AMERICAN DENTAL ASSOCIATION
STATEMENT ON DENTAL UNIT WATERLINES*

Background: Organized dentistry has traditionally assumed responsibility for assessing and improving the quality of dental care provided to patients. The widespread adoption of enhanced infection control methodologies by dental practitioners is just one example of the profession's commitment to high quality patient care.

The Council is sensitive to heavy regulatory burden imposed on dentists in recent years by various federal, state and local government agencies. In some cases, the regulations have been based on limited science. The Council reaffirms its strong belief that both the profession and the public are served when recommendations affecting dental practice are based on sound science and take into account their cost in light of their expected benefit. The recommendations that follow are made in light of these considerations.

Through its continued monitoring of scientific literature, the Council has become aware that the microbiologic quality of water used in dental treatment could be improved. Although there is no evidence of a public health risk due to this phenomenon, steps should be taken to improve the quality of water used in patient care as soon as feasible. The profession, the dental industry, and the research community all have an important role to play in this process. Dental unit waterlines (the tubes that connect the high-speed handpiece, air/water syringe and ultrasonic scaler to the water supply) have been shown to harbor a wide variety of microorganisms including bacteria, fungi, and protozoans. These microorganisms colonize and replicate on the interior surfaces of the waterline tubing, inevitably resulting in adherent heterogenous microbial accumulations termed "biofilms." Biofilms, once formed, serve as a reservoir significantly amplifying the numbers of free-floating microorganisms in the water exiting the waterlines. It has been suggested that heating dental unit water to increase patient comfort, as is the practice in some dental offices, may further augment biofilm formation. In unmaintained dental unit waterline systems, these microbial accumulations can contribute to occasional objectionable odors and visible particles of biofilm material exiting the system.

Water Quality Improvement: Dental unit water systems currently designed for general dental practice are incapable of delivering water of an optimal microbiologic quality. The Council recommends an ambitious and aggressive course to encourage industry and the research community to improve the design of dental equipment so that by the year 2000, water delivered to patients during nonsurgical dental procedures consistently contains no more than 200 colony forming units per milliliter (cfu/ml) of aerobic mesophilic heterotrophic bacteria at any point in time in the unfiltered output of the dental unit; this is equivalent to an existing quality assurance standard for dialysate fluid that ensures the fluid delivery systems in hemodialysis units have not been colonized by indigenous waterborne organisms.

Manufacturers of dental equipment are encouraged to develop accessory components that can be retrofitted to dental units currently in use, whatever the water source (public or independent), to aid in achieving this goal. Further, the ADA should urge industry to ensure that all dental units manufactured and marketed in the U.S.A. in the future have the capability to be equipped with a separate water reservoir independent of the public water supply. In this way, dentists not only will have better control over the quality of the source water used in patient care, but also will be able to avoid interruptions in dental care when "boil water" notices are issued by local health authorities.

At the present time, commercially available options for improving dental unit water quality are limited and will involve some additional expense. They include the use of:

- Independent water reservoirs
- Chemical treatment regimens
- Daily draining and air purging regimens
- Point-of-use filters

*Adopted by the American Dental Association Board of Trustees, December 13, 1995 and ADA Council on Scientific Affairs, September 28, 1995

CHARACTERISTICS OF DUWL BIOFILM

1. Pioneer bacteria colonize new tubing wall with a "conditioning" layer

2. Biofilm grows in thickness and complexity

3. Sticky slime layer protects member organisms from physical and chemical removal and treatment

4. Consortium of participant microbes including bacteria, fungi, protozoa, and nematodes, depends on 90% water content within biofilm for nutrients

5. Water is stagnant 99% of the time allowing for release of organisms into water

6. Sloughing of pieces of dislodged biofilm provides gross downstream contamination

7. Biofilm sloughing is caused by manipulation of the tubing and flushing

8. Microbes protected by biofilm acquire enhanced resistance to chemical antimicrobials and sometimes antibiotics

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Pasteurella spp.	water	opportunistic	wound infections, chronic respiratory infections
Proteus vulgaris	water	?	urinary tract infection
Peptostreptococcus	mouth	?	periodontal disease
Pseudomonas aeruginosa	water	opportunistic	septicemia, abscesses wound & respiratory infections
Pseudomonas cepacia	water	opportunistic	pneumonia, otitis, wound infections
Salmonella typhimurium	hands oral/ fecal	primary pathogen	diarrhea, septicemia
Streptococcus spp.	mouth	primary pathogen	respriatory infections endocarditis, meningitis
Xanthomonas	water	low	urinary tract infections, wound infections
FUNGI			
Penicillium		allergenic / rare opportunistic	respiratory allergic reactions
Cladosporium		allergenic / rare opportunistic	respiratory allergic reactions
Alternaria		allergenic / rare opportunistic	respiratory allergic reactions
Scopulariopsis		allergenic / rare opportunistic	respiratory allergic reactions
PROTOZOA			
Acanthamoeba	water	opportunistic	conjunctivitis, meningitis
Cryptosporidium	water	opportunistic	GI infection, severe dehydration
Microsporidium	water	opportunistic	GI infection
Giardia	water	opportunistic	diarrhea

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TABLE 3

EFFECT OF IMMUNOCOMPROMISING CONDITIONS ON HOST RESISTANCE

CONDITION/FACTOR	SELECTED EFFECTS
Neoplasia	Suppression of T-cell function; variable immunoglobulin levels
Nutritional deficiencies	Alteration of multiple immune mechanisms - epithelial integrity, phagocytosis, immunoglobulin synthesis
Aging	Decreased cellular immunity capabilities; decreased IgG responses to certain antigens
Alcoholism	Nutritional deficiencies; possible suppression of anti-bacterial inflammatory responses
Systemic Lupus Erythematosus (SLE)	Decreased delayed (Type IV) hypersensitivity; reduced complement activity
Asthma	Chronic bronchial inflammation; immediate hypersensitivity reactions to common inhalant allergens
Cystic Fibrosis	Susceptible to lower respiratory tract infections
Tuberculosis	Severe progressive TB may be associated with anergy (ie, lack of immune responsiveness)
Progressive HIV disease (AIDS)	Decreased CD_4-T-lymphocytes; decreased cellular immunity
Diabetes	Decreased phagocytic capability - diminished chemotaxis; poor bacterial ingestion

Adapted from: Molinari, JA: Compend Contin Ed Dent. 16:130-132, 1995 and Ammann AJ: Immunodeficiency Diseases, in Basic and Clinical Immunology (6th edition), DP Stites, JD Stobo, JV Wells (eds), p. 317-355. Appleton & Lange Pub., Norwalk, 1987.

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Diagnostic Quick Reference

Signs and Symptoms	Environmental Tobacco Smoke	Other Combustion Products	Biological Pollutants	Volatile Organics	Heavy Metals	Sick Bldg Syndrome
	pp.5	pp.7	pp.10	pp.13	pp.15	pp.17
Respiratory						
Rhinitis, nasal congestion	■	■	■	■		■
Epistaxis				■[1]		
Pharyngitis, cough	■	■	■	■		■
Wheezing, worsening asthma	■	■		■		■
Dyspnea	■[2]		■			■
Severe lung disease						■[3]
Other						
Conjunctival irritation	■	■	■	■		■
Headache or dizziness	■	■	■	■	■	■
Lethargy,fatigue, malaise		■[4]	■[5]	■	■	■
Nausea, vomiting, anorexia		■[4]	■	■	■	
Cognitive impairment, personality change		■[4]		■	■	■
Rashes			■	■	■	
Fever, chills			■[6]		■	
Tachycardia		■[4]			■	
Retinal hemorrhage		■[4]				
Myalgia				■[5]		■
Hearing loss				■		

[1]Associated especially with formaldehyde. [2]In asthma. [3]Hypersensitivity pneumonitis, Legionnaires' Disease. [4]Particularly associated with high CO levels. [5]Hypersensitivity pneumonitis, humidifier fever. [6]With marked hypersensitivity reactions and Legionnaires' Disease.

Particular Effects Seen in Infants and Children

Environmental Tobacco Smoke: frequent upper respiratory infections, otitis media; persistent middle-ear effusion; asthma onset, increased severity; recurrent pneumonia, bronchitis.

Acute Lead Toxicity: irritability, abdominal pain, ataxia, seizures, loss of consciousness.

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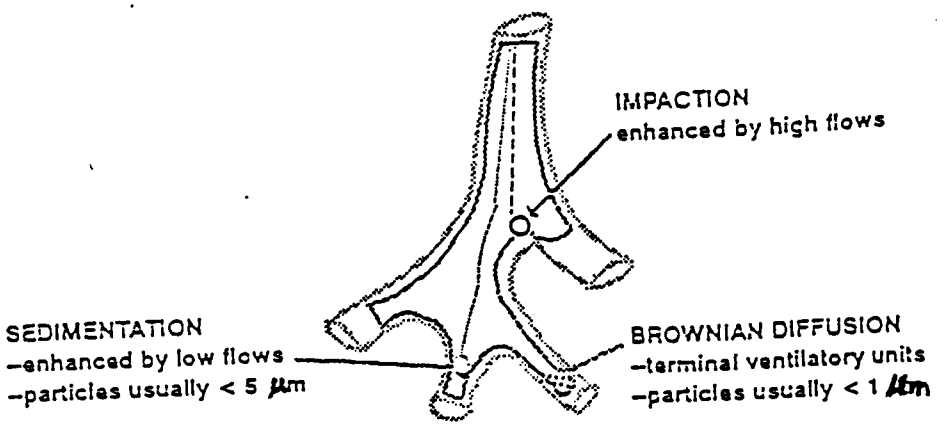

FIG. 1. Mechanisms of aerosol deposition in lung. (Modified from Murray JF, Nadel JA, eds. Textbook of respiratory medicine. Vol 2. Philadelphia: WB Saunders, 1988:313-31.)

TABLE I. Typical sizes for some common aerosol particles

- Tobacco smoke: <1 μm
- Pollens: Approximately 10-30 μm
- Mold spores: Approximately 2-50 μm
- Actinomycete spores: Approximately 1-2 μm
- Foundry dusts: Approximately 50 mm

TABLE II. Major factors determining particle deposition

- Respiratory tract anatomy
- Patterns of airflow
- Mode of inhalation
- Particle characteristics (size, density, charge)

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