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Original Article

Prevalence of *E. coli* and Coliform bacteria in the Dental Unit Waterlines of Private Clinics of Islamabad and Rawalpindi

Muhammad Muhammad[1*], Arsalan Hamid Khan[2], Muhammad Musab Sheth[1], Shanzar Butt[1], Asadullah Shakeel[1], Syed Saboor Tariq[1]

[1] Department of Operative Dentistry, Riphah International University, Islamabad, Pakistan
[2]Gandhara University, Peshawar, Pakistan

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***Corresponding Author:**
Muhammad Muhammad
Department of Operative Dentistry, Riphah International University, Islamabad, Pakistan
dr.muhammad@riphah.edu.pk

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ABSTRACT

Bacteria colonizing surfaces and forming biofilm in dental unit waterlines is a well-documented phenomenon. Pathogenic bacteria from contaminated dental unit water lines are transmitted with aerosols and splatter generated during dental procedures. **Objective:** To identify the presence of coliform bacteria and *E. Coli* in dental unit waterlines of private dental clinics in Islamabad and Rawalpindi to see whether they meet the criteria for drinking water. **Methods:** This is a quantitative study carried out on 30 active dental units. Triple syringe and handpiece outlet water samples were taken. Samples were evaluated by National Institute of Health (NIH) through Polymerase Chain Reaction (PCR). The cultures were incubated twice at 24 and 48 hours. The presence of coliform bacteria and *E. coli* in the samples was evaluated. **Results:** Approximately 20% of the samples were found to have coliform bacteria and *E. coli*. Some private dental clinics in Islamabad and Rawalpindi use dental unit waterlines that do not meet the criteria for drinking water. **Conclusions:** Dental unit water lines (DUWLs) must meet the set criteria for drinking water to reduce the risk of infections. Contamination with coliform bacteria and *E. Coli* were evident in some of the dental clinics. This contamination can be reduced by following Center for Disease Control (CDC) guidelines and using chemical treatment protocols for cleaning dental unit waterlines.

INTRODUCTION

Water is an indispensable component in the provision of dental care. It serves a variety of crucial purposes ranging from irrigation of the operating field and oral rinsing to cooling of rotary instrument [1,2]. The water used in the dental unit waterline systems may be derived from different sources. Common sources include municipal water supply and bottles (tanks) connected to the dental unit [3-5]. Microorganisms can inadvertently enter the dental unit water supply lines via aerosols and droplets generated by the dental instruments [6]. They may also reach the DUWL through contaminated bottled water or mains water. These microorganisms include bacteria, fungi, protozoa, and viruses, some of which may be pathogenic. If present in greater than acceptable numbers, the pathogenic bacteria, such as Legionella, Pseudomonas, and Mycobacteria, may harm the dental staff and patients alike [7-9]. DUWL systems consist of long, narrow-diameter pipes composed of nylon or polyvinyl chloride material. Water may remain stationary for long periods in these pipes. This can lead to a rise in the water temperature. The fluid dynamics within the DUWL systems, therefore, provide the ideal environment for pathogenic bacteria to grow and form microbial biofilms [10]. Not only do biofilms show greater resistance to

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antimicrobials than planktonic bacteria, but the subsequent sloughing of these bacterial biofilms within the dental unit water lines also plays an important role in the spread of infection. Even though fatal incidents reported because of contaminated DUWL are rare, the risk of infection should not be underestimated [11]. According to the Centers for Disease Control and Prevention (CDC), dental unit water used in nonsurgical treatments should have a CFU/mL of less than 500 [12]. The Environmental Protection Agency has set this guideline for drinking water (EPA) [13]. However, according to the American Dental Association (ADA) guidelines, the bacterial contamination of DUWL should not exceed 200 CFUs/ml. The guidelines also recommend a separate water reservoir other than the urban water source, the use of disinfecting chemical solutions in the tubes, routine cleaning of water reservoirs, the use of filters, flushing of the tubes for a few minutes before and after dental procedures, sterilization of handpieces with autoclave, and use of ultraviolet light for disinfection [14]. Many dental offices in Pakistan are connected to municipal water. The water used in dentistry is not standardized, so the minimum criteria to meet is the drinking water. This means the absence of Escherichia coli and other coliform bacteria [15]. This study aimed to identify the water sources and evaluate the presence of *E. coli* and coliform bacteria in the water/air syringe and handpiece outlets in private dental clinics of twin cities, Islamabad and Rawalpindi.

METHODS

This descriptive cross-sectional study was approved by the Ethical review board of Riphah International University (IIDC/IRC/2020/01/010). Water samples were collected from 30 private dental clinics in Islamabad and Rawalpindi from September to December 2020. Units with working air/water syringes and handpiece outlets were included. A convenient sampling technique was used. Permission was taken from concerned authorities prior to the conduction of the study. 100 ml of water from the water/air syringe and handpiece outlets of each dental unit was taken in sterile sample bottles, provided by the National Institute of Health (NIH). Samples were labeled appropriately with the date and time of collection as well as details of the dental units they were obtained from. These samples were then forwarded to the NIH's Department of Microbiology for microbial testing of coliform and *E. coli* bacteria. The data were analyzed by SPSS version 24.0.

RESULTS

In the present study, an evaluation of 30 water samples taken from the DUWLs of private dental clinics of Islamabad and Rawalpindi indicates that 20% of these clinics do not meet the minimum criteria for drinking water (Table 1). Water should be free of coliform bacteria and fecal E. Coli to be considered safe for use in dental practice.

Water samples	Number	Coliform bacteria and E. Coli present (Frequency)	Coliform bacteria and E. Coli present(%)	Coliform bacteria and E. Coli absent (Frequency)	Coliform bacteria and E. Coli absent (%)
Islamabad	15	2	13.3	13	86.6
Rawalpindi	15	4	26.6	11	73.3
Total	30	6	20	24	80

Table 1: Frequency and percentage of coliform bacteria and *E. Coli* found in water samples of private dental clinics of twin cities

DISCUSSION

The current study was conducted to examine the microbial quality of DUWLs of private dental clinics within the twin cities, Islamabad and Rawalpindi. Water samples taken from 30 private clinics, 15 from each of the two cities, were evaluated by microbial testing through NIH. The results showed that 6 out of 30 dental units used water that was contaminated with Coliform bacteria and E. coli, which makes up for 20% of the DUWLs examined. This means that 80% of all private dental clinics evaluated use water that meets the criteria for drinking water. Only 13.3% of the DUWLs of dental clinics of Islamabad were found to contain these bacteria as compared to 26.6% in the clinics in Rawalpindi. This difference may be attributed to better quality of life, higher literacy rate and better socioeconomic conditions that prevails in Islamabad [16].

Numerous studies have been conducted worldwide to determine the bacterial quality of DUWLs [17]. Different studies have yielded considerably distinct results regarding the type, number, and virulence of these organisms. The disparity in these results is not only because of the different testing conditions and water sources but also because of the variable geographical locations in which the studies were conducted. Research conducted in Quito and Caracas, in South America, yielded undesirably high number total viable counts of heterotrophic bacteria and/or coliform bacteria and Pseudomonas in 73% of the water samples. These samples also contained non-tuberculous mycobacteria in large numbers [18]. Another similar study was undertaken in Brazil, however, it included evaluation of DUWLs of public dental clinics instead of private dental practices. In this study, E. coli was not detected in any of the water samples analyzed. However, nine of the thirty samples (30%) exhibited total coliforms. A study, conducted in Iran, demonstrated that 25.5% water samples were positive for coliform bacteria [19]. An audit performed in England, for determining the quality of DUWLs, showed 72 DUWL water samples were tested, and none was contaminated with E. coli, but coliforms were recovered from five of them (7%)

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[20]. This may be attributed to better economy and higher standard of care provided in first world countries compared to developing nations. This variety of results is due to many factors, including but not limited to, socioeconomic circumstances, literacy rates, types of dental practices, professional ethics of practicing dentists, sources of water, protocols used for disinfection of DUWLs, methods of sample collection and testing, and living conditions prevalent in the areas of study. The results of the current study show that many private dental clinics in Islamabad and Rawalpindi, still use water that does not meet the minimum criteria set by the CDC. This emphasizes the need for obtaining water from better sources, use of distilled water for treatment, routine disinfection of DUWLs and regular monitoring of biofilms in the DUWLs, to reduce the risk of infection.

CONCLUSION

DUWLs must meet the criteria for drinking water to reduce the risk of infections. Contamination with coliform bacteria and E. Coli were evident in some of the dental clinics. This contamination can be reduced by following CDC guidelines and using chemical treatment protocols for cleaning of dental unit waterlines.

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