

MEASUREMENTS OF BACTERIA IN DENTAL UNITS USING BACTIQUANT®-WATER

SUMMARY:

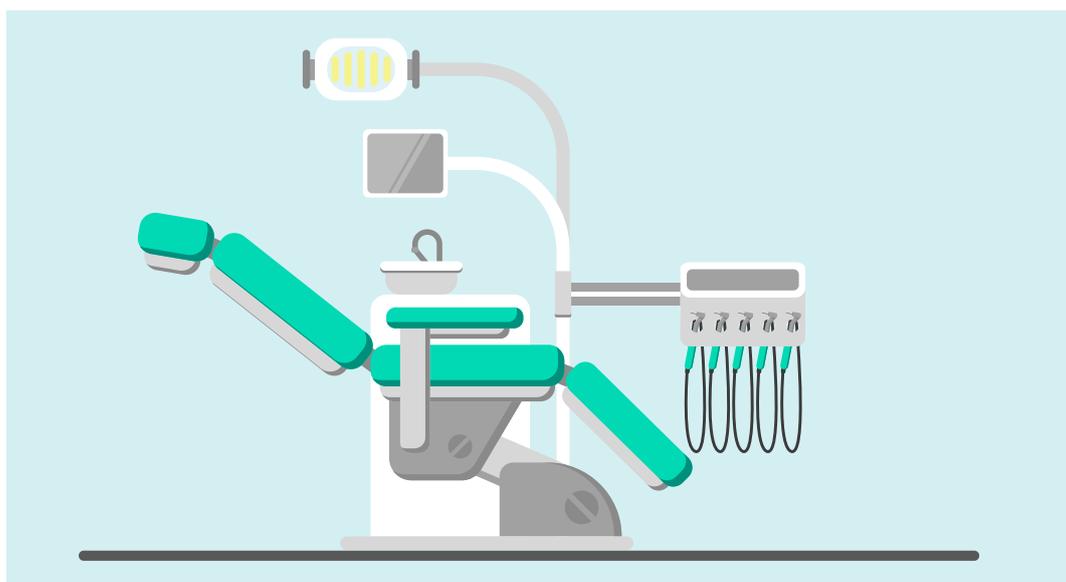
Bactiquant®-water provides a rapid screening tool for verification of Water System Hygiene in dental units and allows professionals to monitor water quality at regular intervals in near real time.

HYGIENE IN DENTAL CHAIRS:

Many investigations have shown that water systems in dental units can be heavily contaminated with high concentrations of bacteria (Coleman et al., 2009, 2010; Larsen et al., 2008). This is mainly due to a complex design of the water system with many possibilities for accumulation of particles and dirt, as well as formation of biofilm in water hoses and connections. Besides that, water will frequently be stagnant in periods where the dental chairs are not in function in weekends and during vacations.

In general, water contaminated with bacteria can lead to smell and discoloration. In water samples with high bacterial loads the risk of finding the bacterial toxin – endotoxin increases (Evans et al., 1978; Martin and Daley., 2001). Endotoxin is a heat stable toxin which is present when gram-negative bacterial cells are disrupted, and can cause adverse health effects if swallowed or inhaled as bio aerosols. In large quantities endotoxin can cause hemorrhagic shock and severe diarrhea, in smaller quantities it can cause fever. Endotoxin has also been implicated in development of asthma in dentists (Pankhurst and Coulter, 2005).

High bacterial loads in water systems associated with poor water quality, also increase the risk of *Legionella* (Bartram (Ed) et al.,2007) and other opportunistic and pathogenic bacteria such as



Pseudomonas (Barben and Schmid, 2008) and atypical mycobacteria (Peralta et al., 2015). Dental units with poor hygiene provide a growth environment for pathogenic bacteria that allow them to survive and proliferate in the biofilms. Pieces of biofilm can spread and establish growth in the water system. Protozoa grazing on biofilm is an important vector for *Legionella* infections. After uptake in the protozoa, *Legionella* proliferate and eventually is released in high numbers into the water. Recent investigations of *Legionella* contamination in dental chairs from Germany, Switzerland, Italy and South Africa have shown a contamination percent ranging from 24 – 33% (Arvand and Hack, 2013).

High bacterial loads in dental chairs give cause for concern for the following reasons:

- Risk of finding high levels of endotoxin
- Risk of allergic reactions by inhalation of bio aerosols
- Increased risk of contamination by *Legionella* and opportunistic pathogenic bacteria such as *Pseudomonas* and atypical mycobacteria
- Smell and discoloration

In conclusion it is important to control the level of bacteria in the dental unit. High bacterial loads indicate the presence of growth conditions that are conducive for bacterial proliferation and biofilm formation.

BACTIQUANT®-WATER:

Bactiquant®-water is a patented field test method for detection and quantification of total bacteria in water samples. The method is based on fluorometric detection of a naturally occurring enzyme

activity in bacteria. The fluorescence output (BQV) is directly correlated with the number of bacteria in the sample. While cultivation of bacteria typically takes several days, enzyme activity can be measured in minutes.

The analysis results have a high repeatability and reproducibility (McKernan et al, 2012). The technology is used for verification of ISO 22.000 HACCP Hygiene Management Systems in the industry and water utilities. Bactiquant®-water has received ETV technology verification by the US-EPA in collaboration with the Battelle standard laboratory in 2012 (EPA/600/R-12/002,2012).

Recently Bactiquant®-water was used as a tool to identify hot spots for increased bacterial presence in water systems of three major Critical Care Facilities in Copenhagen, Denmark. The investigation was conducted by the Capital Region of Copenhagen in collaboration with the Ministry of Environment and Food of Denmark. The conclusion from the study was that Bactiquant®-water provided a rapid and comparative report for water quality within the water network. The study also showed a clear positive relation between high concentrations of bacteria as determined with the Bactiquant analysis and the risk of finding *Legionella* at high concentrations (Nielsen et al., 2016; Miller, 2016).

INTERNAL QUALITY CONTROL IN DENTIST CHAIRS

In the table below are shown indicative accept levels for BQW corresponding to plate counts obtained using DS/EN ISO 6222.

Plate count accept limit (cfu/ml)	BQW accept limit non-chlorinated at a sensitivity of 95%* (BQV)**	BQW accept limit chlorinated water at a sensitivity of 95%* (BQV)***
100	45	100
200	57	200
500	84	500
1000	97	n.d.

*The proportion of detected positive, correctly identified as such – cfu/ml < specified accept limit column 1

**Data originating from large survey on drinking water samples from Copenhagen water Utility (HOFOR), n=974, water samples were analyzed in parallel using plate count (DS/EN ISO 6222) and BQW analysis according to the protocols described by Mycometer A/S

***imperial values obtained in chlorinated water from dental chairs courtesy of Adept Water Technology

Data from surveys of critical care facilities in Denmark indicate that at higher BQV levels than 100, there is a markedly higher risk of finding Legionella at concentrations higher than 100 CFU/L. Also the study showed that no Legionella contaminations were observed at BQV lower than 40 (Miller, 2016).

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