

**Sim Man 3G – HIGH FIDELITY SIMULATION: A METHOD TO FACILITATE PHARMACOLOGY LEARNING BY MBBS STUDENTS**

**Dr. K. Bhuvaneshwari<sup>1\*</sup>, Dr. C. Deena Sangeetha<sup>2</sup>**

*1. Professor and Head, 2. Associate Professor, Department of Pharmacology, PSG Institute of Medical Sciences & Research, Coimbatore, University affiliation. The TamilNadu Dr. MGR Medical University, Chennai, India.*

**\*Email id of corresponding author- [nandabhuvana@gmail.com](mailto:nandabhuvana@gmail.com)**

**Received: 01/08/2017**

**Revised : 01/11/2017**

**Accepted: 09/11/2017**

**ABSTRACT**

**Introduction:** Many students in the II MBBS curriculum find difficult to learn Pharmacology. II MBBS students do not have many opportunities to observe the clinical effects of the drugs as they read about, making learning experience largely theoretical. To improve the learning experience and to facilitate recall by providing an opportunity to observe the clinical effects of drugs using simulation a practical way of teaching method in Pharmacology would improve student understanding of the role of drugs in a given clinical scenario and it would improve their prescription writing skills. **Methods:** 29 II MBBS students attended a lecture class on drugs used in bronchial asthma and underwent a pre-test, followed by demonstration of management of acute exacerbation of bronchial asthma in a simulation model, in smaller groups. Later, their individual management of the simulated patient was assessed by observation & they were asked to write a prescription for maintenance therapy for their patient. A post-test was conducted one month later. **Results:** All students improved their post-test scores, and this was especially marked in those who had scored less than 50% in their pre-test. 70% of students were able to revert bronchospasm within 15 minutes and all students wrote a correct prescription for maintenance therapy. **Conclusions:** Thus, simulation mode of teaching improved the learning skill and outcome, with an added advantage of knowing to interpret clinical data to select the appropriate drugs to solve the clinical problem.

**KEYWORDS:** Bronchial asthma, II MBBS learning, novel pharmacology practical method, novel teaching method.

**INTRODUCTION**

Undergraduate medical students learn Pharmacology through regular lectures and few types of practical methods. Even though they have early clinical postings in various clinical departments to observe /understand the basic concepts like history taking, value of interpretation of lab reports to the related clinical

situation and treatment given, there is less chances to observe and interpret /visualize various effects of drugs other than animal experiments, Computer assisted learning, video based teaching, problem based teaching /learning which are used currently in traditional method as an informative session to improve their knowledge. This many time overload the

students with more information with knowledge gain and may or may not be creating interest in students to practice reflective thinking and better understanding.(1,2) Hence, to understand pharmacology in the 2<sup>nd</sup> professional MBBS program, to acquire good prescription writing skill, the undergraduate MBBS students need some exercises with application based assessment example - learning with need for writing correct , effective prescription individually than making them to recall theory and writing in a paper as simple practical assessment. . In present scenario, students need imagination and memorizing skills, since majority of the assessment in II MBBS program is recall type and do not have much scope for rational thinking.

Pharmacology is a science in the MBBS Curriculum where students are given a complete knowledge of drugs and their role in therapeutics. They are expected to write a complete and rational prescription for any given condition at the end of the year. Teaching is primarily lecture-based and students do not have many opportunities to observe or visualize the effects of the drugs. (1, 2) As part of our continuous commitment to improve quality, to observe and interpretation of drug effects in a realistic model like simulation would positively influence the undergraduate medical students self learning habits and enable them to learn therapeutics effectively during MBBS training to value the rational prescription skills.(3,4,5) Simulation, when used as an adjunct in the II MBBS lecture-based program helps the students to bridge the theory –practice gap. (6) Hence we planned this study to evaluate the use of simulation as a teaching method in Pharmacology. Our objectives were to investigate if the use of SimMan 3G high fidelity manikin, a wireless human patient simulator represents an average-size adult patient useful in teaching core skills like airway, breathing, cardiac, and circulation management with

attached patient monitor that displays vitals, labs, and X-ray. This high fidelity manikin is effective in recognizing, identify drugs and dose with programmable response as simulation based learning environment a practical teaching method to improve student understanding of the role of drugs in a given clinical scenario with specific route and dose of administration and whether it would improve their prescription writing skills.

## **MATERIALS AND METHODS:**

The study was conducted at the Department of Pharmacology and Centre for Clinical Simulation and Research, in a private Medical College after obtaining ethical approval from the Institutional Human Ethics Committee.

### ***A. Pre and Post-test model***

Second MBBS student volunteers (n=30) were participated in this observational study after signing written informed consent using one group pre and post-test model. All students were listened to a preliminary lecture class on the Pathophysiological approach to the pharmacotherapy of bronchial asthma and the management of acute exacerbations of chronic asthma. They were provided with learning material and after a month, were asked to attend a pre-test, a short test with multiple choice questions on the management of acute exacerbation of bronchial asthma and the interpretation of clinical parameters related to assessment of severity of the exacerbation. After the pre-test, smaller groups of student participants were taught the management of acute exacerbation of bronchial asthma, with stepwise therapy according to the severity of symptoms in a simulation model. They were assessed individually, within a month of their demonstration exercise, by observation of their management of acute exacerbation of bronchial

asthma in the simulation model (NAEP guidelines, ERP-3, 2007 Bethesda US).(7) This was followed by post-test with the same pre-validated multiple choice questions, one month later. Learning outcome of each student, who had voluntarily participated in this study with variable learning potential was compared before and after the simulation method of learning.

### *Methodology for SimMan 3G High fidelity simulator way of learning (8)*

To determine whether the students would be able to select and administer the appropriate drug/s to relieve bronchoconstriction in an acute exacerbation of chronic asthma model using SimMan 3G – High Fidelity simulator with in ½ hour to 1 hour, the following methodology (Figure -1) was used.

### **B. Learning assessment after exposure to Simulation Model**

#### **I- Quantitative Assessment:**

A questionnaire was administered to each student after he/she completed the exercise on the simulation model. The first part of the questionnaire was for quantitative assessment, and questions were meant to assess the students' practical knowledge gained through their performance in the asthmatic simulation model. Students were asked to name the drug that had the fastest onset of action and its route of administration. They were also asked to write a prescription-on-discharge for maintenance therapy of the patient they had managed in the simulation model. A Questionnaire with three questions was used in this study mainly to know how the students were able to tackle the problem given to them using problem solving ability in simulation method, with an intention to rate the difficulty level of this simulation method by the students. Parameters like interpretation of the

clinical investigations like PO<sub>2</sub>, HR, RR etc, to choose the drug to reduce the symptoms based on the clinical parameters, to select and apply appropriate drug with route to reduce symptoms using pathophysiological approach were incorporated in the questionnaire. All the students were requested to rate this parameters with likert scale where 0 is no difficulty level, 1 is 20% difficulty and 5 is 100% difficulty. This is to check the friendliness of simulation technique students were asked to rate their difficulty in solving various aspects of the clinical problem they had encountered.

#### **II -Qualitative assessment:**

The students were asked to describe their opinion in learning through this mode of teaching and whether it improved their ease of recollection of pharmacological principles through a questionnaire. They were asked to describe the barriers to learning, if any, in the simulation mode of teaching and to rate their confidence in handling a similar clinical situation.

#### **RESULTS:**

Out of 30 volunteers students, 29 students completed the study and were included in statistical analysis. One of them dropped out as she was unable to attend the initial pre-test. 29 students completed the study and were included in statistical analysis. The pre-test and post test scores on comparison by paired-t test showed a statistical significance (P=0.001) with SPSS version 19.

There was improvement in post-test scores compared to pre-test scores and this improvement was especially marked in those students who had scored less than 50% in the pre-test (Figures 2 , 3 & 4). The vast majority of students (70%) were able to revert bronchospasm in the acute asthma model in SimMan-3G in less

than 15 minutes by timely and appropriate intervention with drugs. Only 10% of students required more than 20 minutes (Figure 5).

### ***Quantitative Analysis***

Most of the students found it very easy to interpret clinical parameters as part of the management of bronchial asthma in the simulation. Only 13% (n=4) of the study participants (n=29) felt a difficulty level of 20%. Almost all students were able to correctly identify the drug for producing effective bronchodilation with immediate improvement in oxygen saturation in the simulation model. Only 7% (n=2) of the study participants failed to identify an appropriate bronchodilator. All the students were able to write a correct prescription for 10 days maintenance therapy after discharge of the simulated patient, and all of them were able to write the correct dose and route of drug administration.

### ***Qualitative Analysis***

All the student participants were asked to answer few open ended questions to assess parameters like any barrier to choose drugs, able to give appropriate prescription for maintenance therapy, simulation mode of learning whether improved their confidence, facilitate recollecting pharmacological principles, able to solve clinical problem using simulation. All the student participants were able to confidently manage the clinical scenario through this learning method and felt that it was easy to clinically apply the pharmacological principles of each drug used. All the students were also confident of giving an appropriate prescription for maintenance therapy after managing the acute exacerbation of asthma and did not encounter any barriers in the choice of appropriate drugs. Simulation improved the student's self-confidence and helped them to recollect the pharmacological principles and apply these principles rationally in therapeutics.

### **DISCUSSION:**

We had carried out a questionnaire-based survey to understand the efficacy of our teaching methods in the students' ability to apply their theoretical knowledge of the pharmacological concepts of drugs in clinical application. We surveyed II MBBS, Final MBBS (end of course) and CRRI (end of internship) to analyze if the training imparted during the Pharmacology course was sufficient for clinical application of pharmacological concepts, according to their current requirement. We identified the need for an active teaching method to enable students to think, apply and reinforce their prescription-writing skills. Because this simulation based exercise is related with assessment and students has commitment to solve given clinical situation using simulation surprised us, that students would have an improved learning experience if they were given the opportunity to observe the clinical effects of drugs in a simulated environment and that this would improve their self-learning and practical skills.(3,4). Present medical undergraduate curriculum-pharmacology teaching under MCI guidelines, facilitate medical students to require good prescription skills with the knowledge on pharmacoeconomics, effective dose calculation, value of drug interactions, appropriate selection of drugs with appropriate Pharmacotherapeutic reasoning, adverse drug reaction(ADR) impact in clinical setup and the need to report ADR to Pharmacovigilance centre, importance of rational use of medicine in clinical practice (RUM) through practical's and in theory classes. Even though all the students are taught and assessed with suitable assessment method, how many students are really carrying the core principles of pharmacology to clinical practice is not clear and difficult to judge.(5)

Pharmacotherapeutic knowledge can be suitably kindled with case based discussion, problem solving exercises to improve the quality of RUM and to develop good prescription writing skills during undergraduate training program. Unless there is an active demonstration of these training, students may tend forget these practical concepts before they become trained medical professional to undergo internship with minimum theory knowledge. (5) Majority of the practical pharmacological assessment are carried out in writing like recall, except very few exercises with OSPE format, may be one of the factor which can induce lack of importance about the applied aspect of the subject pharmacology by the students.

In this study, when students were assessed with pretest after routine theory class on bronchial asthma with pathophysiological way of approaching the disease, to provide good clinical care with clinical Pharmacotherapeutic knowledge, students were scored less than 50%(Figur2-IA), but the same set of students expressed better assessment after witnessing the clinical problem through simulation and the students' scores were more than 50% (Figur2-IA) clearly exhibits the need of clinical way of leaning pharmacology in undergraduate curriculum.(5) This might improve the value of learning pharmacology to self-improve good prescription skills during medical undergraduates training.

Simulation provides more chances to create realistic scenarios and to undergo training, retraining with many times possible. But with patients, medical undergraduate students have little limitation to provide treatment and allowed to observe the treatment procedures, which may not improve the real skill or competency expected to treat the similar clinical situation. Even they make mistakes during problem solving skills training, it's correctable and with

their own pace students can work with simulated patients which is not possible with real patients. These type of training will help the student to develop required skill personally whether real patients available or not. Though this model is very expensive and need special preparation, training and time consuming, when it's used as a learning tool to visualize drug effects during undergraduate training program will definitely improve the quality of training and competencies like problem solving, decision making and interpersonal, drug selection, prescription writing skills expected in the medical undergraduate training.

This study also demonstrated that, pharmacology can be learned in a realistic way using simulated patients not only for one clinical reason but also when there is a change in patient based information's or monitoring the patients vitals for achieving the treatment goal effectively with rationale prescription/ selection of drugs which in turn to value the students responsibility as a future physician. This may motivate the students to learn pharmacology in a systematic way by reading the text books appropriately not only with motive to pass university exam purpose but also equip personally with pharmacological knowledge to solve clinical problems with good drug selection /application skills. by reading text book appropriately.(6) In this study after managing the simulated asthma patient, students were also asked to name the drug with the fastest action in relieving bronchospasm, with its route of administration, based on their experience in the simulated patient, to rate their difficulty in choice of drug and in understanding the clinical parameters used to assess the severity of the clinical problem of the simulated patient and students comfort level (quantitative and qualitative assessment) revealed students improved organizational skills to solve the given simulated patient problem.(6)

Initially 30 students volunteered to participate in the study, but one withdrew. There was a significant improvement in post-test scores for all participants (Figures 3 and 4), but this improvement was especially marked in those students who had scored less than 50% in the initial pre-test (Figure 2). Overall 70% student participants were able to revert bronchospasm within 15 min and 30% took more than 15 min (Figure 5). This method of study closely followed *Kirkpatrick's four levels of assessment* of students learning through simulation method. **(9)**

Level 1: *Assess the simulation training and participant's reaction:*

Initial theory class followed by observing the simulated patient, responsibility to select appropriate drugs in suitable route of administration to reduce the seriousness of the problem with well appreciated learning environment by all the students (Qualitative Analysis)

Level 2: *Improvement in knowledge.* Comparison of pretest and posttest scores (Figures 2, 3 & 4) after students were exposed to simulation, a method to self understand the clinical importance of the given clinical problem solving attitude showed a remarkable shift in the learning outcome in both poor and good performers alike. When pre and posttest scores were compared for poor performers alone, the scores had almost doubled (Figure 2) expressed the need of clinical way of learning pharmacology will provide better understanding of the subject than by memorizing all the Pharmacotherapeutic concepts. **(2)**

Level 3: *Behavioural change or knowledge application in a clinical setting:*

By answering open ended questions, all the student participants were confident, able to

recollect pharmacological principles in the applied format as per the situation or clinical requirement and were able to give a correct prescription (Qualitative analysis).

Level 4: *Impact of simulation training in terms of result:*

Simulation mode improved the learning skills (qualitative analysis) and outcome in terms of marks /knowledge gained (Figures 2, 3 and 4) with an improvement in interpretation of clinical data related to clinical scenario (integrated approach) to select the appropriate drugs to solve the clinical problem (Figure 5).

Studies express that if students are provided with an opportunity to learn in a simulated environment, their learning experience is improved. When they are given an opportunity to observe the clinical effects of the drugs they read about, both their self-learning and their practical skills improve, as a result of moving the students' emotions associated with learning in a positive direction.

High fidelity simulation adopted in this study depends on the type of outcome to be achieved with respect to student's level of learning.<sup>(10)</sup> This study facilitated the 2<sup>nd</sup> professional MBBS student participants to understand and interpret the effects of anti-asthmatic drugs using SimMan 3G – High Fidelity stimulator.

This study also exhibited similarity with *Kolb's learning cycle* and professional competency in learning process as an outcome (Figure - 4, 5) by:

- a) Students experienced the actual medical problem (acute exacerbation of chronic asthma model) given to them through simulation method

- b) Students were able to explore the reasons for the observed clinical problem through recall of their theory exposure
- c) Students were able to recall their knowledge to interrelate and execute plans to stop/overcome the problem exposed to them through simulation
- d) Students were able to apply solutions to overcome/limit the clinical problem given to them using simulation method.

### CONCLUSION:

Hence, this study clearly exhibited the positive role of simulations on changing learning outcome in MBBS professional teaching and training process and showed an improvement in knowledge gained after simulation (Figure 4) with their learning objective.(10,11)Through this study, simulation mode of teaching and learning environment has proved a definite influence on the student mindset for self-learning and kindled interest to teach/learn the subject effectively to achieve the long term goal of clinical application of pharmacological science in undergraduate medical students training. Small sample size of the study participants and questionnaire (quantitative analysis) which is not prevalidated were the limitations of this study.

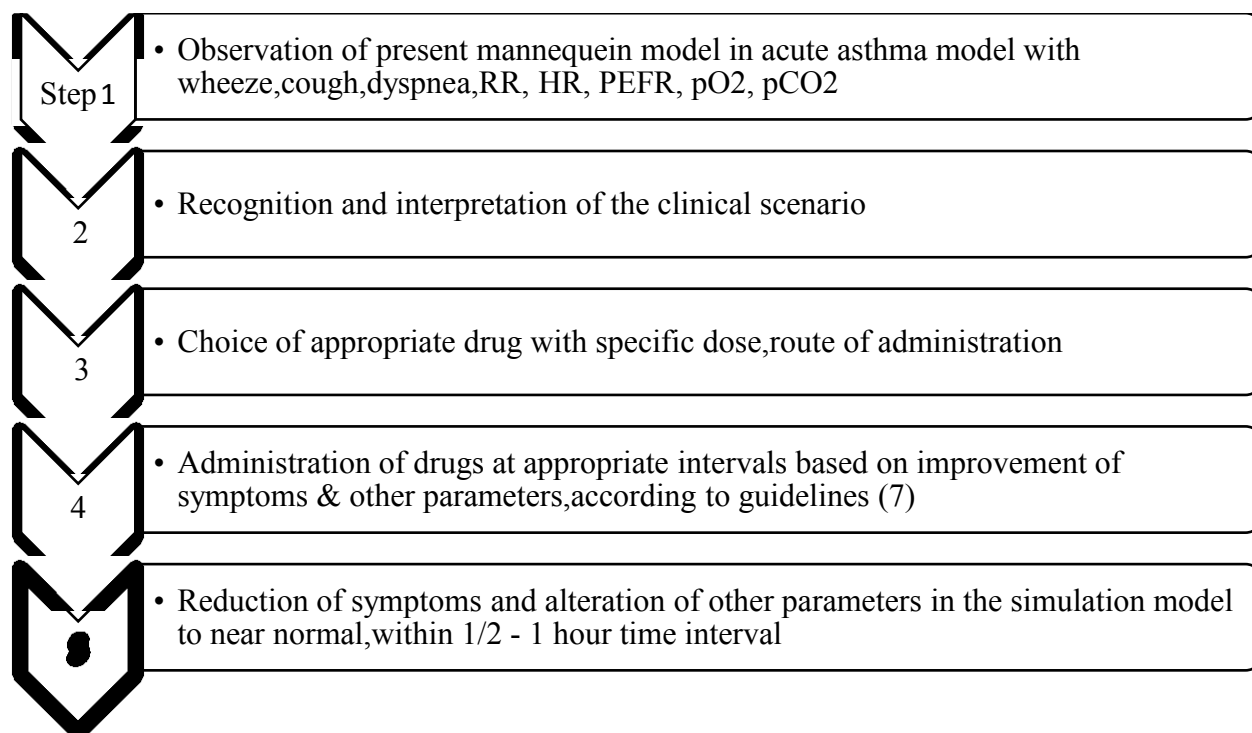
### ACKNOWLEDGMENT:

We express our sincere thanks to the management of PSG Institutions for providing the infrastructure with SimMan 3G High fidelity simulator. Our heartfelt gratitude to the MCI Nodal Centre, Christian Medical College, Vellore, TamilNadu, for their guidance in the design of this project. We also thank the II MBBS student volunteers, The Dean and PSG IMS & R and Hospitals, Centre for Clinical Simulation and Research Lab, Dr. Breetha, of PSG IMS&R, for their help in the execution of this study.

### REFERENCES

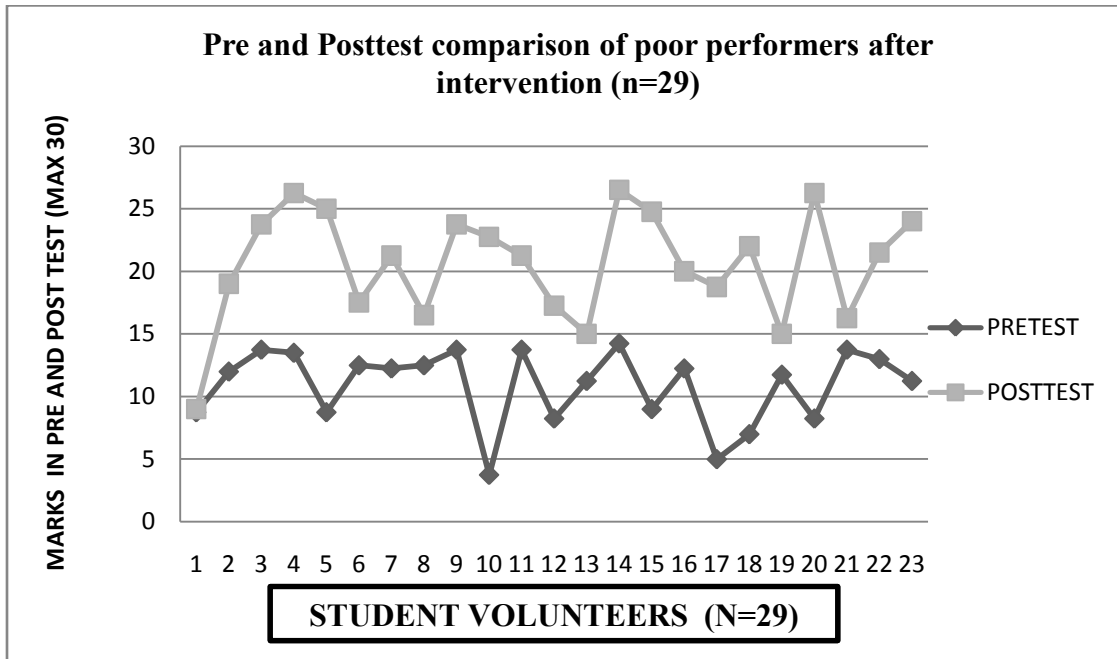
1. Choy SC, Oo PS. Reflective Thinking and Teaching Practices: A Precursor for Incorporating Critical Thinking into the Classroom? Online Submission. 2012; 5(1):167-82.
2. Papanna KM, Kulkarni V, Tanvi D, Lakshmi V, Kriti L, Unnikrishnan B, et al. Perceptions and preferences of medical students regarding teaching methods in a Medical College, Mangalore India. African health sciences. 2013; 13(3):808-13.
3. Fink LD. Creating significant learning experiences: An integrated approach to designing college courses. John Wiley & Sons; 2013 Jul 31.
4. Hertel JP, Millis BJ. Using simulations to promote learning in higher education: An introduction. Stylus Publishing, LLC. 2002.
5. Desai MK, Panchal JR, Shah S, Iyer G. Evaluation of impact of teaching clinical pharmacology and rational therapeutics to medical undergraduates and interns. International Journal of Applied and Basic Medical Research 2016 Jul; 6(3):205.
6. Seropian M, Dillman D, Lasater K, Gavilanes J. Mannequin-based simulation to reinforce pharmacology concepts. Simulation in Healthcare 2007; 2(4):218-23.
7. National Heart, Lung, and Blood Institute. National asthma education and prevention program. Expert panel report. 2007; 3:1-417
8. Munshi F, Lababidi H, Alyousef S. Low-versus high-fidelity simulations in teaching and assessing clinical skills. Journal of Taibah University Medical Sciences 2015; 10(1):12-5.

9. Bates R. A critical analysis of evaluation practice: the Kirkpatrick model and the principle of beneficence. *Evaluation and Program Planning* 2004; 27(3): 341 -347
10. Rodgers DL, Securro Jr S, Pauley RD. The effect of high-fidelity simulation on educational outcomes in an advanced cardiovascular life support course. *Simulation in Healthcare*. 2009; 4(4):200-6.
11. Curtin LB, Finn LA, Czosnowski QA, Whitman CB, Cawley MJ. Computer-based simulation training to improve learning outcomes in mannequin-based simulation exercises. *American journal of pharmaceutical education*. 2011; 75(6):113.

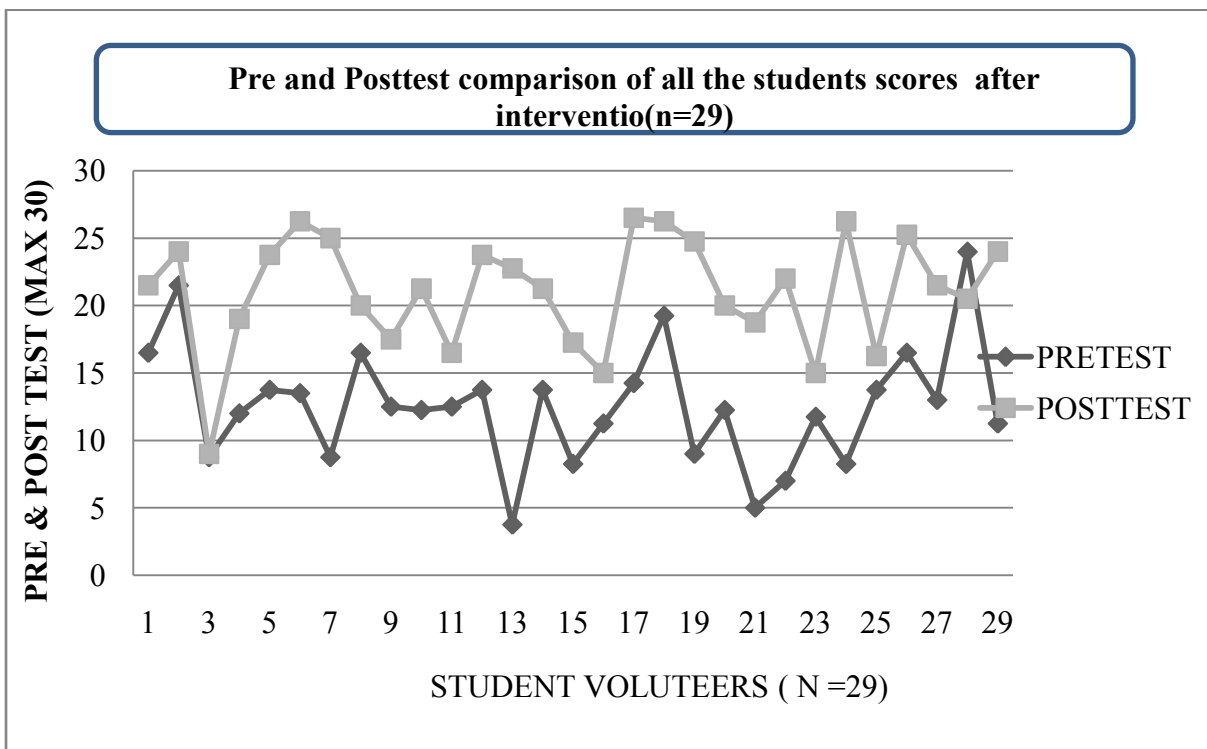




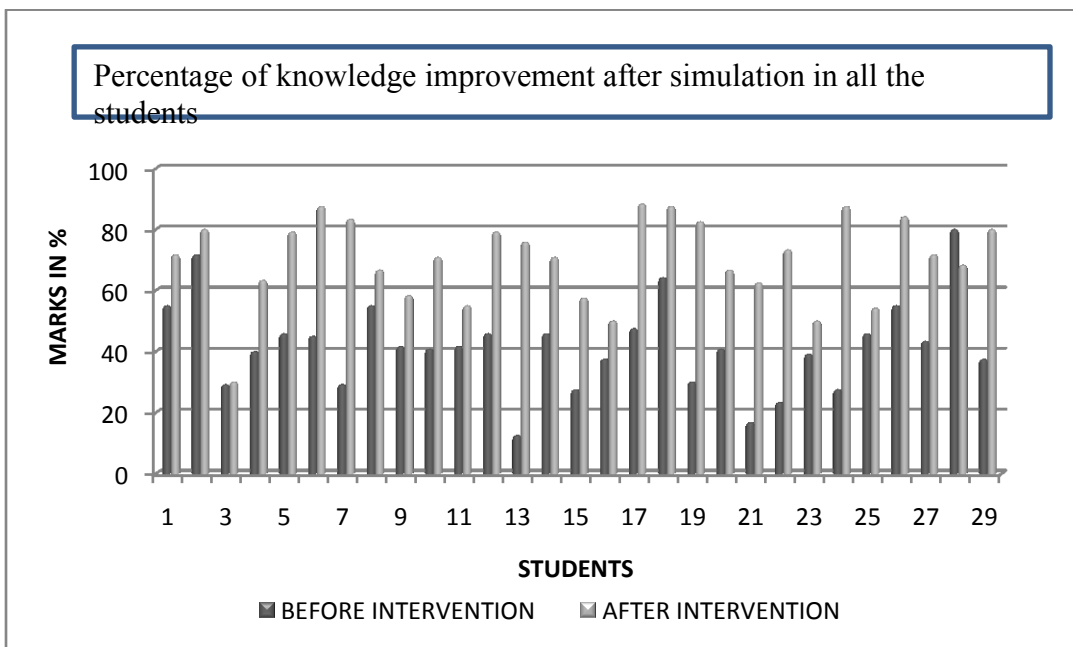
“Figure 1: Computerized case management scenario for Simulator way of Learning”



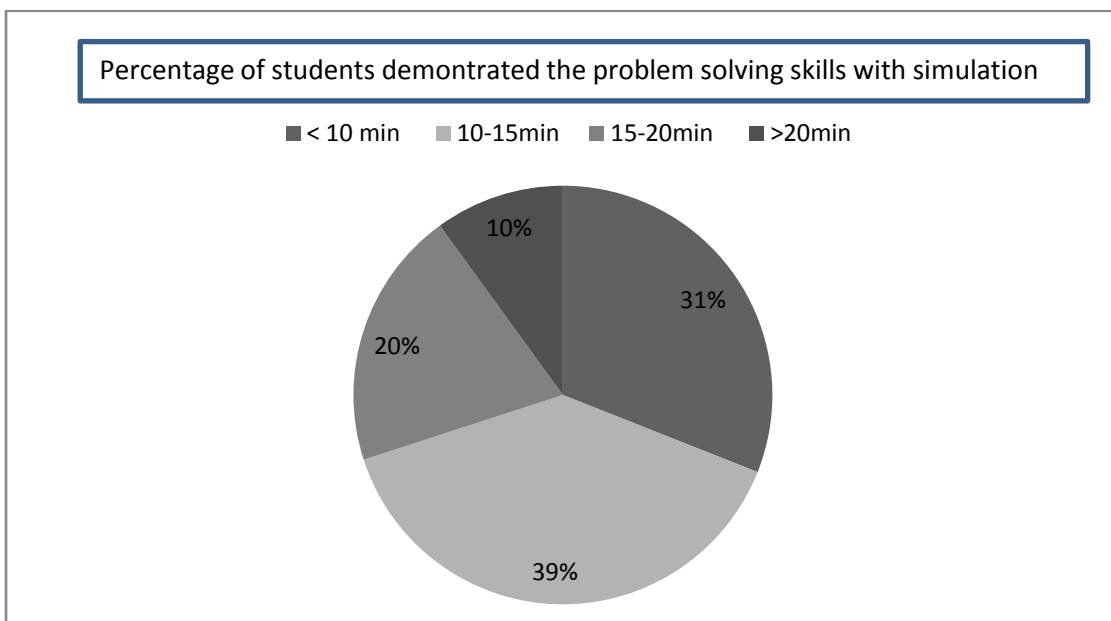
“Figure 2: Simulation influence on learning outcome in students performed with less than 50% in pretest (n=29) [IA]”



“Figure 3: Simulation influence on learning outcome in all the students appeared for pretest (N=29) [IB]”



“Figure 4: Impact of simulation in learning pattern as individual students [IC]”



“Figure 5: Student performance using SimMan 3G-high fidelity simulator]”