

Bio-Hazards in Dentistry

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Abstract

Dental personnel are constantly exposed to many of specific occupational hazards. These leads to various disorders, specific to the profession, which develop and intensify with years. The present paper discusses selected occupational biohazards as well as baseline precautionary measures. When dentist deal with the potential carriers of these biohazard they become infected either directly or indirectly. So it is essential for every practitioner of dentistry to know about biohazards.

Keywords: Airborne; Biohazard; Blood Borne; Engineering Control; Universal Precaution.

Introduction

The Dentist profession is dedicated to promoting and enhancing oral health of every individual leading to the overall wellbeing of an individual. While accomplishing this, dentists are likely to be exposed to various biological health hazards [1]. A biohazard is an organism, or substance derived from an organism, that causes a threat to (primarily) human health. This include medical waste, samples of a microorganism, prions, virus or toxin (from a biological source) that can impact human health

[2]. Transmissible diseases currently of concern to the dental professional are HIV, HBV, HCV and Mycobacterium tuberculosis. A dentist can become infected either directly or indirectly, i.e. by a cut or wound, needle stick injury, aerosols of saliva, gingival fluid and natural organic dust particles [3]. Risk factors spread via saliva and through direct contact include a vast range of microorganisms, from prions through viruses and bacteria to fungi [4].

Biohazards in Dentistry

Table 1 shows the infectious levels of bio-hazards.

Table 1: Infectious Levels of Biohazard (1)

	Level 1	Level 2	Level 3	Level 4
Intensity organisms	Mild Both bacteria and viruses E.g. Eschericia coli, Varicella	Mild Both bacteria and viruses i.e., difficult to contract via aerosol. E.g. hepatitis A, B, C	Severe to fatal Both bacteria and viruses E.g. tuberculosis and anthrax	Fat AI Exclusively viruses E.g. Various hemorrhagic diseases
Precautions decontamination procedures	Minimal	Minimal Antibacterial soap, Disinfectants, autoclave	Mandatory Antibacterial soap, Disinfectants, Autoclave	Mandatory Antibacterial soap, Disinfectants, Autoclave
Vaccines	Not required	Required+Available	Required+Available	Not available
Treatment	Exists	Exists	Exists	Does not Exists

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Viral Hazards [5]

Table 2 depicts the modes of transmission of viruses and their effects on humans.

Table 2:

Category	Name	Transmission to humans	Effect on humans
Viruses (Adenoviridae)	Adenoviridae	Air-droplet, directly	I - adenoviral fever
Viruses (Coronaviridae)	Coronaviridae	Air-droplet	I - mild upper airways diseases
Viruses (Flaviviridae)	Virus of hepatitis C (HCV)	Directly (cut, infection), through blood, blood serum and other human body fluids	I - hepatitis, frequently in the form of a chronic cirrhosis; C - hepatic carcinoma
Viruses (Flaviviridae)	Virus of hepatitis G (HGV)	Directly (cut, infection), through blood, blood serum	I - hepatitis
Viruses (Hepadnaviridae)	Virus of hepatitis B (HBV)	Directly (cut, infection), through blood, blood serum and other human body fluids, especially wound exudate, saliva, semen, vaginal secretion; through sexual intercourse, from mother to foetus	I - hepatitis, frequently in the form of a chronic cirrhosis; C - hepatic carcinoma
Viruses (Hepadnaviridae)	Virus of hepatitis D (HDV = Delta + HBV)	Directly (cut, infection), through blood, blood serum and other human body fluids	I - hepatitis, frequently in the form of a chronic cirrhosis
Viruses (Herpesviridae)	Herpes simplex virus (HSV)/ Simple herpes virus (type 1 and 2)	Directly: through kissing (most frequently - type 1), through sexual intercourse (most frequently - type 2), through a cut in the skin, through hand contact	I - herpes: vesicular inflammation of tunica mucosa of oral cavity and urinary - sexual organs, skin inflammations (eczema and vesicular eruption), keratitis, encephalitis
Viruses (Orthomyxoviridae)	Viruses of influenza (type A, B, and C)	Air-droplet	I - influenza, pneumonia
Viruses (Paramyxoviridae)	Virus of parotitis	Air-droplet, directly	I - parotitis (mumps, childhood and developmental age diseases), possible complications: cerebrospinal meningitis, encephalitis, pancreatitis, orchitis
Viruses (Picornaviridae)	Virus of hepatitis A (type 72 of human enteroviruses)	Faeces-food, directly	I - hepatitis A, gastritis enteritis (mostly in youth)
Viruses (Reoviridae)	Reoviruses	Air-droplet, directly	I - reoviral fevers
Viruses (Retroviridae)	Human Immunodeficiency Virus (type HIV-1, HIV-2)	Directly (through blood, sexual intercourse - homo- and heterosexual), through placenta to foetus	I - AIDS (acquired immunodeficiency syndrome), atrophy of cellular immunity through gradual destruction of lymphocytes T, progressive neuropathy, accompanying infections, death; C neoplasms
Viruses (Retroviridae)	Human leukaemia viruses from T cells (HTLV-1, HTLV-2, HTLV-5)	Directly through blood, sexual intercourse), food (with mother's milk)	I, C - leukaemia of adults, Encephalitis
Viruses (unclassified as yet)	Unidentified hepatitis viruses transmitted through blood	Directly (through blood)	I - hepatitis

Bacterial Hazards [5]

Table 3 describes the bacterial hazards.

Table 3:

Category	Name	Transmission to humans	Effect on humans
Bacteria (Gram-negative facultative anaerobic bacteria)	Actinobacillus actinomycetemcomitans	Orally, air-droplet	I - localized juvenile periodontitis (LJP - localized juvenile periodontitis)
Bacteria (Actinomycetes)	Actinomycesgerencseriae	Orally, directly (cuts)	I - actinomycosis, nodularsuppurative Lymphadenitis
Bacteria (Actinomycetes)	Actinomycesisraelii	Orally, directly (cuts)	I - actinomycosis, nodularsuppurative Lymphadenitis
Bacteria (Actinomycetes)	Actinomycespyogenes	Orally, directly (cuts)	I - actinomycosis, nodularsuppurative lymphadenitis; T - toxic
Bacteria (Actinomycetes)	Actinomycesspp.	Orally, directly (cuts)	I - actinomycosis, nodularsuppurative Lymphadenitis
Bacteria (Gram-negative anaerobic bacteria)	Bacteroidesfragilis	Endogenic resulting from cuts, operation, bites	- pneumonia, oral cavity inflammation, periodontitis, dermatitis, inflammation of female genitals, enteritis, septicaemia
Bacteria (Gram-negative facultative anaerobic bacteria)	Cardiobacteriumhominis	Air-droplet	I - endocarditis
Bacteria (Gram-negative anaerobic bacteria)	Eikenellacorrodens	Directly, air-droplet	I - oral cavity infection, infection of intestines
Bacteria (Gram-negative anaerobic bacteria)	Fusobacterium necrophorum	Directly, endogenic (resulting from damaged tissues)	I - infections of oral cavity, respiratory system, urinary-sexual system, skin, connective tissue, bone, intestine
Bacteria (Gram negative aerobic coccus bacteria)	Moraxella catarrhalis	Air-droplet, directly	I - pneumonia, endocarditis, Meningitis
Bacteria (Gram-negative aerobic coccus bacteria)	Neisseria flavescens	Air-droplet, directly	I - meningitis, septicaemia
Bacteria (Gram-negative aerobic coccus bacteria)	Neisseria meningitidis	Air-droplet, directly	I - meningitis
Bacteria (Gram-positive anaerobic coccus bacteria)	Peptostreptococcus anaerobius	Air-droplet, directly	I - pyogenic infections
Bacteria (Gram-negative anaerobic coccus bacteria)	Porphyromonas spp.	Air-droplet, directly	I - endogenic infections of oral cavity and tooth canals
Bacteria (Gram-positive coccus bacteria)	Streptococcus spp. (S. bovis, S equi, S. mutans, S. salivarius etc.).	Air-droplet, directly	I - pneumonia, endocarditis, inflammations of oral cavity, urinary tract, and of other organs, dental caries

Mode of Exposure

- From the occupational point of view percutaneous exposure incidents particularly needle stick and sharp instrument injuries represents the most efficient method for transmitting blood born infections between patients and health care workers.
- Needles and drilling instruments such as burs represent the common devices as the cause

of exposure and injury. The study carried out in Washington reveals that 66.7% of the percutaneous injuries are sustained by dentists and most of the injuries (70%) occurred during administration of local anesthesia, recapping a needle and performing surgical procedures [6].

- The propelling force of a high-speed dental drill and the cavitation effect of an ultrasonic

scaler, both combined with a water spray, can generate numerous airborne particles derived from blood, saliva, tooth debris, dental plaque, calculus, and restorative materials. Microorganisms can be suspended in and carried by these very small particles into the surrounding air of an operator. Thus, infectious agents responsible for pneumonitis, influenza, and hepatitis, as well as skin and eye infections, may be transmitted during dental procedures [7].

Mode of Transmission

There are 4 basic routes of spreading harmful microorganisms In a dental practice:

- Blood-borne route - through the blood of an infected patient;
- Saliva-droplet route - through a droplet aerosol, emitted by an infected patient and containing particles of saliva, Secretions from the gum, periodontium and teeth;
- Direct contact with a patient and contaminated equipment;

diseases. The risk from these viruses has been the subject matter of numerous publications and to a large extent; it is identified with biological hazards in dentistry (Jolanta and Szymanska, 2005) [4].

Needle-Stick Injury: A Rising Bio-Hazard

Needle Stick Injury (NSI) has been identified as the foremost health allied concern around the globe. The consequences of an injury with a contaminated sharp object are related to various blood borne infection, e.g., Hepatitis-B virus (HBV), Hepatitis-C virus (HCV), and Human Immuno-Deficiency Virus (HIV). The healthcare professionals are at high risk if appropriate and recommended instrument handling is not carried out. [5,6]. The specialty of dentistry is highly susceptible to sharp injuries as most of the instruments used are sharp and there is a limited working area with heavy patient burdened outpatient departments [9].

Health care Workers should

- Minimize the handling of needles, sharps and clinical wastes.

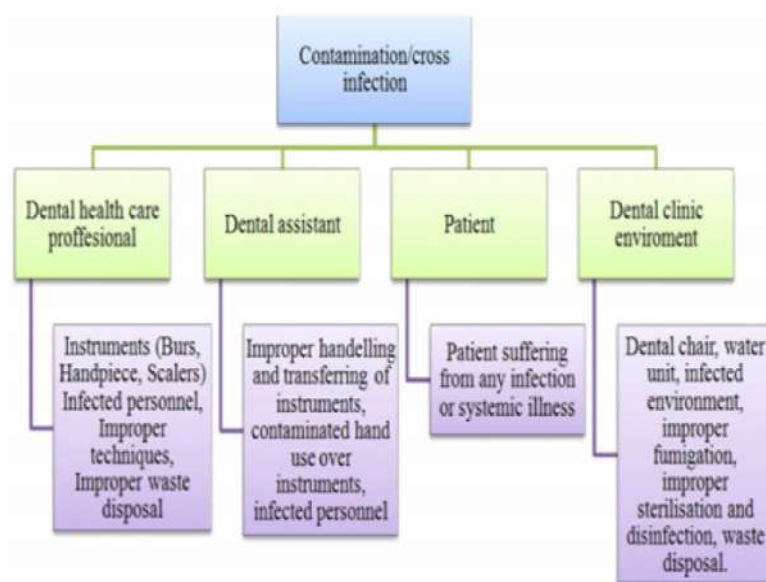


Fig. 1:

- Water-droplet route - through a water droplet aerosol emitted from a hand pieces of a dental unit which may contain microorganisms present in a unit reservoir, or developing in biofilm inside a unit tubing. The greatest risk for the dentist are viruses spread through blood (hepatitis B and C viruses, HIV virus) which cause serious health and life-threatening
- Not bend, recap or otherwise remove needles from disposable syringes.
- Use safe needle handling systems including rigid containers for disposal which should be kept out of reach of children and toddlers.
- Ensure that sharps containers are available at the point of use or in close proximity to work sites to aid in easy and immediate disposal [10]

- Syringe nozzle and needles should be shredded in syringe cutters and needle destroyers [11].

HBV in Dental Practice

- Hepatitis B virus (HBV) remains a major public health problem globally; more than two billion people have been infected worldwide, and of these, 350-400 million suffer from chronic infection.
- Dentists and dental health care workers (DHCWs) are at a high risk of infection with both HBV and HCV during their daily occupational experiences [12].
- Hepatitis B virus which infects the liver can survive outside the body for seven days at room temperature and spreads more easily than HIV. Ninety percent of the people contracting this disease recover fully and develop immunity and up to 10% will become carriers [1].
- In an Indian study in 2010 Jagannathan et. al. found no association between HbsAg status and dental treatment in a group of 71 HBV positive blood donors in Bangalore after multivariate analysis [13].

HCV in Dental Practice

- Hepatitis C virus (HCV) are at increased risk of developing cirrhosis, end stage liver disease and hepatocellular carcinoma. Different risk factors were found to be associated with the transmission of these viruses in various settings. HBV and HCV transmission seems to be also acquired by non-parenteral and non-sexual routes. A large number of patients infected with HCV might have non identifiable routes of viral acquisition [14].
- The prevalence rate of this infection is estimated to be 170 million globally [1].

HIV in Dental Practice

- Exposure to blood borne pathogens poses a serious risk to health care workers. . The risks linked with exposure to blood and body fluids in hospitals became well known with the advent of the HIV/AIDS pandemic.
- Transmission of more than 20 to 60 different pathogens by sharps injuries and exposure to blood and body fluids has been reported [15].
- The risk for transmission of blood-borne

infections, including HBV and HIV, from an infected health care worker to a susceptible patient during an invasive dental or surgical procedure may depend on several factors, including the type of procedure, the infection control precautions, and the individual technique of the health care worker [16].

Transmissible Spongiform Encephalopathies

- The transmissible spongiform encephalopathies (TSEs) caused by prion proteins, termed as Creutzfeldt-Jakob disease (CJD) in humans, have a long incubation period of 10-30 years. Some materials used in periodontal and oral surgery use materials derived from cattle (i.e., certain collagen membranes and sutures) and are supposed to be the transmission agents. No treatment exists [1].

Preventive Measures

- Proper handling, treatment and disposal of biomedical wastes are important elements of health care office infection control programme [17].
- All Dental practitioner must be vaccinated for Hepatitis B, Influenza, Mumps, Measles, Tetanus, Rubella, Tuberculosis, whooping cough.
- In case of exposure to a potential carrier, the dental professional must follow the post exposure prophylaxis.
- *Post-exposure prophylaxis for HBV infection*-the exposed worker should receive the vaccine series for Hepatitis B. In case he is already vaccinated then he must be tested for antibodies to HbsAg and given one dose of vaccine and one dose of HBIG if the antibody levels <10SRU.
- *Post-exposure prophylaxis for HIV infection*-the exposed worker must be tested clinically and serologically for evidence of HIV infection as soon as possible after the exposure. He should report and seek medical evaluation for any febrile illness that occurs within 12 weeks after the exposure.
- Hand washing and hand care:
 - Proper hand washing destroys pathogens, removes blood, debris and contaminating microorganisms and prevents accumulation of blood on damaged hand skin 1.
 - *Surgical hand scrubs*-act fast and have a

broadrange of bactericidal and residual activity [18].

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 blades medicine vials/ ampules or glass bottles etc. [19].

Other Hazards in Dentistry

Stress

The dental profession is often perceived as rather stressful, and a number of studies pay attention to psychological stress and stress-related health problems in the dental population [20].

Rankin and Harris stated that causing pain and discomfort in patients was the source of stress that was Most often mentioned by all examined doctors, and that this factor was more stressful for female doctors than for Maledoctors [8].

Radiation Harmful radiation like Non-ionizing radiation (visible and UV light) and ionizing radiation (X-rays) can cause damage to various body cells. Ionizing radiation is a well-established risk factor for cancer [9].

Latex Hypersensitivity

Gloves and a mask form an integral part of dentist's protective equipment. Latex gloves dusted with cornstarch powder are most often used. The gloves and the mask form an efficient barrier against most pathogens, and as recently proven - they also constitute a very good barrier against viruses, provided the gloves and the mask are intact [21].

Musculoskeletal Disorders

Musculoskeletal complications among dentists are prevalent like other healthcare workers. Most dentists (87.2%) indicated at least one symptom of musculoskeletal diseases in the past year [9].

Conclusion

A dental office generates a number of hazardous wastes that can be detrimental to the environment if not properly managed, as a result of which dental practitioners have been increasingly prone to be exposed to these bio hazardous waste materials. So it is important for the dentist to know how to manage and prevent this exposure by securing basic knowledge of biohazards components. Proper awareness and knowledge of biomedical waste management and handling rules among the people and health care workers is essential. Lack of awareness and knowledge about the health hazards from biomedical waste, improper practices of waste disposal and poor control of waste disposal are the most critical problems associated with health care waste disposal. This article is a brief review of levels of biohazards andbaseline preventive measures as applicable to dentistry. It is a dentist's ethical responsibility to be aware and follow all thepreventive measures against biohazards to help oneself, patients and the environment [1].

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