

High Risk of Mercury
Exposure to Public Health due to Mercury
Amalgam Use in Dentistry in Pakistan

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Policy Brief #34

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A publication of the Sustainable Development Policy Institute (SDPI).

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Sustainable Development Policy Institute is an independent, non-profit research institute on sustainable development.

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Edited by: Salim Khilji

First Edition: July 2013

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Acronyms

ASTDR	Agency for Toxic Substances and Disease Registry
BEP	Best in-house Environmental Practices
EU	European Union
EPA	Environmental Protection Agency
GoP	Government of Pakistan
Hg	Mercury
INC	Intergovernmental Negotiation Committee
PMDC	Pakistan Medical and Dental Council
ng/m³	Nano gram per cubic meter
INC	Institute of Chemical Sciences
OPD	Operative Dentistry
Rfc	Reference concentration
SDPI	Sustainable Development Policy Institute, Islamabad
UNEP	United Nations Environment Program
WCC	World Conservation Congress
WHO	World Health Organization
ZMWG	Zero Mercury Working Group

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Introduction

Dental mercury amalgam, also called silver filling or amalgam filling, is used widely because it's inexpensive, ease of use, and best settling material. Most importantly, it is resin free, which makes it less allergic than composite fillings. These fillings gave off mercury vapors and its amount depends upon cavity size, tooth characteristics, composition, age of amalgam, time taken for filling, the number of fillings, temperature of ingested food/drinking liquids and the activities like chewing & grinding of teeth. (MERC Vermont 1998, Intelligence Service 2012)

Mercury (Hg), the essential constituent of dental amalgam, is also known as quick silver, is a toxic substance of global concern. A persistent pollutant, Mercury is not limited to its source but it travels, on time thousands of kilometers away from the source. Mercury poses risks to environment and human health, especially the health of children. In September 2012, IUCN World Conservation Congress (IUCN WCC-2012) adopted SDPI Motion (M-169) and called upon government representatives of Intergovernmental Negotiating Committee (INC) to support a legally binding treaty on Mercury with an objective to protect human health and the environment from hazardous and toxic Mercury. In January 2013, 140 countries in Geneva adopted a ground-breaking, world's first legally binding treaty on mercury, to be called "Minamata Convention on Mercury," limiting the use and emission of health-hazardous mercury. It shall be open for signatures at a diplomatic conference in Japan, in October 2013 (UNEP 2013)

Scientific evidence, including UNEP Global Mercury report, establishes mercury as an extremely toxic substance, which is a major threat to wildlife, ecosystem and human health at a global scale (Stortbecker 1989). It is also a major threat to fish that constitutes an all-important nutritious component of human diet. Children are more at risk from mercury poisoning, which affects their neurological development and brain. Mercury vapors can cause damages to central nervous system, thyroid, kidneys, lungs, immune system, eyes, gums and skin. Neurological and behavioral disorders include tremors, insomnia, memory and vision problems, neuromuscular effects and headaches. Fetuses and young children are more vulnerable to the mercury vapors. (Pamphlet 1998, Alex Kirby 2013, MERC Vermont 1999, Intelligence services 2012)

There are few investigations carried out and reported in Pakistan on mercury contamination in air. (Khwaja et.al 2012, Khwaja et.al 2005). According to a preliminary report on mercury inventory, published in 2000, the point sources of mercury releases and emissions in Pakistan are dental clinics, a chlor-alkali plant, light products manufacturing units, incinerators and other coal based primary or secondary unit operations. Based on this reported preliminary data, the estimated maximum and minimum emission and transfer of mercury in the country is about 36,900 and 10,800 kg per year, respectively. The estimated amount of mercury consumed in dental sector in the country is reported as 65 kgs/annum (GoP - UNEP 2000). At present, there is no mercury specific legislation in the country. However, development of a mercury management action plan is in the making.

In 2010, a study in Pakistan, evaluating the amalgam use by dentists in the country and its waste management, has indicated that 92% dentists use amalgam often/always, whereas 56% of the study samples disagreed that amalgam should be phased out and replaced with non-mercury fillings. 92% dentists of the selected number of samples perceived amalgam a health risk, whereas 46% considered it an environmental hazard (Rubina et.al 2010). A similar study carried out in Karachi indicated 94% of dentists perform dental amalgam restoration, 57% using hand mixing for dispensing and 55% disposing of mercury waste in the sink. (Iqbal 2011)

In the present study, mercury levels in and around mercury releasing sources and in open air are being examined, to identify "Mercury Hot Spots" in five cities of Pakistan, namely Peshawar, Rawalpindi, Islamabad, Abbottabad and Lahore. This brief report describes and discusses results of our findings at dental clinics, hospitals, dental colleges and teaching hospitals. The selected sampling points at these sites were operative dentistry/treatment sections, adjacent corridors and surrounding open-air.

During the present mercury monitoring study in air at dental sites, the medical doctors, staff and management were alarmed at the observed very high indoor mercury contamination at some dental sites. Immediate remedial/control measures were also sought to protecting the health of staff, patients and visitors.

Methodology

The high precision RA-915+ mercury analyzer (Lumex), calibrated by the supplier was used to measure mercury levels in air at the select sites.

For discussion of the results, US EPA reference level, 300 ng/m³ has been referred (ATSDR, 2012).

Overall summarized findings for mercury levels in air at dental colleges/teaching hospitals (17), general hospitals (7) and private clinics (10) are described in table 1. All visited sites (34) are identified in annexes A, B and C.

Results and Discussion

Among all the visited/monitored dental sites in Lahore, Peshawar, Abbottabad, Rawalpindi & Islamabad, eleven (11) sites were most contaminated with mercury level in air many times higher than the recommended limit of 300ng/m³. Mercury levels in air of operative dentistry (OPD) at 15 out of 17 dental teaching institutions was found to be higher than the recommended limit, whereas, similar higher mercury levels were observed in 5 out of 7 general hospitals and all the 10 private clinics visited (Table 1). Highest mercury levels in OPD air at teaching institutions, general hospitals and private clinics were found to be 44,067, 17,172 and 1,800 ng/m³ and the lowest values at these sites were 109, 174 and 333 ng/m³, respectively (table 1). Among dental sites mercury contamination of air was found to be generally in the increasing order operative section > corridor > open air and at teaching institutions > general hospitals > private clinics.

Table 1: Mercury levels at visited sites in Lahore, Peshawar, Abbotabad, Rawalpindi and Islamabad.

Sr.No	Samples	Sampling Sights	Mercury Levels in OPD air ng/m ³		Above Standard
			Max.	Mini.	*(300ng/m ³) No (%)
01	Dental teaching institutions	17	44067	109	15 (88)
02	General Hospitals	7	17172	174	5 (71)
03	Dental Clinics (Private)	10	1800	333	10 (100)

*ATSDR, 2012

The study also showed the unawareness regarding appropriate handling of mercury/mercury amalgam, mercury containing wastes, improper and inadequate ventilation system and lack of awareness regarding health hazards of mercury to human health. Our findings reveal that the main reasons for the observed elevated levels of mercury in air at OPD, adjacent corridors and

the surrounding air, at some of the visited sites, were the careless use of mercury/mercury amalgam and inappropriate mercury/mercury amalgam waste management.

Recommendations

In order to reduce the risk of mercury exposure to public health, we recommend that use of health hazardous mercury and its emission be banned follow up to signing and ratifying the Minamata Convention on mercury (2013) by the government of Pakistan at the earliest time possible.

- Following the best preventive approach - "Waste Reduction at Source," mercury emissions/releases streams be identified within dental sites through an environmental waste audit, so that accordingly, control measures be designed and implemented at the earliest.
- Non-mercury dental fillings be advised to patients by dentists.
- Best in-house environmental practices (cross ventilation, exhaust fans) and use of best environment friendly technology be encouraged, standard operating procedures for mercury handling, transport and use, be developed and implemented.
- An institutional mercury waste management plan be put in place at all mercury operated sites and the same be periodically monitored and evaluated, by the management.
- Capsulated mercury amalgam use be promoted, as these effectively and substantially reduce mercury waste, releases/emissions to the environment.
- At the identified highly polluted dental sites in the present study (evident from the reported data of snap/spot measurements of mercury vapors in air, at the time of measurements), a follow up comprehensive survey and monitoring program, including measurement of mercury levels for 8 hours exposure period, be developed and implemented at the earliest, to further confirm risks to public health in general and visitors/medicals staff in particular.
- Mercury specific legislation, including national emissions/releases standards, standard minimum mercury in products and protocols for permits/license be introduced for private clinics/teaching institutions.

Acknowledgements

Collaboration of Zero Mercury Working Group (ZMWG) & Institute of Chemical Sciences (ICS), Peshawar University and the financial support by the Sigrid Rausing Trust and the European Commission via the European Environmental Bureau (EEB) for this study is gratefully acknowledged. We are also thankful to our SDPI colleagues, Fareeha Mehmood and Sehrish Jahangir for their part-time valuable contributions towards this study.

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Annex(s)

Annex A: List of Teaching Institutions Monitored.

- University college of dentistry , Lahore (Lat: 073.09311 ;Long: 33.72018)
- Punjab dental hospital , Lahore (Lat: 073.09311 ;Long: 33.72018)
- Fatima Jinnah medical college for women, Lahore (Lat: 073.09311 ;Long: 33.72018)
- Mayo hospital, Lahore (Lat: 073.09311 ;Long: 33.72018)
- Sharif medical and dental college, Lahore (Lat: 073.09311 ;Long: 33.72018)
- Lahore medical and dental college, Lahore (Lat: 073.09311 ;Long: 33.72018)
- Ghurki trust teaching hospital, Lahore (Lat: 073.09311 ;Long: 33.72018)
- Sardar Begum teaching hospital, Peshawar (Lat: 071.50056; Long: 34.00214)
- Khyber college of dentistry, Peshawar (Lat: 071.50056; Long: 34.00214)
- Naseer teaching hospital, Peshawar (Lat: 071.50056; Long: 34.00214)
- Peshawar medical and dental college, Peshawar (Lat: 071.50056; Long: 34.00214)
- Town teaching hospital, Peshawar (Lat: 071.50056; Long: 34.00214)
- Margalla college of dentistry, Rawalpindi (Lat: 071.50056; Long: 34.00214)
- Islamic international dental college, Islamabad (Lat: 071.50056 ,Long: 34.00214)
- Islamabad medical and dental hospital, Islamabad (Lat: 071.50056; Long: 34.00214)
- Ayub Medical college, Abbottabad (Lat: 073.03164, Long:33.68727)
- Frontier medical college, Abbottabad (Lat: 073.03164; Long: 33.68727)

Annex B: List of General Hospitals Monitored.

- Northwest general hospital and research center, Peshawar (Lat: 071.50056; Long: 34.00214)
- Fawad and associates, Peshawar (Lat: 071.50056; Long: 34.00214)
- Polyclinic hospital, Islamabad Rawalpindi (Lat: 071.50056; Long: 34.00214)
- Rawal medical and dental hospital, Islamabad (Lat: 071.50056; Long: 34.00214)
- Shifa international hospital, Islamabad (Lat: 071.50056; Long: 34.00214)
- District Headquarters Hospital, Rawalpindi (Lat: 071.50056; Long: 34.00214)
- Bilal hospital, Rawalpindi (Lat: 071.50056; Long: 34.00214)

Annex C: List of Private Clinics Monitored.

- FMH specialist care center, Lahore (Lat: 073.09311 ;Long: 33.72018)
- The Dental cooperation, Lahore (Lat: 073.09311 ;Long: 33.72018)
- Nasir Shah clinic, Peshawar (Lat: 071.50056; Long: 34.00214)
- Hameed Awan and associates, Peshawar (Lat: 071.50056; Long: 34.00214)
- Zea dentistry center, Peshawar (Lat: 071.50056; Long: 34.00214)
- Syed Nasir Shah clinic, Peshawar (Lat: 071.50056; Long: 34.00214)
- Tariq dental clinic, Islamabad (Lat: 071.50056; Long: 34.00214)
- The art dentist, Islamabad (Lat: 071.50056; Long: 34.00214)
- Agha khan family health center, Islamabad (Lat: 071.50056; Long: 34.00214) ••