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Awareness and implementation of infection control measures in private dental clinics, Makkah, Saudi Arabia

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Abstract

Since the majority of dental patients in Makkah are treated in the private sector, the aim of the present study was to evaluate knowledge and practice of infection control (IC) measures among dentists in private clinics in this region. A self-constructed questionnaire, consisted of 30 items related to IC practices and knowledge, was distributed among 107 private clinics dentists in ten districts of Makkah. The data collected were related to gender, education level, daily work load and years of experience of the participants. Although a significant percentage ($p<0.05$) of participants had hepatitis B vaccination, 14.9% of them were not vaccinated. An unsafe work behavior of bending needles after use was common (70%) and higher among general practitioners, 12.2 % do not dispose of sharps in a safety container, and 2.8% do not believe separation of blood soaked waste is important. The belief that wearing gloves could replace hand hygiene was reported in 15.9%. All participants were aware that contaminated instruments should be autoclaved, but 4.6% did not realize the importance of the using a new hand piece for every patient. Higher percentages of dentists with 10 years of experience were not vaccinated, do not perform hand hygiene after removing gloves, and did not receive any IC continuing education course. In conclusion, IC practice and knowledge among dentists in Makkah private clinics needs improvement. Continued medical education and obligatory IC training programs are recommended to improve their practice and update their knowledge.

Keywords: Infection control, dental clinics, knowledge, attitudes, Saudi Arabia

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Introduction

Dental health care workers (DHCW) are faced with many professional hazards during dental practice. The hazards of the highest risk include blood-borne pathogens, such as hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) as well as Mycobacterium tuberculosis and other viruses and bacteria that colonize the oral cavity and the upper respiratory tract.[1,2] These infections occur through direct contact with blood, saliva, and contaminated water from dental unit waterlines, injury with an anesthetic needles, or exposure of mucous membranes to splashes, droplets, and aerosols. Indirect contact with contaminated instruments during dental procedures may be another route of acquiring infections.[2,3] Such infections can be avoided by safe work practices and following infection control (IC) guidelines in dental settings.[4] Comprehensive IC guidelines were published by the United States Centers for Disease Control and Prevention (CDC) in 2003 as a guidance document for DHCW's in performing clinical procedures, and were updated later for compliance with infection control guidelines, safety precautions, vaccination against most common pathogens and proper post-exposure management.[5,6] In spite of establishment of these guidelines, few dentists in different Asian countries such as Turkey,[7] Iran,[8] India,[9] and China[10] actually follow the standardized IC procedures in their daily practice.

Studies on compliance with IC recommendations among dentists has been previously carried out in other Asian countries such as Pakistan[11] and Jordan,[12] indicating that gaps in some dentists' knowledge might be present. These studies also showed that dentists working in hospitals and dental schools had more adherence to these recommendations than those in the private sector. Data regarding the private sector in Saudi Arabia are limited to two studies in northern region,[13,14] and one earlier study in different regions of Saudi Arabia.[15] However, to the best of the researchers' knowledge, there are no published data about IC knowledge and practice in the dental private sector in Makkah, the largest city in the western region.

The aim of this study was to assess the knowledge and practices related to IC guidelines among dentists in private clinics in Makkah, Saudi Arabia.

Subjects and Methods

This study was conducted between December 2014 and January 2015 in 34 private dental clinics in different districts of Makkah, a city in the Hejaz in Saudi Arabia.

Subjects

A proportional cluster sample method was used to select subjects, with the sample size calculation based on a p value of 0.05 and expected standard deviation of 0.3. To reach the calculated sample size, 35 clinics were randomly selected using a computerized random table from ten districts in Makkah city, in proportion to the clinic density of each district. Participation in the study was optional, and no data about workplace was recorded, helping the participants to reply the questionnaire at liberty.

Questionnaire

The questionnaire was self-structured, designed by the study investigators, and consisted of 30 closed-ended questions (true or false, and multiple-choice questions) about IC guidelines, categorized into two main sections: the first section (15 questions) related to practice of IC guidelines and the second section (15 questions) assessed the knowledge of dentists about these guidelines.

The first section was further divided into six questions related to hand hygiene practice and nine questions related to adherence to standard precautions of IC including vaccination status, use of personal protective equipment, and dealing with sharps. The second section was divided into five questions related to the risk of blood borne pathogens and sharps injury and ten questions related to knowledge about standard precautions of IC. Demographic data collected included gender, level of education (general dental practitioner or specialist), daily workload (either less or more than 10 patients per day) and years of experience (less than five years, six to 10 years and more than 10 years).

The questionnaire was distributed to 10 dentists to test the clarity of the questions. Questions were modified according to the comments and feedback before starting the study. To test its reliability and validity, the questionnaire was distributed twice to 15 dentists

one week apart and the difference between the two responses was tested statistically using a kappa test with a value of 0.85 to 0.94.

Ethical approval

Ethical approval was obtained from the Institutional Review Board at the College of Dentistry, Umm Al-Qura University, before starting the study.

Statistical analysis

After collecting questionnaire, participants were identified by serial study code and initials. Collected data were analyzed using Statistical Package for Social Sciences (SPSS) software, version 17 (IBM, Armonk, NY, USA). Descriptive statistics were computed to assess personal and professional characteristics of the participants. A scoring system was assigned to the included items; 1 for the correct answer and 0 for the incorrect answer. The chi-square test was used to identify any relationship between item responses and gender, education level, daily workload and years of experience. A p value less than 0.05 was considered significant.

Results

A total of 107 dentists (71 males, 66.4%, and 36 females, 33.6%) in 34 private clinics signed the informed consent and participated, which included 81 general practitioners (GPs) (75.6%) and 26 specialists (SP) (24.3%). Among the 35 selected clinics, dentists working in one clinic refused to participate in the study. Participants' daily work load ranged from less than 10 patients (25.2%) to more than 10 patients (74.8%). Among participants, 22 dentists had less than 5 years of experience (20.6%) and 53 had more than 10 years of experience (49.5%).

Table I shows that 65.4% of the participants (n=70) did not perform hand hygiene after removing gloves and 57.9% used alcohol based hand rub after contact with bloody saliva (n=62), with no significant difference between males and females ($p<0.05$). On the other hand, there was a significant difference between GPs and SPs regarding use of alcohol rub when hands were visibly dirty.

Table II shows an insignificant difference in adherence to hand hygiene guidelines between dentists with different daily workloads ($p>0.05$). There was significant difference between participants with different years of experience ($P<0.001$) related to those who do not dry their hands after hand hygiene.

Table III demonstrates compliance among dentists with standard precautions of IC in relation to gender and education level. A significant percentage had hepatitis B vaccination (85.1%). All SPs received HBV vaccination and 19.8% of GPs were unvaccinated. Regardless of their gender and education level, all dentists used autoclaves to sterilize instruments (100%), significant percentages kept them sterile in pouches (n=103; 96.2%) and disposed of needles in sharps containers (n=95; 88.7%). Many dentists were not compliance with standard precautions of IC e.g. bending needles after use (n=75; 70%), and did not change gloves between patients (n=58; 54.2%) ($p<0.05$). Additionally, 11.2% of participants did not wear masks during patient treatment.

Table IV shows compliance with standard precautions of IC in relation to daily workload and the years of experience. Nineteen percent of dentists (n=10) who had more than 10-years of experience were unvaccinated, but among dentists who had less than five years of experience only 4.5% of them were unvaccinated. The unsafe behavior of bending needles after use was higher among participants with daily workloads of more than 10 patients (75%, versus 55.6% with lower daily workload). The incorrect practice of opening drawers with contaminated gloved hands was done by 81.3% of the dentists with daily workloads of more than 10 patients. Compliance with needle disposal in a sharps container was 12.5% among dentists seeing more than 10 patients and 15.1% among those with 10 or more years of experience.

Table V presents the knowledge of dentists about the risk of blood-borne pathogens and sharps injury in relation to gender and education level. There was no significant difference between males and females or between GPs and SPs. Whereas 60.5% of GPs (n=49) were not aware of the management of needle stick and sharps injury, 8.6% of GPs (n=7) did not realize the risk of blood borne pathogens and infectious potential of dental patients.

Table VI represents the knowledge of dentists regarding risk of blood borne pathogens and sharps injury

Table I. Adherence to hand hygiene guidelines in relation to gender and education level

Parameter	By Gender		P value	By education level		P value
	Males N (%)	Females N (%)		GP N (%)	Sp N (%)	
Hand hygiene at correct times						
Yes	29 (40.8%)	11 (30.6%)	0.305	28 (34.6%)	12 (46.2%)	0.247
No	42 (59.2%)	25 (69.4%)		53 (65.4%)	14 (53.8%)	
P value		0.03*			0.03*	
Correct duration of hand hygiene						
Yes	37 (52.1%)	27 (75%)	0.024	50 (61.7%)	14 (53.8%)	0. 434
No	34 (47.9%)	9 (25%)		31 (38.3%)	12 (46.2%)	
P value		0.02*			0.08	
Drying hands after hand hygiene						
Yes	59 (83.1%)	30 (83.3%)	0.979	66 (81.5%)	23 (88.5%)	0.355
No	12 (16.9%)	6 (16.7%)		15 (18.5%)	3 (11.5%)	
P value		0.001*			<0.001*	
Alcohol hand rub when hand visibly dirty						
Yes	15 (21.1%)	7 (19.4%)	0.837	13 (16%)	9 (34.6%)	0.03*
No	56 (78.9%)	29(80.6%)		68 (84%)	17 (65.4%)	
P value		0.001*			0.001*	
Performing hand hygiene after removing gloves						
Yes	57 (80.3%)	27 (75%)	0.529	61 (75.3%)	23 (88.5%)	0.112
No	14 (19.7%)	9 (25%)		20 (24.7%)	3 (11.5%)	
P value		<0.001*			0.001*	
Washing hands with soap and water after contact with bloody saliva						
Yes	34 (47.9%)	11 (30.6%)	0.08	32 (39.5%)	13 (50%)	0.302
No	37 (52.1%)	25 (69.4%)		49 (60.5%)	13 (50%)	
P value		<0.001*			0.113	

*significant p value ≤0.05

in relation daily workload and years of experience. Awareness about blood borne pathogens and sharps injury risks among participants with daily workloads of more than 10 patients was lower than those with lesser workloads. However, this difference was non-significant. There was a significant difference ($p<0.001$) in awareness of the risk of blood-borne pathogens and infectious potential of dental patients according to years of experience (11.3%).

Table VII represents the knowledge of dentists about standard precautions of IC in relation to gender and education level. There was no significant difference between male and female or between GPs and SPs. However, it is observed that five (4.6%) participants did not realize the importance of the use of a new hand piece for every patient and three (2.8%) did not consider separation of blood soaked waste as

Table II. Adherence to hand hygiene guidelines in relation to daily work load and years of experience

Parameter	Daily workload		P value	Years of experience			P value
	<10 patients N (%)	>10 patients N (%)		<5 ys N (%)	6-10 ys N (%)	> 10ys N (%)	
Hand hygiene at correct times							
Yes	13 (48.1%)	27 (33.8%)	0.1610	8 (36.4%)	15 (46.9%)	17 (32.1%)	0.146
No	14 (51.9%)	53 (66.3%)		4 (63.6%)	17 (53.1%)	36 (67.9%)	
P value	0.174			0.113			
Correct duration of hand hygiene							
Yes	17 (63%)	47 (58.8%)	0.647	14 (63.6%)	17 (53.1%)	33 (62.3%)	0.297
No	10 (37%)	33 (41.3%)		8 (36.4%)	15 (46.9%)	20 (37.7%)	
P value	0.05*			0.05			
Drying hands after hand hygiene							
Yes	24 (88.9%)	65 (81.3%)	0.323	20 (90.9%)	29 (90.6%)	40 (75.5%)	<0.001*
No	3 (11.1%)	15 (18.8%)		2 (9.1%)	3 (9.4%)	13 (24.5%)	
P value	<0.001*			<0.001*			
Alcohol hand rub when hand visibly dirty							
Yes	6 (22.2%)	16 (20%)	0.793	3 (13.6%)	7 (21.9%)	12 (22.6%)	0.270
No	21 (77.8%)	64 (80%)		19 (86.4%)	25 (78.1%)	41 (77.4%)	
P value	<0.001*			<0.001*			
Performing hand hygiene after removing gloves							
Yes	24 (88.9%)	60 (75%)	0.06	3 (13.6%)	4 (12.5%)	16 (30.2%)	0.06
No	3 (11.1%)	20 (25%)		19 (86.4%)	28 (87.5%)	37 (69.8%)	
P value	<0.001*			<0.001*			
Washing hands with soap and water after contact with bloody saliva							
Yes	10 (37%)	35 (43.8%)	0.497	8 (36.4%)	13 (40.6%)	24 (45.3%)	0.502
No	17 (63%)	45 (56.3%)		14 (63.6%)	19 (59.4%)	29 (54.7%)	
P value	0.001*			0.02*			

*significant p value ≤0.05

important. One significant result was that 31 (28.9%) of the participants had not received continuing educational courses related to IC.

Table VIII represents the knowledge of dentists about standard precautions of IC in relation to daily workload and years of experience. It shows that no significant difference was present in relation to workload, but significantly higher percentages of participants of more than 10 years of experience (9.4%) did not know that a new hand piece should be used for every patient or realize that separation of blood soaked waste from ordinary waste is important (5.7%).

Table III. Compliance with standard precautions of infection control in relation to gender and education level

Parameter	By Gender		P value	By education level		P value
	Males N (%)	Females N (%)		GP N (%)	Sp N (%)	
Vaccination against hepatitis B						
Yes	57 (80.3%)	34 (94.4%)	0.5	65 (80.2%)	26 (100%)	0.005*
No	14 (19.7%)	2 (5.6%)		16 (19.8%)	0 (0%)	
P value		<0.001*			0.001*	
Changing masks between patients or when it is wet						
Yes	29 (40.8%)	12 (33.3%)	0.452	34 (42%)	7 (26.9%)	0.129
No	42 (59.2%)	24 (66.7%)		47 (58%)	19 (73.1%)	
P value		0.007*			0.001*	
Changing gloves between patients or when torn						
Yes	35 (49.3%)	14 (38.9%)	0.310	41 (50.6%)	8 (30.8%)	0.05
No	36 (50.7%)	22 (61.1%)		40 (49.4%)	18 (69.2%)	
P value		0.112			0.03*	
Using autoclave to sterile instruments						
Yes	71 (100 %)	36 (100%)		81 (100%)	26 (100%)	
No	0 (0%)	0 (0%)		0 (0%)	0 (0%)	
P value						
Keeping sterile instruments in pouches						
Yes	69 (97.2%)	34 (94.4%)	0.473	78 (96.3%)	25 (96.2%)	0.979
No	2 (2.8%)	2 (5.6%)		3 (3.7%)	1 (3.8%)	
P value		<0.001*			<0.001*	
Opening drawers with contaminated gloved hands						
Yes	13 (18.3%)	5 (13.9%)	0.566	15 (18.5%)	3 (11.5%)	0.355
No	58 (81.7%)	31 (86.1%)		66 (81.5%)	23 (88.5%)	
P value		<0.001*			<0.001*	
Bending the needle after use						
Yes	48 (67.6%)	27 (75%)	0.431	58 (71.6%)	17 (65.4%)	0.518
No	23 (32.4%)	9 (25%)		23 (28.4%)	9 (34.6%)	
P value		0.002*			0.001*	
Disposal of needle in safety box						
Yes	65 (91.5%)	30 (83.3%)	0.207	70 (86.4%)	25 (96.2%)	0.118
No	6 (8.5%)	6 (16.7%)		11 (13.6%)	1 (3.8%)	
P value		<0.001*			<0.001*	

*significant p value ≤0.05

Table IV. Compliance with standard precautions of infection control in relation to daily workload and years of experience

Parameter	Daily workload			Years of experience			
	<10 patients N (%)	>10 patients N (%)	P value	<5 ys N (%)	6-10 ys N (%)	> 10ys N (%)	P value
Vaccination against hepatitis B							
Yes	23 (85.2%)	68 (85%)	0.945	21 (95.5%)	27 (84.4%)	43 (81.1%)	0.924
No	4 (14.8%)	12 (15%)		1 (4.5%)	5 (15.6%)	10 (18.9%)	
P value	<0.001*			<0.001*			
Changing masks between patients or when it is wet							
Yes	13 (48.1%)	28 (35%)	0.199	10 (45.5%)	15 (46.9%)	16 (30.2%)	0.120
No	14 (51.9%)	52 (65%)		12 (54.5%)	17 (53.1%)	37 (69.8%)	
P value	0.05*			0.05*			
Changing gloves between patients or when torn							
Yes	17 (63%)	32 (40%)	0.02 *	11 (50%)	17 (53.1%)	21 (39.6%)	0.173
No	10 (37%)	48 (60 %)		11 (50%)	15 (46.9%)	32 (60.4%	
P value	0.143			0.200			
Wearing gown							
Yes	25(92.6%)	76 (95%)	0.637	20 (90.9%)	31 (96.9%)	50 (94.3%)	0.410
No	2 (7.4%)	4 (5%)		2 (9.1%)	1 (3.1%)	3 (5.7%)	
P value	<0.001*			<0.001*			
Using autoclave to sterile instruments							
Yes	27 (100%)	89 (100%)		22 (100%)	32 (100%)	53 (100%)	
No	0 (0%)	0 (0%)		0 (0%)	0 (0%)	0 (0%)	
P value							
Keeping sterile instruments in pouches							
Yes	24(88.9%)	79 (98.8%)	0.07	22 (100%)	31 (96.9%)	50 (94.3%)	0.03*
No	3 (11.1%)	1 (1.3%)		0 (0%)	1 (3.1%)	3 (5.7%)	
P value	<0.001*			<0.001*			
Opening drawers with contaminated gloved hands							
Yes	24 (88.9%)	65 (81.3%)	0.563	18 (81.8%)	28 (87.5%)	43 (81.1%)	0.607
No	3 (11.1%)	15 (18.8%)		4 (18.2%)	4 (12.5%)	10 (18.9%)	
P value	0.001*			0.001*			
Bending the needle after use							
Yes	15 (55.6%)	60 (75%)	0.05*	14 (63.6%)	23 (71.9%)	38 (71.7%)	0.349
No	12 (44.4%)	20 (25%)		8 (36.4%)	9 (28.1%)	15 (28.3%)	
P value	0.001*			<0.001*			
Disposal of needle in safety box							
Yes	25 (92.6%)	70 (87.5%)	0.388	20 (90.9%)	30 (93.8%)	45 (84.9%)	0.648
No	2 (7.4%)	10 (12.5%)		2 (9.1%)	2 (6.3%)	8 (15.1%)	
P value	<0.001*			<0.001*			

*significant p value ≤0.05

Table V. Knowledge about risk of blood borne pathogens and sharps injury in relation to gender and education level

Parameter	By Gender		P value	By education level		P value
	Male N (%)	Female N (%)		GP N (%)	Sp N (%)	
Correct management after sharps injury						
Correct	24 (33.8%)	11 (30.6%)	0.673	23 (28.4%)	12 (46.2%)	
Incorrect	47 (66.2%)	25 (69.4%)		58 (71.6%)	14 (53.8%)	
P value	0.005*			0.001*		
Realizing that risk of infection by HBV is higher than HIV						
Correct	54 (76.1%)	26 (72.2%)	0.437	58 (71.6%)	22 (84.6%)	0.273
Incorrect	17 (23.9%)	10 (27.8%)		23 (28.4%)	4 (15.4%)	
P value	<0.001*			0.002*		
Realizing that every patient in dental clinics must be considered to have infectious disease						
Correct	66 (93%)	32 (88.9%)	0.534	74 (91.4%)	24 (92.3%)	0.786
Incorrect	5 (7%)	4 (11.1%)		7 (8.6%)	2 (7.7%)	
P value	<0.001*			<0.001*		
IC measures for prevention of HBV and HIV are the same						
Correct	55 (77.5%)	25 (69.4%)	0.462	59 (72.8%)	21 (80.8%)	0.488
Incorrect	16 (22.5%)	11 (30.6%)		22 (27.2%)	5 (19.2%)	
P value	0.001*			0.001*		
Correct management after needle stick injury if patient is HBV negative						
Correct	30 (42.3%)	15 (41.7%)	0.523	32 (39.5%)	13 (50%)	0.217
Incorrect	41 (57.7%)	21 (58.3%)		49 (60.5%)	13 (50%)	
P value	0.07			0.04*		

* significant p value $\leq$0.05

Table VI. Knowledge about risk of blood borne pathogens and sharps injury in relation to daily workload and years of experience

Parameter	Daily workload		P value	Years of experience			P value
	<10 patients N (%)	>10 patients N (%)		<5 ys N (%)	6-10 ys N (%)	> 10ys N (%)	
Correct management after sharps injury							
Correct	11 (40.7%)	24 (30%)	0.211	7 (31.8%)	10 (31.3%)	18 (34%)	0.365
Incorrect	16 (59.3%)	56 (70%)		15 (68.2%)	22 (68.8%)	35 (66%)	
P value	0.007*			0.006*			
Realizing that risk of infection by HBV is higher than HIV							
Correct	23 (85.2%)	57 (71.3%)	0.088	15 (68.2%)	22 (68.8%)	43 (81.1%)	0.136
Incorrect	4 (14.8%)	23 (28.8)		7 (31.8%)	10 (31.3%)	10 (18.9%)	
P value	<0.001*			0.006*			
Realizing that every patient in dental clinics must be considered to have infectious disease							
Correct	26 (96.3%)	72 (90%)	0.214	22 (100%)	29 (90.6%)	47 (88.7%)	0.003*
Incorrect	1 (3.7%)	8 (10%)		0 (0%)	3 (9.4%)	6 (11.3%)	
P value	<0.001*			<0.001*			
IC measures for prevention of HBV and HIV are the same							
Correct	21 (77.8%)	59 (73.8%)	0.173	15 (68.2%)	22 (68.8%)	43 (81.1%)	0.137
Incorrect	6 (22.2%)	21 (26.3)		7 (31.8%)	10 (31.3%)	10 (18.9%)	
P value	<0.001*			<0.001*			
Correct management after needle stick injury if patient is HBV negative							
Correct	16 (59.3%)	29 (36.3%)	0.02	10 (45.5%)	12 (37.5%)	23 (43.4%)	0.431
Incorrect	11 (40.7%)	51 (63.8)		12 (54.5%)	20 (62.5%)	30 (56.6%)	
P value	0.05*			0.05*			

*significant P value ≤0.05

Table VII. Knowledge about standard precaution of infection control in relation to gender and education level

Parameter	By Gender		P value	By education level		P value
	Male N (%)	Female N (%)		GP N (%)	SP N (%)	
Soap and water is better than alcohol if hands are dirty						
Correct	31 (43.7%)	20 (55.6%)	0.723	38 (46.9%)	13 (50%)	0.821
Incorrect	40 (6.3%)	16 (44.4%)		43 (53.1%)	13 (50%)	
P value	0.118			0.07		
Wearing gloves replace the need of hand wash						
Correct	11 (15.5%)	6 (16.7%)	0.932	12 (14.8%)	5 (19.2%)	0.562
Incorrect	60 (84.5%)			69 (85.2%)	21 (80.8%)	
P value	0.001*			0.001*		
Knowing the correct sequence of wearing PPE						
Correct	11 (15.5%)	6 (16.7%)	0.932	11 (13.6%)	6 (23.1%)	0.201
Incorrect	60 (84.5%)	30 (83.3%)		70 (86.4%)	20 (76.9%)	
P value	0.001*			0.005*		
Knowing the correct sequence of removing PPE						
Correct	3 (4.2%)	1 (8.2%)	0.394	2 (2.5%)	2 (7.7%)	0.210
Incorrect	68 (95.8%)	35 (97.2%)		79 (97.5%)	24 (92.3%)	
P value	<0.001*			<0.001*		
Wearing eye protection is important						
Correct	65 (91.5%)	34 (94.9%)	0.904	74 (91.4%)	25 (96.2%)	0.893
Incorrect	6 (8.5%)	2 (5.6%)		7 (8.6%)	1 (3.8%)	
P value	<0.001*			<0.001*		
Used dental instruments should be sterilized/disinfected						
Correct	71 (100%)	36 (100%)		81 (100%)	26 (100%)	
Incorrect	0 (0%)	0 (0%)		0 (0%)	0 (0%)	
P value						
New hand piece should be used for every patient						
Correct	68 (95.8%)	34 (94.4%)	0.911	78 (96.3%)	24 (92.3%)	0.897
Incorrect	3 (4.2%)	2 (5.6%)		3 (3.7%)	2 (7.7%)	
P value	<0.001*			0.001*		
Separation of blood soaked waste from ordinary waste is important						
Correct	69 (97.2%)	35 (97.2%)		79 (97.5%)	25 (96.2%)	0.991
Incorrect	2 (2.8%)	1 (2.8%)		2 (2.5%)	1 (3.8%)	
P value	<0.001*			<0.001*		
Clinical contact surface must be disinfected after each patient						
Correct	60 (84.5%)	32 (88.9%)	0.785	70 (86.4%)	22 (84.6%)	0.882
Incorrect	11 (15.5%)	4 (11.1%)		11 (13.6%)	4 (15.4%)	
P value	<0.001*			<0.001*		
Previous attendance of educational course on IC						
Correct	48 (67.6%)	28 (77.8%)	0.321	57 (70.4%)	19 (73.1%)	0.804
Incorrect	23 (32.4%)	8 (22.2%)		24 (29.6%)	7 (26.9%)	
P value	0.001*			<0.001*		

**significant p value ≤0.05*

Table VIII. Knowledge about standard precaution of infection control in relation to daily workload and years of experience

Parameter	Daily workload		P value	Years of experience			P value
	<10 patients N (%)	>10 patients N (%)		<5 ys N (%)	6-10 ys N (%)	> 10ys N (%)	
Soap and water is better than alcohol if hands are dirty							
Correct	14 (51.9%)	37 (46.3%)	0.721	22 (50%)	21 (65.6%)	24 (45.3%)	0.05*
Incorrect	13 (48.1%)	43 (53.8%)		11 (50%)	11 (34.4%)	29 (54.7%)	
P value	0.473			0.549			
Wearing gloves replace the need of hand wash							
Correct	2 (7.4%)	15 (18.8%)	0.135	3 (13.6%)	5 (15.6%)	9 (17%)	0.247
Incorrect	25 (92.6%)	65 (81.3%)		19 (86.4%)	27 (84.4%)	44 (83%)	
P value	<0.001*			<0.001*			
Knowing the correct sequence of wearing PPE							
Correct	3 (11.1%)	14 (17.5%)	0.319	4 (18.2%)	7 (21.9%)	6 (11.3%)	0.189
Incorrect	24 (88.9%)	66 (82.5%)		18 (81.8%)	25 (78.1%)	47 (88.7%)	
P value	<0.001*			<0.001*			
Knowing the correct sequence of removing PPE							
Correct	1 (3.7%)	3 (3.8%)	0.989	1 (4.5%)	2 (6.3%)	1 (1.9%)	0.321
Incorrect	26 (96.3%)	77 (96.3%)		21 (95.5%)	30 (93.8%)	52 (98.1%)	
P value	<0.001*			<0.001*			
Wearing eye protection is important							
Correct	24 (88.9%)	75 (93.8%)	0.463	21 (95.5%)	30 (93.8%)	48 (90.6%)	0.652
Incorrect	(11.1%)	5 (6.3%)		1 (4.5%)	2 (6.3%)	5 (9.4%)	
P value	<0.001*			<0.001*			
Used dental instruments should be sterilized/disinfected							
Correct	27 (100%)	80 (100%)		22 (100%)	32 (100%)	53 (100%)	
Incorrect	0(0)%	0 (0)%		0 (0)%	0 (0)%	0 (0)%	
P value							
New hand piece should be used for every patient							
Correct	26 (96.3%)	76 (95%)	0.802	22 (100%)	32 (100%)	48 (90.6%)	0.007*
Incorrect	1(3.7%)	4 (5%)		0 (0%)	0 (0%)	5 (9.4%)	
P value	<0.001*			<0.001*			
Separation of blood soaked waste from ordinary waste is important							
Correct	25 (92.6%)	79 (98.8%)	0.113	22 (100%)	32(100%)	50 (94.3%)	0.04*
Incorrect	2 (7.4%)	1 (1.3%)		0 (0%)	0 (0%)	3 (5.7%)	
P value	<0.001*			<0.001*			
Clinical contact surface must be disinfected after each patient							
Correct	24 (88.9%)	68 (85%)	0.402	19 (86.4%)	30 (93.8%)	43 (81.1%)	0.531
Incorrect	3 (11.1%)	12 (15%)		3 (16.3%)	2 (6.3%)	15 (14%)	
P value	<0.001*			<0.001*			
Previous attendance of educational course on IC							
Correct	21 (77.8%)	55 (68.8%)	0.318	17 (77.3%)	23 (71.9%)	36 (67.9%)	0.563
Incorrect	6 (22.2%)	25 (31.3		5 (22.7%)	9 (28.1%)	17 (32.1%)	
P value	<0.001*			<0.001*			

*significant p value ≤0.05

Discussion

The aim of this study was to explore the knowledge and practices of IC measures in private dental practices in Makkah.

The first section of questions listed was about hand hygiene practice, as it is one of the most vital components in the practice of the dental IC process and is considered the single most important activity performed to reduce the risk of transmitting microorganisms from dentist to patient i.e. cross infection.[16] The majority of the participants in this study followed the correct guidelines of hand hygiene. However, a considerable percentage of them did not perform hand hygiene after removing gloves (62.6%) or for adequate duration (40.2%), with significant differences between GPs and SPs regarding incorrect use of alcohol rub when hands are visibly dirty. Closely similar results were reported by previous studies done in Saudi Arabia. Haridi *et al*.[17] in a study in Hail in the northern region, found that among DHCWs at health facilities, only 77.5% of participants realized that hand washing is the single most effective way to prevent the spread of infections, and 73.0% denied that wearing gloves eliminates the need for hand washing. An earlier study on undergraduate dental students at Al-Farabi College of Dentistry and Nursing in Riyadh (northern region) concluded that only 70% of students reported washing their hands after each glove change.[18] Accordingly, the results of these studies together with the current study emphasize the need for hand hygiene training in DHCWs delivering dental care in Saudi Arabia.

In the present study, a large percentage (85.1%) of participants had HBV vaccination with a considerable difference between males and females (80.3% vs. 94.4%). This percentage is closely similar to that reported by Al-Dharrab and Al-Samadani in 2012[14] among working dentists in the northern region of Saudi Arabia, where 80.5% of dentists were vaccinated with more females (83%) than (77%) males. Although both percentages are unsatisfactory, they are higher than an earlier study performed by Al-Rabeah and Moamed[13] amongst dentists in the private dental sector in Riyadh (63.5%). These results reflect the increasing awareness among dentists in Saudi Arabia regarding HBV vaccination through this decade, which is also confirmed by the higher percentage (88.9%) recorded by Haridi *et al*.[17] However, all recorded percentages in Saudi Arabia were much higher than that recorded among dental practitioners of the private sector through the same decade in North Jordan (36%).[12] When vaccination was assessed by education level, the present study showed that 100% of SPs were vaccinated, while 19.8% of GPs were not vaccinated, especially those with more than 10 years of experience. This finding is consistent with the study of Al-Dharrab and Al-Samadani,[14] where all dentists having the shortest duration of practice were vaccinated, but they reported no difference in the percentage of vaccination between GPs and SPs.

The Saudi Arabia Ministry of Health Preventive Medicine Department updated its local IC regulations concerned with the high risk of individuals exposed to blood and body fluids, and recommended that those with negative tests for hepatitis B surface antigen and antibody should receive HBV vaccine.[19] However, the Ministry did not impose any obligation regarding HBV vaccination for the completion of registration by the Saudi Commission for Health Specialties.[14]

Using personal protective equipment to prevent transmission of infection from the patient blood or saliva to the hand of the dentist is considered as a core element of IC guidelines in dental surgery.[20] Inquiring about the use of personal protective equipment in the present study revealed that more than half of participants do not change gloves or masks between patients and that 11.2% do not wear masks and 5.6% do not wear a gown during patient treatment, with no significant difference between male and female or between GP and SPs. These findings varied from earlier studies performed in different regions of Saudi Arabia; Al Ruhaimi in 1991[21] reported that 2 to 4% of dental professionals never wore gloves when treating patients. Later, Al-Rabeah and Moamed in 2002[13] reported that all the dentists wore gloves and 90% wore facemasks. Similarly, Al-Dharrab and Al-Samadani in 2012[14] concluded that all male and female dentists used gloves regularly but 18-19.5% did not regularly use a facemask, and dentists of 15 years' experience were more serious towards the use of protective measures. Consequently, the dentists' level of knowledge and practice in the present study

regarding wearing and changing personal protective equipment, and their awareness about the probability of disease transmission via blood, saliva, aerosols and blood splashes, should be improved.

Knowledge of standard precautions of IC among participants demonstrated unsafe practices in that bending needles after use is common (70%) and was higher in GPs, especially those with more years of experience. Moreover, it was surprising that 11.2% of participants do not dispose of sharps in a sharps container and 2.8% ignore the importance of the separation of blood soaked waste, which represent hazards to infection transmission to the community. Haridi *et al*.[17] recorded double that percentage (22.1%) of participants who wrongly believed that bending needles helps them to avoid needle stick injuries, and only 79.5% had correct knowledge about standard precautions for dealing with blood or saliva as a possible source of infection.

Regardless of their gender and education level, all dentists in the present study adhere to sterilization guidelines by using the autoclave to sterilize instruments (100%), but only 96.2% keep them sterile in pouches. However, 4.6% of participants did not realize the importance of the use of a new hand piece for every patient. These results reflect a satisfactory level of awareness among participants about cross infection between patients. Conversely, Haridi *et al*.[17] found that 69.4% of their study participants believed that disinfection kills all organisms. Abdullah and Al Shammery's[15] survey of dentists from the different provinces of Saudi Arabia found that 90.2% sterilize hand Instruments either by autoclave or dry heat, and only 27.1% sterilize hand pieces after each patient by the same means. Al-Rabeah and Moamed[13] in 2002 found that 88.2% of dentists in private dental practices in Riyadh pack sterilized instruments in a plastic bag, and only 37.9% of the dentists sterilized their hand pieces by autoclaving, while 53.7% disinfected them.

Sharps injury is one of the most common occupational risks in dentistry as well as in other health care professions.[22,23] Regarding to dentists knowledge about the risk of blood borne pathogens and sharps injury, 67.3% were not aware of correct management of needle stick and sharps injury, with a higher percentage among GPs. It was also noted that 8.6% of the GPs do not realize the risk of blood borne pathogens and infectious potential of dental patients. Lower awareness about hazards of sharp injuries was recorded by Al-Rabeah and Moamed[13] where only 56.2% of dentists in their study had special containers for sharp objects. On the other hand, greater awareness regarding correct post-exposure management immediately after needle stick or sharps injuries (86.1%) has been recorded among undergraduate dental students.[23]

Unsatisfactory knowledge of the present study participants may be attributed to the fact that only 71.1% of them received continuing educational courses in IC, similar to that of Haridi *et al*.[17] (74.6%).

In conclusion, the results of this study demonstrated that IC practices and knowledge among dentists in Makkah private clinics are not in compliance with IC standards due to several factors, including:

- Routine performance of hand hygiene has been demonstrated, but inadequate awareness about correct duration, dryness and using alcohol were found among dentists with more years of experience.
- Suboptimal compliance with HBV vaccination (85.1%), especially among male GP's.
- The majority of participating dentists displayed good practices of different IC procedures, with the exception of dealing with sharps and wearing /changing personal protective equipment. Unsafe practices were noticed more among dentists with higher daily workload and more years of experience.
- An IC educational course was taken by 71.1% of participants.
- Therefore, we highly recommend that all dentists in private clinics receive a comprehensive pre-employment IC training course and understand the policies of updated international standards of IC in dental practice. This training should be updated annually with appropriate assessment. In addition, hepatitis B vaccination should be included as a mandatory prerequisite for the completion of registration in the Saudi Commission for Health Specialties, with periodic evaluation of antibody level to reduce the possibility of cross infection within the community.

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