An Evaluation of the Drug Calculation Skills of Registered Nurses in the Critical Care Department at a Tertiary Hospital in KSA

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Abstract

Background: Mathematical skills are essential for nurses to ensure the accuracy of drug dose before performing medication administration and also important in prevent medication errors.

Objective: This study are to evaluate the drug calculation skills of critical care department (CCD) registered nurses at King Saud Medical City. A Convenience sample size of 220 CCD nurses 200 completed questionnaire and drug calculation competency skill test.

Method: A cross-sectional survey with drug calculation competency test for CCD nurses. Data analysis was conducted using SPSS (Statistical Package for the Social Sciences).

Result: According to data analysis, 13.9% of participant nurses were unable to get score >80% on drug calculation test. Average score on the skill test exam was 86.1% (SD=0.50). The Largest proportions of incorrect answers were in vasopressors dose calculation.

Conclusion: This article highlighted drug calculation errors were significant in critical care nurses. The common causes of medication errors according to surveyed nurse's feedback related to frequently changing medication orders, nurses suffer from workload.

Keywords: Drug calculations; Medication errors; Critical care department

Literature Review

Drug calculation skills are essential for the accuracy of drug dosing while performing medication administration in healthcare institutions [1,2]. Accurate Drug calculation and administration is an essential part of the nursing practice [3]. Many research have identified that medication errors associated with inaccurate drug calculation and poor mathematical skills of nurses still problem [3,4]. Approximately 40% of daily nursing task are related to drug interventions or medication administration [5,6]. Medication errors include wrong dose, incorrect side effect, and drug omission without clinical justification, incorrect time, incorrect route, drug calculation errors, incorrect patient, and allergy-related errors [7-9]. Although errors occur at every stage of the drug preparation and distribution process [7,9-11], one-third of those that harm patients occur during the administration phase [12]. Many medication errors occur as a result of limited pharmaceutical knowledge and wrong drug calculation [2,12,13]. A descriptive study of 110 Registered Nurses and found that 81% of nurses surveyed were unable to pass 90% of drug calculation test conducted by Bindler and Bayne [4]. Urgent attention into drug calculation skills of registered nurses [14].

In the intensive care unit (ICU) at King Saud Medical City patient estimated medication errors of 1.7 per patient per day were found [5]. Nurses in the critical care department (CCD) administer a variety of medications for critically ill patients. These medications need precise drug calculation. Many, including inotropes, vasopressors, and sedatives are given based on weight and concentration in microgram and per minute. Research indicates nurses drug calculation skills need to improve [15,16]. To achieve this, we should apply medication competencies (calculation, administration) for all ICU nurses for continuous improvement and training and to prevent medication errors [16]. Medication education encompassing mathematical and conceptual drug calculation skills should be identified as a specific competency in ICU nursing educational programs and provided on a continuing basis [17].

Study Purpose (Methodology)

This cross-sectional study was conducted in the Critical Care Department in KSMC (King Saud Medical City, Riyadh, KSA). A total 220 questionnaires distributed in a convenience sample method to critical care nurses in four intensive care departments: T1A1, T1B1, T1A2 and TRCU over a five- month period July and November 2018.

Method

This cross-sectional survey with drug calculation competency test for ICU nurses approved by IRB committee at KSMC. The

first section of the questionnaire included demographic data; Second section consisted of an awareness (drug calculation competency) test.

Aim

This study was to evaluate drug calculation skills essential for ensuring the accuracy of drug dose while performing medication administration. Drug calculation is essential for accuracy of right drug dose, which is one of medication rights. Patient safety is the basis of this study in the effort to make sure correct medication dose and maximum preventive measure regarding medication administration errors and drug calculation errors are implemented.

Research design

A cross-sectional survey with a drug calculation competency test for CCD nurses. Data analysis was based on descriptive statistics.

Sample

A convenience sample of 220 critical care nurses was accessed. A total of 200 completed questionnaires were returned, for a response rate was 90%.

Statistical Analysis

The data on the two outcomes on 'Awareness about the Drug Calculation' was analyzed using SPSS 21. The 'correct response' related to 'Awareness' was scored as '1' and the 'incorrect response' as '0'. This score was converted to percentage and grouped on the 'Competency cut off for Awareness as 80%. Chi Square test was used for the association between demographic variables and Awareness Level. NOVA were performed for the demographic variables and tested for the statistical significance at 5% level.

Results

A total of 220 questionnaires were distributed to nurses working in critical care departments. Of these, 200 of the returned questionnaires were acceptable for the study. The accepted number of respondents (n=200) was more than the minimum estimated sample size (n=113).

Demographics

Two hundred critical care nurses participant in this study. The majority of participants were female nurses (n=196; 98%), aged between 24 and 50 years (mean age 31.95 year SD=6.135) **(Table 1)**.

Table 1 Drug calculation skill test result (demographic variables).

Variables		Frequency	Percentage
Gender	Male	4	2.00%
	Female	196	98.00%
Age	20-30 y	97	48.50%
	31-40 y	85	42.50%
	More than 40 y	18	9.00%
Education	Diploma or High Diploma	19	9.50%
	Bachelor	180	90%
	Other (Msn)	1	0.50%
Experience	Less than 3 Year	54	27%
	4-7 Years	99	49.50%
	More than 7 Years	47	23.50%
Job Position	CN	36	18.00%
	O (HN)	1	0.50%
	SN	163	81.50%
Attend Medication Courses	Yes	90	45.00%
	No	110	55.00%
Nurses Assess Their Drug Calculation Competency	Above average	63	31.50%
	Average	137	68.50%
Medication Administration (Self Assessment)	Yes	180	90.00%

		No	20	10.00%

The academic level of the participant nurses (BSc) was the highest proportion of participants (n=180; 90%), with diploma nurses being second (n=19; 9.5%), and the remaining educated at the MSN level (n=1; 0.5%). The majority of nurses participated had between 4 to 7 years of experience (49.50%), 27% of respondents have less than 3 years nursing experience in critical care while 23.50% indicated experience of more than 7 years. **(Table 1)**.

Bedside nurses represent majority the surveyed sample (n=163; 81.5%). More than half (n=110; 55%) of nurses did not attend any medication course. This may explain that only 31.5% **(Table 1)** of overall participant ranked as competent in drug calculation, while in medication administration perception most of nurses identified themselves as competent (n=180; 90%).

Drug calculation skills exam (Awareness)

According to drug calculation competency policy in King Saud medical city, nurses should answer correctly 80% of questions to be considered as "passing". The mean score in (awareness) skill test exam was 86.1%. The largest proportion of errors was in vasopressors questions. The majority of errors in the calculation can be attributed to questions across the 5 items (paper one skill test Q5, Q6, Q10, Q12 and Q16) the remaining errors could be described as less than 7% **(Figure 1)**. Bedside nurses did better than charge nurses and other staff. This can relate to daily practices **(Table 1)**.

Table 2 Result of awareness.

Demographic		x^2	df	P-Value
Age	20-30 Year	17.883	2	0
	31-40 Year			
	>40 Year			
Gender	Female	1.834	1	0.176
	Male			
Education	Diploma	14.089	2	0.001
Experience	<4 Year	10.978	2	0.004
Job	CN	0.686	2	0.71
	HN			
	SN			
Attend Medication Courses	No	23.33	1	0
	Yes			

There are significant correlation between nurses age and drug calculation awareness result (p>0.001), on the same direction education has significant relation also (p=0.01), ICU experience (p=0.004) and attending medication courses (p<0.001).

CDD nurses gender and job level did not have any correlation with drug calculation result awareness (p>0.05) **(Table 2)**.
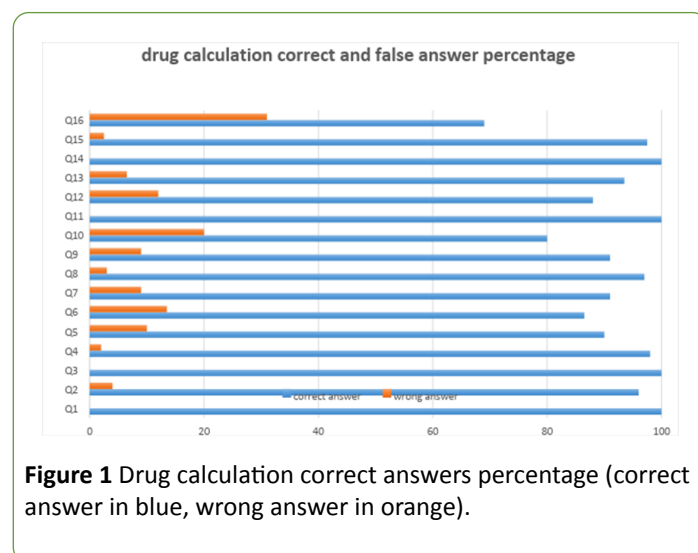

Figure 1 Drug calculation correct answers percentage (correct answer in blue, wrong answer in orange).

Discussion

This article highlighted CDD nurses limited drug calculation skills. Many other studies share same concerns about nurses drug calculation skills [14,17-19] also for intensive care (ICU) nurses [20]. Most nurses consider drug calculation essential to decrease medication errors during the preparation of drugs [21]. This study aimed to evaluate drug calculation skills which are essential for the accuracy of drug dose while performing medication administration [2]. In this study, mean was 86.1%, and 13.9% of participants achieving score of (<80%). A single medication error can affect patient life so all nurses should be highly (100%) competent in drug calculation [12,20,22]. Other findings of this study concur that most nurses error in drug calculation (Inotropes and vasopressor) which need conceptual knowledge [7,23]. Poor drug calculation skills, noncompliance and lack of pharmacological knowledge of nurses have also led for nurses to low exam result [24].

There is considerable relation regarding medication errors and CDD nurses drug calculation awareness result [16].

Conclusion

This article highlighted the significant deficiency of calculation skills in critical care nursing in all level and degrees (diploma and bachelor degree). The common causes of medication errors according to surveyed nurses feedback related to; frequently change medication orders, nurses suffer from workload, fail to a adhere to policy and procedures, using abbreviations and most errors happen in administration phase.

Recommendation

According to Saudi *Central Board for Accreditation of Healthcare Institutions* CBAHI standards; nursing education department started implement drug calculations competency on annual basis, this strategy will assist CDD nurses developing proficiency in drug calculations competency as well. Nurses should encourage to attended medication training courses to prevent medication errors and improve patient safety as priority.

Interventional study is highly recommended.

Acknowledgement

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