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Infection control practices in dental clinics of Al-Jouf region, Saudi Arabia: A cross sectional study

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ABSTRACT

Dental practices have been associated with an increased risk of transmission of infections between patients and dentists, or among patients. *Aim:* This study aimed to evaluate the infection prevention and control (IPC) practices in dental care settings of the Ministry of Health in Al-Jouf region, Saudi Arabia. *Methods:* This cross-sectional study enrolled dental healthcare workers (DHCWs; dentists and dental assistants) working at dental clinics of the Ministry of Health. A structured questionnaire collected data including demographics and work characteristics of the study participants. *Results:* The study recruited 159 DHCWs (response rate= 91.4%). Hand washing was reported by 84.9% after patient treatment, 45.5% before patient treatment, and 30.2% before donning gloves. More than 89% of DHCWs frequently used gloves and masks during dental procedures, changing gloves between patients, and using single syringes for local anesthetic injections. Less than 50% always used sterile gloves, disposable gowns, and eyewear for surgery. More than 87% reported using sterilizing burs all the time. More than 50% reported always immersing used instruments in decontaminant solutions, sterilizing hand pieces, and disinfecting impressions before being sent to the laboratory. HBV vaccination rate was 87.4%. Dentists with a bachelor's degrees or higher were more compliant with IPC practices compared to the less qualified dental support staff. *Conclusion:* Dental IPC practices of DHCWs in Al-Jouf region showed a need to focus more on their importance and implementation among both dentists and support staff via continuous training programs and continuous supervision.

Keywords*:* Infection prevention and control; Dental healthcare workers; HBV vaccination; Hand hygiene, PPE; Disinfection and sterilization; Saudi Arabia.

1. INTRODUCTION

Dental care poses the risk of transmission of many infections to both patients and dental health care workers (DHCWs). DHCWs include all personnel involved in direct patient care, such as; dental hygienists, dental assistants, dentists, laboratory technicians, and dental students, as well as those not

involved in patient care such as administrative and housekeeping personnel (Yadav et al., 2017). Direct contact with infected blood and body fluids, droplet-borne infections, contaminated instruments or objects and surfaces are all means by which infections can be transmitted (Yadav et al., 2017). The most important infections that may spread during dental settings include blood-borne viruses, especially hepatitis B virus (HBV), hepatitis C virus (HCV), and Human ImmunodeficiencyVirus (HIV) (Ayatollahi et al., 2005). In addition, airborne and droplet infections such as Influenza, *Mycobacterium tuberculosis* (TB), and coronaviruses, namely SARS-CoV, MERS-CoV, and SARS-CoV-2 (COVID-19) can also be transmitted (Samaranayake, 2002; Gaffar et al., 2020). Hand hygiene, Personal Protective Equipment (PPE), proper waste disposal, disinfection and sterilization are considered as general standard precautions to protect against blood-borne infections. Immunization against HBV and TB has been recommended for dentist too (Di Giuseppe et al., 2007).

Accordingly, in 2003, the Centers for Disease Control and Prevention (CDC) distributed comprehensive infection control rules for DHCWs that were subsequently updated to conform to infection control guidelines and safety precautions and extend to immunization against common pathogens and post-exposure management (Kohn et al., 2004; de Souza et al., 2006). Negligence and poor compliance of IPC precautions would harm patients and dental care providers alike (Kazi & Saxena, 2012). Therefore, Saudi Arabia have developed and updated guidelines for IPC in dental settings based on guidelines set by the CDC. Additionally, other requirements to ensure safe dental practices such as environmental policies, asepsis and sterilization were included (Kazi & Saxena, 2012). Adherence to standard precautions and CDC infection control guidelines in dental healthcare settings can prevent infection transmission during dental care.

In Saudi Arabia, data on IPC practices among DHCWs are insufficient; particularly in Al-Jouf region. This cross-sectional survey was proposed to fill this gap and to allow for evidence-based development of dental care system in Al-Jouf region.

2. SUBJECTS AND METHODS

Study design and Instrumentation

This questionnaire-based cross-sectional study was conducted between March to July 2021. The local committee for bioethics (LCBE) of Jouf University has approval to conduct this study (LCBE No: 01-07-42). The study involved an electronic self-administered questionnaire which was constructed as a Google Form and distributed to a convenient sample of all dentists and dental assistants (n.=174) working at all the 87 registered Dental Clinics of the Ministry of Health in Al-Jouf region. The study involved an open source and a validated questionnaire based on CDC guidelines for dental infection control that was previously validated and published (Mahasneh et al., 2020). It consists of two parts: Part 1: comprised the details of socio-demographic characteristics of the study participants such as age, gender, work experience, dental health care setting type, and others. Part 2: This section collected details related to IPC practices by the DHCWs. These included items of hand hygiene practices (4 questions), usage of personal protective equipment (10 questions), and the usage of disinfection and sterilization (9 questions). The response of the participants to each question was recorded using a four-point Likert scale as 0, 1, 2 and 3 corresponding to none, rarely, occasionally, and always; correspondingly, their responses were then summed to develop scores, which were used to detect associations between dental IPC practices and potential risk factors.

Participants

The target population of the current study was 174 dental care providers who were responsible for applying IPC guidelines in the dental setting. To have a good representation of the target population, all of them were invited to complete the questionnaire. One hundred and fifty-nine participants have responded and completed the questionnaire with the consent form. Access to data was restricted to the research team.

Data Analysis

The collected data were described in terms of frequency (numbers; No.) and percentage for categorical data, and the mean of Standard Deviation (±SD) for numerical data. Comparisons of the patterns of IPC practices between the different groups were carried out using the Chi-square test X2 and the Fisher Exact test (FET) to compare proportions as appropriate. The Mann-Whitney test and the Kruskal Wallis test were used to compare two and more than two groups, respectively. P-values <0.05 were considered statistically significant. The Statistical Package for Social Sciences (SPSS) software version 20 was used for the analyses of the gathered data.

3. RESULTS

The response rate was 91.4% (159 out of 174). Of those, 101 were dentists and 58 dental assistants (59.8% at PHCs, 24.5% at specialized centers, and 15.7% at hospital). Table 1 shows the demographic characteristics of the study participants. The age of DHCWs ranged between 24 and 61 years witha mean of 30 (± 5.4) years. Females comprised 57.2% of them. About 68.6% of participants were married, and Saudi participants constituted 90.6%. Specialized dentists accounted for 5.7%, and 64.8% of them had bachelor's degree. Four fifths worked at general practice clinics, and more than half of them had a work experience of ≥3 years.

Table 1 Socio-demographic characteristics, education/experience and working conditions of the DHCWs in Al-Jouf region (Total n = 159)

Characteristics		N (%)
Age (years)	Mean ± SD (Range)	30 ± 5.4 years (24 - 61)
	< 30 years	97 (60.3%)
	≤30 years	62 (39.7%)
Gender	Female	91 (57.2%)
	Male	68 (42.8%)
Marital status	Married	109 (68.6%)
	Single	50 (31.4%)
Nationality	Saudi	144 (90.6%)
	Non-Saudi	15 (9.4%)
Highest educational qualification	Diploma	47 (29.6%)
	Bachelor	103 (64.8%)
	Post-graduate	9 (5.7%)
Profession	Dental support	58 (36.5%)
	Dentist	101 (63.5%)
Type of practice of the clinic	General practice	127 (79.9%)
	Specialty	32 (20.1%)
Type of clinics	At hospital	25 (15.7%)
	At PHCs	95 (59.8%)
	At specialized centers	39 (24.5%)
Work experience (years)	Mean ± SD (Range)	4.1 ± 4.2 years (0.3 - 24)
	< 3 years	73 (45.9%)
	≥ 3 years	86 (54.1%)

PHCs = Primary Healthcare Centers.

Patterns of Infection Prevention and Control (IPC) Practices

Figure 1 shows the patterns of IPC practices reported by the DHCWs at Al-Jouf Region. Most of the participants reported always washing their hands after patient treatment (84.9%), 45.5% reported always washing hands before patient treatment, while only 30.2% practiced hand washing before donning gloves and using hand sanitizer occasionally. More than 89% of DHCWs reported always wearing gloves and masks during performing dental procedures, changing gloves between patients, and using single-dose ampoules for local anesthetic injections. About 69.8% always changed masks between patients. Less than 50% always used sterile gloves and disposable gowns for surgery, wear eyewear, asked patients to do pre-operative mouth rinses, and used high-volume evacuation. More than 87% reported always sterilizing burs, endodontic files and used wrapping bags for instrument sterilization. Immersion of used instruments in decontaminant solutions, sterilizing hand pieces, and disinfecting impressions before sending to the laboratory have been reported by more than half of the participants. Less than half reported always wiping surfaces, using surface barriers, and washing impressions.

Vaccination against HBV

The prevalence of HBV vaccination among the study population was 87.4% (139 out of 159). No significant difference in the proportion of vaccinated dental health care workers by their socio-demographic and working conditions was observed.

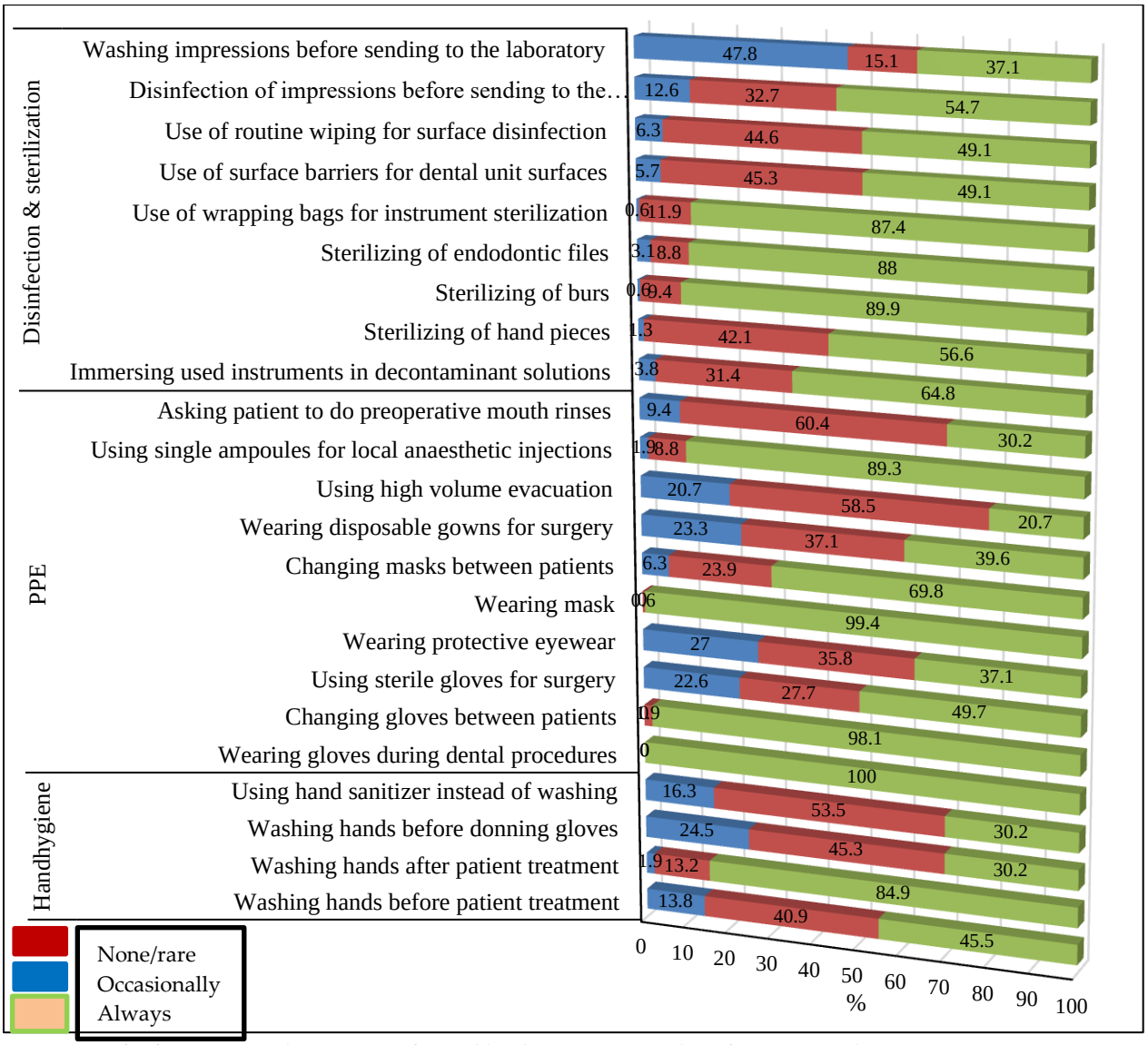

Figure 1 Patterns of infection control practice performed by the DHCWs at Al-Jouf region. Total No. = 159.

Hand Hygiene Practices

Table 2 shows the differences in hand hygiene practice scores among DHCWs by their socio-demographic characteristics and work conditions. Washing hands before patient treatment was more practiced by non-Saudis (P< 0.01**), dentists with post-graduate qualifications (P< 0.01**), and those working at general practice clinics (P< 0.05*). Similarly, washing hands before donning gloves was also more frequently reported among non-Saudi DHCWs and dentists with post-graduate qualifications (P< 0.05*).

Table 2 Differences in hand hygiene practice scores among DHCWs at Al-Jouf region and their socio-demographic characteristics and working conditions

Socio-demographic Characteristics		No. (%)	Mean ± SD			
			Washing hands before patient treatment	Washing hands after patient treatment	Washing hands before donning gloves	Using hand sanitizer instead of washing
Age (years)	<30 years	97 (60.3%)	2.3±0.7	2.8±0.5	2.0±0.8	2.0±0.9
	≥30 years	62 (39.7%)	2.3±0.7	2.8±0.4	2.1±0.8	2.2±0.8
Gender	Female	91 (57.2%)	2.3±0.7	2.9±0.4	2.0±0.9	2.0±0.8
	Male	68 (42.8%)	2.3±0.7	2.8±0.5	2.0±0.7	2.1±0.9

Marital status	Married	109 (68.6%)	2. 2±0.7	2.8±0.5	1.9±0.8	2.1±0.8
	Single/ divorced	50 (31.4%)	2.5±0.6	2.9±0.3	2.2±0.7	2.0±1.0
Nationality	Saudi	144 (90.6%)	2.3±0.7	2.8±0.5	2.0±0.8	2.0±0.8
	Non-Saudi	15 (9.4%)	2.8±0.4**	2.7±0.5	2.5±0.5*	2.3±0.9
Highest educational qualification	Diploma	47 (29.6%)	2.0±0.7	3.0±0.2	1.7±0.7	2.2±0.5
	Bachelor	103 (64.8%)	2.4±0.7	2.8±0.5	2.1±0.8	2.0±0.9
	Post-graduate	9 (5.7%)	2.7±0.5**	2.5±0.5	2.2±0.4*	2.0±1.0
Profession	Dental support	58 (36.5%)	2.1±0.7	2.9±0.4	1.8±0.8	2.3±0.5
	Dentist	101 (63.5%)	2.4±0.7**	2.8±0.5	2.1±0.8*	1.9±1.0
Mode of clinics practice	General practice	127 (79.9%)	2.3±0.7	2.8±0.5	2.0±0.8	2.0±0.9
	Speciality	32 (20.1%)	2.1±0.6*	2.9±0.3	2.0±0.7	2.2±0.6
Type of clinics	At hospital	25 (15.7%)	2.6±0.6	2.8±0.4	2.4±0.6	2.2±0.8
	At PHCs	95 (59.8%)	2.2±0.8	2.8±0.4	1.9±0.9	2.0±0.9
	At specialized centres	39 (24.5%)	2.3±0.6	2.9±0.5	2.1±0.7	2.1±0.7
Work experience	<3 years	73 (45.9%)	2.5±0.7	2.9±0.5	2.2±0.8	1.8±1.0
	≥3 years	86 (54.1%)	2.1±0.7	2.8±0.4	1.9±0.8	2.3±0.6

PHCs = Primary Healthcare Centers. Total n = 159. Data shown are frequency, mean ± SDM and significance as assessed by The Mann-Whitney test or the Kruskal Wallis test as appropriate. * = (P< 0.05); **= (P< 0.01)

Using Personal Protective Equipment

Variations in the scores for the use of PPE among DHCWS were demonstrated in Table 3. Dentists with post-graduate qualifications were more likely to use sterile gloves and disposable gowns for surgery, wear protective eyewear, and change masks between patients (P< 0.001*). Non-Saudis were more likely to practice using sterile gloves and disposable gowns during surgery (P< 0.01*) and to use protective eyewear (P< 0.05*). Changing masks between patients was more frequent among married, Saudi, females with work experience ≥3 years (P< 0.05*). The use of protective eyewear, sterile gloves, and disposable gowns for surgery were more likely to be practiced by DHCWs with work experience 3>years (P< 0.05*). High-volume evacuation use was more frequent among DHCWs aged ≥30 years, married, working in dental clinics at specialized centers, with work experience ≥3 years (P< 0.05*), and among non-Saudi dental support staff (P< 0.01*). DHCWs who were working at general practice clinics were more likely to use sterile, gloves, eyewear, mask, and disposable gowns for surgery (P< 0.05*). Female DHCWs were more likely to ask their patients to do preoperative mouth rinses than males (P< 0.05*).

Table 3 Differences in scores for the use of personal protective equipment among DHCWs at Al-Jouf region and their socio-demographic characteristics and working conditions

Socio-demographic Characteristics		Mean ± SD						
		Using sterile gloves for surgery	Wearing protective eyewear	Wearing masks	Changing masks between patients	Wearing disposable gowns for surgery	Using high volume evacuation	Asking patient to do preoperative mouth rinses
Age (years)	<30 years	2.3±0.8	2.1±0.9	3.0±0.1	2.6±0.8	2.2±0.8	1.7±1.0	2.2±0.7
	≥30 years	2.2±0.8	2.0±0.7	3.0±0.0	2.5±0.7	2.1±0.7	2.1±0.6*	2.2±0.5
Gender	Female	2.2±0.9	2.1±0.8	3.0±0.0	2.7±0.7	2.2±0.8	1.9±0.9	2.3±0.5
	Male	2.3±0.8	2.1±0.8	3.0±0.1	2.4±0.8*	2.1±0.8	1.9±0.9	2.0±0.7*
Marital status	Married	2.2±0.8	2.0±0.8	3.0±0.1	2.7±0.6	2.1±0.8	2.0±0.8	2.3±0.5
	Single/ divorced	2.4±0.9	2.3±0.9*	3.0±0.0	2.4±0.9*	2.3±0.8	1.6±0.1*	2.0±0.8
Nationality	Saudi	2.2±0.8	2.0±0.8	3.0±0.1	2.6±0.7	2.1±0.8	1.8±0.9	2.2±0.6

	Non-Saudi	2.9±0.3**	2.6±0.5*	3.0±0.0	2.3±0.7*	2.7±0.5**	2.5±0.6**	2.4±0.8
Highest educational qualification	Diploma	1.8±0.9	1.6±0.7	3.0±0.0	3.0±0.2	1.7±0.7	2.2±0.4	2.2±0.7
	Bachelor	2.4±0.8	2.3±0.8	3.0±0.1	2.5±0.8	2.3±0.7	1.7±1.0	2.2±0.7
	Post-graduate	2.8±0.4***	2.3±0.5***	3.0±0.0	1.8±0.4***	2.5±0.5***	2.2±0.7	2±0.9
Profession	Dental support	1.9±0.8	1.7±0.8	3.0±0.0	2.9±0.2	1.8±0.8	2.2±0.4	2.2±0.5
	Dentist	2.4±0.7***	2.3±0.8***	3.0±0.1	2.4±0.8***	2.4±0.7***	1.7±1.0**	2.2±0.7
Type of clinics practice	General practice	2.3±0.8	2.2±0.8	3.0±0.0	2.6±0.7	2.2±0.8	1.8±0.9	2.2±0.7
	Speciality	1.9±0.8*	1.7±0.8**	3.0±0.2*	2.7±0.7	1.9±0.7*	2.2±0.6	2.2±0.4
Type of clinics	At hospital	2.6±0.7	2.4±0.9	3.0±0.0	2.4±0.8	2.5±0.7	1.9±0.9	2.2±0.8
	At PHCs	2.2±0.8	2.1±0.8	3.0±0.0	2.6±0.8	2.1±0.8	1.7±1.0	2.1±0.7
	specialized centres	2.1±0.9	1.9±0.7	3.0±0.2	2.8±0.5	2.1±0.8	2.3±0.5*	2.4±0.5
Work experience	<3 years	2.5±0.8	2.4±0.8	3.0±0.1	2.4±0.9	2.5±0.7	1.6±1.1	2.2±0.8
	≥3 years	2.0±0.8***	1.8±0.7***	3.0±0.0	2.7±0.6*	1.9±0.7***	2.1±0.6*	2.2±0.5

The Mann-Whitney test and the Kruskal Wallis test were used as appropriate, PHCs: Primary Healthcare Centers; *: ($P < 0.05$); **: ($P < 0.01$); ***: ($P < 0.001$)

Practicing Disinfection and Sterilization

Table 4 shows variations in scores for disinfection and sterilization activities among DHCWs. Non-Saudis were more likely to sterilize hand pieces, use surface barriers, wipe surfaces (P< 0.01*) and use decontaminant solutions to immersing used instruments (P< 0.05*). DHCWs with work experience 3>years were more frequently using sterilized hand pieces, surface barriers, surface wiping, washing and disinfection of impressions before sending to laboratory (P< 0.01*). Sterilization of hand pieces and using surface barriers were more frequently performed by DHCWs working at hospital attached dental clinics (P< 0.05*). Unmarried DHCWs were found to wash impressions before sending to the laboratory compared to married DHCWs (P< 0.05*).

Table 4 Differences in scores for the use of disinfection and sterilization among DHCWs at Al-Jouf region and their socio-demographic characteristics and working conditions

Socio-demographic Characteristics		Mean ± SD					
		Immersing used instruments in decontaminant solutions	Sterilizing of hand pieces	Use of surface barriers for dental unit surfaces	Use of routine wiping for surface disinfection	Disinfection of impressions before sending to the laboratory	Washing impressions before sending to the laboratory
Marital status	Married	2.6±0.5	2.5±0.5	2.4±0.7	2.4±0.6	2.3±0.8	1.5±1.2
	Single/ divorced	2.6±0.8	2.5±0.7	2.4±0.8	2.3±0.8	2.4±1.0	1.9±1.2*
Nationality	Saudi	2.5±0.6	2.5±0.6	2.3±0.7	2.4±0.7	2.4±0.8	1.6±1.2
	Non-Saudi	2.9±0.2*	2.9±0.2**	2.9±0.3**	2.9±0.3**	2.0±1.3	1.9±1.4
Type of clinics	At hospital	2.8±0.4	2.8±0.4	2.8±0.4	2.6±0.6	2.1±1.1	1.9±1.3
	At PHCs	2.5±0.7	2.4±0.6	2.3±0.8	2.3±0.7	2.4±0.9	1.5±1.2

	specialized centres	2.7±0.5	2.6±0.5*	2.5±0.6*	2.4±0.6	2.4±0.7	1.8±1.1
Work experience	<3 years	2.6±0.8	2.6±0.6	2.5±0.8	2.5±0.8	2.5±0.9	2.0±1.2
	≥3 years	2.6±0.5	2.4±0.5**	2.3±0.6**	2.3±0.6**	2.2±0.8**	1.4±1.1**

The Mann-Whitney test and the Kruskal Wallis test were used as appropriate, PHCs: Primary Healthcare Centers; *: ($P < 0.05$); **: ($P < 0.01$)

4. DISCUSSION

This study was the first to investigate dental IPC practices at Al-Jouf region that gave an insight about the level of compliance with the IPC and determinants for poor defiance and barriers to effective infection control during dental treatments among DHCWs in Al-Jouf region. Dental healthcare has been linked to an increased risk of spread of infection to both patients and DHCWs alike. This cross-sectional survey was carried out to evaluate the major IPC practices among DHCWs at public dental clinics at Al-Jouf Region, Saudi Arabia. The study recruited 159 dental healthcare providers (response rate = 91.4%). The results of hand washing after patient treatment and usage of hand sanitizers were in line with a study involved DHCWs at private dental clinics in Jeddah. They reported practicing hand hygiene before and after patient treatment among 96.7% and 89.4%, respectively (Al-Ahdal et al., 2019). Similarly, 90.1% of dentists in Lebanon were compliant with hand washing before and after patient contact (Dagher et al., 2017). Correspondingly, self-reported IPC practices by 190 dental care providers in Jordan revealed that hand washing was reported by 83.2% after patient treatment, 66.3% before treatment, 45.8% before donning glove, and more than half used hand sanitizers (Mahasneh et al., 2020).

In the current study, hand washing was more frequently reported by dentists who had post-graduate qualifications rather than dental support staff, and those working at general practice clinics. This could be due to the higher levels of knowledge among specialized dentists and poor compliance of the support staff (Mutters et al., 2014). In addition, non-Saudi dentists, with postgraduate education, were more compliant with IPC guidelines. In addition, general dental clinics are supervised by the ministry of health. Similarly, dental support staffs with a diploma degree were less likely to practice washing hands before patient treatment compared to more qualified dentists. Moreover, DHCWs at specialty clinics were more likely to use hand sanitizers instead of washing compared to general practice clinics (41% vs. 24%; P=0.002).

Regarding using PPE, most of DHCWs reported frequently using gloves and masks while performing dental procedures, changing gloves and changing masks between patients. These findings correspond to other previously reported findings in Saudi Arabia (Al-Rabeah & Moamed, 2002; Al-Ahdal et al., 2019), where more than 90% of DHCWs in private dental clinics reported using gloves and masks during patient care and changing them between patients. Similar findings were reported by dental care providers in Jordan (Mahasneh et al., 2020). In addition, 95% of Indian dentists reported using gloves (Yadav et al., 2017) and all dental care providers in Germany used gloves (Mutters et al., 2014). However, only smaller proportions of dental care providers in South Africa used gloves and masks during patient treatment (52.2% and 65.25%, respectively) and only 8.7% reported changing gloves between patients (Mehtar et al., 2007).

Our results have shown that 89.3% of DHCWs commonly used single-ampoule local anesthetics, which was higher than Jordanian dental care providers (82.1%) (Al-Omari & Al-Dwairi, 2005); Additionally, less than half of interviewed DHCWs frequently used sterile surgical gloves (49.7%), wearing protective eyewear during surgeries (37.1%) and used high volume evacuation (20.7%). This is in agreement with previous findings in Lebanon (Dagher et al., 2017), where 43% of dentists reported using goggles. Furthermore, a study of 30 Indian dentists revealed that 20%, 6.6%, and 3.3% reported using sterile surgical gloves, wore protective eyewear and gowns, respectively. Moreover, only 10% used high-volume evacuation (Yadav et al., 2017). On the other hand, higher proportions of DHCWs in the private sector in Jeddah reported using disposable gowns and protective eyewear (72.7% and 75.9%, respectively), (Al-Ahdal et al., 2019). This is compared with, 63.7% and 78.9% of dental care providers in Jordan reported using sterile surgical gloves and masks, respectively (Mahasneh et al., 2020). The lower proportions in our study may reflect on an inadequate supervision at public clinics compared to the private sector.

Out of the participants in the current study, 30% reported always asking their patients to do pre-operative mouth rinses, as compared to 39.5% of DHCWs in Jordan (Mahasneh et al., 2020). In addition, DHCWs with experience <3years were more compliant with IPC guidelines. However, fewer years of work experience among dentists in Lebanon were associated with poor compliance with hand hygiene practices and using PPE. Meanwhile, there were no significant links between the level of educational qualification and infection control practice (Dagher et al., 2017). High-volume evacuation use was more frequently reported by

elderly, married DHCWs with work experiences ≥3 years who were working at dental clinics at specialized centers in our study. An explanation is that more training of DHCWs and stricter supervision is practiced at those specialized centers. Additionally, high-volume evacuation use was more frequent in private clinics than public and academic clinics due to the frequent monitoring of private clinics by the health authorities (Mahasneh et al., 2020).

The current study also showed that female married DHCWs with many years of work experience were more likely to change masks and ask patients to do pre-operative mouth rinses. In line with these results, female dentists were more compliant with the use of PPE such as eyewear and gowns than the males (Dagher et al., 2017). In addition, older dental care providers were likely to ask patients to do pre-operative mouth rinses (Mahasneh et al., 2020). The majority of DHCWs in the public clinics at Al-Jouf region usually sterilized burs (89.9%), endodontic files (88%) and wraped instruments for sterilization (87.4%), which is in agreement with the reported findings by Jordanian dentist (Mahasneh et al., 2020). More than half usually sterilized hand pieces (56.6%), disinfected impressions (54.7%), and immersed used instruments in decontaminating solutions (64.8%). These results correspond with the results reported among DHCWs in the different dental clinics in Jordan (Mahasneh et al., 2020). Meanwhile in India, most of the dentists reported using non-sterilized hand pieces, burs and impression trays (Yadav et al., 2017).

Routine wiping of surfaces, the use of barriers for dental surfaces, and washing impressions prior to being sent to the laboratory were reported by only less than half of the study participants. These were lower than the reported figures from private dental clinics in Jeddah, where 97.1% of DHCWs used protective surface barriers and 95.1% reported disinfection of impressions before sending to laboratory (Al-Ahdal et al., 2019). Private clinics may be privileged by more budget and materials than the public clinics. Moreover, in Jordan, 74.7% did routine wiping of surfaces, 56% used surface barriers, and 76% washed impressions before sending to laboratory (Mahasneh et al., 2020). Correspondingly, DHCWs with high educational qualifications were more adherent to disinfection and sterilization guidelines (Al-Omari & Al-Dwairi, 2005). DHCWs who were working at dental clinics in hospitals reported frequently sterilizing hand pieces and using surface barriers.The prevalence of HBV vaccination among the studied DHCWs was 87.4%. Previous studies in Saudi Arabia reported HBV vaccination coverage ranging from 63.5% to 92.7(Al-Rabeah & Moamed, 2002; Al-Dharrab & Al-Samadani, 2012; Al-Ahdal et al., 2019). Comparable results were observed in Jordan (82.1%) (Mahasneh et al., 2020) and Italy (85.7%) (Di Giuseppe et al., 2007).

Furthermore 90.6% of DHCWs in Lebanon (Dagher et al., 2017) were immunized against HBV. This vaccination was more likely among highly qualified dentists compared to less qualified dental support staff (P>0.001) (Mahasneh et al., 2020). However, there were no significant differences between vaccinated and unvaccinated DHCW among our participants. These findings would guide educational and training programs on biomedical safety, health education programs, and policies implemented at the different dental healthcare centers to decrease the occupational risk of infections during dental treatments. However, this self-reported questionnaire-based cross-sectional study, which reflects only the current situation, is not sufficient to prove a relationship between dental IPC practices and potential risks. Moreover, subjective information is endangered by exaggerated or understated reports. Further large-scale objective follow-up studies are recommended to determine DHCWS compliance with IPC guidelines and identify factors predisposing to poor compliance.

5. CONCLUSION

The dental IPC practices of DHCWs in Al-Jouf region showed a need for more reformation to focus more on the importance and implementation of infection control procedures both for dentists and support staff within the undergraduate education via continuous training programs.

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Ethical approval

The study was approved by the local committee for bioethics (LCBE) of Jouf University (LCBE No: 01-07-42).

Authors' contribution

All authors have made substantive contribution to this study and/or manuscript. Professor Ibrahim Taher, Dr. Amany Ghazy and Dr.Waleed Elawamy have designed the study; Abdulkarim Alshamrani has distributed the questionnaire and collected the data. Dr.

Awad Ashekhi helped in the writing and analysis of results. All authors have prepared the manuscript, and shared in the manuscript's revision.

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Conflict of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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