SPECIAL PROBLEMS RELATED TO DENTAL OFFICES AND DENTAL SCHOOL CLINICAL FACILITIES

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INTRODUCTION

The practice of infection control by the dental profession in both dental offices and clinics has increased dramatically in the past three or four years. Although infection control in dentistry has been practiced to some extent, recent events have greatly accelerated awareness and compliance. These include:

1. The recognition that Hepatitis B is an occupational hazard for dental health care professionals.
2. The real and perceived risks of AIDS.
3. The establishment of guidelines and regulations by various governmental and professional agencies.

Table 1 shows typical goals of infection control in dentistry. They are very similar to those in a hospital setting. A couple have been included which address economic and legal issues. However, a number of unique problems exist for the dental profession in comparison to medicine. Included among these are prolonged close contact with patients, generation of aerosols by the high speed drill, the high incidence of needle and instrument stick, the problems peculiar to sterilization and disinfection of dental instruments, and last but not least, the invisibility of saliva. Crawford dramatically demonstrated saliva spatter by placing red poster paint in the open mouth of a dental manikin and applying a high speed drill. The results are shown in Figs. 1 and 2.

The rationale for infection control techniques in dentistry is based on the Hepatitis B model. Although the main route is from patient to dentist, a number of well documented cases have been caused by dental health care professionals. Of course, the danger also exists of transmission to family if the

Table 1. Goals of Infection Control

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1. To reduce the number of available pathogenic microbes to a level where the normal resistance mechanisms of the body may prevent infection.
 2. To break the circle of infection and eliminate cross-contamination.
 3. To treat every patient as though he or she were infected with a transmissible disease.
 4. To protect patients and personnel from infection.
 5. To protect income and careers of dental personnel.
 6. To protect dental personnel from malpractice suits.
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Fig. 1. Simulation of saliva spatter. Courtesy of Dr. James Crawford, University of North Carolina School of Dentistry.

Fig. 2. Courtesy of Dr. James Crawford, Dental Asepsis, Stoma Press, Seattle, Washington (1979)

dentist contracts the disease. Patient to patient transmission may also occur, as well as contamination from fomites.

Although Hepatitis B is of prime importance to the dentist, several other diseases also have an impact on the dental profession. These will be discussed subsequently. Included among these are HIV infection, Herpes and Legionella. A list of other infectious diseases which the dentist must also be aware of as a possibility is shown in Table 2.

Aside from the potential risk of cross-infection, the dentist has the opportunity to diagnose many systemic infectious diseases which are manifested either initially or early in their course. Among these are Herpes, mucocutaneous candidiasis, Syphilis, Tuberculosis, the acute periodontitis associated with HIV infection, and Hairy Leukoplakia, also associated with HIV.

Of the four Hepatitis viruses presently known, the number of cases of Hepatitis B in the U.S. has been steadily increasing since the mid-1960s and now exceeds the number of cases of Hepatitis A (Fig. 3). The modes of Hepatitis B transmission can either be percutaneous or nonpercutaneous as shown in Table 3. Oral surgical procedures, as will be discussed subsequently, are of particular interest in the context of this presentation. Nonpercutaneous transmission through transfer of body secretions, e.g., saliva or semen, may not be as efficient as the percutaneous route; however, this may be compensated for by continuous exposure.

Table 2. Selected Infectious Hazards Possible
in the Dental Office

Infectious Organism	Transmission	Selected Potential Pathology
Bacteria		
<u>Bordetella pertussis</u>	Nasopharyngeal secretions	Whooping cough
<u>Corynebacterium diphtheriae</u>	Nasopharyngeal secretions	Diphtheria
<u>Enterobacteriaceae</u>		
<u>Escherichia coli</u>	Blood, lesion exudate	Pneumonia, bacteremia, abscesses, wound infections
<u>Proteus vulgaris</u>		
<u>Klebsiella pneumoniae</u>		
<u>Haemophilus influenza</u>	Blood, nasopharyngeal secretions	Pneumonia, meningitis, otitis
<u>parainfluenza</u>	"	Conjunctivitis, endocarditis
<u>Mycobacterium tuberculosis</u>	Pharyngeal secretions	Tuberculosis
<u>Mycoplasma pneumoniae</u>	Pharyngeal secretions	Primary atypical pneumonia
<u>Neisseria meningitidis</u>	Blood, nasopharyngeal secretions	Cerebrospinal meningitis
<u>gonorrhoeae</u>	Blood, lesion exudate, nasopharyngeal secretions	Oral lesions, conjunctivitis
<u>Pseudomonas aeruginosa</u>	Lesion exudate	Pneumonia, wound infections
<u>Staphylococcus aureus</u>	Lesion exudate	Suppurative lesions, bacteremia
<u>epidermidis</u>	"	Endocarditis
<u>Streptococcus pyogenes</u>	Blood, nasopharyngeal secretions	Rheumatic, scarlet fever, otitis media, mastoiditis, peritonsillar abscesses, meningitis, pneumonia, acute glomerulonephritis
<u>pneumoniae</u>	"	Pneumonia
<u>viridans group</u>	"	Endocarditis
<u>Treponema pallidum</u>	Exudate from oral lesions	Syphilis
<u>Actinomyces</u> species (sp)		
<u>Bacteroides</u> sp	Crevicular exudate	Abscesses
<u>Eubacterium</u> sp		
<u>Fusobacterium</u> sp		
Viruses		
<u>Coxsackie virus</u>	Ingestion	Hand/foot/mouth disease, vesicular pharyngitis
<u>Cytomegalovirus</u>	Saliva, blood	Cellular enlargement and degeneration in immunocompromised individuals

Table 2 (cont.)

Infectious Organism	Transmission	Potential Pathology
Epstein-Barr	Saliva, blood	Infectious mononucleosis
Hepatitis A	Blood (rare), ingestion	Liver inflammation, jaundice
B	Blood, saliva, tears, semen	Eventual hepatocellular carcinoma in chronic antigen carriers
non-A, non-B delta	Blood Blood	Coinfection with hepatitis B virus (HBV) required
Herpes <u>simplex</u> 1 and 2	Lesion exudate, saliva	Oral lesions, herpetic whitlow, conjunctivitis
Human immuno-deficiency virus (HIV)	Blood	Acquired immune deficiency syndrome (AIDS)
Measles rubeola	Nasopharyngeal secretions,	
rubella	blood, saliva, vesicle exudate	Generalized vesicular rash
Mumps virus	Saliva, ingestion	Parotitis, meningitis
<u>Poliovirus</u>	Ingestion	CNS paralysis
Respiratory viruses		
Influenza A and B		Flu,
<u>Parainfluenza</u>	Nasopharyngeal secretions	common cold
<u>Rhinovirus</u>		
<u>Adenovirus</u>		
<u>Coronavirus</u>		
<u>Varicella</u>	Vesicle exudate	Chicken pox
Fungi		
<u>Candida albicans</u>	Nasopharyngeal secretions	Candidiasis, cutaneous infections
Protozoa		
<u>Pneumocystis carinii</u>	Nasopharyngeal secretions	Interstitial pneumonia in immunocompromised individuals

Adapted from ADA Research Institute, Dept. of Toxicology.
J. Am. Dent. Assoc. 117:374 (1988).

HEPATITIS — By year, United States, 1952-1987

Fig. 3. Summary of Notifiable Disease, 1987, courtesy of Centers for Disease Control, Atlanta, Ga.

Table 3. Modes of Transmission of Hepatitis B

Percutaneous Transmission
Blood and blood products
Contaminated instruments, or needles
Tattooing
Hemodialysis
Oral surgery
Non-Percutaneous
Transfer of body secretions
Oral (mucosal injury)
Sexual contact
Perianal

The higher than average risk of health care professionals was documented in the early 1950s.^{1,2} Mosley and his co-workers³ in 1975 evaluated hepatitis as a hazard in general practitioners. They demonstrated an increased frequency of infection with Hepatitis B virus among general dentists. In a further study, Mosley and White⁴ showed that specialists with emphasis in surgical forms of dentistry had a significantly higher frequency than general dentists. Other investigators⁵⁻⁷ have demonstrated that the increased risk for the dental health care professional starts with patient contact in dental school and includes not only the dentist but the dental hygienist and assistants as well (Table 4).

Table 4. Prevalence of Serological Markers of Hepatitis B
Among Dental Personnel^a

Category	No. positive	Percent positive
Dental hygienists	10/59	16.9
Laboratory technicians	22/155	14.2
Dental assistants	45/350	12.9
Clerical	5/56	8.9
Other	0/9	0
Total	82/629	13.0

^aCottone, J. Hepatitis B: transmission and epidemiology in the dental profession. Proc. Natl. Conf. on Infection Control in Dentistry, May 1986. USPHS, Atlanta, GA 30333, from data E. A. Schiff, et al., VA cooperative study on hepatitis and dentistry (abstr.), Hepatology 2:688 (1982).

Smith and his co-workers⁸ compared the risk of Hepatitis B in dentists, physicians and demonstrated 3.5-fold greater rate of seropositivity for physicians and dentists than for volunteer blood donors. They also showed a sharp increase in prevalence of anti-HB_s with age among physicians and dentists as compared to a control group of comparable blood donors (Fig. 4).

Cottone and Gobel⁹ in 1983 surveyed the results of a number of investigators who reported on the prevalence of the carrier State of U.S. dentists. This summary shown in Table 5 indicated that U.S. dentists have two to six times the normal risk of developing a Hepatitis B carrier state as the remainder of the population.

Most of the studies involving the transmission of Hepatitis B involve patient to dental health professional.¹⁰⁻¹² However, these have been a number of well documented cases which involve reports of dentists transmitting Hepatitis B to patients. Up until 1985 these involved at least 10 outbreaks involving 172 patients.¹³ The highest number of infected individuals, i.e., 55, attributed to an individual dentist was reported by Rimland.¹⁴ A 1985 outbreak reported by CDC was notable in that it was the first outbreak caused by a dentist which resulted in deaths.¹⁵ The majority of cases involved oral surgeons, but more critical that all of the outbreaks were linked to dentists who practiced without routine use of gloves.

Fig. 4. Prevalence of antibody to Hepatitis B surface antigen (anti-HBs) in dentists, physicians and socioeconomically comparable first time blood donors, J. L. Smith, et al., Comparative risk of Hepatitis B among physicians and dentists, J. Inf. Dis. 133:705-706 (1976).

Table 5. Prevalence of HBV Carrier State in US Dentists^a

Authors	No. surveyed	No. HBsAg	Percentage HBsAg ^b
Feldman and Schiff ¹⁰	236	3	1.27
Mosley et al. ³	1,245	11	0.9
Smith et al. ⁸	174	3	1.7
Hollinger et al. ¹¹	94 ^c	4	3.2
Weil et al. ¹²	511	4	0.8

^aJ. Cottone, W. Goebel, Hepatitis B: the clinical detection of the chronic carrier dental patient and the effects of immunization via vaccine, Oral Surg. 56:449-454 (1983).

^bApproximately 0.3% of US population HBsAg positive.

^cDental students.

AIDS

The presence of HIV in saliva has been documented in several studies. Groopman and his co-workers¹⁶ isolated HIV from the saliva of four ARC patients and of health homosexuals. They also observed the virus by electron microscopy in centrifuged saliva of one patient infected with AIDS. Ho and his co-workers¹⁷ concluded that HTLV-III was present infrequently in saliva of AIDS patients. He was only able to isolate the virus from 1% of saliva samples as compared to 56% of blood cultures from 71 seropositive homosexual men. On the other hand, Archibald et al.¹⁸ detected salivary antibodies that reacted with virus-encoded proteins gp 120 and 160 in 70% and 93% of groups of AIDS patients and ARC patients, respectively. Other epidemiologic studies as summarized by Klein¹⁹ reported on almost 4000 dental health care professionals including greater than 8% who treated known AIDS patients. Of these only one dentist tested positive for HIV without any risk other than occupational risk. This later study reported in 1988²⁰ had a great impact on both the general public and the dental profession due to the banner headlines that appeared in the tabloid press which emphasized the one "doomed dentist" that had acquired HIV infection via occupational transmission.²¹ Up to mid-1988 a total of 59 dental professionals had been reported to CDC as being infected with HIV or having AIDS.²¹ All of these with the exception of the one dentist previously cited, acquired the disease by nonoccupational means.

The significance of the presence or absence of HIV in saliva still remains undetermined; however, Fultz and her co-workers²³ were unable to infect chimpanzees after oral applications with HIV, whereas intervaginal infection was successful. Fox et al.²⁴ demonstrated an HIV inhibitory factor in whole human saliva. They showed that the inhibitory activity was secreted by the major salivary glands and did not exist in whole saliva as a result of leakage of serum components through oral lesions or the gingival crevice. They suggested that the inhibitory activity may provide an explanation for the low risk of oral transmission.

Herpes

Herpetic infection of the digits (Herpetic Whitlow) is a recognized hazard of medical and dental personnel. A recent report of an outbreak of HSV in a dental practice in Scranton, Pa., traced the source to a lesion on the fingers of an ungloved dental hygienist.²⁵ She treated 46 patients when she was infected and 20 of these developed clinical signs and symptoms of severe primary gingival stomatitis which included fever, sore throat and dysphagia.

Legionella

Although Legionella has not generally been considered as a hazard to dental health care personnel, recent reports from dental clinics in the U.S. and Europe have shown increasing antibody titer directly related to the number of years of clinical experience.^{26,27} This suggests that Legionella may be present in the dental clinic environment, possibly the water supply, creating an increased risk for clinical personnel and patients.

Barrier Techniques

In view of the real and perceived danger of cross-infection in the dental operator as documented above, the obligatory use of barrier techniques to prevent these infections becomes self-evident. Of these techniques, none is more important than the use of gloves and masks. As noted previously, the greatest documented risk of transmission of Hepatitis B and Herpes is through direct contact of the patient's mouth with the practitioner's ungloved hand. Masks and glasses serve the function of preventing exposure of the mucous membranes of the practitioner's eyes and face from spattering and splashing by dental procedures, especially the high speed drill.

Other procedures which might properly be classified as barrier techniques, since they prevent cross-infection, are protection against contaminated needles and/or sharp instruments, including their proper handling and disposal, the decontamination of contaminated equipment such as the high speed handpiece, air water syringe and the water lines that service the dental operator. Normal precautions such as flushing the line with water for a few minutes in the morning are insufficient to reduce counts significantly.²⁸ Electron micrographs of sections of plastic tubing showed conclusive evidence of biofilms (Fig. 5). Local infections in the oral cavity with Pseudomonas aeruginosa from unit water have been described.²⁹ Intermittent chlorination has been shown to be an effective method of reducing bacterial counts in dental unit water lines.³⁰

Use of protective covering to shield appropriate surfaces in the dental operator is still another barrier procedure; however, in many cases this is not practical. This necessitates the use of appropriate disinfectants to decontaminate these surfaces.

Liquid sterilants and disinfectants may be divided into four categories: surface disinfectants, immersion disinfectants, immersion sterilants, and hand antimicrobials. Surface disinfectants are usually utilized where the items are too large to be immersed, e.g., cabinets, tables, chairs, etc. Immersion sterilants are utilized for dental instruments of either metal or plastic. These are EPA registered agents that have the capability of killing all living organisms in a recommended immersion time. These contrast with the immersion disinfectants, which are similar to the above only the instruments are disinfected and not washed. Hand or skin antimicrobials are designed to reduce the number of organisms on hands during the specific act of washing or scrubbing.

In considering which liquid disinfectant or sterilant to utilize, it is critical to read and understand the label and/or the accompanying instructions. The efficacy of the agent is perhaps one of the most critical variables and may be interpreted utilizing one or more of several parameters. The shelf life of an agent refers to the time the product remains effective when stored in its original or undiluted form, i.e., on the shelf. In contrast, the use life refers to its effective life after mixing any components or after dilution but without

Fig. 5. Biofilms in dental operator tubing. Courtesy of Dr. J. Mayo, Louisiana State University Medical Center. a. New, unused tubing for air/water syringe, 50x, line = 1,000 μm . b. Used air line from air/water syringe, 75x, line = 100 μm . c. Same as b, 200x, line = 10 μm . d. Used water line from air/water syringe, 50x, line = 1,000 μm . e. Same as d, 2,000x, line = 1 μm .

being utilized. Finally, the re-use life refers to the time that a product is effective in actual use. This is a function of the number of patients treated, the bio-burden (biological material added to the agent) and any water introduced into the agent. In addition, if the EPA registered label does not specify any of these variables the product must be discarded daily.

Operatory Asepsis - Special Problems

The many surfaces of the dental operatory make the prevention of contamination an extremely difficult and time consuming procedure. Figure 6, depicting a typical dental operatory, gives an idea of its complexity. Figures 1 and 2 shown previously demonstrated the magnitude of the potential contribution by aerosol spatter which is produced by the high speed drill.

Although there are a number of effective surface disinfectants (usually an iodophor), the most effective procedure is to cover as many surfaces with disposable covers. For example, an instrument tray may be covered with a bib napkin; lamp handles are usually wrapped with foil (borrowed from those for wrapping baked potatoes). A common problem is how to protect patient records which are usually nearby on a table in the operatory. A simple plastic book cover, which can be wiped down with an appropriate disinfectant will suffice.

The problem of the multi-surface operatory is further complicated by instrumentation, which presents challenging decontamination problems. Prior to current emphasis on infection control techniques, many dentists resisted autoclaving instruments on a number of grounds, including economic, unfamiliarity, rusting and dulling of instruments, etc. Most of these obstacles have been overcome due to current guidelines of the ADA, OSHA and CDC; however, a number of special problems of decontamination and sterilization still exist for dentists.

One of the most difficult is the handpiece. Aspiration of contaminated fluids, including saliva into the handpiece tubing is a common occurrence. Installation of check valves in the water coolant can prevent this. Sterilizable handpieces are available. The problem is that many dentists are concerned that autoclaving will ruin an expensive instrument. Industry has also not gotten its message through very effectively either to the schools or the private practitioner that sterilizable handpieces do exist. In some cases, the instrument may be sterilizable and the practitioner may negate its effectiveness by a post-sterilization lubricant (probably contaminated with a lubricant-loving organisms, such as *Pseudomonas*).

A second group of problems relate to the disinfection of impression materials and intra-oral prosthesis. These impression materials are made of such materials as alginates, hydrocolloids and polysulfides, which obviously cannot be autoclaved and may be susceptible to attack by the usual chemical disinfectant. Brief chair-side sprays of iodophors or sodium hypochlorite, followed by rinsing with tap water is one method of disinfection in these cases.

Order of Preference

(S = sterilization, C = covering, D = disinfection)

1	Head rest cover	C
2	Chair switches	C, D
3	Arm rest	C, D
4	Lamp handles	S, C, D
5	Handpieces	S, C, D
6	Controls	C, D
7	Table surface	C, D
8	Evacuator tip	S or dispose
	Evacuator grip	C, D
9	Cuspidor funnel	C, D
10	Holders	C, D

Fig. 6. Surface components of an operator's chair and their aseptic care. James Crawford, "Clinical Asepsis in Dentistry," Oral Medical Press, Mesquite, Tex. (1986).

The dental technician who usually works in a lab geographically removed from the dentist must be as fully aware of the possibility of cross-infection as any dental health care personnel in direct patient contact. He must follow the same stringent precautions when handling and formulating intra-oral appliances as the dentist.

Plastic materials, if not disposable, can be adequately sterilized by such agents as acid or alkaline glutaraldehyde, provided the appropriate exposure time is used. Usually this is 6-10 hours in order to achieve sterilizing conditions, a factor which many dentists choose to ignore either because of lack of knowledge or economic reasons.

Impact of Guidelines

Since 1982, a number of governmental and professional

agencies have promulgated guidelines regarding infection control procedures in dentistry. These include:

1. ADA Guidelines for Infection Control in the Dental Office and Commercial Dental Lab (June 1982)
2. CDC Recommended Infection Control Practices for Dentistry (April 1986)
3. CDC Recommendations for Prevention of HIV Transmission in Health Care Settings (August 1987)
4. AADS policy statements on infection control practices in dental schools (1986-1988)
5. ADA Accreditation Standards for Dental Education Program
6. OSHA Standards (1988)

As you will note, most of these pronouncements have had only the force of recommendations and guidelines. Last year, OSHA stepped into the picture and it appears that most of these previous recommendations will now have the full force of a governmental regulatory agency behind them. The need for enforcement even after all of the guidelines, educational programs and the fear factor generated by HIV, is reinforced by a number of compliance studies. Studies in the San Francisco area before and 4 months after the report by Klein of the occupationally HIV infected dentist showed significantly greater compliance with recommended infection control guidelines.³¹ A later study in July of 1987 showed even more striking increases; however, even with these substantial increases in compliance, only 73% reported using gloves with all patients and fewer than 60% wore masks.³²

An earlier study in late 1986 of dentists in the Los Angeles area demonstrated that although most dentists are aware of the high risk groups in the population, less than one third of those who attended Continuing Education courses could not name any oral signs and symptoms of AIDS.³³

These studies, together with a number of other earlier compliance studies demonstrate that dental health care workers have certainly increased dramatically their compliance of infection control procedures due to a massive educational effort by professional and governmental bodies. However, as these recent studies demonstrate, there is still a significant lack of compliance and apathy that exists.

It remains to be seen what the impact of the OSHA regulations on the compliance will be. Enforcement of institutional compliance will be difficult in its own right, but eventually will be similar to enforcement in hospitals. It remains to be seen what impact these regulations can possibly have on the office practitioner, although some scattered reports have come through relating to this.

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