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A Study to Assess the Drug Dosage Calculation Skills among Nursing Students with a View to Develop a Mobile Application on Drug Dosage Calculation in a Selected Nursing College, Greater Noida, UP.

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Abstract: ***Background: Numerical and drug calculation skills are reported to be important for patient safety. Medication errors occur repeatedly and universally. Nurses have to be very skill full in mathematical calculation and numerical ability to calculate the proper dose and drug calculation because a single mistake in calculation can lead to severe life threatening condition to patient. Inappropriate drug dose calculation indicate high risk of medication errors. Students and experienced nurses often lack confidence in mathematical calculations. 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 and they can occur as a result of mathematical calculation error and or conceptual error. Ability to calculate drug doses correctly is an essential skill to prevent and reduce medication errors. Nursing research indicates that a poor medication calculation skill is an international issue for the nursing profession. Literature suggests that nurses' drug calculation skills should be monitored. Information technologies, particularly mobile devices, can advance drug dosage calculation processes. The aim of the study was to Assess the Drug Dosage Calculation Skills Among Nursing Students with a view to Develop a Mobile Application on Drug Dosage Calculation. Objectives: 1) To Assess the Drug Dosage Calculation Skills among Nursing Students. 2) To find out the association between drug dosage calculation skills among nursing students with selected Demographic variables that is (Age, Gender, Religion, Professional Education, and Source of information). 3) To develop a Mobile Application on Drug Dosage Calculation. 4) To assess the acceptability of Drug Dosage Calculator App. Methodology: Quantitative research approach was adopted for this study and Descriptive research design was selected for this study. The setting of the study was SNSR, Sharda University. The sample consists of 100 GNM 3rd year, B. Sc. Nursing 4th year and PB. B. sc. Nursing 2nd year studying in SNSR Sharda University and samples were selected by using total enumeration sampling technique. Demographic data was collected by using demographic data questionnaire and Drug Dosage Calculation Skills was assessed by using Structured Self - administered questionnaire and acceptability of Drug Dosage calculator app was assessed by using Five point Likert scale. The investigator developed Barbara Wejnert integrating models of diffusion and innovation for conceptual framework. Results: The collected data was analyzed by using descriptive and inferential statistics. Majority of the nursing students 54 (54%) were of the age group 22 - 25 years, 40 (40%) of the nursing students were of the age group 19 - 21years and 6 (6%) of the samples were of age group. above 25 years, 77 (77%) of the samples were females and 23 (23%) of the samples were males Majority of the samples 80 (80%) of the samples belongs to Hindu, 11 (11%) of the sample belong to Islam, 9 (9%) of the samples belong to Christian.51 (51%) were GNM 3rd year, 45 (45%) of samples were B. Sc. Nursing 4th year, 4 (4%) of sample's were PBB. Sc. Nursing 2nd year.44 (44%) source of information were from the internet, 35 (35%) of sample's source of information were from Lecture, 17 (17%) of sample's source of information were from textbook and 4 (4%) of sample's source of information were from attended conference and workshop. Majority 52 (52%) of nursing students have Poor Skills and 35 (35%) nursing students have Average skills and only 13 (13%) nursing students have Good Skills of drug dosage calculation. There was no significant association between drug dosage calculation skills among nursing students with demographic variables of Gender, Religion, Source of information where p value was greater than 0.05 (p>0.05). There was significant association between drug dosage calculation skills among nursing students with demographic variables of Age, Professional Education where p value was less than 0.05 (p<0.05). Majority 83 (83%) of nursing students were acceptable drug dosage calculator app and 17 (17%) were Neither acceptable, Nor unacceptable drug dosage calculator app. Conclusion: This study indicates that nursing students have poor drug dosage calculation skills.***

Keywords: Assess, Drug dosage calculation, skill, nursing students, Mobile app

1. Background of the Study

Drug dosage Calculation defined as math calculations done for preparing appropriate dose of medicine. It is a skill all nurses and practitioners should practice and master this skill. However, it's not an easy task and many nurses are unsure whether they can accurately do all the mathematics involved.

One of the most common medication errors is the error caused by drug dosage calculations.1[2] Medication dosage calculation errors are the most common errors of nurses. These errors occur due to wrong administration of medication by health care providers and can lead to failure in treatment process and injury to the patient.

Blays and Bath identified three areas of drug calculation errors: conceptual, mathematical and measurement. Conceptual errors involving difficulty setting up the problems correctly or how to construct a calculation; mathematical errors demonstrated students' difficulties in performing basic functions such as additions, subtractions, multiplication, division of whole numbers, decimals and fractions; measurement errors indicated an inability to solve the math calculation, for example students' difficulties in performing long division or multiplication, involving also the conversion between metric and apothecary units of measurement. Mathematical errors indicated that nurses did not understand basic math principles.[1]

Nurses play an important role in patient safety, as nurses are responsible for administrating medication to patients admitted to the ward[2]. In addition to understanding the use and consequences of each drug, they must also calculate drug dosage correctly[3]. Medication errors (MEs) are potentially harmful patient safety events in all age groups.

The rate of MEs for hospitalized children maybe 3 - fold higher than those for adults with significantly serious consequences.[4] Such errors can be attributed to medication dose calculations based on the child's weight, medication dilution, the challenge of children's ability to communicate, high vulnerability of young and sick children, and secondary kidney and liver failure due to MEs. These errors may lead to increased hospital length of stay and associated costs.[5] Ensuring the safe use of medications by adhering to the 5 rights of medication administration (right patient, right medication, right dose, right time, and right route) provides a framework for safe nursing practice.[6] Recently, 5 additional items have been added, including right assessment, right to refuse, right evaluation, right education, and right administration.[7]

Administration of the medication is most important nursing responsibility. The need for accuracy in preparing and administrating medication to children is greater than that of an adult. Pediatric dose is small when it compared with adult dose and a very small calculation mistake can represent a greater error. The ability to perform drug calculation is imperative to patient safety. There are many methods for calculating the drug dosages.[8, 9]

The commonest formula for calculating the drug dosages are:

Calculation of drug dosages:
Desired dose 'x' = Ordered dosage × volume in hand
Hand dosage

Intravenous fluid calculation:

Calculation of ml / hr. for IV fluids:
ml / hr. = Total volume to be infused (ml)
Total time (hrs.)

Calculation of flow rate IV fluids
Rate of flow (gtt/min) = Total volume in milliliters × Drop factor
Total time in minutes

Drops / minute = Total volume in milliliters × Drop factor (macro - drops or micro - drops) hours to administer × 60

Intravenous tubing
Macro - drip factor = 20 or 15 gtt = 1 ml
Micro - drip factor = 60 gtt = 1 ml
The micro - drop giving set has a drip rate of 60 drops per ml.

Literature suggests that nurses' drug calculation skills should be monitored. One of the component skills in drug administration is that of drug dose calculation; nurses and other health workers involved need to calculate doses with complete accuracy. Nurse educators must ensure that all students who qualify to become practicing nurses are competent in drug calculation. Practicing nurses need periodic evaluated continuing education to ensure that they remain competent in key skills such as drug calculation.[10, 11]

Many health professionals find drug dose calculations difficult, and many studies indicate that nursing students have poor medication dose calculation and arithmetic skills. Right dosage calculation and safe drug administration are the two main components for effective treatment of patient. Drugs are prepared and administered in the amount ordered by the physician. Nurses and Nursing students need to be proficient enough in drug calculation and safe drug administration.[12]

Safety in drug calculation and drug administration by nursing students is an area that has been explored by nurse researchers. Drug calculation and drug administration is a common and necessary core competency in nursing care.[13]

Currently, many people of different medical professions are using different mobile health applications and these have a positive effect on their activities and performance.[14 - 15] Mobile devices can provide easy and timely access to information and these tools has replaced traditional models.[10, 11] Information technologies, particularly mobile devices, can advance drug dosage calculation processes.

So, Researcher found there is a great need to Assess the Drug Dosage Calculation Skills among Nursing Students

with a view to develop a Mobile Application on Drug Dosage Calculation.

2. Methodology

Research Approach
The present study aimed to Assess the Drug Dosage Calculation Skills among Nursing Students with a view to develop a Mobile Application on Drug Dosage Calculation in a Selected Nursing College, Greater Noida, UP, with a view to complete the research objectives, quantitative research approach was adopted for this study.

Research Design
Research design is a blueprint to conduct a research study, which involves the description of research approach, study setting, sample size, sampling technique, tools and method of data collection and analysis to answer specific research questions or for testing research hypothesis.[16]

The research design chosen for this study was descriptive research design was used to Assess the Drug Dosage Calculation Skills among Nursing Students with a view to develop a Mobile Application on Drug Dosage Calculation in School of Nursing Sciences and Research, Sharda University , Greater Noida, UP.

Setting
Setting refers to the area where the study is conducted. It may be natural setting of laboratory setting depending upon the study topic and researcher's choice. This study was conducted in School of Nursing Science and Research, Sharda University, Greater Noida, UP.

Population
The entire set of individuals or objects having some common characteristics.[17]

The population of the present study were the nursing students those who are studying in SNSR, Sharda University, Greater Noida, UP.

Target Population:
The target population consist of nursing students those who are studying in SNSR, Sharda University, Greater Noida, UP.

Accessible Population:
The accessible population consist of nursing students those who are studying GNM 3rd year, PBBSC.2nd year and B. Sc. nursing4th year, School of Nursing Science and Research in Sharda University of Greater Noida, UP.

Sample
A representative unit of target population, which is to be worked upon by researchers during their study.[16]

A set of a population selected to participate in a study.[17]

The sample of the study was nursing students those who were studying GNM 3rd year, PBBSC.2nd year and B. Sc. nursing4th year, School of Nursing Science and Research in Sharda University of Greater Noida, UP who were willing to participate and present during the time of data collection.

Sampling Technique
Sampling is the process of selecting a representative part of population.[16]

Sampling technique refers to the process of selecting the population to represent the entire population.[17]

Total Enumeration Sampling Technique was adopted for this study.

Sample Size
The sample size of this study was 100.

Criteria for Sample Selection

Inclusion Criteria
- Students of Selected Nursing College who were studying at SNSR Sharda university, Greater Noida, UP
- Participant who were willing to participate in the study.
- Students who were present at the time of data collection.

Exclusion Criteria
- Students who were absent during the data collection.
- Participants who were not willing to participate in the study.

Variables
Variables are qualities, proprieties or characteristics of persons, things or situations that change or vary.

Variables

Demographic Variable:
- Age
- Gender
- Religion
- Professional Education
- Source of information

In this study the Demographic variables were Age, Gender, Religion, Professional Education and Source of information.

Questions on Drug Dosage Calculation

Checklist Likert Scale to Assess the Acceptability of Drug Dosage Calculator App.

Development of tool
The research instrument was developed by doing study from the literature review. The primary and secondary sources of literature were reviewed to develop at the appropriate tool. Validity of the tool and content was obtained from the twelve experts from different department of Nursing. Their opinions and valuable suggestion were incorporated in the tool and it was finalized by the guide.

Description of the Tool
It consists of two tools:

Tool 1
It consisted of two section:
Section A: Demographic variables
Section B: Questions on drug dosage calculation.

Tool 2: Likert scale to assess the acceptability of drug dosage calculator app.

Section A:

1) Demographic Variable:
Deals with demographic variables that is Age, Gender, Religion, Professional Education and Source of information

Section B:
It deals with structured questionnaire to convey the skills regarding drug dosage calculation among nursing students. It consists of 30 multiple choice question. Each question gives success answer as 1 score. If not answering gives 0 score.

Score Interpretation: The score was interpreted as follows:

Table 1.1: Score Interpretation

S. No	Categories	Score
1	Poor Skills	0 - 10
2	Average	11 - 20
3	Good Skills	21 - 30

Tool 2: Five point Likert scale. It consist of 12 questions to assess the Acceptability of Drug Dosage calculator App.

Table 1.2: Score Interpretation: The score was interpreted as follows:

S. No.	Categories	Score
1	Unacceptable	≤ 20
2	Neither acceptable, nor unacceptable	21 - 40
3	Acceptable	≥41

Mobile app is available at https: //play. google. com/store/apps/details?id=com. app. drugdosagecalculator

Reliability
Reliability is the degree of consistency and accuracy with which an instrument measures the attribute for which it is designed to measure.[33]

Reliability of the tool was measured by Cronbach's alpha method.

The reliability of drug dosage calculation questionnaire was checked by Cronbach's Alpha test and value was 0.78 so tool can be used for the study.

The reliability of likert scale to assess the acceptability of of Drug Dosage calculator App was checked by Cronbach's Alpha test and value was 0.89 so tool can be used for the study.

3. Discussion

A Study to Assess the Drug Dosage Calculation Skills among Nursing Students with a view to develop a Mobile Application on Drug Dosage Calculation in a Selected Nursing College, Greater Noida, UP.

The findings regarding sample characteristics
On demographic variables the results of the study shows that Among the total number of samples majority of the nursing students 54 (54%) were of the age group 22 - 25 years, 40 (40%) of the nursing students were of the age group 19 - 21years and 6 (6%) of the samples were of age group above 25 years. According to their gender among the total number of samples 77 (77%) of the samples were females and 23 (23%) of the samples were males. According to their Religion among the total number of samples majority of the samples 80 (80%) of the samples belongs to Hindu, 11 (11%) of the sample belong to Islam, 9 (9%) of the samples belong to Christian. According to the Professional Education of the samples among the total number of samples majority of sample's 51 (51%) were GNM 3rd year, 45 (45%) of sample's were B. Sc. Nursing 4th year, 4 (4%) of sample's were PBB. Sc. Nursing 2nd year. According to the source of information among the total number of samples majority of sample's 44 (44%) source of information were from the internet, 35 (35%) of sample's source of information were from Lecture, 17 (17%) of sample's source of information were from textbook and 4 (4%) of sample's source of information were from attended conference and workshop.

Objectives of the study were
1) To Assess the Drug Dosage Calculation Skills among Nursing Students.
2) To find out the association between drug dosage calculation skills among nursing students with selected Demographic variables that is Age, Gender, Religion, Professional education and Source of information .
3) To develop a Mobile Application on Drug Dosage Calculation.
4) To assess the acceptability of Drug Dosage Calculator App.

Objective 1: **To assess the drug dosage calculation skills among nursing students**
Responses of the participants on the drug dosage calculation skills by means of Structured Self - administered questionnaire. The skills score of nursing students regarding drug dosage calculation reveled that majority 52 (52%) of nursing students have Poor Skills and 35 (35%) nursing students have Average skills and only 13 (13%) nursing students have Good Skills of drug dosage calculation.

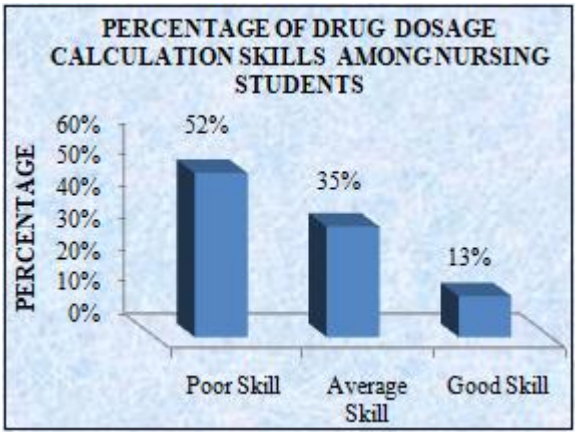

Figure 1.1: Column diagram showing the percentage distribution of samples according to their Skills score on drug dosage calculation

Objective 2: To find out the association between drug dosage calculation skills among nursing students with selected demographic variables that is age, gender, religion, professional education and source of information.

Chi - square values were calculated to find out the association between drug dosage calculation skills among nursing students with selected Demographic variables. It was revealed that there was no significant association between drug dosage calculation skills among nursing students with demographic variables of Gender, Religion, Source of information where p value was greater than 0.05 ($p>0.05$). It was also revealed that there was significant association between drug dosage calculation skills among nursing students with demographic variables of Age, Professional Education where p value was less than 0.05 ($p<0.05$).

S. No.	Demographic Variables	Frequency of Drug Dosage Calculation Skills Among Nursing Students			P - Value (CAL)	DF	$\square^2$
		Poor Skills	Average Skills	Good Skills			
1	**AGE IN YEARS**				.001*	4	18.697
	19 - 21	30	10	0			
	22 - 25	21	22	11			
	Above 25	1	3	2			
2	**GENDER**				.597^{NS}	2	1.031
	MALE	10	10	3			
	FEMALE	42	25	10			
3	**RELIGION**				.238^{NS}	4	5.041
	ISLAM	3	7	1			
	CHRISTIAN	6	2	1			
	HINDU	52	35	13			
4	**PROFESSIONAL EDUCATION**						
	GNM 3RD YEAR.	32	19	0	.001*	4	18.796
	BSC. NURSING 4TH YEAR.	18	14	13			
	PBBSC. NURSING 2ND YEAR	2	2	0			
5	**SOURCE OF INFORMATION**				.794^{NS}	6	3.120
	TEXT BOOKS	8	5	4			
	LECTURE	19	12	4			
	ATTENDED CONFERENCE/ WORKSHOP	3	1	0			
	INTERNET	22	17	5			

Objective 3: To assess the acceptability of drug dosage calculator app.

The Acceptability score of nursing students regarding drug dosage calculator app reveled that majority 83 (83%) of nursing students were acceptable drug dosage calculator app and 17 (17%) were Neither acceptable, Nor unacceptable drug dosage calculator app.

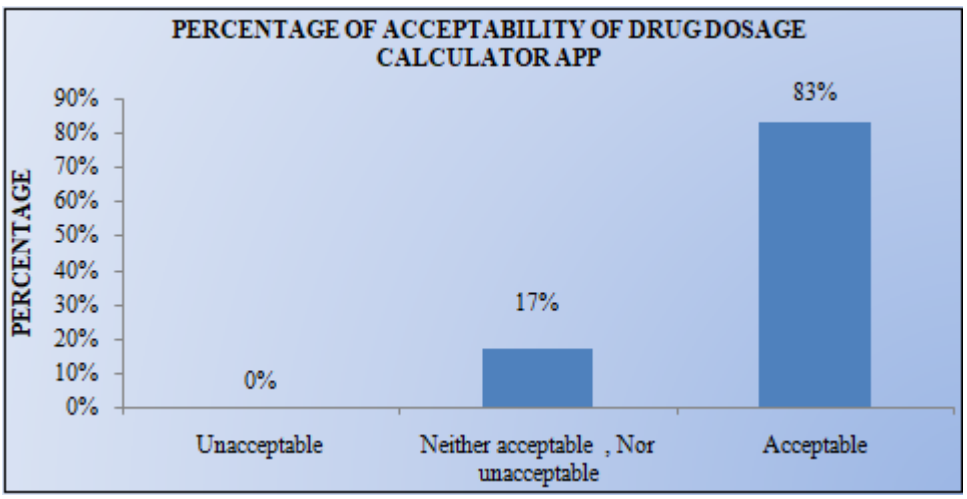

Figure 4.7: Bar Diagram showing the percentage distribution of samples according to Acceptability of Drug Dosage Calculator app.

4. Conclusion

Drug dosage calculation is the most important part of the patient care and nurses needs to update their skills on drug dosage calculation. Mobile application of drug dosage calculations can increase accuracy and reduce error in drug dosage calculation.

The results show the poor skills is not the good skill so nurse needs to update their skills by in - service education, attending conference, workshop related to drug calculation

and use Drug Dosage calculator app. Skill is continuous progression which requires reinforcement and re - education of fresh and changing practice to keep nurses update.

In view of the positive results, the investigator believes that the study would benefit from widening scope and use a much larger sample.

The following conclusions were drawn from the "A Study to Assess the Drug Dosage Calculation Skills among Nursing Students with a view to develop a Mobile Application on Drug Dosage Calculation in a Selected Nursing College, Greater Noida, UP.".

From the findings of the study it can be concluded that,

- Majority of the samples 54 (54%) were of the age group 22 - 25 years.77 (77%) of the samples were females and 23 (23%) of the samples were males.80 (80%) of the samples belongs to Hindu, 51 (51%) were GNM 3rd year, 44 (44%) source of information were from the internet .
- Majority of nursing students 52 (52%) have Poor Skills of drug dosage calculation and 35 (35%) nursing students have Average skills and only 13 (13%) nursing students have Good Skills of drug dosage calculation.
- There was no significant association between drug dosage calculation skills among nursing students with demographic variables of Gender, Religion, Source of information where p value was ($p>0.05$).
- There was significant association between drug dosage calculation skills among nursing students with demographic variables of Age, Professional Education where p value was ($p < 0.05$).
- Majority of nursing students 83 (83%) were acceptable drug dosage calculator app.

Conflict of Interest: There is no conflict.

Source of Funding: Sharda University

SCHOOL OF MEDICAL SCIENCES AND RESEARCH & SHARDA HOSPITAL

SHARDA UNIVERSITY
Beyond Boundaries

Institutional Ethics Committee

Ref. No. SU/SMS&R/76-A/2021/58 Date: 01/05/2021

Ms. Maimonah Ali Abdullah Abbas
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Ms. Maimonah Ali Abdullah Abbas,
The research proposal titled **"A Study to Assess the Drug Dosage Calculation Skills among Nursing Students with a view to develop a Mobile Application for Nurses on Drug Dosage Calculation in a Selected Nursing College , Greater Noida , UP."** **Principal Investigator Ms. Maimonah Ali Abdullah Abbas**, MSc Nursing 2nd Year student under the **Supervision** of Prof. Urmila Devi Bhardwaj, Dean cum Principal, School of Nursing Science and Research, has been approved by the Institution Ethics Committee, SMS&R and Sharda Hospital, Sharda University, by online approval from all the members of IEC, dated 01/05/2021; under the Chairmanship of Prof. K.K Sharma, MBBS, MD (Pharmacology), FIPS, FAMS.

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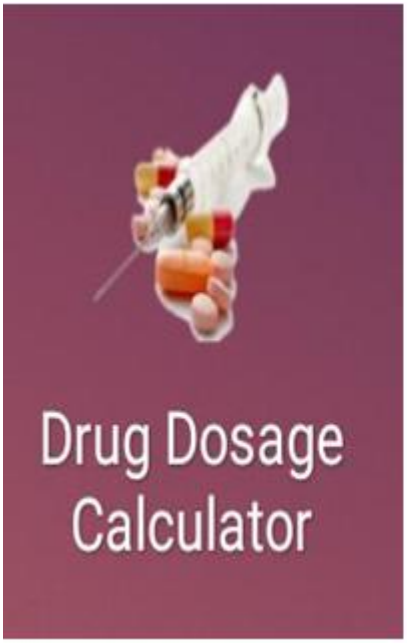
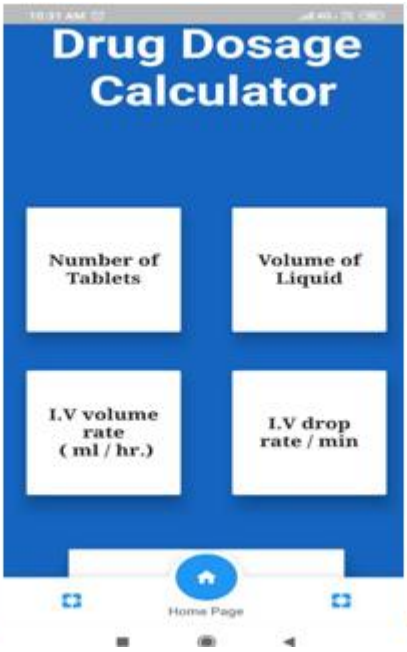
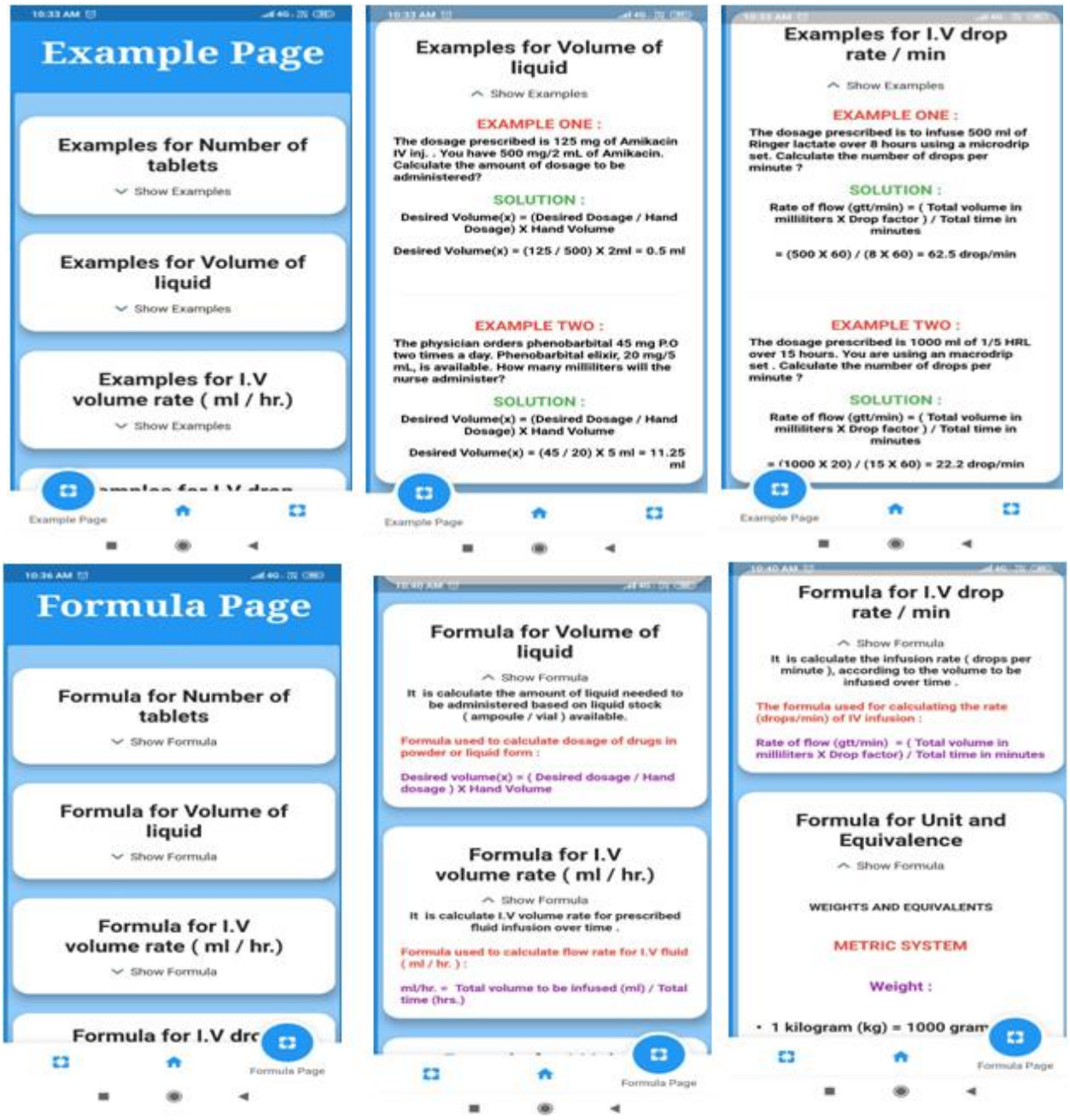
SCREENSHOT OF THE DRUG DOSAGE CALCULATOR APPLICATION AND THE LINK OF MOBILE APP
https: //play. google. com/store/apps/details?id=com. app. drugdosagecalculator







Mobile App Development

Based on the finding of the study a mobile app "Drug Dosage Calculator" App was developed to reduce medication errors, improve Drug dosage calculation and to advance drug dosage calculation processes. Mobile app is available at:

https: //play. google. com/store/apps/details?id=com. app. drugdosagecalculator

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