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OCCUPATIONAL RISK OF CLINIC ATMOSPHERE IN DENTAL OFFICE

VINDHIYA VARSHINI. V[1], N.P. MURALIDHARAN[2*] AND JAYALAKSHMI SOMASUNDARAM[3]

1: Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Science, Saveetha University, 162, PH Road, Chennai - 600077, Tamil Nadu, India

2: Associate Professor, Department of Microbiology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Science, Saveetha University, 162, PH Road, Chennai - 600077, Tamil Nadu, India

3: Chief Scientist, White lab - Material research Centre, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Science, Saveetha University,162, PH Road, Chennai - 600077, Tamil Nadu, India

***Corresponding Author: E Mail: Dr. N.P. Muralidharan: muralidharan.sdc@saveetha.com**

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ABSTRACT

Dental professionals are highly susceptible to a number of occupational hazards. Such as infectious agents, non infectious agents, aerosols, chemicals, amalgam, radiations and certain other subclinical infections. Many of such organisms are found in the mouth and nasopharynx and are potential for aerosolization of blood and saliva during dental procedures, it is likely that transmission occurs frequently in this setting. The aim of this study is to evaluate and to present a short review of recent literature available on Risk factors of clinical atmosphere in dentistry. A detailed study is done by reviewing several articles on the risk factors of clinical set up in dentistry. Thorough search of articles was carried on the databases Pubmed and Google Scholar. Occupational hazards continue to be a major threat in the dental clinical atmosphere and to

dental professionals. The recent dental literature shows that most of the dental procedures produce aerosols and droplets that are contaminated with bacteria and blood. These aerosols represent a common route for disease transmission. In addition to the routine use of standard barriers such as masks and gloves, the universal use of pre-procedural rinses and high-volume evacuations should be implemented.

Keywords: Aerosols, Infections, Non-infectious agents, subclinical infections, splatters, radiations, occupational hazards

INTRODUCTION

Healthcare staff predominantly dentists and the other dental personnel are endangered by infectious diseases **[1–3]**. Among occupational threats for dental professionals, transmission of infections mostly viral diseases such as Hepatitis B, Hepatitis C and acquired immune deficiency syndrome is more critical **[4]**. The World health organization has reported 2.5% of human immunodeficiency virus (HIV) and 40% of Hepatitis B and Hepatitis C infections in healthcare professionals by occupational contacts **[5]**. This issue is of great consideration for dentists, because they have to work with sharp and high-speed instruments daily, accompanied by constant contact with hazardous microorganisms **[6]**. The oral cavity is a most favourable environment with moist, proper temperature, and internal and external metabolites, which promote bacterial growth **[7]**. The previous studies suggests, most of the human pathogens could be obtained from the oral cavity **[8]**. According to the WHO guidelines, personal protective equipment proposes a mask and shield for protection of critical areas of the face against dangerous microorganisms **[9]**. Blood as a main route of transmission **[10]** and saliva although it is bactericidal in nature, are potential microorganism carriers **[11]**. The blood and saliva can both be found in tiny particles including solid particles, vapors, and liquid droplets, which were produced during dental procedures. The massive force of a high-speed dental rotary instruments and the cavitation effect of an ultrasonic scaler, both being used in combination with a water spray, can generate numerous airborne particles derived from blood, saliva, tooth debris, dental plaque, calculus, and restorative materials **[12–14]**. The air-conditioning system could therefore act as a vehicle for the transmission of bacteria and other microorganisms in the dental clinic **[14]**. The quality of water from dental units

in clinics is of greater importance since patients and dental staff are regularly exposed to water and aerosols generated from the dental unit. It has been suggested that Legionella contamination of dental unit waterlines may cause a serious respiratory illness among dentists and patients. Increased levels of Legionella antibodies promotes that dental professionals may experience subclinical infection or mild fever upon continuous exposure to contaminated aerosols **[15]**.

Previously our team had conducted numerous clinical trials **[16-23]** and lab animal studies and in-vitro studies **[24–30]** over the past 5 years. Now we are focusing on epidemiological surveys. The idea for this study stemmed from the current interest in our community.

INFECTIOUS HAZARDS

1. **INFECTIONS**

Dental professionals are more susceptible to a number of identified risks of occupational exposure to blood-borne pathogens like the Human Immunodeficiency Virus (HIV), the hepatitis viruses **[31]**. In dentistry, injuries occur because of sharp needles on a small operating field, frequent patient movement, and the variety of drilling instruments used in dental procedure **[32]**. The risk of HIV transmissions to healthcare workers is mostly through parenteral exposures and 0.1% or less for mucosal exposures **[33, 34]**. A report presented by the Centers of disease control and prevention (CDC), from 1995 to 2001, 13% had HIV-positive patients and did not suffer from a seroconversion (75% of exposed individuals took the three-drug PEP regimen for variable lengths of time) **[35]**. Percutaneous exposure to HBV containing transmission risks about 2% for HBeAg-negative and about 30% for HBeAg-positive blood. Even though reducing the risk for HBV transmission among healthcare professionals by effective HBV vaccination programs, measuring of anti-HBs antibody response after HBV vaccination is essential for all vaccinated individuals with high-risk professions like in dentistry **[31]**.

Bacterial infections also play an important role **[14]** . *Mycobacterium tuberculosis*, the cause of tuberculosis, aerosolized bacteria may remain suspended in the air for long periods of time and inhaled into the

lungs of a susceptible person. There have been reports of transmission of tuberculosis in the dental setting **[36]**.

Other Bacterias, the most common route of transmission is through droplet spread. Bacteria that can be spread in this way include: group A *streptococci, Streptococcus pneumoniae, Haemophilus influenzae, Neisseria meningitidis, Corynebacterium diphtheriae* and *Bordetella pertussis*. These bacteria can lead to a wide range of illnesses from pneumonia, to "strep throat" to meningitis.

Bacteria that are capable of causing serious disease are present in the mouth and saliva. Basic infection control precautions, such as use of gloves and a mask and effective hand hygiene practices, can prevent transmission. This is particularly important for drug-resistant microorganisms. To prevent the transmission of tuberculosis requires prior recognition of infected or high-risk patients and suitable management diagnosis and treatment **[37]**.

NON-INFECTIOUS HAZARDS

1. **Musculoskeletal complications**

Musculoskeletal complications among dentists is more predominant like other healthcare workers and well documented **[38, 39]**. Most of the dentists (87.2%) have shown at least one symptom of musculoskeletal diseases in the past year **[40]**. Severe chronic back pain is reported in more than 25% of dentists with back pain **[41]**. Sitting position induced more severe low back pain than position alternating between sitting and standing **[42, 43]**. Hand/wrist pain complaints among dentists are highly prevalent **[44–46]**. Neck and shoulder complaints were less reported than back pain. The level of Education and continuous working were significant risk factors for shoulder pain. Musculoskeletal pain and disorders are the major threat to dental profession with an idiopathic cause. There is a relationship between the biomechanics of seated working postures, repeated unidirectional twisting of the neck, working in same position for a longer periods, operator's flexibility and core strength, operators knowing how to properly adjust ergonomic equipment, and physiological damage or pain **[47]**.

2. **Radiations**

Ionizing radiation: Taking X-ray machines in the dental office predispose dentists to suffer from ionizing radiation **[48, 49]**. Exposure to dental X-rays can predispose to potential risk of cancer, which was revealed in previous studies **[50, 51]**. Several studies have shown correlation between dental X-ray exposure and increased risks of brain cancer **[52, 53]**, tumors of the parotid gland **[54]** and breast cancer **[55]** and thyroid cancer **[56, 57]**. Thyroid cancer being the most common cancers in the worldwide, and shows positive effects to dental radiation exposure due to the location of the thyroid gland. Non-ionizing radiation: This has recently popped a concern since the use of composites and other resins, next to the use of lasers in dentistry procedures, Curing lights are also a potential risk in causing cancer, while placing restorative resins leads to phototoxic and photoallergic reactions originating from absorbed radiation **[58]**. which has added another potential hazard to eye and other percutaneous tissues that may be directly exposed **[47]**.

3. **Volatile chemicals**

Anesthetic gases in the dental office: Using nitrous oxide gas regularly over an extended period of time may contain hazard **[59]**. Nitrous oxide is widely used in both dental theatres and community dental clinics. Many of these clinics, especially community dental clinics, do not have the necessary ventilation and anaesthetic gas scavenging availability. On chronic exposure to nitrous oxide, the most commonly reported side effects are: increase in the rate of spontaneous abortion, infertility and reproductive difficulties, congenital anomalies and delay of fetal growth; increase in the incidence of cancer in the uterine cervix and kidney, liver diseases; adverse effects on bone marrow function and immune system, generalized neurological disorders and psychomotor impairment **[60, 61]**.

4. **Mercury spills**

It has been proved that mercury vapors at high dosed exposure can lead to biological and neurological insults **[62]**. Amalgam capsules which have sealed amalgam powder are used with lower mercury toxicity level, water irrigation and high

suction, good ventilation and proper collection, and discarding of amalgam have substantially diminished the mercury toxicity **[47, 61]**.

5. **Water line contamination and subclinical infection**

Microbial colonies are adhered to solid surfaces wherever there is enough moisture are known as the biofilm. The microbes in the biofilm produce a protective polysaccharide matrix that provides a mechanism for surface attachment and retention to the waterline. Dental unit water quality has become an issue of concern in both infection control practices and occupational exposures in dental office settings. The microbes from this biofilm reach the oral environment via water sprayers which is used often in dental practice and causes serious subclinical infections. In a recent study, Ricci *et al.* reported on transmission of *L. pneumophila* from a dental unit to a patient, who developed a fulminant LD and died from septic shock **[63]**.

6. **Allergens and Irritants**

Latex gloves are the main source of the type 1 hypersensitivity, certain dental materials such as acrylate compounds and silica dust causes respiratory hypersensitivity, detergents, lubricating oils and X-ray processing chemicals can also lead to an allergic skin reaction **[64]**.

Dentists are exposed to different types of hazards in their daily practices. Many pathogens are localised in the oral cavity, which can be transmitted in different ways during dental procedures. Usually through air/water syringe and high-speed rotary instruments which are often used in dental procedures. Two basic ways for spreading pathogenic microorganisms in a dental practice are via blood and saliva through droplet aerosol of infected patients.

DISCUSSION

According to the study conducted by Checchi *et al* **[65]**, showed that there is no significant difference between the left and right side of the face. However, higher levels of oral microorganisms were produced and found to threatful during particular dental procedures, especially during scaling **[66]**. Splatter shows limited permeability into the respiratory system **[66]**, but can have contact with the mucosa of nostrils, open mouth, eyes, and skin. They are settled down on hair, clothes and in surroundings of the splatter source. Therefore, other diseases like skin and eye infections may be transmitted during dental

treatment procedures from these infectious bioaerosols. Currently, the most serious diseases threatening dentists and their staff are hepatitis B and acquired immunodeficiency syndrome (AIDS); dental professionals are at risk of acquiring these diseases during dental operative procedures **[67]**. According to Larato *et al*. **[68]**, have observed patterns of microbial air contamination before, during, and after dental treatment in a closed operation. A subsequent decrease of atmospheric microbial contamination was noticed 2 hours after the end of the working period. According to Williams *et al.* **[69]**, reported that when heavy droplets fall to the floor they become part of the floor dust. Aerosols particles, which are light in weight, remain suspended in the air, leaving a residue called droplet nuclei that can reach the respiratory passages of those who are exposed like patients are dental clinic staff. According to the study conducted by Fine **[70]**, as also many other studies, has proved that preprocedural oral rinsing with an antiseptic mouthwash has reduced the viable microbial content of bioaerosols produced during dental operative procedures.

CONCLUSION

Personal protective equipment such as masks, gloves, Eye loupes/ goggles and high power suction, good ventilations are known to reduce aerosol and vapour hazards. Implementation of periodical monitoring of the water quality of dental units is an important measure of infection prevention in the dental practice. Other than these barrier utilities and quality treatment of water lines, certain other considerations such as pre-procedural rinses, proper waste disposals and managements should be implemented. There are some serious nosocomial infections / community-acquired infections from dental clinic setup such as HIV, HBV and many other respiratory diseases, to which the personal care, vaccinations and other preventive measures are to be followed. Hence, utmost care has to be taken to prevent the cross-contamination.

AUTHOR CONTRIBUTION

Data collection: V. Vindhya varshini[1]

Data Analysis and interpretation: V. Vindhya varshini[1]

Drafting the article: V. Vindhya varshini[1]

Critical Revision of the article: Dr. N.P. Muralidharan[2]

Final approval of the version to be published: N.P. Muralidharan[2], Jayalakshmi Somasundaram[3].

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CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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