



Knowledge, Attitude and Practices of Infection Prevention Measures among Nursing Students at Mufulira College of Nursing and Midwifery, Mufulira, Copperbelt Province, Zambia

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Abstract

Introduction: Infection prevention (IP) is a very essential component in the health service provision within the health care system and is a set of standard precautions employed to prevent transmission of diseases that can be acquired by contact with blood, body fluids, non-intact skin (including rashes), and mucous membranes. According to the World Health Organization, 7.1 million cases of HAI occur every year. One out of every 20 people suffers from hospital infection. This leads to 99,000 cases of death every year and imposes an estimated cost of \$ 32 million to society. Considering the important role of nursing students in managing and controlling nosocomial infections, their knowledge and performance in infection control have been studied in different countries. The main objective of this study is to determine knowledge, attitude and practices of infection prevention among nursing students at Mufulira College of Nursing and Midwifery. **Methods:** This was a descriptive cross-sectional study design where 100 respondents' 2nd and 3rd year nursing students participated in the study. Participants were randomly selected. A self-administered structured interview schedule was used to collect data. SPSS computer software package version 23.0 was used to analyze data. Fisher's exact tests were used to test the significance of the association between Knowledge on IP and Attitude towards Infection Practices among nursing students. A 95% confidence interval and the P value of 0.05, were used to ascertain the degree of significance. **Results:** Majority of the respondents (96%) had good practice. More than half (58%) of

respondents revealed high knowledge levels. Almost all the respondents (98%) had a positive attitude towards IP. Chi-square test on knowledge (P-value 0.04) and $P \leq 0.05$, indicates that there is an association between IP practices and knowledge levels of nursing students and attitude (P-value 0.002), $P \leq 0.05$ indicates that there is an association between IP practices and attitude of nursing students. On multivariable logistic analysis, students with low knowledge levels had 2.13 times higher odds of poor infection prevention practices compared to those with high knowledge levels and this effect was significant (AOR: 2.134, CI: 1.341 - 4.842, $P = 0.04$). Similarly, students with a negative attitude had 3.10 times higher odds of poor infection prevention practices compared to those with a positive attitude and this effect was highly significant (AOR: 3.104, CI: 1.146 - 8.346, $P = 0.02$). **Conclusion:** The study has established the presence of good IP practices among nursing students. This does not support the initial assertion that nursing students have poor IP practices as they frequently comply with teaching advice. The findings have also demonstrated high knowledge levels on IP practices among nursing students being the key component in preventing infection transmission.

Subject Areas

Nursing

Keywords

Infection Prevention Practices, Knowledge, Attitude

1. Introduction

Infection prevention (IP) is a very essential component in the health service provision within the health care system and is a set of standard precautions employed to prevent transmission of diseases that can be acquired by contact with blood, body fluids, non-intact skin (including rashes), and mucous membranes. The WHO's May 2022 Global Report on Infection Prevention and Control (IPC) reveals a significant disparity in HAI prevalence: 7% of patients in high-income countries (HICs) versus 15% in low- and middle-income countries (LMICs) experience at least one HAI during hospitalization [1].

IPC measures form the cornerstone for preventing HAIs and AMR [2] [3]. Studies demonstrate that the implementation of comprehensive IPC measures has reduced the surgical site infection (SSI) rate in congenital heart disease patients from 9.5% in 2010 to 3% in 2021, IPC interventions are estimated to prevent 35% - 55% of HAIs [4]. However, significant variations in IPC structures persist due to disparities in healthcare capacities and resource allocation, challenging systematic IPC assessment and targeted improvement. Considering the important role of nursing students in managing and controlling nosocomial infections, their knowledge and performance in infection control have been studied in different countries. The main objective of this study is to determine knowledge, attitude

and practices of infection prevention among nursing students at Mufulira College of Nursing and Midwifery. The prevalence of nosocomial infections in developed countries is 7% and in developing countries, it is 10%. Knowledge and performance of nursing students, as future nurses, play a key role in controlling nosocomial infections. Today, special attention has been paid to the training of nursing students in order to increase their knowledge and performance in preventing and controlling nosocomial infections [5].

Considering the important role of nursing students in managing and controlling nosocomial infections, their knowledge and performance in infection control have been studied in different countries. Banu, *et al.*, [6] reported nursing students' satisfactory knowledge and compliance while gaps remain in translating knowledge into consistent clinical practice. This indicated the need to strengthen hands-on training, mentorship, and institutional support is recommended to enhance infection control outcomes. The results of a study in India showed that 75% of the nursing students had good knowledge about the management of nosocomial infections, but their performance was poor.

Students' knowledge of nosocomial infection is important because infection can affect patients' health in many ways. Nosocomial infection may lead to severe chronic illness, permanent disabilities and, ultimately, death [7]. In addition, the students' knowledge of infection control will help in developing effective precaution and treatment strategies, reducing the incidence, as well as the morbidity and mortality rates among patients diagnosed with nosocomial infection [8]. Simple practical procedures that are part of the components of standard precautions against HCAI have been found to be effective in reducing the HCAs. Simple hand hygiene when performed well can reduce the prevalence of HCAI substantially. Improved compliance in hand hygiene with standard alcohol-based rub can reduce the rate of nosocomial infections by as much as 40%. In a study conducted by Blomgren, *et al.*, [9] it was reported that it is necessary for nursing student and qualified nurses to receive proper education on hand hygiene knowledge and to have an educational program that does not separate the groups but combines them with continuing education, since the students will someday be influencing future hand hygiene knowledge as a peer, together with the nurse. To strengthen patient safety and reduce the risk of harm, HAI must be prevented. There are evidence-based guidelines and action bundles on how to prevent HAI. In all evidence-based guidelines, hand hygiene (HH) plays a pivotal role and is acknowledged as the foremost measure in mitigating HAI and preventing the transmission of resistant bacteria among patients [9].

According to Arefian, *et al.*, [10] healthcare-associated infections prolong the length of stay. A hospital-wide infection control program did not alter the prolongation of length of stay. The spread of these infections, however, can be controlled. There are several simple and cost-effective strategies that can help prevent infections, from the basic tenet of hand hygiene to the team-oriented approach of Comprehensive Unit-based Safety Programs.

2. Materials and Methods

2.1. Study Design, Setting, and Participants

A descriptive cross-sectional design was used to agree on the knowledge, attitude and practices of infection prevention among nursing students. The study was conducted at Mufulira College of Nursing and Midwifery at Ronald Ross General Hospital. It is a nursing school that provides training of Midwifery students and registered nursing students. The qualification offered is a diploma in registered nursing and midwifery. The nursing school has a student population of about 800 nursing students and midwifery students. They were considered eligible if they were learners at the Mufulira College of Nursing and midwifery, learners who were present at the time of interview, students who consented to participate in the study and in 2nd and 3rd year nursing students. The study excluded nursing students who were on the clinical placement and could not be available for an interview, mentally ill and nursing students who were not learners at Mufulira college of nursing and midwifery. The study was conducted from January 2024 to July 2025. A simple random sampling method was used to choose participants using a sampling frame for eligible second and third year nursing students who were present during the period of data collection. A lottery method was used in which the researcher gave each member of the population a number. The researcher drew numbers from the box randomly to choose samples.

2.2. Data Collection Procedure

Ethical clearance and permission were sought from the University of Zambia Biomedical Research Ethics Committee (UNZABREC REF. No. 1662-2021) and data was collected over a period of 8 weeks. Participants were assured of anonymity and confidentiality by interviewing them in privacy individually after consenting to participate with their signature. The researcher administered a questionnaire in face-to-face interviews that lasted about 30 minutes.

2.3. Instruments

A modified structured questionnaire was used to determine knowledge, attitude and practices of infection prevention among nursing students at Mufulira College of Nursing and midwifery. The tool was validated for measuring nursing student's IP practices by conducting a pilot study in a similar study setting. Internal consistency was measured with Cronbach's Alpha of 0.871 on IP practice questions, 0.83 on knowledge questions and 0.79 on attitude questions. The instrument comprised of a series of questions that were closed-ended. The structured questionnaire contained questions under six sections; Section A: Demographic Characteristics (age, marital status, employment status, education level and income), Section B: knowledge on IP. Knowledge on IP practices among nursing students was graded as high with a score $\geq 5/10$ as this demonstrated knowledge on the key facts about Infection Prevention and low with a score of $\leq 4/10$. Section C: Attitude

towards IP practices among nursing students. Attitude towards IP practices among nursing students was graded as positive if the patient scored $\geq 6/10$ as this demonstrated a positive attitude towards IP practices and negative attitude if the student scored $\leq 5/10$ questions in section C. Section D: IP practices among nursing students. IP practices among nursing students were graded as good with a score of $\geq 6/10$ as this demonstrated a good practice of IP and poor with a score of $\leq 5/10$ in section D.

2.4. Data Analysis

Data were analyzed using the IBM® Statistical Package for Social Sciences (SPSS®) for Windows version 23.0. The Fisher's exact test was used to determine an association between predictor variables (demographic factors, knowledge of nursing students on practices of IP, Attitude of nursing students towards practices of IP) and the outcome variable (practices of IP among nursing students). For the categorical variables, a Fisher's exact test was used. The Confidence Interval (CI) of (95%) was set and set level of significance at 5%. The binary logistic regression analysis was used to determine the true predictor of practices of IP.

3. Results

The interview was conducted with 100 participants of whom majority 70% were aged 21 - 30 years. More than one third of the respondents 82% were single, majority 62% were males. According to the level of training, out of 100 respondents, the majority (98%) were second years. Less than half of the respondents 30% were working from surgical ward, 25% were working from medical ward, 25% were working from casualty and 20% were working from maternity/labour ward. Less than half of the respondents 50% were on the ward for 1 week, 40% were on the ward for 2 weeks, 4% were on the ward for 4 weeks, 4% were on the ward for 3 weeks and 2% were on the ward for 5 weeks **Table 1**. **Table 2** shows majority of the respondents 96% had good practice of IP with the mean practice score was high (Mean = 8.6 out of 10, SD = 1.2), with a median score of 9 indicating consistently strong performance with low variability whereas more than half (58%) of respondents revealed high knowledge levels with the mean knowledge score of 7.2 out of 10 (SD = 1.8), with a median of 7, suggesting moderate dispersion in knowledge levels among participants. Almost all the respondents (98%) had a positive attitude towards IP with the mean attitude score was 4.6 out of 5 (SD = 0.5), with a median of 5, indicating very low variability and generally favorable attitudes **Table 2**.

Table 3 shows that there was a statistically significant association between knowledge levels and practices of IP among nursing students, between attitude and practices of IP among nursing students.

Table 4 shows the binary logistic regression model was tested for multicollinearity, Hosmer and Lemeshow test of fitness for data, and omnibus test of model coefficients and classification accuracy. The dependent variable was practices of

IP: Good (1) and Poor (0). The results of the binary logistic regression analysis showed that holding other variables constant, students with low knowledge levels had 2.13 times higher odds of poor infection prevention practices compared to

Table 1. Demographic characteristics of nursing students (n = 100).

Characteristics	Frequency	Percent
Age		
15 - 20	24	24%
21 - 30	70	70%
31 - 40	6	6%
Sex		
Female	62	62%
Male	38	38%
Year of training		
Second year	98	98%
Third year	2	2%
Period spent		
1 week	50	50%
2 weeks	40	40%
3 weeks	4	4%
4 weeks	4	4%
5 weeks	2	2%
Status		
Married	8	8%
Single	82	82%
Separated	10	10%

Table 2. Overall knowledge levels on IP practices (n = 100).

Characteristics	Frequency	Percent
High knowledge levels	58	58%
Low knowledge levels	42	42%
Overall attitude towards IP practices (n = 100)		
Positive attitude	98	98%
Negative attitude	2	2%
Overall practices of IP (n = 100)		
Good	96	96%
Poor	4	4%

Table 3. The relationship between practices of IP and other factors (n = 100) using a Cross tabulation analysis.

Characteristics		Practices of IP		P value
		Good	Poor	
Knowledge	High knowledge levels	56 (58.3%)	2 (50%)	0.04
	Low knowledge levels	40 (41.7%)	2 (50%)	
Attitude	Positive attitude	94 (97.9%)	4 (100%)	0.002
	Negative attitude	2 (2.1%)	0 (00%)	

Table 4. Binary logistic regression analysis of practices of IP by knowledge and attitude.

Variables	Indicator	Odds ratio	Adjusted estimates		P value
			95% CI		
			Lower	Upper	
Knowledge	High knowledge levels	Ref			
	Low knowledge levels	2.134	1.341	4.842	0.04
Attitude	Positive attitude	Ref			
	Negative attitude	3.104	1.146	8.346	0.002

those with high knowledge levels and this effect was significant (AOR: 2.134, CI: 1.341 - 4.842, P = 0.04). Similarly, students with a negative attitude had 3.10 times higher odds of poor infection prevention practices compared to those with a positive attitude and this effect was highly significant (AOR: 3.104, CI: 1.146 - 8.346, P = 0.02).

4. Discussion of Findings

Most of the respondents 70% were of the age group 21 - 30 years, 24% were 15 - 20 years. The lowest 6% were 31 - 40 years. This is due the fact the average age of completing secondary school in Zambia is 19 years and above. This is in accordance with the ministerial pronouncement (Dr. John Phiri) that pupils should be enrolled into grade one at the age of seven years of age and pupils stay in the society at least a year before going into college by then they would have been 21 years and above [11]. In relation to gender of the respondents, the majority 62% were males while 38% were females out of which, almost all the respondents 98%, were second years while 2% were in third year. This is because at the time the research was being conducted only second years were in clinical areas with one third year who was re-sitting, making second year students more and readily available for the students. Most of the respondents 42% were allocated to surgical ward, 34% were in the medical ward, 14% were in casualty and 10% were in maternity/labor ward. This is due to the fact that students need to rotate during their training to different departments as per [12] Nursing and Midwifery Council of Zambia

(NMCZ) guidelines cap 31 of 1997 in accordance to their level of training. The respondents were said to have been in these ward allocations for different periods of time of which 44% were a week old, 42% were 2 weeks, 8% were 4 weeks old and 4% were 3 weeks old and only 2% were 5 weeks old in the respective departments.

With regard to practices of IP, the researcher established that almost all the respondents 96% have good practice. Of the respondents who had good practices, the specific area indicated by majority of respondents were “following the policy/guidelines on infection prevention in their practice, decontamination of instruments which come in contact with body fluids, having had a needle stick injury and washing hands”. The findings of this study agree with a study conducted in Zambia on Infection Prevention by Chembe, [13] on infection prevention guidelines which revealed almost all of the respondents 98% having heard of Infection Prevention Guidelines or Universal Precautions. Since the majority follows guidelines and policies laid down, it means that the correct things are being done the right way hence a reduction in cross infection by student nurses is expected.

Similar to the current study results, Tafere, *et al.* [14], findings showed that most nurses were knowledgeable and had good practices on IP. However, a substantial proportion of nurses had inadequate knowledge and practice regarding infection prevention. The nurses' knowledge and practice were associated with years of work experience and status of training on infection prevention. Moreover, the education level of nurses was another predictor variable of the knowledge of nurses. Therefore, healthcare workers in the hospital setting should adhere to the national infection prevention protocols. The policy designers should provide training for nurses on infection prevention to improve knowledge and practice in this area. Furthermore, to attain more detailed information, future research should involve a qualitative study.

In contrast to a study conducted on the nurses by Akter, *et al.*, [15], results showed that nurses' practice on infection prevention was low to moderate level. Additionally, no consistence was found in a study conducted by Appiah and Isaac, [16], who also reported poor infection prevention practices among the staff they were learning from. So, nurses should need to increase preventive practices for infection prevention. Study results also showed that those who have training their practice was good. It can be suggested that to increase preventive practice among the nurses, development of training program on infection control should be increased. Further study is needed with diverse population and culture. Future intervention study also necessary the improvement of preventive practice among nurses in Bangladesh. It is also important that more attention is focused on infection prevention and control in clinical practice among nurses.

In this regard, students play a very important part by decontaminating instruments thereby breaking the chain of infections. Contrary to a study conducted by Niquice, *et al.*, [17] which reported the prevalence of needle stick injuries in HCWs to be between 5.6% and 94.5%, and career time to be between 36.4% and 81.99%, where the lowest prevalence is observed in studies in High-Income coun-

tries. Generally, results indicate a high global prevalence of NSIs among HCWs. The high prevalence of NSIs, despite existing strategies, suggests the inadequacy of current management strategies or the lack of adequate adherence to available standard precautions to prevent needle stick injuries. In agreement with World Health Organization (WHO) [18] one should wash hands before and after touching the patient, before handling an invasive device for patient care, regardless of whether or not gloves are used and after contact with body fluids or excretions, mucous membranes, non-intact skin, or wound dressing.

In relation to the knowledge of respondents on IP, more than half 58%, of respondents revealed high knowledge levels. Of the respondents who had high knowledge, the specific areas where respondents had low knowledge included “heard about infection prevention from different sources, definition of infection prevention, importance of IP, waste disposal and color codes, meaning and understanding of the term universal infection prevention measures (UIPM), availability of protective clothing and equipment”. Once one has the knowledge, they are likely to practice IP. This shows a high level of dissemination of information about infection prevention in the nursing training schools. This is attributed to the fact that IP is one of the topics that is taught in nursing schools and the practice being enhanced in the clinical areas.

Findings of this study are consistent with a study by Rahiman *et al.*, [7] in which the majority of the students were overall evaluated as having good level of knowledge. In another study by Chikte, U. [7] nursing students were reported having good levels of knowledge. Similarities were also found in a study conducted among nursing students by Appiah and Isaac (2021). It was concluded from the study that most of the student nurses had adequate information about HAIs and wish to adhere to the Infection prevention protocols. According to Noor, *et al.*, [19] it was reported that health care safety issues, health care associated infections (HCAIs) are a significant cause of morbidity and mortality in developing countries specially in Pakistan. Environment of hospital favors certain infections during the period of admission patients, these are termed as Health care associated infections. Contaminated equipment’s, unaware medical staff, unhealthy hospital environment and not satisfactory standard measures promote Hospital acquire infections, nosocomial infections/Health care associated infections (HCAIs). On the contrary, findings from a study by Olorunfemi *et al.*, [20] indicated that nursing students had low knowledge and do not practice infection prevention. In relation to waste disposal and color codes, the majority 46% stated that black is for domestic waste, 38% stated that yellow is for clinical waste and 16% stated that red is for infectious waste. This could be that the majority of the respondents are not knowledgeable enough about the waste disposal color codes and there use especially the red color this could be attributed to the fact that in the clinical area the common colors that are displayed are yellow and black.

Similarly, in a study conducted by Adam, *et al.*, [21] reported that more than 60% of healthcare facilities lacked proper waste segregation systems, and many

reported insufficient colour-coded or covered bins. For infectious garbage, incineration was the most common approach (33.57%), whereas for sharps waste, pit burning was the most common option (52.48%). Geographic location and the type of waste management strategies used were significantly correlated, indicating regional inequalities. These results draw attention to the numerous discrepancies and structural shortcomings in current systems for managing medical waste. Therefore, addressing gaps in waste management through policy enforcement, funding, and healthcare worker training is paramount to reducing healthcare-associated infections and improving healthcare safety in Somalia.

One of the factors that could have affected practice of IP by the nursing students is the availability of protective clothing, equipment and according to the study, it shows that the majority 48% indicated that one should wear gloves when coming in contact with the patient which is a universal precaution, 42% think that one should only wear gloves when coming in contact with body secretions and 10% think that one should wear gloves when handling contaminated equipment or materials. The findings above show that some students are able to stick to the principles of IP while others still don't put it into practice. This could be that when it comes to wearing of gloves, staffs on the ward put an emphasis on hospital economy hence forgetting the principles of IP. According to the Clinical Guide (CG139) [22] health care workers must use gloves only once. They must put them on immediately before the activity, remove them as soon as it is completed and dispose them off accordingly. They must change gloves between different activities for the same patient, as well as between careering for different patients. In another context, IP has an advantage on the clients, health care providers and the community. This was evidenced by the respondents' responses on the advantages of IP to the client, of which majority of the respondents 34% stated that it prevents the spread of infection, 26% stated that it reduces the risk of spread of infection, 24% stated that it prevents nosocomial infection and 16% stated that it reduces the duration of stay in the hospital. All the above answers show that students have knowledge about the importance of infection prevention and control. According to Krasovska K.O. and Globina N.I. (2025), hospital infection control is essential to protect patients, healthcare workers and the wider community from HAIs and healthcare workers play an important role in the effective implementation of infection control measures. Krasovska and Globina further reported that, the use of Personal Protective Equipment (PPE), hand hygiene, environmental cleaning, screening and isolation, sterilization and disinfection, surveillance and reporting, vaccination and the introduction of innovative technologies in hospital infection control are important elements of the prevention and control of HAIs. These measures are important to protect patients, healthcare workers and all society (Krasovska, and Globina, 2025).

In relation to the advantages of IP infection to the health care providers, the majority of the respondents 34% stated that it creates a conducive environment for the health workers to work, 42% states that it protects the health worker from

acquiring infection while 24% stated that it prevents infection from the patient to the health worker. All the above answers show that students have knowledge about the importance of infection prevention and control. According to Wagenen, [23] states that infection prevention and control practices are important in maintaining the safe environment for everyone by reducing the risk of potential spread of disease. These practices are designed to reduce the risk of hospital associated infections and to ensure safe and healthy hospital environments for our patients, health care providers and visitors.

In relation to attitude, almost all the respondents 98% had a positive attitude towards infection prevention. Of the respondents who had positive attitude the specific areas were “Importance of infection prevention, awareness of the management of IP in the hospital, need for improvement, areas of IP to be improved, whether the hospital should continue with the infection prevention program, why the hospital should continue with the infection prevention program, always wear protective clothing when coming in contact with the patient, reason for always wearing protective clothing when coming in contact with the patient and infection prevention is difficult to observe and guidelines on IP positively influencing infection prevention”.

Findings of this study are not consistent with a study by Ward, [24] which found that nursing students generally perceived a negative attitude towards IPC. Inconsistency was also found in a study Chikte, U. [7] which reported nursing students having poor attitude scores, with little difference in practice scores observed between different years of study.

According to Noor A, *et al.*, [19] it was reported that health care safety issues, health care associated infections (HCAIs) are a significant cause of morbidity and mortality in developing countries specially in Pakistan. Environment of hospital favors certain infections during the period of admission patients, these are termed as Health care associated infections. Contaminated equipment's, unaware medical staff, unhealthy hospital environment and not satisfactory standard measures promote Hospital acquire infections, nosocomial infections/Health care associated infections (HCAIs). A well-functioning IP and control program helps minimize this risk for our patients, residents, visitors and our staff. According to Wagenen, [23] states that infection prevention and control practices are important in maintaining the safe environment for everyone by reducing the risk of potential spread of disease. These practices are designed to reduce the risk of hospital associated infections and to ensure safe and healthy hospital environments for our patients, health care providers and visitors.

Majority 82% strongly agreed that the hospital should continue with the infection prevention program. This could be that students understand the importance of infection prevention, infection prevention measures are being observed and are put into practice by student nurses and members of staff on the wards and students are able to see it. With regard to wearing protective clothing, majority 70% say that one should always wear protective clothing when coming in contact with

a patient to protect themselves from getting infection. This could be that students have good attitude towards infection prevention and this could also be attributed to the fact that students understand the importance of wearing protective clothing. According to Soni, *et al.*, [25] healthcare facilities must have the necessary equipment to implement standard precautions for all patients. Among these, hand hygiene is the most effective measure for preventing the transmission of infections, which is achieved by washing hands with soap and warm water or by rubbing hands with alcohol- or non-alcohol-based hand sanitizers. Gloves can also be used as a standard precaution; new gloves must be used for each patient and disposed of after each patient interaction.

The majority of respondents, 82% strongly agreed that practicing hand hygiene can prevent infection transmission while 18% agree that practicing hand hygiene can prevent infection transmission. This means that hand hygiene is one of the measure that is supported and practiced by all student nurses in IP. This could be attributed to the fact that students understand the importance of hand hygiene and able to put it into practice. In contrast, a similar study was conducted by [26]. The results have shown that during 53.2% of the 312 observations, participants followed the aseptic procedure to clean their hands. The knowledge of hand hygiene was moderate (49.7%) among the total study population. A significant relationship has been found between knowledge level and receiving structured training on hand hygiene. Gender, age, profession and training on hand hygiene, were found as significant factors in the use of routine use of alcohol-based hand rub. The findings of these studies show the importance of structured training on hand hygiene to improve knowledge among healthcare workers, which could substantially reduce healthcare-associated infections. Further research with a more recent sample is needed to assess potential changes in hand hygiene training.

Slightly more than half 66%, strongly agreed that the effectiveness of the decontamination process is achieved in 10 minutes. This could be that the students are knowledgeable about the decontamination process. Contrary to the current study results, Alfy, *et al.*, [27] reported a suboptimal decontamination practice at the MRL and the need to apply a higher concentration (500 ppm) of sodium hypochlorite to reduce the overall microbial load. Alfy, *et al.*, [27] also demonstrated the importance of quantitative assessment to monitor decontamination practices and ensure staff compliance. More studies are needed to identify bacterial communities within the laboratory, which will help provide guidance regarding the types, proper concentrations, and appropriateness of the in-use disinfectants. Furthermore, large-scale studies on the acceptable level of residual contamination following any decontamination process are urgently recommended.

Half of the respondents 50% agreed that use of hand rub can prevent the transmission of infections. This shows that the respondent knows that the hand rub is effective in infection prevention. This could be attributed to the fact that the respondent use hand rubs to prevent infection. According to Center for Disease Control and Prevention (CDC), [28] stated that alcohol base hand sanitizer kills most of the microorganisms that can cause infection and it's a preferred way to

clean the hands in between the activities in a health care setting. This is because alcohol based hand sanitizer is more effective and it dries faster than using soap and water and does not create antibiotic- resistance super buds.

An association between practices of IP and knowledge and attitude was analyzed. Pearson's Chi square tests as well as Fisher's exact tests were used to test for significance with the P-value set at 0.05. In this study, it was revealed that there was an association between knowledge on IP and practices of IP among nursing students. Therefore, in this study, respondents with high knowledge also had good practices of IP. These findings agree with the findings of Olorunfemi *et al.*, [20] which revealed a significant relationship between KPIC among nursing students using Spearman's correlation coefficient, which showed $P < 0.001$. Results also revealed an association between attitude of nursing students and their practices of IP. Therefore, majority of respondents who had a positive attitude also had good practices of IP. These findings are similar to the findings of Rahiman *et al.*, [7] which showed a significant association between attitudes ($P < 0.05$) and practice ($P < 0.05$).

Analysis to determine predictors of practices of IP was done using multivariate binary logistic regression model at 95% level of significance. The binary logistic regression model was tested for multicollinearity, Hosmer and Lemeshow test of fitness for data, and omnibus test of model coefficients and classification accuracy. From the statistical analysis of practices of IP, it was discovered that knowledge and attitude predicted practices of IP among nursing students. Thus, nursing students who had high knowledge levels with odds ratio more than 1 (2.134) and positive attitude with odds ratio more than 1 (3.104) were more likely to achieve good practices of IP. These findings are similar to the findings of Jamiran and Ludin, [29] whose study reviewed that nursing students that have good knowledge showed significantly good attitude ($P = 0.002$) and good attitude showed significantly good practice of infection control ($P = 0.001$). Similarly, in a study conducted by Olorunfemi *et al.*, [20] results revealed that there was a significant relationship between KPIC among nursing students using Spearman's correlation coefficient, which showed $P < 0.001$. In relation to this study, the level of KPIC measures was poor among nursing students, and those who are knowledgeable about infection control also have high compliance to infection control; therefore, it can be recommended that laborious training on infection control measures of nursing students prior to clinical posting. Consistence was also found in a study Chikte, U. [7] which reported a positive correlation found between students' total attitude and total practice scores. Furthermore, showed significant associations between gender and knowledge attitudes and practice. Based on the results of this study, it is recommended that interactive infection control courses that promote critical thinking are implemented during the nursing training course along with more stringent forms of assessments focusing on infection prevention and control, during clinical training.

5. Conclusion

This study has revealed significant relationships between practice and factors such

as attitude and knowledge towards IP. The study revealed that almost all the respondents 58%, have high knowledge levels on IP while 42% have low knowledge levels on IP and in relation to attitude, it showed that almost all the respondents, 98% have a positive attitude towards IP while 2% have a negative attitude towards IP while concerning the variable practice it showed that almost all the respondents, 96% have good levels of practice of IP while 4% have poor practicing levels of IP. According to the results on the relationship between the dependents and independent variables, it concluded that the majority (97.9%) student nurses with a positive attitude towards IP also had good practice of IP and that the majority (58.3%) student nurses with high knowledge had good practice of IP. The benefits of good practice of IP promote both the health of the health care team and patients in the clinical setup. The implication of these findings is that these student nurses require the promotion and maintenance of a positive attitude and knowledge towards the practice of IP. Deliberate and vigorous efforts should be made at the nursing schools and health facilities to promote and maintain IP thereby ensuring a 100% practice of IP by student nurses.

6. Recommendations

1) Recommendations to MOH: Ministry of health should look into the issue of medical equipment and instruments to use in the clinical area to facilitate the excursion of infection prevention. This will in turn help the student nurses to practice IP according to standards and guidelines. Ministry of health should strengthen the policy of hospitals having IP committees which should ensure that the standards and guidelines are being followed in the clinical areas. This will help the students to learn and put to practice IP as they are more likely to follow what is being practiced by the qualified nurses.

2) Recommendations to hospitals: The hospital should at all times have in place a functioning infection prevention committee. This is to ensure that infection prevention is observed in the hospital and all the necessary requirements to implement the measures are in place.

The hospital should ensure that infection prevention meetings are held according to the stipulated time intervals during which students should be included. The hospitals should come up with a deliberate policy of conducting random inspection in the wards and other departments to note if the right things are being done the right way.

3) Recommendations to nursing training schools: Nursing training schools should continue with the good works of providing knowledge to student nurses during the lecture blocks on infection prevention and its importance.

Nursing training institutions ensure they have qualified clinical teachers who should tally with the number of students. This is to ensure effective provision of skills to students and facilitate easy demonstrations to student nurses. The clinical teachers should almost at all-time be present in the clinical areas where students are allocated to ensure continuous monitoring and evaluation.

7. Limitations of the Study

The study sample size (n = 100) was limited, thus generalization of results should be with caution as it only represented views of nursing students who were schooling at Mufulira College of nursing and midwifery. The sample size comprised of nursing students from the urban and peri-urban settings hence the result may not be generalized for the rest of Zambia. The case may be different from nursing students in rural areas, as rural nursing colleges do not have specialized lecturers and lack access to adequate learning materials to provide sufficient information on practices of IP. The data collecting tool used comprised closed ended questions and this could have limited the respondents from giving much more required information.

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Conflicts of Interest

The authors declare no conflicts of interest.

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