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## A National Survey of Dental Hygienists' Infection Control Attitudes and Practices

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**Purpose.** The objectives of this study were to: 1) investigate the infection control practices of practicing dental hygienists, 2) document the attitudes and practices of dental hygienists toward patients with infectious diseases, and 3) determine if professional affiliation affected the attitudes and/or practices of the respondents.

**Methods.** A 49-item survey consisting of eight demographic, nine attitudinal, and 32 practice questions was used for this study. A stratified sampling method was used, in which the United States was divided into four regions. Three states were selected from each region according to geographic location and population. Five percent of registered dental hygienists within each selected state were randomly selected for inclusion in the study. All analyses were conducted using the Statistical Package for Social Scientists (SPSS v.10, Chicago, IL).

**Results.** Of the 2,009 surveys mailed, 104 were undeliverable. A total of 856 completed surveys were returned from practicing dental hygienists for a response rate of 44.9%. Overall, this study found an increased use of barriers and personal protective equipment in comparison to previous studies. A majority of respondents (53.9%) felt that treating patients with HIV or AIDS increased their personal risk for contracting the disease. The majority of respondents also reported always using extra precautions with HIV/AIDS patients (63.5%) and hepatitis patients (60.1%). In addition, most respondents reported they would not use an ultrasonic scaler when treating HIV/AIDS (65.8%) or hepatitis (58.9%) patients, indicating an alteration in clinical practice habits.

**Conclusion.** The majority of dental hygienists surveyed reported altering infection control practices and treatment techniques when treating HIV/AIDS or hepatitis patients. While there has been an improvement in compliance with recommended infection control guidelines, practitioners still have misconceptions, and possibly fear, regarding infectious diseases and disease transmission.

**Keywords:** Infection control, disease transmission, universal precautions, aerosols, personal protective equipment, attitude of health professional, practices, dental hygienist

### Introduction

Over the last two decades, attitudes of health care providers towards infection control and treatment of patients with infectious diseases have changed dramatically.<sup>1-20</sup> Most oral health care professionals have realized the importance of

infection control and have incorporated Occupational Safety and Health Administration (OSHA) guidelines into their practices to prevent disease transmission.<sup>1</sup> Due to the media, public awareness of the possibility of disease transmission within the dental office has forced even more compliance with OSHA standards in order to assure apprehensive patients.

A key element of infection control is the concept of universal precautions. This concept was introduced by the Centers for Disease Control and Prevention (CDC) as a means to reduce the risk of transmission of blood-borne pathogens in health care settings. The primary principle behind this concept is based upon the premise that clinicians cannot rely definitively on the medical history and examination of a patient to determine the absence or presence of infectious diseases.

Therefore, the same infection control procedures should be used for all patients.<sup>21-23</sup> In 1996, the CDC expanded this concept and changed the term to standard precautions. The 2003 guidelines state: "Standard precautions integrate and expand the elements of universal precautions into a standard of care designed to protect health care personnel and patients from pathogens that can be spread by blood or any other body fluid."<sup>21</sup>

The emergence of the Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS) has also been correlated with compliance with infection control guidelines. However, oral health care workers continue to indicate a reluctance to treat patients with HIV/AIDS or those in high-risk groups.<sup>1-17</sup> Although dentistry has come a long way in infection control practices, patients with infectious diseases continue to be treated with different infection control methods.<sup>1</sup>

## **Review of the Literature**

Previous studies have investigated the knowledge, attitudes, and practices associated with infection control and the treatment of patients with infectious diseases. These studies, which date as far back as the early 1980s, have been conducted with a variety of oral health care workers, including dental assistants, dental hygienists, and dentists.

Several studies have been conducted to investigate the infection control knowledge, practices, and attitudes of dentists.<sup>2-9</sup> In 1998, Gershon et al. reported that 98% of Maryland dentists surveyed believed that following recommended infection control procedures (ICP) would protect them from exposure to HIV.<sup>2</sup> Although 69% of the respondents indicated a tolerance for and acceptance of treating patients with AIDS, 43% reported that they would rather refer HIV patients elsewhere, and 56% felt that they should have the right to refuse to treat HIV patients. HIV was believed to be transmitted through saliva by 44% of the respondents, and 67% felt that it could be transmitted by a splash to the eyes or mouth.<sup>2</sup>

A national survey of endodontists regarding infectious diseases and attitudes toward infection control was conducted by Cohen et al.<sup>3</sup> Ninety-five percent of endodontists reported receiving a hepatitis B vaccine during the period from 1982 to 1995, and 99% reported wearing gloves during every patient contact. In general, most respondents felt that infection control measures protected them from transmissible diseases. The majority of respondents also reported that they were willing to treat patients with transmissible diseases.<sup>3</sup>

Verrusio et al. compared the results of two national surveys of infection control practices conducted by the American Dental Association (ADA) during 1986 and 1988.<sup>4</sup> Results from these surveys indicated an increase in hepatitis B vaccination and in following ICP. Verrusio et al. attributed education, the media, and the AIDS epidemic to the increase in knowledge of infectious diseases. However, results from these surveys suggest that education and understanding of HIV infection have not eradicated irrational fears about this disease.<sup>4</sup>

Other studies also report a reluctance of dentists to treat patients with HIV.<sup>5-7</sup> Moretti and colleagues found that 30% of respondents would not treat patients suspected of having HIV, even if the patients had no clinical signs or symptoms of AIDS or AIDS Related Complex (ARC).<sup>5</sup> Survey results from Gerbert's study revealed that while California dentists were reluctant to treat patients with AIDS, 70% felt the responsibility to do so.<sup>6</sup> Forty-seven percent of the respondents also believed that AIDS was transmitted through saliva.<sup>6</sup>

Differences in infection control practices and attitudes of dentists, dental hygienists, and dental assistants were reported in two different studies.<sup>10,11</sup> Both studies reported that dental hygienists were more likely to use recommended ICP than dentists or dental assistants. Results also revealed a reluctance to treat AIDS patients in all three groups; however, those that reported thorough ICP were more willing to treat patients with AIDS. Although dental hygienists scored higher on ICP, all three groups (dentists, dental hygienists, dental assistants) fell short of following standard ICP.<sup>10,11</sup>

Several studies of dental hygienists' infection control attitudes and practices have been conducted.<sup>12-20</sup> A 1990 survey of ethical issues in dental hygiene was conducted by Gaston et al.<sup>12</sup> The most common ethical dilemma reported was observation of clinical practice behavior in conflict with standard ICP. The authors suggested that many of the ethical dilemmas reported occurred because dental hygienists often have limited control over the manner in which they practice.<sup>12</sup>

In 1991, a survey of Pennsylvania dental hygienists was conducted to study the knowledge, attitudes, and infection control practices in relation to AIDS and AIDS patients.<sup>13</sup> The majority of dental hygienists surveyed had comprehensive knowledge about AIDS (94.2%) and CDC-recommended ICP (92%). Most respondents reported routine use of basic infection control practices including safety glasses, masks, gloves, disposable items, surface disinfection of light handles, instrument bracket tray, and patient chair switches. Seventy-one percent of respondents indicated that infection control measures used for hepatitis B provided sufficient protection against HIV transmission. However, the majority of respondents (85%) expressed a moderate or high amount of "worry" in treating AIDS patients, with only 15% indicating slight or no worry. Fifty-three percent agreed that dental hygienists should be required to treat AIDS patients. Some areas of infection control procedures in which respondents reported low rates were: 1) taking or wearing soiled work clothing home (94%), 2) wearing jewelry during clinical duties (88%), 3) not changing soiled, contaminated clothing between patients (82%), and 4) blood and saliva contamination on their face during treatment in the past year (84%). In addition, only 69.5% of the respondents had received the hepatitis B vaccine. Snyder concluded that Pennsylvania dental hygienists were not following CDC guidelines on proper operatory aseptic techniques and in differentiating ICP based on perceived patient HIV status.<sup>13</sup>

A 1993 survey of Rhode Island dental hygienists and certified dental assistants suggested that lack of compliance with infection control guidelines is multifactorial.<sup>14</sup> Although the majority of respondents (75% dental hygienists, 74% dental assistants) had attended an infection control course within the previous year and were satisfied with their implementation of infection control, many recommended ICP were not practiced routinely. Wood suggested that since recent infection control education did not impact the respondents' compliance with infection control guidelines, future studies should investigate other possible reasons for non-compliance.<sup>14</sup>

Daniel et al. conducted a survey of Mississippi dental hygienists, investigating their knowledge and use of infection control techniques, attitudes pertaining to universal precautions and the risk of clinician/patient cross-infection, and attitudes toward treatment of patients with infectious diseases.<sup>15</sup> Results indicated that while 98% of respondents believed that barrier techniques were effective, some believed patients infected with HIV/AIDS (43%), hepatitis B (31%), or tuberculosis (40%) are best treated in "public clinics" rather than in private practice settings. Respondents also felt that patients with infectious diseases pose a health threat to dental hygienists. Furthermore, 65% of the respondents felt that all oral health care workers and patients should be tested for HIV/AIDS. An increase in the use of infection control procedures, as compared to other studies conducted during the same time frame, was also reported. Increased use of infection control techniques was found among the more recent and younger graduates. However, the use of gloves appeared to be approaching 100%, and use of other personal protective equipment continued to increase compared to previous studies.<sup>15</sup>

Although there is scientific support for the increase in infection control practices by oral health care professionals, data about current infection control practices and attitudes of dental hygienists is limited and, to date, no national study of dental hygienists has been conducted. The purpose of this study was to summarize the attitudes and practices of practicing dental hygienists in regards to infection control, infectious disease, and disease transmission and to determine if professional affiliation affected the attitudes and/or practices of the respondents.

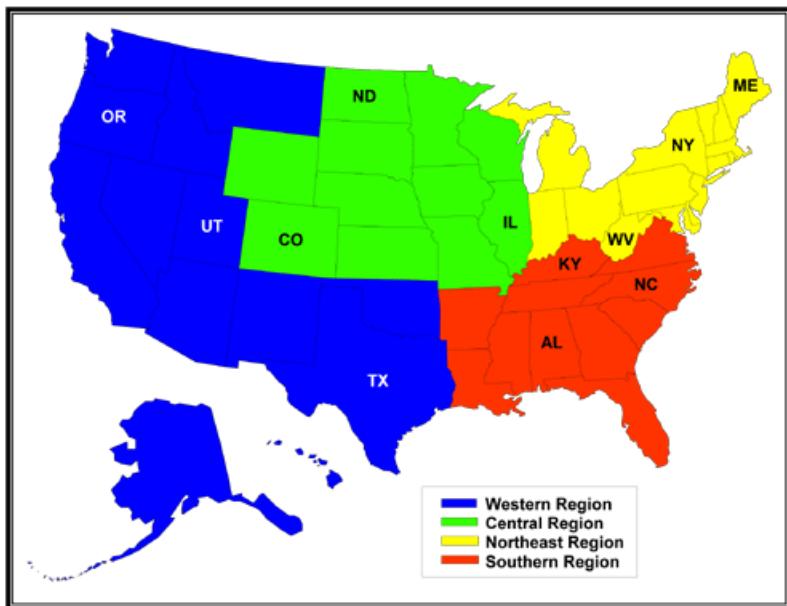
## Methods

A 49-item questionnaire was used to survey a stratified random sample of practicing dental hygienists within the United States. The questionnaire was developed by the investigator and consisted of eight demographic, nine attitudinal, and 32 practice questions. The questionnaire included questions with a Likert rating scale, as well as multiple-choice and yes/no questions. Infection control and infectious disease questions were developed to measure practices and attitudes reported in the literature in order to compare results to previous studies.<sup>1-17</sup> The survey instrument and study proposal was approved by the Baylor College of Dentistry Institutional Review Board at Texas A&M University Health Science Center.

### ***Sampling Method***

A stratified random sample was conducted in which the United States was divided into four regions according to geographic boundaries. Three states were assigned from each region according to rural and urban population distributions. Approximately 5% of each assigned state's registered dental hygienists were randomly selected for inclusion in the study and assigned a tracking code in order to follow up with non-responders. A stratified random sampling method was used in order to sample a large population that is disbursed over a wide geographical region (Figure 1). This method was also chosen to achieve a sample similar to that of the general population of dental hygienists within the United States. Previous studies in this area of research have used convenience samples or random samples based on a single state's dental hygiene population.

**Figure 1. United States Regional Map**



A pilot study was conducted among a national sample of dental hygienists. Two dental hygienists from each of the assigned 12 states were randomly selected for inclusion in the pilot study ( $n=24$ ). Two identical surveys were mailed to the same subject at two different time intervals in order to determine test/re-test reliability. Of the 24 subjects chosen, only six returned both surveys. Due to the number of subjects who returned both surveys, test/re-test reliability could not be determined. However, results from the pilot study revealed four questions in which several subjects answered differently on the second survey than their original survey. Four subjects changed their response to one attitudinal question when asked if they feel that their profession places them at a high risk for contracting infectious diseases. The other three questions, to which these subjects changed their responses, were practice questions pertaining to: taking contaminated clothing home, stating "too much trouble" as a reason for not wearing personal protective equipment (PPE), and use of a pre-procedural mouth-rinse. These four questions were not modified; however, other changes were made to the survey in order to improve clarity.

### **Data Collection**

In October 2001, the revised 49-item survey was mailed with a cover letter and self-addressed, stamped return envelope to the 2,009 randomly selected subjects. A second mailing with survey, cover letter, and self-addressed, stamped envelope was sent to non-responders four weeks after the initial mailing.

Data were collected and entered into the Statistical Package for Social Scientists (SPSS, v. 10, Chicago, IL). SPSS was used for descriptive data analysis, frequency distributions, and cross-tabulations. Chi-square statistics were used to identify associations between descriptive variables and practice and attitude variables. The level of significance was set at alpha < 0.05.

### **Results**

Of the 2,009 surveys mailed, 104 were undeliverable. A total of 930 surveys were returned. Non-practicing dental hygienists (n=69) and incomplete surveys (n=5) were excluded from the study. Eight hundred fifty-six surveys were analyzed for a response rate of 44.9%. Response rates according to state are reported in Table I. Because not all participants answered every question, the number of responses to each question vary. Demographic characteristics can be found in Table II. A majority of the respondents were female (n=846, 99.3%) with 16 to 21 or more years of clinical practice experience (n=402, 47.0%), had an associate degree in dental hygiene (n=567, 66.7%), and practiced in general dentistry (n=751, 89.0%) 31 to 40 hours a week (n=419, 49.1%). Approximately 71% (n=603) reported that they were not members of the American Dental Hygienists' Association (ADHA).

**Table I. Response Rate by State**

STATE	N	Frequency (n)	Percent (%)
Alabama	160	28	17.5%
Colorado	155	56	36.1%
Illinois	285	125	43.8%
Kentucky	76	37	48.6%
Maine	150	59	39.3%
New York	424	166	39.1%
North Carolina	188	84	44.7%
North Dakota	21	13	61.9%
Oregon	115	66	57.4%
Texas	362	177	48.9%
Utah	36	24	66.7%
West Virginia	37	21	56.7%

**Table II. Demographic Characteristics of Respondents**

CHARACTERISTIC	n	%
<b>Gender</b>		
Female	846	99.3%
Male	6	0.7%
<b>Years in Clinical Practice</b>		
1 to 5	190	22.2%
6 to 10	152	17.8%
11 to 15	112	13.1%
16 to 21+	402	47.0%
<b>Dental Hygiene Education</b>		
Certificate	58	6.8%
Associate	567	66.7%
Bachelor	211	24.8%
Master	14	1.6%
<b>Practice Setting</b>		
General	751	89.0%
Periodontic	29	3.4%
Pediatric	19	2.3%
Education	16	1.9%
Public Health	8	0.9%
Other	21	2.5%
<b>Hours per Work Week</b>		
Under 10	62	7.3%
10 to 20	117	13.7%
21 to 30	210	24.6%
31 to 40	419	49.1%
41+	45	5.3%
<b>ADHA Membership</b>		
Member	251	29.4%
Non-member	603	70.6%

### *Attitudes*

Results from attitudinal questions related to treating patients with infectious disease are reported in Table III. A majority (n=441, 52.4%) of respondents felt that working in an oral health care profession placed them at a high risk for contracting infectious disease, and approximately 54% (n=455) believed treating patients with HIV/AIDS increased their personal risk for contracting HIV. Thirty-eight percent (n=321) felt that double-gloving was appropriate when treating this population, while 25.4% (n=214) reported that different sterilization and disinfection methods were necessary. Others reported that infectious disease patients should be treated in an isolated operatory (n=97, 11.5%) and referred to a public health clinic for dental treatment (n=60, 7.1%).

**Table III. Attitudes Related to Treating Infectious Disease Patients**

ATTITUDINAL QUESTIONS	YES	NO
High risk profession	52.4% (441)	47.6% (401)
Patients with HIV increase risk	53.9% (455)	46.1% (389)
HIV/hepatitis patients: treated same as non-infectious patients	67.3% (568)	32.7% (276)
HIV/hepatitis patients: treated by other specified means	13.4% (113)	86.6% (731)
HIV/hepatitis patients: double glove	38.0% (321)	62.0% (523)
HIV/hepatitis patients: different sterilization/disinfection	25.4% (214)	74.6% (630)
HIV/hepatitis patients: treated in isolated operatory	11.5% (97)	88.5% (747)
HIV/hepatitis patients: referred to public health clinic	7.1% (60)	92.9% (783)

Respondents were asked to indicate which source(s) they felt could transmit HIV. Transmission by means of blood (n=809, 94.8%) and needle stick or instrument injury (n=831, 97.4%) were the most common responses; however, saliva (n=382, 44.9%), splash/spatter (n=354, 41.5%), and aerosols (n=259, 30.4%) were also reported as means of HIV transmission. Respondents were also asked to rate the importance of minimizing aerosols when using the air/water syringe, ultrasonic scaler, and air polisher. The majority (n=619, 72.5%) reported aerosol reduction as very important during dental hygiene treatment. Another 20.1% (n=172) felt that minimizing aerosols was somewhat important, while 7.4% (n = 63) selected somewhat unimportant or very unimportant. Most of the respondents stated no need for further training in infection control and occupational safety (n=610, 72.3%) and reported that adequate infection control materials and equipment were being used in daily practice (n=745, 88.4%). When asked if oral health care professionals should be concerned about dental unit water and waterlines, 79.2% (n=668) reported yes, while 20.8% (n=175) reported no concern for the quality of water and condition of dental unit waterlines.

### **Practices**

Practice alterations according to disease status are summarized in Table IV. When treating a patient with known or suspected infectious disease, the majority of responders reported always or often using extra infection control precautions with HIV/AIDS (n=532, 63.5%) and hepatitis (n=503, 60.1%) patients. Most respondents also reported they would not use an ultrasonic or sonic scaler when treating HIV/AIDS (n=559, 65.8%) or hepatitis (n = 499, 58.9%) patients. A greater majority stated they would not use an air polisher with an HIV/AIDS (n=656, 77.8%) or hepatitis (n=603, 71.4%) patient.

**Table IV. Practice Alterations According to Disease Status**

PRACTICE QUESTIONS	n	%
Extra infection control precautions with HIV/AIDS patients		
Always/Often	532	63.5%
Sometimes	76	9.1%
Rarely/Never	230	27.5%
Use of an ultrasonic/sonic scaler with HIV/AIDS patients		
Yes	290	34.2%
No	559	65.8%
Use of an air polisher with HIV/AIDS patients		
Yes	187	22.2%
No	656	77.8%
Extra infection control precautions with hepatitis patients		
Always/Often	503	60.1%
Sometimes	93	11.1%
Rarely/Never	241	28.8%
Use of an ultrasonic/sonic scaler with hepatitis patients		
Yes	348	41.1%
No	499	58.9%
Use of an air polisher with hepatitis patients		
Yes	242	28.6%
No	603	71.4%

The majority of respondents reported always using disinfectant and barriers on the dental unit, with the exception of hand pieces, in which only 48.2% (n = 355) reported always using barriers over hand pieces. When compared to the other dental unit equipment, the x-ray unit and switches were another area in which respondents reported less frequent use of disinfectants (n=592, 72.6%) and barriers (n=422, 54.5%). Barriers used to cover the air/water syringe (n=473, 62.0%), suction (n=427, 57.4%), and hand pieces (n=355, 48.2 %) were less frequently reported than the dental chair (n=560, 72.4%), bracket tray (n=541, 74.0%), and light handles/switches (n=624, 76.8%).

Approximately 57% (n=478) reported flushing waterlines for two to three minutes at the beginning of the day. Another 38.5% (n=325) reported using separate water reservoirs, and 31.7% (n=268) reported periodic chemical treatment as a means to improve dental unit water and waterlines. Other reported measures taken for waterline management were the use of filters, such as iodine cartridges, (n=106, 12.5%) and continuous chemical treatment (n=64, 7.6%). Approximately 14% (n = 119) reported taking no measures to improve dental unit water.

Approximately 67.5% (n=551) of respondents reported always wearing a lab coat, whereas 13.7% (n=106) reported always using a disposable gown. Of those surveyed, a majority indicated always using safety glasses (n=547, 68.9%), while approximately 41% (n=307) reported always using prescription glasses for protective eyewear. Items chosen less frequently for PPE were visor face shield (n=121, 16.6%), facemask with shield (n=94, 12.6%) and side shields for prescription glasses (n=108, 15.3%). Most respondents reported using a facemask on a daily basis (n=764, 93.2%). Almost 100% of respondents reported always using gloves (n=549).

The most common reasons reported by respondents for not using PPE were 1) "too hot" (n=116, 13.9%) and 2) "interferes with working skills" (n=93, 11.2%). Other reported reasons included: "PPE unavailable" (n=65, 7.8%), "forget" (n=35, 4.2%), "bothers the patient" (n=20, 2.4%), and "too much trouble" (n=19, 2.3%). A majority of respondents (n=596, 71.6%) reported that there was never a time when PPE was not used.

Approximately 50% (n=424) said they always or often took contaminated clothing (scrubs/lab coat) home. Another 50.2% (n = 420) stated rarely or never changing contaminated clothing between patients. Less than half (n=328, 38.5%) of respondents changed face masks after each patient, while 39% (n=332) reported changing face masks after several patients. Eighteen percent (n=153) reported changing facemasks once a day and a small percentage (n=35, 4.1%) indicated not wearing a facemask.

Responders also reported sometimes (n=330, 38.7%) having patients wear protective eyewear, whereas only 28.4% (n=242) stated always or often supplying protective eyewear for their patients. A very low percentage (n=160, 18.8%) of dental hygienists surveyed said they always or often use a pre-procedural mouth-rinse prior to treatment. A very low percentage of respondents indicated having received education on the clinical use of aerosol reduction devices for the ultrasonic (Safety Suction(tm) n=75, 8.8%) and air polisher (Jetshield(tm) n=81, 9.6%). Approximately 19% (n=157) reported that they had never received clinical training from an educational institution or continuing education course on the use of ultrasonic scalers, air polishers, or aerosol reduction devices.

Cross-tabulations were conducted among respondents who reported percutaneous injuries with practices in handling contaminated instruments and preventive measures taken after injury with a contaminated instrument. Respondents who reported two or more percutaneous injuries also indicated a higher rate of using exam gloves and bare hands when handling or cleaning contaminated instruments than those reporting one or no injury. Altogether, those that reported an incident of injury were less likely to use utility gloves when handling or cleaning contaminated instruments. The cross-tabulations were used only to report trends in incidents of occupational exposure and post-exposure protocol in relation to infection control practices associated with handling instruments. Respondents were not asked how they were injured with contaminated instruments, only how many incidents had occurred over the past two years. Therefore, details as to practices and procedures at the time of occupational exposures are unknown.

The majority of responders reporting three or more percutaneous injuries also indicated that no preventive measures were taken following an exposure (n=11, 61.1%). This group was also less likely to report blood testing of the clinician (n=1, 5.6%) or patient (n=1, 5.6%). The most frequent preventive measure reported among all three groups was the completion of an incident report after an injury. Several respondents selected "other" and commented that they bled the area and washed the site thoroughly with soap and water. Cross-tabulation results also showed that those reporting one or two injuries indicated clinician blood testing (n=41, 32.5%; n=10, 21.7%) more frequently than patient blood testing (n=22, 17.5%; n=4, 8.7%).

Chi-square analysis indicated differences in infection control attitudes and practices among ADHA members and non-members. As summarized in Table V, ADHA members were more likely to have patients wear protective eyewear ( $\chi^2=17.837$ ,  $p<0.001$ ) and rinse with mouthwash prior to treatment ( $\chi^2=19.947$ ,  $p<0.001$ ). A significantly greater number of ADHA members also reported that there was never a time when they did not use recommended PPE ( $\chi^2$ ,  $p=0.033$ ). ADHA non-members reported a greater use of extra infection control precautions with HIV ( $\chi^2=12.271$ ,  $p=0.002$ ) and hepatitis ( $\chi^2=12.207$ ,  $p=0.002$ ) patients. Non-members were more likely to state they felt an increased personal risk when treating HIV patients ( $\chi^2=18.320$ ,  $p<0.001$ ) and altering infection control practices by double-gloving ( $\chi^2=11.028$ ,  $p=0.001$ ). When asked which source the respondent believed was a means for HIV transmission, a greater number of non-members responded that HIV could be transmitted through dental aerosols ( $\chi^2=4.244$ ,  $p=0.039$ ).

**Table V. Chi-square Analysis of ADHA Members and Non-members Regarding Attitudes and Practices.**

QUESTIONS		Member	Non-Member	$\chi^2$	p-value*
Patients Wear Protective Eyewear During Treatment	Always/Often	37.5% (94)	24.5% (147)	17.837	<0.001
	Sometimes	37.8% (95)	39.2% (235)		
	Rarely/Never	24.7% (62)	36.3% (218)		
Pre-rinse Used Prior to Treatment	Always/Often	27.5% (69)	15.2% (91)	19.947	<0.001
	Sometimes	34.3% (86)	34.2% (205)		
	Rarely/Never	38.2% (96)	50.6% (303)		
Extra Infection Control Precautions with HIV/AIDS Patients	Always/Often	56.2% (136)	66.4% (395)	12.271	0.002
	Sometimes	7.9% (19)	9.6% (57)		
	Rarely/Never	36.0% (87)	24.0% (143)		
Extra Infection Control Precautions with Hepatitis Patients	Always/Often	51.8% (127)	63.5% (375)	12.207	0.002
	Sometimes	11.0% (27)	11.2% (66)		
	Rarely/Never	37.1% (91)	25.4% (150)		
Never a Time When PPE is Not Used	Yes	77.0% (187)	69.3% (407)	4.535	0.033
	No	23.0% (56)	30.7% (180)		
Treating HIV Patients Increases Personal Risk for Disease	Yes	42.3% (105)	58.8% (349)	18.320	<0.001
	No	57.7% (143)	41.2% (245)		
Double-Glove to Treat HIV Patients	Yes	29.3% (72)	41.8% (249)	11.028	0.001
	No	70.7% (174)	58.2% (347)		
HIV Transmitted Through Aerosols	Yes	25.1% (63)	32.5% (195)	4.244	0.039
	No	74.9% (188)	67.5% (405)		

\*Significance level set at alpha <0.05.

## Discussion

This study is the first national survey conducted of dental hygienists' infection control attitudes and practices. Questions in this survey were developed to gather new information, as well as traditional infection control data, in order to evaluate the current attitudes and practices of dental hygienists. As reported in previous studies, this study supports the conclusion that dental hygienists have embraced the infection control guidelines established by OSHA and CDC to prevent disease transmission. However, dental hygienists continue to feel the need to use additional infection control precautions and alter clinical practices when providing treatment for patients with HIV/AIDS and hepatitis.

Results from this survey are similar to previous studies that surveyed dental hygienists' infection control knowledge, attitudes and practices.<sup>1,13-20</sup> Respondents in this study expressed some of the same attitudes and practices that were described in previous studies dated as far back as 1980, thereby revealing more than two decades of unchanging attitudes and practices associated with infectious disease.<sup>1-20</sup> Persistent attitudes and practices among oral health care professionals may stem from their fear of contracting a disease that can alter and/or shorten life. These perceptions could also contribute to the clinical practice choices made by clinicians.

Previous studies addressed issues such as willingness to treat HIV patients and fears associated with treating this population; however, treatment and infection control alterations had not been explored. In a 1996 survey of Mississippi dental hygienists, 40% of respondents reported that HIV/AIDS patients were best treated in public clinics.<sup>15</sup> Results from this study show a decline in this attitude, with only 7.3% of respondents indicating that HIV/AIDS patients should be treated in public health clinics. This finding supports those of Cohen and Daniel, which show an increased willingness to treat individuals with HIV/AIDS and less desire to refer HIV/AIDS patients elsewhere for dental treatment.<sup>3,15</sup>

This study revealed that the majority of dental hygienists felt that being in the dental hygiene profession placed them at a higher risk for contracting infectious diseases. An even greater number believed that treating HIV/AIDS patients would increase their personal risk for contracting the disease. Respondents within this group were also more likely to report a need to alter infection control measures and practices. One respondent reported not wishing to see "these patients."

Blood is the single most important source of HIV transmission in the dental environment.<sup>23-27</sup> HIV may be transmitted by needle stick or injury with a contaminated instrument; however, the occurrence of such transfer is low.<sup>24-28</sup> A 1995 study reported that of 710 health care workers (HCW) who were percutaneously exposed to HIV, the risk of acquiring the disease was directly related to three factors: 1) deep tissue penetration into an artery or vein, 2) visible blood contamination on the instrument that caused the injury, and 3) a source patient in the terminal stages of AIDS.<sup>25</sup> To this date, there has been no evidence to support the transmission of HIV or hepatitis C through aerosols or saliva in the dental setting.<sup>21,24-29</sup>

Data from this study also reveal a conflict in the attitudes and practices of respondents. While the majority believe that HIV patients should be treated the same as others, most respondents in this study still admit an unwillingness to use the ultrasonic scaler and feel the need to double-glove and alter disinfection and sterilization practices when treating this population. Further results revealed that, although most clinicians in this study were using appropriate PPE and infection control measures, respondents still felt the need to use added precautions when treating HIV/AIDS and hepatitis patients, suggesting an uncertainty of universal/standard precautions in protecting against blood-borne diseases. Furthermore, respondents may have adopted certain practices, such as double-gloving, due to a learned or observed behavior from an educator or colleague. Future studies should inquire as to where or from whom these practices were learned. Some respondents may have incorporated their own standards due to a fear of contracting HIV.

Respondents chose dental aerosols, splash/spatter and saliva frequently as a means for HIV disease transmission. These findings are similar to those reported by Gershon et al.<sup>2</sup> and Gerbert.<sup>6</sup> Approximately 45% of dental hygienists surveyed in this study reported HIV transmission through saliva and 41% through splash/spatter, indicating an attitude that has survived even with the implementation of standard precautions. However, the most surprising percentage in this study were the 30 % of respondents who felt HIV could be transmitted through dental aerosols.

The new CDC guidelines recognize bacteria laden aerosols and recommend minimizing dental aerosols to reduce the potential for disease transmission.<sup>21</sup> Several studies have found bacteria and blood in aerosols produced during ultrasonic scaling and air polishing.<sup>30-32</sup> Use of PPE, such as gloves, mask, and protective eyewear, protect the clinician from skin and mucous membrane exposures. Since respondents from this study indicate uncertainty in how HIV is transmitted, this may explain the reluctance to use clinical devices that create aerosols, such as the ultrasonic scaler and air polisher.

Although the majority of dental hygienists surveyed felt it was "very important" or "important" to minimize dental aerosols, very few used the high-volume suction or aerosol reduction devices for the ultrasonic scaler or air polisher. Low use of the high-volume suction may occur because of difficulty in managing the suction without the benefit of a dental assistant during dental hygiene treatment. Dental hygienists are less likely to have a dental assistant to assist with minimizing dental aerosols. Several new products designed for the ultrasonic scaler and air polisher have been developed to minimize dental aerosols. Studies evaluating aerosol reduction devices have shown a significant decrease in the number of microorganisms generated during ultrasonic scaling and air polishing.<sup>30-32</sup> Very few dental hygienists surveyed reported use of and education on aerosol reduction devices, which indicates an area that may need to be addressed in dental hygiene curricula and continuing education courses.

Recent research reports suggest that use of a mouth rinse prior to treatment reduces the amount of bacteria present in the oral environment.<sup>21,22</sup> A surprisingly low percentage of dental hygienists surveyed reported always or often using a pre-procedural mouth rinse. Although pre-procedural mouth rinses are recommended, future studies should explore the reasons associated with non-use.

Results from this study show improvement over previous studies in compliance with OSHA guidelines regarding soiled work clothing. A 1991 survey of Pennsylvania dental hygienists reported 94% of respondents took or wore contaminated work clothing home, and 82% did not change soiled, contaminated clothing between patients.<sup>13</sup> A comparison with data

from this study shows a 44% and 58% decline in these practices. These findings suggest that more dentists are complying with OSHA guidelines by providing employees with laundry service or facilities. This study also showed an increase in respondents that changed soiled, contaminated clothing between patients.

Unlike previous studies of dental hygienists, this survey questioned respondents about dental unit waterlines. Although the majority reported being concerned about the quality of water coming from the dental unit, less than half reported using separate water reservoirs, filters, or chemical treatments to improve water quality. However, the majority of respondents did report beginning the day by flushing waterlines for two to three minutes. While most dental hygienists surveyed were concerned about dental unit water and waterlines, implementing the appropriate measures to improve water quality may not be possible due to equipment and supplies available in dental offices.

Data from this study show that of respondents who reported a percutaneous injury, the majority took no preventive measures. Those who reported more than one incident were also less likely to complete an incident report or have clinician or patient blood testing completed. These findings raise concern as to why recommended post-exposure measures are not being implemented in dental practices and may need to be evaluated in future studies. Further studies should also gather more information regarding the cause and details of percutaneous injuries reported by respondents.

Table V highlights the major infection control attitudes and practice differences between ADHA members and non-members. Results support the assumption that studies using a convenience sample, such as only ADHA members, may bias research results and limit inference to the general practicing dental hygiene population.<sup>8</sup> The sampling measures taken in this study were done to achieve a true representation of dental hygienists' infection control attitudes and practices across the United States. The difference between ADHA members and non-members may be due to members having greater access to research publications and continuing education programs through national, state, and local associations. Furthermore, results indicate that members of ADHA may be more knowledgeable about infectious disease transmission, thus decreasing the likelihood of feeling a need to alter clinical practices.

The limitations of this study are consistent with those found in survey research. Although this questionnaire was pre-tested and revised, misinterpretation of questions and a desire by the respondent to answer questions correctly cannot be controlled.

## Conclusion

Data from this research reveal new and old attitudes and practices that may be affecting the level of care provided to those with infectious diseases. Therefore, it is crucial that dental and dental hygiene educators lead the way in changing attitudes and practices of future and currently practicing oral health care professionals. New graduates should be provided the most current scientific information and equipment to treat infectious disease patients. Students should also have multiple experiences in providing treatment for individuals with infectious diseases, such as HIV/AIDS or hepatitis. Education can be accomplished at all levels and is the first step in changing the attitudes and practice habits of oral health care professionals.

In conclusion, the findings from this study confirm that recommended infection control measures and personal protective equipment have been incorporated into the daily practice of most dental hygienists. However, the attitudes and practices reported by some respondents suggest a lack of understanding of the concept of standard precautions and the mode of transmission for HIV and hepatitis. This uncertainty may be the primary reason for alterations in clinical practices when treating infectious disease patients. Further results indicated that ADHA members were less likely to alter practices when treating infectious disease patients. These findings suggest that professional affiliation may have impacted the attitudes and practices of respondents possibly through exposure to current research in disease transmission. Therefore, education is an indispensable key to effecting change in the attitudes and practices of dental hygienists, whether treating infectious disease patients or treating patients with "unknown" disease.

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## Notes

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