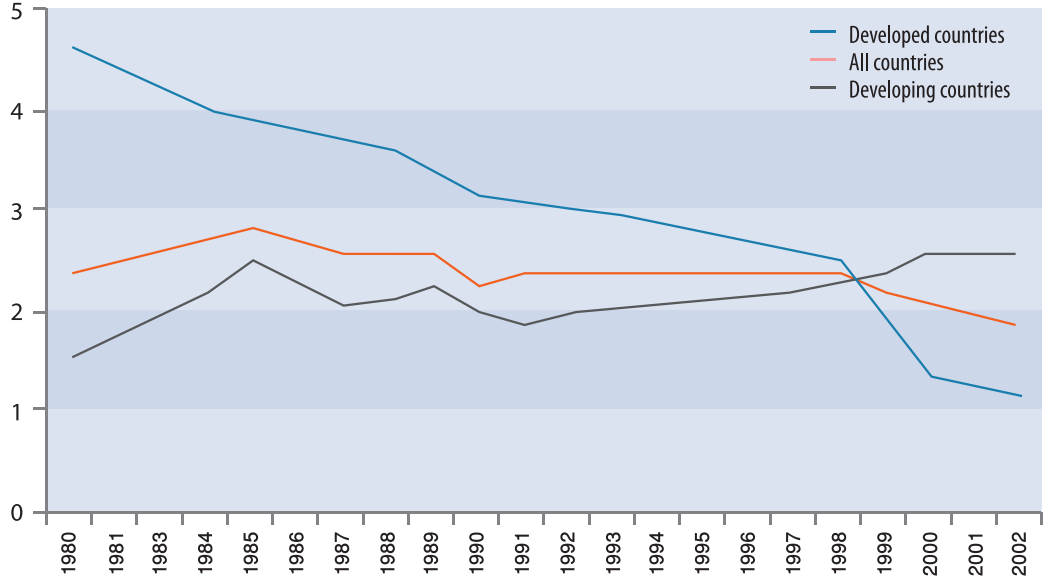
The World Health Organization has suggested that the decreased incidence of caries in children in higher income countries during the 20 years up to 2002 (see Figure 6) is the result of various public health measures, coupled with changing living conditions, healthy lifestyles and improved oral hygiene practices. Nonetheless, WHO has concluded that "despite much effort in health promotion and disease prevention, dental restorations are still needed" (WHO 2011).

In fact, amalgam use in higher income countries remains a prime target for phase down, with 124 metric tons of mercury consumed for dental applications in the European Union and North America in 2010 alone (AMAP/UNEP 2013).

The changing diet in many low- and middle-income countries has resulted in a higher consumption of sugars and thus a higher caries risk among 12-year-olds (WHO 2003). The increasing need for dental restorations in these countries can only be reversed with the development and implementation of a public oral health policy adapted to the local situation.

Improving global oral health at the roots will not only contribute to the phasing down of amalgam, but will also deliver social and economic benefits to the population. Nevertheless, the limitations of programs for dental hygiene to adequately address the problem of dental mercury are noted in a report for the European Commission, "…preventative policies are only one instrument among others as they cannot fully address mercury pollution caused by dental amalgam" (DG ENV 2012).

Figure 6: Caries in 12-year-olds, expressed in DMFT (decayed, missing and filled teeth)



Sources: The World Oral Health Report (WHO 2003)

The importance of minimally invasive dentistry

A Norwegian guideline was developed promoting minimally invasive dentistry on the basis of health care legislation, which took several years to complete. After reviewing the research, the Norwegian health authorities came to the following conclusions:

- When a dental filling is placed, the technique should involve the least possible amount of tooth tissue removal.
- While, on the basis of available information at the time, they considered amalgam to be the longest lasting, least expensive, and most durable filling material, it requires the removal of more healthy tooth tissue than mercury-free fillings.
- Every effort should be made to reduce the exposure of patients and dental health care personnel to chemical substances during dental treatment, both when placing and removing dental fillings.

In summary, despite efforts to prevent caries, dental amalgam use remains high even in many higher income countries (AMAP/UNEP 2013). Those countries implementing amalgam reduction measures may find it useful to develop evidence-based guidelines encouraging the use of mercury-free dental fillings. Moreover, in parallel with minimally invasive mercury-free dental fillings, health promotion and disease prevention programs should be an integral part of responsible oral health care.

Time to Act Now!

The experiences with mercury-free dental restorations in surveyed countries demonstrate that amalgam use can be phased down and even eliminated. The major force now driving global momentum toward reducing mercury use in dentistry is the Minamata Convention, which identifies a number of actions that can be taken:

1. **Setting national objectives aiming at dental caries prevention and health promotion, thereby minimizing the need for dental restoration.**
2. **Setting national objectives aiming at minimizing the use of dental amalgam.**
3. **Promoting the use of cost-effective and clinically effective mercury-free alternatives for dental restoration.**
4. **Promoting research and development of quality mercury-free materials for dental restoration.**
5. **Encouraging representative professional organizations and dental schools to educate and train dental professionals and students in the use of mercury-free dental restoration alternatives and in promoting best management practices.**
6. **Discouraging insurance policies and programs that favor dental amalgam use over mercury-free dental restoration.**
7. **Encouraging insurance policies and programs that favor the use of quality alternatives to dental amalgam for dental restoration.**
8. **Restricting the use of dental amalgam to its encapsulated form.**
9. **Promoting the use of best environmental practices in dental facilities to reduce releases of mercury and mercury compounds to water and land.**

Each country adhering to the Convention is obliged to implement two or more of the measures listed above to phase down amalgam use, while taking into account the country's domestic circumstances and relevant international guidance. In implementing these measures, it is hoped that countries will benefit from the experiences and evidence presented in this brochure.

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