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ORIGINAL PAPER

Traditional teaching method versus simulation-based teaching method in the prevention of medication errors among nursing students

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ABSTRACT

Introduction and aim. The effective and safe administration of medication is the responsibility of every health care provider involved in patient care. One of the biggest problems with nursing education is the gap between theory and practice, which pave ways for medication errors to occur at any level of the medication administration process. This can be rectified by using an efficient teaching strategy that harmoniously blends nursing theory and practical skills. the aim of the study was to evaluate the effectiveness of the traditional teaching method versus simulation-based teaching method on level of knowledge, attitude, and practice on prevention of medication errors among nursing students in selected colleges, Puducherry.

Material and methods. The research approach and design used for the study were quantitative approach and quasi-experimental pre and post-test control group design respectively. The study settings were selected 4 nursing colleges in Puducherry. The sample size was 100 (50 in experimental group I and 50 in experimental group II) which was selected by using simple random and stratified sampling technique. pre-test was done to assess the level of knowledge, attitude and practice on prevention of medication error for both experimental groups utilizing the self-administered knowledge, attitude questionnaire and checklist. The experimental group I received traditional teaching method and experimental group II received simulation-based teaching method. Post-test was done after one week using the same tool.

Results. The study results revealed that out of 100 nursing students, majority 35 (70%) and 38 (76%) of the nursing students were in the age group of 20–21 years, 40 (80%) and 39 (78%) of them were female, 50 (100%) and 41 (82%) of them were staying as day scholars, 40 (80%) and 41 (82%) had one attempt to clear the pharmacology subject in the experimental group I and II respectively. The level of knowledge, attitude, practice showed a statistically significance difference at $p<0.05$ between the pre and post-test within the experimental group I and II respectively. The effective mean scores of knowledge, attitude and practice showed a statistically significance difference at $p<0.05$ between the experimental group I and II respectively, revealed that the simulation-based teaching method was more effective over the traditional teaching method. There was a significant positive correlation at $p<0.05$ exist between the level of knowledge and attitude, knowledge and practice in the experimental group I. The association between the post-test level of attitude and the gender variable showed a statistically significant at $p<0.05$ in the experimental group II.

Conclusion. The study concluded that the simulation-based teaching method was effective which can be utilized as a means to educate the nursing students during their academic performance.

Keywords. nursing students, prevention of medication error, simulation-based teaching method, traditional teaching method

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Introduction

Patient safety is the primary objective of high-quality healthcare. It is an important component for both patients and healthcare professionals. Every person in the world will use medications to prevent and cure sickness at some point in their lives. Patients must receive the appropriate medication during the course of their medication therapy at the proper dosage, concentration, and timing.[1] However, medication can be fatal if it is inappropriately stored, prescribed, dispensed, administered and monitored inadequately. Globally, the cost associated with medication errors has been estimated at US$ 42 billion annually or almost 1% of total global health expenditure.[2]

According to the National Patient Safety in the UK and the Institute of Medicine in the US, medication errors cause a substantial mortality rate in each year. According to the Institute of Medicine (USA) 44,000 to 98,000 deaths, occur in each year because of medical errors. Among them, 7,000 deaths are linked to medication errors. In India, 5.2 million medication errors occur in each year.[3]

The healthcare systems are highly complex because it requires cooperation and collaboration between numerous organisations, different professions, and technical assistance. The complexity of the health care system may allow for the possibility of errors and increase the consequences of such medication errors. Any stage in the medication administration process, including the selection of medicine, drug preparation, dispensing, and administration, is prone to medication errors. Similarly, patients who are the ultimate consumers of medications also make mistakes at any point in their treatment. Thirty pharmacovigilance centres were recently founded in India and are supported by the World Bank. These centres have been monitoring cases of adverse medication reactions.[4]

According to the Food and Drug Administration (FDA), a medication error is defined as any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer. Medication errors are one of the most common patient safety hazards in many countries. They are typically caused by a lack of collaboration among health care professionals.[5]

Medication administration errors may be made by the patient or the healthcare professional. Communication is a big part of the medication administration issue. Patients frequently aren't aware that mistakes can occur and don't actively participate in understanding what is being said to them. Medication errors are commonly recognised when the patient develops clinical manifestations after the medication has been taken and alerting the healthcare professionals. The basic approaches for identifying and evaluating medication errors are spontaneous reporting, medication chart examination, analysis of medical prescriptions, and direct observation.[6] Health professionals do not purposefully make medication errors. They receive training to provide "error-free" medical care. When mistakes are discovered, however, there is a tendency to "blame" the professionals responsible for the error. Sometimes a person receives a formal punishment from their professional bodies, which may include fines, licence suspensions, or even licence revocation. Who was responsible for a medication error is less important than what, how and why it happened. Instead of focusing on the healthcare worker who made the error, the first stage in any investigation into medication errors should be a review of the drug use and delivery pathways within a healthcare system.[7]

Intravenous administration of medicine is associated with the highest medication error frequencies. Intravenous medication errors have more serious consequences for patients than any other administration route because the bioavailability of intravenous-administered medications is high. The therapeutic dose range for intravenous drugs is generally low, and the effects of medication are difficult to reverse. Many intravenous medication administrations are high-alert medications. If administered incorrectly, it also carries a higher risk of seriously harming patients. Therefore, efforts must be made to educate the health care professionals, especially nurses who play a crucial role in the administration of medication.[8] The lack of coordination between theory and practices is one of the main issues with nursing education. The actual application of academic information is challenging for nursing students at least in India. The gap between theory and practices makes learning more difficult, and a student's professional integration suffers from a lack of comprehension of nursing terms and concepts. This is accomplished by having a thorough understanding of healthcare science, where nursing theory and practical abilities are harmoniously merged. A teaching strategy that goes in this direction is simulation-based teaching.[9]

Adult learners can gain skills, competences, knowledge, or behaviours by putting themselves in situations that are similar to those encountered in real life. The purpose of the simulation teaching methods is to address issues that occur in real-life settings and thoroughly examine them. According to Fink, "Simulation is the controlled representation of reality". The learner acts in a simulation, the simulation reacts, and the learner learns from the feedback. Simulation is the recreation of the most important parts of a real-life event. Simulation is not a technology but rather an instructional technique. It is a technique that can help in creating a successful and enjoyable experience. It engages learners by putting them in the real-life struggle. In recent decades, the simulation technique has been used successfully in education.[10]

Simulation is a teaching and training method for nursing students that attempts to make them properly

understand and enhance. It also improves the knowledge, skills, and attitudes in all nursing care. This approach reduces the likelihood that students will carry out their duties improperly. It also allows them to interact with and experience a real medical environment.[11] Simulators can be divided into low-fidelity, medium-fidelity, and high-fidelity based on how closely they resemble reality. Simulators with low fidelity are used to educate beginners on the fundamentals of technical skills. Simulators with moderate fidelity are used to introduce and further understand a spectrum of increasingly complicated competencies. High-fidelity simulators have the ability to speak, breathe, blink, and react to physical and pharmacological interventions either automatically or manually.[12]

The National Reference Simulation Centre (NRSC) was founded in October 2018 by a Tetra Partite collaboration between the Indian Nursing Council (INC), Jhpiego, Laerdal, and SGT University Delhi with the goal of implementing inter-professional education through simulation-based education. It was designed to complement the clinical components of all four years of the B.Sc. Nursing programme, including Nursing Foundations, Medical Surgical Nursing I and II, Child Health Nursing, OBG Nursing, and Community Health Nursing. Nursing professional bodies around the world have embraced simulation (National League for Nursing, Nursing & Midwifery Council).[13]

Recently the use of simulation in nursing education has increased because of growing awareness of simulation's availability and utility in nursing education. Now a days simulators are becoming more affordable. The awareness of the importance of patient safety and the scientific data supporting the use of simulation in skill development among health care professionals are increasing.[14]

Aim

To evaluate the effectiveness of the traditional teaching method versus simulation-based teaching method on level of knowledge, attitude, and practice on prevention of medication errors among nursing students in selected colleges, Puducherry.

Material and methods

Research approach and design

A quantitative research approach was adopted for this research study. A quasi-experimental, non-randomized pre-test and post-test control group design was adopted for this research study.

Variables

- Independent variable: traditional teaching method and simulation-based teaching method.
- Dependent variable: level of knowledge, attitude and practice on prevention of medication errors

Study setting

The city of Puducherry is located in the Union Territory of Puducherry. There are around 14 stand-alone institutions and 76 colleges which are affiliated to Pondicherry University which is a central university. There are around 10 colleges of nursing of which 8 are affiliated to Pondicherry University, which are considered for this study. The total student strength of final-year B.Sc. nursing students ranged from 36 to 60 in each college which worked to 262.

Population

All nursing students studying in the colleges of nursing in Puducherry.

Sample

Nursing students studying in selected colleges of nursing in Puducherry who fulfilled the inclusion criteria and were available during the period of study.

Sample size calculation

Calculated sample size to compare two means with a given power

$n = [Z(1-(\alpha/2)) + Z(1-ß))2] * (2\sigma2) (\div d2)$

Where n is the required sample size: $Z(1-(\alpha/2)) + Z(1-ß))$ were values from the standard normal distribution that account for the chance of type I error and type II error; α was the standard deviation and d was the effect size which was the difference between the means.

Were:

Alpha value = α = 1.96% CI

80% power value = ß = 0.84

Standard deviation = 2.669 (2.7)

Effect size (difference between the means) = 3

n = ((1.96+0.84) 2 x 2(2.7) 2) / 1.5 2

n = 114.3 / 2.25 = 50 for each group.

Total sample size was 50 (experimental group I) + 50 (experimental group II) = 100

Sample size

The total sample size was 100. 50 in experimental group I and 50 in experimental group II.

Sampling technique

The simple random sampling technique was adopted for college selection, and the stratified sampling technique was adopted for sample selection.

Sampling criteria

Inclusion Criteria

Students who were:

- both male and female,
- willing to participate in the study,
- available during data collection period.

Exclusion Criteria
Students who were:
- having arrear in pharmacology subject,
- had previous experience with simulation,
- sick and on leave.

Ethical consideration
Ethical clearance was obtained from the IEC. The permission from the individual college authorities and an informed consent from each of the participants were obtained.

Development and description of the tool
The tool was prepared and organized into 4 sections:

Section – A:	Demographic variables of the nursing students
Section – B: Part I:	Structured questionnaire of knowledge on prevention of medication errors (multiple choice questionnaire)
Part II:	Structured questionnaire of attitude towards prevention of medication errors (Likert scale)
Part III:	Checklist of practice on prevention of medication errors
Section – C:	The Creighton Competency Evaluation Instrument (used for simulation scenario evaluation for debriefing section but the data was not taken for statistical analysis)

Description of intervention
Traditional teaching method and simulation-based teaching method was the intervention.

Traditional teaching method
The traditional teaching method included a 45-minutes session of lecture method of teaching followed by a 15-minutes demonstration of intravenous medication administration procedure. In the lecture method, the lesson plan included that the student will be able to acquire in-depth knowledge regarding the prevention of medication errors, to value the importance of medication error prevention, and be able to perform safe medication administration. The subtopics were:
- meaning of medication error – 2 minutes,
- definition of medication error – 2 minutes,
- difference between medication errors and adverse drug reaction – 3 minutes,
- causes of medication errors – 10 minutes,
- types of medication errors – 5 minutes,
- strategies for prevention of medication errors – 15minutes,
- effects of medication errors on patient – 5 minutes.

The audio-visual aids used were blackboard, power point presentation, chart, pamphlet, and handout. At the end of the class, the topics were summarised and concluded. In the demonstration, the objectives were clearly explained to the student. The demonstration environment was oriented to the student before the procedure. Students were taught how to deliver IV medications in a safe manner while following all drug administration guidelines, reducing the risk of medication errors during the demonstration.

Simulation-based teaching method
Before the simulation-based teaching method, an introduction to simulation was given to the students with the use of a power point presentation for 5 minutes. The simulation-based teaching method was for 60-minutes, the simulation session included pre briefing: 15-minutes, running scenario: 20-minutes, and debriefing: 25-minutes (the detailed of the simulation session of 60 minutes was provided in appendix). The scenario topic was preventing intravenous medication errors. The learning objectives were to:
- administer medication through Intravenous safely without errors,
- recognize the rationale of every step of the procedure being performed,
- demonstrate therapeutic communications in care of the patient.

The simulation environment was oriented towards the students. Available equipment, articles, and how to handle the hybrid simulators were explained to the students. The simulation scenario and all the simulation information were explained to all the students. Each student separately participated in a simulation scenario and had the role of a student nurse followed by debriefing session that took place in groups. Facilitators and cofacilitators analysed the simulation act.

Validity
Six experts from the field of nursing professionals who had received training on simulation-based teaching and biostatistician scrutinized the tool.

Reliability
The reliability of the instrument was established by the split-half method. The reliability value for knowledge was found to be 'r'= 0.76, attitude 'r' = 0.79 and practice 'r' = 0.80, which indicated that the instrument was highly reliable.

Data collection procedure
The researcher got the required permission from the institute authorities to conduct the research study. Permission was obtained from the selected study settings priorly. The data was collected for a period of one month. Each subject was explained about the purpose of the study and written consent was obtained prior to the study. The researcher introduced herself to the participants and a rapport was established with the subjects. The researcher assured the subjects that all their responses would be kept confidential. Four Colleges were selected using simple random sampling technique and out of the four selected colleges two colleges were selected for experimental

group I and two other colleges for experimental group II using simple random sampling. 25 subjects were selected from each of the four colleges using stratified sampling technique for selecting boys and girls proportionately. Two colleges selected for experimental group I was given traditional teaching whereas experimental group II was given simulation-based teaching on the prevention of medication errors. During the pre and post-test, while teaching the prevention of medication errors all the student's mobile phone were collected and kept in separate box away from the students. During the skill evaluation and after the scenario act separate room were arranged for the students who completed the given task.

A pre-test was conducted on day 1st. The students were gathered in classroom without any external disturbances and a self-administered knowledge and attitude questionnaire were distributed and asked to answer the questions. The time allotted to fill in the questions was 30 minutes. After the completion of questionnaire, the students were individually orientated to OSCE station and asked to do the intravenous medication administration procedure separately in skill lab within the allotted time of 10 minutes. Once the procedure was done the students were asked to occupy the separate room which was arranged priorly away from the classroom to prevent the sharing of the information.

The intervention was given on the same day, for experimental group I the traditional teaching on prevention of medication error was taken in the classroom, it includes 45 minutes session of the lecture method of teaching using the audio-visual aids such as power point, chart, pamphlet, leaflet and blackboard which was followed by a 15 minutes demonstration of intravenous medication administration procedure in the skill lab.

For experimental group II simulation introduction session was given for 15 minutes using the power point presentation in classroom which was followed by simulation-based teaching session for 60 minutes in three phases. In phase-1 all the students were participated in pre-briefing session for 15 minutes in group and after that they were asked to go back to classroom. In phase-II the students were individually undergone the scenario act for 20 minutes and upon completion of the act they were asked to occupy the separate room arranged away from the classroom. The simulation act was evaluated by using the Creighton Competency Evaluation Instrument. Finally in phase-III debriefing session was conducted for 25 minutes involving all the students in group whereas the debriefing questions were asked and explored for each student separately.

Post-test was conducted on 8th day using the same tool as that of the pre-test. The same procedure was implemented for all the 4 selected nursing colleges for the collection of data on the different days (data collection chart was attached in appendices)

Results

Regarding age, majority of the nursing students were in the age group of 20–21 years. In relation to gender, majority of the nursing students were females. Regarding place of stay, majority of the nursing students were days scholars. In relation to number of attempts on pharmacology, majority of the nursing students had one attempt to clear the pharmacology subject.

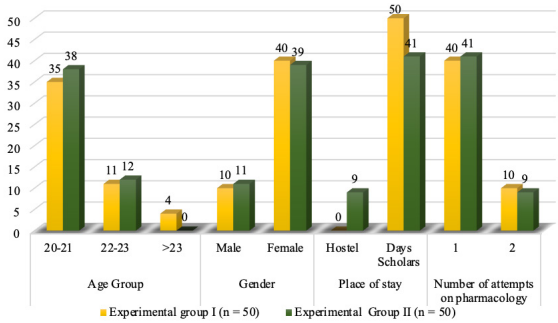

Fig. 1. Frequency and percentage distribution of socio demographic variables of the nursing students

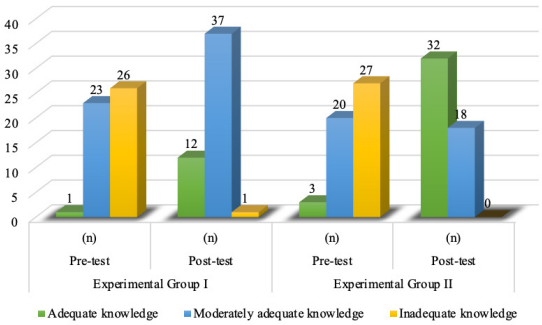

Fig. 2. Comparison of pre and post-test level of overall knowledge on prevention of medication errors within the experimental group I and II

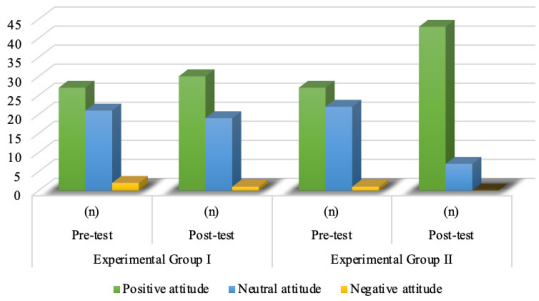

Fig. 3. Comparison of pre and post-test level of attitude towards prevention of medication errors within the experimental group I and II

In experimental group I, majority 26 (52%) of the nursing students had inadequate knowledge in the pre-test whereas only 1 (2%) had inadequate knowledge in the post-test. In experimental group II, majority 27 (54%)

of the nursing students had inadequate knowledge while none of them had inadequate knowledge in the post-test.

In experimental group I, majority 27 (54%) and 30 (60%) of the nursing students had positive attitude in the pre and post-test respectively. In experimental group II, majority 27 (54%) and 43 (86%) of the nursing students had positive attitude in the pre and post-test respectively.

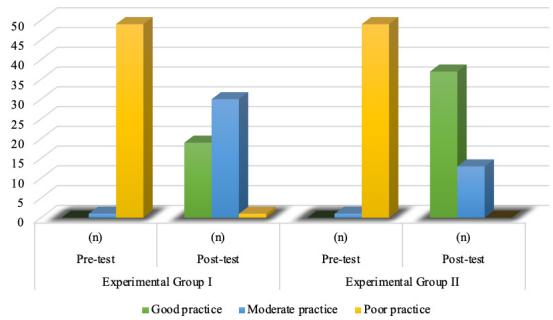

Fig. 4. Comparison of pre and post-test level of practice on prevention of medication errors within the experimental group I and II

In experimental group I, majority 49 (98%) and 1(2%) of the nursing students had poor practice in the pre and post-test respectively. In experimental group ii, majority 49 (98%) of the nursing students had poor practice in the pre-test whereas none of them had poor practice in the post-test (Table 1).

In experimental group I the pre-test mean scores of overall knowledge was 9.16 whereas the post-test mean scores of overall knowledge was 13.28. The post-test mean scores of overall knowledge was higher than that of the pre-test.

In experimental group II the pre-test mean scores of overall knowledge was 9.52 whereas the post-test mean scores of overall knowledge was 15.08. The post-test mean scores of overall knowledge was higher than that of the pre-test.

Comparison of pre and post-test mean scores of attitude towards the prevention of medication errors within the experimental group I and II

In experimental group I, the pre-test mean scores of attitude was 7.26 whereas the post-test mean scores of attitude was 7.52. The computed paired 't' test value 1.218 at p=0.229 revealed that there was no statistically significant difference in the attitude between the pre and post-test. But the mean scores of the post-test was higher than that of the pre-test.

In experimental group II, the pre-test mean scores of attitude was 7.50 whereas the post-test mean scores of attitude was 8.44. The computed paired 't' test value 4.305 at p=0.000 revealed a highly statistically significant difference in the attitude between the pre and post-test. Traditional teaching method and simulation-based teaching method increased the level of attitude among nursing students in the experimental group I and II respectively.

Table 1. Comparison of pre and post-test mean scores of overall knowledge and various aspects of knowledge on prevention of medication errors in experimental group I and II [a]

Aspects of knowledge	Experimental group I n=50				Paired t – test value and p
	Pre-test score		Post-test score		
	Mean	(SD)	Mean	(SD)	
Meaning of medication error	1.12	0.65	1.80	0.45	t=6.263 p<0.001 *** (S)
Adverse drug event	0.28	0.45	0.58	0.50	t=3.130 p=0.003 ** (S)
Causes of medication error	2.02	1.17	2.40	1.03	t =1.719 p=0.092 (NS)
Types of medication error	1.66	1.04	2.16	1.31	t=2.150 p=0.037 * (S)
Rights of medication administration	1.90	1.01	2.42	0.91	t=2.800 p=0.007 **(S)
Strategies for prevention of medication error	1.50	0.91	3.22	1.25	t=7.523 p<0.001 ***(S)
Effects of medication error	0.68	0.47	0.70	0.46	t=0.216 p=0.830 (NS)
Overall, knowledge score	9.16	3.28	13.28	2.63	t=6.458 p<0.001 ***(S)
Aspects of knowledge	**Experimental group II (n=50)**				**Paired t – test value and p - value**
	Pre-test score		**Post-test score**		
	Mean	**(SD)**	**Mean**	**(SD)**	
Meaning of medication error	1.28	(0.83)	1.88	(0.33)	t=4.818 p<0.001 *** (S)
Adverse drug event	0.20	(0.40)	0.54	(0.50)	t=3.351 p=0.002 **(S)
Causes of medication error	2.08	(1.17)	2.98	(1.02)	t =3.870 p<0.001 *** (S)
Types of medication error	1.32	(0.89)	2.68	(1.24)	t=5.915 p<0.001 *** (S)
Rights of medication administration	2.32	(0.93)	2.70	(0.61)	t=2.474 p=0.017 * (S)
Strategies for prevention of medication error	1.54	(1.16)	3.27	(1.34)	t=7.435 p<0.001 *** (S)
Effects of medication error	0.78	(0.42)	0.96	(0.20)	t=2.641 p=0.011 *(S)
Overall, knowledge score	9.52	(3.26)	15.08	(2.64)	t =8.842 p<0.001 *** (S)

[a] S – significant; NS – not significant

Comparison of pre and post-test mean scores of practice on prevention of medication errors within the experimental group I and II

In experimental group I, the pre-test mean scores of practice was 2.73 whereas the post-test mean scores of practice was 6.78. The computed paired 't' test value 12.913 at p<0.001 revealed a highly statistically significant difference in the practice between the pre and post-test (Table 2).

In experimental group II, the pre-test mean scores of Practice was 1.52 whereas the post-test mean scores of practice was 8.19. The computed paired 't' test value

27.674 at p=0.000 revealed a highly statistically significant difference in the practice between the pre and post-test. Traditional teaching method and simulation-based teaching method significantly increased the level of practice among nursing students in the experimental group I and II respectively.

Table 2. Comparison of effective mean scores of overall knowledge, attitude and practice on prevention of medication errors between the experimental groups [a]

Knowledge	Experimental group I n=50		Experimental group II n=50		Independent t – test value and p
	Mean	SD	Mean	SD	
Effective	4.12	4.51	5.61	4.44	t =1.658 p=0.101 (NS)
Attitude	**Experimental group I n=50**		**Experimental group II n=50**		**Independent t – test value and p**
	Mean	SD	Mean	(SD)	
Effective	0.26	1.51	0.94	1.54	t=2.227, p=0.028 *(S)
Practice	**Experimental group I n=50**		**Experimental group II n=50**		**Independent t – test value and p**
	Mean	SD	Mean	SD	
Effective	4.04	2.21	6.67	1.70	t=6.644, p<0.001 ***(S)

[a] S – significant; NS – not significant

The effective mean scores of overall knowledge, attitude and practice of the experimental group II were higher than that of the experimental group I.

In experimental group I, there was a statistically significant correlation between the knowledge and attitude towards the prevention of medication errors as well as between the knowledge and practice (skill) on prevention of medication errors (Table 3).

Table 3. Correlation between the level of knowledge and attitude, knowledge and practice, attitude and practice on prevention of medication error in the experimental group I and II [a]

Experimental group I (n=50)	Attitude	Practice
Knowledge	r=0.330 p=0.019 *(S)	r=0.340 p=0.016 *(S)
Attitude	–	r=-0.065 p=0.656 (NS)
Experimental group II (n=50)	**Attitude**	**Practice**
Knowledge	r=0.125 p=0.393 (NS)	r=0.114 p=0.434 (NS)
Attitude	–	r=-0.210 p=0.144 (NS)

[a] S – significant; NS – not significant

There was a significant association between the level of attitude and the demographic variables gender (Table 4).

Table 4. Association between the post-test level of knowledge, attitude and practice with their selected demographic variable in the experimental group I and II [a]

Knowledge						
Experimental group I (n=50)						
Demographic variables	**Sub variables**	**No.**	**Mean**	**SD**	**F ratio/'t' value**	**p**
Age group	20–21	35	13.03	2.45	0.825	0.444 (NS)
	22–23	11	14.18	2.89		
	>23	4	13.00	3.56		
Gender	Male	10	14.40	2.67	1.528	0.133 (NS)
	Female	40	13.00	2.57		
Place of stay	Hostel	0	–	–	Not applicable	
	Days Scholars	50	13.28	2.63		
No. of attempts on pharmacology	1	40	13.15	2.52	0.696	0.490 (NS)
	2	10	13.80	3.12		
Experimental group II (n=50)						
Age group	20–21	38	14.84	2.73	0.947	0.348 (NS)
	22–23	12	15.67	2.27		
	>23	0	–	–		
Gender	Male	11	14.82	3.22	0.314	0.755 (NS)
	Female	39	15.10	2.48		
Place of stay	Hostel	9	13.89	2.47	1.469	0.148 (NS)
	Days Scholars	41	15.29	2.62		
No. of attempts on pharmacology	1	41	15.15	2.71	0.607	0.547 (NS)
	2	9	14.56	2.30		
Attitude						
Experimental group I (n=50)						
Demographic variables	**Sub variables**	**No.**	**Mean**	**SD**	**F ratio/'t' value**	**p**
Age group	20–21	35	7.54	1.33	0.020	0.980 (NS)
	22–23	11	7.45	1.13		
	>23	4	7.50	1.29		
Gender:	Male	10	7.50	1.43	0.055	0.956 (NS)
	Female	40	7.52	1.24		
Place of Stay	Hostel	0	-	-	Not applicable	
	Days Scholars	50	7.52	1.26		
No. of attempts on pharmacology	1	40	7.57	1.26	0.661	0.544 (NS)
	2	10	7.30	1.34		
Experimental group II (n=50)						
Age group	20–21	38	8.39	0.82	0.677	0.502 (NS)
	22–23	12	8.58	0.90		
	>23	0	-	-		
Gender	Male	11	7.91	0.70	2.508	0.016 *(S)
	Female	39	8.59	0.82		
Place of stay	Hostel	9	7.67	0.87	3.369	0.001 (NS)
	Days scholars	41	8.60	0.74		
No. of attempts on pharmacology	1	41	8.39	0.86	0.895	0.375 (NS)
	2	9	8.67	0.71		
Practice						
Experimental group I (n=50)						
Demographic variables	**Sub variables**	**No.**	**Mean**	**SD**	**F ratio/'t' value**	**p**
Age group	20–21	35	6.79	1.27	0.067	(NS)
	22–23	11	6.67	1.09		
	>23	4	6.93	1.63		
Gender	Male	10	6.72	1.16	0.161	(NS)
	Female	40	6.79	1.27		
Place of stay	Hostel	0	-	-	Not applicable	
	Days scholars	50	6.78	1.24		
No. of attempts on pharmacology	1	40	6.81	1.26	0.351	0.727 (NS)
	2	10	6.65	1.17		

Experimental group I (n=50)						
Age group	20–21	38	8.29	1.14	1.038	0.304 (NS)
	22–23	12	7.87	1.45		
	>23	0	–	–		
Gender	Male	11	8.14	1.36	0.162	0.872 (NS)
	Female	39	8.21	1.20		
Place of stay	Hostel	9	8.78	1.09	1.626	0.111 (NS)
	Days scholars	41	8.06	1.22		
No. of attempts on pharmacology	1	41	8.31	1.12	1.492	0.142 (NS)
	2	9	7.65	1.56		

[a] S – significant; NS – not significant

Discussion

Existing level of overall knowledge on prevention of medication errors among experimental group I and II

Majority 26 (52%) and 27 (54%) of the nursing students had inadequate level of knowledge, whereas 23 (46%) and 20 (40%) had moderately adequate level of knowledge, while only 1 (2%) and 3 (6%) had adequate level of knowledge on prevention of medication errors among experimental group I (traditional teaching method) and II (simulation teaching method) respectively.

The above findings of the study was supported by a descriptive study conducted by Raghavendran et al., to assess the knowledge level of students regarding the prevention of medication errors in a selected nursing college, Kanpur and the result showed that 129 (64.5%) of the students had an inadequate level of knowledge, 49 (24.5%) had a moderately adequate level of knowledge and 22 (11%) had an adequate level of knowledge.[15]

Existing level of attitude towards the prevention of medication errors among experimental group I and II

Majority 27 (54%) of the nursing students had positive attitude in both experimental group I and II, whereas 21 (42%) and 22 (44%) had neutral attitude, while only 2 (4%) and 1 (2%) had negative attitude in the experimental group I and II respectively.

The above findings of the study were supported by Shaju et al., who had conducted a descriptive study to assess the knowledge and attitude regarding medication error among nursing students in a selected college at Mangalore and the results showed that majority 88% of the students had positive attitude whereas 12% had negative attitude towards the medication error.[16]

Existing level of practice on prevention of medication errors among experimental group I and II

In both experimental group I and II, majority 49 (98%) of the nursing students had poor practice whereas only 1 (2%) had moderate practice.

The second objective was to compare the effectiveness between traditional teaching method and simulation-based teaching method on prevention of medication errors.

Knowledge

Comparison of pre and post-test level of overall and various aspects of knowledge on prevention of medication errors within the experimental group I and II

Overall level of knowledge among experimental group I on prevention of medication error, majority 26 (52%) had inadequate knowledge while 23 (46%) had moderately adequate knowledge and only 1 (2%) had adequate knowledge in the pre-test, whereas in the post-test, majority 37 (74%) had moderately adequate knowledge while 12 (24%) had adequate knowledge and only 1 (2%) had inadequate knowledge.

The above findings were supported by a study conducted by Kumar et al., to evaluate the effectiveness of lecture cum demonstration on knowledge and skill regarding cranial nerve assessment among B.Sc. nursing students in Lucknow. Where the results revealed that in the pre-test, majority 80% of the students had inadequate knowledge, 20% had fairly adequate knowledge and none of them had adequate knowledge, while in the post-test none of them had inadequate knowledge whereas 75.5% had fairly adequate knowledge and 24.4% had adequate knowledge.[17]

Effectiveness of the two-teaching methods (traditional teaching method and simulation-based teaching method) on level of knowledge on prevention of medication errors

The computed paired 't' test value 6.458 at $p<0.001$ revealed a highly statistically significant difference between the pre and post-test means scores, indicating that the overall knowledge between the pre and post-test were not similar. Thus, it could be inferred that the traditional teaching method was effective in improving the overall knowledge on prevention of medication errors.

The above findings were supported by the study conducted by Patil et al., to assess the effectiveness of lecture cum Demonstration method on knowledge regarding neurological assessment among undergraduate nursing students from selected colleges of Chandrapur and results findings revealed that the post-test mean score was 18.22 higher than that of the pretest mean scores of 9.1. The calculated t value was 14.95 at $p<0.001$, showed a highly statistically significant difference between the pre and post-test level of knowledge.[18]

In experimental group II the computed paired 't' test value 8.842 at $p<0.001$ revealed a highly statistically significant difference between the pre and post-test means scores, indicating that the overall knowledge between the pre and post-test were not similar. Thus, it could be inferred that the stimulation-based teaching method was effective in improving the overall knowledge on prevention of medication errors.

The above findings were supported by the study designed by Frenzel et al., to evaluate the use of sim-

ulations in preparing students to identify and reduce medication errors and promote patient safety among third-year pharmacy students. The results showed that overall knowledge of post-test score (83.9%) was higher than that of the pre-test score (81.5%).[19]

Effectiveness of traditional teaching method versus simulation-based teaching method on the level of knowledge on prevention of medication errors

In experimental group I the computed independent 't' test value 1.658 at p=0.101 revealed that there was no statistically significant difference in the overall knowledge between the experimental group I and II. The effective mean scores of the experimental group II (simulation-based teaching method) was higher than that of the experimental group I (traditional teaching method), indicating that simulation-based teaching method was more effective than the traditional teaching method.

The above findings were supported by the study conducted by Jyoti et al., to evaluate the effectiveness of simulation-based training versus traditional method of teaching on the retention of birthing care on knowledge and skills among B.Sc. nursing fourth year students and results showed that the knowledge mean score for simulation group (23.05) was higher than traditional teaching group (17.87).[20]

So, the hypothesis H_1 which stated that there will be significant difference between the effective mean of knowledge between experimental group I and II among nursing students on prevention of medication errors was not accepted.

Attitude

Effectiveness of the two-teaching methods (traditional teaching method and simulation-based teaching method) on level of attitude towards the prevention of medication errors

The computed paired 't' test value 4.305 at p<0.001 revealed a highly statistically significant difference in the attitude between the pre and post-test, which indicated that the mean scores of attitude between the pre and post-test were not similar.

Thus, elicited that the attitude towards the prevention of medication errors had significantly increased in the post-test than that of the pre-test. Which clearly showed that the simulation-based teaching method was effective on improving the attitude towards the prevention of medication errors.

The above findings were supported by the study conducted by Frenzel et al., where the results showed that there was a significant improvement in the post-test of Attitude at p<0.05.[19]

Thus, it could be inferred that the traditional teaching method and simulation-based teaching method was effective in improving the level of attitude towards the prevention of medication errors.

Effectiveness of traditional teaching method versus simulation-based teaching method on the level of attitude towards the prevention of medication errors

In experimental group I, the computed independent 't' test value 2.227 at p=0.028 revealed that there was a statistically significant difference in the attitude between the experimental group I and II, indicating that the effective mean scores of attitude between the experimental group I and II were not similar. Thus, it was elicited that the level of attitude towards the prevention of medication errors had significantly increased in the experimental group II than that of the experimental group I, implied that the simulation-based teaching method was more effective than the traditional teaching method.

So, the hypothesis H_2 which stated that there will be significant difference between the effective mean of attitude between experimental group I and II among nursing students on prevention of medication errors was accepted.

Practice

Comparison of pre and post-test level of practice on prevention of medication errors within the experimental group I and II

In experimental group I, 49 (98%) and 1 (2%) of the nursing students had poor practice, likewise 1 (2%) and 30 (60%) had moderate practice in the pre and post-test respectively, while none of them had good practice in the pre-test whereas 19 (38%) had good practice in the post-test.

The above findings was supported by a study conducted by Kumar and Pandey to evaluate the effectiveness of lecture cum demonstration on knowledge and skill regarding cranial nerve assessment among B.Sc. nursing students and the results findings revealed in the pre-test 85.5% of the students had inadequate skills, 14.5% had fairly adequate skills and none of them had adequate skills, whereas in the post-test 9% had inadequate skills, 71.5% had fairly adequate skills and 19.5% had adequate skills.[17]

In experimental group II, 49 (98%) of the nursing students had poor practice in the pre-test whereas none of them had poor practice in the post-test. Similarly, 1 (2%) and 13 (26%) of the nursing student had moderate practice in the pre and post-test respectively. With regard to good practice, none of them had good practice in the pre-test whereas 37 (74%) had good practice in the post-test.

The above findings was supported by a study conducted by Sharma et al., evaluated effectiveness of simulation technique, on practice regarding selected nursing procedure among B.Sc. nursing students and the results showed that in the pre-test (88.8% and 97.5%) had poor practice, (11.3% and 2.5%) had satisfactory practice and none of the students had good practice in intravenous

and intramuscular practice administration, whereas in the post-test none of them had poor practice, (77.5% and 46.4%) had satisfactory practice and (22.5% and 53.6%) had good practice.[21]

Thus, it could be inferred that the shift of level of practice (skill) of majority of the nursing students from poor practice in the pre-test to good practice in the post-test showed the effectiveness of traditional teaching method and simulation-based teaching method in improving the level of practice (skill) on prevention of medication error among nursing students.

Effectiveness of the two-teaching methods (traditional teaching method and simulation-based teaching method) on level of practice in the prevention of medication errors

The study revealed that in experimental group I, the computed paired 't' test value 12.913 at p<0.001 revealed a highly statistically significant difference in the practice between the pre and post-test, indicating that the mean scores of practice between the pre and post-test were not similar

Thus, it was elicited that the practice on prevention of medication errors had significantly increased in the post-test than that of the pre-test. Implying that the traditional teaching method was effective on improving the level of practice on prevention of medication errors.

The above findings was supported by a study conducted by Pandey and Vijaya, evaluated the effectiveness of lecture cum demonstration on knowledge and skill regarding cranial nerve assessment among B.Sc. nursing students and the results findings revealed that the effective mean was 5.82 with calculated t=8.74 at p<0.05 showed a statistically significant difference between the pre and post-test.[17]

In experimental group II, the computed paired 't' test value 27.674 at p<0.001 revealed a highly statistically significant difference in the practice between the pre and post-test, indicating that the mean scores of practice between the pre and post-test were not similar

Thus, it was elicited that the practice on prevention of medication errors had significantly increased in the post-test than that of the pre-test. Implying that the stimulation-based teaching method was effective on improving the level of practice on prevention of medication errors.

The above findings was supported by a study conducted by Sharma et al., evaluated effectiveness of simulation technique, on practice regarding selected nursing procedure among B.Sc. nursing students and the results showed that the mean difference was 1.113 and 1.513 for intravenous and intramuscular administration Practice with calculated t= 23.648 and t= 23.648 at p=0.05 showed a statistically significant difference between the pre and post-test.[21]

Thus, it could be inferred that the traditional teaching method and simulation-based teaching method was effective in improving the level of practice on prevention of medication errors.

Effectiveness of traditional teaching method versus simulation-based teaching method on the level of practice in the prevention of medication errors

In experimental group I the computed independent 't' test value 6.644 at p<0.001 revealed that there was a highly statistically significant difference in the practice between the experimental group I and II, indicating that the effective mean scores of practice between the experimental group I and II were not similar.

Thus, it was revealed that the level of practice on prevention of medication errors had significantly increased in the experimental group II than that of the experimental group I, which implies that the simulation-based teaching method was more effective than the traditional teaching method.

The above findings was supported by the study conducted by Jyoti et al., who evaluated the effectiveness of simulation based training versus traditional method of teaching on the retention of birthing care on knowledge and skills among B.Sc. nursing fourth year students and results showed that the skill mean score for simulation group (37.23) was higher than traditional teaching group (29.23) at t=33.23 at p<0.05 showed a highly statistical significant difference between the two groups.[20]

So, the hypothesis H_3 which stated that there will be significant difference between the effective mean of practice between experimental group I and II among nursing students on prevention of medication errors was accepted.

To correlate the level of knowledge and attitude, knowledge and practice and attitude and practice on prevention of medication errors among nursing students in selected colleges, Puducherry

The study findings revealed that in experimental group I, the significant r=0.330 at p=0.019 and r=0.340 at p=0.016 revealed that there was a statistically significant correlation between the knowledge and attitude, knowledge and practice on prevention of medication errors respectively.

Thus, it could be inferred that when the level of knowledge increased, the level of attitude also increased, similarly when the level of knowledge increased, the level of practice (skill) also increased on prevention of medication errors among experimental group I.

The above finding was supported by the study conducted by the Reddy and Ramesh, where the results showed that there was a positive correlation between post-test level of knowledge and practice at r=0.21 and p<0.05.[22]

In experimental group II, the non-significant r=0.125 at p=0.393 and r=0.114 at p=0.434 revealed that there was

no statistically significant correlation between the knowledge and attitude, knowledge and practice on prevention of medication errors among experimental group I.

The non-significant r=-0.065 at p=0.656 and r=-0.210 at p=0.144 revealed that there was no statistically significant correlation between the attitude and practice on the prevention of medication errors among the nursing student in the experimental group I and II respectively.

So, the hypothesis H_4 which stated that there will be significant correlation between the level of knowledge and attitude, knowledge and practice, attitude and practice among nursing students on prevention of medication errors in the experimental group I and experimental group II was not accepted except the level of knowledge and attitude, knowledge and practice among nursing students in experimental group I.

To associate between the post-test level of knowledge, attitude and practice with their selected demographic variables in the experimental group I and II

The present study results revealed that the association between the post-test level of knowledge and practice with their selected demographic variable in the experimental group I and II revealed a non-significant p value, which showed that there was no statistically significant association between level of knowledge and practice with any of the selected demographic variable in experimental group I and II respectively.

With respect to association between the post-test level of attitude with their selected demographic variable in the experimental group I revealed a non-significant p value, which showed that there was no statistically significant between the level of attitude with their selected demographic variables in the experimental group I.

With regard to the association between the post-test level of attitude with their selected demographic variable in the experimental group II revealed a non-significant p, which showed there was no statistically significant association between attitude and the demographic variables except gender which was statistically significant at p=0.016.

So, the hypothesis H_5 which stated that there will be significant association between post-test level of knowledge, attitude and practice with their selected demographic variables in the experimental group I and experimental group II was not accepted except the post-test level of attitude with their gender demographic variable in the experimental group II.

Nursing implication

Nursing services

- Since the concept of simulation is new in nursing services, it can be utilized for job training and continuing nursing education for nursing personnel. It aids in improving the quality of patient care.
- The requirement for high-quality nursing care focused on patient safety has increased, thus nurses can embrace these novel simulation-based interventional strategies by honoring their ICT abilities to improve their performance at health care settings.
- The use of simulation is proposed to enhance healthcare professional collaboration, interdisciplinary communication, and team training.

Nursing education

- Through simulation, students can learn and practice nursing procedures in a less risky but real-life environment. The safety of patients will be increased by learning through simulation.
- Students will be trained for various nursing procedure through the use of simulations, which also help them to develop their critical thinking and self-reflection skills before going to bed side.
- Effective communication and collaboration can be taught by utilizing simulation through team training, implementation of a standardized approach to communications.
- Simulation can be integrated into Nursing education as an efficient teaching strategy that harmoniously blends nursing theory and practical skills.

Nursing administration

- Policy changes should enable the use of simulation in nursing personnel recruitment and promotion.
- Administrations can plan on holding a continues nursing education and in-service educations to empower faculty in simulation-based activities and thereby promote quality nursing care.

Nursing research

- Encourage Nurses in research activities on Simulation to improve the body of Knowledge for their profession.
- Emphasis on utilization of the Simulation based study results in Practice.

Recommendation

- Replication of the study may be done with the large samples in different settings to generalize the study findings.
- Comparative study can be conducted by using different types of simulation method.
- This study can be conducted by using other teaching methods.
- Comparative study can be conducted on different groups.
- A follow-up study may be taken up to determine the long-term effects of intervention in terms their level of knowledge, attitude and practice.

Conclusion

The study result proved the effectiveness of the traditional teaching method and the simulation-based teaching method in raising the level of knowledge, attitude, and practice in the prevention of medication errors among nursing students in selected colleges of nursing at Puducherry. It also proved that the simulation-based teaching method was more effective than the traditional teaching method. It has been unveiled that simulation-based teaching method was effective which can be utilized as a means to educate the nursing students during their academic performance.

Declarations

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Author contributions

Conceptualization, R.R., F.C.A. and K.D; Methodology, R.R.; Software, R.R.; Validation, R.R., F.C.A. and K.D.; Formal Analysis, R.R.; Investigation, R.R.; Resources, R.R.; Data Curation, R.R., F.C.A. and K.D; Writing – Original Draft Preparation, R.R.; Writing – Review & Editing, R.R, F.C.A. and K.D.; Visualization, R.R.; Supervision, F.C.A. and K.D.; Project Administration, R.R.

Conflicts of interest

The author(s) declare no competing interests.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Mother Theresa post graduate research nstitute of health science ICE committee.

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