Bacterial contamination of dental unit waterlines: knowledge and attitude among dental practitioners

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Context
Knowledge and attitude of dentists about dental unit waterlines (DUWLs) is of considerable importance as they along with patients are regularly exposed to water and aerosols generated from the dental unit.

Aims
The aim was to assess the knowledge and attitude toward contamination of DUWLs among interns and postgraduate students at a dental teaching institute in Sri Ganganagar, Rajasthan.

Settings and design
A cross-sectional questionnaire-based survey was conducted during December 2018 at a dental teaching institute in Sri Ganganagar, Rajasthan.

Participants and methods
A pretested structured questionnaire was used to collect desired information from postgraduates and interns. Data were subjected to descriptive and inferential statistics using SPSS (v21.0 IBM) software. Ethical clearance was obtained from Institutional Ethical Board before the start of the study.

Results
Results showed that postgraduates had higher statistically significant mean±SD knowledge score (8.53±2.04) compared with interns (7.56±2.29) (P=0.02). The mean±SD knowledge score of male (7.70±2.19) and female (8.27±2.23) was found to be statistically nonsignificant (P=0.16), and the difference in mean±SD attitude score based on their clinical experience (amid their period of internship and postgraduation) was found to be statistically significant (P=0.03).

Conclusion
The participants who responded to this survey generally did not have enough knowledge about disinfection or testing of DUWLs. However, they were concerned about the well-being of the patient and were ready to adopt an effective method of DUWL disinfection in the future. Conducting workshop or continuing dental education programs on disinfection of DUWL may improve the attitude toward disinfection of DUWLs.

Keywords:
contamination, dental practitioners, dental unit waterlines, knowledge and attitude

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Introduction

Mainstay of any infection control protocol is identifying all possible transmission routes of infectious agents. The devices that are placed within the oral cavity and that are not easily or routinely disinfected owing to their design or some other consideration are of particular concern in dentistry [1]. A dental chair unit is equipped with a dental unit waterline (DUWL), which is a system of thin, plastic tubes [2] that are used to irrigate the oral cavity during dental treatment and provide cooling to certain items of equipment such as air rotors and scalers [3].

Bacterial biofilms, which may be reservoirs for pathogens, may be present in dental unit water systems (DUWS) [4]. Biofilm is defined as a mass of microorganism attached to a surface exposed to moisture and forms just anywhere there is a moist nonsterile environment [5]. It includes the surfaces related to natural water environment and also biomedical materials implanted in or associated with the human body. Dental plaque is the finest example of biofilm in dentistry. Thus, permanent infection of the water delivery system is caused by a type of plaque developing inside DUWLs [6].

The quantity of microorganisms present in the water used in the unit chair affects the safety of the patients and employees in dentistry [7]. The infected water from the DUWL is recognized as a risk factor for systemic diseases as well as oral diseases as it may

work directly or indirectly in the mouth [8], and it can cause serious infections, especially in the elderly and immune compromised patients, leading to conjunctivitis as well as respiratory-related diseases and bowel disorders [9].

As DUWL acts as a reservoir that facilitates the contamination of dental unit water resulting in the infection, the current study is an approach to assess the knowledge and attitude regarding bacterial contamination of DUWLs among interns and postgraduate students of a dental teaching institute in Sri Ganganagar, Rajasthan.

Participants and methods

A cross-sectional questionnaire-based survey was conducted at a dental teaching institute in Sri Ganganagar, Rajasthan, during the time period of December 2018. The convenience sample included postgraduates and interns of the institute for assessing their knowledge and attitude toward contamination in the DUWLs. A total number of 154 questionnaires were distributed among the students who were present on the day of the survey. Of the students, 139 responded, leading to a response rate of 90%. As 18 forms that were incompletely filled were excluded, the final sample consisted of 121 participants.

Ethical clearance from the Institutional Ethical Committee was obtained before commencement of the study. The purpose was explained to the respondents before the start of the study. The identity of the study participants was kept anonymous. The structured questionnaire, containing 30 self-administered, close-ended questions used in the study, was formulated based on previous studies in the same field, which included 22 knowledge-based and 8 attitude-based questions regarding the microbial risk associated with DUWS [10].

The questionnaire was divided into two sections: section A contained sociodemographic details and professional background information of the participants, and section B comprised 30 close-ended multiple-choice questions based on the knowledge and attitude on DUWL. Total knowledge/attitude score was calculated on the basis of each participant's response. Each positive response was scored as '1' and another response as '0.' The total score was a simple sum of responses ranging from 1 to 30.

Data were subjected to descriptive and inferential statistics using SPSS (v21.0 IBM, Chicago, Ill., USA) software. Unpaired *t* test was used to compare the means, whereas χ^2 test was used for comparing proportions. Pearson correlation was done to correlate the knowledge and attitude among all the participants.

Results

Table 1 shows a comparison of mean scores of knowledge and attitude scores based on educational qualification. The mean knowledge score of undergraduates (7.56 ± 2.29) was found to be significantly lower than postgraduates (8.53 ± 2.04) (P = 0.02). The difference in mean attitude score of undergraduates (3.63 ± 1.77) and postgraduates (4.89 ± 1.62) was also found to be statistically significant ($P \leq 0.01$).

Table 2 shows a comparison of mean scores of knowledge and attitude based on clinical experience amid their period of internship and postgraduation. The variation in mean knowledge score of participants when compared on the basis of clinical experience was not found to be statistically significant (P = 0.38), whereas the mean attitude score of participants with such experience (4.05 ± 1.87) and those without the experience (4.96 ± 1.33) was found to be statistically significant (P = 0.03).

Table 3 shows that neither the knowledge nor the attitude score showed statistically significant difference by sex (P = 0.16 and 0.37, respectively).

Graph 1 shows the scatter plot for the correlation between knowledge and attitude regarding disinfection of DUWL among dental practitioners. There was a positive correlation found between the knowledge and attitude (0.37), with statistically significant difference (P = 0.0003).

Table 4 shows the response by the participants to the selected questions asked based on their sex, education, and experience (amid their period of internship and postgraduation). Results showed that the postgraduates had higher statistically significant proportions of correct responses when compared with the interns for the questions related to microbial growth in DUWL (P = 0.001), flushing

Table 1 Mean scores of knowledge and attitude according to educational qualification

Scores	Qualification	*n*	Mean±SD	*t* test	*P*
Knowledge score	Undergraduate	64	7.56±2.29	5.93	0.02*
	Postgraduate	57	8.53±2.04		
Attitude score	Undergraduate	64	3.63±1.77	16.79	<0.01*
	Postgraduate	57	4.89±1.62		

*Statistically significant.

Table 2 Mean scores of knowledge and attitude according to clinical experience (amid their period of internship and postgraduation)

Scores	Experience (amid their period of internship and postgraduation)	*n*	Mean±SD	*t* test	*P*
Knowledge score	Present	23	7.65±8.02	0.77	0.38
	Absent	98	8.10±2.29		
Attitude score	Present	23	4.05±1.87	4.81	0.03*
	Absent	98	4.96±1.33		

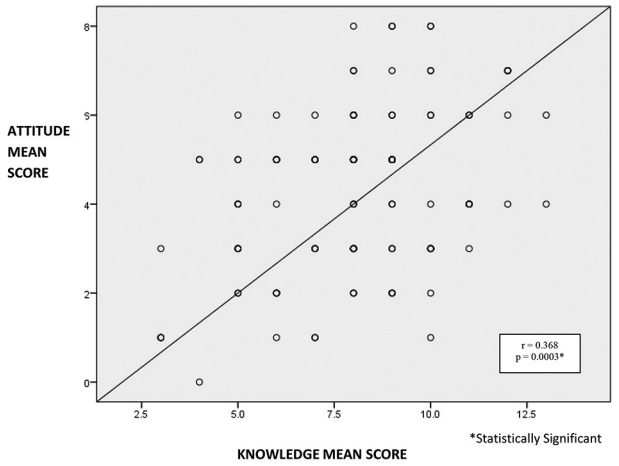
*Statistically significant

Table 3 Mean scores of knowledge and attitude scores according to sex

Scores	Sex	*n*	Mean±SD	*t* test	*P*
Knowledge score	Male	54	7.70±2.19	1.96	0.16
	Female	67	8.27±2.23		
Attitude score	Male	54	4.39±1.93	0.82	0.37
	Female	67	4.09±1.71		

of dental waterlines (P = 0.004), and guidelines of OSAP, American Dental Association, and Center for Disease Control and Prevention for sterilization (P = 0.004).

Graph 1



Correlation between knowledge and attitude mean score.

Discussion

Water supply to the apparatus connected to the unit chair, the mouthwash system, and the cuspidor is provided by the waterline of the dental unit. The backwash point as well as the waterline through which the water passes can be contaminated, and an environment where bacteria can easily reproduce is created if the patient's saliva or blood flows backward during the unit chair's operation [11].

Results showed that postgraduates had statistically higher significant knowledge score compared with interns, which is in accordance with the previous study conducted by Kengadaran *et al.* [12] showing that postgraduate had higher mean knowledge score compared with undergraduate, and academicians had higher mean knowledge score than nonacademicians. The reason can be owing to postgraduates being under the direct surveillance of the staff or owing to more emphasis given on sterilization and disinfection in their postgraduate curriculum. However, the difference in attitude score was not found to be statistically significant.

Now with the fact that effectiveness of the DUWL cleaning regimen can be checked by testing the exiting water, when asked about the same, females and participants with clinical experience amid their period of internship and postgraduation were seen to have higher knowledge as compared with the others, though the results were not found to be statistically significant.

When asked about bacterial growth in the DUWLs, 61.4% of postgraduates responded correctly about the legionella growth, which was found to be statistically significant. According to Lal *et al.* [13], this growth can be owing to the use of hard water, which can lead to the calcium coating of the inner surfaces of DUWS tubings and valves, which favors biofilm growth.

Over the question raised on infection caused by DUWL, 45.5% of the respondent in the present study were aware about the infections caused, whereas a study done by Robert *et al.* [14] reported that only one-third of the dentist respondents in their survey answered that the water circulating in the dental unit chair waterline transports many microorganisms and that the dental patients and employees are thus at risk for infection.

About the disinfection of the waterline, 54.9% of the respondents in the present study answered correctly, which is more than the study conducted by Bhadra *et al.* [15] in the year 2018, which showed that 40% knew the evidence-based methods and products regarding DUWL disinfection.

When asked about flushing of dental waterlines, 42.9% of the total participants were in its favor and 56.1% of the postgraduates responded correctly about its effect in controlling the contamination in DUWL, which was found to be statistically significant. According to the study conducted by Pankhurst *et al.* [7], blood-borne viruses such as

Table 4 Response by the participants to the selected questions asked and based on their sex, education, and experience (amid their period of internship and postgraduation)

Response	Sex		Education		Experience	
	Male	Female	Interns	Postgraduate	Absent	Present
How to check the effectiveness of a dental unit waterline cleaning regimen						
Incorrect	32 (59.3)	29 (43.3)	34 (53.12)	27 (47.4)	52 (53.1)	9 (39.1)
Correct	22 (40.7)	38 (56.7)	30 (46.88)	30 (52.6)	46 (46.9)	14 (60.9)
χ^2; *P*	3.0528; *P*=0.080		0.3997; *P*=0.527		1.4461; *P*=0.229	
Dental waterlines are conducive to which growth?						
Incorrect	28 (51.9)	38 (56.7)	44 (68.8)	22 (38.6)	54 (55.1)	12 (52.2)
Correct	26 (48.1)	29 (43.3)	20 (31.2)	35 (61.4)	44 (44.9)	11 (47.8)
χ^2; *P*	0.2854; *P*=0.593		11.0563; *P*=0.001*		0.0644; *P*=0.79	
Effect of flushing of dental waterlines to control contamination in waterlines						
Incorrect	33 (61.1)	36 (53.7)	44 (68.7)	25 (43.9)	57 (58.2)	12 (52.2)
Correct	21 (38.9)	31 (46.3)	20 (31.3)	32 (56.1)	41 (41.8)	11 (47.8)
χ^2; *P*	0.8817; *P*=0.347		8.2663; *P*=0.004*		0.330; *P*=0.565	
The current OSAP, ADA, and CDC recommendations for maintaining sterilization regarding dental unit waterline and to avoid cross-contamination						
Incorrect	23 (42.6)	36 (53.7)	39 (60.9	20 (35.1)	51 (52.04)	8 (34.8)
Correct	31 (57.4)	31 (46.3)	25 (39.1)	37 (64.9)	47 (47.96)	15 (65.2)
χ^2; *P*	1.484; *P*=0.223		8.0633; *P*=0.004*		2.2207; *P*=0.136	
According to OSAP, organisms have not been identified in dental unit waterlines?						
Incorrect	48 (88.9)	51 (76.1)	51 (79.7)	48 (84.2)	78 (79.6)	21 (91.3)
Correct	6 (11.1)	16 (23.9)	13 (20.3)	9 (15.8)	20 (20.4)	2 (8.7)
χ^2; *P*	3.2775; *P*=0.072		0.4146; *P*=0.07		1.7178; *P*=0.189	

ADA, American Dental Association; CDC, Center for Disease Control and Prevention. *Statistically significant.

hepatitis B and HIV that are secreted in the saliva have been shown experimentally to be sucked back into the handpiece and have been recovered distally in the dental waterlines, and flushing can substantially reduce the level of bacteria present in water used for dental treatment from three various sources such as air water syringe, high-speed air turbine handpiece, and oral rinse [16].

In the context of national/international guidelines for controlling microbial contamination of DUWS, 51.2% of the total respondents were not aware about it, whereas 64.9% of postgraduates responded accurately regarding the guidelines and was found to be statistically significant. Contrary to this, in the results achieved by Kamma *et al*. [3], 98% respondents were unaware of these guidelines, which indicates that the national dental organizations should be more proactive in the dissemination of information on this area of cross-infection control.

The safety of the patients and employees in dentistry is closely related to the number of microorganisms in the water used in the unit chair. Bacterially infected water from the unit chair is recognized as a risk factor for systemic diseases as well as oral diseases as it may work directly or indirectly in the mouth. Therefore, Center for Disease Control and Prevention and American Dental Association recommend a 500/ml maximum live bacterial level in the DUWL and a 200/ml colony-forming unit (CFU), respectively. Water is considered potable if it has less than 1 fecal coliform/100 ml and less than 500 CFU/ml. It has been argued that total bacterial counts higher than 500 CFU/ml might conceal the presence of some pathogens, as the detection of coliform bacteria is impaired by high bacterial loads. Thus, attention has to be paid to this hazardous issue in India.

The current study concluded that overall participants showed limited knowledge about disinfection or testing of DUWLs. However, they were concerned with the well-being of the patient and were ready to adopt an effective method of DUWL disinfection in the future. In this area, we need to sensitize the interns and update the postgraduates on this issue, so that they can apply the same in their clinical practice.

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Conflicts of interest
There are no conflicts of interest.

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