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Infection Prevention and Control Practices, and Barriers to Compliance among Medical Doctors and Clinical Medical Students, in a State University Teaching Hospital, Southeast Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: Objective of study was to assess infection prevention and control practices, and barriers to compliance among doctors, and students in a state university teaching hospital.
Study Design: The study was of descriptive, cross sectional design.
Place and Duration of Study: Conducted in the departments of Medicine, and Surgery, Enugu state University Teaching hospital, Southeast Nigeria. Four weeks in August 2019 was used in collecting data from 61 doctors, and 100 students.
Methodology: Self-administered questionnaire was used in collecting information from respondents, selected through Convenience sampling method. Data was analyzed using Statistical Package for Social Sciences (SPSS) version 22. Results were expressed in frequencies and percentages of responses.
Results: More than 50.0% doctors reported compliance with hand hygiene, face mask use, eye goggle use, protective gown use, head cover use, hand gloves use, and disposal of sharps in

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Safety boxes. However, 95.1% of doctors recap used needles. Also, more than 50.0% of medical students reported good compliance with the above-stated items except for the use of eye goggles and use of hand gloves when attending to fever patients. Up to 76.0% of students recap used needles. Respectively, 70.5% of doctors and 67.0% of students identified inadequate supply of personal protective equipment as a barrier to compliance with infection prevention and control practices. Also, 67.2% of doctors and 65.0% of students forget to wash their hands as prescribed. 19.7% of doctors and 37.0% of students didn't know that needles/sharps should be disposed of in safety boxes.

Conclusions: Infection Prevention and Control (IPC) practices are relevant components of the healthcare system, and involve different methods designed to mitigate the risk of spreading infectious diseases in healthcare facilities. Most of the respondents in this study, had good hand hygiene, and personal protective equipment uses and practices, but the embarrassing level of recapping used needle practice.

Keywords: Infection; prevention; control; practice; barriers; doctors; students.

1. INTRODUCTION

Healthcare-associated infections (HAIs), also commonly called hospital-acquired infections have been a global healthcare delivery problem, but are worse in developing countries where the percentage of infected patients could be more than 25% in some settings [1]. For patients, these are infections that they did not have or incubate when they arrived at the healthcare facility. These infections could also manifest after the patients have been discharged home, or left the health care facility environment [2]. Generally, HAIs increase morbidity, mortality, patients' hospital stay, cost of health care, and development of antimicrobial drug resistance. HAIs are also occupational hazards to Health Care Workers (HCWs), and medical students [3-5]. It is estimated that the global disease burden resulting from exposure of HCWs to Hepatitis B and Hepatitis C was 40%; and 4.4% for HIV infection [6]. Visitors and caregivers could also be victims of HAIs. Some authors rated HAI as the commonest adverse event that threatens the safety of patients globally [7,8]. More than 80% of global HAI manifest as urinary tract infections (usually catheter-associated), surgical site infections, bloodstream infections (commonly associated with the use of intravascular devices), and pneumonia (usually associated with the use of ventilators) [9,10].

Infection Prevention and Control (IPC) is a discipline whose main objective is to prevent HAI [11]. IPC practice is an essential component of a good health care system. IPC measures are usually based on the route of transmission of the infectious agents [12]. Practices of IPC developed over years from "Isolation Techniques for use in Hospitals (1970)", "Universal Precautions (1985 – 1988)", "Body Substance Isolation (1987)" and finally settled for "Standard Precautions" in 1996. These efforts were usually championed by the United States Center for Disease Prevention and Control (CDC) [11]. While Universal Precaution was essentially in response to the emergence of HIV/AIDS transmitted through human blood and other materials, Standard Precaution is an improvement on Universal Precaution and Body Substance isolation. Standard Precaution is to be applied to all patients at all times and includes hand hygiene, respiratory hygiene, use of personal protective equipment (PPE), environmental cleaning, and waste management [13]. Standard precaution is the most effective way to prevent infection in the hospital and entails a set of recommendations designed to prevent or minimize exposure to infectious agents by hospital staff [12]. Standard precautions assume that the blood and body substances of all patients are potential sources of infection, regardless of the diagnosis, or presumed infectious status [14,15].

As a result of the COVID-19 pandemic; in addition to standard precautions, the Nigeria Centre for Disease Control (NCDC) recommended more key strategies to limit or prevent transmission of COVID-19 in health care settings. These are; early recognition and source control, implementing empiric additional precautions, implementing administrative controls, and use of environmental and engineering controls including ventilation [16]. Early recognition and source control strategy involves screening all patients that present in the health facility, isolating those that are suspected of harboring infection, and notifying the appropriate persons that will ensure proper

handling of the patients. Empiric additional precautions include contact, droplet and airborne precautions. On the other hand, Administrative controls are those steps such as training, setting up triaging areas etc, that the management is recommended to take, in other to prevent or control infections; while Engineering and Environmental controls ensure proper ventilation, provision of properly set up isolation room, provision of the closed suction system, erection of barriers, etc [16].

Medical practitioners and clinical students get exposed to a variety of infections in the hospital settings in the course of discharging their duties. This has severe public and personal health consequences [17,18]. Outcomes of some studies in America [19], Europe [20,21], Middle East Asia [22], and Africa [23,24] indicate that HCWs contract these infections while carrying out their various duties at their workplaces. Poor knowledge and practices of IPC have been reported among HCWs in Nigeria [25]. As an interface between patients and the health sector, HCWs are exposed to infections when they come in contact with infected patients and contaminated instruments [26,27]. Studies have also shown discrepancies between the level of knowledge of IPC among health care workers in tertiary institutions and its application in practices [28-30]. Several studies have shown the benefits of effective infection control measures in reducing morbidity and mortality, preventing disease transmission and developing of a cost-effective healthcare system [31-34].

It was observed in our study health facility, that even with the provision of hand hygiene stations, and some personal protective equipment for health care workers, many including medical doctors did not use them. This study was designed to assess the level of IPC practices, and the barriers that hinder good IPC practices among doctors and medical students in the facility. Findings from this study will ultimately be useful in planning and implementing better IPC practices in this health facility, and others.

2. MATERIALS AND METHODS

2.1 Study Area

This study was conducted in Enugu state, located in the southeastern part of Nigeria. Enugu State University Teaching Hospital Parklane is one of the four public tertiary health institutions in Enugu State, and it is a state government owned health institution. The other three are owned by the federal government of Nigeria. This state tertiary health institution and the University of Nigeria Teaching hospital are the only institutions in Enugu state, where medical students are trained [35,36]. This study was conducted in August 2019, in the Medical and Surgical Outpatient departments of the teaching hospital. The hospital had five clinical departments during the study period. These were Community Medicine, Internal Medicine, Surgery, Paediatrics, Obstetrics and Gynaecology. The other non-clinical departments usually found in any standard teaching hospital, also exist in our study teaching hospital. She had a total of 270 medical doctors of different cadres in her employ [37]. This study was conducted in the departments of Internal Medicine, and Surgery. Clinical medical students of Enugu State University College of Medicine undergo their clinical medical training in the teaching hospital. These were year four, five and six medical students.

2.2 Study Design

This was a descriptive, cross-sectional study.

2.3 Study Population

The study was conducted among doctors in the departments of Internal Medicine and Surgery, on one hand; and Clinical medical students that were doing their medicine or surgery rotations on the other hand. The hospital during the course of this study had 37 medical doctors in Internal Medicine department, and 34 in the Surgery department; making a total of 71 (seventy-one). Medical students that did their rotations in the Internal Medicine at that time were 68, while 63 did their Surgery posting, giving a total of 131 (One hundred and thirty-one).

2.4 Sample Size Determination and Sample Selection

Sample size determination, with the degree of accuracy set at 0.05 [38], gave 60 respondents for the medical doctors and 99 respondents for the Clinical medical students. Convenience sampling, which is a non-probability method, was used to collect information from 61 doctors and 100 medical students. One respondent each was added to the calculated sample sizes of the doctors and medical students, with the aim of slightly improving the validity of the findings.

The following formulae were used to calculate the sample sizes [38];

(A) $n = \frac{z2pq}{d2}$ (For sample calculation when population is over 10,000). Must be calculated first

(B) $nf = \frac{n}{1 + \frac{(n)}{(N)}}$ (Adjustment for population less than 10,000)

n = Desired sample size when population is greater than 10,000
z = Standard normal deviate, usually set at 1.96, which corresponds to 95 percent confidence level (0.05 accuracy)
p = Proportion in the target population estimated to have a particular characteristics. 50% (0.5) is usually used
q = 1.0-p
d = Degree of accuracy desired, usually set at 0.05.
nf = Desired sample size when population is less than 10,000
N = Estimate of the population size that is less than 10,000

2.5 Sampling Instrument and Data Collection

A self-administered, structured questionnaire was used to collect information from respondents over a period of one month. The questionnaire was divided into three sections namely; Socio-demographic characteristics, Practice of Infection prevention and control, and Barriers to infection prevention and control practices. The questionnaire was pretested at the General Outpatient Department of the Teaching Hospital before the study was conducted at the departments of Internal Medicine and Surgery. The initial plan to randomly select samples was jettisoned since some doctors that fell into the sample group were not cooperative; hence we kept visiting the clinics and distributed the questionnaire to available doctors until we got the calculated sample size.

2.6 Data Analysis and Management

Data were analyzed using Statistical Package for Social Sciences (SPSS) for Windows, version 22. The results were expressed in terms of frequencies and percentages of responses given to each question, with the ultimate purpose of assessing the level of IPC practices among doctors and clinical medical students; and also the main barriers that hinder good IPC practices among the study population.

3. RESULTS

A total of sixty one (61) medical doctors, and one hundred (100) clinical medical students participated in the study. The findings are summarized as shown below.

Table 1. Socio-demographic characteristics of doctors

Variable	Frequency (n = 61)	Percent (%)
Sex		
Male	35	57.4
Female	26	42.6
Age		
21 – 25	10	16.4
26 – 30	21	34.4
31 – 35	7	11.5
36 – 40	9	14.8
41 – 45	12	19.7
46 – 50	1	1.6
Above 50	1	1.6
Religion		
Christian	61	100.0
Marital Status		
Married	34	55.7
Single	27	44.3
Doctor's Rank		
House Officer	29	47.5
Medical Officer	1	1.6
Registrar	10	16.4
Senior Registrar	6	9.8
Consultant	15	24.6

3.1 Socio-demographic Characteristics of Doctors (Table 1)

Sixty one medical doctors participated in the study. There were more male doctors (57.4%), than females (42.6%). Highest number of respondents were within 26 – 30 years age group (34.4%), followed by 41 – 45 years age group (19.7%). Only two persons aged 46 years and above (3.2%) participated in the study. All the participants were Christians, with 55.7% being married and 44.3% single. House Officers were more in number (47.5%) than any other rank, while only one Medical Officer (1.6%) participated in the study. Consultants are next in number (24.6% to the House Officers, followed by Registrars (16.4%), and finally Senior Registrars (9.8%).

3.2 Socio Demography Characteristics of Medical students (Table 2)

Majority of the medical students were males (57.0%), while 47.0% were females. Quite a large number of the students were in the age group 21 – 15 years (80.0%), while 16.0% were in the group 26 – 30 years. Only one (1.0%) respondent fell into the age group 20 years and below, while 3 (3.0%) were 31 years and above. Only one person (1.0%) was a Muslim, while the rest were Christians; and also only 7 (7.0%) were married. Most of the students were in their 500 level of study (54.0%), followed by 32.0% that were in 600 level, while only 14.0% were in 400 level.

3.3 Infection Prevention and Control Practices among Medical Doctors and Clinical Medical Students (Table 3)

An almost equal percentage of medical doctors and students (98.4% and 97.0% respectively) agreed that they practice hand hygiene, while 85.2% and 81.0% responded that they always use face masks in the hospital environment. Only 14.0% of students use eye goggles in the hospital when indicated, while as high as 67.2% of medical doctors use eye goggles when indicated. More doctors (80.3%) make use of protective gowns when indicated, as against 53.0% of students that comply with the same practice. More doctors (82.0%) a use head cover when indicated, while 67.0% of students use the head cover when indicated. Slightly more doctors (98.4%) than students (92.0%) change gloves after examining every patient, while 95.1% of doctors wash their hands after the removal of gloves, and 81.0% of students do the same. About half of the doctors (52.5%) put on hand gloves when attending to fever patients, but only 34.0% of students practice the same. All the doctors (100.0%) however put on hand gloves when attending to bleeding patients, while 97.0% of medical students always put on hand gloves when attending to bleeding patients. An almost equal percentage of doctors (88.5%) and students (86.0%) put on hand gloves when attending to vomiting patients. Only 4.9% of doctors and 24.0% of students do not recap needles after injection. As high as 96.7% of doctors and 84.0% of students dispose of sharps in puncture-proof containers for sharps

Table 2. Socio demography characteristics of medical students

Variable	Frequency (n = 100)	Percent (%)
Sex		
Male	53	53.0
Female	47	47.0
Age		
Below 20	1	1.0
21 – 25	80	80.0
26 – 30	16	16.0
31 – 35	1	1.0
36 – 40	2	2.0
Religion		
Christian	99	99.0
Muslim	1	1.0
Marital status		
Married	7	7.0
Single	93	93.0
Students level of study		
400	14	14.0
500	54	54.0
600	32	32.0

3.4 Some Barriers to Good Infection Prevention and Control Practices among Medical Doctors and Clinical Medical Students (Table 4)

The majority of the doctors (70.5%) and students (67.0%) believe that inadequate supply of PPE by the hospital management is a barrier to PPE use in the facility. Most of the respondents (57.4% of doctors and 62.0% of students) do not believe that any discomfort associated with PPE use is a barrier to using PPE, and also do not believe that lack of PPE knowledge hinders their using them (57.4% of doctors, and 60.0% of students). Most, again (57.4% of doctors and 72.0% of students) do not see a lack of correct knowledge on hand washing techniques as a barrier to regular hand washing practice as prescribed. About half of the doctors (50.8%) do not believe that lack of adequate water supply is a barrier to regular hand washing practice as prescribed; while more students (64.0%) share the same belief. With respect to the availability of liquid soap, 57.4% of doctors, and 60.0% of students do not agree that the lack of liquid soap is a barrier to regular hand washing practice as prescribed. The majority of the respondents (75.4% of doctors, and 80.0% of students) again do not see the occurrence of emergencies as a barrier to regular hand washing practice as prescribed. However, most doctors (67.2%), and

students (65.0%) commonly forget to wash their hands as prescribed. The majority do not consider hand washing a time-consuming activity (83.6% of doctors, and 82.0% of students). Only 19.7% of doctors knew sharps and used needles should be disposed of in Safety Boxes, while 37.0% of students possess this knowledge.

4. DISCUSSION

Good knowledge of Infection Prevention and Control does not always translate into good IPC practices by healthcare workers [39]. It is good IPC practices that prevent HAI morbidity and mortality among healthcare workers, patients and visitors to healthcare facilities [40,41]. Doctors and medical students in the study tertiary health facility reported varying levels of IPC practices (Table 3). The practice of hand hygiene and the use of facemask among medical doctors and students in this study is impressive, with each group reporting above 80.0% correct practice. Some previous studies in Nigeria found lower hand washing practices among doctors, and health care workers generally. In a 550-bed capacity tertiary hospital in Northwest Nigeria in 2015, only 52.0% of the medical doctors washed their hands in between patients' care [42], and 58.5% of HCWs practiced hand hygiene after touching patients [29]. The relatively poor performance with respect to hand hygiene in these studies could be attributed to less training and awareness of IPC in those facilities, though there are no research findings to support this assertion. In another earlier study (2013) in Nigeria, consistent use of facemask when undertaking procedures likely to generate splashes was as low as 51.2% [43]. In 2015 also, a lower practice rate of 66.7% for hand washing after patients' care/contact with body fluid, when compared to our finding, was reported in Ethiopia [39]. This could also imply better IPC training at our study site. Higher hand washing practice rate (99.4%), and use of facemask (93.9%) were recorded among Clinical year medical students in Malaysia in 2016 [44]. This could have resulted from probably more IPC training for health care workers, and a better health system in Malaysia.

There is a wide gap in the number of doctors that used eye goggles when indicated (67.2%) when compared to medical students (14.0%). This could imply very poor knowledge among medical students on the use of eye goggles. The eye goggles use among doctors in this study is comparable to the finding in the year 2015 (60.0%), in a similar study conducted in Northwestern Nigeria [42].

Eye goggles use among clinical year medical students of a private medical school in Malaysia is still just about average (49.1%) [44]. It is thus important to improve the content of IPC training given to medical students. An overwhelming majority of doctors in the study health facility reported using protective gowns (80.3%) when compared to medical students that reported slightly above average usage of protective gowns among them (53.0%). This is close to 50.2% of usage recorded among healthcare workers in a tertiary hospital, Edo state, Nigeria [43]. Lower usage rates of 46.0% were recorded among doctors in a tertiary referral centre in Northwest Nigeria [42]; and 41.33% among healthcare workers in Debre Markos referral hospital, Northwest Ethiopia [39]. Though Ethiopia is a developing country like Nigeria, where IPC practices are generally said to be poor, when compared to developed countries; this very poor usage of protective gowns could be a pointer to poor health system or inadequate training and awareness activities. Malaysia, which could be said to be more developed than Nigeria and Ethiopia, recorded protective gown usage of 84.8% among clinical medical students [44]. This probably could have resulted from better IPC training and awareness activities in Malaysia.

More doctors (82.0%) than medical students (67.0%), used head covers in our study when indicated. This is in keeping with the expectation that doctors ought to be more knowledgeable than medical students on IPC issues. Head cover use among medical students in our study, though lower, is still comparable with 72.7% use among clinical year medical students of a private medical school in Malaysia [44].

It is commendable to note that overwhelming numbers of doctors (98.4%) and medical students (92.0%) change gloves after examining each patient. The finding here is better than what was documented in a study among health workers (80.2%) in a tertiary hospital, in Edo State, Nigeria [43]. This finding in Edo state, Nigeria could have been better, if the study was conducted among doctors and medical students only. Data from the other cadre of health care workers could have contributed to lowering the overall score. It is also commendable that impressive numbers of doctors (95.1%) and medical students (81.0%) wash their hands after the removal of gloves. This practice was again

reported to be lower (72.5%) in the same Edo, Nigeria study [43]. Barely half of the doctors (52.5%) put on hand gloves when attending to fever patients, while a very low number of medical students (34.0%) do the same. Efforts ought to be made to improve on this practice since occasionally you could have fever cases that point to highly contagious diseases such as viral haemorrhagic fever. All doctors in the study group put on hand gloves when attending to bleeding patients, while as high as 97.0% of medical students do the same. This could be a result of the high awareness created among health care workers globally, about Universal precautions, with the advent of HIV/AIDS epidemics. The practice of the use of hand gloves when attending to vomiting patients was also good among doctors (88.5%) and medical students (86.0%). A very worrisome finding in this study is the practice of recapping needles after injection. This is the only area in this study, where doctors reported worse practice (95.1%) than medical students (76.0%). Some doctors believe that carefully recapping needles after injection is safer overall since it is argued that the hospital has poor waste disposal practices, and some used needles could be seen lying around. This assertion requires further research work. It was found in 2013 in Edo state, Nigeria that only 36.3% of health workers always or sometimes recap needles after injection [43]. Also in a tertiary referral centre, in Northwest Nigeria, it was found that only 31.3% of doctors recap needles after injection [42]. This better practice in Edo state and Northwest Nigeria could be a result of better sensitization and awareness creation activities. Curiously, a high practice rate of recapping (79.4%) was also recorded among clinical medical students in Malaysia [44]. The practice of disposing of sharps in puncture-proof containers is impressive among both doctors (96.7%), and medical students (84.0%) in our study. This good IPC practice is also high (80.0%) among health workers in a tertiary hospital, in Edo State, Nigeria [43]. Above-average practice (64.7%) was recorded among healthcare workers in Debre Markos referral hospital, Northwest Ethiopia [39]. It is possible that better sensitization and awareness activities could have achieved better results on this aspect of IPC practice in Nigeria, than in Ethiopia.

Table 3. Infection Prevention and Control practices among medical doctors and students

Question	Doctor/ Student	Correct practice	Wrong practice
Do you practice hand hygiene	Doctor	60 (98.4%)	1 (1.6%)
	Student	97 (97.0%)	3 (3.0%)
Do you always use face mask in the hospital environment?	Doctor	52 (85.2%)	9 (14.8%)
	Student	81 (81.0%)	19 (19.0%)
Do you always use Eye Goggles when indicated?	Doctor	41 (67.2%)	20 (32.8%)
	Student	14 (14.0%)	86 (86.0%)
Do you always use protective gown when indicated?	Doctor	49 (80.3%)	12 (19.7%)
	Student	53 (53.0%)	47 (47.0%)
Do you always use head cover when indicated?	Doctor	50 (82.0%)	11 (18.0%)
	Student	67 (67.0%)	33 (33.0%)
Do you change gloves after examining every patient?	Doctor	60 (98.4%)	1 (1.6%)
	Student	92 (92.0%)	8 (8.0%)
Do you wash your hands after removal of gloves?	Doctor	58 (95.1%)	3 (4.9%)
	Student	81 (81.0%)	19 (19.0%)
Do you put on hand gloves when attending to Fever patients?	Doctor	32 (52.5%)	29 (47.5%)
	Student	34 (34.0%)	66 (66.0%)
Do you put on hand gloves when attending to bleeding patients?	Doctor	61 (100.0%)	0 (0.0%)
	Student	97 (97.0%)	3 (3.0%)
Do you put on hand gloves when attending to Vomiting patients?	Doctor	54 (88.5%)	7 (11.5%)
	Student	86 (86.0%)	14 (14.0%)
Do you recap needles after giving injection?	Doctor	3 (4.9%)	58 (95.1%)
	Student	24 (24.0%)	76 (76.0%)
Do you dispose sharps in puncture proof containers for sharps (Safety boxes)?	Doctor	59 (96.7%)	2 (3.3%)
	Student	84 (84.0%)	16 (16.0%)

Table 4 summarizes some barriers to good infection prevention and control practices reported by doctors and medical students that participated in this study. Many of the doctors (70.5%), and medical students (67.0%) believed that inadequate supply of Personal Protective Equipment by the hospital management was a barrier to using it in the hospital. This non-availability of PPE at the service delivery points in hospitals was documented in studies among health care workers in some other health facilities in Nigeria and other developing countries such as Ghana. As high as 91.3% of doctors in a tertiary hospital, South-South Nigeria reported a lack of appropriate resources as being a barrier to the practice of infection control measures [45]. The finding among health care workers in the Lower Manya Krobo District, Ghana on the availability of PPE being a barrier to its use (74.0%) [46], was slightly higher than our finding among doctors. This reported non-availability of PPE in the health facilities in some developing countries could be a result of poor funding of the healthcare delivery system, or perceived non-importance of PPE, by health care managers in these places. These assertions require further research work. Very few doctors (4.9%) and medical students (11.0%) in our study perceived discomfort associated with donning PPE, as a barrier to using them. Our finding is comparable to 5.0% of healthcare workers in the Lower Manya Krobo District of Ghana that reported protective gear was uncomfortable [46]. Some studies such as the one conducted in 2016 at King Faisal Specialist Hospital & Research Center, a tertiary care hospital in Jeddah, Saudi Arabia, however, found that 86.0% of healthcare workers perceive the use of PPE as "stressful [47]. The Saudi Arabian study was conducted during an outbreak of Middle East Respiratory Syndrome Coronavirus (MERS-CoV) infection, and there were many patients whose care, mandatorily required health care workers to don full PPE. This invariably became a source of stress, since the frequency of donning and doffing the PPE increased. It is possible that this high level of PPE being seen as uncomfortable would have been reported in our study, and the Ghanaian study if the studies were conducted during disease outbreak periods. As high as 37.7% of doctors not being sure if lack of knowledge is a barrier to their use of PPE in this our study could be a pointer to poor PPE knowledge among them. Many doctors were aware that they could get infected during the process of doffing PPE. This may contribute to their unwillingness to use PPE. This thinking however requires further research work.

Only 4.9% of doctors and 13.0% of medical students reported a lack of knowledge as a barrier to their using PPE. This could account for the above-average use of PPE by respondents in this study (Table 3) above. However, insufficient training in infection control measures, which could imply a lack of knowledge; was reported as being a barrier to PPE use by 91.0% of doctors in a Saudi Arabian study conducted during the MERS Coronavirus outbreak [48]. Respondents in our study have never been challenged with coping with caring for large numbers of infectious disease patients at a point in their practice; hence they have never been exposed to frequent use of PPE. Curiously, a reasonable number of doctors (42.6%), reported lack of knowledge as a barrier to hand washing practice, when compared to the number (4.9%) that saw lack of knowledge as a barrier to the use of PPE. While fewer doctors (4.9%), than medical students (13.0%) believed that lack of knowledge was a barrier to the use of PPE, more (42.6%) believed that lack of knowledge was a barrier to the practice of hand washing; when compared to medical students (28.0%). It is possible that the doctors were aware that a specific technique was required for hand washing, at specified five moments; and responded to that particular question as it affects their hand washing technique and knowledge of five moments for hand washing knowledge. A national web-based survey conducted among health care workers in Qatar, between November 2020 and January 2021; revealed that only 3.8% of respondents reported that lack of hand hygiene training was a barrier to the practice of hand hygiene [49]. It is most likely that more training provides more opportunities to improve one's knowledge of hand hygiene; hence respondents in the cited Qatar study had a lot more knowledge than the medical students and doctors in our own study. Qatar is a more advanced country than Nigeria and probably has a more organized health care delivery system.

A higher proportion of doctors than medical students responded that lack of adequate water supply (49.2%), and lack of liquid soap (42.6%) were barriers to regular hand washing practice as prescribed. On the other hand, only 36.0% of medical students reported that lack of adequate water supply was a barrier to regular hand washing practice as prescribed, while 40.0% believed that lack of liquid soap was also a

barrier to regular hand washing practice as prescribed. Water supply to the hospital whose doctors and students we studied could be problematic since the main source of water is through vendors that use water tanker vehicles. However, in spite of this; a majority of the doctors (50.8%), and medical students (64.0%) did not perceive a lack of adequate water supply as a barrier to regular hand washing practice as prescribed. Also, the majority of the doctors and medical students (57.4% and 60.0% respectively) did not believe that lack of liquid soap was a barrier to regular hand washing practice as prescribed. Liquid soap used in the study health facility is produced in the hospital. This possibly improved the availability of liquid soap.

Most doctors (75.4%) and students (80.0%) did not believe that the occurrence of medical/surgical emergencies constituted a barrier to regular hand washing practice. Some researchers in Ghana however reported that just half (50.0%) of the respondents in research among health care workers did not believe that occurrence of medical/surgical emergency was a barrier to compliance with standard precaution generally [46]. On the other hand, some researchers in Canada in the year 2007, found that health care workers were less likely to comply with recommended IPC practices when attending to patients with severe illnesses. The authors suggested that this could be due to the health care workers prioritizing the safety of the patient [50]. This apparent better result among respondents in our study could be because doctors and medical students by their training appreciate the importance of infection prevention and control practices. With respect to forgetfulness of washing hands, a majority of doctors (67.2%), and students (65.0%) again submitted that they commonly forget to wash their hands as prescribed. This probably could be because the doctors and students had not received any formal training on IPC before this study was conducted. Doctors and medical students probably would not commonly forget to wash their hands if they are trained on the World Health Organization's 5-moments of hand hygiene. Forgetfulness of general IPC practices was reported among 10.5% of respondents in a study on compliance and barriers to the use of

Table 4. Barriers to good infection prevention and control practices among medical doctors and students

Question	Doctor/ student	Yes	No	Not sure
Is inadequate supply of Personal Protective Equipment (PPE) by the hospital management a barrier to use?	Doctor	43 (70.5%)	18 (29.5%)	0 (0.0%)
	Student	67 (67.0%)	33 (33.0%)	0 (0.0%)
Is PPE making you uncomfortable a barrier to the use?	Doctor	3 (4.9%)	35 (57.4%)	23 (37.7%)
	Student	11 (11.0%)	62 (62.0%)	27 (27.0%)
Is lack of PPE knowledge a barrier to your use of PPE?	Doctor	3 (4.9%)	35 (57.4%)	23 (37.7%)
	Student	13 (13.0%)	60 (60.0%)	27 (27.0%)
Is lack of knowledge on correct hand washing technique a barrier to your regular hand washing practice, as prescribed?	Doctor	26 (42.6%)	35 (57.4%)	0 (0.0%)
	Student	28 (28.0%)	72 (72.0%)	0 (0.0%)
Is lack of adequate water supply a barrier to your regular hand washing practice, as prescribed?	Doctor	30 (49.2%)	31 (50.8%)	0 (0.0%)
	Student	36 (36.0%)	64 (64.0%)	0 (0.0%)
Is lack of liquid soap a barrier to your regular hand washing practice, as prescribed?	Doctor	26 (42.6%)	35 (57.4%)	0 (0.0%)
	Student	40 (40.0%)	60 (60.0%)	0 (0.0%)
Is the occurrence of medical/surgical emergency a barrier to your regular hand washing practice, as prescribed?	Doctor	15 (24.6%)	46 (75.4%)	0 (0.0%)
	Student	20 (20.0%)	80 (80.0%)	0 (0.0%)
Do you commonly forget to wash your hands as prescribed?	Doctor	41 (67.2%)	20 (32.8%)	0 (0.0%)
	Student	65 (65.0%)	35 (35.0%)	0 (0.0%)
Do you consider hand washing practice a time-consuming activity?	Doctor	10 (16.4%)	51 (83.6%)	0 (0.0%)
	Student	18 (18.0%)	82 (82.0%)	0 (0.0%)
Do you know that Sharps and used needles should be disposed in Safety Boxes for disposal of sharps and used needles?	Doctor	12 (19.7%)	24 (39.3%)	25 (41.0%)
	Student	37 (37.0%)	18 (18.0%)	45 (45.0%)

infection prevention and control measures among health care workers during the COVID-19 pandemic in Qatar, in 2021 [49]. It is probable that most of the respondents (89.5%) in the cited Qatar study, did not forget to practice IPC because they could have been better trained on IPC than respondents in their own study. Since Qatar is more developed than Nigeria, it is also probable that the health system is more developed. The finding in this study, that most doctors (83.6%) and medical students (82.0%) did not consider hand washing practice a time-consuming activity, implies that most of them had a good attitude and perception of hand hygiene. Giving them adequate training on hand hygiene would greatly improve their practice. Proper disposal of sharps and used needles is key to preventing Healthcare-Associated infections that occur as a result of sharp/needle prick injuries. It is worrisome to find in this our study that very few doctors (19.7%) knew that sharps and used needles should be disposed of in safety boxes. Hospital management providing safety boxes at service delivery points in the hospital, and training doctors and other health care workers on the use of safety boxes are of utmost importance.

5. CONCLUSIONS

Good IPC practice among health care workers, including medical doctors and clinical medical students is key to preventing morbidity and mortality resulting from Healthcare-Associated infections. Doctors in this study demonstrated good practice of essential hand hygiene and the use of personal protective equipment, giving correct responses in over 50.0% of the questions asked in these areas. Their practice of recapping needles after injections is however very worrisome, with as high as 95.1% of them indulging in this practice. Even clinical medical students performed better in this aspect, with 24.0% of them recapping needles after injection. Clinical medical students also reported good hand hygiene practices and use of PPE of over 50.0% in all aspects that were investigated except the use of eye goggles when indicated and using hand gloves when attending to fever patients.

In the area of barriers to good IPC practice, over 50.0% of doctors and clinical medical students considered an inadequate supply of PPE and forgetfulness of hand washing, barriers to good IPC practices. Only very few doctors (19.7%), and students (37.0%) knew that sharps and used needles should be disposed of in safety boxes. This is a huge barrier to good IPC practice and is worrisome. Additionally, 59.0% of doctors considered the non-availability of Safety boxes, a barrier to IPC practices.

6. LIMITATION TO THE STUDY

Conducting the study only in two clinical departments is a limitation because the finding cannot be correctly said to apply to the whole five clinical departments in the hospital. It is possible that certain factors in the other three clinical departments enhanced or hindered IPC practices.

CONSENT

Written informed consent was obtained from each respondent prior to completing the questionnaire. The objectives of the study were adequately explained to the respondents. Respondents were informed that participation in this research was voluntary and that they have the right to withdraw consent and discontinue in the participation of the study at any given time.

ETHICAL APPROVAL

Ethical approval for this study was obtained from the Medical Research Ethical Review committee, of Enugu State University Teaching Hospital, Enugu.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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