

A Survey of United States Dental Hygienists' Knowledge, Attitudes, and Practices with Infection Control Guidelines

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Introduction

Clinical practice guidelines are evidence-based recommendations set forth by regulatory and advisory agencies to promote safety in the implementation of patient care. In 2003, the Centers for Disease Control (CDC) developed and issued the Guidelines for Infection Control in Dental Health-Care Settings.¹ Although a plan for evaluation should be included when guidelines are developed and implemented, no formal mechanism for evaluating clinical practice guidelines has been established in either the medical or dental literature.²⁻³ This study was designed to assess the knowledge, attitudes and practices of U.S. dental hygienists with current (2003) CDC infection control guidelines (ICG).

Knowledge, attitudes and practices and compliance with ICG among nurses and hospital personnel has been studied extensively, and findings indicated low compliance.⁴⁻⁹ Poor compliance with ICG can impact the health and safety of workers and patients.¹⁰⁻¹² Disease transmission has been linked to lapses in proper infection control in hospitals.¹¹⁻¹⁵ Reasons for health care workers' low compliance with ICG needs further study, and strategies to improve compliance need to be developed.¹⁶ McCoy, et al suggested that a positive safety climate or culture including regular training, monitoring by supervisors and positive reinforcement leads to better compliance.¹⁷

Research agendas of the American Dental Hygienists' Association (ADHA) and the CDC include health and safety objectives.^{1,18} This study

Abstract

Purpose: To assess knowledge, attitudes and practices of U.S. dental hygienists with infection control guidelines (ICG). Research has shown improved compliance with specific aspects of dental ICG is needed. This study supports the American Dental Hygienists' Association National Research Agenda's Occupational Health and Safety objective to investigate methods to decrease errors, risks and or hazards in health care. Data are needed to assess compliance, prevention and behavioral issues with current ICG practices.

Methods: A proportional stratified random sample (n=2,500) was recruited for an online survey. Descriptive statistics summarized demographic characteristics and knowledge, attitudes and practices responses. Spearman's rho correlations determined relationships between knowledge, attitudes and practices responses (p<0.05). Dominant themes were identified from open-ended responses.

Results: A 31% response rate (n=765) was attained. Respondents agreed/strongly agreed with familiarity with ICG (86%) and believed ICG are relevant to their patients (88%). Responses indicated low compliance (rarely/never used) with handpiece sterilization (n=209, 31%), utility glove use (n=317, 47%), and pre-procedural rinsing (n=324, 48%). Significant relationships were found between ICG implementation and access to necessary supplies (rs=0.549), supervisors' expectations for using ICG (rs=0.529) and no time to use (rs=-0.537). Themes from comments indicated time is a barrier, and respondents' perceived a need for involvement of all co-workers.

Conclusion: Dental hygienists are adhering with most aspects of the ICG. High compliance with ICG among respondents in this study was associated with positive safety beliefs and practices, whereas lower compliance with ICG was associated with less positive safety beliefs and practices. A safety culture appears to be a factor in compliance with ICG.

Keywords: knowledge, attitudes, behaviors, infection control
This study supports the NDHRA priority area, **Occupational Health and Safety:** Investigate methods to decrease errors, risks and or hazards in health care and their harmful impact on patients.

supports the ADHA National Research Agenda's Occupational Health and Safety objective to investigate methods to decrease errors, risks and or hazards in health care. Data are needed to

assess dental health care workers' compliance, prevention and behavioral issues related to current ICG. Evidence suggests a need for improved compliance with some aspects of the ICG in dental settings.^{3,19,20}

Most of the knowledge, attitudes and practices studies in dentistry and dental hygiene, conducted between 1995 and 2005, were related to attitudes and practices in treating patients with HIV/AIDS and compliance with specific dental procedures.²⁰⁻²³ Daniel reported, based on a literature review, that oral health care providers fear of treating persons with HIV/AIDS decreased between 1986 and 1996 and concluded that the change in attitudes was possibly related to increased compliance with ICG.²³ A 1999 study by McCarthy et al found that infection control practices of Canadian dentists (n=4,107) varied widely with age and size of community. Dentists aged >60 years reported low compliance with Hepatitis B vaccination (71.8%) and handpiece sterilization (54.9%), and refusal to treat HIV patients (26.9%); however, they also had a higher compliance with hand washing. Dentists from smaller communities were more compliant with Hepatitis B vaccination and less compliant with use of ICG manuals and handwashing.²¹

Studies by King and Muzzin²⁰ and Wood²² indicated that dental hygienists have adopted established ICG and are compliant with most aspects of them. However, these studies showed low compliance with pre-procedural rinsing. King and Muzzin found that, of 160 U.S. dental hygienists surveyed, 18.8% "always" or "often" and 32% "sometimes" used pre-procedural rinsing.²⁰ Wood reported, based on a survey of Rhode Island dental hygienists (n=171), 9% "always" and 51% "sometimes" used pre-procedural rinsing.²² These findings indicate that, although pre-procedural rinsing may have improved between 1995 and 2005, adherence to this aspect of the ICG continued to need improvement. Wood's study also indicated low compliance for handpiece sterilization (n=171, 67% always) and utility glove use in preparing instruments for sterilization (n=110, 61% always).²²

A 2008 study by Myers et al evaluated knowledge, attitudes and practices of general practice dentists (n=4,107) with CDC hand hygiene guidelines.¹⁹ Results showed $\leq 25\%$ of respondents reported inadequate hand hygiene practices. Findings indicated that 6% of dentists did not wash or sanitize their hands at the beginning of the clinical work day, and 11% did not wash or sanitize between patients. The majority of dentists (71%)

washed their hands with soap and never used alcohol products at the start of the day; however, 51% used a combination of soap and/or alcohol hand sanitizers between patients.¹⁹

The purpose of this study was to assess the knowledge, attitudes and practices of dental hygienists with regard to the CDC ICG. This survey assessed 4 research questions:

1. What do dental hygienists know about CDC ICG?
2. What are the attitudes of dental hygienists regarding ICG?
3. What are the infection control behaviors used by dental hygienists?
4. Are there any relationships among knowledge, attitudes and practices data?

Methods and Materials

Research Design and Instrument

This descriptive survey was designed to determine knowledge, attitudes and practices of dental hygienists with current CDC ICG. A 41-item questionnaire was used to survey a proportional stratified random sample of dental hygienists. The questionnaire consisted of 3 parts, including 10 demographic questions and 31 knowledge, attitudes and practices items (part 1 and part 2). The questionnaire, Attitudes Regarding Infection Control Guidelines, was adapted from Larson's tool to assess dentists' barriers to adherence with hand hygiene guidelines.²⁴ This tool was based upon Cabana's framework, developed to assess compliance with practice guidelines and was confirmed by hypothesis testing.²⁵ Cabana identified 6 domains representing barriers to guideline adherence.²⁵ Larson established construct and content validity of the instrument.²⁴ Permission from Larson to use and modify that instrument was obtained by the primary investigator (PI) in this study.

Demographic questions included sex, age, degree type, years of practice and practice setting. Part 1 of the questionnaire included 20 statements (on agreement or disagreement) and 2 additional open-ended questions specific to the 2003 CDC ICG to assess knowledge, attitudes and practices of dental hygienists. The investigator modified these statements from Larson's original instrument to adapt them to the 2003 CDC ICG for dental settings. Subjects rated their knowledge, attitudes and practices behaviors in part 1 by using a 6-point Likert-type scale. Thirteen of the 20 knowledge, attitudes and practices items were positively worded, with a score of 6 indicating strong agreement. Seven items were negatively worded, with 1 indicating strong disagreement, so

these items were reverse scored for data analyses.

Part 2 included 9 statements (on percentage of time the behavior was used) that were added to Larson's original instrument based on information in the literature previously indicating low compliance with pre-procedural rinsing, utility glove use and hand-piece sterilization.^{20,22,23} Subjects rated frequency of their behaviors in part 2 by using a 5-point Likert-type scale with 1 indicating "never" and 5 indicating "almost always (>90% of the time)."

Three open-ended questions provided respondents with an opportunity to comment regarding factors and barriers influencing implementation of ICG or any related issues. Qualitative thematic analysis of participants' comments identified predominant themes which emerged in response to the open-ended questions.

After the instrument was redesigned for dental hygienists, the PI convened a panel of expert dental hygiene clinicians to evaluate content validity. Ten dental hygiene practitioners with over 10 years of experience each reviewed the items and provided feedback on content and clarity based on criteria provided by the PI. The evaluation criteria included length of time to complete the survey, clarity of the questions and format of the survey, and also asked for suggestions for improvement. The survey instrument was revised to enhance clarity and content validity. Approval was obtained from the Human Subjects Committee at the PI's institution. Surveys were coded with a number available only to the PI to ensure that individual identity was protected for confidentiality while also allowing a mechanism for follow up of non-responders.

Sampling

A customized master list of licensed dental hygienists was purchased from the ADHA and its marketing company (INFOCUS Marketing, Inc.). The ADHA's database included information regarding 158,000 licensed dental hygienists regarding demographics, category of work (clinical practitioner, educator, retiree or student) and mailing address. A customized list was created by INFOCUS Marketing Inc. to meet pre-established inclusion and exclusion criteria for the study. The customized list included a proportional stratified random sample of all dental hygienists who worked in clinical practice settings, included both members and non-members of ADHA, and excluded students and retired dental hygienists. INFOCUS Marketing Inc. required a minimum purchase of 2,500 names. After exclusions were applied, a percentage of dental hygienists in each of the 50 states in the U.S. were sampled according to

each state's population of dental hygienists, so that each state was proportionately represented. This stratification method was utilized to contain costs and to gain a fair representation of dental hygienists in each state.

Data Collection

Postal mail addresses were the only available means of contact from the ADHA master list, so this study utilized a mixed mode survey method. The mixed method included sending a letter via bulk postal mail inviting the 2,500 subjects in the proportionate randomized sample to participate in an online survey. An Internet address was provided in the initial letter for subjects to access the online survey at a website hosted by the PI's academic department. To improve the response rate, Dillman's Tailored Design Method was used.²⁶ Strategies included initially sending letters via postal mail to invite all subjects to participate in an online survey, sending post cards to all subjects 1 week after the initial mailing to thank those who completed the survey and provide a gentle reminder to non-responders to complete the survey and a follow-up mailing 2 weeks later for all non-responders.

Data Analyses

Data were collected online via Survey Monkey™ and downloaded into a Microsoft Excel spreadsheet. Cronbach's alpha was used to assess internal reliability of the 6 domains originally developed by Cabana. These domains were not validated with a value of 0.70 in this population, therefore, the domains were not used to develop scales in subsequent data analyses. Statistical analysis was limited to descriptive statistics and Spearman's Rho correlations. Data were entered into statistical software (IBM SPSS release 19.0.0, copyright 2010, SPSS Inc.) for analyses. Descriptive data summarized demographic characteristics and knowledge, attitudes and practices item responses from part 1 and part 2. Spearman's rho correlations were used to determine relationships among demographics and knowledge, attitudes and practices item responses. The level of significance for all data analyses was set at <0.05.

Results

Demographics

A 31% response rate (n=765) was attained. The majority of respondents were white (95%), female (99%) and aged 42 or older (88%). Most subjects had entry-level associate degrees (68%), worked in general private practice (78%), worked in one practice setting (70%), worked more than 25 hours per

week (61%) and had practiced more than 10 years (99%). Thirty-three respondents (4%) were not employed, but were seeking employment. Alternative practice types reported (n=102, 13%) included hospital settings, community/public health settings, military, prisons and temporary agencies. Ninety-nine percent were ADHA members. Demographic data describing the sample are reported in Table I.

Results: Knowledge and Attitudes

Table II shows knowledge, attitudes and practices responses for part 1 of the survey. Four questions in part 1 assessed respondent's ratings of their knowledge of the ICG. Respondents agreed/strongly agreed that they were familiar with the ICG (n=703, 86%), the ICG was accessible (n=702, 77%) and the ICG are based on sound scientific evidence (n=689, 82%).

Fourteen items in part 1 of the survey instrument assessed attitudes about the ICG. These dental hygienists believed the ICG was relevant to patients (n=699, 88% agreed/strongly agreed), and believed that the supervisor expected use of the ICG (n=696, 86% agreed/strongly agreed). They did not believe that the ICG is cumbersome and inconvenient (n=415, 61% disagreed/strongly disagreed), or that they lacked time to use the ICG (n=534, 77% disagreed/strongly disagreed). Sixty-one percent of respondents strongly to somewhat agreed that they felt competent using alcohol-based hand products.

Results: Practices (Behaviors)

Two items in part 1 assessed infection control practice behaviors including whether the ICG had been implemented (n=696, 78% agreed/strongly agreed) and if respondents had access to necessary infection control supplies (n=698, 81% agreed/strongly agreed). Items in part 2 of the survey were also designed to assess practice behaviors (Table III). Six items assessed the percentage of time specific infection control practices were used. Responses indicating non-adherence to ICG included pre-procedural rinsing (n=324, 48% rarely/never used), slow speed handpiece sterilization after each use (n=209, 31% rarely/never used), utility glove use for handling contaminated instruments (n=317, 47% rarely/never used) and utility glove use for cleaning the treatment operatory (n=452, 66% rarely/never used). Approximately half of all respondents (n=193, 28% almost always or often and n=158, 23% sometimes) indicated use of alcohol-based hand gels for hand hygiene. Forty-six percent of respondents (n=218) believed patients prefer to see traditional hand washing.

Table I: Demographic of U.S. dental hygienists

	n	%
Age		
18-23	0	0
24-29	0	0
30-35	20	3%
36-41	67	9%
42-47	104	13%
48-53	199	26%
54-59	242	32%
>60	126	17%
Race		
White	717	95%
African American	3	0.5%
Asian	18	2%
Hispanic	8	1%
Native American	2	0.5%
Other	6	1%
Other	6	1%
Practice Setting		
One setting	527	70%
More than one setting	181	30%
Dental Hygiene Degree Entry Level		
Certificate/Associate	575	77%
Bachelor	180	23%
Highest Degree Held		
Certificate/Associate	378	50%
Bachelors	307	40%
Masters	69	9%
Doctorate	5	1%
Practice Type		
General private practice	594	78%
Solo practice (1 DDS)	136	18%
Partner (2 DDS)	95	12%
Group (3 or more DDS)	59	8%
Specialty practice	171	22%
Unemployed/seeking employment	33	4%
Other setting	102	13%
Years Practiced		
5-9	5	1%
10-14	93	12%
15-19	90	12%
20-24	100	13%
25-29	116	15%
30+	355	47%
Hours Worked Per Week		
0-8	82	11%
9-16	70	10%
17-24	143	19%
25-32	215	28%
33-40	218	29%
>41	26	3
ADHA Membership		
Membership	747	99%
Non-member	5	1%

Table II: Descriptive Statistics – Part 1 Knowledge, Attitudes and Practice Survey Items

Survey Items	n	SA	A	SWA	SWD	D	SD
Knowledge Items							
I am familiar with the ICG and its recommendation.	703	289 (41%)	315 (45%)	84 (12%)	7 (1%)	5 (1%)	3 (0)
The ICG is readily accessible if I want to refer to it.	702	243 (35%)	295 (42%)	114 (16%)	28 (4%)	16 (2%)	6 (1%)
The ICG is based on sound scientific evidence.	689	230 (33%)	336 (49%)	96 (14%)	17 (3%)	8 (1%)	2 (0)
*There are other guidelines that conflict with this one.	665	10 (2%)	40 (6%)	124 (19%)	211 (32%)	197 (29%)	83 (12%)
Attitude Items							
If we follow the recommendation of the ICG in our practice setting, it is likely that infection rates will decrease.	698	351 (50%)	270 (39%)	47 (7%)	14 (2%)	11 (1%)	5 (1%)
If I follow the recommendations of the ICG regarding hand washing, It is likely that my hands will be in worse shape (e.g. drier, more skin damage).	699	52 (7%)	122 (18%)	187 (27%)	98 (14%)	170 (24%)	70 (10%)
*The costs of the ICG outweigh the benefits.	695	88 (13%)	58 (8%)	35 (5%)	69 (10%)	218 (31%)	227 (33%)
I have confidence that the developer of the ICG is well qualified and knowledgeable about infection control.	700	216 (31%)	360 (51%)	87 (12%)	26 (4%)	3 (1%)	8 (1%)
The recommendations of the ICG are relevant to my patient population.	699	299 (43%)	315 (45%)	64 (9%)	14 (2%)	4 (1%)	3 (0)
The person I report to expects me to use the ICG.	696	306 (44%)	285 (41%)	64 (9%)	24 (3%)	10 (2%)	7 (1%)
*It is not really practical to follow the ICG recommendation.	696	8 (1%)	14 (2%)	57 (8%)	70 (10%)	251 (36%)	296 (43%)
*I do not wish to change my infection control practices, regardless of the ICG recommendations.	694	13 (2%)	19 (3%)	33 (5%)	108 (15%)	269 (39%)	252 (36%)
I feel competent using alcohol hand products (hand sanitizer gels) for routine hand hygiene.	698	95 (14%)	213 (31%)	115 (16%)	121 (17%)	103 (15%)	51 (7%)
My patients prefer to see me do a traditional hand wash.	695	131 (19%)	187 (27%)	143 (21%)	124 (18%)	85 (12%)	25 (3%)
My patients prefer seeing me performing various infection control procedures (i.e. handling instruments, surfaces, and/or barriers, cleaning/disinfecting/sterilizing).	695	168 (24%)	225 (32%)	136 (20%)	84 (12%)	68 (10%)	14 (2%)
*I don't have time to use the ICG.	690	13 (2%)	7 (1%)	44 (7%)	92 (13%)	207 (30%)	327 (47%)
If I don't use the ICG, I may be liable for malpractice.	696	256 (37%)	265 (38%)	93 (13%)	50 (7%)	19 (3%)	13 (2%)
*The ICG is cumbersome and inconvenient.	691	8 (1%)	52 (8%)	116 (17%)	100 (15%)	218 (31%)	197 (28%)
Practice/Behavior Items							
I have access to the necessary supplies and equipment to use the ICG.	698	307 (44%)	259 (37%)	71 (10%)	31 (4%)	18 (3%)	12 (2%)
I personally have implemented the recommendations of the ICG.	686	259 (38%)	274 (40%)	91 (13%)	26 (4%)	28 (4%)	8 (1%)

*=negatively worded items

Likert Scale Used: 6=Strongly Agree (SA); 5=Agree (A); 4=Somewhat Agree (SWA); 3=Somewhat Disagree (SWD); 2=Disagree (D); 1=Strongly Disagree (SD)

Table III: Descriptive Statistics – Part 2 Knowledge, Attitudes and Practice Survey Items

Practice/Behavior Questions	n	AA 5	O 4	S 3	R 2	N 1
In your work setting, what percentage of the time do you use waterless alcohol-based hand sanitizer gels for hand hygiene?	686	54 (8%)	139 (20%)	157 (23%)	195 (28%)	141 (21%)
In your work setting, what percentage of the time do you have patients use pre-procedural mouth rinses?	687	132 (19%)	67 (10%)	164 (24%)	224 (33%)	100 (14%)
In your work setting, what percentage of the time do you use heavy duty, puncture resistant utility-type gloves when handling contaminated instruments?	682	167 (24%)	102 (15%)	96 (14%)	170 (25%)	147 (22%)
In your work setting, what percentage of the time do you use heavy duty, puncture resistant utility-type gloves when cleaning the treatment operatory?	684	111 (16%)	40 (6%)	81 (12%)	193 (28%)	259 (38%)
In your work setting, what percentage of the time do you heat sterilize (autoclave) slow-speed hand pieces used for polishing?	684	306 (45%)	73 (11%)	96 (14%)	110 (16%)	99 (14%)

Likert Scale Used: 5=Almost Always (AA)=>90%; 4=Often (O)=51 to 90%; 3=Sometimes (S)=10 to 50%; 2=Rarely (R)=<10%; 1=Never (N)

Correlations

Spearman’s Rho correlations were used to assess relationships between knowledge, attitudes and practices items. All data values listed in Table IV were statistically significant ($p < 0.05$) and were moderate or high correlations ($r_s > 0.30$). Statistically significant weak correlations ($r_s < 0.30$) are not reported.

Significant direct relationships were found between implementation of the ICG and positive attitudes regarding: familiarity with the ICG ($r_s = 0.537$), belief in the qualifications of the ICG developer ($r_s = 0.406$), access to the ICG ($r_s = 0.413$) and infection control supplies ($r_s = 0.549$), belief in relevance of ICG to patients ($r_s = 0.462$), and belief that the person they report to expects them to use the ICG ($r_s = 0.529$). Significant direct associations also were found between the negative attitude that the ICG is not practical and negative attitudes about: the ICG being inconvenient and cumbersome to use ($r_s = 0.540$), having no time to use the ICG ($r_s = 0.582$) and not wanting to change infection control behaviors ($r_s = 0.549$). Significant inverse relationships were found between implementation of the ICG and the following knowledge, attitudes and practices items: not practical to use the ICG ($r_s = -0.501$), no time to use the ICG ($r_s = -0.489$), ICG are cumbersome & inconvenient to use ($r_s = -0.414$) and not wanting to change infection control behaviors regardless of ICG ($r_s = -0.402$).

Open-Ended Questions

Dominant themes were identified through qualitative analysis of 3 open-ended items. Themes related to factors that influenced implementation of the ICG

included: patient safety/preventing disease transmission, personal safety, laws/regulations, ethical/professional responsibility and scientific evidence/research.

Dominant themes identified related to barriers to using the ICG included time, staff education and training, attitudes and cooperation of others in the office, lack of supplies, high cost of supplies, employer unwillingness to support full implementation, environmental waste issues, and a lack of understanding of the ICG.

Although no dominant themes emerged from the item asking for general comments, responses characterized challenges dental hygienists face and practice patterns. The most frequent responses indicated that utility gloves were “cumbersome,” there is a lack of dental hygiene handpieces so they could not be sterilized after each use, metal cassettes are used frequently, dental hygienists fear losing their job if they “blow the whistle” on inadequate infection control practices, ICG are “overkill” and plastic barriers are “cumbersome, inconvenient and pollute the environment.” Several respondents described infection control practices used in their office. Respondents expressed a need for involvement of all dental coworkers in infection control education.

Discussion

Demographic characteristics of the respondents in this study, with one exception (ADHA membership), were similar to the 2007 National ADHA profile of dental hygienists with regards to gender, race, age, type of practice setting, practice type, years practiced and entry level degree.²⁷ The National ADHA profile of dental hygienists, based

Table IV: Correlation Statistics Indicating Associations between Knowledge, Attitudes and Practice Items

Knowledge, Attitudes and Practice Items	Familiarity with ICG	Belief in Expertise of Developers	Access to ICG	Relevance to Patients
Familiarity with ICG	-	0.360	0.565	0.430
Belief in Expertise of ICG Developers	0.360	-	0.349	0.657
Accessibility of ICG	0.565	0.349	-	0.381
Relevance to Patients	0.430	0.657	0.381	-
Supervisor Expects Use of ICG	0.467	0.454	0.400	0.591
Not Practical to Use ICG	-0.398	-0.419	-0.332	0.498
No Time to Use ICG	-0.367	-0.343	-0.253	0.379
Cumbersome & Inconvenient to use ICG	-0.321	-0.300	-0.274	-0.324
Access to Infection Control Supplies	0.423	0.376	0.403	0.437
Do Not Wish to Change Behavior	-0.291	-0.304	-0.271	-0.369
I've Implemented the ICG	0.537	0.406	0.413	0.462
Knowledge, Attitudes and Practice Items	Supervisor Expects Use of ICG	Not Practical to Use ICG	No Time to Use ICG	Cumbersome & Inconvenient to Use ICG
Familiarity with ICG	0.467	-0.398	-0.367	-0.321
Belief in Expertise of ICG Developers	0.454	-0.419	-0.343	-0.300
Accessibility of ICG	0.400	-0.332	-0.253	-0.274
Relevance to Patients	0.591	-0.498	-0.379	-0.324
Supervisor Expects Use of ICG	-	-0.447	-0.423	-0.300
Not Practical to Use ICG	-0.447	-	0.582	0.540
No Time to Use ICG	-0.423	0.582	-	0.545
Cumbersome & Inconvenient to use ICG	-0.300	0.540	0.545	-
Access to Infection Control Supplies	0.576	-0.442	-0.484	-0.385
Do Not Wish to Change Behavior	-0.350	0.549	0.472	0.378
I've Implemented the ICG	0.529	-0.501	-0.489	-0.414
Knowledge, Attitudes and Practice Items	Access to Infection Control Supplies	Do Not Wish to Change Behavior	I've Implemented the ICG	
Familiarity with ICG	0.423	-0.291	0.537	
Belief in Expertise of ICG Developers	0.376	-0.304	0.406	
Accessibility of ICG	0.403	-0.271	0.413	
Relevance to Patients	0.437	-0.369	0.462	
Supervisor Expects Use of ICG	0.576	-0.350	0.529	
Not Practical to Use ICG	-0.442	0.549	-0.501	
No Time to Use ICG	-0.484	0.472	-0.489	
Cumbersome & Inconvenient to use ICG	-0.385	0.378	-0.414	
Access to Infection Control Supplies	-	-0.376	0.549	
Do Not Wish to Change Behavior	0.378	-	-0.402	
I've Implemented the ICG	0.549	-0.402	-	

*Values listed were all statistically significant moderate or high correlation >0.30 (p≤ 0.05)

on a 44% response rate, (n=5,001/11,366), was White/non-Hispanic (92%), female (99%), mean aged 44 years, with an entry level associate degree and an average of 18 years of experience working in 1 general private practice setting (72%) either solo (66%) or small group (22%). Similarly, the majority of respondents in the current study were White females, aged 42 years or older, with an entry-level associate degree and more than 10 years of experience working in 1 general private practice setting.

Dental hygienists in this study were knowledgeable about the ICG and had positive attitudes regarding the ICG. The majority of respondents believed the ICG is relevant to their patients, had access to the ICG, and believed the person they report to expected them to use the ICG. Most participants reported they did not find the ICG to be impractical, cumbersome or inconvenient to use. Results related to infection control practices indicated that most respondents had adequate supplies to use the ICG and had implemented the ICG.

Specific infection control practices that were previously identified in the literature as needing improvement indicated little change.^{20,22} Dental hygienists in this study reported a high level of knowledge, access to and belief in the ICG, and reported they did not fully comply only in a few instances. Low compliance with ICG recommendations for pre-procedural rinsing, utility glove use, and handpiece sterilization were reported. These findings are similar to King and Muzzin's national survey showing that use of pre-procedural rinsing was "very low" at 18.8% (n=160)²⁰ and in Wood's study of Rhode Island dental hygienists indicating pre-procedural rinsing was used 51% (n=171) of the time.²² Wood's study also indicated that 67% (n=171) always heat sterilized their hand pieces after each use and 61% (n=110) always used utility gloves which is similar to the findings for these practices in the current study. It appears that little change in these practices has occurred since 1995. Interventions targeted toward improvement of compliance of these behaviors need to be developed and implemented for all dental professionals. Interdisciplinary webinars or online learning modules may be one strategy to reach a large audience of dental healthcare workers. Dental and dental hygiene educators also need to focus on teaching these practices to improve compliance.

Daniel's reported that fear of contracting HIV or Hepatitis B decreased due to the significant changes in infection control recommendations

Table V: Dominant Themes and Sample Comments From Open-Ended Questions

Open-ended Comments	Dominant Themes and Sample Comments
Factors Influencing Implementation of the ICG	Patient & Personal Safety/Disease transmission <ul style="list-style-type: none"> • "I want to protect my patients" • "I don't want to spread diseases"
	Laws/Regulations <ul style="list-style-type: none"> • "Being "forced" to do it"
	Ethical responsibility <ul style="list-style-type: none"> • "It's the right thing to do"
	Scientific evidence/research <ul style="list-style-type: none"> • "The experts recommend it"
Barriers to Implementing the ICG	Time <ul style="list-style-type: none"> • "It takes too much time to do"
	Staff education/training <ul style="list-style-type: none"> • "Other staff members do not get much education"
	Attitude/cooperation of others in office (changing habits) <ul style="list-style-type: none"> • "People are not willing to change and follow protocols, and they criticize me for doing it" • "Complacent dentists and undertrained assistants do not appreciate the value of these guidelines"
	Lack of supplies <ul style="list-style-type: none"> • "Dentists are cheap and skimp on supplies"
	Cost <ul style="list-style-type: none"> • "Supplies cost a lot"
	Unfamiliar with the ICG <ul style="list-style-type: none"> • "I'm not familiar with the entire guidelines"
	Employer unwillingness to change <ul style="list-style-type: none"> • "To get the dentist owner to place patient safety first, before the "crunch" of time (safety over time efficiency)"
	Environmental Waste <ul style="list-style-type: none"> • "Ridiculous amount of disposables going into the environment"

between 1986 and 1996.²³ Dental hygienists practicing during that time, including the majority of respondents in the current study, witnessed the development and implementation of ICG due to the heightened awareness of HIV and Hepati-

tis B. Daniels's reported that low compliance with pre-procedural rinsing, utility gloves use and handpiece sterilization may be related to lack of formal education with these procedures because they were introduced after graduation from dental hygiene school.²³ It is interesting to note that these same practice behaviors were found to be in low compliance in the current study.

Approximately half of respondents in this study reported that they believed they were somewhat to strongly competent in using alcohol hand products (hand sanitizer gels) for routine hand hygiene. This finding is consistent with findings Myers's study of general practice dentists (n=4,107) indicating 51% used hand sanitizers in combination with soap.¹⁹

McCoy et al suggested that a positive safety climate or culture including regular training, monitoring and positive reinforcement leads to better compliance with infection control guidelines.¹⁷ The findings of this knowledge, attitudes and practices study indicate that most participants had implemented the ICG and also reported the presence of several factors that support a positive safety climate. These factors included supervisor/employer expectations, sufficient resources such as access to the ICG and adequate supplies and the belief that patient safety is protected by the ICG. Conversely, the respondents who believed the person they reported to did not expect them to use the ICG reported that they did not have time to use the ICG, believed it was not practical to use the ICG and felt the ICG was cumbersome and inconvenient to use indicating a less positive safety culture or climate.

Most respondents in this study worked in a general private dental practice. The practice owner most frequently is the dental hygienists' supervisor in the dental practice setting. The dentist-supervisor, or designee such as the office manager, often oversees office infection control policies and monitors costs of supplies, and is very influential in establishing the safety climate in the practice. Targeting education and/or interventions toward the individuals who foster or influence the safety culture in dental practices may be an effective way to promote positive change in the safety culture or climate to increase compliance with ICG.

Barriers reported in the open-ended questions revealed factors that might also explain low compliance reported with a few aspects of the ICG. Some of those factors included time for adequate infection control in a tight schedule, attitudes/co-

operation of other staff members (dentists, dental assistants, schedulers) and disagreement about infection control practices (changing established habits), employers' unwillingness to change or provide adequate training and/or supplies, and high costs associated with full ICG implementation.

Overall, it appears that dental health care workers are aware of the importance of following ICG and are generally compliant with implementation.¹⁹⁻²³ These findings differ from results of studies reporting attitudes and practices of nurses or hospital personnel.⁴⁻⁹ Documented cases of disease transmission linked to lapses in infection control during dental treatment are rare; whereas health care acquired infections (HAIs) are prevalent in hospital settings. Hands are the biggest culprit in cross contamination and have been identified in several studies of nurses and hospital personnel as the cause for many HAIs.¹¹⁻¹⁵

Limitations of this study included homogeneity of respondents despite the randomization used in subject selection. Ninety-nine percent of the subjects in this study were ADHA members; therefore, results are representative of members of that professional association. In the general population of dental hygienists, approximately 23,000 (20%) of 115,000 are ADHA members.²⁸ King and Muzzin's study of dental hygienists indicated that ADHA members were more compliant with infection control practices as compared to non-members. They suggested that professional affiliation may impact knowledge, attitudes and practices through exposure to current research and education.²⁰ The high percentage of ADHA members in this sample might have influenced results indicating high rates of adherence to ICG. Non-response bias from younger dental hygienists with fewer years of experience also may have impacted results of this study; however, national data indicate the average age of the practicing dental hygienists is 44 years.

Another limitation was the low response rate, possibly related to using the mixed mode survey method. The master list from ADHA's marketing group included postal mail addresses and no email addresses. Bulk mail was used to contain costs, and incorrect addresses were not able to be tracked.

Future research should include studying the infection control knowledge, attitudes and practices of other groups of dental healthcare workers such as dental assistants, dentists, and office

managers. Assessment of reasons for continued low compliance with pre-procedural rinsing, utility gloves use, and handpiece sterilization, and targeted interventions for improvement need to be developed and evaluated.

Conclusion

Dental hygienists are knowledgeable about ICG, have implemented ICG and are compliant with most aspects of the ICG. High compliance with ICG among respondents in this study was associated with positive safety beliefs and practices; whereas lower compliance with ICG was associated with less positive safety beliefs and practices. Positive beliefs about infection control and a safety culture or climate in the work set-

ting seem to be important in compliance with ICG and are influenced by decision makers in the practice.

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