

# Evaluation of Disinfection Quality of Dental Faculty Units of Ahvaz Jundishapur University of Medical Sciences, Southwest of Iran in 2017

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## Abstract

**Introduction:** Performing dental practices in the oral environment leads to the transmission of microorganisms in saliva and blood to working surfaces and dental devices and their infection. Preventing transmission of infection through these devices is an important task of a dentist. Hence, this research was conducted to evaluate the disinfection quality of the dental faculty units of Ahvaz Jundishapur University of Medical Sciences (AJUMS) in Iran.

**Materials and Methods:** In order to evaluate the quality of disinfection of the units, sampling was performed from all glasses spittoon surfaces of 90 units of the clinical unit of the AJUMS dental faculty before and after disinfection by personnel. Then, the bacteria were cultured in a medium and examined.

**Results:** The mean (and standard deviation) of the total infection of units of the dental faculty was 46534.4 (583380.4) colonies per 1 ml before disinfection and 40265.6 (52131.1) colonies per 1 ml after disinfection, reflecting significant decrease in number of bacterial colonies after disinfection ( $P < 0.001$ ). In addition, a significant decrease was seen in the number of bacterial colonies in the restoration, pediatric, orthodontic and diagnosis units ( $p < 0.05$ ), but the difference before and after disinfection was not significant in the prosthetic, endodontic, surgical and periodontal units. In addition, the most common types of microorganisms in the whole units of the dental faculty were *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Streptococcus*, respectively, and after disinfection, the most common types of microorganisms were *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Enterococcus*, respectively.

**Conclusion:** In general, this study showed that the disinfection method of units in dental faculty can not reduce the severity of infection of the units. Given what was stated, it is recommended that the method and the substances used to disinfect the unit to be changed.

**Keywords:** infection control, disinfection methods, Deconex, dental faculty

## 1. Introduction

Performing dental actions in the oral environment transmits the microorganisms in saliva and blood to working surfaces, dental devices and instruments and their infection. Thus, preventing the transmission of infection through these devices is an important task of a dentist (Javaheri & Zanganeh, 2008; Valian, Shahbazi, Farshidnia, & Tabatabaee, 2014). In most dental treatments, infection with blood is unavoidable. Thus, steps should be taken to eliminate the microbes accurately from the devices used in dentistry (Taheri, Bakianian, Fallah, & Nik Kerdar, 2010; Eskandarloo & Mashouf, 2006). Although the devices should be sterilized daily with dry heat and autoclave, there is a need for devices and equipment which cannot be sterilized by thermal methods such as unit chair, rotary, unit glasses spittoon, cabinets, amalgamators, external surfaces of oven, suction, floor and walls (Sultanpour & Sayed, 2001). Generally, release of suspended particles in the dental environment is one of the ways of transmission of infection in dentistry. Clinical surfaces in dentistry are not directly in contact with the patient, although they can be infected during work and then act as a source of microbial infection. These surfaces can be infected directly through the diffusion of suspended particles and splashing blood, saliva and water containing body fluids or through contact with infected dental devices or contact with infected gloves. The light key, the unit key, the control key of chair and dental stool are examples of clinical surfaces (Valian, Shahbazi, Farshidnia, & Tabatabaee, 2014). Although the use of disposable covers on some surfaces touched by the dentist has been accepted, some parts of the unit often remain uncovered and the principles of infection control are ignored in these parts. Dental stool or dental chair is one of the cases prone to infections due to proximity to the unit and the site for performing the dental practice. Experience has shown that most students and dentists often replace the dental stool with infected gloves, and thereby, they indirectly transmit the infection (Teksoy et al., 2011; Cristina et al., 2008). The unit glasses spittoon is also continuously infected by blood and saliva. Therefore, these surfaces should be disinfected to prevent the transmission of infection. Control of pathogenic agents in the environment requires the use of appropriate methods for disinfection. Disinfection is performed by physical and chemical agents. By using them, we can reduce the rate of microorganisms causing pathogens. Chemicals such as 70% Alcohol and deconex, used as solvent in the workplace, are some of these substances (Teksoy et al., 2011). The performance of disinfectants will be effective if used in the manner recommended by the manufacturing company (Christensen et al., 1989; Best et al., 1990; Ardakani et al., 2008). Inappropriate use will not result in proper cleaning and disinfection. Thus, the type of its using by the consumer will affect the result of the work. Based on the reports of different studies on the dental unit infection (Valian, Shahbazi, Farshidnia, & Tabatabaee, 2014; Taheri, Bakianian, Fallah, & Nik Kerdar, 2010; Sultanpour & Sayed, 2001; Cristina et al., 2008; Ardakani et al., 2008), this study was conducted to evaluate the disinfection quality of dental units at Ahvaz Jundishapur University of Medical Sciences (AJUMS).

## 2. Methods and Materials

In this study, in order to evaluate the quality of disinfection of units, sampling was performed from all glasses spittoon surfaces of 90 clinical units of Ahvaz Jundishapur University of Medical Sciences (AJUMS) Dental faculty including pediatric, prosthetic, endodontic, restoration, periodontal, orthodontic and surgical units. In addition, defective units and the units, which were not used, were excluded from study. Sampling was performed before disinfection of the unit at the end of the working day, at 14:45. Then, the service force, which is responsible for disinfecting the units, disinfected the units in accordance with the procedure. The sample taken after disinfection of the units was taken on the morning of the next day and at the beginning of the working day, at 8:00 am (about sixteen hours later). All parts of the unit glasses spittoon were sampled by a sterilized swab in a width of 2 cm and a length of 10 cm, which was immersed to sterilized physiology serum. The swap movement on the blood agar was rotary. The swab was then placed in a sterile test tube containing 5 ml of sterile physiology serum and the test tube was closed. Samples were immediately transferred to the laboratory of microbiology during 10 minutes at the Faculty of Medicine at the clod box (manufactured by Igloo Company of USA). The same thing was done in the same way after disinfection of the unit by the personnel exactly from the place where it was first sampled. Sterile gloves were used during sampling and in each time of sampling, the gloves were replaced. In the laboratory, test tubes containing the sample were shaken for 30 seconds to isolate the bacteria completely, and in the vicinity of the flame at a radius of 15-20 cm, 0.01 cc of the sample was taken by sampler and placed in blood agar culture media. The culture medium was incubated for 24 hours at 37 ° C and in 10% co2 conditions. Then, the culture medium was removed from heating room and the number of colonies was counted. To obtain the colony count of bacteria in 1cc of physiological serum, the number of obtained colonies was multiplied by 100. In order to identify the dominant bacterium, one of the most similar colonies was cultured in blood agar culture medium and incubated for 24 hours at 37 ° C and conditions of 10% co2. Then, for isolation of bacteria Gram positive and gram negative, cocci and Bacillus bacteria, gram staining lam was prepared. Then, each of bacteria was tested for

the diagnostic tests according to the shape below the microscope. Biochemical tests such as catalase, coagulase to detect gram-positive cocci, other tests such as oxidase, nitrate, and citrate, fermentation of lactose sugars, galactose, glucose and sucrose were used for differential diagnosis of other bacteria. To examine the samples before and after disinfection of the unit, McNeimar and the descriptive statistics analysis were used, which it was performed in SPSS 22 software.

### 3. Results

The findings of this study showed that the mean (and standard deviation) of the total units of the dental faculty was 46534.4 colonies per 1 ml before disinfection and 40265.6 colonies per 1 ml after disinfection, indicating that the infection of units decreased by 6269 colonies on average after the disinfection. This decrease was statistically significant ( $P < 0.001$ ) (Table 1). The findings also showed that the most common types of microorganisms in the whole units of the dental faculty before the disinfection were *Pseudomonas aeruginosa* (17%), *Staphylococcus aureus* (12%) and *Streptococcus spp* (11%), respectively. The most common types of microorganisms in the whole units of the dental faculty after disinfection were *Pseudomonas aeruginosa* (32%), *Staphylococcus aureus* (11%), and *Enterococcus* (10%) (Table 2). In addition, bacterial infection in each unit before and after disinfection was also studied in this study. The results of this study are presented in Table 3.

Table 1. Infection of units before and after disinfection of the environment in the whole dental faculty

Colony per 1 ml	Before disinfection	After disinfection	P.value
Number of units	90	90	
mean	46534.4	40265.6	0.001
SD	53380.4	52131.1	

Table 2. Frequency distribution of the most common types of microorganisms in the whole unit of the dental faculty

types of microorganisms	Before disinfection		after disinfection	
	f	%	f	%
<i>Pseudomonas aeruginosa</i>	15	17	29	32
<i>Staphylococcus aureus</i>	11	12	10	11
<i>Streptococcus spp</i>	10	11	9	10
Enterococci	-	-	9	10
Total	90	100	90	100

Table 3. Comparison of the mean number of bacterial colonies in each unit of the dental faculty before and after disinfection

unit	n	before disinfection		after disinfection		p-value
		mean	SD	mean	SD	
Diagnosis	8	687.5	581.71	250.00	261.86	*0.011
Orthodontic	12	1958.33	1962.12	983.33	860.06	*0.05
Pediatric	13	17661.33	40984.34	1238.46	2729.63	*0.002
Restoration	9	52030.8	55897.1	35684.6	61620.9	*0.012
Periodontic	9	61366.67	57672.43	49444.44	57456.94	0.342
Prosthesis	12	101500.00	29444.86	101333.33	30022.21	0.317
Endodontic	10	57150.00	55800.9	56740.00	56200.46	0.124
Surgical	13	70100.00	52651.9	69361.54	5355.98	0.134
Total	86	48554.65	53760.66	42031.4	52671.55	**0.000

\*significant difference at the level of 0.05

\*\*significant difference at the level of 0.001

### 4. Discussion

Despite all of its dangers for health of dentists, dentistry is one of the popular fields of study in Iran (12-16). As patients use a unit glasses spittoon in most of dental treatments to wash their mouths and discharge the accumulated fluids in the mouth, and this area is not covered with plastic or other disposable materials, infection with blood

and saliva of this area is unavoidable. On the other hand, when using the unit glasses spittoon, there is a possibility of contact of this area with the patient's hands and face (especially in children). Therefore, elimination of microbe from this area seems to be an essential (Valian, Shahbazi, Farshidnia, & Tabatabaee, 2014; Cristina et al., 2008). In this regard, various methods have been developed in recent years for disinfection of equipment and various surfaces in the dental office and various studies have been carried out in this regard. Given the different results of the studies (Christensen et al., 1989; Best et al., 1990; Ardakani et al., 2008; Larsen et al., 2000; Azimi-Hoseini et al., 2007) on the effect of these methods, this study was conducted to evaluate the quality of disinfection of dental units of the Ahvaz Jundishapur University of Medical Sciences (AJUMS) in southwest of Iran in 2017. It should be noted that in the pilot study of this study, it was found that the disinfection of the units was performed by the service forces and the solution used to disinfect the surfaces and units of the dental faculty of Ahvaz was DESOMED RAPID AF (Dr. Trippen co, German). This solution is quaternary ammonium compound containing alcohol and was one of the intermediate design facts. In a study conducted to investigate the antibacterial effect of three disinfectant solutions on different levels of dentistry in Iran, Nosuhi et al. (2012) compared the Deconex, Microzed and Alprocid solutions with each other. The findings of this study showed significant difference between the number of bacterial colonies before and after disinfection and any of the three disinfectant solutions (Nasoohi et al., 2012). Anbari et al. (2014) also showed that ethanol, oxygenated water and Deconex, compared to ultraviolet radiation, had an acceptable disinfection effect on the surface and equipment of the research laboratory and showed that Deconex reduced the microbial load (Anbari, Nabi, & Khalili, 2014). The present study also showed that the use of DESOMED RAPID AF (Dr. Trippen co, German) reduced the total mean microbial load of the evaluated area in units of dental faculty after disinfection, and this decrease was statistically significant ( $p < 0.001$ ). These findings are consistent with those of previous studies.

As the mean number of bacterial colonies in the total units examined to show the effects of disinfecting solution can be influenced by standard deviation and as in each treatment unit, the type of dental services provided to patients and thus the use of unit glasses spittoon and the rate and type of infection created in different units are different, for more accurately evaluation of the result of the disinfection process, the effect of DESOMED RAPID on the microbial infection was also investigated separately in each unit. Interestingly, the results showed that a decrease in the number of bacterial colonies was observed in restoration, pediatric, orthodontic and diagnosis units, and there was a significant difference in the level of infection in these units before and after disinfection. There was no significant difference before and after disinfection in the prosthetic, endodontic, surgical and Periodontic units. This could be due to the difference in treatment provided in these units. The presence of any infection in at least one plate, even fewer than 10 colonies per 1 cc, represents a lack of sterilization. Presence of at least 100 colonies per plate has been defined as severe infection. It has also been observed that there is no clear difference between the 100-colonial boundary in 1 cc solution and higher boundaries (Azimi-Hoseini et al., 2007). Thus, severe infection is defined as presence of more than 100 colonies per 1 cc, unfortunately, it is concluded that the disinfection process in the faculty has not been effective in practice and the rate of infection in the units before and after disinfection, despite significant reduction in the number of colonies in the culture of samples in some units, is high.

In justifying these results, it can be stated that aerosols with a diameter of less than 50 microns can remain in the suspended space for a long time (Rautemaa, Nordberg, Wuolijoki-Saaristo, & Meurman, 2006; Coleman, O'Donnell, Boyle, & Russell, 2010) and after that the disinfection process perfumed at the end of the day, they sat during fourteen to fifteen hours on different parts of the unit, including the unit glasses spittoon and caused infection and positive microbial culture. Accordingly, it is recommended that the unit disinfection process to be performed before working on each patient in order to provide more safety, especially for people who have a weakened immune system. Infecting endodontic files with salivary of 30 patients admitted to the restorative, endodontic and surgical units, Sabouri et al examined the disinfecting effects of microton and deconex. They identified the following microbes in infected files: *Staphylococcus aureus*, Nonpathogenic, *Staphylococcus*, *Streptococcus Viridans* pneumonias, *Neisseria suprophyticus*, *Corynebacterium* spp, *Candida albicans* and *Bacillus subtilis* (Saboori, Fallah, & Dastgerdi, 2006). In examining the effects of deconex, microton, cidex for disinfection of turbines and parasites in the restorative unit at Shiraz Dental Faculty in Iran Sharafeddin et al also isolated the following microbes: *Viridans streptococci*, *Diphtheroidase*, *Filamentous fungi*, various species of *Veillonella* and *Lactobacillus* (Sharafadin, Sadeghi, & Kohanteb, 2004). In the present study, the most common isolated bacteria included *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus* and *Enterococcus*. These results indicate that isolated microbial species vary widely in different studies. These differences may be due to the fact that a specific therapeutic unit was considered in each study and the method of research was also very different in these studies.

Al-Hiyasat et al in Iran showed that the presence of *Pseudomonas aeruginosa* in 86% of the water systems of dental units at the beginning of the working day. They showed that the number of *Pseudomonas aeruginosa* colonies decreased after working with unit compared to that in beginning of work (Al - Hiyasat, Ma'ayeh, Hindiyeh, & Khader, 2007). In the present study, the most common microbial strain cultured before and after the disinfection of unit was *Pseudomonas aeruginosa*. Moreover, the number of colonies not only did not decrease one day after disinfection, but also increased. In this regard, the results of these two studies are consistent. The reason for this increase in the number of colonies is the proliferation of *Pseudomonas aeruginosa* microbe during one day with the help of organic particles present in the biofilm on the unit glasses spittoon (24). This bacterium also prevents the growth of other bacteria by producing bacteriocin. The use of unit during the day by applying water pressure leads to elimination of bacteria, which have a slight adhesion to biofilm. *Pseudomonas aeruginosa* is a gram-negative opportunistic pathogenic bacterium, so that the rate of mortality in those affected with *Pseudomonas aeruginosa* has been reported 50%. One of the characteristics of *Pseudomonas aeruginosa* is high resistance to the types of antibiotics (Poole, 2004; Estahbanati, Kashani, & Ghanaatpisheh, 2002; Ebrahimzadeh Shiraz, Rezaei Yazdi, & Alijanianzadeh, 2017). Schelstraete et al showed that patients with cystic fibrosis had received *Pseudomonas aeruginosa* out of the home environment (such as the dental environment) (Schelstraete et al., 2007). Therefore, the transmission of this pathogen to patients with weakened immune system in dental centers is a great concern. According to some researchers, the effects of disinfection of quaternary ammonium compounds, such as Deconex or DESOMED RAPID AF (Dr. Trippe co, German), are reduced against hard water and organic and non-organic sediments such as gas and cotton (Saboori, Fallah, & Dastgerdi, 2006; American Dental Association, 1992; Oeding, 2004). It seems that when these items are taken into account when disinfecting the units, the effectiveness of the disinfectant increases. However, in the study conducted by Azimi Hosseini et al in Iran, none of the disinfectants (Deconex and Microton) were able to completely eliminate the *Pseudomonas aeruginosa* (Azimi-Hosseini et al., 2007). Considering this issue and the results of this study, it seems that the use of another disinfectant such as hypochlorite besides the DESOMED RAPID solution to be necessary to overcome this bacterium. In addition, the issue of knowledge management should also be considered in this regard, and the special attention should be paid to storing, sharing and applying the results of this research (providing the right information to right people at the right time) (Gilavand, 2017).

## 5. Conclusion

In general, this study showed that the disinfection methods in dental faculties cannot change the severity of infection of the units. The most common microbial strain in the units of the faculty was *Pseudomonas aeruginosa*, which is an opportunistic bacterium. It can cause disease in patients with weakened immune system. The used solution cannot eliminate this bacterium. Given what was reported, it is recommended that the method and the type of substance used for disinfecting to be changed.

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