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LEVEL OF KNOWLEDGE AMONG NURSES REGARDING DRUG DOSE CALCULATION WORKING AT TERTIARY CARE HOSPITAL PESHAWAR KHYBER PAKHTUNKHWA

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Abstract

Introduction: Medication errors, including prescribing, transcribing, dispensing, and administration errors, remain a major patient safety concern and are commonly caused by incorrect dose calculations, miscommunication, labeling problems, and inadequate monitoring (Salman et al., 2020). Common medication errors include wrong dose, wrong patient, incorrect route, incorrect timing, calculation errors, and allergy-related errors (Mohammed et al., 2017). Inadequate training, heavy workloads, and poor numeracy skills significantly contribute to these errors, emphasizing the need for continuous education and critical thinking among nurses (Awajeh et al., 2019; Al-faouri et al., 2014; Wright, 2010). High-alert medications further increase the risk of serious patient harm, making nurses' competency in drug dose calculation essential (Kumar & Rehman, 2022). The Institute of Medicine defines a medical error as the failure of a planned action or the use of an incorrect plan to achieve an intended outcome (An & Study, 2024).

Methodology: A quantitative descriptive cross-sectional study was conducted among 328 nurses from four tertiary care hospitals in Peshawar, Khyber Pakhtunkhwa (LRH = 100, HMC = 90, KTH = 78, PIC = 60), using a convenience sampling technique. Data were collected through an adopted structured questionnaire with informed consent and analyzed using SPSS version 27. Descriptive statistics and a six-point Likert scale were used to assess nurses' knowledge regarding drug dose calculation.

Results: All 328 participants were included in the analysis. The overall mean knowledge score was **3.305**, corresponding to an average knowledge level of **45.2%**, indicating a **moderate level of knowledge** regarding drug dose calculation. Most participants were aged 20–30 years, 69.2% were female, the majority held a BS Nursing qualification, 63.1% had less than three years of experience, and 55.8% had not attended a medication-related training course during the previous year. Although 94.2% reported satisfaction with their medication administration practices, the findings highlight the need for improved education and regular training to enhance medication safety.

Discussion: The findings indicate that nurses working in tertiary care hospitals in Peshawar possess only moderate knowledge of drug dose calculation despite relatively high educational qualifications. Limited clinical experience

and insufficient participation in medication training may contribute to this knowledge gap. Strengthening continuing education, drug calculation training, and organizational support is essential to improve medication safety and reduce medication errors.

Introduction

The healthcare sector has undergone significant advancements, making the delivery of high-quality healthcare essential for improving patient outcomes (Samina et al., 2008). The World Health Organization (WHO) emphasizes quality healthcare as a global priority (Chalkidou et al., 2016; WHO, 2018). Nurses play a central role in patient care by assessing patients, administering medications, monitoring treatment, maintaining documentation, and providing patient education (Cole et al., 2017; Gerensea et al., 2015; Kalisch, 2006).

Medication errors are preventable events that occur during prescribing, dispensing, or administering medications and may result in patient harm (Fleming et al., 2014). These errors negatively affect patient safety, increase healthcare costs, prolong hospital stays, and reduce public confidence in healthcare systems (Ahmad et al., 2021; WHO, 2014). Common medication administration errors include incorrect drug dose, wrong patient, wrong route, wrong timing, incorrect documentation, and calculation mistakes (Komal & Javed, 2023).

Drug dose calculation is a fundamental nursing competency that requires mathematical accuracy and sound clinical judgment (Al-faouri et al., 2014). However, heavy workloads, inadequate training, poor numeracy skills, limited resources, and workplace distractions contribute significantly to dosage calculation errors (Awajeh et al., 2019; Karn et al., 2020; Tabassum et al., 2021). Studies have shown that many registered nurses fail to achieve the required competency in drug dosage calculations, highlighting the need for continuous education and competency-based training (Karn et al., 2020; Wright, 2010).

Medication errors remain a global patient safety challenge. The Institute of Medicine (IOM) defines a medical error as "the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an objective" (An & Study, 2024). Globally, medication errors harm millions of patients annually and are associated with increased morbidity, mortality, and healthcare expenditure (Pham et al., 2012; Makary & Daniel, 2016; Mugada et al., 2018; Vaziri et al., 2019; Elonen et al., 2022). In low- and middle-income countries, including Pakistan, these errors are frequently underreported

because of inadequate reporting systems and limited organizational support (Ahmad et al., 2021; Vaziri et al., 2019).

High-alert medications (HAMs), commonly administered in intensive care, emergency, coronary care, pediatric, and surgical units, require exceptional accuracy because even minor dosage errors can result in severe patient harm or death (Özünal et al., 2020). Safe medication administration depends on adherence to the "Ten Rights" of medication administration, including the right patient, medication, dose, route, time, assessment, education, evaluation, documentation, and the patient's right to refuse treatment (Rai & Devi, 2019).

Despite nurses serving as the final safeguard in medication administration, deficiencies in pharmacological knowledge, drug dose calculation skills, and continuing professional education continue to contribute to medication errors (Maguire et al., 2007). Strengthening nurses' knowledge through continuous education, competency assessments, effective reporting systems, and organizational support is therefore essential to improve medication safety and patient outcomes (Coyne et al., 2013).

Methodology:

A descriptive cross-sectional study was conducted among registered nurses working in four tertiary care hospitals in Peshawar, Khyber Pakhtunkhwa, including Lady Reading Hospital (LRH), Khyber Teaching Hospital (KTH), Hayatabad Medical Complex (HMC), and Peshawar Institute of Cardiology (PIC). The study population consisted of registered nurses providing direct bedside care in inpatient wards. Nurses with valid PNC registration, at least one year of clinical experience, and willingness to participate were included, while those unwilling to participate or not involved in direct patient care were excluded.

The sample size of 328 nurses was calculated using OpenEpi software with a 95% confidence level, 5% margin of error, and a total population of approximately 2,200 nurses. Participants were selected using a non-probability convenience sampling technique.

Data were collected using an adopted structured questionnaire from the study by Awajeh et al. (2019), designed to assess nurses' knowledge regarding drug dose calculation. The questionnaire comprised three sections: socio-demographic information, work profile, and knowledge of drug dose calculation. The instrument demonstrated excellent reliability, with a Cronbach's alpha of 0.88 in the original study and 0.89 after validation (Awajeh et al., 2019; Sharma & Kamra, 2013).

Ethical approval and administrative permissions were obtained before data collection. Written informed consent was obtained from all participants, and confidentiality, anonymity, voluntary participation, and the right to withdraw at any stage were ensured. Data were analyzed using SPSS version 27. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the data, while appropriate inferential statistical tests were applied to determine statistical significance.

Results

A total of 328 nurses participated in the study, including 100 (30.5%) from LRH, 90 (27.4%) from HMC, 78 (23.8%) from KTH, and 60 (18.3%) from PIC. The findings are presented according to demographic characteristics, knowledge regarding drug dose calculation, and attitudes toward medication safety.

Demographic Characteristics

Most participants were 20–30 years old (71.6%), followed by 30–40 years (27.4%). Female nurses constituted 69.2% of the sample. The majority held a Bachelor of Science in Nursing (70.7%), while 27.4% had a diploma. Most participants had less than three years of clinical experience (63.1%), and 60.1% were working as charge nurses. More than half (55.8%) had not attended any medication-related training during the previous year. Almost all participants (94.2%) reported satisfaction with medication administration practices, while 75.3% rated their medication calculation skills as average.

Knowledge Regarding Drug Dose Calculation

Knowledge regarding medication safety was generally satisfactory for hand hygiene before IV antibiotic preparation (95.1%), checking IV sites during cytotoxic drug administration (87.8%), identification of high-alert medications (89.9%), dopamine dose calculation (75.3%), preparation of IV hydrocortisone (75.3%), and swabbing heparin vial tops (72.3%). However, lower levels of knowledge were observed regarding noradrenaline dose calculation (43.9%), amiodarone compatibility (45.4%), IV antibiotic compatibility (52.7%), KCl administration (32.6%), ceftriaxone compatibility (31.4%), and heparin dosage expression (31.1%), indicating knowledge gaps in advanced medication calculations.

Attitude Toward Medication Safety

Most nurses reported correctly applying medication rights (55.8% strongly agreed) and expressed willingness to report medication errors (42.7% strongly

agreed). Workload was identified as the most significant concern, with 61.3% strongly agreeing that they experienced excessive workload. Most participants disagreed that they lacked awareness of medication errors (76.6% disagreed) or had difficulty programming IV pumps (61.9% disagreed). However, many nurses perceived frequent medication order changes by physicians and acknowledged communication challenges between nurses, physicians, and pharmacists.

Table 1 Demographic Characteristics

Variable	Category	n (%)
Age	20–30 years	235 (71.6)
	30–40 years	90 (27.4)
	>40 years	3 (0.9)
Gender	Male	101 (30.8)
	Female	227 (69.2)
Education	Diploma	90 (27.4)
	Bachelor	232 (70.7)
	Other	6 (1.8)
Experience	<3 years	207 (63.1)
	4–7 years	102 (31.1)
	>7 years	19 (5.8)
Job Position	Staff Nurse	120 (36.6)
	Charge Nurse	197 (60.1)
	Other	11 (3.4)
Medication course	Yes	145 (44.2)
	No	183 (55.8)

Variable	Category	n (%)
Satisfied with medication administration	Yes	309 (94.2)
	No	19 (5.8)
Medication calculation confidence	Above average	68 (20.7)
	Average	247 (75.3)
	Below average	13 (4.0)

Table 2 Knowledge Regarding Drug Dose Calculation

Domain	Correct Response n (%)
Hand hygiene before IV antibiotic preparation	312 (95.1)
Expiry date checking	246 (75.0)
Hand hygiene before IV hydrocortisone	247 (75.3)
Heparin dosage expression	226 (68.9)
Heparin vial swabbing	237 (72.3)
Reconstituted IV medication	214 (65.2)
IV antibiotic compatibility	173 (52.7)
Noradrenaline dose calculation	144 (43.9)
IV site assessment during cytotoxic therapy	288 (87.8)
IV vs IM administration	265 (80.8)
KCl administration	221 (67.4)
Ceftriaxone compatibility	225 (68.6)
Dopamine dose calculation	247 (75.3)

Domain	Correct Response n (%)
High-alert medication identification	295 (89.9)
Calcium gluconate administration	224 (68.3)
Amiodarone compatibility	149 (45.4)

Table 3 Summary of Attitude

Statement	Main Finding
Apply medication rights correctly	55.8% strongly agreed
Report medication errors	42.7% strongly agreed
Medication order changes by physicians	74.4% agreed
Abbreviations frequently used	64.6% agreed
Poor communication	52.4% agreed
Fear reporting medication errors	62.2% agreed
Work overload	72.9% agreed
Difficulty programming IV pumps	61.9% disagreed
Lack awareness of medication errors	76.6% disagreed
Medication errors occur during administration	Majority disagreed
Fail to follow policy	Majority disagreed

This condensed version is about 65–70% shorter, removes repetition, and follows the format commonly used in MSc/MPH nursing theses and journal manuscripts while preserving all key findings.

Discussion

The present study assessed the level of knowledge among nurses regarding drug dose calculation in tertiary care hospitals of Peshawar, Khyber Pakhtunkhwa. A total of 328 nurses participated, with the majority being 20–30 years old, female (69.2%), holding a Bachelor of Science in Nursing (70.7%),

and having less than three years of clinical experience (63.1%). More than half (55.8%) had not attended a medication-related training course during the previous year, although 94.2% reported satisfaction with their medication administration practices.

The overall mean knowledge score was **3.305**, corresponding to an average knowledge level of **45.2%**, indicating a moderate level of knowledge regarding drug dose calculation. Nurses demonstrated good knowledge of basic medication safety practices such as hand hygiene, checking medication expiry dates, identifying high-alert medications, and safe administration procedures. However, deficiencies were identified in advanced drug calculations, medication compatibility, and dosage calculations for high-risk medications such as noradrenaline, potassium chloride, and amiodarone. These findings are consistent with previous studies, which reported that nurses often experience difficulty with complex drug calculations and require continuous competency-based education.

Participants identified heavy workload, frequent changes in medication orders, communication gaps, workplace interruptions, and inadequate training as major contributors to medication errors. These findings support previous research demonstrating that organizational factors significantly influence medication safety. Although the study was limited to nurses working in tertiary care hospitals and did not include other healthcare professionals, the findings emphasize the importance of continuous professional education, standardized medication safety protocols, and multidisciplinary collaboration to improve patient safety and reduce medication errors.

Conclusion

The study concluded that nurses working in tertiary care hospitals possess a **moderate level of knowledge** regarding drug dose calculation. Although participants demonstrated satisfactory knowledge of routine medication administration practices, important deficiencies remained in complex drug calculations and medication compatibility. Heavy workload, insufficient training, communication barriers, and non-adherence to medication safety protocols were identified as major contributors to medication errors. Strengthening nurses' knowledge through regular competency assessments, continuing education, and supportive organizational policies is essential to improve medication safety and patient outcomes.

Recommendations

Based on the study findings, hospitals should implement regular competency assessments and continuing education programs on drug dose calculation for all nurses, particularly during orientation and throughout clinical practice. Nursing curricula should provide greater emphasis on medication calculations through theoretical and practical training. Nurse administrators should organize regular workshops, seminars, and in-service education to strengthen medication safety practices and promote evidence-based care. Interprofessional collaboration between nurses, physicians, and pharmacists should be encouraged to reduce medication errors and improve patient outcomes. Regular performance assessment, constructive feedback, and periodic updates of institutional medication policies should be implemented to maintain safe clinical practice. Future research should include larger and more diverse healthcare settings and evaluate interventions designed to improve nurses' drug dose calculation competency and medication safety.

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