



DENTAL PRACTICE Environmental Footprint

Dentistry is a branch of medicine which deals with evaluation, diagnosis and treatment of diseases, disorders and conditions of the oral cavity, areas around the mouth and/or associated structures and their impact on the human body.¹ It is an essential part of health services, but the way it is practiced is not environmentally sustainable. Oral health care professionals use vast amounts of resources in their daily clinical operations, which contribute to the global pollution burden and climate change. The field of dentistry has various subspecialties and nearly all of them create a carbon footprint via the appliances or techniques used in the day-to-day running of a dental office. In simpler terms, an operational dental clinic has various environmental impacts occurring as a result of unsustainable or faulty practices. There is increasing awareness of the problems but there is lack of knowledge on how to become more environmentally sustainable. This brief paper aims to give some insights to the oral health care practitioners in going 'GREEN'.

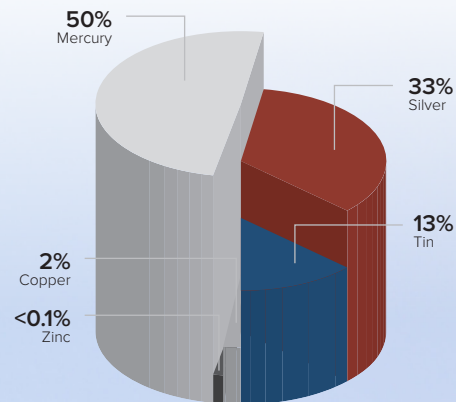
Major Contributors

AMALGAM FILLINGS

Probably the biggest environmental threat that finds its way out of a dental office is dental amalgam. Amalgam which contains 50% elemental mercury is often misinterpreted as "silver fillings" among common masses who are unaware of the presence of mercury in it.

Mercury, an established neurotoxin is extremely toxic in nature and causes major environmental and health hazards. Pregnant women and children in the developmental stage are most affected by it, where it can cause hindrance in the development of the nervous system and can also cause premature delivery.

High level of exposure can damage the brain, lungs and kidneys in people across all age groups². Dental Amalgam is also the largest source of mercury in breast milk, and can cross the placental barrier harming the developing fetus.



Composition of Dental amalgam



Mercury released during placement of a restoration-**6-8 µg**

Mercury released during removal of a restoration-**15-20µg**

Mercury released during Trituration-**1-2µg**

Mercury released during Dry Polishing-**44µg**

According to a study³ on dental practices mercury waste is one of the biggest sources of mercury in the waste water system. Once amalgam is wrongly disposed of and washed down the drain, the conditions present in the sewer sludge are conducive to converting mercury to methylmercury which is a potent health hazard. In the waterways, it enters the food chain, bioaccumulating and biomagnifying at every step till it reaches back to us via the food we consume (mainly shellfish).

While most people believe that mercury vapor release from amalgam only happens while the filling is placed or removed, in reality, mercury vapors are released even during activities like mastication and brushing. Mercury vapors once released, can travel up to hundreds of kilometers.



Processes like manual trituration and mulling, incorrectly disposing non-contact amalgam (amalgam filling which is left over post restoration and is disposed of), wrongly handled mercury spill pose serious threat to the health of the dentists, dental assistants and auxiliaries who deal with mercury-based fillings on a day-to-day basis. Several guidelines⁴ suggest that the average daily exposure to mercury vapors in a workplace setting (an average of 8 hour a day) should range between 25-50µg/m³. Activities like dry polishing in a single sitting can generate up to 44µg of mercury in the surrounding environment.⁵

SILVER IN DENTAL CLINICS

Traditional X-ray machines are being used at many dental clinics, hospitals and teaching institutions all across the country till date. These traditional units require the X-ray



Conventional x-ray film

films to be developed in dark rooms which house the developer and fixer solutions. The X-ray fixer solution has silver content. These solutions once used and spent are discharged into sewers or disposed wrongly leading to environmental pollution. Another source of silver is unused films. They contain unused silver which if disposed along with regular waste can be toxic to the environment. The X-ray fixer solution also contains harmful substances like ammonium thiocyanate and boric anhydride which act as an irritant to the skin, eyes and respiratory tract, along with having a toxic effect on lungs, blood kidney and long-term exposure can result in organ damage as well.⁶

LEAD IN DENTAL OFFICES

A typical dental film packet consists of the outer cover, a black paper, the X-ray film and the thin lead foil. Each dental film has a thin lead foil surrounding it. After the X-ray is performed, and the film is taken out from the packet for further processing, the black paper and lead foil finds its way to the dustbins, where the majority of it ends up in the landfills. Once it is in landfills, it stays for roughly the next 2000 years⁷. When lead comes in contact with the soil surface, it can also be absorbed by plants and enter the food chain.⁸ Being a potent neurotoxin, it endangers human health when it comes in contact with human beings.

The conventional X-ray system used in dental clinics generates annual waste of 4.8 million lead foils and 28 million liters of X-ray fixer solution

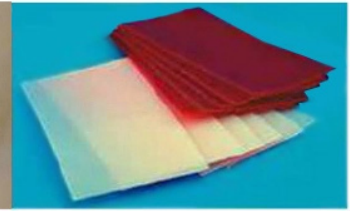
- Environment Protection Agency

GYPSUM, DENTAL WAX & DENTAL CASTING ALLOYS

Gypsum, a commonly used dental material used for making models, used as plaster of Paris, dental stone and a pre-clinical teaching material is mostly discarded in the bin and ultimately the landfills once it is used. In the landfill, it produces hydrogen sulfide as a result of reduction. The hydrogen sulfide not only produces a rotten egg smell in the landfill, but also acts as a potent irritant for the eyes, nose and throat and may also result in difficulty in breathing among sensitive groups. It may also result in poor memory function and impaired balance.⁹

Dental waxes also find usage across a lot of procedures in dentistry, mainly in creating occlusal rims during construction of complete or partial dentures. Dental waxes and gypsum are majorly used during the early preparatory stage of denture making and get completely discarded post the initial process. Most dental practitioners treat them both as one-time use products and discard them in the dustbin post usage. Dental waxes and gypsum can be reclaimed and recycled with a majority of their properties intact post the recycling process. Both dental wax and gypsum can be recycled and reused a number of times without affecting their basic properties.

Dental casting alloys and base metal alloys are used in the process of crown & bridge preparation. A major percentage of these alloys gets wasted (roughly 40-50%) during the preparatory stage of metal crowns



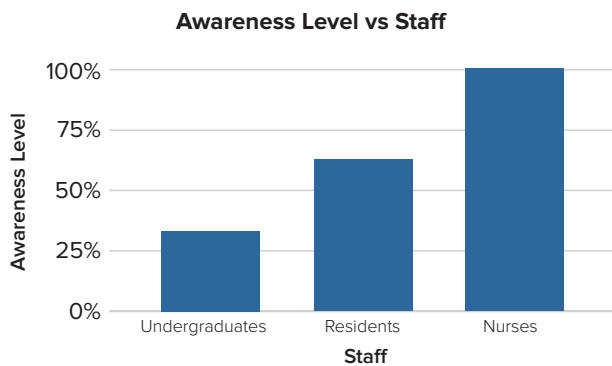
Different types of waxes used in a dental clinic

& bridges. These metals which can be put to other uses are discarded into the bins. Similar to dental wax and gypsum, they retain 90-95% of their original mechanical properties even after treatment which can later be reused.¹⁰ As these materials are termed as “Super Alloys”, they find wide application in other industries as well and thus this dental waste can act as a raw material for various other enterprises. However, some manufacturers indicate their single usage.¹¹



BIOMEDICAL WASTE

Most dental setups generate biomedical waste in all four categories (yellow, red, blue and white) and they come under the ambit of the Biomedical Waste Management Rules, 2016. However, a lot of study reports project that most dental clinics do not follow the norms laid down under the rules. Lack of strict monitoring by prescribed regulatory authorities on the waste generation by dental hospitals and clinics is suggestively the major cause. Another possible explanation is lack of knowledge among young dentists and dental students. As per a study¹² conducted in a tertiary care facility in Delhi, more than 65% of undergraduate dental students were unaware of biomedical waste management. Thus, it is needed to educate and train students at the undergraduate level so that they understand the importance of proper segregation and disposal of waste once they begin practicing.



Awareness levels on biomedical waste management among various staff members in a Delhi dental hospital

DISPOSABLE ONE-TIME USE PRODUCTS

Dental clinics are one of the major consumers of disposable products. These products include patient bibs, chair sheets, plastic cups, disposable plastic syringes, disposable plastic suction tips, paper towels, plastic impression trays, disposable patient gowns and disposable sterilization pouches. Apart from single-use items, dental practices leave behind a huge paper trail, in the form of extensive dental records, appointment sheets and the most common of them all, paper cups. Paper cups are extensively used in dental clinics for gargles, rinsing and mouth washing. In the United States alone, \$2,000 worth of money is spent in an average clinic on paper products and syringe tips¹³.

OTHER PRACTICES IN A DENTAL CLINIC THAT CAN NEGATIVELY AFFECT THE ENVIRONMENT ARE:

- **Cold sterilization methods.** - Cold sterilization involves sterilizing reusable items in a dental clinic like suction tips, cheek retractors etc. by immersing them in chemicals. Such a process is carried out for products which cannot withstand high temperatures. These chemicals can be glutaraldehyde, peracetic acid, or hydrogen peroxide. Hydrogen Peroxide is a widely used chemical for cold sterilization procedures. Cold Sterilization takes roughly 3-4 hours to become effective.
- **Use of chemical-laden disinfectants-** Chemical disinfectants are slightly less effective than sterilization liquids as they do not damage bacterial spores. A wide variety of chemical-laden disinfectants are commercially available ranging from ethyl alcohol to formalin & phenols.
- **Mercury-containing vapor lamps/fluorescent light bulbs**

GREEN DENTISTRY

Green dentistry is a relatively new and emerging concept in dentistry. Most dental offices are privately-owned small establishments and hence are hesitant in investing in environmental-friendly practices. But small steps can be taken at various levels to assist in the process of achieving sustainable dental practice. Adopting few or all of these suggestions can go a long way in converting a general dental clinic to a “greener, safer & eco-friendly” clinic. There are also financial and reputational benefits to becoming more sustainable for dental practices.

STEPS AT THE CONSTRUCTION LEVEL

- A clinic should be well-ventilated and have adequate natural lighting which results in reduced requirement of artificial light during daytime. Good ventilation also helps in easy dispersal of vapors generated during mechanical dental procedures.
- Flooring of the dental clinic should be made using materials like Linoleum
- Lead-free & volatile organic compound (VOC) free wall paints should be used
- LED lights instead of Fluorescent/ CFL tubes ought to be installed
- Use of motion detectors for air conditioning & tube lights/light bulbs should be encouraged.



- Adequate lockable storage space must be created away from the patient operating area to ensure safe storage of chemicals and dental products.
- A water-less central vacuum system which comes with an amalgam trap should be installed
- Digital X-ray systems should be set up which do not require lead containing X-ray films or silver-based fixer solutions for processing. It also emits 70-90% less radiation than conventional radiation and thereby is less harmful.

STEPS AT THE PROCUREMENT LEVEL

- Mercury-free restorative materials for endodontic procedures should be procured
- Procurement of stainless-steel products like suction tips, impression trays instead of plastic ones needs to be encouraged.
- Cloth-based sterilization pouches, aprons, patient bibs and chair sheets instead of disposable plastic ones ought to be procured.
- Procurement of recycled stationery items should be the norm. Paper-based products like paper cups should be replaced with steel/glass.
- Procurement of chemical-free disinfectants should be done
- Procurement of glass-based needles instead of plastic disposable ones is required.
- If mercury-based restorative material is being used, mercury spill kits for timely and scientific management of any accident/spill should be ordered. Additional kits should also be kept and should be immediately available once, the current ones are spent.

STEPS AT THE OPERATIONAL LEVEL

- Dentists must inform patients about the ill-effects of mercury clarifying the misnomer “silver fillings” and encourage them to shift to alternative filling materials like glass ionomer cements & composite resins. Pregnant women and children should be discouraged from having amalgam fillings as a treatment option for carious teeth
- Biomedical waste must be segregated at source in 4 separate color-coded bins to avoid cross contamination
- Tying up with a CBWTF is recommended to ensure proper disposal of the biomedical waste and safeguarding the health of the patient’s visitors and the staff working in a dental clinic.
- Adequate training must be provided to all staff members on biomedical waste management, usage of proper PPE, mercury spillage and its harmful effects on health & environment.
- Usage of proper personal protective equipment at all times is essential when in the operating area.
- Patient records, follow-ups, x-rays should be maintained electronically thereby reducing paper consumption.
- If the traditional X-ray system is being reused, spent fixer solution and lead foils should be collected and sent for recycling.
- Used dental waxes, dental alloys and gypsum should be sent for recycling to allow reclaim as most of these products retain 80-90% of their properties after undergoing treatments.
- Steam sterilization must be done to sterilize dental instruments instead of a chemical-based treatment.
- Incorporating the 4Rs in dental practice: Reduce, Reuse, Rethink and Recycle at all times is crucial.

Endnotes

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