

Original Research Article

## Predictors of Practicing Universal Precaution in Prevention of Nosocomial Infection among Medical and Nursing Students in a Nigerian Teaching Hospital

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### ABSTRACT

**Background:** Hospital acquired infections are increasingly becoming a public health problem and happen usually as a result of poor compliance to standard precaution practices among Health Care Workers (HCW). Health care students are exposed to infectious diseases during their clinical training and may have to perform certain procedures which place this young inexperienced population at a significant risk of contracting and transmitting such diseases.

**Objectives:** To determine the predictors of compliance with universal precaution practices among medical and nursing students in a Nigerian teaching hospital.

**Study design:** A cross-sectional study was conducted involving 423 under-graduate medical and nursing students from University of Maiduguri Teaching Hospital.

**Materials and Methods:** Respondents were selected using multi-stage stratified random sampling. Data was collected using a pretested structured self-administered questionnaire and analyzed using IBM-SPSS version 22. Chi-square test was used for association between categorical variables while Spearman's correlation was used to analyze correlation between continuous variables. Logistic regression was used to determine predictors of practice.

**Results:** The mean practice score was 63.7 ±8.7; about 72.8% had good practice. Predictors of practice were age (AOR = 1.2, 95% CI = 1.12 - 1.28) and year of studies (AOR = 2.4, 95% CI = 1.17- 5.40).

**Conclusion:** Majority of participants had good practice scores however there is still room for improvement.

**Key words:** Practice, Universal precaution, Predictors, Standard precaution, Nosocomial infection, Medical and Nursing students, Nigeria.

### INTRODUCTION

Nosocomial infections otherwise known as hospital acquired infections happen usually as a result of poor compliance to universal or standard precaution practices among HCW. [1] These diseases are increasingly becoming a public health problem as there are approximately

more than a million people who are infected with nosocomial infections in the world today. [2] Over 5000 people die yearly in the UK from these diseases, [3] and the prevalence in Nigeria has been reported to be as high as 28.9% in certain regions. [2]

Health care students are exposed to infectious disease patients and as part of

their clinical training may have to perform certain procedures on them which places this young inexperienced population at a significant risk of contracting as well as transmitting such diseases. [4] Compliance with standard precaution has been reported to be rather poor among health care students. [1,5,6] This may be as a result of limited supplies of personal protective equipment for training purposes especially in low income countries. [4]

The role of standard precaution is to prevent the transmission of such nosocomial diseases and also to serve as protection for health workers, students and patients. [4] Proper compliance however needs resources which is often lacking especially in developing countries. [1,7] Nigeria is a developing country that was among those affected by the recent *Ebola* virus disease outbreak. [8,9] This is an infection known for its high tendency for nosocomial spread [10,11] and is just one out of many others affecting the region. [12] This history further emphasizes the need for conducting studies to assess the level of compliance with standard precaution in the health care systems of such vulnerable countries. Continuous research provides updated data [13] which is useful for monitoring trends and improvements and is also useful towards implementation of intervention strategies. Therefore, this study aims to determine the predictors of compliance with standard precaution among medical and nursing students in a Nigerian teaching hospital.

## MATERIALS AND METHODS

Multi-stage Stratified random sampling method was used in selecting a total of 423 medical and nursing students for this cross-sectional study from August through September 2015 where 90.7% of the target population were responsive. These were health care students in their clinical years of training at the University of Maiduguri Teaching Hospital Nigeria. This is the only University with a teaching hospital in the North-Eastern part of Nigeria

which comprises of six states.

Participants that gave a written consent were administered a pre-tested structured questionnaire. This study instrument was used to collect data on socio-demography and practices regarding compliance with standard precaution such as hand washing, the use of hand sanitizers, the use of Personal Protective Equipment (PPE) such as gloves, facemask, goggles and apron, method of disposal of needles, sterilization and disinfection, and availability of facilities.

The questionnaire contained 21 questions of which 16 were positive and 5 were negative that assessed practices based on the responses “1= never, 2= sometimes, 3= often and 4= all the time”. Positive statements attracted one (1) mark for responding “never” and increased by one (1) mark for each response up to four (4) for “all the time”. Likewise for negative statements four (4) marks were awarded for responding “never” and decreased by one (1) mark for each response down to (1) for “all the time”. Practice in this study was categorized as good or poor based on a score above or below 70% of the total marks achievable respectively.

To assess the validity and reliability of the study instrument, face and content validity as well as internal consistency methods were used. This was done on 48 students which were about 10% of the total sample size. Validity was assessed by experts in the field while the Cronbach’s  $\alpha$  value for its internal consistency was 0.82.

### Statistical analysis

Using IBM SPSS version 22; data was analyzed. For descriptive analysis, frequencies and percentages were displayed for all variables. While for the analytical phase of the study concerning categorical variables, their association was determined by the Chi-square test method. Spearman’s rank correlation was also used to correlate continuous as well as ordinal variables. Simple logistic regression was used to reconfirm associations from Chi-square test, those variables with significant associations

were subsequently used for Multiple Logistic regression analysis to obtain adjusted odds ratios using Forward Likelihood-ratio (Forward L-R) at  $\alpha < 0.05$  and 95% confidence interval.

Before embarking on this study, ethical approval was first obtained from the study location which was University of Maiduguri Teaching Hospital in Nigeria. This was then followed by a second approval from the ethics committee for research involving humans at University Putra Malaysia who supervised this study.

## RESULTS

**Table 1: Distribution of participants by socio-demography (N = 423)**

Socio demographic Variable	Median	IQR	N	%
<b>Gender</b>				
Male			223	52.7
Female			200	47.3
<b>Age</b>				
<24	24	5	193	45.6
≥24			230	54.4
<b>Field of study</b>				
Medicine			251	59.3
Nursing			172	40.7
<b>Year of study</b>				
First year			57	13.5
Second year			62	14.7
Third year			63	14.9
Fourth year			62	14.7
Fifth year			65	15.4
Sixth year			114	27.0
<b>Ethnicity</b>				
Hausa			317	74.9
Yoruba			64	15.1
Igbo			42	9.9
<b>Religion</b>				
Islam			278	65.7
Christianity			145	34.3
<b>Marital status</b>				
Single			337	79.7
Married			86	20.3

Abbreviations; IQR, inter-quartile range

Socio-demographic characteristics of participants are shown in Table 1. The female population was less than males who formed 52.7% of the respondents. The youngest in terms of age was 16 years while the oldest was 39 years. The median age was 24 years (Inter-quartile Range = 5). Medical students were also the majority (59.3%) compared to their nursing counterparts. In terms of year of studies, the final year medical students or otherwise sixth-year students were 27.0% of the population which was the highest. The

majority ethnicity was Hausa (74.9%) which was the local language of the study location. Muslims (65.7%) were also the majority religion which is also common in the study location and single respondents were 79.7% of the total population which would be normal for undergraduate students.

Participant's responses to the universal precaution practices questionnaire are presented in Table 2. Hand hygiene practices were generally good as most respondents washed their hands regularly before (62.9%) and even more so after (78.7%) attending to a patient however, a lesser percentage (58.2%) would regularly use hand sanitizers every time they washed their hands. More than one-third (40%) of respondents did not regularly wear gloves when attending to patients. A majority (76.1%) practiced regular changing of gloves for each patient they attended and a similar proportion (76.1%) regularly covered their wounds with an impermeable substance before attending to patients.

Most of respondents (76.6%) would regularly use gloves even when contact is with sweat only, however unavailability was a problem as about half (49.4%) reported that the hospital did not provide adequate gloves to use for each patient. About one fifth (22.3%) had to attend to patients with their bare hands on a regular basis because of unavailability of gloves and a similar proportion (23.4%) had to buy their own gloves often because the hospital could not provide. Concerning other barrier methods, majority would regularly wear and apron (60.5%) and face mask (64.6%) but less than half (48.9%) would regularly wear goggles if there was a chance of exposure to and spillage of blood or bodily fluids.

About two-thirds of participants (63.3%) regularly recapped used needles while 75.1% would regularly dispose them in the sharps box. A majority (67.6%) would regularly clean surfaces used for patient care, a problem though was quarter of respondents (25.8%) would use only water to clean used equipment. An approximately equal number of respondents

practiced regular disinfection (67.9%) and sterilization (68.3%) of non-disposable equipment. The use of full Personal

Protective Equipment (PPE) when attending to highly infectious patients was regularly practiced by 67.6%.

**Table 2: Participants responses to universal precaution questionnaire (N = 423)**

Sr. No.	Statement	Never n (%)	Sometimes n (%)	Often n (%)	All the time n (%)
1.	I wash my hands before attending to every patient	42 (9.9)	115 (27.2)	85 (20.1)	181 (42.8)
2.	I wash my hands after attending to every patient	22 (5.2)	68 (16.1)	93 (22.0)	240 (56.7)
3.	I use hand sanitizers every time I wash my hands	45 (10.6)	132 (31.2)	101 (23.9)	145 (34.3)
4.	I wear protective gloves every time I attend to a patient	38 (9.0)	131 (31.0)	100 (23.6)	154 (36.4)
5.	I change gloves for each patient I attend to	37 (8.7)	64 (15.1)	78 (18.4)	244 (57.7)
6.	When I have a wound, I cover it with an impermeable cover before attending to patients	42 (9.9)	59 (13.9)	86 (20.3)	236 (55.8)
7.	When contact is with sweat only, I do not use gloves	201 (47.5)	123 (29.1)	56 (13.2)	43 (10.2)
8.	The hospital provides adequate gloves to use for each patient	91 (21.5)	118 (27.9)	83 (19.6)	131 (31.0)
9.	I attend to patients with my bare hands due to unavailability of gloves	190 (44.9)	139 (32.9)	62 (14.7)	32 (7.6)
10.	I have to buy my own gloves because the hospital cannot provide	184 (43.5)	140 (33.1)	59 (13.9)	40 (9.5)
11.	I wear protective apron if there is a chance of exposure to blood or bodily fluids	59 (13.9)	108 (25.5)	89 (21.0)	167 (39.5)
12.	I wear face mask if there is a possibility of spitting or spillage of bodily fluids	57 (13.5)	93 (22.0)	84 (19.9)	189 (44.7)
13.	I wear goggles if there is possibility of spitting or spillage of bodily fluids	96 (22.7)	120 (28.4)	81 (19.1)	126 (29.8)
14.	I recap used needles	94 (22.2)	61 (14.4)	59 (13.9)	209 (49.4)
15.	I dispose used needles in the sharps box	41 (9.7)	64 (15.1)	56 (13.2)	262 (61.9)
16.	I clean surfaces for patient care after use	48 (11.3)	89 (21.0)	97 (22.9)	189 (44.7)
17.	I wash all equipment used for patient care with water only	235 (55.6)	79 (18.7)	49 (11.6)	60 (14.2)
18.	I disinfect all non-disposable equipment used for patient treatment immediately after use	57 (13.5)	79 (18.7)	82 (19.4)	205 (48.5)
19.	I sterilize all non-disposable equipment used for patient treatment immediately after use	62 (14.7)	72 (17.0)	83 (19.6)	206 (48.7)
20.	When attending to highly infectious disease patients I always wear full personal protective equipment	45 (10.6)	92 (21.7)	76 (18.0)	210 (49.6)

**Table 3: Practice scores distribution of respondents**

Field of Study Practice categories					
		Poor Practice <50%	Average Practice 50%-69%	Good Practice ≥70%	Total
Medicine:	n	1	43	207	251
	%	0.4%	17.1%	82.5%	100.0%
Nursing:	n	0	71	101	172
	%	0%	41.3%	58.7%	100.0%
Total	n	1	114	308	423
	%	0.2%	27.0%	72.8%	100.0%

**Table 4: Association and correlation between socio-demographic variables and practice (N = 423)**

Socio-demography Practice scores						
	Good Practice n (%)	Poor Practice n (%)	$\chi^2$	df	$r_s$	P
<b>Gender</b>			2.104	1		0.147
Male	169 (75.8%)	54 (24.2%)				
Female	139 (69.5%)	60 (30.5%)				
<b>Age</b>					0.269	<0.001*
<b>Field of study</b>			29.080	1		<0.001*
Medicine	207 (82.5%)	44 (17.5%)				
Nursing	101 (58.7%)	71 (41.3%)				
<b>Year of studies</b>						
Medicine (4,5,6)					-0.034	0.595
Nursing (1,2,3)					0.343	<0.001*
<b>Ethnicity</b>			0.173	1		0.677
Hausa	229 (72.2%)	88 (27.8%)				
Others	79 (74.5%)	27 (25.5%)				
<b>Religion</b>			0.679	1		0.410
Islam	206 (74.1%)	72 (25.9%)				
Christianity	102 (70.3%)	43 (29.7%)				
<b>Marital status</b>			4.016	1		0.045*
Single	238 (70.6%)	99 (29.4%)				
Married	70 (81.4%)	16 (18.6%)				

Abbreviations:  $\chi^2$ , Chi-square; df, degree of freedom;  $r_s$ , Spearman's correlation; \*, p<0.05

The mean practice score was  $63.77 \pm 8.74$  and the minimum and maximum scores were 40 and 82 respectively. Practice scores distributions are presented in Table 3. Most respondents had good practice scores (72.8%). A higher proportion of medical (82.5%) compared to nursing (58.7%) students had good practice scores.

Practice categories were analyzed for association with categorical variables using Chi-square test while continuous and ordinal variables were correlated with continuous practice scores using Spearman's correlation. According to the results in Table 4, socio-demographic variables such as field of study and marital status were associated with practice while age and year of study also correlated with practice scores.

Variables with significant association and correlation with practice were entered into the final regression model and analyzed for independent predictors of practice. As shown in Table 4, the odds of having good practice was significantly higher with increasing age (AOR = 1.20, 95% CI = 1.122-1.286,  $p < 0.0001$ ), and with regards year of study fourth-year students were more than twice more likely to have good practice (AOR = 2.45, 95% CI = 1.117-5.402,  $p = 0.025$ ).

Table 5: Independent Predictors of practice (N=423)

Variables	AOR	95%CI	p
Age	1.20	1.122-1.286	<0.001*
Year of studies(4)	2.45	1.117-5.402	0.025*

Abbreviations: AOR, Adjusted Odds Ratio; CI, Confidence interval; \*,  $P < 0.05$

## DISCUSSION

Poor compliance with universal precaution as well as the unavailability of the required protective equipment has immensely contributed to the spread of the infectious diseases. [11] There is currently a low level of compliance with preventive measures among HCW [14] as well as poor knowledge of standard infection control practices especially in resource poor regions. [15] In view of this, this study assessed the practices of medical and nursing students with regards to compliance

with universal precaution such as hand hygiene, use of barriers, disposal of sharp instruments, sterilization and disinfection. From the results, a majority had good practices. In addition, which was similar to other studies unavailability is still a major hindrance to compliance with universal precautions was assessed in this study. Room for improvement still exists, as only total compliance among all HCW is acceptable.

The role of good hand hygiene practice in the prevention of nosocomial infections cannot be over-emphasized. However, compliance has been relatively low as previous studies have reported that less than half of HCW comply with the recommended hand hygiene practices. [14] This was also the case in this study as only a small proportion practiced good hand hygiene all the time, which was similar to another study in Nigeria. [16] More respondents practiced hand washing after as compared to before attending to a patient; an earlier study in Nigeria also had similar results. [17] This habit if left to persist poses a great risk to patients as studies have shown that without proper hygiene the hands are a source of infection and are capable of harboring blood borne pathogens under the fingernails for as long as 120 hours. [18]

Still concerning hand hygiene, using only water to wash the hands removes only a minor portion of microbes present by mechanical action only. However the use of hand sanitizers eliminates them more effectively both by mechanical and chemical action as well. [14] From findings in this study however, only a third of respondents used hand sanitizers for hand washing all the time. As much as negligence may be a seemingly obvious explanation, factors such as unavailability should also be taken into consideration. [7,19]

In terms of usage of barriers, the constant use of hand gloves was low. Only about one-third of respondents would always use them when attending to patients. This was different from what was reported

in another study in Nigeria [17] where compliance was much higher. Similarly, just over half of respondents changed gloves in between patients regularly which were a lower level of compliance compared to another study from Nigeria. [17] Unavailability also may also be related to the poor compliance towards usage of hand gloves in this study as less than a third of respondents reported to have access to hospital provided gloves all the time.

Usage of other protective clothing such as goggles, face mask and apron was also low in this study and similar to other studies in Nigeria [16,17] Lack of adequate protective equipment continues to be one of the major factors contributing to the high number of HCW affected by infectious diseases. [11,16] Therefore until this issue is fully addressed, HCW will continue to be on a somewhat suicide mission whenever they are treating patients with highly infectious and fatal diseases. The habit of constant compliance with universal precaution needs to be inculcated in young health workers or students because studies have shown that besides unavailability, negligence [16] which becomes a habit overtime also plays a role in non-compliance especially in highly demanding situations. [14] Therefore, to address this issue the habit of total compliance needs to be cultivated at an early age in health students and monitored throughout practice.

Only about two thirds of respondents regularly practiced proper disposal of needles in the sharps box and a fewer proportion would recap them before disposal. A similar problem was reported in another study in Nigeria where 80% would dispose but only 14% practiced recapping. [17] Junior health workers such as janitors who usually handle such waste have the least knowledge of infectious diseases [20] and poor practices such as this places them at significant risk of infection by needle stick injuries while performing their duties.

About 14% of respondents in this study would never disinfect non-disposable equipment before reusing, and a similar

proportion would never sterilize. Similar results were reported in Nigeria. [7] Unavailability of the required equipment for sterilization and disinfection has been cited as the most common reason for poor compliance [7] however, this is unacceptable as multiple uses of equipments without the proper infection control practices can lead to more harm than benefit. No figure is insignificant, as it only requires a single occurrence of such poor practices to result in hazard, therefore urgent intervention such as funding is needed to control and prevent such activities.

In this study, compliance with universal precaution in the prevention of nosocomial infections improved with age. Age was also a predictor of practice as after controlling for potential confounders as older respondents more likely to have good practice compared to younger ones. The association between age and practice was also reported by a study in Hong Kong [21] however, these findings were different from others in Nigeria [7] and Liberia. [22] This would mean that older and therefore more experienced respondents who correspondingly have better practices are better suited for handling sensitive tasks however, this might be somewhat difficult to achieve especially in outbreak scenarios where there is limited man power [14]

Field of study was associated with practice as medical students had better compliance than nursing. This association was however not significant after controlling for potential confounders. This result differed from what was reported from Nigeria. [7,17] Switzerland, [14] Hong Kong [21] and Korea [23] where nurses had better compliance. The nature of “hands on the job training” of nurses might explain why previous studies have reported nurses to have better compliance with universal precaution compared to doctors. The change in this trend observed in this study might be better explained by other factors probably peculiar to the study location.

Practice scores positively correlated with year of studies and after controlling for

potential confounders fourth-year students were more likely to comply with universal precaution compared to first-year students. The level of specialization of HCW has also been previously reported to be associated with practices in earlier studies in Hong Kong [21] where higher level workers had better compliance. However, recent studies in Nigeria reported results that differed from this. [7,17] At the location for this study, medical students begin clinical training at the fourth-year; at this stage they are being introduced and taught various aspects of clinical practice including compliance with universal precaution which might explain the association between this year and practice. This knowledge can be harnessed by putting more emphasis on the initial years of training as students may most likely practice what is being taught at this phase and retain it through later years. However to maintain this momentum, continuous supervision and close monitoring is required.

There was an association between practice scores and marital status in this study. A majority of married respondents had good practices compared to those that were single. This association was however not significant after multivariate analysis to control for potential confounders. This was similar to a study in Liberia [22] where more married respondents adhered to precautionary practices in preventing infectious diseases compared to singles. This result however differed from other studies in Nigeria. [7,17] Socio-cultural factors might provide an explanation for this association, which is beyond the scope of this study. Further research may need to be conducted to better explain the reasons behind this association.

## CONCLUSION

In conclusion a majority of respondents had good practices although adherence to certain preventive measures were still deficient, only 100% compliance in terms of practicing universal precaution is acceptable and therefore room still exists for

improvement. Significant predictors of practice were age and year of studies. Practice improved with increasing age and fourth-year students which were otherwise fresh medical students in clinical training were more likely to exhibit good practice of universal precaution.

## Recommendations

Practices cannot improve without availability of the required equipment therefore it is government's responsibility to first ensure both availability and accessibility to these necessities through increased funding before the issue of compliance can be tackled. Hand sanitizers should be made available and the practice of good hand hygiene should be made mandatory under any circumstance. The required equipment can be demanded by health workers as a condition for services. The full personal protective equipment kit should be made available to ensure familiarity with its use. Students should be trained on sterilization and disinfection procedures so they can perform themselves. Students follow the foot-steps of their mentors therefore examples need to be set and consistently followed by senior health workers. Students should be trained on the recommended universal precaution practices from the point of entry, and then henceforth continued close and regular monitoring should be done by government as well as hospital management to encourage compliance and continuity.

## Limitations

This study is limited by its cross-sectional nature as data collected represented information only at one point in time. The self reported nature of responses and the Hawthorne effect may affect reports of the actual practices compared to what would have been achieved through direct observation as participants sometimes have a tendency to report socially acceptable answers.

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

### **Ethical approval**

Ethical approval was obtained from the ethics committee of the University of Maiduguri Teaching Hospital as well as the supervising university for this study which was University Putra Malaysia.

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