

Practices of Infection Control Among Dental Care Providers at Makkah

Nadir Hamzah Metair¹, Mahdi Ahmed Alzahrani², Eman Ali Ahmed Alrajhi³, Asma Ahmed Alajraa⁴, Jafar Ahmed S Altayari⁵, Sultan Shaher Mnawer Alansari⁶, Ibrahim Ali Alsulaimani⁷, Abdullah Sultan Alotaibi⁷, Abdulilah Ibrahim Alabdullatif⁸, Ibrahim Ali AlAhmari⁹, Hatim Abdullah Alghemlas¹⁰, Sattam hamad aljrewey¹¹, Abdulaziz Naser almunyif¹¹, Abdullah Mohammed alkadi¹², Hadia mohammed alshammery¹², Fahad Jaralnabi Almalki¹²

¹MBBS, disaster medical management, Department of Planning and Investment Stimulation in the Health of the Makkah Al-Mukarramah Region

²Anesthesia technician, King Abdulaziz Hospital

³Pharmacist, ALYAMAMAH HOSPITAL

⁴Nursing specialist, Second health cluster

⁵Nursing, Khulais Primery Health, Care Center

⁶X-ray technician Department, Khulais General Hospital, Makkah Health Cluster, Ministry of Health, Saudi Arabia

⁷General dentistry, Ghiran primary care center, Saudi Arabia

⁸General Dentist, Howtat Bani Tamim General Hospital, Saudi Arabia

⁹Dental Technicin, North of Riyadh Dental Center, Saudi Arabia

¹⁰General Dentist, laban second health center, Saudi Arabia

¹¹General Dentist, Al Faisaliah PHC in Al Majmaah, Saudi Arabia

¹²Laboratory technician, King Khalid Hospital in Al Kharj, Saudi Arabia

Abstract

Background: A wide range of microorganisms poses a threat to patients and dental care teams. Implementation of safety guidelines is thus essential to prevent infection in dental clinics. Aim: To investigate the level of infection-control practices among dental health-care providers in Makkah. Methods: A self-administered questionnaire was distributed to dental care providers from hospitals, and dental centers. The questionnaire covered sociodemographic variables, professional characteristics, and recommended guidelines of infection control. Results: A total of 190 questionnaires were obtained out of 500 distributed questionnaires (response rate: 38%). Females accounted for 62.6% of the sample and 64.7% were dentists. The majority was vaccinated against hepatitis B (82.1%) and wash their hands as usual behavior before (66.3%) and after (83.2%) treatment. Approximately 87.9% wear gloves and 78.9% wear masks while performing dental procedures. Autoclave sterilization and puncture resistant containers for sharp instruments were used by 90.5% and 88.4%, respectively. The majority (81.0%) had protocols for emergency treatment of needle stick or other sharps accidents. High volume evacuation was used in 28.6% of public hospitals compared to 19.4% in academic institutions ($P < 0.01$). In addition, surface barriers for dental unit surfaces were used by 70.2% of private dental clinics, 50% of public hospitals, and 36.1% of academic institutions ($P < 0.001$). Finally, compared to dentists, dental support staff showed low compliance with infection-control guidelines. Conclusion: The overall practice of infection-control measures among the participants is very good. Educational programs and training strategies should be implemented to maximize and enhance the compliance of the dental care providers with infection-

control guidelines. Keywords: infection control, dental care providers, vaccination, sterilization, disinfection.

Keywords: *Practices, Infection Control, Dental Care Providers.*

Introduction

In dentistry, a wide range of microorganisms poses a threat to patients and dental care providers such as *Mycobacterium tuberculosis*, hepatitis viruses, staphylococci, streptococci, herpes simplex virus types, human immunodeficiency virus, mumps, influenza, rubella and others (Yadav et al., 2017). In dental environment, pathogens can be transmitted through direct contact with infected blood, saliva, or other body fluids; or indirectly via contaminated instruments, materials and surfaces.² In addition, pathogens can be transmitted through inhalation of airborne pathogens in splattered droplets or aerosols from saliva and respiratory fluid (Taiwo & Aderinokun., 2002; Aurangjeb et al., 2013). The Infection-Control Practices for Dentistry was among the first guidelines for the prevention of infection by blood and body fluids of patients.¹ According to these guidelines, all patients should be treated as potentially infectious in order to prevent disease transmission (Kaz & Saxena., 2012). Therefore, implementing infection-control precautions is the standard of care to protect both patients and dental care professionals and to ensure a safe working environment. Among such precautions are personal protective equipment (PPE), hand hygiene, waste management and sterilization (Gordon et al., 2001).

Preventing infection exposure in dental care settings can also be achieved efficiently by immunization.⁶ Therefore, many dental education institutions and dental care facilities have a comprehensive immunization policy for their students and dental care providers (Di Giuseppe et al., 2007; DeCastro et al., 1999). However, most patients are not similarly protected, which may increase the risk of transmission of infectious diseases between

patients. PPE such as gown, gloves, face mask and eye protection have been shown to be an effective means of preventing the transmission of pathogens (Mitchell & Russell., 1989; Gershon et al., 1998). However, any failure to comply with implementing infection-control measures can harm both patients and health care teams (Gordon et al., 2001).

In Saudi Arabia specially Makkah, few studies have evaluated the level of infection control in dental practice. These studies were limited either to one institution, private dental clinics or to dental technicians in commercial dental laboratories (Mandourh et al., 2017). Therefore, the aim of this study was to evaluate the level of infection-control practices among dentists and dental care providers in the different dental sectors in Jordan. In addition, the study examined the association between socio-demographic and professional characteristics of the participants and their practice of infection-control measures.

Materials and Methods

Study Design and Instrumentation

This cross-sectional survey was conducted between January and May 2022. Approvals were obtained. The study involved a self-administered questionnaire that was distributed to a convenient sample of the dentists, and dental care providers from public hospitals and University affiliated hospitals) and at Makkah city, Saudi Arabia.

The questionnaire was developed in English and was based on the Guidelines for Infection Control in Dental Health Care Settings of the US Centers for Disease Control and Prevention (Al-Dwairi ., 2007; Centers for Disease Control and Prevention., 2003). The questionnaire was pilot tested on 20 participants to ensure its

clarity and content validity. The questionnaire was divided into several sections. The first section collected personal sociodemographic variables (age, sex, specialty, and university degree). The second section collected information about the professional characteristics of participants. The last part was about the participants' practice of vaccination, personal protective equipment, hand hygiene, waste management and sterilization. Data entry was reviewed by random audit of 10% of the entered information.

Participants

The target population of the current study is approximately 5000 dental care providers who are responsible for applying the infection-control guidelines in the dental setting. To have a good representation of the target population, a total of five hundred subjects (10%) were invited to complete the questionnaire. One hundred and ninety participants agreed to complete the questionnaire by signing the consent form. Participation was voluntary and questionnaires were not identified by name or code to maintain anonymity and confidentiality. Access to data was restricted to the research team.

Data Analysis

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) software version 21.0 (SPSS®: Inc., Chicago, IL, USA). Frequencies and percentages were produced. Chi-square test was used to compare between subgroups. The level of significance was set at ($P \leq 0.05$).

Results:

The response rate was 38% (190 out of 500). Table 1 shows the demographic characteristics of the study participants. About two third (60.5%) of the sample were older than 30 years. Females accounted for 62.6% of respondents and approximately 52.6% held bachelor degrees. Two thirds of respondents were dentists while the remainder were members of the dental support staff. The mode of practice of the clinic showed that 52.6%

worked in general dentistry and the remainder were from specialty practices.

Variable	N(%)
Age (Years)	
<30	75(39.5)
30–39	63(33.2)
≥40	52(27.4)
Gender	
Male	71(37.4)
Female	119(62.6)
Educational level	
High school	12(6.3)
Diploma	41(21.6)
Bachelor	100(52.6)
Higher education	37(19.5)
Profession	
Dentists	123(64.7)
Dental support staff	67(35.3)
Mode of practice of the clinic	
Speciality	90(47.4)
General practice	100(52.6)

Results revealed that 82.1% of participants were vaccinated against hepatitis B. The distribution of the non-vaccinated fraction was 34.4% of dental support staff and 9.9% of dentists ($\chi^2 = 19.15$; $P < 0.0001$). In addition, diploma/high school degree holders tended to be unvaccinated compared with participants holding other degrees (31.7% vs 39.6%, respectively, $\chi^2 = 25.83$; $P < 0.001$). With respect to other demographic variables, there were no statistical significant differences regarding hepatitis B vaccination. Table 2 summarizes the practice of hand hygiene, use of personal protective equipment, and sterilization and disinfection among participants. The majority of respondents reported practiced hand washing after treatment (83.2%) and prior to starting treatment (66.3%). About one-half (45.8%) reported usually washing hands before wearing gloves. With respect to materials used in handwashing, 49.5%, 32.1%, and 27.9% reported washing their hands using plain soap, hand sanitizer and antiseptic solutions, respectively. The majority of participants reported an acceptable level of personal protective equipment use. This includes constantly wearing gloves while performing dental procedures (87.9%),

changing gloves between patients (89.5%), wearing sterile surgical gloves (63.7%) and masks (78.9%) while performing surgical dental operations, and using single ampoules for local anaesthetic injections (82.1%).

Table 2 reveals that immersing used instruments in decontamination solution, sterilizing hand pieces, burs and endodontic files were performed frequently by the majority of the study sample (68.9%, 74.2%, 83.2% and 84.2%, respectively). About 78.0% of

participants reported that they use wrapping bags for instrument sterilization; while a slightly less proportion (74.7%) use routine wiping for the disinfection of surfaces in the dental care facility. Approximately, 56.0% of subjects reported that they use surface barriers for dental unit surfaces. Dental impressions were reported to be treated either by washing with water or chemical disinfection before sending to the laboratories by 76.0% and 64.7% of participants, respectively.

Variable	Response N(%)		
	Always	Occasionally	Rarely/None
Hand hygiene			
Washing hands before patient treatment	126(66.3)	45(23.7)	19(10.0)
Washing hands after patient treatment	158(83.2)	27(14.2)	5(2.6)
Washing hands before donning gloves	87(45.8)	65(34.2)	38(20.0)
Using hand sanitizer instead of washing	61(32.1)	84(44.2)	45(23.7)
Protective personal equipment			
Wearing gloves while performing dental procedures	167(87.9)	17(8.9)	6(3.2)
Changing gloves between patients	170(89.5)	16(8.4)	4(2.1)
Using sterile surgical gloves for surgery	121(63.7)	36(18.9)	33(17.4)
Wearing protective eyewear	68(35.8)	62(32.6)	60(31.6)
Wearing mask	150(78.9)	20(10.5)	20(10.5)
Changing masks between patients	90(47.4)	62(32.6)	38(20.0)
Wearing disposable gowns for surgery	84(44.2)	46(24.2)	60(31.6)
Using high volume evacuation	69(36.3)	66(34.7)	55(28.9)
Using of single ampoules for local anaesthetic injections	156(82.1)	20(10.5)	14(7.4)
Asking your patient to do preoperative mouth rinses	75(39.5)	68(35.8)	47(24.7)
Disinfection and sterilization			
Immersing used instruments in decontaminant solutions	131(68.9)	44(23.2)	15(7.9)
Sterilizing of hand pieces	141(74.2)	34(17.9)	15(7.9)
Sterilizing of burs	158(83.2)	25(13.2)	7(3.7)
Sterilizing of endodontic files	160(84.2)	21(11.1)	9(4.7)
Use of wrapping bags for instrument sterilization	149(78.4)	30(15.8)	11(5.8)
Use of surface barriers for dental unit surfaces	107(56.3)	45(23.7)	38(20.0)
Use of routine wiping for surface disinfection	142(74.7)	36(18.9)	12(6.3)
Chemical disinfection of impressions before sending to the laboratory	123(64.7)	31(16.3)	36(18.9)
Washing impressions with water before sending to the laboratory	144(75.8)	27(14.2)	19(10.0)

There was no statistically significant difference regarding practicing hand hygiene by demographic and work characteristics except in specific areas as shown by bi-variate analysis in Table 3. Females (26.1%) rarely washed their hands before wearing gloves compared with male (9.9%) subjects ($\chi^2 = 7.3$; $P=0.026$). Dental support staff (19.4%) reported that they rarely wash their hands before starting patient care compared to only 4.9% of dentists ($\chi^2 = 10.36$; $P=0.006$). Participants with a diploma degree reported that they always wash their hands after patient treatment at a lower proportion compared with the others (χ^2 value = 13.37; $P=0.038$). Approximately 41.0% of participants from specialty clinics reported that they always use hand sanitizer instead of washing hands compared with 24.0% of those in general practice clinics (χ^2 value = 12.17; $P=0.002$).

Demographic	Practice of Hand Hygiene and Use of PPE			χ^2 value; Sig
	Rarely (N%)	Occasionally N(%)	Always N(%)	
Washing hand before donning gloves				
Gender				7.3; 0.026
Male	7(9.9)	27(38.0)	37(52.1)	
Female	31(26.1)	38(31.9)	50(42.0)	
Washing hands before starting treatment				
Profession				10.63; 0.006
Dentist	6(4.9)	32(26.0)	85(69.1)	
Support dental staff	13(19.4)	13(19.4)	41(61.2)	
Washing hands after treatment				
Education level				13.37; 0.038
High school or less	0(0.0)	2(16.7)	10(83.3)	
Diploma	3(7.3)	11(26.8)	27(65.9)	
Bachelor	2(2.0)	9(9.0)	89(89.0)	
Higher	0(0.0)	5(13.5)	32(86.5)	

education			5)	
Using hand sanitizer instead of hand washing				
Mode of practice				12.17; 0.002
Specialty	25(27.8)	28(31.1)	37(41.1)	
General practice	20(20.0)	56(56.0)	24(24.0)	
Preprocedural mouth rinsing				
Age (years)				10.7; 0.030
<30	22(29.3)	31(41.3)	22(29.3)	
30-39	16(25.4)	24(38.1)	23(36.5)	
≥40	9(17.3)	13(25.0)	30(57.7)	
Using high volume evacuation				
Practice type				30.23; <0.0001
Private	17(20.2)	25(29.8)	42(50.0)	
Academic	6(16.7)	23(63.9)	7(19.4)	
Public	32(45.7)	18(25.7)	20(28.6)	

Table 4 presents practices of instrument sterilization and management of sharps waste. The majority of respondents (90.5%) reported that they use an autoclave to sterilize instruments in their dental clinics. Moreover, 72.6% of participants immerse the used instruments in decontamination solution after treatment. About one half of respondents (51.1%) reported that 1 week was the time since last maintenance of the sterilization devices. One week as a preferred time to use sterilized, wrapped packed instruments were reported by 72.1% of participants. Table 4 shows that approximately (81.0%) of participants reported that they have an appropriate protocol for emergency treatment of needle stick and other sharp accidents with significant differences between public hospitals (90%) and academic institutions (69.4%, $\chi^2=7.36$, $P=0.025$) (Table 5).

Variable	Response N(%)	emergency treatment of needle stick or other sharp accidents?	
Which of the following do you use to sterilize instruments in dental clinic Autoclave Boiling Washing Disinfectant solution	172(90.5) 9(4.7) 6(3.2) 3(1.6)	Yes	153(80.5)
		No	37(19.5)
		Do you keep detailed records of these accidents?	
		Yes	123(64.7)
		No	67(35.3)
When do you immerse the used instruments in decontaminant solutions?		Do you use puncture resistant container for sharp instruments?	
Before treatment		Yes	168(88.4)
After treatment		No	22(11.6)
Time since last maintenance of the sterilization devices		Table 5 shows that the participants from academic institutions use wrapping bags for instrument sterilization ($\chi^2=11.27$; $P=0.027$), surface barriers for dental unit surfaces ($\chi^2=21.76$; $P<0.0001$), and wash impressions with water before sending to laboratories ($\chi^2=19.61$; $P<0.001$) in lower frequencies compared to public and private dental clinics. maintain detailed records of such incidents. Furthermore, 88.4% of participants use puncture-resistant containers for sharp instruments with a significantly higher proportion of those who work in public hospitals (95.7%) compared to those who work in academic institutions (77.8%, $\chi^2=7.81$; $P=0.020$) (Table 5).	
One week			
Four weeks			
Six weeks			
Twelve or more weeks			
Preferred time of use of sterilized, wrapped packed instruments			
One week			
Four weeks			
Six weeks			
Twelve or more weeks			
Having an appropriate protocol for			

Practice	Work Type			χ^2 value; Sig.
	Private N(%)	Academic N(%)	Public N(%)	
Use wrapping bags for instrument sterilization				11.27; 0.027
Rarely	5(6.0)	4(11.1)	2(2.9)	
Occasionally	10(11.9)	11(30.6)	9(12.9)	
Always	69(82.1)	21(58.3)	59(84.3)	
Use surface barriers				21.76; <0.001
Rarely	6(7.1)	10(27.8)	22(31.4)	
Occasionally	19(22.6)	13(36.1)	13(18.6)	
Always	59(70.2)	13(36.1)	35(50.0)	
Washing impressions with water				19.61; 0.001
Rarely	2(2.4)	10(27.8)	7(10.0)	
Occasionally	10(11.9)	5(13.9)	12(17.1)	
Always	72(85.7)	21(58.3)	51(72.9)	
Having protocol for emergency for needle stick/sharp				7.36, 0.025

accidents				
Yes	65(77.4)	25(69.4)	63(90.0)	
No	19(22.6)	11(30.6)	7(10.0)	
Using special container for sharp instruments				7.81; 0.020
Yes	73(86.9)	28(77.8)	67(95.7)	
No	11(13.1)	8(22.2)	3(4.3)	

Discussion

In dental practices, an infectious disease can be transmitted in many routes such as direct contact with blood, oral fluids and other body secretions. Also, indirect contact with contaminated instruments, operatory equipment and environmental surfaces is very possible (Ahmad et al., 2013). Therefore, it is essential to adhere to the universally recommended guidelines in order to prevent cross-infection among dental health-care providers and patients as well as between patients themselves. This comprehensive study aimed to assess the level of infection-control practices of dental health-care providers including vaccination, hand hygiene, use of PPE, sterilization and disinfection in hospitals and clinics in Makkah, Saudi Arabia. In addition, the current study examined the correlations between sociodemographic and professional characteristics of the participants and their practice of infection-control measures. In general, the study findings showed that the majority of the participants follow universal guidelines regarding vaccination against hepatitis B virus, using PPE, disinfection and sterilization, and dealing with sharp instruments. However, the self-reported infection-control practices did not reach optimal-desired levels.

Hepatitis B Virus is a well-recognized occupational risk in dental professionals, since it can be transmitted by exposure to blood and body fluids of an infected person. In this study, the majority of participants were vaccinated against hepatitis B (82.1%), this is higher than that was reported by previous studies from Jordan (36%) and Pakistan (71.6%), and less than the findings of a study from New Zealand (94.2%), Italy (85.7%) and Saudi Arabia (90.6%). The majority of hepatitis B non-vaccinated individuals was from dental support

staff (Al-Omari & Al-Dwairi., 2005; Ch et al., 2018; Lamb et al., 2019; AlAhdal et al., 2019).

Good hand hygiene performed by dental practitioner is considered an effective method to prevent and control infection transmission in dental practice environment (Mutters et al., 2014). This study showed that the majority of participants practice handwashing following patient treatment more than before starting treatment. Finding of this study is lower than a study conducted in Saudi Arabia that showed about 96.7% and 89.4% of the participants perform hand hygiene before and after contacting patients, respectively (; AlAhdal et al., 2019). However, in Pakistan, Ch et al (2018) reported that 79% of the participants wash their hands before and after treatment. The results of the current study showed that washing hands are affected by gender and academic degree. Males reported washing their hands before wearing gloves more than do females. In a study from Germany, it was reported that males conducted better hand hygiene than females after treatment, while females conduct correct hand hygiene more than males before treatment (Mutters et al., 2014). However, some previous studies^{19–21} showed that females reported better hand hygiene practices than males (McCarthy et al., 1999; McCarthy et al., 1994; Osazuwa-Peters et al., 2012). Dental support staff wash hands before treatment less frequently compared to dentists, and those with a diploma degree reported washing their hands after patient treatment less frequently than others in accordance with the conclusions of Mutters et al (2014) who reported a lower compliance of dental assistants with infection-control procedures due to insufficient knowledge. The current findings showed dental care providers in specialty clinics use hand sanitizer for washing hands more than who work in general

dental practice. In addition, participants who work in academic settings reported practicing handwashing less than those who work in private and public dental settings. The reason for such differences could be due to the pressure of work as a result of variations in the number of patient-care visits between the various settings.

Generating aerosols, droplets of water, saliva, blood, microorganisms, and other debris are very common during the performance of dental procedures. Therefore, disease transmission via travelling droplets and aerosol, which remain for a long time in the air, is a major concern in the dental environment. To minimize the susceptibility to airborne and blood born infections, dental care providers should adequately use PPE such as gloves, protective gowns, and face mask (Yadav et al., 2017; Kazi & Saxena., 2012). The majority of respondents reported wearing gloves (87.9%) and masks (78.9%) frequently while performing dental procedures. The majority of participants (89.5%) reported changing gloves between patients, however only 47.4% of them reported changing masks. This finding is similar to that of other studies (Yadav et al., 2017; Ch et al., 2018; Sukumaran et al., 2017). However, the reported proportions of the current study are higher than the findings of a previous study in Jordan, where 81.8% of participants reported that they wear and change gloves and 54.5% wear masks (Al-Omari et al., 2005) . Whereas a study from a South African Province by Mehtar et al., 2007 shows that only 52.2% and 65.25% of dental care providers reported wearing gloves and masks, respectively, while only 8.7% change gloves after each patient. The present findings also showed that wearing sterile surgical gloves, protective disposable surgical gown and use of high volume evacuation were reported to be less frequently practiced by participants. Yadav et al (2017) reported that 20% of the studied dentists use sterile surgical gloves, 10% use high volume evacuation, and 3.3% use protective gown. Using of high volume evacuation by the participants in private clinics is higher than that in public hospitals and academic institutions. This could be due to the fact that private clinics

are usually more frequently inspected than public ones.

Patient-care items should be categorized and sterilized or disinfected depending on the potential risk for infection associated with their use. The study findings revealed that the majority of participants always perform disinfection and sterilization. Sterilization of hand pieces is performed by 74.2% of the participants, which is higher than that reported in a study from Tanzania (54.2%)²⁴ and lower than that in a study from New Zealand (99.5%)(Christian et al., 2014; Lamb et al., 2019). In addition, results showed that surface disinfection for routine wiping was reported by 74.7%, which is less than the findings that were reported in a study from Saudi Arabia (95.1%) and higher than that reported from India (Yadav et al., 2017; AlAhdal et al., 2017). Participants from academic institutions reported that they use surface barriers less than reported by public hospitals and private clinics. This could be due to the unavailability of the materials or budget restrictions. Furthermore, 65% of the participants reported disinfecting impressions. This percentage is less than the findings from Saudi Arabia (95.1%)¹⁷ and New Zealand (71.8%) (AlAhdal et al., 2017; Lamb et al., 2019). Significantly higher proportions of those worked at public hospitals and private clinics reported that they wash impressions with water before sending to laboratories more than those who worked at academic institutions. In general, the safety practices with respect to sterilization procedures were more adequate in public and private sectors than academic institutions. More investigations are needed to uncover the reasons behind such observation. In addition, frequent inspection of academic dental centres by the government is recommended.

Participants who are 40 years old and greater were more eager to perform disinfection and sterilization periodically in comparison with those younger than 30 years old. Participants with bachelor degree or higher showed significantly better disinfection and sterilization practices than those without certification, and work in private dental clinics (Al-Omari et al., 2005). Thus, more training on safety guidelines

should be applied to dental care providers, especially young and less educated.

Using autoclave for instrument sterilization is the preferred method due to its safety, rapid and lethal effect of pressurized steam on all microorganisms (Yadav et al., 2017). The majority of participants reported using autoclave sterilization of dental instruments. This is in accordance with other studies as Ch et al., 2018 and Ahmed ., 2015 and higher than what was reported in a previous study in Jordan by Al-Omari 2005 and Al-Dawiri 2007, 63%, whereas the findings of a study conducted by Banglani et al (2016) show that 76% of dental practitioners were using an autoclave.

Although performing maintenance and monitoring of autoclaves is very important to ensure perfect sterilization cycle, only half of the participants reported performing the last maintenance of the sterilization devices within a period of 1 week. Therefore, it is recommended to increase the training and education in autoclave biosafety measures and periodic maintenance. Many dental instruments are sharp and can cause injuries when handled such as needle sticks. This type of accident can be a potential source of infections. Needle stick injuries and sharp accidents should be prevented by following the recommended measures including implementing an emergency protocol, maintaining detailed reports, and safely disposing of sharp objects (Yadav et al., 2017). The majority of participants reported appropriate protocol for emergency treatment of needle stick and sharp accidents. However, approximately 65% reported that they keep detailed records of those accidents compared to 10% in India and in Germany 35% by dentists and dental assistants 42%, respectively (Mutters et al., 2014). Using puncture-resistant containers for sharp instruments was reported by most of the participants (88.4%) which is higher than that was reported in a previous study in Jordan (31.8%) and less than that was reported in Saudi Arabia (99.2%) (AlAhdal et al., 2017). Although the overall practice in dealing with sharp objects among the study sample is good, it is recommended to optimize the performance of appropriate disposing protocols

of sharp objects, compliance to the recommended guidelines during needle stick emergency, and maintaining detailed records of the accidents in the dental environment.

Conclusion

The overall practice level of infection-control measures among dental care providers in Makkah is good. There is an improvement in the adherence of dental care providers to the universal guidelines of infection control compared to previous studies. However, this level is not absolute as other studies have shown in various countries. Dental support staff showed less compliance with infection-control guidelines. Therefore, educational programs and training strategies should be implemented to maximize the compliance of dentists, as well as enhancing the compliance of dental support staff with infection-control guidelines.

Academic curricula should emphasize on infection-control practice, by including comprehensive theoretical and practical courses of the most current infection-control measures. Also, dental support staff should be certified in order to practice dental assisting and dental hygiene. Finally, consistent infection-control compliance evaluations of various dental environments by well-trained persons/specialized committee is highly recommended.

Reference

- [1] Ahmad IA, Rehan EA, Pani SC. Compliance of Saudi dental students with infection control guidelines. *Int Dent J*. 2013;63(4):196–201. doi:10.1111/idj.12030
- [2] Ahmed H. Methods of sterilization and monitoring of sterilization across selected dental practices in Karachi, Pakistan. *J Coll Physicians Surg Pak Oct*. 2015;10:713–716.
- [3] AlAhdal A, Aljehani W, Ali G, Bayoumi A. Knowledge, attitude and practice of infection control measures in private

- dental clinics in Jeddah, Saudi Arabia. *Int J Dent Oral Health*. 2019;5(1):1–6.
- [4] Al-Dwairi ZN. Infection control procedures in commercial dental laboratories in Jordan. *J Dent Educ*. 2007;71(9):1223–1227. doi:10.1002/j.0022-0337.2007.71.9.tb04388.x
- [5] Al-Omari MA, Al-Dwairi ZN. Compliance with infection control programs in private dental clinics in Jordan. *J Dent Educ*. 2005;69 (6):693–698. doi:10.1002/j.0022-0337.2005.69.6.tb03953.x
- [6] Aurangjeb AM, Zaman T, Badruddoza M. Practice of dental surgeons about dental splatter and aerosol. *City Dent Coll J*. 2013;10(2):10–16. doi:10.3329/cdcj.v10i2.16314
- [7] Banglani MA, Punjabi SK, Banglani M. Cross infection control-A study. *Pak Oral Dent J*. 2016;36(2):286–288.
- [8] Centers for Disease Control and Prevention. Guidelines for Infection Control in Dental Health-Care Settings. *MMWR: Centers for Disease Control and Prevention*. US Department of Health; 2003
- [9] Ch AN, Usman N, Kiran S, Zahra T, Khalid H, Akhtar MU. Cross infection control in dental institutions. *Pak Oral Dent J*. 2018;38 (4):419–422.
- [10] Christian M, Kikwilu EN. Knowledge, attitude, reported behaviour and perceived challenges to adhering to infection control measure in dental practice among dental practitioners in Tanzania. *Tanzan Dent J*. 2014;18(2):64–71.
- [11] DeCastro MG, Denys GA, Fauerbach LL, et al. APIC position paper: immunization. *Am J Infect*. 1999;27(1):52–53.
- [12] Di Giuseppe G, Nobile CG, Marinelli P, Angelillo IF. A survey of knowledge, attitudes, and behavior of Italian dentists toward immunization. *Vaccine*. 2007;25(9):1669–1675. doi:10.1016/j.vaccine.2006.10.056
- [13] Gershon RR, Karkashian C, Vlahov D, Grimes M, Spannake E. Correlates of infection control practices in dentistry. *Am J Infect*. 1998;26(1):29–34.
- [14] Gordon B, Burke F, Bagg J, Marlborough H, McHugh E. Systematic review of adherence to infection control guidelines in dentistry. *J Dent*. 2001;29(8):509–516. doi:10.1016/S0300-5712(01)00043-4
- [15] Kazi MM, Saxena R. Infection control practices in dental settings-a review. *J Dent Allied Sci*. 2012;1(2):67–71. doi:10.4103/2277-4696.159148
- [16] Lamb A, Hong C, De Silva H, Thomson W, Broadbent J. New Zealand oral health practitioners' cross-infection control practices. *N Z Dent J*. 2019;115(1):5–10.
- [17] Mandourh, M. S., Alhomaidhi, N. R., Fatani, N. H., Alsharif, A. S., Ujaimi, G. K., Ghaida'a, M. K., & Afifi, I. K. (2017). Awareness and implementation of infection control measures in private dental clinics, Holy Makkah, Saudi Arabia. *International Journal of Infection control*, 13(1).
- [18] McCarthy GM, Koval JJ, MacDonald JK, John MA. The role of age-and population-based differences in the attitudes, knowledge and infection control practices of Canadian dentists. *Community Dent Oral Epidemiol*. 1999;27(4):298–304. doi:10.1111/j.1600-0528.1999.tb02024.x
- [19] McCarthy GM, MacDonald JK. Gender differences in characteristics, infection control practices, knowledge and attitudes related to HIV among Ontario dentists. *Community Dent Oral Epidemiol*. 1996;24 (6):412–415. doi:10.1111/j.1600-0528.1996.tb00890.x
- [20] Mehtar S, Shisana O, Mosala T, Dunbar R. Infection control practices in public dental care services: findings from one South African Province. *J Hosp Infect*. 2007;66(1):65–70. doi:10.1016/j.jhin.2007.02.008
- [21] Mitchell R, Russell J. The elimination of cross-infection in dental practice—a 5-year follow-up. *Br Dent J*. 1989;166(6):209–211. doi:10.1038/sj.bdj.4806775
- [22] Mutters NT, Hägele U, Hagenfeld D, Hellwig E, Frank U. Compliance with infection control practices in an university hospital dental clinic. *GMS Hyg Infect Control*. 2014;9(3):1–5.

- [23] Osazuwa-Peters N, Chinedu Azodo C, Oluyemisi Ehizele A, Ndubuisi Obuekwe O. Gender differences in characteristics, occupational exposure, and infection control practices among dental professionals in Edo State, Nigeria. *South Afr J Epidemiol Infect.* 2012;27 (2):61–65. doi:10.1080/10158782.2012.11441486
- [24] Sukumaran P, Pin CW, Hong OZ, Mariam A. An audit of infection control practices amongst dental students in University of Malaya, Malaysia. *Arch Orofac Sci.* 2017;12(1):1–13.
- [25] Taiwo J, Aderinokun G. Assessing cross infection prevention measures at the Dental Clinic, University College Hospital, Ibadan. *Afr J Med Med Sci.* 2002;31(3):213–217.
- [26] Yadav BK, Rai AK, Agarwal S, Yadav B. Assessment of infection control practice in private dental hospital. *Int J Res Med Sci.* 2017;5 (11):4737–4742. doi:10.18203/2320-6012.ijrms20174687