Knowledge, Attitudes and Practice of Nurses in Renal Dialysis Units Regarding Infection Control in Abha City – Saudi Arabia, 2015

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ABSTRACT

Background: patients on hemodialysis are at risk of nosocomial infections especially Hepatitis C Virus (HCV) and Hepatitis B Virus (HBV). Nurses' adherence to infection control procedures is instrumental to control the transmission of the virus among patients. The identification of gaps in knowledge, attitudes and practices (KAP) of nurses aims at tailoring related training programs.
Aim: the study was conducted to determine the knowledge, attitudes and practices of nurses working in dialysis units regarding standard recommendations of infection control.
Methods: a cross-sectional study was conducted between December 2014 and January 2015 targeting all nurses in three dialyses units affiliated to the Ministry of Health in Abha city. Data was collected using a self-administered questionnaire to assess nurses' KAP and an observation checklist to report on the environmental aspects.
Results: one hundred and nine nurses were included with a response rate of 94.78%. Most of them were Saudi nationals (62.39%) and holding a diploma (78.90%). The percentage score was 60.18 ± 17.51 for knowledge, 85.59 ± 8.09 for attitudes and 92.11 ± 7.98 for practice. Nurses' practice was high despite the deficiency in knowledge. Gaps in practice were identified including not always adherent to hand washing (15% to 18%), use of eyewear when blood splash is likely (31.19%), simultaneous care for positive and negative patients (24.77%), passing needles from hand to hand (29.36%) and recapping needles after use (25.69%). Multivariate linear regression analysis revealed that attitudes towards infection control, attempt to access infection control guidelines, on job training and being non-Saudi independently predicted higher practice scores.
Conclusion: nurses' knowledge is deficient but their performance is significantly related to their attitudes. Nurses tend to be adherent to certain infection control practices than the others. Training in infection control should address the gaps in performance with emphasize on creating favorable attitude.
Keywords: Hepatitis C Virus, knowledge, attitude, practices, nurses, renal dialysis

INTRODUCTION

Chronic kidney disease (CKD) refers to either an irreversible decline in renal functions or a decrease in glomerular filtration rate (GFR) of less than 60 mL/min/1.73 m^2 over a period of time 3months or more [1]. CKD ranges from simple micro albuminuria marked by the leakage of excessive protein to the urine due to damage of kidney tissues with 5 distinct stages to end with end stage renal disease (ESRD) [2].

ESRD is considered a growing worldwide public health problem [3]. The growing problem of ESRD is attributed to ageing of the population and the increase in the rates of diabetic nephropathy, ischemic nephropathy and other comorbid conditions [3, 4].

The systematic reviews of 44 studies conducted in 2012 by Hassanien*et al*.[3] concluded that the incidence of ESRD is increasing in countries of Gulf Cooperation Council (GCC). A pilot study conducted by Alsuwauda *et al.*[5] in 2008 in commercial

centers in Riyadh, Saudi Arabia, showed that 5.7% of participants are affected by CKD. The incidence and the prevalence of ESRD has increased in last two decade by 15-20 fold in Saudi Arabia; the prevalence of ESRD is 753 per million populations with an annual incidence of 172 per million populations [6].

Renal replacement therapy (RRT) in the form of renal transplant or renal dialysis is deemed essential for survival for patients with ESRD. Renal transplant is the most cost effective approach that ensures a better quality of life yet not always available or affordable. Accordingly, renal dialysis is currently the most commonly adopted method [2, 3].

As of 2013, the number of the dialysis units in Saudi Arabia were 184 units affiliated to the Ministry of Health (MoH) (65%), governmental sectors other than the Ministry of health (12%) and private sector (23%) with a total of 5,086 dialysis machines serving 18,160

patients - 25% of them are in the waiting list of renal transplant - compared to 11,437 patients in 2011 [7]. It is predicted that the number of these patients will exceed 15,000 by the year 2015 [8].

Health care associated infections are considered frequent threats to the safety of patients on dialysis setting. Hemodialysis patients are vulnerable to hepatitis B virus (HBV), hepatitis C virus (HVC) and human immunodeficiency virus(HIV) infections for many reasons in dialysis setting including the failure to use proper hand hygiene, contamination of the instrument, or improper disinfection [9].

In the eastern Mediterranean region, the published figures of HBV associated with hemodialysis in 2004 were 11.8% in Bahrain [10] and 6% in Morocco [11]. The rate of HCV associated with hemodialysis in 1996 was 27% in Lebanon [12]. Much higher rate reaching 48.9% was reported from Syria in 1998 [13]. In Libya, the reported prevalence in 2012 for HBV with or without HCV in hemodialysis units ranged from 0% to 75.9% with an incidence of HCV conversion ranging from 1.5% to 31% [14]. In Yemen, in 2015, HCV among patients with ESRD on dialysis reached 40.2% [15].

Hemodialysis units are unlike any other general wards. The risks are magnified because of the type of patients. There are strong evidences supporting that the sharing of machines has a major role in the transmission of viral infection among patients on hemodialysis and suggested possible transmission via accidental contamination of the venous pressure monitoring system [16, 17]. Karkar *et al.*[18]predicted a reduction in the incidence of HCV among Saudi patients receiving hemodialysis from 2.4% to 0.2% if separate dialysis machine is used for patients positive for the virus in addition to the strict adherence to the universal infection control policies.

Best practice for infection control in dialysis has been described in several evidence based guidelines. These include guidelines developed by the Center for Diseases Control and Prevention (CDC) [19], the Association of Professionals in Infection Control (APIC) [20]and the World Health Organization (WHO) [21]. These guidelines[19,20, 21] address major safety measure such hand hygiene, use of personal protective equipment (PPE), injection safety, handling patient's items cleaning and disinfecting the external surface of dialysis, and the surrounding environment.

Infection acquired in hemodialysis units was found to be the main cause of hospital admission [22, 23].The compulsory immunization of ESRD patients on dialysis with hepatitis B vaccine brought down the rates of HBV infection [24]. HCV infection among patients on dialysis is now of serious concern. The treatment of HCV infection is very complicated as ribavirin often causes hemolytic anemia [25, 26]. Also, interferon based therapy and pegylated interferon (PEG-INF) are associated with very poor response because of low levels of the tolerability [27].

Concerted efforts should be directed to the prevention of HCV in hemodialysis setting by raising awareness of health professionals of the practice associated with the spread of the infection and empowering them to strictly adhere to infection control procedures.

The aim of this study was to acquire information regarding the awareness of nurses and the infection control procedures that should be followed in hemodialysis units to identify the gaps that should be addressed by education programs.

SUBJECTS AND METHODS

A descriptive cross-sectional study was conducted from December the 1st, 2014to January the 31st, 2015 in the three governmental renal dialyses units affiliated to the MoH in Abha city. These three dialysis units are Asser Central Hospital (ACH) dialyses unit with a capacity of 10 dialysis machine and serves a daily average of 20 patients, King Abdulaziz Daughter's dialysis center with a capacity of 38 dialysis machine and serves a daily average of 52 patients and Abha General Hospital (AGH) dialysis unit with a capacity of 45 dialysis machine and serves a daily average of 50 patients.

The target population of this study is nurses working in the three hemodialysis units in Abha city. A total of 115 of nurses are working in the dialysis unit of Asser central hospital (n= 18), King Abdulaziz Daughter's dialysis center (n= 41) and Abha General Hospital dialysis unit (n= 56). All nurses working in these centers, Saudi and non-Saudi nationals, and available during the time of the study were included in the study. From the 115 nurses working in these three dialysis unit, 109 nurses were available and included in the study giving a response rate of 94.78%.

Data were collected using a self-administered questionnaire and an observation checklist. A self-administered questionnaire

designed in English was used to collect data from nurses in hemodialysis units. The questionnaire is composed of 65 closed ended, pre-coded questions covering nurses' characteristics and working experience (12 questions), availability of infection control guidelines and equipment (3 questions). A set of 10 questions was designed to test nurses' knowledge. It has 22correct responses covering knowledge about hand hygiene, care for dialysis machine and patients' evaluation for infection. Nurses' attitudes were measured by 19 statements answered on 5 point scale ranging from strongly agree (scored 5) to strongly disagree (scored 1). Nurses' practice was evaluated by 21 statements answered on 5 point scale ranging from always (scored 5) to never (scored 1). Reverse scoring was considered for negative statements. A checklist was developed to report on the policy and environmental aspects of hemodialysis unit. The checklist is composed on 10 items inquiring into the presence of approved policy for infection control, presence of a protocol for the prevention and dealing with needle stick injury, dealing with patients infected with HBV and HCV, the use of separate dialysis machine for infected patients, presence of sharp box, hand washing basin and limiting visitors to the unit.

A list of nurses working in the three dialysis unit was constructed. Several visits were paid to the dialysis units at the end of the morning and evening shift. Nurses available were met for 15 minutes at the end of their shift. They were introduced to the study, its purpose and intended outcome. Nurses were invited to participate. The questionnaire were distributed to the nurses and collected the next day. The dialysis unit was inspected by the investigator in the presence of the head nurse. The investigator filled the checklist during inspection of the unit.

A pilot study was conducted in November 2014 in the dialysis unit in King Khalid University Hospital (KKUH) in Riyadh. The questionnaire and procedures of implementation of the study were tested on 11 nurses who represented 10% of the nurses working in the dialysis units in KKUH. The questionnaire was well understood by the nurses. The completion of the questionnaire took nearly 30 minutes. No modification was introduced to the questionnaire and methods of data collection based on the pilot testing.

Ethical approval was obtained from the Institutional Review Board (IRB) in King Saud University (KSU). Nurses were requested to participate and sign an informed written consent.

The Statistical Package for Social Sciences (SPSS ver. 19) was used for data entry and analysis. Frequency distribution and cross tabulation were conducted to identify data entry error. Data were described using the mean and standard deviation as well as number and percentages. Three scales were constructed for knowledge, attitudes and practices. The knowledge scale was constructed by assigning a score to each correct answer and summing the number of scores that ranged from zero to 22 then expressed as percentage of the maximum scores. It included three subscales for hand hygiene (11 correct responses; scores ranging from zero to 11), care for dialysis machine (3 correct responses; score ranging from zero to 3) and patients' evaluation (8 correct responses; score ranging from zero to 8). The attitudes scale was constructed by summing the responses to the 19 statements with a score ranging from 19 to 95 and expressed as percentage of the maximum scores. The practice scale was constructed by summing the responses to the 21 statements with a score ranging from 21 to 105 and expressed as percentage of the maximum scores. Higher scores on these scales indicate higher level of knowledge, attitudes and practice.

The Cronbach alpha reliability was used to test the reliability of the three developed scales. The Cronbach alpha was 0.749 for the knowledge scale, 0.733 for the attitudes scale and 0.769 for the practice scale. The Student's t-test and the one way analysis of variance (ANOVA) were used to test the significance in the percentage scores on the practice scale in relation to characteristics of nurses and working experience. Pearson's correlation (r) was used to test the linear association between the percentage scores on the practice scale and nurses' age, duration of practice, percentage scores on knowledge and attitudes scales. The full model and step wise linear regression analysis was conducted to identify the predictors of higher percentage scores on the practice scale. Significance of the obtained results was judged at the 5% level.

RESULTS

The study included 109 nurses. Their mean age ranged from 23.0 to 64.0 years with a mean of 30.4 ± 7.5 years. Most of nurses were Saudi nationals (62.4%). The majority of expatriate nurses were Indians (51.2%) and

Philippine (29.3%). The majority of nurses (78.9%) were holding a diploma in nursing. They were practicing for an average of 8 years (7.99±6.74 years) and they have been working in dialysis unit for an average duration of 6 years (6.1±5.07). More than half of the nurses reported receiving on job training in infection control (58.7%). Also, more than half of them received training in infection control in dialysis unit (51.38%); the last training of 82.15% of these nurses was within 6 months of the interview. The majority (85.3%) of nurses expressed a need for training in infection control in dialysis unit.

In respect to the availability of infection control guidelines and equipment in dialysis unit, the majority of nurses reported the presence of infection control guidelines in dialysis unit (81.7%) and they have attempted to access the guidelines (88.1%). The majority of nurses reported an adequate supply of infection control equipment including gloves (97.3%), masks (96.3%) and gowns (90.8%). Lower proportions reported an adequate supply of caps (77.1%) and biohazard containers (68.8%).

Nurses' knowledge of infection control was assessed in respect to hand hygiene, caring for dialysis machine and the evaluation of the status of patients on dialysis for hepatitis B and C infections. The overall mean percentage scores on the knowledge scale was 60.2±17.5 with a minimum of 22.7 and a maximum of 86.4.

In respect to the knowledge of situations associated with hand washing, 94.5% reported hand washing after removal of gloves and 89% of nurses reported hand washing before wearing of gloves. Lower proportion (59.6%) reported hand washing after preparation of dialysis machine.

Nurses' knowledge of situations associated with wearing gloves was, in order of frequency, preparing dialysis machine (87.2%), putting patients on dialysis (72.5%), when providing patients' care (67.9%), taking patients off dialysis (67.0%) and when handling care equipment (56.9%).

Knowledge of situations associated with replacing gloves, the most frequently reported situation by nurses was when providing care to each patient (87.2%) followed by before administration of intravenous medications (71.6%) and preparation of dialysis machine (60.6%).

Nurses were asked about their knowledge of the frequency of microbiological testing of dialysis machine. The largest proportion of nurses (74.3%) had the knowledge that microbiological testing should be performed on monthly basis. Much lower proportions (17.4%) had the knowledge that microbiological testing should be performed on quarterly basis while few reported at weekly (4.6%) and yearly (3.7%) intervals. The largest proportion of nurses (68.8%) had the knowledge that unused items taken to dialysis station should be disinfected or discarded if disinfection is not feasible while 44.95% reported returning the items to clean area. Almost one tenth (9.2%) had the knowledge that it can be used on other patients. Only 1.8% was not aware about how to deal with unused items taken to dialysis station. More than half of the nurses (56.9%) had the knowledge of the viability of hepatitis B virus on surfaces at room temperature for one week. A shorter duration of viability ranging from 12 hours to 72 hours was reported by 43.1% of nurses.

Of the factors that increase the susceptibility of dialysis patients to hepatitis B and C, the majority of nurses (82.6%) had the knowledge that the susceptibility of these patients to these infections increases because of sharing equipment in dialysis setting. This was followed by immunosuppressed status (56.9%), prolonged vascular access (29.4%). Only 1.8% of nurses did not know the factors that increase the susceptibility of patients on dialysis to hepatitis B and C. Knowledge of the use of alanine transaminase and aspartate aminotransferase was reported by 55.96% and 35.78% of nurses respectively. The use of anti-HCV was reported by 65.14% of nurses. Only 18.4% of nurses had the knowledge that the patients on dialysis should be monitored monthly for the early detection of infection with HCV. Three quarters of nurses (74.3%) had the knowledge that these patients should be monitored at quarterly intervals. Only 14.68% of nurses had the knowledge of re-screening patients on dialysis negative for hepatitis C every six months. The largest proportions (76.2%) reported intervals of 3 months while one tenth (9.2%) reported a monthly interval.

Nurses' attitudes towards infection control procedures in dialysis unit were explored in six areas including patients' susceptibility, testing and immunization of patients on dialysis, providing care to dialysis patients, susceptibility and protection of workers in dialysis units, the use of gloves and the infection control procedures in dialysis unit. The overall mean percentage scores on the

attitude scale was 85.6+8.1 with a minimum of 53.7 and a maximum of 95.8.

Inquiry was made into the practice of nurses pertinent to infection control procedures including hand washing, wearing gloves, the use of personal protective equipment, patients' care, handling dialysis items and dealing with the source of infection. The overall mean percentage scores on the practice scale was 92.1+8.0 with a minimum of 70.5 and a maximum of 100.

The percentage scores of nurses on the practice scale in relation to their characteristics and working experience is presented in table **1**. The table shows that the mean scores on the practice scale was significantly higher among expatriate nurses (P= 0.0000), those who received an on job training in infection control in dialysis unit (P= 0.0196), especially those who received recent training (P= 0.0023). The mean percentage scores was significantly higher among nurses who reported the presence of infection control guidelines (P= 0.0003) as well as those who attempted the access of the guidelines (P= 0.0023). No significant differences were observed in the percentage scores on the practice scale in relation to nurses' education degree, on job training in infection control, and the expressed need for more training in infection control in dialysis unit.

Table **2** shows that the percentage scores on the practice scale is significantly and positively correlated with nurses' age (r= 0.210, P= 0.028), the percentage of their scores on the knowledge of caring for dialysis machine (r= 0.317, P= 0.001) and the percentage scores on the attitudes scale towards infection control (r= 0.423, P= 0.000). No significant correlation was observed between the percentage scores on the practice scale and the duration of practice as well as the percentage scores on knowledge subscale related to hand hygiene and evaluation of patients' status.

Table**3** depicts the results of the full model linear regression of the percentage scores on the practice scale in relation to nurses' characteristics, working experience, and the percentage scores on the knowledge and attitudes scale. Adjusted for other variables, a significantly higher percentage scores on the practice scale is predicted by being an expatriate nurse (P= 0.012), receiving an on job training in infection control (P=0.000), attempt to access infection control guidelines (P=0.008) and the percentage scores on the attitudes towards infection control (P=0.000). This model explains only 37% of the variability in the percentage scores on the practice scale (Adjusted R square= 0.37).A higher percentage scores on the practice scale is independently predicted by higher scores on the attitudes scale towards infection control, attempt to access infection control guidelines, receiving on job training in infection control and being an expatriate nurse (Table**4**).

Inquiry into policy and protocol for infection control revealed that an approved policy for infection control is present and in place in the three dialysis unit. All units have a protocol for the prevention of needle stick injury and a protocol for the prophylaxis following needle stick injury. All units use separate dialysis machine for patients infected with HBV and HCV. Abha General Hospital doesn't have a protocol for dealing with patients with HBV and HCV. Asser Central Hospital and King Abdulaziz Daughters' dialysis Center don't have a protocol for dealing with patients with HBV but they have a protocol for dealing with patients with HCV(Table **5**).

A sharp box and an accessible hand washing basin is present in the three dialysis unit. Asser Central Hospital and Abha General Hospital limit visitors to dialysis area which was not the case in King Abdulaziz Daughters' dialysis Center (Table **5**).

DISCUSSION

It is universally recognized that the consistent and rigorous implementation of infection control measures reduces considerably the incidence rates of nosocomial infections. Interventions to improve adherence to infection control policies could reduce the prevalence of these infections, allowing more resources to be allocated to other areas of healthcare delivery. However, in different settings it has been repeatedly shown that the level of compliance with standard infection control procedures is sub-optimal [28-33], despite the fact that evidence-based procedures promoting appropriate practices are widely published [34, 35].

Nurses enrolled in this study showed an overall satisfactory level of practice of infection control procedures reflected by their overall scores of 92.11%. However, the Inquiry into the practice in different areas related to infection control procedures showed that nurses in dialysis unit are adherent more frequently to certain procedures than others. One of the lessons learnt from this study is that knowledge about infections and means of controlling it in healthcare setting is important however, the

translation of knowledge into practice is not always the case. Among nurses in this study, it is their attitudes towards infection control that predicted independently their practice. To cultivate proper practice culture amongst nurses working in dialysis units, it is prudent, therefore, to monitor and enhance, through effective measures, their attitudes towards infection control practices.

More than 90% of nurses in this study reported being always adherent to wearing gloves when attending to patients and drawing blood samples as well as the changing of gloves between patients. However, it has been observe that non-negligible proportions of nurses ranging between 15% and 18% were not always adherent to hand washing practices and 19.27% perceived that gloves substitute hand washing. The practice of hand hygiene before and after any contact with the patient and patient's environment and after removal of gloves fall in category I level of evidence in preventing infection in healthcare setting[20]. Although hand hygiene is the least expensive mean of preventing healthcare-associated infections, the prevalence of sub-optimal practice has been, and is still, high [36]. Failure to attend to hand hygiene has serious consequences, including the negative effects on patients' health and their confidence in healthcare delivery. Nurses are well placed to reinforce and vocalize good hand hygiene techniques to influence culture change and tackle hand-hygiene compliance at all levels in their healthcare institutions.

The extent of nurses' use of personal protective equipment was unsatisfactory in this study as 88% reported always wearing gowns though their adequate supply is maintained as reported by 90% of the nurses. Almost one third (31.2%) of nurses were not always adherent to the use of eyewear in situations involving splashing of blood. The review of literature conducted by Bublitz[37] have shown that renal dialysis nurses are at considerable risk of permucosal (splash) contamination with increased likelihood of acquisition of major communicable diseases including HBV, HCV and HIV. For the prevention of the transmission of infections in hemodialysis units, the CDC recommends the wearing of gowns, face shields, eyewear or masks by health workers to protect themselves and prevent the soiling of clothing when performing procedures during which spurting or splattering of blood might occur [38]. In this respect, Bublitz[37] emphasized that the availability of facial protective equipment and their suitability to healthcare

workers is of significant importance for adherence to their use.

Almost 90% of nurses in this study reported that they always clean vascular access under aseptic precautions before connecting patients and 96.33% reported that their secure vascular access under aseptic precautions after completing the dialysis session. The majority of nurses in this study acknowledged the susceptibility of patients on dialysis to HBV and HCV as reflected by their attitudes. However, their knowledge of the reasons was deficient as considerably low proportions of nurses attributed the susceptibility of dialysis patients to vascular exposure (29.4%) and immune suppression (56.9%). In contrast, 82.57% attributed the susceptibility of these patients to sharing of equipment. Eleftheriadis et al.[39] reported the impaired acquired immunity among patients on hemodialysis as a result of the uremic status, the dialysis procedure, the chronic renal failure complications and the therapeutic interventions for their treatment. Zacks and Fried[40] postulated different reasons for the causes and source of HCV and HBV in hemodialysis patients including blood transfusion, exposure to contaminated equipment and nosocomial routes such as patient-to-patient exposure and duration of hemodialysis.

Only two thirds (67.9%) of nurses in this study agreed that HBV and HCV may spread from sero-negative to sero-positive patients. A substantial proportion of nurses agreed that the dialysis of sero-positive and sero-negative patients should not be in the same room (94.5%) and that a separate dialysis machine (91.8%) and equipment as chair and bed (85.3%) should be dedicated for seropositive patients. However, the simultaneous provision of care to sero-positive and sero-negative patients was reported by almost a quarter of nurses (24.8%) and this was the constant practice of 17.4% of them. This practice is against the recommended guidelines for infection control[38] and carries the hazards of the spread of infection among patients in dialysis attended by the same nurse. This erroneous practice maybe partially attributed to pressure of work and the high demand for nurses' services in this typically over-stretched healthcare facility [41].

The time between acquiring the infection with HBV or HCV is very long. It ranges from 45 to 160 days for HBV and from 14 days to 168 days for HCV. Chronic HBV infection is often asymptomatic and acute

infection could be symptomatic in 10% of children and 30 to 50% of adults. Published evidence suggests that HBV and HCV patients are capable to spread the infection despite no clear symptoms [42, 43].Persons with chronic infection with mutations in the precore region of the HBV genome that prevent the expression of HBeAg but allow the expression of infectious virus has been described. High titers of HBsAg have been observed in these persons despite the fact that they were HBeAg negative [44]. Different types of viral hepatitis are indistinguishable based on clinical symptoms alone and serologic testing is necessary to establish a specific diagnosis of hepatitis [45]. From these facts it is clear that patients who are acutely infected may be difficult to identify. These patients could be a potential hazard of infection to nurses, other healthcare workers and patients. Therefore the CDC guidelines recommend that all hemodialysis patients should be routinely tested on admission and, for susceptible patients, on monthly basis afterwards [38].

In this study, although 95% strongly agreed or agreed that testing patients for hepatitis B and C before the first dialysis session, approximately 30% of nurses strongly disagreed or disagreed that patients maybe seropositive without showing any manifestations, and only 18% correctly responded that hemodialysis patients should be tested on monthly basis.

The CDC guidelines recommend that all patients and healthcare workers in hemodialysis unit should be vaccinated for HBV. Dialysis machine and related peripherals could be a substantial source of transmission of viruses and bacteria. These include not only frequently touched surfaces, but also waste containers, blood tubing clipped to waste containers, and items placed machines such as dialyzer caps and medication vials [46, 47]. In addition, there is a significant likelihood that items used by patients or taken to patient's dialysis station could become contaminated with body fluids and serve as a substantial source of infection to other patients either directly or by contamination of the hands of personnel. In this study awareness and practice of nurses of these recommendations was adequate as the majority of them reported that they always dispose in designated container used dialyzer line and dialyzer (89.9%) and bedside single use items (95.4%). However, almost a quarter of nurses in this study were not always adherent to the disinfection of non-disposable items taken to the dialysis station.

The report of nurses in this study showed that a proportion of them were not adherent to the proper handling of needles in dialysis unit as 17% of nurses reported not always discarding needle at the point of use. Moreover, 29.36% of nurses reported passing needles directly from hand to hand and 25.69% reported recapping needles after use. These practices increase the risk of needlestick injury which is not uncommon in healthcare setting[48]and may be responsible for the transmission of at least 20 different pathogens as reported by Collins *et al.*[49]. The study of Mitsui et al (1992) which included PCR testing for HCV RNA in source patients and healthcare workers in Japan showed a 10% risk of transmission of HCV from a source patient with HCV RNA-positive blood following needlestick injury[50]. These facts suggest that occupational exposures will continue to occur despite improved methods of preventing exposure. Therefore measures to reduce risk-taking behaviours in regards to these occupational exposures among nurses should be implemented and frequently monitored.

Almost all nurses in this study agreed that healthcare workers in dialysis unit are at high risk of HBV and HCV infection and that protection with full dose of hepatitis B vaccine and adherence to infection control guidelines is essential for their protection. Indeed, adherence to infection control guideline is of paramount importance in view of the absence of hepatitis C vaccine. Findings of this study underscored the importance of the accessibility of infection control guidelines to nurses in dialysis unit as it predicted independently better adherence to infection control procedures.

This study showed that there are gaps in standard performance of nurses in dialysis unit that warrant the control of the spread of infections between patients and to healthcare workers. Training in infection control independently predicted better performance especially among those who received recent training. On job training in infection control should be frequent and emphasize on shaping nurses attitudes in addition to the delivery of sound knowledge and standard practice.

There are some limitations that should be acknowledged. The inclusion of only three hemodialysis units in one city limits the generalizability of findings to other hemodialysis centers in Saudi Arabia. The knowledge, attitude and practice of nurses were

based on self-report using a questionnaire form. In questionnaire-based surveys, participants typically tend to overstate their awareness and actual practices and select what they perceive to be an ideal response. Though direct observation of nurses' routine performance would have reflected more accurately their performance yet, it is often infeasible and may also influence the respondent's behavior.

In conclusion, it has been observed that the nurses tend to be adherent to certain infection control practice than the others. Overall, the performance of nurses is acceptable but the intention is to reach best practice in all related areas.

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Table 1: Percentage of scores on the practice scale in relation to characteristics and working experience of nurses in dialysis unit- Abha, 2015

Characteristic & working experience	No.	$\bar{x}$	s	Min	Max	Test of significance	P-value
Nationality							
Non-Saudi	41	95.66	4.35	83.81	100.00	4.4602*	0.0000
Saudi	68	89.97	8.89	70.48	100.00		
Education							
Diploma	86	91.72	7.80	71.43	100.00	0.9954*	0.3218
Bachelor degree	23	93.58	8.64	70.48	100.00		
On job training in infection control							
Yes	64	91.68	8.76	70.48	100.00	0.6667*	0.4873
No	45	92.72	6.77	74.29	100.00		
Training in infection control in dialysis unit							
Yes	56	93.84	7.22	70.48	100.00	2.3804*	0.0196
No	53	90.28	8.40	71.43	100.00		
Last training in infection control in dialysis unit							
6 month ago	46	95.01	5.60	74.29	100.00	5.5349**	0.0023
1 year ago	4	95.00	6.38	85.71	100.00		
2 years ago	4	81.90	13.20	70.48	93.33		
3 years ago	2	88.57	10.77	80.95	96.19		
		.	.	.	.		
Need of more training							
Yes	93	91.58	7.99	70.48	100.00	1.6787*	0.0961
No	16	95.18	7.45	70.48	100.00		
Presence of infection control guidelines							
No	20	86.43	7.58	71.43	96.19	3.7271*	0.0003
Yes	89	93.39	7.54	70.48	100.00		
Attempt to access infection control guidelines							
No	13	85.86	9.67	71.43	98.10	3.1279*	0.0023
Yes	96	92.96	7.39	70.48	100.00		

* Student1s t-test   ** ANOVA

Table 2: Correlation between the percentage scores on the practice scale and nurses' age, work duration and the percentage scores on the knowledge and attitudes scales – Abha, 2015

	r	P-value
Age (years)	.210	.028
Duration of nursing practice	.170	.078
Duration of practice in dialysis unit	.150	.119
Total Knowledge	.061	.531
Knowledge of hand hygiene	.060	.533
Knowledge of caring for dialysis machine	.317	.001
Knowledge of evaluation of patients' status	-.128	.185
Attitudes towards infection control	.423	.000

Table 3: Full model linear regression analysis of the percentage of scores on the practice scale in relation to nurses' characteristics, working experiences and the percentage scores on the knowledge and attitudes scale – Abha, 2015

Independent variables	Coefficient	SE	Standardized Coefficient	t	P-value
(Constant)	51.193	11.430		4.479	.000
Age (years)	-.057	.245	-.053	-.231	.817
Nationality (non-Saudi=1, Saudi=2)	-5.271	2.052	-.321	-2.568	.012
Education (Diploma=1, Bachelor=2)	-2.456	1.893	-.126	-1.298	.197
Duration of nursing practice (years)	-.281	.369	-.237	-.762	.448
Duration of practice in dialysis unit (years)	.353	.342	.224	1.035	.303
On job training in infection control (No=1, Yes=2)	7.641	1.784	.473	4.282	.000
Training in infection control in dialysis unit (No=1, Yes=2)	-3.665	1.982	-.231	-1.849	.068
Need more training in infection control (No=1, Yes=2)	.572	1.864	.025	.307	.760
Presence of infection control guidelines (No=1, Yes=2)	1.712	2.017	.083	.849	.398
Attempt to access infection control guidelines (No=1, Yes=2)	6.602	2.419	.269	2.729	.008
Total knowledge	-.013	.038	-.028	-.329	.743
Attitudes towards infection control	.391	.091	.397	4.287	.000

Adjusted R square = 0.370348

Table 4: Stepwise linear regression analysis of the percentage of scores on the practice scale in relation to nurses' characteristics, working experiences and the percentage scores on the knowledge and attitudes scale – Abha, 2015

Independent variables	Coefficient	SE	Standardized Coefficient	t	P-value
(Constant)	48.113	10.101		4.763	.000
Attitudes towards infection control	.374	.086	.379	4.361	.000
Attempts to access infection control guidelines (No=1, Yes=2)	7.242	1.900	.295	3.812	.000
On job training in infection control (No=1, Yes=2)	7.672	1.749	.475	4.385	.000
Nationality (non-Saudi=1, Saudi=2)	-3.497	1.291	-.213	-2.708	.008

Adjusted R square = 0.386264

Table 5: Infection control policy, protocol and facilities in the three dialysis units- Abha, 2015

Policy, protocol and facilities	Asser Central Hospital	Abha General Hospital	King Abdulaziz Daughters
Approved policy for infection control	Yes	Yes	Yes
Protocol for prevention of needle stick injury	Yes	Yes	Yes
Protocol for prophylaxis following needle stick injury	Yes	Yes	Yes
Protocol for dealing with patients with HBV infection	No	No	No
Protocol for dealing with patients with HCV infection	Yes	No	Yes
Separate dialysis machine for patients infected with HBV	Yes	Yes	Yes
Separate dialysis machine for patients infected with HCV	Yes	Yes	Yes
Presence of sharp box	Yes	Yes	Yes
Presence of an accessible hand washing basin	Yes	Yes	Yes
Limiting visitor to dialysis units	No	No	Yes