Compliance with infection control standard precautions guidelines: a survey among dental healthcare workers in Hail Region, Saudi Arabia

Hassan Kasim Haridi, Abdalmohsen Saud Al-Ammar and Moazzy Ibraheim Al-Mansour

Journal of Infection Prevention
2016, Vol. 17(6) 268–276
DOI: 10.1177/1757177416645344
© The Author(s) 2016
Reprints and permissions:
sagepub.co.uk/journalsPermissions.nav
jip.sagepub.com

Abstract

Background: The concept of standard precautions (SP) has been a cornerstone of dental infection control (IC) practice. Full adherence with SP guidelines is still a matter of concern in many institutions. The objectives of the present study were to assess and characterise compliance with SP guidelines among dental healthcare workers (DHCWs) and to analyse factors that affect compliance.

Methods: A regional cross-sectional questionnaire survey among DHCWs in all health facilities was carried out from August to November 2014.

Results: A total of 307 returned valid self-report questionnaires with a response rate of 73.1%. Most participants (86.3%) were aware of the SP guidelines, 84.4% received IC training and 88.9% received hepatitis B vaccination. Compliance with SP was found to be high; the majority (90.1%) attained 75% on the compliance scale. In the multivariate logistic regression model, perceived higher institutional commitment as regard IC requirements (odds ratio [OR], 4.34; $P < 0.001$), perceived training as adequate (OR, 3.51; $P = 0.003$), dentist job (OR, 2.99; $P = 0.035$) and younger age (OR, 0.59; $P = 0.041$) were independently predicted as good compliant behaviour.

Conclusions: This survey revealed high self-reported compliance with SP guidelines. Institutional factors appear to have an important role. Attention should be paid to dental assistants and private DHCWs.

Keywords

Standard precautions, compliance, dental healthcare workers (DHCWs), healthcare-associated infections, Saudi Arabia, infection control

Date received: 7 October 2015; accepted: 27 March 2016

Introduction

The intimate contact between patients and dental professionals and sharp instruments occurs under conditions of limited accessibility and poor visibility, during invasive procedures which frequently cause bleeding, and in the oral cavity which harbours a diverse, abundant and complex microbial community. This work environment exposes dental healthcare workers (DHCWs) to the risk of acquisition of blood-borne pathogens, including hepatitis B, hepatitis C, HIV and other potentially serious infectious diseases (Walsh, 2011).

The 2003 Center for Disease Control (CDC) Guidelines (CDC, 2003) are a comprehensive and evidence-based source for infection control practices relevant to the dental clinic that have been developed for the protection of DHCWs and their patients. It reduces the risk of

General Directorate of Health Affairs, Hail Region, Saudi Arabia

Corresponding author:

Hassan Kasim Haridi, General Directorate of Health Affairs, Hail Region, P.O. Box, 2510, Hail, 81461, Saudi Arabia.
Email: hassankasim@hotmail.com

transmission of microorganisms from known and unknown sources of infection (blood, body fluids, excretions, secretions, etc.). These standard precautions (SP) apply to all patients regardless of their diagnosis or presumed infection status. The principles of SP include: hand hygiene; the use of personal protective clothing, e.g. gloves; surgical masks; eye protection; management of healthcare waste; correct handling and disposal of needles and sharps; effective cleaning; decontamination and sterilisation of equipment; instruments and environment; and use of appropriate disinfectants.

Clinical dental and auxiliary staff should additionally protect themselves by ensuring up-to date immunisation against hepatitis B and other infectious disease (CDC, 2011).

All dental staff engaged in any aspect of the care of the patients should receive thorough training and understand the policies adopted in the practice of prevention of cross-infection and cross-contamination (CDC, 2003).

In spite of the long period since the introduction of the concept of SP, full adherence is still a matter of concern in many institutions, even in developed countries (Oosthuysen et al., 2014). Lack of appropriate knowledge of SP, lack of personal protective equipment (PPE), low-risk perception and low perception of institutional safety environment were frequent factors linked to non-adherence to SP (Gammon et al., 2008).

This survey was undertaken to assess the level of compliance with SP and its determinants among DHCWs in healthcare facilities in Hail Region, Saudi Arabia, in order to provide useful information for formulating evidence based training programs to promote safer dental healthcare.

Methods

Study design and location

A cross-sectional study was conducted between August to November 2014, among DHCWs in Hail Region, Saudi Arabia. The region is located at the north of the country in four governorates with an area of 103,887 km² and an estimated population of 670,468 (2014) (Central Department of Statistics, 2015). Dental healthcare services in the region are provided through 131 public and 37 private dental facilities (Dental Department, 2015).

Participants

DHCWs in all dental health facilities in the region that have direct daily contact with patients or specimens were the target population for the study. The total number of registered DHCWs in the region at the time of the survey was 471, of whom 274 were dentists and 197 full-time dental assistants (Dental Department, 2015). The survey aimed to reach all registered DHCWs during the survey period. Staff who

were on annual vacations, maternity leave, newly employed or engaged in administrative work were excluded.

Data collection tool

An anonymous, self-administered, pre-coded, structured questionnaire was used to assess the knowledge and practice of SP among the survey participants. The content of the questionnaire was developed from the literature on SP guidelines (CDC, 2003). The final data collection form has four main parts. The first part comprised eight questions on basic characteristics and biographical data (age and gender), assignment, affiliation, experience as a healthcare worker, previous training in infection control, adequacy of training and hepatitis B immunisation status. This section also included questions on the availability of a written infection control guidelines, instruction on the guidelines from the infection control team during workplace and work practices inspections and what to do in case of exposure to sharp injuries or to blood and body fluids. The second part contained eight questions which sought to ascertain the level of knowledge and understanding of the concept of SP, covering the following areas: general concept, hand hygiene, PPEs, dealing with needles and sharps, disinfection and environmental sanitation, sharps injuries and other occupational exposures to blood and body fluids, and transmission of blood-borne diseases. Items were in the form of closed questions (true or false, and multiple-choice options). The third part comprised seven questions to ascertain the level of compliance with SP, covering the following areas: compliance with SP guidelines with all patients all the time; wearing gloves in situations of high risk of exposure to biological agents such as dealing with procedures involving exposure to blood and other potentially infectious materials; hand hygiene before wearing gloves; hand hygiene after removing gloves; disposal of used needles and sharps separately from other wastes; compliance with safe handling of biological specimens; and compliance with precautions taken to prevent environmental spread of infectious material. The fourth part contained three questions concerned with the perception of institutional commitment to infection control requirements, including: provision of adequate supplies of PPEs; availability of hand-washing facilities with clean running water and hand hygiene products; and providing sufficient supplies for the collection of sharps and medical wastes.

A pilot test of the data collection tool was conducted with 20 dentists and dental assistants during dental symposium in February 2014.

Face and content validity of the questionnaire was assessed by four experts in the field of infection control and occupational health. The reliability was assessed by using Cronbach's alpha. The value of the coefficient for the overall items of the questionnaire was 0.73. A reliability coefficient (0.79) for the subsets of items included to ascertain the compliance with SP guidelines (practice); (0.78) for

items included to ascertain institutional commitment with infection control requirements and 0.41 for knowledge subset of questions were estimated.

Questionnaire administration

The data collection took place between August and November 2014. Three trained coordinators who did not have any medical, supervisory or administrative responsibilities at the time of the survey distributed questionnaires to participants present in each dental clinic at the time of the survey. Before questionnaire administration, coordinators gave a briefing on the aims of the study, emphasised the right of non-participation and confidentiality of the process. Participants were asked not to disclose their identity to assure them that this survey was only for academic purposes. Completed questionnaires were collected from each facility after 2 days of distribution.

Statistical analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) software, version 20.0 (SPSS, Chicago, IL, USA). Frequencies and percentages, means and standard deviations were used to summarise data, and Mann–Whitney U and Kruskal–Wallis tests of significance were applied, where appropriate.

For knowledge questions, a scoring system was assigned for the included items: 1, correct response; 0, incorrect and ‘do not know’ responses. For practice questions (compliance with SP) and questions related to institutional commitment with IC requirements, a scoring system was assigned for the included items: 1, for ‘never’; 2, for ‘rarely’; 3, for ‘sometimes’; and 4 for ‘always’. A scale was created for each domain with points attributed for each question, with maximum score of 8, 28 and 12 points for knowledge, practice and institutional commitment with IC requirements, respectively. To confirm whether the participants had good knowledge or good compliance, a correct response percentage of 75% or more was considered adequate. Indication of full compliance with SP was set at 90% of the maximum score to capture the important predictors of full compliance.

Compliance with SP guidelines as an outcome variable was analysed with binary logistic regression against the possible independent variables including demographic, professional and workplace characteristics, institutional factors; awareness and knowledge of SP guidelines, perceived institutional commitment with infection control requirements, and exposure to sharp injuries and/or to blood or body fluids (listed in Table 1). Any variable resulting in a value ≤ 0.25 in the univariate analysis was included in the multivariable model. The variables included in the model were then subjected to a backward multivariate logistic regression analysis to control the effect of confounding and determine the

significant independent predictors. The results of the logistic regression analysis are presented as odds ratios (ORs) and 95% confidence intervals (CIs). A two-sided *P* value for all tests < 0.05 was considered significant.

Ethical considerations

The protocol of the study was reviewed and approved by the Regional Bioethics Committee of the General Directorate of Health Affairs, Hail region, with the approval number 2014/3 dated 11/8/2014. Prior permission for the research proposal and data collection tool was obtained from the local health authority in Hail Region and individually from each health facility participated in the survey. Anonymity and confidentiality of the responses were maintained and voluntary participation and the right to non-participation was emphasised. Participation was considered as an informed consent.

Results

Of the 420 questionnaire distributed, a total of 318 were returned giving an initial response rate of 75.7%. A total of 11 questionnaires were incomplete and excluded from the analysis, giving a final response rate of 73.1% (307). Respondents from the private sector were less likely to participate in the survey compared to the respondents from the public sector ($n = 129$) 65.4% vs. ($n = 189$) 86.7%. Yet, the population was fairly representative for assignment, gender and age distribution compared to the reference population (Dental Department, 2014).

Of all participants, 165 (53.8%) were dentists and 142 (46.2%) were dental assistants. The age range was 20–59 years (mean age, 34.87 ± 8.67 years); dental assistants were younger with mean age (30.35 ± 7.78 years) compared to dentists (38.76 ± 7.44). Overall 96 (58.9%) dentists had practised ≥ 10 years, while dental assistants had less experience with only 24 (17%) having practised ≥ 10 years. The female-male ratio was 1:3.1 among dentists and 3.3:1 among dental assistants. A total of 189 (61.6%) belonged to the public sector, the 118 others (38.4%) were from the private sector. Table 2 displays the demographic and basic characteristics of the participants.

Table 3 describes the professional and institutional characteristics of the participants. Most of the participants (84.4%) received training in infection control with a significant difference ($P = 0.002$) between dentists (90.3%) and dental assistants (77.5%) and between participants from the public (90.5%) and private sectors (74.6%) ($P < 0.001$).

For assessment of participant knowledge (with maximum possible knowledge score of 8), the mean score (SD) was 4.91 (1.54); with median 5 (upper quartile score 6, lower quartile score 4). The minimum expected mean (75% of the maximum score) was 6 points. Only 38.4% achieved

Table 1. Logistic regression analysis of demographic, professional and institutional factors associated with good compliance* with standard precautions guidelines among dentists and dental assistants, in Hail region, Saudi Arabia, 2014.

Predictors	Univariate logistic regression		Multivariate [†] logistic regression	
	OR (95% CI)	P value	aOR (95% CI)	P value
Job (0, dental assistant; 1, dentist)	1.26 (0.76–2.09)	0.373	4.08 (1.32–12.61)	0.014
Gender (0, male; 1, female)	1.70 (1.02–2.82)	0.041		
Age (years) (0, <40; 1, ≥40)	1.01 (0.57–1.82)	0.965	0.23 (0.07–0.82)	0.023
Length of practice in years (0, <10; 1, ≥10)	0.60 (0.36–1.01)	0.054		
Practice setting (0, private; 1, public)	1.18 (0.71–1.98)	0.522		
Have received infection control training (0, no; 1, yes)	0.52 (0.24–1.08)	0.080		
Adequacy of the training received (0, inadequate, uncertain; 1, adequate)	4.06 (2.09–7.91)	<0.001	4.23 (1.71–10.45)	0.002
Aware with SPs guidelines (0, no; 1, yes)	5.26 (2.06–13.44)	<0.001		
Have a written IC guideline in his/her department (0, no; 1, yes)	0.75 (0.38–1.51)	0.422		
Have received instruction with IC guidelines (0, no; 1, yes)	3.00 (1.25–7.21)	0.014		
Received instruction about what to do in case of needlestick injury (0, no; 1, yes)	9.44 (3.18–28.03)	<0.001		
Received HB vaccination (0, no; 1, yes)	0.52 (0.22–1.27)	0.154		
Checked for HB antibodies after vaccination (0, no; 1, yes)	1.73 (0.98–3.04)	0.058		
Exposed to sharp injury/blood or body fluids in the last 12 months (0, no; 1, yes)	0.48 (0.29–0.81)	<0.01		
Perceived institutional commitment with infection control requirements (scale)	4.29 (2.83–6.51)	<0.001	3.82 (1.91–7.64)	<0.001
Knowledge of standard precautions guidelines (scale)	1.32 (1.10–1.59)	<0.01		

*Attained 90% of the compliance score (full compliance).

[†]Final model: -2Log likelihood = 109.15; X² = 46.80, df = 4, P < 0.001; Nagelkerke R² = 0.44.

aOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.

this minimum expected knowledge score. Comparing the two groups, the mean knowledge among dental assistants was 4.46 (±1.50) and the median was 5.0, compared to mean (SD) 5.30 (±1.47); the median was 6.0 among dentists, with significant statistical difference ($P < 0.001$).

The majority (88.9%) of the participants received hepatitis B vaccination, but only 67.5% had HB antibodies checked after vaccination.

With a maximum possible score of 28 for compliance with SP (practice), the mean score (SD) was 24.86 (3.40); with median 26 (upper quartile score 27, lower quartile score 23). The majority (90.1%) of the staff scored 75% of the maximum score.

Comparing the two groups, the mean compliance score among dental assistants was 24.96 (±3.18) and the median was 25.5; among dentists the mean was 24.79 (±3.60) and the median was 26.0, with no significant statistical difference ($P = 0.724$).

Table 4 depicts the mean scores ± SD and the percentage of attainment for every individual item of practice included in the compliance scale compared to the maximum score (maximum possible score of 4 for every item).

Table 1 presents the results of logistic regression analysis of demographic, professional and institutional factors associated with good compliance with SP guidelines among DHCWs. In the univariate analysis, the following

Table 2. Demographic characteristic and work settings among 307 dentists and dental assistants, in Hail Region, Saudi Arabia, 2014.

Characteristics	Total (n = 307) n (%)	Dentists (n = 165) n (%)	Dental assistants (n = 142) n (%)	P value*
Gender				
Male	160 (52.1)	125 (75.8)	35 (24.6)	<0.001
Female	147 (47.9)	40 (24.2)	107 (75.4)	
Age (years)				
<30	101 (32.4)	17 (10.3)	84 (59.2)	<0.001
30–39	125 (40.7)	78 (47.3)	47 (33.1)	
40–49	65 (21.2)	61 (37.0)	4 (2.8)	
50+	16 (5.2)	9 (5.5)	7 (4.9)	
Mean (SD)	34.87 ± 8.67	38.76 ± 7.44	30.35 ± 7.8	
Experience (years)				
<5	97 (31.9)	25 (15.3)	72 (51.1)	<0.001
5–9	87 (28.6)	42 (25.8)	45 (31.9)	
10–15	69 (22.7)	57 (35.0)	12 (8.5)	
16–20	30 (9.9)	23 (14.1)	7 (5.0)	
>20	21 (6.9)	16 (9.8)	5 (3.5)	
Mean (SD)	9.24 ± 6.47	11.61 ± 6.33	6.49 ± 5.47	
Work setting				
Public	189 (61.6)	104 (63.0)	85 (59.9)	0.816
Private	118 (38.4)	61 (37.0)	57 (40.1)	

*Chi-square test – Yates corrected.

predictors were found to be positively associated with the compliance behaviour with SP: female gender (OR, 1.70; 95% CI, 1.02–2.83; $P = 0.041$), awareness of SP guidelines (OR, 5.26; 95% CI, 2.06–13.44; $P < 0.001$), instruction in infection control guidelines (OR, 3.00; 95% CI, 1.25–7.21; $P = 0.014$), instruction about what to do in case of exposure to sharp injuries and/or exposures to blood and body fluids (OR, 9.44; 95% CI, 3.18–28.03; $P < 0.001$), higher perception of institutional commitment to infection control requirements (OR, 4.29; 95% CI, 2.83–6.51; $P < 0.001$), higher knowledge scores (OR, 1.32; 95% CI, 1.10–1.59; $P = 0.003$) and the received training described as adequate (OR, 4.06; 95% CI, 2.08–7.91; $P < 0.001$). Those who experienced sharp injuries and/or exposed to blood and body fluids reported lower compliance with SP guidelines (OR, 0.48; 95% CI, 0.29–0.81; $P = 0.00$).

In multivariate logistic regression model, adjusting for other predictor variables, perceived higher institutional commitment to IC requirements (OR, 3.82; 95% CI, 1.91–7.64; $P < 0.001$), received training described as adequate (OR, 4.08; 95% CI, 1.71–10.45; $P = 0.002$), younger age (≤ 40 years) (OR, 0.23; 95% CI, 0.07–0.82; $P = 0.023$) and dentist job (OR, 4.08; 95% CI, 1.32–12.61; $P = 0.014$) were the factors that independently predicted compliance with SP guidelines.

Discussion

Data about infection control practices among DHCWs in Hail Region is lacking. This survey was conducted to explore the compliance of DHCWs with SP guidelines in the region in order to guide infection control activities and training programmes and improve the safety climate in dental healthcare facilities.

Most of the participants (86%) were aware of the standard precautions guidelines and had received training in infection control (84%). This level of awareness was comparable to DHCWs in some other Gulf countries (Mustafa et al., 2015).

The results of the study demonstrated a good compliance with the SP guidelines. More than 90% reached a reported compliance score of 75% of the maximum score, and more than half of the staff (52%) attained 90% of the score or higher. Although these figures may represent an overestimate because they are derived from self-reporting of adherence to infection control practices (Larson et al, 2004), they are better than the findings of a previous study in 2002; which identified an 8.4% self-reported compliance with infection control procedures among dentists in Riyadh (Al-Rabeah and Mohamed, 2002). This could be in part due to higher institutional commitment towards establishing a

Table 3. Professional and institutional factors among 307 dentists and dental assistants, in Hail Region, Saudi Arabia, 2014.

Characteristics	Total (n = 307) n (%)	Dentists (n = 165) n (%)	Dental assistants (n = 142) n (%)	P value
<i>Aware of standard precaution guidelines</i>				
Yes	265 (86.3)	145 (87.9)	120 (84.5)	0.391*
No	42 (13.7)	20 (12.1)	22 (15.5)	
<i>Attended any IC training.</i>				
Yes	259 (84.4)	149 (90.3)	110 (77.5)	0.002*
No	48 (15.6)	16 (9.7)	32 (22.5)	
<i>Perceived adequacy of training received</i>				
Adequate	147 (47.9)	61 (37.0)	50 (58.1)	0.001*
Inadequate/uncertain	160 (52.1)	104 (63.0)	36 (41.8)	
<i>Have IC guidelines in his/her department</i>				
Yes	251 (82.6)	141 (86.0)	110 (78.6)	0.090*
No	53 (17.4)	23 (14.0)	30 (21.4)	
<i>Have instructed about IC guidelines.</i>				
Yes	258 (86.3)	136 (86.1)	122 (86.5)	0.910*
No	41 (13.7)	22 (13.9)	19 (13.5)	
<i>Have instructed about what to do in case of sharp injuries and exposure to blood and body fluids</i>				
Yes	242 (82.6)	137 (84.6)	110 (80.3)	0.331*
No	52 (17.4)	25 (15.4)	27 (19.7)	
<i>Received HB vaccination</i>				
Yes	271 (88.9)	147 (89.1)	124 (88.6)	0.886*
No	34 (11.1)	18 (10.9)	16 (11.4)	
<i>Checked for HB antibodies (for vaccinated)</i>				
Yes	183 (67.5)	96 (65.3)	92 (74.2)	0.091*
No	88 (32.5)	51 (34.7)	31 (25.8)	
<i>Exposed to sharp injuries or blood and body fluids in the last 12 months</i>				
Yes	130 (42.3)	76 (46.1)	54 (38.0)	0.1556*
No	177 (57.7)	89 (53.9)	88 (62.0)	
<i>Scale of knowledge[†] of SPs (mean ±SD)</i>	4.91 ± 1.54	5.30 ± 1.47	4.46 ± 1.50	<0.001 [‡]
Median (25, 75 percentiles)	5 (4, 6)	6 (4, 6)	5 (4, 5)	
<i>Scale of compliance[§] with SPs (mean ±SD)</i>	24.86 ± 3.40	24.79 ± 3.59	24.96 ± 3.18	0.724 [‡]
Median (25, 75 percentiles)	26 (23, 27)	26 (24, 27)	25 (23, 28)	
<i>Scale of perceived institutional commitment^{**} with infection control requirements (mean ±SD)</i>	10.93 ± 1.62	10.91 ± 1.80	10.96 ± 1.39	0.802 [‡]
Median (25, 75 percentiles)	12 (10, 12)	12 (11, 12)	12 (10, 12)	

*Chi-square test – Yates corrected.

†Maximum score = 8.

‡Mann–Whitney/Wilcoxon two-sample test (Kruskal–Wallis test for two groups).

§Maximum score = 28.

**Maximum score = 12.

HB, hepatitis B; IC, infection control; SPs, standard precautions.

Table 4. Response distribution of self-reported compliance with individual items included in the standard precautions compliance scale among 307 dentists and dental assistants, in Hail Region, Saudi Arabia, 2014.

Practice item	Score* Mean (SD)	% attained of maximum score
Follow SPs with all patients all time.	3.46 ± 0.69	86.5
Wearing gloves in high-risk situations exposing to blood and other potentially infectious materials	3.69 ± 0.64	92.3
Wash hands before wearing gloves	3.5 ± 0.79	87.8
Wash hands after removing gloves	3.76 ± 0.56	94.0
Dispose of used needles and other sharps separately from other wastes in sharps containers	3.8 ± 0.57	95.0
Compliant with precautions taken to prevent environmental spread of infected particulates	3.07 ± 0.98	76.8
Compliant with precautions taken for safe handling of biological specimens	3.39 ± 0.89	84.8

*Maximum score of 4 for every individual item.

safer dental healthcare, based on providing training, satisfying infection control requirements for both structure and process, and the investment of considerable resources into improving the quality of healthcare.

The crucial influence of institutional factors on compliance with SP was demonstrated in our study. Two independent predictors for good compliance out of four in the multivariate logistic regression model reflected this influence: the perceived commitment of the institutions to satisfy infection control requirements and the perception of adequacy of the received training. This implies that it is essential to emphasise, maintain and improve the structural support for infection prevention within the institutions to assure compliance with SP. The present study also demonstrated the importance of providing adequate supplies of PPE, containers used for collection of sharps and medical wastes, and hand-washing facilities with clean running water and hand hygiene products. This result was similar to the findings from other studies in which 'availability of protection equipment' was correlated with compliance with SP (Amaran et al., 2013; Garland, 2013; Gershon et al., 1995; Gulilat et al., 2014).

Adequate training is also an important influence on compliance with SP. The results of this study showed that 'describing the training provided by the institution as adequate' was an independent predictor of good compliance with SP. As reported by previous studies, training programmes for prevention of occupational exposures to blood-borne pathogens play a major role in enhancing knowledge and safe behaviour of HCWs (McCarthy et al., 1999; Shaghaghian et al., 2014; Wang et al., 2003; Yang and Mullan, 2011). Our study corroborates other studies which have demonstrated that staff with good practice have better knowledge (Abdulraheem et al., 2012; Al-Rabeah

and Mohamed, 2002; Gershon et al., 1995; Michalsen et al., 1997; Snyder, 1993; Tada et al., 2014).

The discrepancy between reported knowledge and practice identified by this study as indicated by a better practice score (90% of the staff achieved 75% of the maximum score) than the knowledge score (only 38% achieved 75% of the maximum score) may reflect the propensity of people to inflate their socially desirable behaviours when self-reporting (Larson et al., 2004). However, it might be also attributed in part to the compulsory rules of the institutions that necessitates the use of gloves and other PPEs, separation of needles and sharp objects in sharp containers and the availability and easy access to other IC equipment.

In our study, we found that DHCWs with lower compliance were more likely to report sharp injuries and/or exposure to blood and body fluids, confirming the importance of compliance with SPs in protecting from exposure to BBVs, a finding consistent with other studies (Gershon et al., 2009). Women were found to report a better compliance with SP, which was a frequent finding in similar studies (Gershon et al., 1995; McCarthy et al., 1999; Vaz et al., 2010), but contrary to some others (Tada et al., 2014). Younger age was found to be independently associated with good compliance with SP guidelines. This finding is consistent with those of other researchers who determined that younger healthcare professionals were more inclined to implement clinical practice guidelines than were older professionals (Cleveland et al., 2012; Francke et al., 2008).

Vaccination is one of the best ways to protect healthcare workers from infections, but vaccination is only available for HB virus. HB vaccine is 95% effective in preventing the disease and its chronic consequences (WHO, 2009). Earlier reports about hepatitis B vaccination converge among DHCWs in Saudi Arabia highlighted low coverage.

In 1991, only 25.3% of dental specialists, 14.4% of dental practitioners, 25.5% of dental assistants and 42.9% of hygienists were vaccinated (Al-Ruhaimi, 1991). In 2002, a better vaccination coverage (63.5%) was reported among dentists of the private dental sector in Riyadh (Al-Rabeah and Mohamed, 2002). The majority (88.9%) of the participants in the present study received HB vaccination, which is equal or higher than the rates reported from recent studies in Saudi Arabia (Al-Dharrab and Al-Samadani, 2012; Alqahtani et al., 2014; Al-Hazmi, 2015) and other countries (Adekanle et al., 2015; Giri and Phalke, 2013; McCarthy and MacDonald, 1997; Osman et al., 2015). The high rate of HB vaccine utilisation can be explained by being mandatory for all healthcare workers, available in all institutions and provided free of charge.

Post-vaccination testing for antibody to hepatitis B surface antigen (anti-HBs) response is indicated for DHCWs who have blood or patient contact and are at ongoing risk for injuries with sharp instruments or needlesticks. Knowledge of antibody response should guide appropriate post-exposure prophylaxis (CDC, 2003).

Our study found only 67.5% of staff had their HB antibodies checked. This is of concern because a recent report from south-western Saudi Arabia suggested that a considerable proportion of HCWs (23.3%) and health students (66.7%) were lacking anti-HBs and are susceptible to HB infections (Alqahtani et al., 2014).

We found that DHCWs in the private dental healthcare setting were significantly less likely to have received HB vaccination compared to their colleagues working in the public sector (82.8% compared to 92.6%) and to have a post vaccination HB antibody titre assessment (60.2% compared to 71.6%). This important problem should be addressed by the employing institutions.

Limitations

The results of our study may be subject to some limitations common to surveys. A major limitation is that measuring compliance on bases of self-reporting is likely to be associated with over-rating (Larson et al., 2004). Direct observation prospectively would be of value in verifying and complementing the present survey. Our research investigated exposures retrospectively which may be associated with recall bias, particularly in relation to sharp injuries and/or blood and body fluids; although less likely for important events (hepatitis B vaccination), or events practised repeatedly in daily work such as hand washing, disposal of sharps, etc. The knowledge subset of questions of the survey had low reliability (Cronbach's $\alpha < 0.7$), which could be due to relatively concise items in the subscale and variability; the knowledge subset of questions assessed a wider variety of aspects regarding infection control, therefore, heterogeneity of the knowledge subscale may have led to the low Cronbach's coefficient. A more

detailed knowledge questions will be considered in a subsequent study. Another limitation in the sample is that respondents from the private sector were less likely to participate in the survey compared to the respondents from the public sector (65.4% vs. 86.7% response rate, respectively). Yet, the population was fairly representative for assignment, gender and age distribution and both response rates were reasonable.

In conclusion, this study has indicated good self-reported compliance with SP guidelines among DHCWs, but this needs to be verified by a further direct observation study. The study also confirms the importance of infection control education in increasing compliance with SP and the need to especially target dental assistants and HCWs in the private sector. Training programs should be tailored to satisfy the educational needs of these audiences.

Acknowledgements

We thank the Regional Dental department of the General Directorate of Health Affairs, Hail Region, Saudi Arabia for giving permission to conduct the study and for their cooperation during the process of data collection. Our thanks also go to the study participants, who devoted their time to give valuable information.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Peer review statement

Not commissioned; blind peer-reviewed.

References

- Abdulraheem IS, Amodu MO, Saka MJ, Bolarinwa OA and Uthman MMB. (2012) Knowledge, awareness and compliance with standard precautions among health workers in north eastern Nigeria. *Journal of Community Medicine & Health Education* 2: 1000131.
- Adekanle O, Ndububa DA, Olowookere SA, Ijarotimi O and Ijadunola KT. (2015) Knowledge of hepatitis B virus infection, immunization with hepatitis B vaccine, risk perception, and challenge to control hepatitis among hospital workers in a Nigerian tertiary hospital. *Hepatitis Research and Treatment* 2015: 439867.
- Al-Dharrab A and Al-Samadani K. (2012) Assessment of hepatitis B vaccination and compliance with infection control among dentists in Saudi Arabia. *Saudi Medical Journal* 33: 1205–1210.
- Al-Hazmi AH. (2015) Knowledge, attitude and practice of dentists concerning the occupational risks of hepatitis B virus in Al Jouf Province, Saudi Arabia. *Nigerian Journal of Clinical Practice* 18: 276–281.
- Alqahtani JM, Abu-Esy SA, Mahfouz AA, El-Meki AA and Asaad AM. (2014) Seroprevalence of hepatitis B and C virus infections among health students and health care workers in the Najran region, south-western Saudi Arabia: The need for national guidelines for health students. *BMC Public Health* 14: 577.

- Al-Rabeah A and Mohamed AG. (2002) Infection control in the private dental sector in Riyadh. *Annals of Saudi Medicine* 22: 13–17.
- Al-Ruhaimi KA. (1991) Response of dental professionals in Saudi Arabia towards hepatitis B vaccine and glove wearing. *Odonto-stomatologie Tropicale* 14: 24–28.
- Amoran O and Onwube O. (2013) Infection control and practice of standard precautions among healthcare workers in northern Nigeria. *Journal of Global Infectious Diseases* 5: 156–163.
- Center for Disease Control and Prevention (CDC). (2011) Immunization of Health-Care Personnel Recommendations of the Advisory Committee on Immunization Practices (ACIP). *Morbidity and Mortality Weekly Report* 60: 1–45.
- Center for Disease Control and Prevention (CDC). (2003) Guidelines for Infection Control in Dental Health-Care Settings—2003 CDC. *Morbidity and Mortality Weekly Report* 52: 1–61.
- Central Department of Statistics & Information, Saudi Arabia. (2015) Population estimates by province & administrative area 2010–2025. Available at: <http://www.cdsi.gov.sa/pdf/PopulationEstimates2010-2025-admareas.pdf> (accessed 13 July 2015).
- Cleveland J, Bonito AJ, Corley TJ, Foster M, Barker L, Gordon Brown G, Lenfestey N and Lux L. (2012) Advancing infection control in dental care settings: Factors associated with dentists' implementation of guidelines from Centers for Disease Control and Prevention. *Journal of the American Dental Association* 143: 1127–1137.
- Dental Department. (2014) General Directorate of Health Affairs, Hail Region, Saudi Arabia. Statistical Report 2014.
- Francke AL, Smit MC, de Veer AJ and Mistiaen P. (2008) Factors influencing the implementation of clinical guidelines for health care professionals: a systematic meta-review. *BMC Medical Informatics and Decision Making* 8: 38–49.
- Gammon J, Morgan-Samuel H and Gould D. (2008) A review of the evidence for suboptimal compliance of healthcare practitioners to standard/universal infection control precautions. *Journal of Clinical Nursing* 17: 157–167.
- Garland KV. (2013) A survey of United States dental hygienists' knowledge, attitudes, and practices with infection control guidelines. *Journal of Dental Hygiene* 87: 140–151.
- Gershon RR, Pearson JM, Sherman MF, Samar SM, Canton AN and Stone PW. (2009) The prevalence and risk factors for percutaneous injuries in registered nurses in the home health care sector. *American Journal of Infect Control* 37: 525–533.
- Gershon RR, Vlahov D, Felknor SA, Vesley D, Johnson PC, Delclos GL and Murphy LR. (1995) Compliance with universal precautions among health care workers at three regional hospitals. *American Journal of Infection Control* 23: 225–236.
- Giri PA and Phalke DB. (2013) Knowledge and vaccination status of hepatitis B amongst medical interns of rural medical college, Loni, Maharashtra, India. *South East Asia Journal of Public Health* 3: 19–22.
- Gulilat K and Tiruneh G. (2014) Assessment of knowledge, attitude and practice of health care workers on infection prevention in health institution Bahir Dar city administration. *Science Journal of Public Health* 2: 384–393.
- Larson EL, Aiello AE and Cimiotti JP. (2004) Assessing nurses' hand hygiene practices by direct observation or self-report. *Journal of Nursing Measurement* 12: 77–85.
- McCarthy GM, Koval JJ, John MA and MacDonald JK. (1999) Infection control practices across Canada: do dentists follow the recommendations? *Journal of the Canadian Dental Association* 65: 506–511.
- McCarthy GM and MacDonald JK. (1997) The infection control practices of general dental practitioners. *Infection Control and Hospital Epidemiology* 18: 699–703.
- Michalsen A, Delclos GL, Felknor SA, Davidson AL, Johnson PC, Vesley D, Murphy LR, Kelen GD and Gershon RR. (1997) Compliance with universal precautions among physicians. *Journal of Occupational and Environmental Medicine* 39: 130–137.
- Mustafa E, Humam A and Al-Mosuli T. (2015) Evaluation of dental assistants awareness concerning infection control policy of blood borne diseases. *Journal of International Dental and Medical Research* 8: 21–24.
- Oosthuysen J, Potgieter E and Fossey A. (2014) Compliance with infection prevention and control in oral health-care facilities: a global perspective. *International Dental Journal* 64: 297–311.
- Osman T, Omer A, Abdelmonem R, Ibrahim N, Sirag R, Elabdeen SZ and Khalifa N. (2015) Epidemiology of sharp injuries and hepatitis B vaccination among Sudanese dental house officers. *International Arab Journal of Dentistry* 6: 29–36.
- Shaghaghian S, Pardis S and Mansoori Z. (2014) Knowledge, attitude and practice of dentists towards prophylaxis after exposure to blood and body fluids. *International Journal of Occupational and Environmental Medicine* 5: 146–154.
- Snyder GA. (1993) Pennsylvania dental hygienists' knowledge, attitude and infection control practice in relation to AIDS and AIDS patients. *Journal of Dental Hygiene* 67: 188–196.
- Tada A, Watanabe M and Senpuku H. (2014) Factors influencing compliance with infection control practice in Japanese dentists. *International Journal of Occupational and Environmental Medicine* 5: 24–31.
- Vaz K, McGrowder D, Alexander-Lindo R, Gordon L, Brown P and Irving R. (2010) Knowledge, awareness and compliance with universal precautions among health care workers at the University Hospital of the West Indies, Jamaica. *International Journal of Occupational and Environmental Medicine* 1: 171–181.
- Walsh LJ. (2011) *Microbiology*. 7th ed. Sydney, Australia: Royal Australasian College of Dental Surgeons.
- Wang H, Fennie K, He G, Burgess J and Williams AB. (2003) A training programme for prevention of occupational exposure to bloodborne pathogens: impact on knowledge, behaviour and incidence of needle stick injuries among student nurses in Changsha, People's Republic of China. *Journal of Advanced Nursing* 41: 187–194.
- World Health Organization (WHO). (2009) Health topics, Hepatitis, Hepatitis B vaccines: WHO position paper. Weekly epidemiological record 84, 405–420. Available at: <http://www.who.int/entity/wer/2009/wer8440.pdf> (accessed 12 July 2015).
- Yang L and Mullan B. (2011) Reducing needle stick injuries in healthcare occupations: an integrative review of the literature. *ISRN Nursing* 2011: 315432.