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Research Paper

An Emphasis on Wide Usuage and Handling of Bio Medical Waste -Dental Perspective

Medical Science

KEYWORDS : Biomedical waste, dental waste, hospital waste, waste management

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ABSTRACT

Any waste generated consequent to health care activity, from an environment point of view, is health care waste. Dental practices generate large amounts of dental waste which is of environmental concern. Adequate knowledge, information of handling, treatment and disposal of biomedical wastes are important elements of dental health care. Dental waste management can be effective and an efficient compliance-related practice. This review article discusses about some common wastes produced by dental offices and provides practical suggestions for reducing the impact of our profession on the environment.

INTRODUCTION

Dental hospital is a complex multidisciplinary system which consumes lots of items for delivery of dental care. [1] Since last few years there has been a rapid mushrooming of dental hospitals and clinics, both in government and corporate sector to cater to the needs of expanding population. Correspondingly, there has been increase in the quantum of dental health care wastes.

Though the quantity from each set up may not be as in general hospital, the collective quantity is certainly significant. [1] The waste generated as a result of patient care activities like diagnosis, treatment, or research, has the potential to transmit various viral, bacterial or parasitic diseases to the staff, patients and population at large. [2] So the aim of this paper was to review and analyze critically the current available literature on bio medical waste management in the field of dentistry and discuss best management practices regarding the waste generated in the dental sector.

HISTORICAL BACKGROUND

The essences of cleanliness was captured by the Dravidians , who in 5000 B.C gave due emphasis to safe and effective sewerage systems, to get rid of all solid and liquid waste generated by the population. They were indeed the pioneers as far scientific waste management is considered. [3]

Until fairly recently, medical waste management was not generally considered an issue. In the 1980s and 1990s, concerns about exposure to human immunodeficiency virus (HIV) and hepatitis B virus (HBV) led to questions about potential risks inherent in medical waste. [4] Hospital waste generation has become a prime concern due to its multidimensional ramifications as a risk factor to the health of patients, hospital staff and extending beyond the boundaries of the medical establishment to the general population.

- Waste : "any material, solid, liquid or gas, that is unwanted and/ or unvalued, and discarded or discharged by its owner."[1]
- Hospital Waste: refers to all waste, biologic/non-biologic that is discarded not intended for further use. Medical waste is a subset of hospital waste.[5]
- Bio Medical waste (BMW): any waste which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities or in the production or testing of biologicals.[6]

Biomedical Waste are generated in different health care establishments which include:[7]

1. Hospitals
2. Health-care centers

09. **Dental Clinics**

3. Acupuncturists

10. Pathology and microbiological Laboratories

4. Nursing Homes
5. Tattooists
6. Research centre
7. Blood transfusion centers & Blood banks
8. Animal Research
8. Physician's office

Composition of Hospital waste [8]

a. Non Hazardous- 80%
b. Hazardous - 20%
c. Hazardous but not infective – 5%
d. Hazardous but infective - 15%

RATIONALE OF HOSPITAL WASTE MANAGEMENT

The concern for biomedical waste management has been felt globally with the rise in deadly infections such as AIDS, Hepatitis B due to improper disposal of health care waste.

Hospital waste management is a part of hospital hygiene and maintenance activities. In fact only 15% of hospital waste i.e. "Biomedical waste" is hazardous. But when hazardous waste is not segregated at the source of generation and mixed with nonhazardous waste, then 100% waste becomes hazardous. [9]

What's happening? (Fig. 1)

A cross-sectional study of 432 private dental practitioners was conducted regarding Dental health care waste disposal among private dental practices in Bangalore City, India in 2008- to assess the knowledge, attitude and behavior of private dental practitioners on health care waste management. It was concluded that awareness have to be implemented regarding knowledge, segregation, handling and proper disposal of biomedical waste. [10]

A study was conducted to assess the awareness about biomedical waste management among dental professionals and auxillary staff in Amritsar, India and it was concluded that there was lack of awareness about most aspects of management of biomedical waste. [11]

Health Care Establishments (HCEs) are in operation without the adequate authorization from State Pollution Control Board (SPCB)/Pollution Control Committee (PCC) which means that waste generated from such facilities goes unaccounted and is dumped without any adequate treatment illegally. [12]

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Biomedical waste management issues:
A major issue related to current Bio-Medical waste management in many hospitals is that the implementation of Bio-Waste regulation is unsatisfactory as some hospitals are disposing of waste in a haphazard, improper and indiscriminate manner. Lack of segregation practices, results in mixing of hospital wastes with general waste making the whole waste stream hazardous. [13] Inappropriate segregation ultimately results in an incorrect method of waste disposal. Most importantly there is no mechanism to ensure that all waste collected and segregated, reaches its final destination without any pilferage. Additional hazard includes recycling of disposables without even pre-treatment of infectious waste.

Management of BMW is important to:
1. To reduce its impact on the community.
2. To support conservation of natural resources and preservation of environmental quality.
3. To maintain order and cleanliness in the health care settings
4. To reduce the cost and handling time

Bio-Medical waste management and handling rules have been notified in 1998.
The rules were amended twice in 2000, primarily to address administrative matters. The rule makes it mandatory for the health care establishments to segregate, disinfect, and dispose their waste in an ecofriendly manner. [12] An important prerequisite and key to successful waste management program is segregation which is the separation of different types of waste as per treatment and disposal option. Segregation and collection of various categories of waste should be done at source, in separate containers so that each category is treated in a suitable manner to render it harmless. For waste management to be effective, the waste should be managed at every step, from acquisition to disposal. [7, 14] Schedule I of the Bio-Medical rules contains the categories of Bio-Medical Waste (Refer to Table1). Schedule II contains the Color coding and the type of container for disposal of different Bio Medical waste categories. (Refer to Table2). [6,7]

Ministry of Environment and Forests has revised the Bio Medical Waste (Management and Handling) Rules promulgated under the Environment Protection Act. The Rules now called the Bio Medical Wastes (Management and Handling) Rules 2011 has been notified for information of the masses and feedback received from all fronts would be considered by the Central Government. The new Rules on BMW are elaborate, stringent and several new provisions have been added in it. (Refer to table no.3) O ne of the features of the new rules in 2011 is that now every occupier, operator regardless of the number of patients being serviced has to seek prior authorization from the prescribed authority which is the State Pollution Control Board for States. .**It is Applicable to all persons who-Generate**, **Collect Receive Store Transport Treat Dispose and handle the biomedical waste.** [4, 12, 15]

Label for bio-medical waste containers/bags- Collection of biomedical waste should be done as per BMW (management and handling rules, 1998) rule 6, Schedule II and the containers/bags should be labeled as per guidelines of schedule III, i.e., biohazard and cytotoxic symbol. [7,16] Waste streams that are designated for recycling/reclamation can be labeled as recyclable materials, e.g. "Scrap metal - to be recycled." (Fig .2)

Labeling helps to know the origin of waste, warns the staff and general public of hazardous nature of waste. The containers should have the biohazard symbol and the label should be non-washable and prominently visible. It should contain day, month, year, date of generation, waste category number, class and waste description along with senders name and address and all emergency contacts and addresses. [7,14,16,17]

Dental practices use and generate infectious metal-bearing solid dental waste substances that may be or are regulated under federal, state or local environmental regulations. [12,18] As dental practitioners, we must recognize that some of the materials and procedures we use to provide dental health services may present challenges to the environment. Realizing this, we can begin to take measures to minimize the production of these wastes and their potential environmental effects. Improper handling of dental waste will convert non-hazardous waste into hazardous. [19]

Hazardous dental waste Non hazardous dental waste

1. Amalgam waste 1. Offensive waste(gloves,mouth masks)
2. Sharps 2. X-ray films, lead foils
3. X-ray waste 3. Plaster cast waste
4. Chemical disinfectants 4. Base metals
5. Soiled waste 5. Acrylic dentures
6. From lab cultures,
7. Monomers

Green innovation has been the key technology internationally in all fields. Attempts to reuse the resources and decrease the amount of waste have to be encouraged.
To ensure compliance with the law, these materials must be properly handled, recycled, treated and/or disposed.[20-22] Recycling these materials minimizes potential impacts on the environment and liability for the dental practice. Therefore, recycling should be the waste management option selected whenever possible.

OPTIONS AVAILABLE AND BEST PRACTICES [3, 19, 23-35]

Substance/ Material	Hazard	Disposal/color code
Amalgam waste	a. Teeth with amalgam fillings– Hazardous- Dental Amalgam particles are a source of mercury, which is known to be neurotoxic and nephrotoxic(johcd b. Non hazardous- unused set amalgam , amalgam capsules	It should be disposed of in the "Scrap Amalgam" container to avoid incineration Use amalgam separators-designed to remove amalgam waste particles completely in dental office. These separators remove the particles using different techniques such as sedimentation, filtration, centrifugation, ion exchange. According to ADA mercury and silver in amalgam wastes should be recovered through distillation process and sent for recycling.
Spent X ray fixer- Collect and store used fixer in a closed plastic container labeled with the words, "Hazardous Waste-Used Fixer,	Hazardous-free ionic silver acts as an enzyme inhibitor by interfering with the metabolic processes of organisms.	Silver Recovery - Use a Silver recovery unit to recapture the silver from the fixer and once the container is full, contact a Certified Waste Carrier for recycling or the treated fixer can be disposed of down a drain.
X ray developer	Hazardous-contains hydroquinone	Used x-ray developer-High dilution disposal
Undeveloped-X ray films	Hazardous- Silver can contaminate the soil and groundwater if it is sent to a landfill	Silver recovery -Silver can be reclaimed from X-ray film
Developed –X ray films developed film	Non-hazardous	has little residual silver and can be placed in the regular solid waste stream.

Lead foils	hazardous-Lead is a heavy metal that affects neurological development and functions and can potentially leach from landfills into the environment	Lead Recovery - Label the container as hazardous waste, recycled by contacting a certified waste carrier for recovery of silver
Base metals, stainless steel wires brackets crowns, impression trays	Metal poisoning of biological systems depending on degree of corrosion Conventional dental impression trays are generally made of metal or plastic. Since dental impression trays are expensive, they are cleaned after having been used so that they can be used repeatedly leading to cross infection	Recycle, recasting of alloys for fixed prosthesis can be done without affecting its hardness Disposable impression trays-have been developed a disposable impression paper tray as disclosed in Japanese Patent Laid-open No. HEI 4-317648 (1992). This disposable tray is composed of a thermoplastic resin with reinforced fibers.

Impression materials, (decontaminated)	Rubber based materials minor portion in polymerized form containing zinc considered -hazardous waste Alginate	disposed in a sanitary landfill
		Waste/used alginate- used to generate calcium silicate cement-through high temperature calcinations
Plaster of Paris cast/ investments	If this material is disposed of at a normal landfill, it may produce hydrogen sulphide gas. For this reason, it is prohibited from landfill	Gypsum recovery-landfill in separate dedicated cell for gypsum.
Disinfectants (chemical waste)	Inactivation of essential biologic system	Collection & disposal as hazardous waste/ high dilution disposal in waste water
Etchants / organic / in organic acids	Related to byproducts of acid attack & corrosive effect	Collection & disposal as hazardous waste/ high dilution disposal in waste H_2O
Monomers (including resins & composites) IDJ1998vol:48,161-166	Poisoning of biological system. Source of potent allergies	Collection & disposal as hazardous waste

Substance/ Material	Hazard	Disposal/color code
Disinfectants (chemical waste)-for sterilization, disinfecting, cleaning	Inactivation of essential biologic system-hazardous	Collection and disposal as hazardous waste/ local municipality should be consulted, before discharging chemicals into the sewer system, if pH is <2 and >12.
Etchants/organic/in-organic acids	Related to by-products of acid attack and corrosive effect.	Collection and disposal as hazardous waste/high dilution disposal in waste water.
Monomers(including resins and composites)	Poisoning of biological system. Source of potent allergies.	Collection and disposal as hazardous waste
Acrylic dentures(non-biodegradable)	Hazardous-Burning of plastics releases carcinogens like dioxin and furan.	Long term land fill.
zinc based compounds	Toxic to aquatic organisms(Unused cements should not be disposed into sewer system)	Disposed as solid waste
Offensive waste –gloves, mouth masks, infected plastic syringes, tubings, rubber dam sheets	If incinerated dioxins, furans and other harmful gases-carcinogenic	Disinfection By chemical treatment, autoclaving/ shredding or stored in puncture proof sharp container containing 1% NaoCl for disinfection
Clinical waste (extracted teeth, tissues, sharp needles, burs, human anatomical waste, microbiological waste soiled plastic waste)	Source of infection	Deep land fill, High temp incineration
Soiled waste	Items contaminated with blood and body fluids-cotton, soiled plaster casts-Source of cross infection	Autoclaving/microwaving/chemical treatment

CONCLUSION:

All these aspects require and necessitate more awareness and training in infection control and BMW management of both dental and non dental personnel. It is recommended that this important facet should be included in the curriculum of under-graduate and post graduate dental academics and also should be mandatory for dental hygienist, dental technicians, and dental operating room assistant. [4] It is ideal and desirable that occupational safety be a prime consideration for any system of waste management.

Society at large, including dentistry is concerned about the environment. With new knowledge and the introduction of environmental management, the dental profession may improve its image, become more efficient and effective. It is advantageous to be able to demonstrate environmental concerns and actions to minimize the profession's impact on environment.

2011	1998
Every occupier generating BMW, irrespective of the quantum of wastes comes under the BMW Rules and requires to obtain authorization	Occupiers with more than 1000 beds required to obtain authorization
Duties of the operator listed	Operator duties absent
Categories of Biomedical Waste reduced to Eight	Biomedical waste divided in ten categories
Treatment and disposal of BMW made mandatory for all the HCEs	Rules restricted to HCEs with more than 1000 beds
A format for annual report appended with the Rules	No format for Annual Report
Form VI i.e. the report of the operator on HCEs not handing over the BMW added to the Rules	Form VI absent

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Table 3: BMW Rules- 2011 vs. 1998(courtesy: Biomedical waste rules made stringent. Available from:http://www.cseindia.org/node/3702.

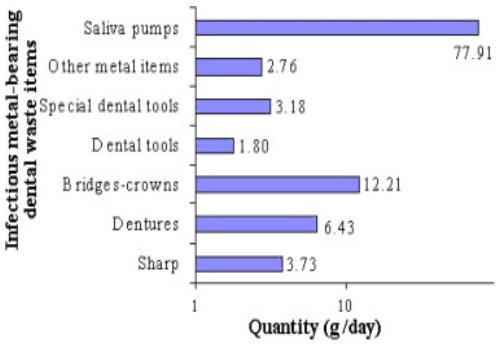


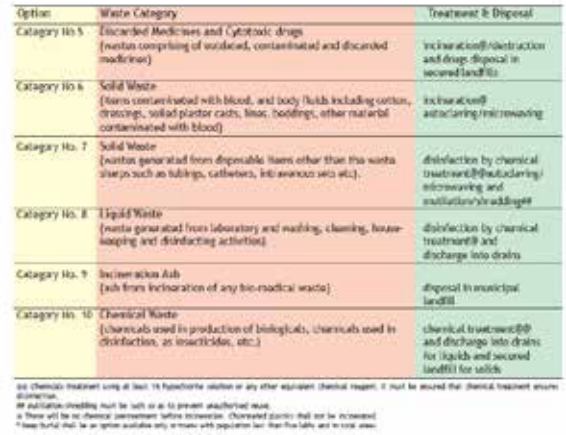
Fig 1(courtesy: S. Kontogianni, A. Xirogiannopoulou, A. Karagiannidis Investigating solid waste production and associated management practices in private dental units. Waste management. 2008; 8:1441-1448.

Table:1(HospitalWaste management. K Park-park's textbook of Preventive and Social medicine. 18th edition.

Schedule 1

Bio-Medical Waste (Management and Handling) Rules, 1998

Option	Waste Category	Treatment & Disposal
Category No. 1	Human Anatomical Waste (human tissues, organs, body parts)	Incineration@/deep burial*
Category No. 2	Animal Waste (animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals colleges, discharge from hospitals, animal houses)	Incineration@/deep burial*
Category no 3	Microbiology & Biotechnology Waste (wastes from laboratory cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures)	local autoclaving/ micro-wawing/ Incineration@
Category No 4	Waste sharps (needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)	disinfection (chemical treatment@@/autoclaving/ micro-wawing) and mutilation/shredding##



Schedule 2

Bio-Medical Waste (Management and Handling) Rules, 1998

Colour Coding	Type of Container - I Waste Category	Treatment options as per Schedule I
Yellow	Plastic bag Cat. 1, Cat. 2, and Cat. 3, Cat. 6.	Incineration/deep burial
Red	Disinfected container/plastic bag Cat. 3, Cat. 4, Cat.7	Autoclaving/Microwaving/ Chemical Treatment
Blue/White translucent	Plastic bag/puncture proof Cat. 4, Cat. 7. Container	Autoclaving/Microwaving/ Chemical Treatment and destruction/shredding
Black	Plastic bag Cat. 5 and Cat. 9 and Cat. 10. (solid)	Disposal in secured landfill

Notes:

1. Colour coding of waste categories with multiple treatment options as defined in Schedule I, shall be selected depending on treatment option chosen, which shall be as specified in Schedule I.
2. Waste collection bags for waste types needing incineration shall not be made of chlorinated plastics.
3. Categories 8 and 10 (liquid) do not require containers/bags.
4. Category 3 if disinfected locally need not be put in containers/bags.

Table: 2(Hospital Waste management. K Park-park's textbook of Preventive and Social medicine. 18th edition.

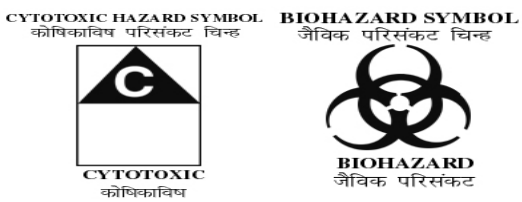


Fig :2-labelling of bio medical waste

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