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# NUMERICAL SKILLS AND DRUG CALCULATION ABILITIES OF NURSING STUDENTS: AN ASSESSMENT STUDY

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## ABSTRACT

**Background:** Patient safety is a key concern for nurses; ability to calculate drug doses correctly is an essential skill to prevent and reduce medication errors. It has been reported that many newly graduated healthcare professionals have low levels of competency in the area of drug dose calculation. **Aims:** The purpose of this study was to assess the drug dosage calculation knowledge and proficiency among our nursing students. **Methods:** Data was collected through pre-designed semi-structured questionnaire. Data was compiled and tabulated by using MS excel and was analyzed. **Results:** The results showed that students were competent in calculating dosages based on body surface area and those expressed in international units (IU). They were competent in calculating renal function and the number of tablets required for a prescription. 52% of the nursing students in the current study failed the mathematical skill test, with a score below the passing grade of 50%. Dose calculation skills (solid-liquid drugs) were scored below 50% was 30.5%, and 75% of the students scored less than 50% in drug calculation skills (intravenous fluid and infusion rates). The solid-fluid drug dose and injection calculation skills of the students were better than the intravenous and infusion rate calculation skills. The study results showed the significant improvement in drug dosage calculation knowledge and proficiency among the study participants. **Conclusion:** Drug dose calculation continually provides challenges among healthcare graduates, and additional and varied learning resources may enable students to attain and retain an acceptable standard of skill throughout their professional careers.

**KEYWORDS:** Drug dose calculations, nursing students.

## INTRODUCTION

Drug therapy forms one of the important components of care of sick person. Studies amongst doctors, nurses and paramedical confirm that many healthcare providers are not sufficiently competent in calculating drug doses[1] Drug calculation skills are essential for the accuracy of drug dosing while performing medication administration in healthcare institutions.[2,3] Accurate Drug calculation and administration is an essential part of the nursing practice.[4] Approximately 40% of daily nursing task are related to drug interventions or medication administration.[5] Mathematical skill and proficiency underpin a number of nursing activities, with the most common application being in relation to drug dosage calculation and administration. Medication errors have been identified as the most common type of error affecting patient safety and the most common single preventable cause of adverse events[6] and they can occur as a result of mathematical calculation error and or conceptual error. Although errors occur at every stage of the drug preparation and distribution process,[7] one-third of those that harm patients occur during the administration phase[8] Many medication errors occur as a result of limited pharmaceutical knowledge and wrong drug calculation.[2]

Further a literature review indicates that there is lack of research in the area of drug dosage calculation proficiency of the nurses that could lead to serious medication errors and threat to patient safety.[9] Therefore, this study was planned with the purpose to assess the drug dosage calculation knowledge and proficiency amongst our nursing students.

## METHODS

Ten questions were formulated based on the curriculum requirements, what is relevant and important for safe clinical practice. An example of this set of 10 questions is shown in appendix. Thirty minutes were allowed for the testing. 5 marks were awarded for a correct answer; zero for an incorrect answer. No half marks were given. The scores for each item and overall scores were computed and compared. Mathematical skills were scored from Q.no. 1,2,3. Dose calculation skills (solid-liquid drugs) were computed from Q.no. 2,3,7 and Drug calculation skills (intravenous fluid and infusion rates) from Q.no. 8,9,10.

## RESULTS

A total of 102 questionnaires were distributed to nursing students. Of these, 100 of the returned questionnaires were acceptable for the study. The majority of participants were female students(n=90). The questionnaires were designed to test mathematical skills, metric

conversions, calculations. The median scores for the mathematical and drug dose calculation were as shown in table no.1.

Table 2 shows the variation of mathematical and drug dose calculation scores in range less than 50, within 50-80 and more than 80. Fig. 1 shows percentage of correct and incorrect answers. The different types of errors encountered in the study are depicted in the fig.no.2.

**Table 1: Mathematical and drug dose calculation skills: median.**

| | **Median score** |
|---|---|
| Mathematical skills % | 50 |
| Drug calculation skills (solid-liquid drugs and injections) % | 79 |
| Drug calculation skills (intravenous fluid and infusion rates) % | 41 |

**Table 2: Mathematical and drug dose calculation skills scores.**

| | **<50%** | **50-80%** | **>80** |
|---|---|---|---|
| Mathematical skills % | 52 | 26.4 | 21.6 |
| Drug calculation skills (solid-liquid drugs) % | 30.5 | 21.9 | 47.6 |
| Drug calculation skills (intravenous fluid and infusion rates) % | 75 | 11.5 | 13.5 |

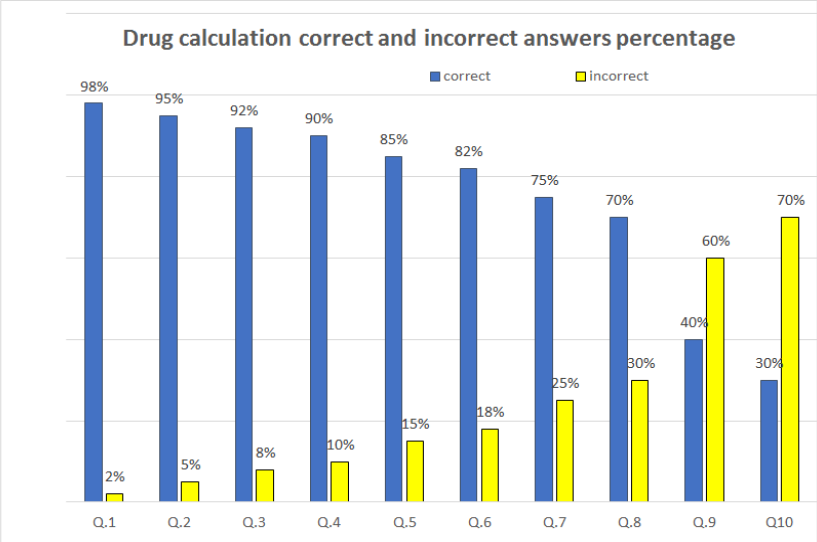


**Fig. 1: Drug calculation correct and incorrect answers percentage.**

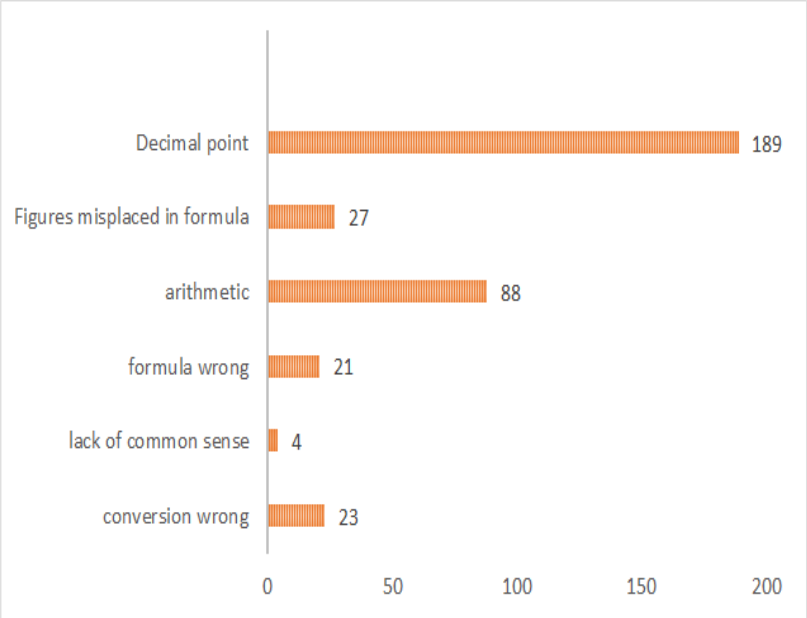


**Fig. 2: Type and number of errors.**

## DISCUSSION

98% of the students answered Q.1 correctly and 70% of the students answered Q.10 inaccurately. The most probable reason for this could be that intravenous fluid and infusion rate calculations are more complex, and students' knowledge of the rate-proportion concept is very important for making these calculations correctly. The intravenous fluid and infusion rates will be calculated incorrectly if the data are not correctly placed within the dose calculation equation.

The highest number of error (189) was seen in decimal point placement. Though seemingly easy it can lead to important pertinent issues (efficacy and safety) regarding drug doses. This aspect should be given importance in their teaching learning nursing course from the commencement of their program. The majority of errors in the calculation can be attributed to questions across the 5 items (Q6, Q7, Q8, Q9 and Q10).

Although essential mathematical skills are key skills that nurses should possess, 52% of the nursing students in the current study failed the mathematical skill test, with a score below the passing grade of 50%. These results indicate that the mathematical skills of these students are quite poor. The results of our study are similar those of studies conducted in the USA, Australia, Finland, and England.[10,11] The important factor is the common use of calculators among students and practising nurses, even for the simplest calculations in daily life and clinical practice. In the current study, the students were not allowed to use calculators when

completing the questionnaire. Calculators are widely used in clinical practice, and they are known to significantly reduce calculation errors.[12]

Dose calculation skills (solid-liquid drugs) were scored below 50% was 30.5%, and 75% of the students scored less than 50% in drug calculation skills (intravenous fluid and infusion rates). These results are alarming. The solid-fluid drug dose and injection calculation skills of the students were better than the intravenous liquid and infusion rate calculation skills; these poor intravenous fluid and infusion rate calculation skills are worrisome. The dose calculation skills of students have been shown to be poor.[11] Dose calculation skills are among the most commonly used skills in clinical practice. Even a single error can threaten a patient's life, so correct dose calculation among students is of vital importance for patient safety. Solid-fluid drug dose and injection calculations are conceptually easy, but students make errors due to poor mathematical skills.[10] Students consistently scored lowest in those questions based on strength and unit's conversion. This indicates that students have a poor understanding of the concepts of dilution. It has been stated in a number of studies that many qualified healthcare professionals have trouble in this area of calculations.[13]

Students scored well in mathematical and solid liquid drug dose calculation skills and very poor in intravenous dose calculation skills. Results suggest that though weak they definitely can improve with incorporation of teaching learning sessions in this aspect.

## CONCLUSION

This study indicates that nursing students have poor mathematical and drug dose calculation skills. Medication errors represent a leading medical cause of patient mortality. The study recommends that medication education, encompassing mathematical and conceptual drug calculation skills should be identified as a distinct competency in nursing curricula and continuing education programme.

## REFERENCES

1. Coben, 2010; Conroy et al., 2008; Eastwood, 2009; McMullan, Jones & Lea, 2010; Simpson, Keizer's & Lind, 2009.
2. Dosi NME, Newell R Nurses' knowledge of pharmacology behind drugs they commonly administer. J Clin Nurs, 2009; 18: 570-580.
3. Fleming S, Brady AM, Malone AM An evaluation of the drug calculation skills of registered nurses. Nurse Education Practice, 2014; 14: 55-61.

4. O'Shea E Factors contributing to medication errors: A literature review. J Clin Nursing, 1999; 8: 496-504.
5. Al-Zaagi AI, Al-Dossari DS, Salem SO, Qureshi NA Medication safety unit programs in King Saud Medical City, 2012-2013: Safe medication management and use with a focus on patient. Br J Med Res., 2015; 8: 384-407.
6. Gerry A, Helen K. Adverse events in drug administration: a literature review. J Nurs Manag, 2003; 11: 130-140.
7. Biron AD, Loiselle CG, Lavoie-Tremblay M. Work interruptions and their contribution to medication administration errors: an evidence review. Worldviews Evid Based Nurs, 2009; 6: 70-86.
8. Gladstone J. Drug administration errors: a study into the factors underlying the occurrence and reporting of drug errors in a district general hospital. J Adv Nurs., 1995; 22: 628-637.
9. Wright, K. Do calculation errors by nurse's cause medication errors in clinical practice? A literature review. Nurse Educ Today, 2010; 30(1): 85-97.
10. Blais K. & Bath J.B. Drug calculation errors of baccalaureate nursing students. Nurse Educator, 1992; 17: 12–15.
11. Grandell-Niemi H, Hubli M. & Leino-Kilpi H. Medication calculation skills of graduating nursing students in Finland. Advances in Health Sciences Education, 2001; 6: 15–24.
12. Bliss-Holtz J. Discriminating types of medical calculation errors in nursing practice. Nursing Research, 1994; 4: 373-375.
13. Oldridge, G.J., Gray, K.M., McDermott, L.M., Kirkpatrick, C.M.J. Pilot study to determine the ability of health-care professionals to undertake drug dose calculations. Internal Medicine Journal, 2004; 34: 316-319.

**Appendix**

| Sr.no | Questions |
|---|---|
| 1. | Metric system<br>i. 1 drop = .....mL<br>ii. Convert 0.5g to mg .....<br>iii. Convert 250 mcg to mg .....<br>iv. Convert 50ml to litres .....<br>v. 2 tablespoons = …. mL |
| 2. | 250 mg/5 ml penicillin syrup is available. How many mg of penicillin are there in 20 ml syrup? |
| 3. | A linctus is available as 25mg/5ml and we need to give the patient 50mg. What volume will be given? |

| | |
|---|---|
| 4. | Calculate the dose for a 6yr. old child for a drug whose adult dose is 500mg/day. |
| 5. | Calculate the total dose of parenteral iron required by a 40kg woman having Hb of 8 gm%. |
| 6. | A 52kg, 78-year-old lady is admitted to hospital suffering from a severe urinary tract infection that has not responded to other drugs prescribed by her GP. Her creatinine level is 230 µmol/L. What is the patient's creatinine clearance in mL/min? |
| 7. | The prescribed dosage of a drug is 10 mg/kg daily. How many 400-milligram tablets should be given each day to a patient who weighs 80 kg? |
| 8. | You have on hand diazepam 5 mg/mL. Administer 8 mg IV push stat. to a patient having a seizure. How much should you draw into the syringe? |
| 9. | The patient is receiving an antibiotic IV at the rate of 50 mL/hr. The IV solution contains 1.5 gram of the antibiotic in 1000 mL. Calculate the mg/hour given. |
| 10. | Prepare and give dopamine infusion in a dose of 5µg/kg/min in a 60kg adult. Dopamine is available as 400mg in 5ml (80mg/ml) which is required to be diluted in 500ml of dextrose saline. |