

Microbial Contamination in Dental Settings : A Systematic Review

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Abstract

Background: The human body is a reservoir for thousands of microbes which lives in a harmonic relation with the human body. Any increase in the number of these microbes through contamination can lead to a hazardous complication. The field of “dentistry” deals with the minute structures of oral cavity and any small contamination can cause hazardous effect.

Aim: To assess the contamination caused by microbes in a dental setup.

Materials and Methods: A literature review was performed using Pub Med, science direct, Wiley online library, Cochrane, using key word microbial contamination and dental institution. Of total 256 articles from various sources were collected out of which 8 final articles were related to research topics. The review is reported according to the PRISMA guidelines.

Results And Conclusion: The available articles suggested that there were different sources of contamination. It was found that every material used was a potential contaminant.

Keywords: contamination, dental institution, microbes

INTRODUCTION

Microbes are potentially a significant reservoir of contamination and even cross contamination in a dental setup be it a dental institution or dental clinics.

^[1] Microbial contamination refers to the non-intended or accidental introduction of microbes such as bacteria, yeast, moulds, fungi, virus, prions, protozoa or their toxins and by products.

The main foci of this contamination being the dental unit water lines, water used for mixing, washing, cleaning the various instruments involved in any dental procedure or the contamination of materials used like impression materials, restorative materials, pumice powders and pumice slurry etc. These sources mentioned above along with others sources serves as a favorable environment for microbial biofilm formation. ^[2,3]

The common contaminants which are prevalent in a dental setup includes Streptococci spp., staphylococci sp, Enterococci sp., Pseudomonas aeruginosa, Legionella and other gram negative rods which are of potential threat. ^[4] The most common fungi contaminants were Aspergillus, Rhizopus and Penicillium, Candida albicans and Cladosporium. ^[5]

The contamination by the microorganisms which are mentioned above can be fatal in patients who are immunocompromised or other immune system problems, it can also be fatal for pregnant women, elderly, graft recipients, smokers and alcoholics and mostly children. ^[1]

In this profession the routes of contamination are-

- Direct route of contamination
- Blood-borne route of contamination
- Aerosol emitted from the rotatory instruments which use both air and water ^[6]

These contaminants are a potential pathogen to a wide range of health issues, the most common being the ‘common cold/influenza’ followed by other serious diseases like Hepatitis B, HIV-AIDS, Herpes which are caused due to blood contact. ^[7] The current guidelines set by the American dental association in dental healthcare settings recommend that dental unit output water should amount to 200 CFU/ for aerobic bacteria. Anything exceeding this value results in contamination. ^[1,2,5] Recently the contamination caused by dental personnel in and around a dental setup is gaining critical heights and is a topic of discussion in today’s society.

MATERIALS AND METHODS

OBJECTIVE

To assess the contamination caused by microbes in a dental institution.

Inclusion criteria-

- Original articles
- Full text articles
- Articles showing the prevalence of microbial contamination in dental institution.

Exclusion criteria

-Articles showing the prevalence of contamination in other setups.

SEARCH STRATEGY: Literature review was performed using the search engines Pub Med, science direct, Wiley online library, Cochrane. The key words used for searching was “microbial contamination” and “dental institution”. A total 256 articles from various search engines were collected and out of which 7 final articles related to research topics were finalized.

SEARCH ENGINES: The following search engines were used-

- Pubmed
- Scopus
- Wiley online library
- Elsevier science direct
- Ovid medicine
- Cochrane library

- Prospero
- Osf
- Grey literature

RESULTS:

A Literature review was performed using search engines. The key words used for searching was “microbial contamination” and “dental institution”. A total 256 articles from various search engines were collected and out of which 7 final articles related to research topics were finalized. There were around 104 duplicates which were removed. Amongst the rest, the articles without full text were also removed which led to 66 articles. Out of those 66 articles 7 were selected for the final study purpose. Figure 1 shows the PRSIMA flowchart that depicts the articles identified, screened, duplicates removed and the final articles included for qualitative analysis.

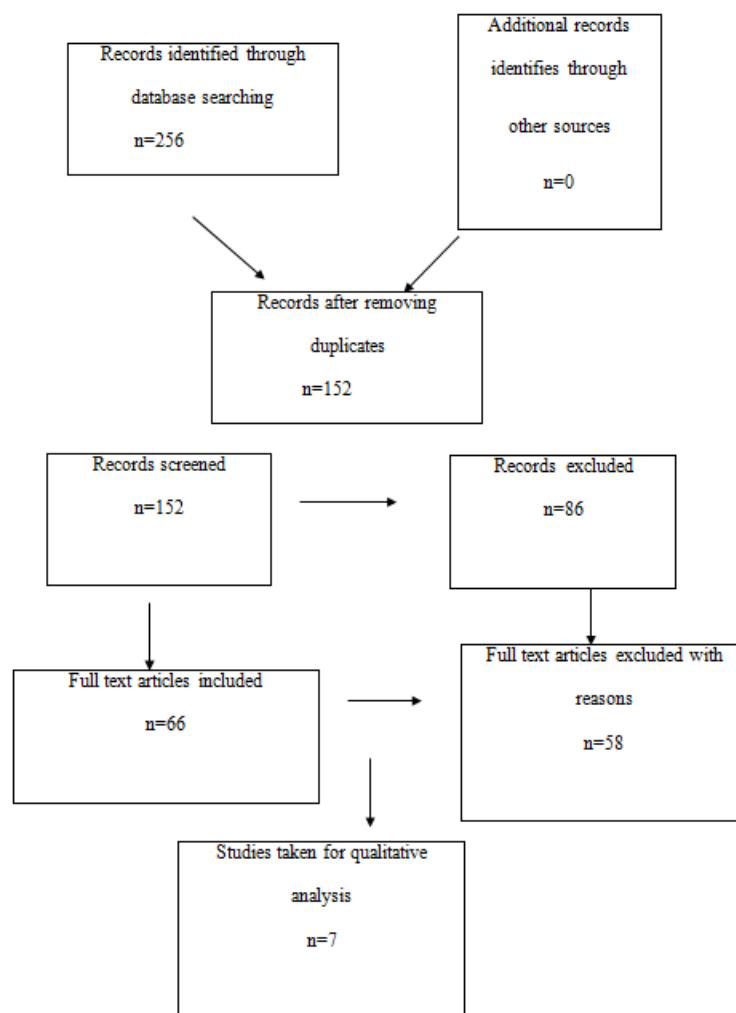


Figure 1: Prisma flow diagram showing the number of studies identified, screened, assessed for eligibility, excluded and included in systematic review.

TABLE 1: CHARACTERISTICS OF THE INCLUDED STUDIES IN THE SYSTEMATIC REVIEW

| AUTHOR | COUNTRY OF STUDY | STUDY SITE | SOURCES OF SAMPLES | EXAMINATION PROCEDURE |
|--|------------------|---|---|--|
| Shailee Fotedar, Et al 2014 ^[2] | INDIA | H.P. Government Dental College, Shimla | -Water from the dental unit water lines. -Water samples from the tap. | -Aerobic culture by the spread plate method on MacConkey Agar. -Aerobic culture by the spread plate method on blood agar. -Presumptive Coliform count. |
| Silvano Monarca, et al 2000 ^[5] | ITALY | University of Brescia, Italy | -Bacterial contamination of air. -Bacterial contamination of surfaces. -Bacterial contamination of water in dental units. | -Spore tests for autoclaves, chemiclaves and oven. -Sterility test for sterilised instruments |
| Fairborz Vafaee; et al 2013 ^[3] | IRAN | Hamadan University of Medical sciences | -Specimen of pumice powders and pumice slurry | -Inoculated onto selective and non-selective media in order to count the total colony forming unit. -Isolated fungi and bacteria were identified using gram staining and differential diagnostic tests. |
| Victor Hugo et al 2016 ^[7] | BRAZIL | University of Nilton Lins, Brazil | -Samples were collected from dental chairs and spitters. | Culture by: -MacConkey agar -PIA agar -BHI agar -Mueller-Hinton agar -Sabouraud agar |
| Hegde PP, Et al 2006 ^[4] | INDIA | KLES Institute of Dental Sciences, Belgaum | -Samples were collected from the bar soap used in the clinic. | Culture by: -Blood agar -MacConkey agar -Peptone water |
| Neethu Salam, et al 2017 ^[8] | INDIA | Pushpagiri College of Dental Sciences, Tiruvalla, Kerala, India | -Water from the dental unit water lines. | -Centrifugation and the inoculation in the different media. |
| M. GUIDA, et al 2012 ^[6] | ITALY | University of Naples Pellegrini Hospital, Naples, Italy | -Water -Air -Surfaces samples | -Total Viable Count -Active sampling was performed using the Surface Air System (SAS) sampler and Passive sampling was done. -A RODAC plate, was pressed on the surface to be tested, and then incubated at 36°C for 48 h. |

TABLE 1(CONTINUED): CHARACTERISTICS OF THE INCLUDED SYSTEMATIC REVIEW

| AUTHOR | ORGANISMS PRESENT AND PREVALANCE OF ORGANISMS | COMMONLY CONTAMINATED REGIONS | CONCLUSION | QUALITATIVE ASSESSMENT |
|------------------------------|--|--|--|------------------------|
| Shailee Fotedar, et.al. 2014 | Staphylococcus coagulase negative | Dental unit water line | Only microorganism found was staphylococcus coagulase negative and the levels were higher than that recommended by CDC. | Good |
| Silvano Monarca, et.al. 2000 | β -haemolytic Streptococci Streptococci Fungi-60.8% Staphylococcus aureus | Autoclaves Chemiclaves Endodontic instruments Trolley surfaces | There was ineffective management among the group of dental personnel and the need to increase knowledge of procedures to control infection and comply with these methods of prevention. | Good |
| Fairborz Vafae; et.al. 2013 | PUMICE POWDER S.epidermidis 70.5% E. coli 23.6% Acinetobacter & B. cereus 11.8% Enterobacter & diphtheroids 5.9% PUMICE SLURRY S. epidermidis 45% diphtheroids 35% E. coli 30% Citrobacter 20% Staphylococcus aureus 15% Enterobacter 10% Citrobacter & Proteus 5%. | Pumice powder Pumice slurry | Microbial contaminations were detected in the pumice powder and pumice slurry in dental laboratories: Gram-positive bacteria, and Gram-negative bacteria were found. | Good |
| Victor Hugo et.al 2016 | Staphylococcus aureus Klebsiella pneumoniae Escherichia coli Acinetobacter spp. Enterobacter spp. | Dental Chair Stand Spittoon | The contamination of surfaces of dental units was found and therefore it is a matter of great importance that should be discussed among professionals and students of dentistry to search for more effective ways to prevent cross-infection. | Good |
| Hegde PP, et.al. 2006 | Aerobic spore bearers 25% Aspergillus niger 18.7% Candida parapsilosis 25% Diphtheroids 12.5% E.coli 78.1% Klebsiella sp 87.5% Propionibacterium acnes 6.25% Staph.aureus 18.7% Staph.citreus 56.2% Staph.epidermidis 100% | Bar soap | The "in-use" bar soap is a harbour for microorganisms, possibly causing greater harm and thus nullifying the original purpose of handwashing. | Fair |
| Neethu Salam, et. al. 2017 | Escherichia coli Pseudomonas Klebsiella Enterococci | Dental unit water line (Airtor line, scaler unit, 2-way syringe and oral rinse unit) | The colony-forming units in water samples are higher in number than the ADA recommended value. Presence of indicator organisms such as E. coli and Enterococci indicates faecal contamination of water may cause several systemic infections, mainly to the immunocompromised, the elderly and children. | Good |
| M.GUIDA, et.al. 2012 | Pseudomonas Aeruginosa Legionella spp | water samples from tap water water samples from dental unit water system | There is need to improve disinfection procedures and air treatment systems in the considered environment | Good |

Table 1 shows the studies conducted in different areas which further shows the prevalence of some common microorganisms in dental setups. These microbes can be really hazardous to the human species if not managed properly.

DISCUSSION:

The research yielded 256 researches which were assessed and 7 articles were selected for the study purpose. Shailee Fotedar et.al.^[2] conducted a study in a government dental college in Shimla, India. For this study water samples from the dental unit water line of 9 dental chairs and water from the taps were collected and assessed. Tests were done using MacConkey agar, Sheep blood agar and Presumptive Coliform count. On the MacConkey Agar no growth was obtained in 7 samples but one paired sample showed growth of contaminants and one showed the growth of gram positive cocci. On the Sheep blood agar all the samples showed growth of coagulase negative staphylococci.

In an another study conducted in Italy by Monarca, et.al.^[5] did the evaluation of environmental bacterial contamination and also emphasised on the procedures to control cross infection dental surgeries. The sources which were collected for bacterial contamination were of air, surfaces and water in dental units. Spore tests and sterility test were conducted. The organisms found were β -haemolytic Streptococci, streptococci, fungi and staphylococcus aureus. This study highlighted the need for procedures to control infection and comply with these methods of prevention.

Another study article which was done by Vafae F, et.al.^[3] in Hamadan University of Medical sciences, Iran. For this study article samples of pumice powders and pumice slurry from dental laboratories were taken for examination. The samples were inoculated onto selective and non-selective media in order to count the total colony forming unit. Organisms detected were staphylococcus aureus, E.coli, Acinetobacter, S.epidermidis and Enterobacter.

Coelho et.al.^[7] for their study took samples from dental chairs and spittoons. The samples were cultured in MacConkey agar, PIA agar, BHI agar, Muller-Hinton agar and Saboraud agar. The dental units were contaminated with Enterobacter spp, Klebsiella pneumoniae, Escherichia coli and Acinetobacter spp.

Guida M et.al.^[6] in the year 2012 evaluated the samples of water, surrounding air and the surface samples. These water samples were given for total viable count, air samples for active sampling and the surface samples were examined using RODAC plate. The results showed the presence of Pseudomonas Aeruginosa and Legionella spp.

Salam N et.al.^[8] collected water samples from the dental unit water lines. Centrifugation and inoculation of the samples were done in different media which in result showed the presence of Enterococci,

Escherichia coli, Pseudomonas and Klebsiella. The colony-forming units in water samples are higher in number than the ADA recommended value i.e. 200cfu/ml.

Hegde PP, et.al.^[4] in the year 2006 collected samples from the bar soap used in the several dental clinics in Belgaum. These samples were cultured in blood agar MacConkey agar and Peptone water. The samples yielded species of Aerobic spore bearers Aspergillus niger, Candida parapsilosis, Diphtheroids, E.coli, Klebsiella sp, Staph.epidermidis, Staph.aureus, Staph.citrus and Propionibacterium acnes.

Out of the 7 articles included for qualitative assessment, all the articles were found to be good with minimal amount of bias except for 1 article reported by Hegde et al. who had failed to assess at various intervals and hence rated as fair.

In a study conducted in 2003 in Brazil, water samples were collected from the dental unit water line and it was evaluated for microorganism. Biofilm was found in all the water lines and the colony forming pathogens were present. This biofilm serves an excellent source of reservoir for growth of organisms.^[9] This is similar to a study conducted by Ghosh et.al.^[1] the dental unit water lines were evaluated which also showed the presence of microorganisms. This article also focuses on the effective management of these biofilms in dental unit water lines. These management methods when used effectively will reduce the biofilm accumulation and will inturn lead to decreased microbial content.

CONCLUSION:

All the study articles taken for this systematic review presented with the accumulation of biofilms and the presence of microorganisms. Some of these microbes live in harmony with the human body but any aggravating factor which increases the concentration of these microbes could lead to harmful effects on the same human body. The most common organisms present were Staphylococcus aureus, streptococci, E.coli and Acinetobacter species which were present in higher concentration than the ADA recommended value i.e. 200cfu/ml. There should also be proper management techniques which should be taken into consideration to atleast minimise the concentration of these organisms.

REFERENCES:

- [1] Ghosh S, Mallick SK. Microbial biofilm: contamination in dental chair unit. *Ind Med Gaz.* 2012;145(10):383-7.
- [2] Fotedar S, Ganju S. Microbial contamination of dental unit water lines in HP Government Dental College, Shimla. *The Saudi Journal for Dental Research.* 2015;6(2):129-32.
- [3] Vafae F, Radan P, Firouz F, Heidari B, Izadi A, Khoshhal M, et.al. Microbial contamination of pumice powder and slurry in dental laboratories of Hamadan. *Avicenna Journal of Dental Research.* 2013;5(2).
- [4] Hegde PP, Andrade AT, Bhat K. Microbial contamination of "In use" bar soap in dental clinics. *Indian Journal of Dental Research.* 2006;17(2):70.
- [5] Monarca, Silvano, Mario Grottole, Daniela Renzi, Corrado Paganelli, Pierluigi Sapelli, et.al.. "Evaluation of

- environmental bacterial contamination and procedures to control cross infection in a sample of Italian dental surgeries." *Occupational and environmental medicine*. 2000: 721-726.
- [6] Guida M, GallÃ F, Di Onofrio V, Nastro RA, Battista M, Liguori G, et.al.. Environmental microbial contamination in dental setting: a local experience. *Journal of preventive medicine and hygiene*. 2012;53(4).
- [7] Coelho, Victor Hugo Marques, Gisely Naura Venâncio, Thiago Fontanella Cestari, Maxine Ennata Alves de Almeida, and Carolinie Batista Nobre da Cruz. "Microbial contamination of a University dental clinic in Brazil." *Brazilian Journal of Oral Sciences*. 2016: 248-251.
- [8] Salam N, Mulamoottil VM, George B. Assessment of Microbial Contamination in Dental-Unit Water Lines: An Analytical Study. *Journal of Indian Association of Public Health Dentistry*. 2017;15(1):97.
- [9] Souza-Gugelmin, Maria Cristina Monteiro de, et al. "Microbial contamination in dental unit waterlines." *Brazilian dental journal*. 2003: 55-57.