

Review Article

GREEN DENTISTRY: A METAMORPHOSIS TOWARDS AN ECO-FRIENDLY DENTISTRY: A REVIEW

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ABSTRACT

Traditional Dentistry produces waste materials that cause harm to the soil and to the biosphere. So it is the need of the hour what every one of us in the Dental profession can do our bit to protect our planet. Eco-Dentistry or "Green Dentistry" is an approach to Dentistry that combines Dental practices and environmental conservation. A green Dental practice use non-toxic products, reduce waste, reduce the carbon footprint, saves energy, water, money, incorporates high tech innovations and focuses on wellness and integrative practices. It is the wave of the future. The purpose of this review is to raise widespread awareness of environmental alternatives in the Dental community and to provide a series of "green" recommendations that Dentists around the world can implement to become leading stewards of the environment

INTRODUCTION

What exactly is "going green"? What does it mean to the practice of Dentistry? Dental healthcare professionals know the importance of preserving the environment and the environment's contribution to overall health and well-being (Hawken, 1993). The color green has healing power and is understood to be the most restful and relaxing color. Green can help enhance vision, stability and endurance. Renewal, growth, and hope are related to this color and it indicates safety in the advertising of drugs and medical products¹. Green Dentistry is an approach to dentistry that combines dental practices and environmental conservation. The concept to conserve natural resources can be traced back to the 1800s. However, it was not until 1970 that the first Earth Day was established (Hawken, 1993; Newman, 2010). Increasing consumption of diminishing natural resources, air and water pollution, ever-growing landfills, and the effects of global warming, makes saving our environment imperative. So going green is the right thing to do. The concept of going green involves a person, family, or group becoming more conscious about the destruction of the environment and adopts practices that help reduce waste or become more energy efficient.

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The color green is used because it reminds us of the outdoors and the environment (Shetty, 2011). Similarly, field of Dentistry has adopted this concept so as to make it environmental-friendly. Dentists have adopted practices to reduce/minimize the environmental impacts in office administration, marketing, construction, design, and dental processes and materials. This is called as green dentistry or eco-dentistry (<http://www.ecodentistry.org/?aboutgreendentistry>). Eco-dentistry association defines green Dentistry as "a high-tech approach that reduces the environmental impact of Dental practices and encompasses a service model for dentistry that supports and maintains wellness" (Laboratory diagnoses biosafety and quality control, ?).

It is based on waste reduction, energy conservation, and pollution prevention. Green means different things to different people in different circumstances. There are different shades of green: different degrees to which we can green our Dental practice. Whichever shade of green are chosen—whether greening the current practice, planning a new green clinic in an existing building, or designing a new green clinic building (Laboratory diagnoses biosafety and quality control, ?). Dentistry can lessen the combined environmental impact by utilizing the "Four R's of Going Green," namely, "Recycle, Reduce, Reuse and Rethink (Hawken, 1993)."

Classification (Hiltz, 2007 and Arenholt Blindslev, 1992):

Non-hazardous waste

This constitutes about 85% of the waste generated in most healthcare set-ups. This includes waste comprising of food remnants, fruit peels, wash water, paper cartons, packaging material etc.

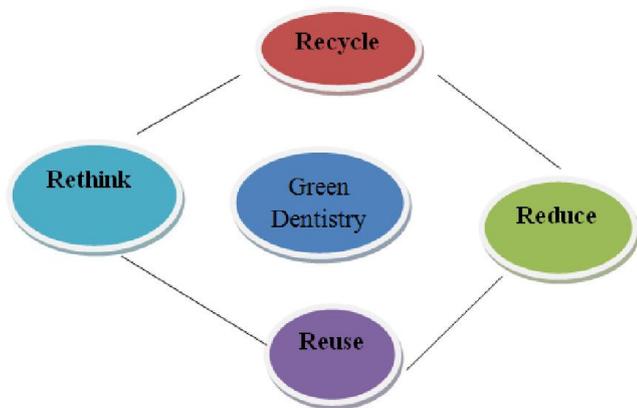


Fig. 1. The 4 R's of Green Dentistry

Hazardous waste

Potentially infectious waste

Over the years different terms for infectious waste have been used in the scientific literature in regulation and in the guidance manuals and standards'. Those include infectious, infective, medical, biomedical, hazardous, red bag, contaminated, medical infections, and regulated medical waste. All these terms indicate basically the same type of waste, although the terms used in regulations are usually defined more specifically. It includes.

- Blood and blood products.
- Dressings and swabs contaminated with blood, pus and body fluids.
- Laboratory waste including laboratory culture stocks of infectious agents.
- Potentially infected animals used in diagnostic and research studies.
- Potentially injected material. Excised tumors and organs, extracted teeth etc.
- Sharps which include needle, syringes blades etc.

Potentially toxic waste:

- Chemical waste: It include disinfectants (hypochlorite, gluteraldehyde, iodophors, phenolic derivatives' and alcohol based preparation), X-Ray processing solutions, monomers and associated reagents, base metal debris(dental amalgam in extracted teeth).
- Pharmaceutical waste: It includes anesthetics, sedative, antibiotic and analgesics etc.
- Radioactive waste: Includes waste contaminated with radionuclide;

Advantages of Green Dentistry

- Reduces waste and pollution.
- Saves energy, water and money.

- Supports a wellness lifestyle, focusing on preventative care and lifelong dental and whole body health.
- Uses high-tech practices.

Concept of Eco-Friendly Dentistry

- Do high-tech dentistry
- Reduces dental waste and pollution
- Saves water, energy and money

Greening the Current dental practice (Hawken, 1993; Newman, 2010; Shetty, 2011; <http://www.ecodentistry.org/?aboutgreendentistry>; Laboratory diagnoses biosafety and quality control, ?; Seymour Block, 2001; Hiltz, 2007; Arenholt Blindslev, 1992; Chin *et al.*, 2000; Farhani *et al.*, 2007; Shetty Vittaldas, 2012; EzineArticles.com/?expert=Shan; <http://naturaldentistry.us/holistic-dentistry/green-dentistry>; <http://www.bourncreative.com/meaning-of-thecolor-green>; Chin *et al.*, 2008; Kao *et al.*, 2004; Samek, 1994; Anderson, 1999; Chilibeck, 2000; Rogers, 1989; Pockrass, 2005; Palenik, 2003; Anderson, 1999 and Hiltz, 2007)

Most of the practice may already be a light shade of green. A variety of options are available for Dentists to be as green as they want to be. Many practices have already taken steps to become a greener practice, such as installing an amalgam separator or switching to digital X-rays. Here are some ideas for greening your Dental practice:

Infection Control

Dental office infection control and sterilization processes can be a major source of pollution and waste in the traditional Dental practice. Chemicals used in infection control and sterilization processes in Dental office can be quite dangerous. They can jeopardize employee health, contribute to poor office air quality, and can pollute our community's water stream. Non-toxic alternatives for infection control and sterilization have the same or greater effectiveness in getting the job done, while protecting the health and safety of dental practitioners, patients, and our neighborhoods.

X-ray wastes: 10, 11

- X-Ray fixer solutions: It is considered hazardous waste because of high silver content. It has to be disposed off as a hazardous waste or sent to silver recovery systems. X-ray fixers contain chemicals such as ammonium thiocyanate and boric anhydride. These chemicals are known to be skin, eye, and respiratory tract irritants, and hazardous if ingested or inhaled. They also may be toxic to the blood, thyroid, kidneys, and liver, and repeated or prolonged exposure can produce target organ damage.
- Developer solutions can go into waste water drain. X-Ray developer fixer should not be mixed. If mixed they should be separated and treated independently.
- X-ray lead foil/shields: Lead foil that shields X-ray film or protective lead shields should not be disposed of in the garbage. These materials are hazardous waste unless they are recycled for their scrap metal content. Lead foils and shields contain pure lead. Lead is treated as hazardous waste or recycled for scrap metal content.

In the environment, lead waste is held in the topsoil, where it can remain for as long as 2000 years. It is readily picked up by plants and enters our food system. Lead is a deadly neurotoxin.

- Dentists can use digital X-Ray equipment, which eliminates need for processing chemicals. In addition, digital X-Ray's reduce patient radiation exposure.
- Cleaners for X-ray Developer Systems: Many cleaners for X-ray developer systems contain chromium. According to photo industry representatives, the environmentally safe cleaners are as effective as the chromium-based cleaners.

Amalgam

Dental amalgam particles are a source of mercury, which is known to be neurotoxic and nephrotoxic. Mercury vapor or elemental mercury, is the most significant form for the dentist's and patients health care concerns.

Precautions during preparing placement of Amalgam:

- Instead of manual manipulations only preencapsulated amalgam always should be used.
- The capsules should be recapped after use and stored in closed containers for recycling.
- Avoid skin contact with mercury or freshly mixed amalgam. High-volume evacuation systems must be employed during finishing or removing amalgam restorations.
- After condensation, the scrap should be collected and stored in water, glycerin or X - Ray fixer in a tightly capped jar (almost filled with liquid to reduce the space where mercury can collect).
- Rubber dams, high volume evacuation and water cooling should be used to reduce the vapor released during removal of old amalgam restorations.
- Amalgam scrap should be disposed of as hazardous waste or should be sent to a recycler. Waste mercury is disposed similarly.
- Since amalgam decomposes on heating; amalgam scrap should not be disposed in the waste that could eventually be incinerated.
- Another option is to install an amalgam separator. Amalgam separators that comply with the International Organization for Standardization (ISO) 11143, when used with traps and vacuum pump filters can achieve better than 95% amalgam removal efficiency
- Alternative to silver amalgam as a filling material are glass ionomers, indirect restorative dental materials dental ceramic, gold alloys, composites etc

Plastics

Disposable syringes, bottles, surgical gloves are examples of plastics used in Dental clinic. Once hailed as a wonder natural plastic is now a serious environmental and health concern due to its non-biodegradable nature. Burning of plastics releases carcinogens like dioxin and furan. Designing eco-friendly, biodegradable plastics are the need of the hour.

Blood-soaked materials

It must not be discarded with regular garbage. They should be separated from other wastes, collected in yellow liner and stored for fewer than 4 days. For any longer, the material must be refrigerated (below 4°C). Once a certain amount has been collected, a biomedical waste carrier must be contacted for disposal.

Flowable quantities of blood may be sewerred; however, bulk amounts of blood should not be disposed of into a septic system. Swabs or dressings that are bloody and dripping need to be treated as infectious medical waste. If they contain only a small amount of blood that will not drip out of the material, they can be placed in the garbage.

Dental laboratory waste

Like disposable trays or impression materials may be considered general waste and treated accordingly.

Disposal of sharps

Needles, scalpels, reamers, broaches, and other sharp objects that could cause a puncture wound should not be placed in the garbage even if they are sterilized. This type of waste should be placed in a rigid puncture-resistant labelled container, designed to prevent the loss of the contents and labelled with a visible biohazard emblem or with the visible words "biohazard," "sharps," or "infectious waste." A heavy-walled detergent bottle with screw-on cap is acceptable for WIDNR and OSHA standards. Disposal should be through a licensed infectious waste transporter or a registered sharp collection station. Red bags are used for disposing sharps, tubing, gloves blood bags, plastic bottles, syringes etc. Yellow bags are used for waste with significant health care risk, such as human waste, cotton, extracted teeth etc. Blue bags are used for blades medicine vials/ampules or glass bottles etc.

Disinfectants

Used disinfectants may be discharged directly to the sewage system. Residue left in containers may be rinsed down the drain; the container may be disposed of in the garbage or recycled through your local recycling program. Flush the drain well when disposing of any disinfectant. Straight alcohols, ethers, and peroxides are considered flammable and should not be sewerred because of the possibility of explosion.

Chemical Waste

Used chemical sterilizer waste may be discharged to the sewer system. Flush the drain well when disposing of this waste. Any unused chemical is a hazardous waste if it has a flash point below 140 degrees Fahrenheit, or if it contains high concentrations of formaldehyde. Buy only the amount of chemical sterilizer that you need; this will eliminate the need to dispose of the excess material.

Choose an efficient HVAC system

The heating, ventilation, and air conditioning (HVAC) systems have a high impact on energy use and must be specified carefully. High-efficiency HVAC systems are readily available but must be appropriately designed for the space. A heat pump system with a geothermal heating and cooling source provides a great low-energy. Geothermal systems use wells or piping to tap into the natural stability of the temperature of the Earth below the immediate surface.

Reduce waste

When we reduce our waste, we reduce overhead costs, save valuable materials, and minimize impact on landfills. Most people don't realize that water purification plants and wastewater treatment plants consume a great deal of energy, use large quantities of materials, and create much waste.

There are many ways in which dental clinics can reduce both water consumption and wastewater output.

Some of the ways are

- Recycle bottles, cans, batteries, and paper as much as possible.
- Re-use lab and shipping boxes.
- Switch to cloth sterilization bags and patient barriers.
- Switch to stainless steel impression trays, suction tips.
- Use glasses and mugs instead of disposable cups.
- Use of laundering cloth bibs instead of using disposable paper ones.
- Use re-usable face shields.
- Use washable dishes and cutlery in the staff break room.

Go paperless

By switching to digital patient files and billing, we can increase staff efficiency and reduce the material costs of folders, labels, and preprinted forms. We can also try using electronic forms on which patients can enter information. When paper cannot be avoided, use recycled paper products.

Energy conservation

The various ways of conserving energy includes the following:

- **Use solar energy-** Solar energy is free; make the most use of it you can. Solar roof panels that heat water bring a fairly quick return on your investment, sometimes as short as three to five years. Solar photovoltaic panels that generate electricity take longer to provide a return, but with the costs of these systems on the decline, this may soon change.
- **Green Building-** A green building is environmentally responsible and resource efficient through its life cycle: From its design, construction, and operation to maintenance, renovation, and demolition. US based Leadership in Energy and Environmental Design (LEED) is the dominant global rating system, also popular in India. TERI conceived Green Rating for Integrated Habitat Assessment; a National Rating System of India is equivalent of LEED. It uses a star rating (five stars equivalent to LEED's platinum rating). A green dental building may cost more up front but, in the long run, will save money through lower operating costs over the life of the building. Simple ways to go green are as follows:
 - Use concrete instead of bricks. Its improved thermal efficiency reduce heating and cooling load. It's light reduces cost and energy in transportation
 - Use double wall glass in window so as to reduce direct heat gain and glare while maximizing the sunlight entering your rooms
 - Paint your exteriors and room walls with eco-friendly nontoxic paints that do not use petrochemicals involved in creation of traditional paints that can pollute the atmosphere through toxic fumes when discarded irresponsibly
 - Use linoleum, a more environmentally friendly choice for flooring
 - Hire an environmentally friendly landscape company that uses natural growth product and procedures as an alternative to harmful pesticides to care for your office's lawn
 - Check around windows and doors for cold or hot air escaping into or out of the building. Use weather stripping or re-caulk in areas where leakage is found.

- **Water heaters-** Lowering the temperature on water heaters is a quick and easy step for energy conservation. It is advised use the cold rinse cycle in the washer for laundry
- **Programmable thermostat-** The thermostat(s) can be programmed to run on different temperatures at different times of the day. Depending on the outside temperature, adjust the temperature while the office is closed to conserve electricity.
- **Use compact fluorescent lamps-** Another way to reduce your monthly electric bill is to replace incandescent light bulbs with compact fluorescent lamps (CFLs). CFLs last several years and use about 75 percent less electricity. Switching off lights on lunch breaks and use of energy saving bulbs in reception and communal areas
- **Reduce phantom power-** Never forget the devices us "vampire power" or "phantom electricity" we use on a daily basis but don't typically think about-the trickles of electricity that drain from certain appliances, transformers, and equipment even when not in use. Devices that use phantom power include electronic phones, surge-protected extension cords, small transformers for electronics, and instant-on devices like TVs, monitors, and computers.
- **Choose new equipment wisely.** When it's time to replace appliances, monitors, and computers, look for equipment with the energy star label. Some energy-efficient devices pay for themselves in just a few years with their reduction in energy use. Don't forget to recycle any old devices you replace!

Use healthy cleaning products and paints

Chemical cleaning products can release VOCs (volatile organic compounds) into your clinic environment. VOCs are not good for your health or your patient's health. Some people develop allergic reactions to VOCs; for this reason alone, it's a wise decision to reduce the VOCs in your clinic environment. Switch to eco-friendly cleaning products to reduce or eliminate this source of VOCs and possibly reduce costs. In addition, consider using low-VOC or no-VOC paints when putting that fresh coat of paint on your clinic.

Technique evolution for waste reduction

Digital technologies offer early diagnosis, preventive therapies, and education that serve the needs of wellness lifestyle patients committed to maintaining long-term wellness and seeking to avoid invasive or expensive procedures. Many high-tech cosmetic practices see a boost in new patients and practices success when they recognize the eco-friendly value of their high-tech investments.

More High-Tech, Eco-Friendly, Wellness-Based Dental Technologies:

- CAD/CAM Systems in office laboratory restorations which is convenient completion of lab-quality restorations in single appointment, comfort of digital impressions and reduces greenhouse gases produced from patient and staff travel for multiple appointments, and the shipping of impressions and final restorations, sometimes as far as overseas which is useful for the patient as well as the environment.
- Digital Impressions.
- Digital Oral Cancer Screening.

- Digital Patient Charting.
- Instead of old x-ray machines prefer digital imaging (x-rays) which has instant image availability, improved image quality, enhanced diagnostic efficacy, minimal radiation
- On-site Biomedical Waste Disposal Systems.
- Oral Detoxification with Laser Hygiene Technologies.

Conclusion

Reducing waste, changing patterns of consumption and limiting the amount of adverse chemicals entering the breathable air of dental office are achievable and realistic goals. Lack of knowledge and increased cost of waste management are important issues that impend waste management. Dentists have power to create a cleaner, greener planet for future generations. To conclude we quote Ray Kroc "As long you are green, you are growing. As soon you are ripe, you start to rot." So let us go green today and save mother Earth from biohazards for a better tomorrow.

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