

Factors Affecting Infection Control Measures Performed by Dental Workers

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Abstract

Background We aimed to investigate factors associated with personal self-protection in infection control among dental care workers.

Methods A cross-sectional survey with self-report questionnaire was conducted between Jan and Dec, 2018. 275 dentists and 298 dental assistants were enrolled from randomly selected dental care settings.

Results Compliance with wearing hair caps, facial masks, and hand washing is not as high as oral masks and gloves (over 90%). For dentists, the level of clinical setting (aOR=3.1, $P<0.001$) and the correct use of disinfectants for impression materials (aOR=2.0, $P<0.05$) were associated with hair cap wearing. Gender (aOR=0.15, $P<0.05$) and correct use of indicator during sterilization (aOR=2.9, $P<0.05$) were associated with facial mask wearing. The correct use of indicator during sterilization (aOR=2.4, $P<0.05$) and disinfection for impression materials (aOR=2.2, $P<0.05$) were associated with hand washing. For dental assistants, longer work experience (aOR=1.05, $P<0.05$), working days (aOR=1.82, $P<0.05$), the correct use of disinfectants for impression materials (aOR=2.4, $P<0.001$), and the frequent use of gloves (aOR=8.0, $P<0.05$) were associated with facial mask wearing. The surface disinfection of working tables (aOR=2.8, $P<0.001$) and the frequent changing of gloves (aOR=5.96, $P<0.05$) were associated with hand washing.

Conclusions Gender, the length of work practice, and correct techniques for sterilization use were identified as major factors associated with compliance with self-protection in infection control among dental care workers.

Introduction

Infection control aims to prevent disease transmission and to promote a safe working environment. Reports of infectious disease transmission in dental clinics have been documented in previous studies. The regulation of infection control for all health care institutions and workers, including dental care professionals, is guided by government agencies and dental professional organizations to prevent working injury or exposure to blood and other potentially infectious materials. Infection control forms an important part of the practice for both patients and professional personnel in dental health care.

An investigation of US dental practitioners showed that only 26% of responding dentists had implemented three or four of the CDC recommendations. Thirty-four percent of practitioners had implemented none of the suggested recommendations in daily practice¹. The recommendations of infection control may not be successfully implemented in their clinical practice². A systematic review indicated that implementation strategies including audit and feedback, reminders, education, and multifaceted intervention have had some success in the dental setting, but more evidence regarding the effectiveness of each type of strategy is required³. Additionally, the knowledge and attitude of practitioners might also play certain roles in the compliance with recommendations. However, in previous studies, knowledge and attitudes regarding these recommendations were not associated with adherence

to infection control procedures among dental faculty members and students in dental colleges^{4,5}. Many studies have elucidated the related factors leading to compliance with infection control procedures, but none of these studies have examined the gaps in infection control in terms of dental care workers' perceptions, their attitude towards infection control procedures, or their number of years of practice. Risk factors are expected to be different in different types of dental clinics. Therefore, it is important to delineate the factors associated with the recommended guidelines according to different work characteristics, infection control procedures, and compliance rates.

The purpose of this study is to investigate perceptions and attitudes towards recommended infection guidelines and to reveal the factors associated with infection guidelines among dental care workers, including dentists and dental assistants.

Materials And Methods

Study area and settings

This is a cross-sectional study conducted in Taiwan between Jan 2018 and Dec 2018 at privately run dental clinics and associated hospitals. The participating clinics were under no strict selection criteria, and mostly all operate in a similar fashion. We believe our study sample to be sufficiently random and representative given that clinics were chosen from different, geographically distant areas of Taiwan: north, south, east, and west. This study complied with STROBE guidelines.

Questionnaire

The survey instrument used was a self-administered questionnaire. The anonymous questionnaire contained sixty-nine questions composing four major categories: personal characteristics; perception and attitude towards infection control procedures; exposure risk and training; and knowledge about and perception and attitude towards infectious disease. The expert validity and content validity of the questionnaire were verified prior to the investigation. This study was approved by Institutional Review Board of Taipei Medical University (TMU-JIRB: N201804006)

Study Sample

As dental clinic sizes vary by area, we used the probabilities proportional to size (PPS) method [6] to randomly select subjects from different clinical settings in each area. A total of 60 hospitals and 340 dental clinics from four areas were therefore selected. We invited a dentist and a dental assistant from each setting to respond to the questionnaire. The finished questionnaire was returned by post. The questionnaire return rates for dentists and dental assistants were 68.75% and 74.5%, respectively.

Statistical Analysis

Data are summarized as the means (standard deviations, SDs) for continuous variables and counts (percentages) for categorical variables. Comparisons of personal characteristics and perceptions and attitudes towards infection control between dentists and dental assistants were performed by using the chi-squared test or t test as applicable. Multivariable backward stepwise logistic regression models were used to analyze factors associated with perceptions and attitudes towards infection control. All statistical analyses were performed with SAS 9.4.

Results

A total of 573 subjects (275 dentists and 298 dental assistants) participated in this study. Table 1 shows the personal characteristics of the two groups. A disproportionately higher percentage of dentists (81%) than dental assistants (3%) were male. More than half of the dentists were older than 50 years old, but the majority of assistants were younger than 50 years old. Therefore, the length of practice was significantly longer among the dentists. Among the dental assistants, only one-fourth had health-related backgrounds. There was no significant difference in the working days per week for the two groups. The majority of dentists (60%) treated 11–20 patients every day. Only a small group (4%) saw more than 30 patients per day. In both groups, approximately 20% of the samples were based out of hospitals.

Table 1
Personal characteristics of the included dentists and dental assistants

Characteristics	Dentists		Dental assistants		P-Value
	N = 275		N = 298		
	N	%	N	%	
Gender					< 0.0001 ^a
Male	222	80.73	8	2.68	
Female	53	19.27	290	97.32	
Age (years)					< 0.0001 ^a
<=30	20	7.33	94	31.76	
31 ~ 40	48	17.58	118	39.86	
41 ~ 50	57	20.88	61	20.61	
51 ~ 60	91	33.33	15	5.07	
>=61	57	20.88	8	2.70	
Length of practice (years)					< 0.0001 ^b
Mean, Sd.	22.49	, 11.21	9.63	, 7.39	
Professional background					
Health related major			74	25.17	
Other majors with professional training			220	73.83	
Working days per week					0.054 ^b
Mean, Sd.	5.24	, 0.68	5.13	, 0.72	
Number of patients treated per day					
0 ~ 10	52	18.98			
11 ~ 20	161	58.76			
Sd.: standard deviation					
^a Chi-squared test					
^b t-test					
Variables with missing values: Age (dentist 2; DA 2); Length of practice (dentist 3; DA 2); Professional background (DA 4); Working days per week (dentist 3; DA 1); Number of patients treated per day (dentist 1); Setting level (DA 1)					

Characteristics	Dentists		Dental assistants		P-Value
	N = 275		N = 298		
21 ~ 30	50	18.25			
> 30	11	4.01			
Setting level					0.40 ^a
Hospital	55	20.00	68	22.90	
Local dental office	220	80.00	229	77.10	
Sd.: standard deviation					
^a Chi-squared test					
^b t-test					
Variables with missing values: Age (dentist 2; DA 2); Length of practice (dentist 3; DA 2); Professional background (DA 4); Working days per week (dentist 3; DA 1); Number of patients treated per day (dentist 1); Setting level (DA 1)					

We further compared the personal protection barrier techniques implemented in the two groups (Table 2). We found that the compliance with wearing gloves was high in both groups (95% of dentists and 92% of dental assistants, $p = 0.08$). Gloves were changed after treating each patient by the majority of dentists (97%) and assistants (95%). However, allergies to protective gloves were more frequent among dental assistants (40%) than among dentists (27%) ($p = 0.001$). The strategies employed to address the reaction, including consuming allergy medication or changing the type of gloves, were similar for the two groups. It is interesting to see that the hand washing behavior before putting on gloves was similar between dentists (75%) and assistants (76%) ($p = 0.65$), but assistants were more likely to wash their hands (92%) than dentists (84%) ($p = 0.005$) after removing gloves.

Table 2
Barrier techniques for infection control among dentists and dental assistants

Variables	Dentist		Dental assistants		P-Value ^a
	N = 275		N = 298		
	N	%	N	%	
Gloves					0.08
Yes (yes and optional)	262	95.27	273	91.61	
No	13	4.73	25	8.39	
Frequency of changing gloves					0.29
Every patient	263	96.69	280	94.92	
More than one patient	9	3.31	15	5.08	
Glove allergy					0.001
Yes	74	26.81	118	39.6	
No	201	73.19	180	60.4	
Has allergies and takes medical treatment					0.78
No	47	65.28	74	63.25	
Yes	25	34.72	43	36.75	
Has allergies and changes to different gloves					0.77
No	22	31.88	34	29.82	
Yes	47	68.12	80	70.18	
Changes type of gloves					0.27
Did not change	22	31.88	34	29.82	
Latex with powder	8	11.59	24	21.05	
Latex without powder	30	43.48	48	42.11	
Non-latex	9	13.04	8	7.02	
Washes hands before putting on gloves					0.65

^a Chi-squared test

Variables with missing values: Frequency of changing gloves (dentist 3; DA 3); Has allergies and takes medical treatment (dentist 2; DA 1); Has allergies and changes to different gloves (dentist 5; DA 4); Work attire (dentist 0; DA 9); Washes hand after removing gloves (dentist 1; DA 0)

Variables	Dentist		Dental assistants		P-Value ^a
	N = 275		N = 298		
Yes	205	74.55	227	76.17	
No	70	24.45	71	23.83	
Washes hands after removing gloves					0.005
Yes	231	84.31	274	91.95	
No	43	15.69	24	8.05	
Oral masks					0.07
Yes	272	98.91	288	96.64	
No	3	1.09	10	3.36	
Hair caps					0.011
Yes	57	20.73	37	12.42	
Optional	109	39.64	114	38.26	
No	109	39.64	147	49.33	
Facial mask					< 0.0001
Yes	99	36.00	37	12.42	
Optional	134	48.73	121	40.60	
No	42	15.27	140	46.98	
Work attire					0.027
Casual clothes	10	3.64	12	4.15	
Work clothes	184	66.91	220	76.12	
Scrubs	81	29.45	57	19.72	
^a Chi-squared test					
Variables with missing values: Frequency of changing gloves (dentist 3; DA 3); Has allergies and takes medical treatment (dentist 2; DA 1); Has allergies and changes to different gloves (dentist 5; DA 4); Work attire (dentist 0; DA 9); Washes hand after removing gloves (dentist 1; DA 0)					

As far as other personal protection means, we found that compliance with wearing oral masks was very high in Taiwan for both groups (99% in dentists and 97% in dental assistants). However, the behavior of wearing hair caps, goggles, and other protective attire was different between dentists and dental assistants. A higher proportion of dentists (60.3%) wore hair caps ($p = 0.011$) and facial masks (goggles)

($p < 0.0001$) than assistants (50.7%). Dental assistants were more likely (76%) than dentists (67%) to wear uniform gowns but less likely to wear protective gowns (29% for dentists and 20% for assistants) ($p = 0.027$).

The behavior of disinfection and sterilization for infection control was similar in dentists and dental assistants (Table 3). Compliance with the use of autoclaves for sterilizing general dental instruments, extraction instruments, and hand pieces was excellent in Taiwan for both dentists and dental assistants. Dental assistants (78%) were more likely than dentists (73%) to autoclave dental burs ($p = 0.014$). Approximately 80% (453/574) of the participants used chemical indicators during sterilization. The most frequent disinfectant was glutaraldehyde. Seventy-five percent of dentists and 81% of dental assistants conducted surface disinfection of working tables. For impression materials, approximately 70% used water for disinfection.

Table 3
Disinfection and sterilization for infection control among dentists and dental assistants

Variables	Dentist		Dental Assistants		P-Value ^a
	N = 275		N = 298		
	N	%	N	%	
General dental instrument disinfection					0.056
Autoclave	246	93.89	267	92.39	
Chemicals	3	1.15	12	4.17	
Other	13	4.96	9	3.13	
Extraction instrument disinfection					0.24
Autoclave	263	97.41	280	95.56	
Other	7	2.59	13	4.44	
Handpiece disinfection					0.52
Autoclave	231	86.19	255	87.63	
Chemicals	11	4.10	7	2.41	
Other	26	9.70	29	9.97	
Bur disinfection					0.014
Autoclave	199	73.43	229	77.89	
Chemicals	50	18.45	58	19.73	
Other	22	8.12	7	2.38	
Chemical indicator use during sterilization					0.37
Yes	213	77.45	240	80.54	
No	62	22.55	58	19.46	
Disinfectant					0.20
Glutaraldehyde	156	65.27	135	59.73	

^a Chi-squared test

Variables with missing values: General dental instrument disinfection (dentist 13; DA 10); Extraction instrument disinfection (dentist 5; DA 5); Handpiece disinfection (dentist 7; DA 7); Bur disinfection (dentist 4; DA 4); Disinfectants (dentist 36; DA 72); Surface disinfection of working tables (dentist 0; DA 1); Disinfection of impression materials (dentist 1; DA 0)

Variables	Dentist		Dental Assistants		P-Value ^a
	N = 275		N = 298		
Phenol & NaOCl	38	15.90	34	15.04	
Alcohol	12	5.02	9	3.98	
Others	33	13.81	48	21.24	
Surface disinfection of working tables					0.09
Yes	207	75.27	241	81.14	
No	68	24.73	56	18.86	
Disinfection of impression materials					0.36
Disinfectant	84	30.66	81	27.18	
Water	190	69.34	217	72.82	
^a Chi-squared test					
Variables with missing values: General dental instrument disinfection (dentist 13; DA 10); Extraction instrument disinfection (dentist 5; DA 5); Handpiece disinfection (dentist 7; DA 7); Bur disinfection (dentist 4; DA 4); Disinfectants (dentist 36; DA 72); Surface disinfection of working tables (dentist 0; DA 1); Disinfection of impression materials (dentist 1; DA 0)					

Factors associated with personal protection behavior, such as wearing hair caps and facial masks and hand washing, were identified using multivariable logistic regression. The full model is presented in Table 4. The reduced model is presented in Table 5. For wearing hair caps, we found that setting level was a significant factor for both dentists (aOR = 3.10, 95% CI: 1.38–6.96) and dental assistants (aOR = 2.33, 95% CI: 1.10–4.96). Using disinfectants for impression materials was also positively associated with hair cap wearing (aOR = 2.03 for dentists (95% CI: 1.04–3.95) and 3.55 for dental assistants (95% CI: 1.79–7.02)). Surface disinfection of working tables was also a significant factor for hair cap wearing for assistants (aOR = 3.00, 95% CI: 1.35–6.65) but not for dentists.

Table 4

Factors associated with hair cap, facial mask wearing and hand washing by multivariable (full model)

Variables	Hair Cap		Facial Mask		Hand washings	
	Dentist	Dental Assistant	Dentist	Dental Assistant	Dentist	Dental Assistant
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Gender						
Female			1.00			
Male			0.22* (0.05– 0.99)			
Length of practice						
years				1.05** (1.01– 1.09)		1.06* (1.01– 1.10)
Setting level						
Local dental office	1.00	1.00		1.00		
Hospital	2.86** (1.37– 5.97)	2.53** (1.28– 4.99)		2.03* (1.07– 3.84)		
Frequency of changing gloves						
More than one patient				1.00		1.00
Every patient				6.71* (1.35– 33.28)		5.61** (1.59– 19.81)
Bur disinfection						
Chemical		1.00				

* $P < 0.05$ ** $P < 0.01$ Backward selection with $P < 0.05$

Variables	Hair Cap		Facial Mask		Hand washings	
	Dentist	Dental Assistant	Dentist	Dental Assistant	Dentist	Dental Assistant
Autoclave		2.28* (1.12–4.67)				
Chemical indicator use during sterilization						
No			1.00		1.00	
Yes			3.38** (1.53–7.46)		1.95* (1.04–3.62)	
Surface disinfection of working tables						
No		1.00				1.00
Yes		2.48* (1.23–5.00)				2.98** (1.52–5.85)
Disinfection of impression materials						
Water	1.00	1.00	1.00	1.00	1.00	1.00
Disinfectant	2.16* (1.19–3.93)	3.64** (1.90–6.95)	3.47* (1.15–10.46)	2.17* (1.18–4.00)	2.05* (1.09–3.87)	2.43* (1.10–5.34)
* $P < 0.05$						
** $P < 0.01$						
Backward selection with $P < 0.05$						

Table 5

Factors associated with hair cap, facial mask wearing and hand washing by multivariable (reduced model)

Variables		Hair Cap		Facial Mask		Hand washing	
		Dentist	Dental Assistant	Dentist	Dental Assistant	Dentist	Dental Assistant
		OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Gender							
Female		1.00	-	1.00	-	1.00	-
Male		0.93 (0.42- 2.03)	-	0.15* (0.02- 0.98)	-	0.65 (0.30- 1.41)	-
Age							
Dentist	Dental Assistant						
≤ 40	≤ 30	1.00	1.00	1.00	1.00	1.00	1.00
41 ~ 50	31 ~ 40	1.14 (0.36- 3.62)	0.84 (0.42- 1.66)	0.42 (0.06- 3.00)	0.94 (0.49- 1.80)	1.49 (0.45- 4.92)	0.83 (0.39- 1.74)
51 ~ 60	≥ 41	0.36 (0.08- 1.57)	1.31 (0.55- 3.17)	0.17 (0.01- 1.92)	1.19 (0.50- 2.83)	0.90 (0.19- 4.21)	1.21 (0.42- 3.46)
≥ 61		0.73 (0.10- 5.09)		0.27 (0.01- 6.43)		2.61 (0.33- 20.89)	
Length of practice							
years		1.01 (0.95- 1.08)	1.01 (0.97- 1.06)	1.06 (0.96- 1.17)	1.05* (1.00- 1.10)	1.00 (0.93- 1.06)	1.05 (0.99- 1.11)

† $P < 0.10$ * $P < 0.05$ ** $P < 0.01$

Variables	Hair Cap		Facial Mask		Hand washing	
	Dentist	Dental Assistant	Dentist	Dental Assistant	Dentist	Dental Assistant
Working days per week						
> 5 days	1.00	1.00	1.00	1.00	1.00	1.00
≤ 5 days	1.59	1.77†	1.00	1.82*	1.39	1.17
	(0.87– 2.91)	(0.95– 3.27)	(0.41– 2.45)	(1.01– 3.30)	(0.77– 2.52)	(0.59– 2.32)
Setting level						
Local dental office	1.00	1.00	1.00	1.00	1.00	1.00
Hospital	3.10**	2.33*	2.96	1.58	1.29	1.23
	(1.38– 6.96)	(1.10– 4.96)	(0.61– 14.35)	(0.78– 3.20)	(0.59– 2.85)	(0.52– 2.86)
Number of patients treated per day						
0 ~ 10	1.00	-	1.00	-	1.00	-
11 ~ 20	1.36	-	1.56	-	1.74	-
	(0.63– 2.94)		(0.53– 4.53)		(0.83– 3.65)	
> 20	1.63	-	1.56	-	1.40	-
	(0.66– 4.05)		(0.42– 5.78)		(0.59– 3.33)	
Professional background						
Other majors	-	1.00	-	1.00	-	1.00
Health related major	-	1.42	-	1.52	-	1.15
		(0.71– 2.83)		(0.79– 2.95)		(0.52– 2.55)

† $P < 0.10$

* $P < 0.05$

** $P < 0.01$

Variables	Hair Cap		Facial Mask		Hand washing	
	Dentist	Dental Assistant	Dentist	Dental Assistant	Dentist	Dental Assistant
General dental instrument disinfection						
Chemicals	1.00	1.00	1.00	1.00	-	1.00
Autoclave	0.61	5.45	2.71	0.67	-	2.85
	(0.02-17.31)	(0.60-49.10)	(0.07-101.24)	(0.16-2.80)		(0.55-17.74)
Extraction instrument disinfection						
Not autoclave	1.00	1.00	-	1.00	1.00	1.00
Autoclave	0.33	1.12	-	2.08	4.87	0.54
	(0.02-5.53)	(0.22-5.55)		(0.47-9.19)	(0.70-34.01)	(0.09-3.45)
Handpiece disinfection						
Chemicals	1.00	1.00	1.00	1.00	1.00	1.00
Autoclave	1.10	0.35	0.91	1.79	0.55	0.91
	(0.24-5.01)	(0.05-2.39)	(0.11-7.28)	(0.17-18.72)	(0.10-3.17)	(0.11-7.33)
Bur disinfection						
Chemicals	1.00	1.00	1.00	1.00	1.00	1.00
Autoclave	0.58	2.09†	1.89	1.33	0.47†	0.52
	(0.26-1.32)	(0.87-5.03)	(0.66-5.42)	(0.59-3.00)	(0.20-1.10)	(0.19-1.40)
Chemical indicator use during sterilization						
No	1.00	1.00	1.00	1.00	1.00	1.00

† $P < 0.10$

* $P < 0.05$

** $P < 0.01$

Variables	Hair Cap		Facial Mask		Hand washing	
	Dentist	Dental Assistant	Dentist	Dental Assistant	Dentist	Dental Assistant
Yes	1.01 (0.46–2.07)	1.24 (0.59–2.63)	2.94* (1.19–7.24)	0.97 (0.47–1.98)	2.36* (1.17–4.75)	1.96† (0.93–4.16)
Surface disinfection of working tables						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	1.94† (0.99–3.84)	3.00** (1.35–6.65)	1.34 (0.53–3.39)	2.05† (0.99–4.25)	1.31 (0.67–2.56)	2.76** (1.29–5.90)
Disinfection of impression materials						
Water	1.00	1.00	1.00	1.00	1.00	1.00
Disinfectant	2.03* (1.04–3.95)	3.55** (1.79–7.02)	3.03† (0.91–10.14)	2.40** (1.25–4.61)	2.24* (1.11–4.53)	2.25† (0.97–5.25)
Gloves						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	3.45 (0.62–19.27)	0.56 (0.16–1.92)	1.66 (0.28–9.67)	0.94 (0.28–3.17)	0.41 (0.09–1.84)	0.59 (0.13–2.65)
Frequency of changing gloves						
More than one patient	1.00	1.00	1.00	1.00	–	1.00
Every patient	0.77 (0.11–5.39)	1.57 (0.38–6.54)	3.06 (0.37–25.27)	8.04* (1.39–46.47)	–	5.96* (1.39–25.51)
Oral masks						
† $P < 0.10$						
* $P < 0.05$						
** $P < 0.01$						

Variables	Hair Cap		Facial Mask		Hand washing	
	Dentist	Dental Assistant	Dentist	Dental Assistant	Dentist	Dental Assistant
No	1.00	1.00	-	1.00	1.00	1.00
Yes	5.07	0.55	-	1.78	8.67	1.62
	(0.39–66.17)	(0.09–3.48)		(0.30–10.50)	(0.62–120.63)	(0.21–12.39)
† <i>P</i> < 0.10						
* <i>P</i> < 0.05						
** <i>P</i> < 0.01						

Factors related to facial masks were different between dentists and assistants. Gender (male; aOR = 0.15 (95% CI: 0.02–0.98)) and chemical indicator use during sterilization (aOR = 2.94, 95% CI: 1.19–7.24) were significant factors for dentists. For assistants, a longer working experience (aOR = 1.05 (95% CI: 1.00–1.10) per year longer), fewer working days per week (aOR = 1.82, 95% CI: 1.01–3.30), the use of disinfectants for impression materials (aOR = 2.40, 95% CI: 1.25–3.30), and the frequent use of gloves (aOR = 8.04, 95% CI: 1.39–46.47) were positively associated with wearing facial masks. The use of chemical indicators during sterilization (aOR = 2.36, 95% CI: 1.17–4.75) and disinfectants for impression materials (aOR = 2.24, 95% CI: 1.11–4.53) were associated with hand washing for dentists, whereas surface disinfection of working tables (aOR = 2.76, 95% CI: 1.29–5.90) and frequent changing of gloves (aOR = 5.96, 95% CI: 1.39–25.51) were associated with hand washing for assistants.

The results of multivariable logistic regression with backward selection are shown in Table 5. The use of disinfectants for impression materials was consistently positively associated with the three personal protection behaviors for both dentists and assistants. The others remain similar as in the full model. However, the frequency of changing gloves became insignificant.

Discussion

The present survey aimed to elucidate not only the perceptions and attitudes of infection control but also the factors associated with infection control among dentists and dental assistants. Most dental care workers were aware of the standard infection control guidelines. Overall compliance with infection control parameters, including wearing gloves, changing gloves for each patient, and wearing oral masks, was 90% or above. The compliance with these parameters was not different between dentists and dental assistants. The compliance with infection control practices has improved since our previous survey⁶. The level of compliance was comparable to the DHCWs in some other countries. The compliance with hand washing after removing gloves was slightly lower (84%) among dentists than among dental assistants (96.6%) (*P* < 0.05), whereas compliance with wearing hair caps and facial masks was higher

among dentists than among dental assistants. The performance of dental assistants was not satisfactory with respect to some infection control areas.

The results of the study demonstrated the use of accurate methods for sterilizing the instruments. More than 90% of respondents used autoclave disinfection for general dental instruments and extraction instruments, and more than 70% of respondents used autoclaving as the major disinfection method for headpieces and burs and followed the standard guidelines for the use of chemical indicators during sterilization. Our results were consistent with those of other studies. Gurevich et al reported that 68% of respondents believed they were sterilizing their instruments but did not use appropriate chemicals or exposure times, and 49% of respondents did not use biological indicators ⁷.

The behavioral factors associated with wearing hair caps and facial masks, and hand washing were not fully identical between dentists and dental assistants. First, the common factor for these self-protection behaviors was the use of the correct method of disinfection for impression materials. For wearing hair caps, common factors between dentists and dental assistants were the work setting and the methods employed for impression material disinfection. Staff working in hospitals were more likely to wear hair caps. The possible reason could be due to the higher standard for infection control in hospitals. Two additional parameters, bur disinfection and working table disinfection, were associated with the behavior of wearing hair caps among dental assistants. Male dentists were less likely to wear facial masks, whereas dentists that followed standard procedures in the use of chemical indicators during sterilization were more likely to wear facial masks. Similar factors were also observed for hand washing among dentists. Dental assistants with longer lengths of practice or who frequently changed their gloves were more likely to perform hand washing. The differences in the factors associated with these self-protection behaviors suggest that different educational or audit programs should be made available for different targeted staff members. For example, audit programs for wearing masks should focus on educating male dentists. Compliance with infection control among both dental and dental assistants remains inadequate, and more training along with monitoring is required to improve compliance.

The attitude towards and knowledge concerning the prevention of infection and compliance with self-protection remain insufficient in many countries worldwide. As concluded in these studies, providing correct information for infection control procedures requires the development and implementation of a curriculum for dental schools and of continuing dental education for practicing dentists. Continuing infection control education for dental assistants is also very important. In addition, we must continue to improve current infection prevention and control strategies to prevent the unexpected outbreak of fatal infectious diseases such as COVID-19 ^{8,9}.

Our study had some limitations. The study did not assess the association between the overall levels of knowledge and compliance with the infection control procedure. Further studies are needed to find further associations between knowledge items and adherence to infection control.

Conclusion

Gender, length of working practice, and correct techniques in the use of sterilization are major factors associated with the compliance with self-protection in infection control among Taiwanese dentists and dental assistants.

Abbreviations

CDC: Centers for Disease Control and Prevention; US: United State; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology (collaboration); PPS: probabilities proportional to size; SDs: standard deviations; DHCWs: Dental Health Care Workers. SAS: Statistical Analysis System: OR: odd ratio; aOR: adjusted odd ratio. COVID-19: coronavirus discovered in late 2019

Declarations

Ethics approval and consent to participate

This study was approved by Institutional Review Board of Taipei Medical University (TMU-JIRB: N201804006). The consent was obtained from the participants who voluntary to participate and the data were kept confidential.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

All authors declare that there are no any competing interests to disclose.

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Authors' contributions

HCC and YCY were major contributor in writing the manuscript, AMFY and SLSC analyzed and interpreted data in this study. All authors read and approved the final manuscript.

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