Knowledge of the Administration of Medications among Undergraduate Nursing Students in Selected Clinical Sites in Kenya

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Summary

BACKGROUND

Medication administration is one of the critical competencies in nursing to ensure patient safety. Globally, a lack of competence in medication administration has been associated with high morbidity and mortality rates and poor patient outcomes. This study focused on assessing knowledge of medication administration among undergraduate nursing students.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted between June and August 2021 in two County Referral Hospitals in Kenya. The study aimed to establish the level of knowledge on medication administration among second-year nursing students starting their clinical rotations, mainly in the medical/surgical wards. The census method was used to recruit 147 participants based on the pre-defined inclusion criteria. The data was collected using a pretested interviewer-administered knowledge questionnaire based on the World Health Organization (WHO) training curriculum on medication safety. The data was then cleaned, coded and analysed using SPSS version 26. Descriptive and inferential statistics were used to summarise and compare the results.

RESULTS

The average score for the medication administration knowledge was 64.8 %, S.D=5.8. The highest score was 79%, whereas the lowest was 43 %. Poor performance was noted in five of the six categories of medication administration, whereby the total number of participants who passed the knowledge assessment with a score of 70% and above was 43 (29.3%) per the international recommendations. The proportion of those who passed differed significantly from those who failed the knowledge assessment, χ^2 (1, n=147) =25.31, p<0.05. The results of one sample chi-square test indicated that most students failed the knowledge assessment in the various categories (p<0.05).

CONCLUSION AND RECOMMENDATIONS

The pass mark for high-risk skills such as medication administration is 70%. Therefore, the participants' knowledge was below the recommended pass mark. Nurse educators must identify the gaps in teaching and consider including the WHO medication safety curriculum guidelines and teaching strategies in the existing institutional

undergraduate nursing curriculums to enhance the medication administration process and patient safety.

Introduction

Patient safety is globally considered one of the fundamentals of quality nursing care. Various healthcare facilities are currently faced with the challenge of promoting patient safety due to a shortage of resources and inadequate training of healthcare workers. Globally, it is estimated that 10% of hospitalised patients experience a patient safety issue(1). The Institute of Medicine (IoM) estimates that up to 98,000 deaths in the United States are linked to medication errors(2). This translates into the 14th cause of the global disease burden. Nurses make up more than 50% of the healthcare workforce, hence, playing a vital role in promoting patient safety.

Improving medication safety among students is one of the primary focuses of the World Health Organization(WHO) patient safety curriculum developed in 2011 (3). In 2017, WHO further launched the third Global Patient Safety Challenge: Medication Without Harm, which aimed at preventing medication-related harm by improving the strategies to prevent medication administration errors (4). A gap between abstract, theoretical knowledge and practical skills has been identified in the literature. For instance, in a cross-sectional study that sought to explore the clinical learning environment of nursing students, the students expressed that they were not adequately prepared to handle the medication administration process at the beginning of their clinical rotation(5). Further, literature has shown that nursing students submit the most significant number of medication error reports that reach the patient, accounting for up to 44.8%, ranked second among all medical errors(6,7). The

student nurses are supposed to learn safe medication practices anchored in the traditional six rights of medication administration(8).

The medication administration process involves three steps: ordering, dispensing and administration(8). The last step is where the nurses' responsibility lies. The ability to safely administer medications is a critical component in nursing. The process of administering medications is complex, thus, requiring knowledge in various aspects such as dosage calculations, medication route techniques, dispensing systems and protocols. Inadequate training and experience in the nursing workforce have been closely associated with medication errors (9). Nursing students' theoretical and practical medication competence is part of clinical decision-making. Strong knowledge of pharmacology and medication management is a requirement to tackle issues related to patients' management procedures in various patient care settings(10). A systematic review to synthesise the available evidence on medication errors among nursing students concluded that only a few studies had analysed the errors involving nursing students (11).

Literature shows that poor medication knowledge is related to the limited number of opportunities the students have for medication administration in the clinical area due to either facility protocols or policies, lack of well-equipped clinical sites and high student: mentor ratios (2). Additional literature indicates a significant gap in medication administration knowledge as taught in various pre-registration nursing programs(1,2). In an exploratory study conducted in India, students reported that more

time was spent teaching the pre-clinical sciences than nursing interventions (12).

In Kenya, up to 20% prevalence of medication errors has been reported (13). This has been attributed to the inability to follow the medication administration guidelines due to poor medication administration knowledge. Anecdotal evidence has also indicated that the students' entry knowledge level on medication administration is poor. Most students need help doing simple dosage calculations and observing the rights of medication administration when they begin clinical rotations. Due to a lack of empirical data on this critical patient safety issue, the magnitude of the problem still needs to be determined and thus could be higher. Therefore due to the limited published studies in Africa and especially Kenya on the students' medication administration knowledge, it was necessary to study this critical aspect of patient safety.

Materials and Methods
Study design
This descriptive cross-sectional study was conducted in June-August 2021 in two County referral hospitals in Kenya. The two County referral hospitals were conveniently sampled based on the accessibility and the availability of the required number of nursing students. The participants consisted of 147 second-year Bachelor of Science in Nursing students starting their clinical rotations mainly in the medical/surgical wards. After the power analysis calculation, the sample size was 56 participants per group, with the alpha level set at 0.05 and the power level at 0.8. Evidence-based research recommends over-recruitment of 5-30% (14,15) to avoid attrition bias. Therefore, 30% more participants were recruited; 112+ (30%*112) = Total sample 146.

The Census method was used to recruit the participants. The inclusion criteria involved all direct entries from the selected universities undertaking their clinical rotation and completing the pharmacology and introductory nursing skills course in their respective institutions. Students repeating the clinical rotation were excluded because they already had prior clinical experience.

Study tools
An interviewer-administered questionnaire was used to assess the participants' knowledge of medication administration. The questionnaire comprised various components and content drawn from the literature review. Pretesting of the tool was done to ensure quality assurance using the test-retest method among at least 10% (31 participants) from a different institution and clinical area that was not participating in the study. The internal consistency and reliability of the tool were ascertained because Cronbach's α was 0.81. The questionnaire was organised into seven (7) parts in line with the content of the medication administration process to ensure face validity. Two experts were consulted to guide the questionnaire's content and improve the face validity. The items in the study tool were also compared with the study's objectives to ensure construct validity.

Study procedure
After recruitment, the study participants who consented completed the study questionnaire. The questionnaire focused on medication administration knowledge based on the steps of the medication administration process. The questionnaires were collected, checked for completeness and accuracy, and coded before the data entry. The knowledge scores for all the questionnaires were calculated in percentages.

Data management
The data was entered using EpiData version 3.1 and then exported to the Statistical Package for the Social Sciences (SPSS) version 26 for analysis. The Kolmogorov-Smirnov test ascertained the normality and similarity of the

two groups, p<0.05. The demographic data were analysed using descriptive statistics. Inferential statistics, such as one sample chi-square test, were used to assess any statistical significance between those who passed and those who failed the knowledge test. The data were presented in percentages and tables.

Ethical considerations

The Kenyatta University Ethics Review Committee approved the study (Approval number: PKU/2160/11308). The National Council of Science, Technology and Innovation, NACOSTI (License number: NACOSTI/P/20/8031) granted the research permit. The two clinical sites also approved the study. The researchers adhered to the Ministry of Health (MoH) and World Health Organization's (WHO) guidelines on the COVID-19 pandemic. The study was carried out in adherence to the requirements of the Declaration of Helsinki.

Results

Demographic characteristics

All the respondents were second-year BSc. in Nursing students undertaking clinical rotation. The sample was predominantly college-age (20 ± 1yrs), and slightly more than half, 87 (59.2%), were female. The respondents were equally distributed in the two clinical sites. Table 1.

Medication administration knowledge

The medication administration knowledge performance was analysed based on the local grading scale in various nursing schools as follows; <50=fail, 50-64=satisfactory, 65-74=good, $\geq$ 75=very good. The results were further analysed based on a pass/fail cut (<70=fail, 70$\geq$=pass) according to the recommended international grading scale for high-risk skills (16,17).

Infection Prevention and Control (IPC) Knowledge

As shown in table 2, the students were evaluated on their knowledge of infection control during drug administration. From our findings, most (109;74%) participants scored below 65%. Out of the remaining 38 (26%), only 12 (8.2%) scored 75% and above.

Table 1:
Demographic characteristics

Characteristics	Frequency (%)
Age(years)	Mean (20.4) SD (1.06)
Gender:	
Male	60(40.8)
Female	87(59.2)
Clinical site 1	74(50.3)
Clinical site 2	73(49.7)

Table 2:
Infection Prevention and Control (IPC) Knowledge

IPC scores	Frequency (%)
Fail	35 (23.8)
Satisfactory	74 (50.3)
Good	26 (17.7%)
Very good	12 (8.2%)

Principles of medication administration knowledge

The principles of medication administration knowledge findings showed that nearly half, 71 (48.3%) of the students scored below 65%, and a quarter 56(38.1), scored between 65 and 74 %. Only 20 (13.6%) participants scored 75% or higher. Table 3.

Right patient knowledge

On the "the right patient" knowledge, 124 (84.4%) scored more than 75%, categorised as an excellent score. However, only 9 (6.1%) students failed in this category (Table 3).

Right time knowledge

Participants were also assessed on the right time for medication administration. The results suggest that almost half, 68 (46.3%) of the students failed. However, only 11 (7.5%) students scored 75% or higher. Table 3 has the details.

Table 3:

Rights of Medication Administration

Rights of Medication Administration	Frequency (%)
Principles of Medication Administration Knowledge	
Fail	11 (7.5)
Satisfactory	60 (40.8)
Good	56 (38.1)
Very Good	20 (13.6)
Right Patient Knowledge	
Fail	9 (6.1)
Satisfactory	6 (4.1)
Good	8(5.4)
Very good	124 (84.4)
Right Time Knowledge	
Fail	68(46.3)
Satisfactory	68 (46.3)
Good	0 (0.0)
Very Good	11 (7.5)
Right Route Knowledge	
Fail	16 (10.9)
Satisfactory	92 (62.6)
Good	32 (21.8)
Very Good	7 (4.8)
Right Documentation Knowledge	
Fail	43 (29.3)
Satisfactory	71 (48.3)
Good	0 (0.0)
Very Good	33 (22.4)
Right Dose Knowledge	
Fail	40 (28.3)
Satisfactory	46 (31.3)
Good	0 (0.0)
Very Good	59 (40.2)

Right route knowledge

Table 3 shows the results of the correct route assessment. Based on these findings, the majority (108;73%)scored below 65%. It is also noted that only a small proportion, 7 (4.8%) of the students, scored 75% and above.

Right documentation knowledge

Table 3 also shows the results of the correct documentation whereby most

A sample chi-square test was performed to determine whether those who passed the various categories differed from those who failed. As shown in Table 4, most students failed the knowledge assessment (p<0.05). On the contrary, students 132 (89.8%) significantly passed the right patient category, χ^2 (1, n=147) =93.12, p<0.05. Further shown in table 4 is the total medication administration knowledge whereby 43 (29.3%) of the participants passed with a score of $\geq$ 70%, whereas more than two-thirds, 104 (70.7%), failed with a score <70% (p<0.005).

Total medication administration knowledge

The mean score for the total medication administration knowledge was 64.8%, SD 5.9,

participants, 114 (77.6%), scored below 65%, whereas 33 (22.4%) scored 75% or higher.

Right dose knowledge

More than half, 86 (59.6%) participants scored 50% and below. Additionally, only 59 (40.2%) out of the 147 participants scored 75% and above. Table 3.

High-risk skills score

whereas the median score was 65.6 %. The minimum score was 43%, whereas the maximum score was 79%. Table 5.

Discussion

This study aimed to assess the knowledge of medication administration among undergraduate nursing students in two County referral hospitals. Analysis of the demographic characteristics showed that most of the respondents were female and of college age. This is similar to other studies that have also reported more female participants (11,18,19). This similarity implies that nursing has traditionally been a female-dominated profession.

Table 4:
High-risk skills pass mark

MA Knowledge Category	Pass [Frequency (%)]	Fail [Frequency (%)]	One sample χ^2	df	Asymp. Sig.
Principles of MA	42(28.6)	105(71.4)	27.000[a]	1	0.000
IPC guidelines	19(12.9)	128(87.1)	80.823[a]	1	0.000
Right patient	132(89.8)	15(10.2)	93.122[a]	1	0.000
Right time	11(7.5)	136(92.5)	106.293[a]	1	0.000
Right route	39(26.5)	108(73.5)	32.388[a]	1	0.000
Right documentation	33(22.4)	114(77.6)	44.633[a]	1	0.000
Right Dose	59(40.1)	88(59.1)	5.721[a]	1	0.017
Total Medication Administration	43(29.3)	104(70.7)	25.313[a]	1	0.00

Medication administration knowledge

Infection Prevention and Control Practices

The current study's findings show that nearly a quarter (35; 23.8%) of respondents failed the infection prevention and control practices category with a score of below 50%. This finding is consistent with Chan's study on medication errors among nursing students, whereby more than 50% (n=19) of the respondents failed the infection prevention and control category (18). Despite rigorous theoretical and practical learning opportunities on infection control during medication administration, the students continue to generate these errors, thus, compromising patient safety(20). Therefore, it is imperative to examine the knowledge of infection control and develop strategies to improve this vital aspect of medication administration.

Rights of medication administration

The majority (124;84%) of the participants in the study scored 75% and above in the patient identification category. Additionally, consistent with the above findings, Musafiri & Daniels reported that 100 (80%) students in the Western Cape perceived themselves as able to identify the right patient using two identifiers during medication administration (21). The two researchers associated the above findings with the fact that the patient's identification is emphasised the most as opposed to the other rights of medication administration.

One of the critical steps in the medication administration process is knowing the six rights of medication administration. Violating any of the six rights puts the students at risk of making a medication error and compromising the patients' safety. It is vital to ascertain that the patient being treated is the one receiving the medication. To maintain the therapeutic effect, medications should be administered at the right time as ordered by the prescriber. In this study, 46.3% (n=68) of the respondents failed to identify the correct time of medication administration. This finding is comparable to a study done in Indonesia, where students stated that the medications were administered at inappropriate times to save time and get the task over with (6). These time-related errors are common, whereby medications are administered up to two hours prior or two hours late. These errors have been attributed to the limited human resource, whereby the ratio of nurses to patients is very high. The fact that the students have to prepare the medications under supervision is the other reason contributing to delay in the administration.

Table 5:
Total medication administration knowledge

Statistics		
Total Knowledge Scores		
N	Valid	147
	Missing	0
Mean		64.88
Median		65.57
Mode		66[a]
Std. Deviation		5.886
Minimum		43
Maximum		79
a. Multiple modes exist. The smallest value is shown		

Medications are administered using different routes. The current study indicated that 108 (73.5%) of the respondents failed to identify the correct route of medication administration. These findings correlate with what was reported by Bowling, whereby 75.3% of the students were unable to state the correct route of medication administration in a study to evaluate safe medication administration (22). According to Bowling, most educators emphasised the commonly used routes, such as oral, intramuscular and intravenous, compared to the less commonly used routes of medication administration; thus, the deficiency in knowledge.

The student's ability to administer the correct dose is associated with mathematical and clinical calculations competence. The majority, 88 (59.1%) of the respondents in this study, were unable to perform simple dosage calculations. This is comparable to a study by Koharchik at the University of Maine, the United States, to evaluate the nursing students' dosage calculation proficiency. According to the study, 35% of the participants failed all the questions on dosage calculations, whereas only 13% had no calculation errors(23). The current study and Koharchik associate poor performance in dosage calculation with the nursing students' negative attitude towards mathematical calculations.

Medication errors have also been reported because of gaps in documentation. The findings of this study showed that 114 (77.6%) of the respondents failed the documentation category. Documentation is vital to indicate that the medication was given in adherence to the rights of medication administration. The errors related to documentation have been identified as problem areas in previous research (1,24). Literature shows that there has been a lack of consensus on whether documentation is considered one of the rights of medication administration. For that reason, little emphasis is put on documentation compared to the other rights. This highlights the need for the students to consistently document the nursing care provided to the patients and, most notably, the skills that impact patient safety.

Total medication administration knowledge

This study's mean knowledge score of 64.8 % was below the recommended scores for high-risk skills. The internationally recommended pass mark for high-risk skills such as medication administration is 70 % (16,17). Moreover, the participants failed in five out of the six categories of medication administration, with a pass mark lower than the recommended 70%. These findings are coherent with a study done in Sri Lanka, which showed that the pre-licensure students' medication administration knowledge score was 47% (25). Consistently, a systematic review indicated that there were gaps in medication administration knowledge among undergraduate BScN students. These gaps were attributed to deficiencies in the pharmacology content learned in class and a lack of practice in the clinical content (2).

Similar gaps are also identified in a different study whereby the students' performance in medication administration before the intervention was 5 out of 10 (50%) (26). Moreover, Musafiri & Daniels agrees with the above findings whereby only 19.2% of the students in a descriptive study perceived themselves as competent in medication administration(21). The results are similar to that of Musafiri & Daniels and Craig et al.'s where there was poor knowledge at baseline among the two groups. The intervention and control groups had a mean score of 16.9(67%) and 17.1(68%), respectively, out of the possible 25 points(27).

In contrast, the findings of this study are opposed by Sulosaari in Finland in a study to assess nursing students' theoretical competence in medication administration. In the said study, the

students attained 72% in the medication administration knowledge test(10). This performance was deemed better compared to previous studies. The researcher, however, still admits that there were deficiencies identified in certain items of the knowledge test. The researcher in the above study associates the difference in theoretical competence with the confounders that were not eliminated during the study.

In Summary, there is a clear indication of potential gaps in acquiring medication administration knowledge that needs to be addressed to achieve optimum patient safety.

Study limitations

The first major limitation of the current study was the need for more financial support. The researchers entirely relied on themselves to fund the study, thus limiting the number of clinical sites that could have been included. Data was collected from only two clinical sites; therefore, the study's results may not be generalisable to other clinical sites. The other limitation was collecting data amidst the COVID-19 pandemic, which introduced unforeseen financial challenges, including the cost of purchasing masks and hand sanitisers.

Conclusion

The findings indicate that more than half of the student's knowledge of medication administration was poor. This was denoted by the average student's medication administration performance being below the recommended level.

Recommendations

The gaps in knowledge identified in this study were mainly attributed to the need for more practice and incorporation of the appropriate teaching strategies among nursing students in administering medications before they start clinical rotations. For that reason, exploring the gaps in undergraduate nursing curriculums and teaching strategies is imperative. There is also a need for nurse educators to include the WHO medication safety curriculum guidelines and teaching strategies in the already existing institutional undergraduate nursing curriculums to enhance the medication administration process and patient safety to fill the identified gaps.

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