

**DENTAL AEROSOL & SPLATTER- A SILENT HAZARD & IMPLICATION ON  
INFECTION CONTROL IN DENTISTRY**Gagan Raj\*<sup>1</sup>, Suma B. S.<sup>2</sup> and Garima Mangal<sup>3</sup><sup>1</sup>Post Graduate Student, Department of Public Health Dentistry, Buddha Institute of Dental Sciences & Hospital, Patna, India.<sup>2</sup>Professor HOD; Department of Public Health Dentistry, Buddha Institute of Dental Sciences & Hospital, Patna, India.<sup>3</sup>Reader, Department of Public Health Dentistry, Buddha Institute of Dental Sciences & Hospital, Patna, India.**\*Corresponding Author: Dr. Gagan Raj**

Post Graduate Student, Department of Public Health Dentistry, Buddha Institute of Dental Sciences &amp; Hospital, Patna, India.

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**ABSTRACT**

Dentist, dental hygienist and oral health care workers practices in a highly contaminated environment which is the human mouth where they are exposed to variety of bacteria, viruses, fungi and protozoan from many sources. Various dental procedures can result in the formation of aerosol and splatter. Aerosols are combination of both liquid and solid particles less than 50 micrometres in diameter whereas splatter was defined as airborne particle which are larger than 50 micron in diameters. There is a long history of infections that have been transmitted by an airborne route. Sources of dental aerosol produced during dental procedures are from the: Patient, Dental unit waterlines (DUWL) and Instruments. Professional interest has developed concerning dentally produced aerosols and the potential for disease transmission to clinicians and patients. Professional interest has developed concerning dentally produced aerosols and the potential for disease transmission to clinicians and patients. It includes screening of patients, Immunization of dental personnel, Personal hygiene and hand hygiene, Personal protective equipments, Dental unit waterlines (DUWL), Sterilization and disinfection. Thus It is virtually impossible to completely eliminate the risk posed by dental aerosols, minimizing the risk by adopting protective procedures along with universal barrier techniques together with immunization protocol requires attention.

**KEYWORDS:** Dental Aerosol and splatter; Dental unit water line; Personal protective equipment; Infection control.

**INTRODUCTION**

Dentist, dental hygienist and oral health care workers practices in a highly contaminated environment which is the human mouth where they are exposed to variety of bacteria, viruses, fungi and protozoan from many sources. Dental unit being the main unit of dental surgery equipment consist of dental chair, operator chair, a lamp and a spittoon. Every dental unit has a minimum of three working hand pieces that is high speed hand piece, low speed hand piece and an air water syringe. The unit is supplied with water through a system of thin plastic tubes which constitutes dental unit water lines.<sup>[1]</sup> Apart from that, every chair is equipped with an ultrasonic scaler unit for carrying out oral prophylaxis. All these equipments, when used for various dental procedures can result in the formation of *aerosol and splatter*.<sup>[2]</sup> which are commonly contaminated with bacteria, virus, fungi and blood. Microorganism which is present in the mouth and respiratory tract can be transported in the aerosol produced during dental procedures leading to respiratory infections, skin infection and other systemic diseases in immunocompromised patient. They also contaminate the mucous membrane of the mouth, respiratory passages,

eyes of dental professionals and patients and the surrounding surfaces. The most rigorous aerosol and splatter emission occurs during oral prophylaxis with ultrasonic scaler tips and during the use of bur with high speed hand piece.<sup>[1]</sup>

Spread of infection through splatter and aerosol is considered a major risk factor for the dental professionals because of transmission of the infection from the patient to health care providers.<sup>[2]</sup> The highest levels of infection control and safe, best practice need to be standard for all oral health professionals and patients.<sup>[3]</sup>

Hence this article highlights on the reasons and potential risks that can be encountered with dental aerosols and splatter & recommendations for the control of the same.<sup>[4]</sup>

**Definition of Aerosols & Splatter**

The terminology *aerosol and splatter* in dental environment were proposed by *Micik* in their pioneering work on aerobiology.<sup>1</sup> *Aerosols* are combination of both

liquid and solid particles. Majority of the particles in the aerosol are less than 50 micrometres in diameter<sup>[9]</sup> and when the water gets evaporated, they form ‘droplet nuclei’ which is composed of saliva, dried serum and microorganisms. The size of the droplet nuclei varies from 0.5 to 10 microns which can reach pulmonary alveoli or float in the air for several hours. They can also penetrate deep into the respiratory system.<sup>[1]</sup>

The term *splatter* was defined as airborne particle which are larger than 50 micron in diameter. Splatters are further depicted as a mixture of air, water and / or solid substances which is of 50 microns to several millimetres in diameter and are visible to naked eye.<sup>[1]</sup>

Aerosol and splatter production which occur with usage of ultrasonic scaler tip and burs at a high speed hand piece is considered to be very exhaustive or intensive. They have sufficient mass and kinetic energy to move ballistically and settle on object due to gravitational forces. They have limited penetration into the respiratory system.<sup>[5]</sup>

**Contents of Dental Aerosols**

(I) The main pathogenic microorganisms are Mycobacterium Tuberculosis, Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Cytomegalo Virus, Herpes Simplex Virus, Human Immuno Deficiency Virus, SARS Virus, H1N1 Virus.<sup>[5]</sup>

(II) Components of saliva, nasopharyngeal secretion, plaque, blood, tooth component and any material used in dental procedures, such as abrasives for air polishing and air abrasion etc.<sup>[4]</sup>



**Diagram showing visible aerosols cloud produced by ultrasonic scaler and air polisher.**

**History of Airborne Infection**

There is a long history of infections that have been transmitted by an airborne route. Even before the discovery of specific infectious agents such as bacteria and viruses, the potential of infection by the airborne route was recognized.<sup>[4,6]</sup> Some diseases known to be spread via an airborne route are listed in Table 1.

Disease	Methods of Trasmission
Pneumonic Plague	Patient to patient without the usual insect vector (flea); apparently by inhalation of the causative bacteria.
Tuberculosis	Droplet nuclei expelled from the patient by coughing, once considered an occupational disease for dentist.
Influenza	Apparently associated with coughing but may require direct contact with the patient.
Legionnaires’ Disease	Aerosolization of <i>Legionella Pnemophila</i> has been associated with air conditioning systems and hot tub spas
Severe Acute Respiratory Syndrome (SARS)	Spread by direct contact and aerosolized droplets.

**Source of Dental Aerosol Causing Infections**

Sources of dental aerosol produced during dental procedures are from the:

1. Patient
2. Dental unit waterlines (DUWL)
3. Instruments

1. **Patients:-** Dental aerosol can be produced from the patients. The amount of contamination of dental aerosol depends on the quality of saliva, nasal and throat secretion, blood, dental plaque, periodontal infection, blood and presence of any dental infection. Therefore aerosol composition differs from patient to patient

depending on the site and type of the procedure like tooth preparation and oral prophylaxis.<sup>[1]</sup>

## 2. Dental Unit Waterlines (DUWL)

The tubing in DUWL is constructed in such a way that, the centre of the lumen has the maximum flow of water and the periphery has the minimal flow. Reasons of contamination of DUWL may be due to narrow bore

water lines, water stagnation, heating of dental chair unit, anti-retraction valve failure and contamination of reservoir bottles. The bacterial biofilm which forms on the surface of the DUWL tubings are very adherent. Microorganisms from the biofilm that shed during the usage of dental units through the DUWL to the oral cavity can lead to spread of infection.<sup>[7]</sup>

## 3. Instruments

### Instruments which can produce dental aerosol seen in table 2:-<sup>[4]</sup>

Ultrasonic and Sonic Scalers	Considered the greatest source of Aerosol contamination; use of a high volume evacuator will reduce the airborne contamination by more than 95%
Air polishing	Bacterial counts indicate that airborne contamination is nearly equal to that of ultrasonic scalers; available suction device will reduce airborne contamination by more than 95%
Air water Syringe	Bacterial counts indicate that airborne contamination is nearly equal to that of ultrasonic scalers; high volume evacuator will reduce airborne contamination by more than 99%
Tooth preparation with air turbine hand piece	Minimal airborne contamination if a rubber dam is used
Tooth preparation with Air abrasion	Bacterial contamination is unknown; extensive contamination with abrasive particles has been shown

### Risks to the Dental Surgeons and Patients

#### Professional interest has developed concerning dentally produced aerosols and the potential for disease transmission to clinicians and patients.<sup>[8]</sup>

During the dental procedures, the most contaminated area was found to be the doctor's and assistant's masks followed by the dental unit lamp, surfaces close to the spittoons and mobile instrument material table.

Among the microorganisms which are isolated from these contaminated surfaces include streptococcus genus (42%), staphylococcus (41%) and gram negative bacteria. Microorganism isolated from the environment of dental clinic includes nondiphtherial corynebacterium, Staphylococcus aureus (0.6%), Pseudomonas spp. (0.6%) and fungi (0.9%).<sup>[1]</sup>

Aerosol is created when high-powered devices need compressed air and water to work effectively. Most procedures performed by the dental team have the potential for creating contaminated aerosols and splatter. Aerosols are tiny particles or droplets which remain suspended in air.<sup>[9]</sup> These aerosols represent an infection hazard due to their gross contamination with microorganisms and blood. A fourfold increase of airborne bacteria has been observed in areas where aerosol producing equipment was used. Aerosols can float in air for considerable time before being inhaled by dental staff and other patients. There is some evidence for greater prevalence of respiratory diseases and elevated antibody levels to Legionella pneumophila in dental workers. Oral bacteria have been detected two meters from the procedure field, indicating the existence of aerosolized oral bacteria in dental practice. Numerous airborne particles derived from blood, saliva, tooth debris, dental plaque, calculus and restorative material

are produced by an ultrasonic scaler when used in combination with water spray. Bacterial diseases, viral infections and other skin infections are cause by the microorganisms which were isolated in dental aerosols. Increased use of ultrasonic scalers and turbine hand pieces is responsible for decreased air quality in the dental office due to increased aerosol contamination.<sup>8</sup> Miller in a study concluded that aerosols generated from the patients' mouth contain millions of bacteria per cubic foot of air. King et al. reported that could be recovered 6 inches from the mouth of patient and the CFUs formed were significantly reduced when aerosol reduction device was used. Aerosols may not only contain bacteria but also HIV virus and mycobacterium tuberculosis. The most intensive aerosol and splatter emission occurs during the work of an ultrasonic scaler tip and of a bur on a high-speed hand piece. Thus when the patient enters the dental clinic, every attempt should be made from the dentist's end to avoid cross contamination.<sup>[9]</sup>

### Preventive Measures

#### Professional interest has developed concerning dentally produced aerosols and the potential for disease transmission to clinicians and patients.<sup>[10]</sup>

1. **Screening of patients** - A thorough case history should be taken as it helps in early diagnosis of the disease before the commencement of any dental procedure.
2. **Immunization of dental personnel** against Hepatitis A, Hepatitis B, Influenza, Mumps, Measles, Tetanus, Rubella, Tuberculosis, and whooping cough, Varicella, MMR, DPT, Rubeola, Meningitis, Polio and Diphtheria for infection control should be done at proper periodic intervals.<sup>[1]</sup>
3. **Personal hygiene and hand hygiene** of dental personnel should be maintained.<sup>[4]</sup>

4. **Personal protective equipments** to be used during dental treatment are gloves, mouth mask, head cap, face shield, eye protective wear (goggles/ eye wear) and gowns.<sup>[7]</sup>

5. **Dental unit waterlines (DUWL)**

a) Approaches in risk reduction for DUWL can be broadly divided into

A) **Non chemical approach:** - include flushing of DUWL water, improving the quality of water, using anti retraction valves and retrograde aspiration.

B) **Chemical approach:** - includes the use of chemical disinfectants which have broad spectrum anti-microbial activity like Chlorhexidine gluconate, povidine iodine, glutaraldehyde, ethanol, hypochlorite and peroxide.

6. **Sterilization and disinfection** - external sterility of dental hand piece can be achieved with autoclaving whereas internal sterility can be achieved by chemiclave.<sup>[2]</sup>



**Fig. 1: Shows the standard precautions to be followed and the personnel protective equipments to be used.**

7. **Protocols to be followed prior to any dental procedure**

- Preprocedural rinses with water and 0.12 to 2% chlorhexine gluconate or essential oil containing mouthwashes for duration of 60 seconds can cause substantial reduction in bacterial counts.
- The water line has to be flushed at the start of each clinical day and between patients, for 30 seconds to 1 minute to reduce microbial accumulation due to overnight waterline stagnation.
- High vacuum suction/evacuator which is correctly positioned near the hand piece and close to the mouth can reduce 90% of aerosol production.
- Use of rubber dam during conservative procedures.
- At the end of the day, the suction lines should be cleaned with ammonia or enzymatic detergent with water.<sup>[1,4]</sup>

**CONCLUSIONS**

Dental fraternities are highly exposed to the hazardous effects of the aerosols and splatter produced during dental procedures.<sup>[2]</sup> The ADA and CDC have recommended that all blood-contaminated aerosols and splatter should be minimized. Occupational Safety and Health Administration regulations state that “all procedures involving blood or other potentially infectious materials shall be performed in such a manner as to minimize splashing, spraying, spattering, and generation of droplets of these substances.”<sup>[4]</sup> Thus It is virtually impossible to completely eliminate the risk posed by dental aerosols, minimizing the risk by adopting protective procedures along with universal barrier techniques together with immunization protocol requires attention.<sup>[2]</sup>

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**CONFLICTS OF INTEREST**

There are no conflicts of interest.

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