Research Article

# Competency in Calculating Drug Doses in a Cross-sectional Study amongst Second Year, Third Year and Final Year Nursing Students

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**ABSTRACT**

Mathematical skills are essential for nurses to ensure the accuracy of drug dose before performing medication administration and also important in prevent medication errors. It has been reported that many newly graduated healthcare professionals have low levels of competency in the area of drug dose calculation. The aim pf the study is to assess the level of knowledge on drug dose calculation among second year, third year and final year nursing students. Second year, third year and final year nursing students were given a questionnaire, consisting of drug dose calculation questions. Data was compiled and tabulated by using MS excel and was analyzed. The study related to level of knowledge regarding drug dosage calculation among IInd year had 17(56.66%) inadequate knowledge, 8(26.66%) had moderate knowledge and 5(16.66%) had adequate Knowledge, for IIIrd year nursing students 8(26.66%) had inadequate knowledge, 10 (33.33%) had moderately and 12(40%) had adequate knowledge and Final year had 1(3%) inadequate knowledge, 12(40%) had moderate knowledge and 17(57%) had adequate knowledge. The results showed that final year students were competent in calculating dosages based on body surface area and those expressed in international units (IU). They were competent in calculating problems (renal function and the intravenous infusions) for a prescription. In the present study concluded that comparing the level of knowledge between Second year, third year and final year nursing students, final year nursing students having adequate level of knowledge than second year and third year regarding drug dosage calculation.

**Keywords:** Drug dose calculations, nursing students, medication errors.

## INTRODUCTION

The skills and competencies of healthcare professionals have become an increasing focus of healthcare research. Drug administration is one of the most essential and common tasks performed by nurses.[1] Approximately 40% of daily nursing task are related to drug interventions or medication administration.[2] 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 [3] 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,[4] one-third of those that harm patients occur during the administration phase.[5] Many medication errors occur as a result of limited pharmaceutical knowledge and wrong drug calculation. Oldridge et al (2004) observed that while a doctor may prescribe drugs and write doses in milligrams, etc. it is generally the remit of nurses and pharmacists to interpret prescriptions and patient charts in order to dispense and administer the drugs to patients. This might suggest that doctors do not need the same level of skill in the area of drug dose calculations. [6]

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.[7] Therefore, this study was planned with the purpose to assess the drug dosage calculation knowledge and proficiency amongst our nursing students.

## METHODS

The study was a descriptive cross-sectional design and convenient sampling technique was followed. Data was collected using structured questionnaire. Data analysis was done with SPSS.

The survey was conducted with 2nd year, 3rd year and final year nursing students. 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 1. Thirty minutes were allowed for the testing. 3 marks were awarded for a correct answer; zero for an incorrect answer. No half marks were given.

**Score Interpretation:** The score was interpreted as follows:

Inadequate knowledge: 0-10

Moderately adequate: 11-20

Adequate knowledge: 21-30

## RESULTS

Questionnaires were distributed to nursing students. Of these, 90 returned questionnaires from each batch were considered acceptable for the study.

The mathematical and drug dose calculation skills scores for nursing student as shown in table no.1.

The study related to level of knowledge regarding drug dosage calculation among II[nd] year had 17(56.66%) inadequate knowledge, 8(26.66%) had moderate knowledge and 5(16.66%) had adequate Knowledge, for III[rd] year nursing students 8(26.66%) had inadequate knowledge, 10 (33.33%) had moderately and 12(40%) had adequate knowledge and Final year had 1(3%) inadequate knowledge, 12(40%) had moderate knowledge and17(57%) had adequate knowledge. (Fig: 1)

The common errors encountered in the study are as shown in the fig.no. 2.

**Table 1:** Mathematical and drug dose calculation skills scores

| Percentage of nursing students with a score <50% | | | |
|---|---|---|---|
| | 2nd year | 3rd year | Final year |
| Mathematical skills % | 78.4% | 52% | 5% |
| Drug calculation skills % | 69.7% | 37.6% | 6.75% |
| Drug calculation skills (solid-liquid drugs and injections) % | 52.4% | 30.5% | 12.2% |
| Drug calculation skills (intravenous fluid and infusion rates) % | 86.5% | 25.4% | 15.2% |

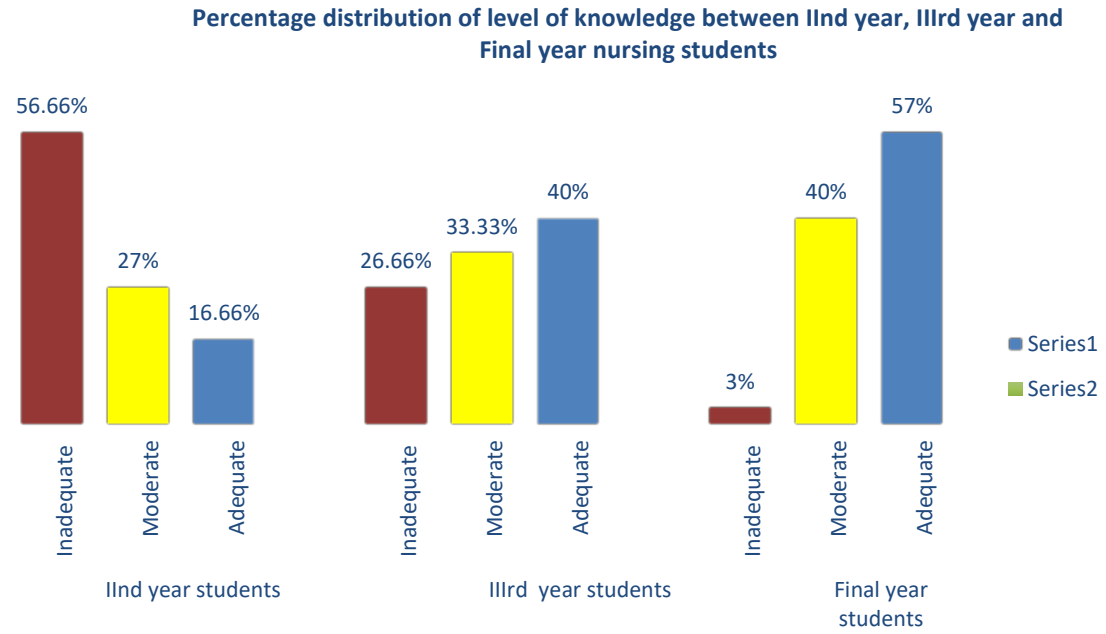


**Figure 1:** Percentage distribution of level of knowledge between 2[nd], 3[rd], and final year nursing students.

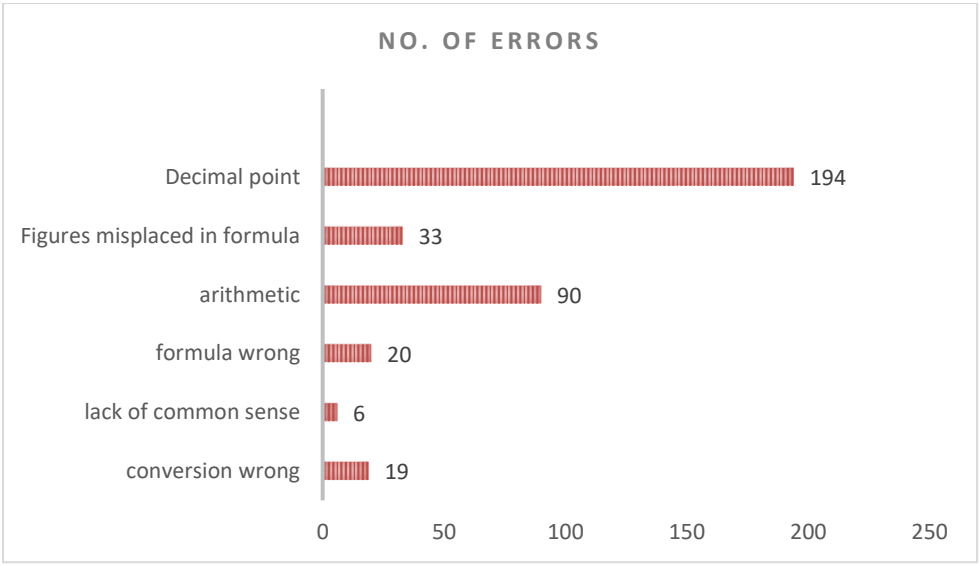


**Figure 2:** Type and number of errors

**Appendix 1:**

| 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. |

## DISCUSSION

The discussion of the present study was based on the findings obtained from the descriptive and inferential statistical analysis of collected data.

Percentage of nursing students with a score <50% were higher in Second year as in contrast to third year and final year. The study related to level of knowledge regarding drug dosage calculation among II$^{nd}$ year had 17(56.66%) inadequate knowledge, 8(26.66%) had moderate knowledge and 5(16.66%) had adequate Knowledge, for III$^{rd}$ year nursing students 8(26.66%) had inadequate knowledge, 10 (33.33%) had moderately and 12(40%) had adequate knowledge and Final year had 1(3%) inadequate knowledge, 12(40%) had moderate knowledge and17(57%) had adequate knowledge.

More students became competent, during their final year than during the third year and second year of study. This could be due, in part, to the fact that by final year students have more calculation practice in hospital wards.

The highest number of error (194) 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.

Second year students however have not yet developed the skills and confidence to work calculations out without guidance. Students from second year and third year 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 e.g. 1 in 1000 and concentration e.g. % w/v. It has been stated in a number of studies that many qualified healthcare professionals have trouble in this area of calculations.[6]

The final year students were competent in calculating dosages based on body surface area and those expressed in international units (IU). They were competent in calculating problems (renal function and the intravenous infusions) for a prescription. The results of the survey also revealed that final year students performed better in questions within a clinical scenario. The results of other studies also confirm this theory (Wright, 2006; Wright, 2007; Wheeler et al., 2008). [8,9,10]

## CONCLUSION

In the present study concluded that comparing the level of knowledge between 2$^{nd}$ year, 3$^{rd}$ year and final year nursing students, final year nursing students having adequate level of knowledge than 2$^{nd}$ and 3$^{rd}$ year students regarding drug dosage calculation. Therefore, nursing students must be taught mathematical calculation skills for medication administration early right from the first year and should be an imperative component in their curriculum.

## REFERENCES

1. O'Shea E. Factors contributing to medication errors: a literature review. Journal of Advanced Nursing, 8, 1999, 496–504.

2. 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, 8, 2015, 384-407.

3. Gerry A, Helen K, Adverse events in drug administration: a literature review. J Nurs Manag, 11, 2003, 130-140.

4. Biron AD, Loiselle CG, Lavoie-Tremblay M, Work interruptions and their contribution to medication administration errors: an evidence review. Worldviews Evidence Based Nurs, 6, 2009, 70-86

5. 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, 22, 1995, 628-637.

6. 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, 34, 2004, 316-319.

7. Wright, K. Do calculation errors by nurse's cause medication errors in clinical practice? A literature review. Nurse Education Today, 30(1), 2010, 85-97.

8. Wheeler, D.W., Wheeler, S.J., Ringose, T.R. Factors influencing doctors' ability to calculate drug doses correctly. International Journal of Clinical Practice, 61, 2007, 189-194.

9. Wright, K. Barriers to accurate drug calculations. Nursing Standard, 20, 2006, 41-45.

10. Wright K. Student nurses need more than maths to improve their drug calculating skills. Nurse Education Today, 27, 2007, 278-285.

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