Available online at www.ujpronline.com
Universal Journal of Pharmaceutical Research
An International Peer Reviewed Journal
ISSN: 2831-5235 (Print); 2456-8058 (Electronic)

RESEARCH ARTICLE

INFECTION CONTROL: STANDARD PRECAUTION MEASURES KNOWLEDGE, ATTITUDE AND PRACTICE OF MEDICAL DOCTORS AND NURSES IN SUDAN

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Article Info:

Article History:
Received: 2 August 2021
Reviewed: 6 September 2021
Accepted: 8 October 2021
Published: 15 November 2021

Cite this article:
Saeed AA. Infection control: standard precaution measures knowledge, attitude and practice of medical doctors and nurses in Sudan. Universal Journal of Pharmaceutical Research 2021; 6(5):7-13.
https://doi.org/10.22270/ujpr.v6i5.666

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Abstract

Background and objectives: The emergence of life-threatening infections has highlighted the need for effective infection control programs in all health care settings. These programs are used to support hospitals in reducing the risk of healthcare-associated infection or nosocomial infection, and this study describes the knowledge, attitude, and practice (KAP) of standard infection control precautions among Health Care Workers in 3 teaching hospitals in Sudan.
Methods: A cross-sectional study was conducted between March and August 2018 among healthcare workers in 3 teaching hospitals: Omdurman Teaching Hospital, Khartoum Bahri Teaching Hospital and Khartoum Teaching Hospital in Sudan. Data for 254 nurses and 283 working physicians were collected via a self-structured questionnaire to assess the KAP core components of standard precautions. The percentage of professional knowledge and practice scores was calculated and occupational differences in the average professional knowledge and practice scores were ascertained.
Result: A total of 429 out of 537 participating healthcare workers completed the questionnaire with a response rate of (79.9%), of whom (52.9%) were physicians and (47.1%) were nurses, (39.6%) of doctors and (53.5%) of nurses have a good level of knowledge, about (96%) of doctors and (97%) of nurses wash their hands after handling any bodily fluids, and this indicates that nearly And the doctors have a similar level of practice as well as a positive attitude. Total (91.1%) of doctors and (85.6%) of nurses think that they can be the source of transmission.
Conclusion: Based on the findings of our study, the majority of nurses had good knowledge compared to fair knowledge physicians, with positive attitudes and practices of both physicians and nurses towards the infection control program. Policies that promote training of health care workers in standard precautions and ensure that infection control and prevention resources in health facilities are regularly provided are required in Sudan.
Keywords: Compliance, healthcare workers, infection control, standard precautions, Sudan.

INTRODUCTION

Nosocomial infections (NIs) or Hospital–acquired infections (HAI) spread worldwide, both developed and developing countries can be affected. It burden patient and public health[1]. Hospital acquired infection can be defined (An infection acquired in hospital by patient who was admitted for a reason other than that infection)[2]. Different pathogens such as bacteria, viral and parasites may cause nosocomial infections. The infecting organisms vary among different patient, health care settings, different facilities, and different countries[3]. In Sudan data regarding nosocomial infections are few. Today 1,400,000 patients directly and indirectly suffer from side effect of nosocomial infection according to statistics from World Health Organization (WHO)[4] and in the United States, the Centres for Disease Control and Prevention estimated roughly 1.7 million hospital-associated infections, from all types of microorganisms, including bacteria and fungi combined, cause or contribute to 99,000 deaths each year[5].

NIs has significant consequences on patients, their families, and the community as a whole e.g. increased morbidity, mortality, and length of hospitalization and may contribute substantially to raise both the direct and indirect cost of the health care services, which result in additional costs to treat infected cases[6]. The emergence

of life-threatening infections has highlighted need for efficient infection control programs in all health care settings which used to support hospitals in reducing the risk of health-care-associated or nosocomial infections[7]. These infection prevention measures can be cost effective and can yield substantial return on their investment. However, some measures will be more cost effective than others, achieving the same clinical goals[8]. WHO describes the infection control protocol as a various practices which, when used appropriately, restrict the spread of infections by focusing on monitoring and prevention of transmission of infections between patient and other patients, health care workers and visitors[7]. Infection control occupies a unique position in the field of patient safety and quality universal health coverage[1]. Inadequate infection control favors the spread of microorganisms in health care facilities that might cause health care associated infections (HAIs). HAIs aggravates the patient's general health status resulting in additional prescription of antibiotics, leading to increased cost for patients and the health care systems, antibiotic resistance as well as increase length of hospitalizations[9].

Standard Precautions:

Standard precautions are work practice that are required for basic level of infection control for all body substances (except sweat and tears) of all people considered to be potential source of infection and will help in preventing spread of infection between person to another[10] and should be performed for the treatment and care of all patient regardless of their infection status. These standard precautions include:

- Hand washing and antisepsis (hand hygiene).
- Use personal protective equipment when handling blood, body substance, excretion and secretion.
- Appropriate handling of patient care equipment and soiled linen.
- Prevention of needle stick/sharp injuries.
- Environmental cleaning and spells management.
- Appropriate handling of waste[7]. There are many precautions can prevent transmission of pathogens e.g.:

1. Contact precautions are intended to prevent transmission of infectious agent, which are spread by direct or indirect contact with patient or patient's environment[11].
2. Droplet precaution is intended to prevent transmission of pathogens spread through close respiratory or mucous membrane contact with respiratory secretions[11].
3. Airborne precaution prevents transmission of infectious agents that remain infectious over long distances when suspended in the air[11].

Role of Doctors in infection control: Complying with practice approved by the infection control committee, and the recommendations of antimicrobial use committee regarding the use of antibiotics. Notifying cases of hospital acquired infection to the team as well as the admission of infected patients and protecting their own patients from these infections. Finally instituting appropriate treatment for any infection[1].

Role of Nurses in infection control: Nurses play a major role in preventing and control of infection at primary, secondary and tertiary level[12]. They are responsible for providing medication, dressing, sterilization, disinfection and involved in more contact with patients and other healthcare workers. Therefore they are more exposed to barriers NIs[6].

This study aimed to identify the current infection control measures used, to assess the knowledge, behaviour and practice of physicians and nurses and to compare them with regard to infection control

MATERIALS AND METHODS

A descriptive cross-sectional based study. The data was collected from three teaching hospitals, Omdurman teaching hospital, Al-Khartoum-Bahrry teaching hospital and Al-Khartoum teaching hospital between March-August 2018 for 254 nurses and 283 medical doctors working in that hospitals using non-probability Convenience sampling method. Data was collected using a validated and pre- tested self-administered questionnaire that guided by the research objectives and the information obtained from WHO and centres for diseases control and prevention (CDC). Questionnaire was developed in English for doctors and translated to Arabic for nurses.

The questionnaire had five sections:

1. Demographics and requirement.
2. The knowledge about the standard precautions and transmission based precautions.
3. The attitude of doctors and nurses regarding infection control.
4. The practice of doctors and nurses in hand hygiene and using of personnel protective equipment.
5. The reasons for non-compliance with infection control standards.

Statistical analysis

Data was analysed by statistical package of social science (SPSS) version 23. Chi-square test was used to identify the different among categorical groups p-value, less than 0.05 was considered for statistical significance.

RESULTS

A total of 537 Health Care Workers (HCWs) (doctors and nurses) were included, 429 completely responded with response rate of 79.9%, concerning the professional categories of respondents 47.2% were nurses with response rate of (79.5%) and 52.9% were doctors with response rate of 80.2%. From nurses 24.8% were male while 75.2% were female, doctors 37.4% were male and 62.6% were female. The mean age of doctors was 26.6 (SD 5.2) while 38.2 (SD 10.4) for nurses, mean of work experience was 2.8 years (SD 3.9) while 14.62 (9.17) years for nurses. The remaining socio-demographic results presented in the Table 1.

Relationship between participants and infection control department:

Nurses had better communication (49.5%) with infection control department in area of health status compared to 33% form doctors, in area of provision of

preventive services and investigation for exposure by mean of 50.5% for all compared to 33.5% for doctors and in area of investigation of exposure 56.9% compared to 22.5% for doctors.

Table 1: Representation of the social and demographic characteristics of health care workers surveyed.

Characteristics	Doctors		Nurses	
Work position for doctors				
House officer	87	38.3%	-	-
Medical officer	74	32.6%	-	-
Registrar	57	25.1%	-	-
Consultant	9	4%	-	-
Qualification for nurses				
Diploma	-	-	97	48%
Bachelor's degree	-	-	89	44.1%
Other	-	-	16	7.9%

Nurses underwent more investigations before placed in their position in area of immunization status (61.9% compared to 41.4%), history of condition (54.5% compared to 38.8% of doctors), physical examination (56.4% compared to 41.4% for doctors) and received education program in infection control by mean of 42.1% compared to 39.6% for doctors as shown in Table 2.

Knowledge of HCWs about infection control:

Large number of nurses (70.3%) agreed that they know the presence of written protocol for infection control in their hospitals comparing to a small number of doctors (22%). The mean knowledge of doctors (71.4%) and nurses (67.6%) regarding hand washing materials was approximately similar as stated in Table 3, but the knowledge about the minimum time of hand washing which is 1 minute was found superior in doctors (40.5%) compared to nurses 25.7%. While nurses had more knowledge regarding the recap of needle. The knowledge of both nurses and doctors in keeping doors closed in situation of airborne disease was inadequate.

Overall level of knowledge of infection control protocol:

Association of knowledge score with different variant:

There is only a statistical significant relationship between the score percent of knowledge and the education program of infection control of nurses (p=0.045).

Practice of HCWs about infection control:

In area of practice for hand washing for 1 minute only 24.3% of nurses and 37 % of doctors wash their hands for at least one minute and (16.3%) doctors, (20.8%) nurses in time more than 1 minute. Practice regarding hand washing (Table 4) and frequency of changing PPE (Table 5) was approximately similar in both nurses and doctors. However, (39.6%) of doctors agreed with that they don't remember or care to frequently wash their hands also 16.3% of nurses stated it as shown in Table 4. Large number of nurses (57.9%) and doctors (70%) wash their hands with tap water as shown in Table 6.

Attitude of HCWs towards infection control:

HCWs had a positive attitude toward infection control. However, large number of them (74.8% from doctors 65.4% from nurses) thinks that the work load affects their ability to apply infection control guidelines. A few of them agreed with the lack of infection control policies in hospitals. The attitudes towards HAIs (Healthcare Associated Infections) were encouraging since a high percentage of respondents reported positive global and specific believes (75.8%) doctors and (54.9%) nurses disagree with the statement "I feel that infection control policies and guidelines are enough in the hospital".

Table 2: Representation of the main characteristics of the participants.

Characteristics	Doctors		Nurses	
	Yes %	No %	Yes %	No %
Communication with infection control department regarding				
Health status	33	67	49.5	50.5
Provision of preventive services	33.5	66.5	50.5	49.5
Investigation for exposure	22.5	77.5	56.9	43.1
Investigation done before placed in this position				
Immunization status	41.4	58.6	61.9	38.1
History of condition	38.8	61.2	54.5	45.5
Physical examination	41.4	58.6	56.4	43.6
Periodic laboratory test	-	-	43.6	56.4
Education program in infection control	36.6	63.4	57.45	42.6

Table 3: Representative level of knowledge of nurses and doctors about infection control.

Staff	Level of knowledge			
	Poor <50%	Fair (50-79 %)	Good > 80%	Mean±SD
Doctors	0.9%	59.5%	39.6%	2.39±0.5
Nurses	0 %	46.5%	53.5%	2.53± 0.5

Table 4: Representation of health care worker practice on infection control.

Characteristics	Doctors		Nurses	
	Yes %	No %	Yes %	No %
Frequency of washing hands				
After handling any body fluids	96	4	97	3
Between contact with different patients	83.3	16.7	91.9	8.9
Between task and procedure in the same patient	49.3	50.7	69.3	30.7
Immediately after removing gloves	81.5	18.5	91.6	7.6
Don't remember or care to frequently wash my hands	39.6	60.4	16.3	83.7

Total 74.5% from doctors and 68.8% from nurses disagree with statement "It is not my responsibility to comply with HAIs guidelines", 74.9% from doctors and 74.7% from nurses disagree with statement "I don't have to wash hands when I use gloves" these documents are important because they help to reduce the rate of nosocomial infection if HCWs comply with these documents. About believes, 89.8% doctors and 92.6% nurses believes that following the prevention guidelines will protect themselves, patients and visitors, 91.1% from doctors and 85.6% from nurses believes that they can be source of transmission.

Reasons for non-compliance of HCWs with infection control standards: The majority of doctors and nurses revealed that their reasons for non-compliance with using PPE and washing their hands is due to non-availability and lack of hand washing material respectively as shown in Table 7.

Table 5: Representation of the Frequency of Change of Personnel Protection Equipment (PPE).

Characteristics	Gloves		Masks		Protective clothing		Eye protection	
	Doctor %	Nurse %	Doctor %	Nurse %	Doctor %	Nurse %	Doctor %	Nurse%
After each patient	83	93.6	12.8	31.2	30	18.3	7.9	12.4
After few patient	6.6	2	18.1	23.3	15.4	13.9	4.4	7.9
Daily	2.2	2	14.1	7.4	8.7	17.3	4.8	9.9
More than once daily	4.4	1.5	10.1	8.4	7.5	5.4	3.1	3.5
If it is become soiled	1.8	1	7	7.4	7.4	11.4	4	4
I don't use	1.8	0	37.9	12.4	32.6	15.8	75.8	62.4

Table 6: Representation of knowledge of health care workers about hand washing materials.

Characteristics	Doctors		Nurses	
	Yes %	No %	Yes %	No %
Washing hands using plain soap	83.7	16.3	61.9	38.1
Washing hands using alcoholic hands rub	79.7	20.3	65.8	34.2
Washing hands using water less antiseptic agent	52	48	84.6	10.4
Washing hands using tap water	70	30	57.9	42.1

DISCUSSION

The mean of age 26.6 years for doctors and 38.2 years for nurses, this result is similar to the result reported in previous studies conducted in Sana'a city in Yemen that shows the majority of participant nurses were 25-year-old and above (6), also compared to a study in Nigeria with mean of 35 years for nurses and mean of 34 years for doctors[22]. In the present study most of participants are female with (62.2%) of doctors and (75. 2%) of nurse.

Relationship between participants and infection control department:

The current study revealed that (58.6%) doctors and (38.1%) nurses did not received investigations regarding immunization status before they were placed in this position. Therefore, both patients and HCWs were exposed to hospital acquired infections, in line to study in Zambia (76.4%) of nurses did not receive appropriate vaccination regarding infection control[12]. In our study, we found that a (63.4%) of doctors and (42.6%) of nurses didn't received an education program in infection control.

Knowledge of HCWs about infection control:

Large number of nurses (70.3%) agreed that they know the presence of written protocol for infection control in their hospitals comparing to a small number of doctors (22%). The mean knowledge of doctors (71.4%) and nurses (67.6%) regarding hand washing materials was approximately similar, but the knowledge about the minimum time of hand washing which is 1 minute was found superior in doctors (40.5%) compared to nurses 25.7%. In overall level of knowledge (53.5%) of nurses were with good knowledge comparing with (39.6%) of doctors, and (46.5%) of nurses with fair knowledge comparing with the large number of doctor (59.5%) with fair knowledge, only (0.9%) of doctors with poor knowledge and the result show no poor knowledge for nurses, which is low compared to study conducted in hospital of Kerman city showed 74.5% of nurses had good knowledge about hand hygiene[4]. A finding of similar study in Palestine show that two-third of the study group didn't have previous course in infection control and half of them with fair knowledge, the author suggested that this finding was due to inadequate training in infection control program[15], also a study conducted in Zambia revealed that (86.7%) of their participants didn't attend service training regarding infection control and (68.9%) of them had poor knowledge[12]. In addition, study in Yemen showed that (71%) of nurses with fair knowledge and (3%) with poor knowledge[6], whereas in Zabol (43%) of

nurses with poor knowledge and (51%) with average knowledge, Comparing with study in Pakistan (73%) of HCWs with sufficient knowledge[5] and Compared to Kanwalpreet Sodhi study stated that in their study the overall knowledge and awareness regarding different infection control practices were excellent[16].

Association of knowledge score with different variant:
In the present study we found that there is a significant relationship between score percent of knowledge of nurses and education programs (p=0.045) but doctors didn't have this significant relationship.

Table 7: Representation of reasons for non-compliance of health care workers with infection control.

Characteristics	Doctors		Nurses	
	YES%	NO%	YES%	NO%
Why wouldn't you wear personnel protective equipment?				
Time consuming	23.8	66.2	12.9	87.1
Not comfortable	23.3	76.7	10.4	89.6
Not available	81.5	18.5	69.8	30.2
Not important (no risk for HAIs)	11	89	16.8	83.2
Why wouldn't you wash your hands?				
Lack of hand washing	68.3	31.7	56.4	43.6
Materials				
Causes irritation and Dryness	19.8	80.2	17.8	82.2%
Low risk of acquiring	10.6	89.4	20.8	78.2%
Infections				
No time, busy practice	25.6	74.4	23.8	76.2%
I forget to do	27.8	72.2	18.3	81.7%

There's no significant relationship with age, work experience, qualification and experience for both doctors and nurses. Unlike a study conducted in Palestine there's no significant relationship between score percent of knowledge and education programs for nurses, in contrast there is a significant relationship between score percent of knowledge for doctors and their work position (p=0.03) and education programs (p=0.043) but there is no relationship with gender (p=0.094) and work experience (p=0.053)[15]. Similar result in Juba reported that there's no significant relationship between score of knowledge and gender[20].

Practice of HCWs about infection control:

Failure to perform appropriate hand hygiene is considered to be the leading cause of health care associated infections (HCAIs), because that hand hygiene is a major component of standard precautions and one of the most effective methods to prevent the transmission of pathogens associated with health care[26]. The current study shows that(96%) doctors and (97%) nurses wash their hands after handling any body fluids, (83.3%) doctors (91.1%) nurses between contacts with different patients, (69.3%) of nurses wash between task and procedure in the same patient but less than half of doctors do that, and usually most of them work in the surgery unit, (81.5%) doctors (91.6%) nurses immediately after removing gloves, (39.6%) doctors (16.3%) nurses don't remember to wash their hands. This malpractice may lead to transmission of HAIs.

This result is similar to the result reported in study in dental clinics in Khartoum state, Sudan, which revealed that (89.6%) of dentists wash their hands before and after each patient and (93.6%) of them after removing gloves[10], compared to a study conducted in Ethiopia which showed that (68.7%) of HCWs wash their hands before examining patients[18], and a study in Zambia, (75.4%) of nurses wash their hands before and after direct contact with patient[12], another study in Namibia (72.8%) of health science students wash their hands before and after contact with patients and (87.7%) after the removal of gloves[25]. In line of a study conducted in Iran which concluded that (85.5%) of nurses wash their hands after touching body fluids[27], compared also to study in Bolan medical complex hospital (BMCH) in Pakistan stated that about >70% respondents had insufficient knowledge of hand hygiene, 97% from respondents always wear gloves when touch body fluid, 75% of participants always changes gloves between patients and 25% not always used, 70% respondents never re-use disposable gloves and 30% had opposite practice.[13] Regarding the materials used by nurses and doctors to wash their hands in the current study we found that (79.7%) doctors, (65.8%) nurses use alcoholic hands rub and (52%) doctors, (84.6%) nurses use water less antiseptic agent and also large number use the plain soap 83.7% from doctors and 61.9% from nurses. All these materials are recommended by CDC and WHO. The CDC recommend that when hands are visibly dirty or contaminated with proteinaceous material or are visibly soiled with blood or other body fluids, wash with either a non-antimicrobial soap and water or an antimicrobial soap and water and if it is not visibly soiled, use an alcoholic-based hands rub for routinely decontamina-ting hands, WHO recommended that if exposed to a potential spore-forming pathogens is strongly suspected or proven, including outbreaks of *Clostridium difficile*, hand washing with soap and water is the preferred means[26,28]. Total 70% doctors, 57.9% nurses use tap water to wash their hands. Definitely use of tap water alone is not enough to decontaminate hands and the quality of water is important in hand washing when performing an operation.

Comparing with the study conducted in dental clinics by Idris which had a results lower than our study that stated (19.2%) of dentist's wash their hand with ordinary soap and water, this difference may be because the dentist's apply all their work orally so there is high risk for transmission of infection if they don't wash their hands by antiseptic soap[10]. In the present study (37%) of doctors and (24.3%) of nurse wash their hands in time not less than 1 minute and (16.3%) doctors, (20.8%) nurses in time more than 1 minute. The CDC recommended that the minimum time for hand washing is not less than 20 seconds and WHO recommended that the time from 40 to 60 seconds for hand washing and from 3 to 5 minutes for surgeons[26,28]. With regard to the finding of PPE compliance in the present study, there's significance variation between the practice and the PPE recommendations. The use of PPE generally, except gloves is below the current recommendations. There is high adherence (83% doctors, 93.6% nurses) to the use of gloves after each patient in contrast to lower adherence to wear the other equipment's, and this is supported by the fact that the most reported reason for not wearing the mask and eye protection was “Not available”. The reason reported by study in dental unit is “no need for them”, this study similar to our study in that the highest adherence was to gloves wearing (99.2%) and the lowest to eye protection[10].

Attitude of HCWs towards infection control:

The attitudes towards HAIs (Healthcare Associated Infections) were encouraging since a high percentage of respondents reported positive global and specific believes, (75.8%) doctors and (54.9%) nurses disagree with the statement "I feel that infection control policies and guidelines are enough in the hospital, these documents are important because they help to reduce the rate of nosocomial infection if HCWs comply with these documents. Like a Study conducted in Zambia revealed that 52.8% of nurses don't think that infection control policies and guidelines are enough in the hospital[12].

About believes, 89.8% doctors and 92.6% nurses believes that following the prevention guidelines will protect themselves, patients and visitors. Similar result found in Italy show that 89.2% of HCWs think that hand hygiene measure reduces the risk of HAI among patients. Total 91% doctors, 85.6% nurses think that they can be source for transmission of hospital acquired infection[14]. Regarding the compliance to the guideline, 74.8% doctors and 65.4% nurses are unable to apply the infection control guidelines due to work load.

The HCWs have a positive attitude about hand washing when using gloves where 74.9% doctors and 74.7% nurses disagree with the statement “I don't have to wash hands when I use gloves”. This result is in contrast with the result reported in Zambia which showed that 96.9% of nurses think that it's not necessary to wash their hand when using gloves[12].

Only 18.1% of doctor and 28.7% of nurses believe that it not their responsibility to comply with IC protocol and this small per cent may affect in the transmission in HAI. Unlike a Study in Zambia showed that about 6.7% of nurse agrees with this statement[12]. Reasons for non-compliance of HCWs with infection control standards: In the present study (68.3%) of doctors and (56.4%) of nurses revealed that their reason for non-compliance with hand washing guidelines was lack of hand washing material” also the reason for non-compliance to wearing PPE, (81.5%) doctors and (69.8%) nurses stated that "not available”.

CONCLUSIONS AND RECOMMENDATION

Based on the findings of the current study, the majority of nurses had good knowledge compared to fair knowledge physicians, with positive attitudes and practices of both physicians and nurses towards the infection control programme. However, we conclude that the patient is exposed to infection-related illnesses due to lack of resources, inadequate training program and workload.

It's recommended to update doctors and nurse’s knowledge and practice through continuing in service educational programs and providing training program for new HCWs about infection control at regular intervals and it's advised to increase their communication with infection control department for optimal outcome. Investigation must be done for HCWs before employing. Also it's important provide HCWs with the needed materials to minimize risk of HAIs and health hazards.

ACKNOWLEDGEMENTS

The authors extend their thanks and appreciation to the National University, Sudan to provide necessary facilities for this work.

AUTHOR’S CONTRIBUTION

Saeed AA: Writing original draft, review, literature survey, editing, methodology, data curation.

DATA AVAILABILITY

Data will be made available on reasonable request.

CONFLICT OF INTEREST

No conflict of interest associated with this work.

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