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Awareness and Knowledge About Dental Aerosols among Dental Students

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Abstract:- Dental aerosolsare ultrafine particles that are generated during the dental procedures. These aerosols are air suspended and pose a risks to the clinician.The purpose of this study is to evaluate the awareness and knowledge level of dental students about dental aerosols.This study was conducted among 100 participants to evaluate the knowledge of the dental students as the poor understanding about this may pose an increased risk of occupational hazard to dentists. A 25-item survey instrument was developed and randomly distributed to students using social media; The data of 100 people were collected randomly . The questions were premeditated to evaluate the knowledge of the subjects. Participants information was maintained anonymous throughout the study and participants were asked to provide honest answers. The study concludes, the participants have basic knowledge about the aerosols but the knowledge about the spread of aerosols and preventive measures seems to be inadequate among the students.

- *AIM:*

The aim of this study was to assess the awareness and knowledge about the dental aerosols among the dental students of Tamil nadu.

I. INTRODUCTION

The production of airborne material during dental procedures is evident to the dentist and the patient.During dental care, there are at least three possible sources of airborne contamination: dental instrumentation, saliva and respiratory sources, and operating site. The majority of dental procedures using mechanical instrumentation can create airborne particles from the place where the tool is used. [1] . Fine aerosols (FA's) are constantly produced by ultrasonic devices that are used for scaling and other procedures and high – speed handpieces,mainly when used with coolants [2]. These procedures generate largenumber of particles and splattering and may spread microorganisms from the oral cavity of patients [3]. These aerosols depict an infection hazard due to their gross contamination with microorganisms and blood [4]. Dentalclinics are always at high exposure to a wide range of pathogenic microorganisms.Secretions such as oral bacteria,saliva, and blood are spread to the air by hand pieces and ultrasonic scalars, which are regularly used for treatment, in the form of aerosols and splatters containing pathogenic microorganisms. Therefore, dental clinics have major risk of spread of infection compared to other medical institutions [5]. Since these two are two distinct concepts, it is important to distinguish between aerosols and splatter. The distinction lies in their height. Aerosols have a diameter less than 50 micrometers those particles are too small so that they can remain in air until they settle on the surface of the atmosphere [6].

Though the dental aerosols pose a major risk in spreading of infections, they took a center stage in news during the spread of SARS-COV -2. However, COVID-19 is the latest one [8]. These aerosols that contain microorganisms originating in the oral cavity of the patient through dental procedures that uses air coolants, water spray, airroters etc. and also from the waterlines of the dental unit (DUWLs) [10]. Infection control has become an important aspect of the dental operating system because of the increasing risk of airborne spread of infections and is now an indispensable part of the curricula of dental colleges [11].

In the present study, we evaluated the awareness and knowledge level about the dental aerosols among the dental students.

II. MATERIALS AND METHODOLOGY

This survey study was conducted to assess the awareness and knowledge about Dental aerosols among the dental students. This study was conducted randomly among the dental students of Tamil nadu in India. The questionnaire was made in online filling format through Google forms. Then the link of the google forms was circulated among the population through social media platforms like WhatsApp and Facebookgroups etc., The link of the google forms was started circulating on August 2020 and it took around two months for collecting a complete data of all the participants. The study sample included 100 participants. A structured custom-madequestion is composed of 25 knowledge-based questions in e forms (written in English) was designed to assess their awareness

and knowledge level about Dental aerosols. The purpose of the questionnaire was clearly explained to the participants.The questionnaire also includes demographic details. The people who are not willing to participate was also excluded in this study. All the questions are marked mandatory to ensure that the participant is answering all the questions. Participants was asked to complete and submit the response to this online survey. Subsequently summary of responses wasanalyzed through google forms itself and statistics were made.

➢ *Inclusion Criteria:*
Dental students (1st year to final year)
Dental trainees (interns)

➢ *Exclusion Criteria:*
Students those who are not willing to participate

III. RESULTS

➢ *Demographic Data:*

The filled questionnaires acquired were analyzed on MS excel and charts were formulated for easy depiction of the results. The survey was conducted for 100 people out of which 31% Male (n = 31) and 68% Female (n=68). Among which 46%(n=46) are people in internship phase and 54%(n = 54) are students from 1st year to final year.

KNOWLEDGE AND AWARNESS ABOUT DENTAL AEROSOLS (Table 1) (Figure 1)

Subjects were asked to answer wide range of questions regarding the Composition,sources of aerosol, preventive measures to reduce aerosols in clinical practice etc. to access their knowledge level. About 90% (n=90) of students participated in this survey are aware about the term 'Dental aerosol'.

In the medical literature, the airborne transmission of measles, tuberculosis and SARS is well documented [1]. About 82% of students have basic knowledge about the diseases that spreads through dental aerosols.

COMPOSITION OF DENTAL AEROSOLS (Table 2) (Figure 1)

The composition of bioaerosols is heterogeneous; they involve water, blood debris, microorganisms, mucosal cells, restorative materials, tooth fragments, and large amounts of saliva.[3].Majority of the students answered correctly about the compositions of aerosol i.e.73% of participants have knowledge about it .Aerosols are classified based on particle size: spatter (> 50 μm), droplet (≤ 50 μm), and droplet nuclei (≤ 10 μm).Being the larger particle, spatter will fall before other items (floor, countertop, sinks, bracket, table, device, patient, operators, etc.) are contacted [7], 38% of participants are aware about the size of the aerosol'sparticles. The nose typically filters air particles above 10 microns and about 15% of students are aware of this. If a particle is, <10 microns, it can enter through the respiratory system. If it is <2.5 microns, it can enter the alveolus. When the participants were asked about this 42% of students answered correctly. A particle that is smaller than 0.1 micron, or an ultrafine particle like the COVID-19 virus, can enter the and only 19% of students were aware of this.

SOURCES OF DENTAL AEROSOLS (Table 3)(Figure 2)

There are three potential sources of airbornecontamination during dental treatment: dental instrumentation, saliva and respiratory sources, and the operative site [1] ,4 % of students answered correctly.A Droplet nucleus can contaminate the surfaces in a range of 3 feet and may remain airborne in a range of 30 minutes to 2 hours [7]. About 32% of students answered correctly as 3 feet and 47% of students are aware that the aerosols may remain airborne up to 2 hours.Waterlines from the dental unit have also been shown to harbour bacteria. Dental treatments and waterline aerosolized bacteria may cause severe infections [7] and about 49% of participants are aware about this. In dental settings, 90% of aerosols produced are <5 μm and only 31 % of students have knowledge about this. when the students were asked about microorganisms that are predominantly present in aerosols, 37% of students answered *staphylococcus spp.* And *streptococcus spp,* which is correct and 39% of students answered *legionella spp.,actinomycoses spp*. During periodontal procedures which is also correct. 54% and 44% of students have knowledge about the procedures that generates high amount and low number of aerosols respectively.

PREVENTIVE MEASURES (Table 4) (Figure 3)

The large diameter (> 8 mm) of the high-volume evacuator (HVE) allows high volumes of air to be filtered in a short time and reduces the quantity of bioaerosols by up to 90% [7]. About 23% of students answered HVE. Only 19% of students have knowledge about the devices that are used to remove the aerosols from the air.53% of students are aware of the effective preprocedural rinse that are used to minimize the spread of microbes through aerosols. The CDC recommends water and air should be discharged for a minimum of 20 seconds to 30 seconds between each appointment. This should be completed for all devices that connect to a waterline that enter patient mouths, such as handpieces, ultrasonic scalers, and air/water syringes [7] and only 38% of students are aware of this.

IV. DISCUSSION

This study was basically designed to assess the awareness and knowledge level of dental students about the aerosols and splatter and its harmful effects and preventive measures. The basic understanding of this among dental students is very relevant because dental care practitioners are highly exposed to patient aerosols from the oral cavity containing many pathogenic microorganisms [3].Severe acute respiratory syndrome (SARS) has been reported in China, Canada and other countries recently. it is a new form of coronavirus, a family of viruses that is usually associated with the common cold, appears to be causing this severe flulike disease. The exact mechanisms by which severe acute respiratory syndrome (SARS) spread remains uncertain, but it is clear that the primary method is through

aerosolized droplets that produced by coughing or other means of spreading [1].

The majority of the dental team's procedures have the ability to produce contaminated aerosols and splatters. Small particles or droplets that stay suspended in the air are aerosols. As the droplets carries the blood and saliva, they play a role in the spread of the infection [4].In their pioneering work on aerobiology, Micik and colleagues8-12 used the terms 'aerosol' and 'splatter' in the dental environment. According to Micik and colleagues' aerosols have been defined as the particles less than 50 micrometers in diameter.larger dropletsi.e.splatter (>50µm) fall to the ground quickly; therefore,larger droplet transmission requires close physical proximity between an infected individual and aclinician. On the other hand, small droplets that are <50µm residues of evaporated droplets have a lowsettling velocity, so they may remain in the air for alonger time and has a capacity to enter the respiratory tract or contaminate surfaces (WHO,2014) .The smaller aerosol particles (0.5 to 10 µ m in diameter) have the ability to penetrate and lodge in the smaller lung passages and can carry the greatest potential for infection transmission.[1,9].

The oral cavity is a harbours multitude species of aerobic and anaerobic bacteria, viruses and fungi. Normal oral micro flora of a patient harbours a highconcentration of Advisory Committee of Dangerous Pathogens hazard group 2 microorganisms [6]. Specific microbes aerosolized during dental procedures have been identified by many studies. Micrococcus, Staphylococcus, and Streptococcus species determined by Manarte-Monteiro et al have been aerosolized during endodontic and restorative treatments. Viridans streptococci and staphylococci were the most common bacteria aerosolized during restorative treatment with high-speed instruments found by Rautemaa et al.Streptococci were aerosolized during endodontic access by Pina-Vaz et al. Actinomyces, Fusobacterium, Capnocytophaga, and Streptococcus species that were aerosolized during periodontal therapy were identified by Feres et al. [7]. At the same time, the study of Dental water unit reservoir reveals the presence of Staphylococcus aureus, beta hemolytic Streptococci, Escherichia coli, Ralstonia pickettii, Sphingomonas paucimobilis, Brevundimonas vesicularis, Moraxella lacunata, Moraxella spp., etc. [8].

In dental clinics, aerosols are produced while using dental hand pieces, such as ultrasonic scalers, air rotors, micromotors and/or air-water syringes.The microbial contamination of DUWLs(Dental unit water lines)also plays an important role.Settled aerosols, containing microorganisms from water and the oral cavity, are likely to carry infectious microorganisms and may lead to cross-transmission and infection in susceptible patients and dental staff [10]

The largest volume of aerosol and splatter that can be disseminated at a substantial distance from the operating site is created by ultrasonic scaling. Prophylactic scaling is usually achieved using an ultrasonic scaler, which works by allowing the tip to vibrate with a sound wave using a liquid medium. Such a liquid medium allows the release of aerosols containing the patient's blood and saliva that may contain bacteria. In specific, ultrasonic scalers have been reported to produce more aerosols than handpieces and air water syringes. For this cause, it has also been stated that the use of an ultrasonic scaler is associated with an increase in the prevalence of respiratory diseases among dental medical staff. [5,11]. Airborne pollutants often have a possible chance of entering the ventilation system and spreading bacteria. The risk of air pollution can be reduced by high quality particulate air (HEPA) filters and UV chambers in the ventilation system. Air disinfection using a 250-265 nm ultra-violet radiation lamp demonstrates very high fungicidal, virucidal and bactericidal action by breaking DNA chains and denaturation of proteins[11].

The purpose of patients use of antimicrobial mouth rinses prior to dental treatment is to reduce the use of antimicrobial mouth rinses. Number of microorganisms emitted in the form of aerosols or splatter from a patient that may contaminate Field operating. Chlorhexidine is commonly used as an antimicrobial agent for the mouth. The lining of the mouth absorbs it and is slowly released over a long period of time.In addition, a broad spectrum of antimicrobial activities against gram-positive bacteria, gram-negative bacteria and multiple infectious viruses have been shown. It is important to use personal safety devices, along with the following precautions: mouth rinses, suction evacuation and rubber dam isolation. [5,12] however it is impossible to completely eliminate the aerosols but employing these methods can significantly reduce the aerosol load.

V. CONCLUSION

To conclude, this study presents a unique comparison of data designed to evaluate the knowledge and awareness of dental aerosols among dental students. This study shows that most of the students are aware of the term dental aerosols but the knowledge about its nature of spread and prevention seems to be inadequate among the dental students as everyone has to have knowledge about this to prevent the diseases that spreads through the aerosols. It is essential for the dental students to have adequate knowledge about this in order to minimize the production of dental aerosols generated during dental procedures, since dental professionals are highly exposed to aerosols. However eliminating the aerosols completely is nearly impossible but by practicing the protective measures we can reduce the certain amount of aerosols that can prevent the bidirectional spread of infections from patients to dentists and vice versa .So to conclude , the educational interventions are needed to improve the knowledge and awareness about dental aerosols among dental students in order to minimize the occupational hazard to the dentists generated by aerosols .

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Table 1

AWARENESS AND KNOWLEDGE ABOUT AEROSOLS			
QUESTION	**OPTION**	**FREQUENCY**	**PERCENTAGE**
1. Are you aware that inhalation of aerosols produced during dental procedures may cause adverse respiratory effects	yes	90	90
	no	10	10
2. Which of following diseases known to be spread by droplets or Aerosols	1.TB	6	6
	2.SARS	2	2
	3.COVID 19	7	7
	4.Pneumonic plaque	3	3
	5.All the above	82	82

Table 2

COMPOSITION OF DENTAL AEROSAL			
QUESTIONS	**OPTION**	**FREUENCY**	**PERCENTAGE**
4. A dental aerosol consists of	1.saliva	11	11
	2.nasopharyngeal secretion	8	8
	3.plaque	6	6
	4.blood	2	2
	5.all the above	73	73
5. Which of the following true?	1. Splatter (≤50 μm) droplet (>50μm) droplet nuclei (≤10 μm)	20	20
	2. Splatter (≤10μm) droplet (>50μm)droplet nuclei (≤50μm)	30	30
	3. Splatter (>50μm) droplet (≤50μm) droplet nuclei (≤10 μm)	38	38
	4. None of the above	12	12
7. The aerosol particles of size has capacity to penetrate and lodge in smaller passages of lungs	1. 0.5 to 10 μm	42	42
	2. Less than 50μm	41	41
	3. More than 50μm	10	10
	4. None of the above	7	7
12. The human nose typically filter the air particles microns.	1.>40	22	22
	2.>30	34	34
	3.>20	29	29
	4.>10	15	15
13. Aerosol particles less than 0.1 micron or ultra-fine particles like covid 19 virus can enter	1.nose	20	20
	2.alveoli	29	29
	3.blood stream	19	19
	4.respiratory tract	32	32

Table 3

SOURCES OF DENTAL AEROSOLS			
QUESTION	**OPTION**	**FREQUENCY**	**PERCENTAGE**
8. The potential source of airborne contamination during dental treatment is /are	1. Dental instrumentation	14	14
	2. Saliva and respiratory sources	21	21
	3. Operative site	11	11
	4. ALL The above	54	54
9. A droplet nuclei can contaminate the surface in range of	2 feet	31	31
	3 feet	32	32
	4 feet	25	25
	5 feet	12	12
10. A droplet nuclei may remain airborne for up to	1.does not remain at all	11	11
	2. 5 to 10 mins	29	29
	3. 30 mins to 2 hrs.	47	47
	4. 2 to 3 hrs.	13	13
14. Dental unit water lines (DUWL) have also been shown to harbour bacteria.	1.true	49	49
	2.false	17	17
	3.may be	34	34
15. In dental settings, 90% of aerosols produced are	1.<15µm	21	21
	2.<10µm	39	39
	3.<5 µm	31	31
	4.<0.1µm	9	9
16. The predominant microorganism isolated from bio aerosol in dental clinics is/are	1. Staphylococcus and streptococcus species	38	38
	2. Fusobacterium	8	8
	3. Actinomyces species	17	17
	4.all the above	37	37
17. Microorganisms that are aerosolized during periodontal therapy are predominantly	1. Actinomyces	31	31
	2. Pseudomonas	18	18
	3. Legionella	7	7
	4.Nontuberculous mycobacteria	5	5
	5. All the above	39	39
19. _____produce more airborne contamination than any other instruments/procedures in dentistry	1. Laser units	9	9
	2. Air polisher	23	23
	3. Ultrasonic scaling and cavity preparation	54	54
	4. Hand instrumentation	14	14
20. Which of the following procedure generates lower levels of aerosols and splatter	1.air polishing	9	9
	2.extraction	44	44
	3.ultra-sonic scaling	24	24
	4.none of the above	23	23

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Table 4

PREVENTIVE MEASURES IN REDUCING AEROSOLS			
QUESTION	**OPTION**	**FREUENCY**	**PERCENTAGE**
21. Which of the following is considered most effective in minimizing aerosolized spreading of infection	1. universal barrier protection (masks gloves etc.)	41	41
	2. pre procedural rinse with chlorhexidine	19	19
	3. Rubber dam	17	17
	4. High volume evacuator	23	23
22. A device that helps to remove airborne contamination from air is /are UV chamber	1. UV chamber	15	15
	2. HEPA filter	19	19
	3. N95 mask	24	24
	4. both A nd B	42	42
23. Which of the following is the most effective preprocedural rinse in reducing bacterial aerosols	1. Herbal mouth wash	10	10
	2. 0.12% chlorhexidine gluconate	53	53
	3.water	7	7
	4.all the above	30	30
24. According to CDC (Centre for disease control) water and air should be discharged for a minimum of ____ seconds after each patient.	1. 5 to 10 seconds	16	16
	2. 10 to 20 seconds	31	31
	3. 20 to 30 seconds	38	38
	4. 30 to 40 seconds	15	15

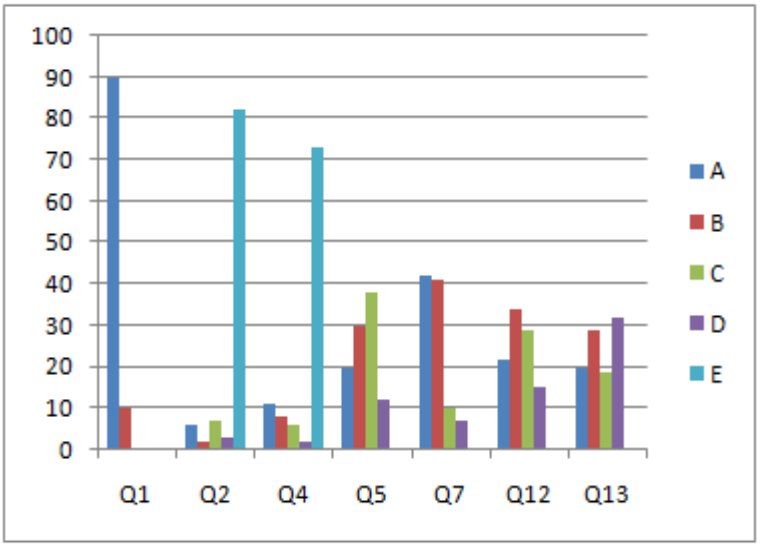

Figure 1

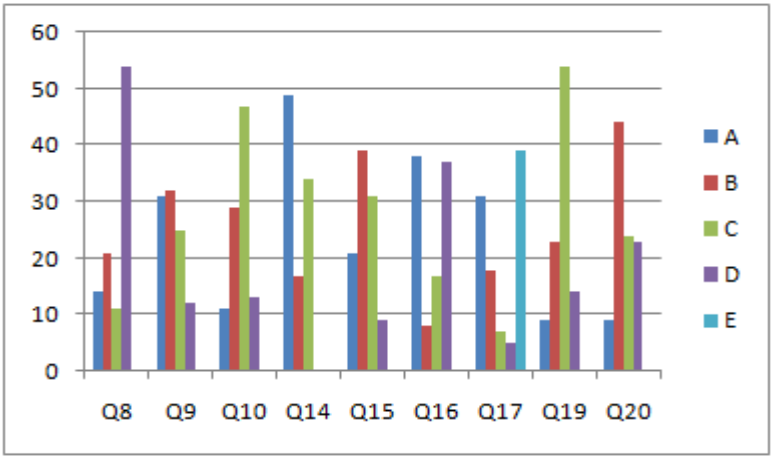

Figure 2

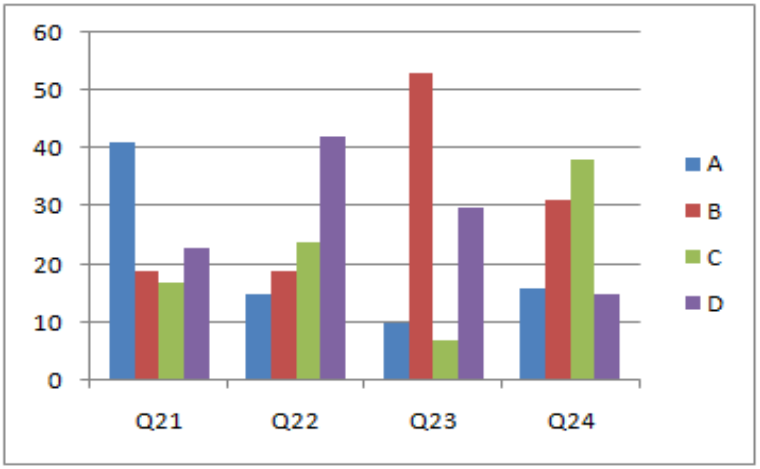

Figure 3

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