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Original Research Article

## Novel strategy of skill lab training for parenteral injection techniques: a promising opportunity for medical students

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### ABSTRACT

**Background:** The aim was to set up an experimental pharmacology skill lab to facilitate training of specific modules for development of core competencies of parenteral drug administration and intravenous drip settings using mannequins for development of skills in administering injections for undergraduate medical students, which will be assessed using objective structured practical examination.

**Methods:** High quality mannequins were procured from reputed companies in coordination with the biomedical engineering department of the tertiary care teaching institution. Sufficient number of multi-venous access arms, buttock injection model and models for subcutaneous and intradermal injections were obtained to facilitate individual training of 150 students in small groups during practical classes according to the checklist for the procedure. Ethical committee approval was deemed unnecessary for this study as it was a part of curriculum development.

**Results:** Students practiced the technique confidently, without the fear doing it in a patient. This gave them the opportunity to practice in a real human surface texture, which gave them better understanding about the depth and extent of insertion of devices. Moreover, they could easily follow the steps in the check list which enabled them to practice as per protocol.

**Conclusions:** Because of the hands-on training the students receive, we have seen a greater trend toward self-learning and better adherence to the injection technique protocol. Hence mannequin-based learning can be considered as very effective in acquiring procedural skills under the new medical curriculum in India. However, considering the high initial investment and further need of constant maintenance, cost effective mannequins need to be introduced and popularized.

**Keywords:** Skill training, Pharmacology, Parenteral drug administration, Mannequin-based learning

### INTRODUCTION

The main purpose of introducing the competitive based medical education in India was to attain observable abilities by the students in a time-dependent, learner centered manner.<sup>1,2</sup> Rather than facts, this curriculum emphasizes on outcomes that are relevant to the daily practice of medicine. The student has the opportunity to learn at his or her own pace, with the ultimate goal of all students successfully achieving competencies regardless of when they do so.<sup>3</sup>

In the traditional model of medical education, learning took place by observation of more experienced colleagues.

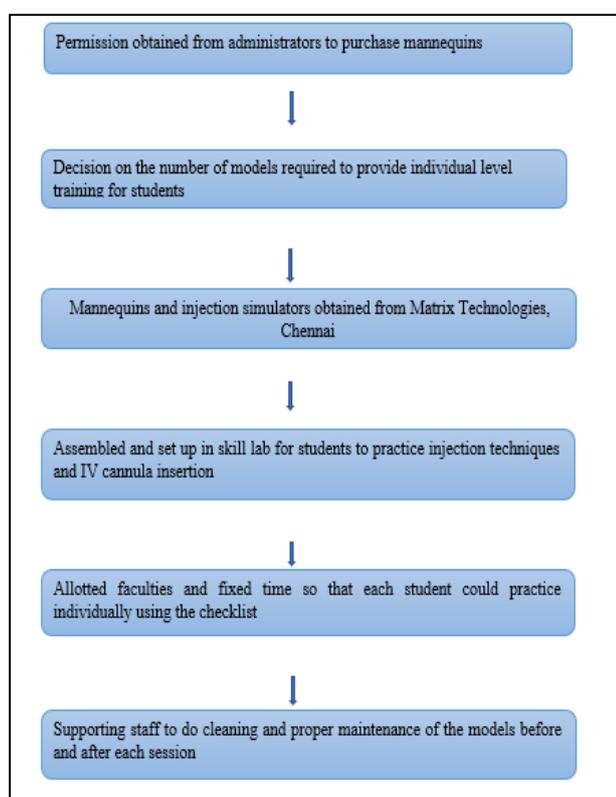
Simulation models creates a realistic clinical experience for students.<sup>4</sup> To improve the quality of care in daily clinical practise, undergraduate medical students should combine basic pharmacological knowledge with the acquisition of clinical skills. In this context, medical simulation is an effective educational tool for training medical students, increasing patient-centered medical learning, and improving aptitude and knowledge.<sup>5</sup> Simulation appears to be valid in the education of undergraduate medical students, as it facilitates the acquisition of clinical reasoning skills and reduces clinical risk for the patient. In fact, simulation provides a relatively realistic setting in which medical students can become acquainted with standardised clinical scenarios and

repeatedly perform practise of procedures without putting patients at risk.

Training based on simulation, particularly the use of high-fidelity mannequins to boost medical training, has played a key role in the teaching of several disciplines in medicine, leading to error reduction and improved safety, as well as in other health professions such as pharmacy and nursing, over the last decade.<sup>6,7</sup>

## METHODS

Immediately after the launch of competency based medical curriculum in India which mandated the use of mannequins for practice of parenteral drug administration skills for undergraduate medical students, our department started discussions with companies which provide good quality mannequins based on recommendations and experience from other institutes.



**Figure 1: The flowchart of setting up the skill lab and plan of execution of training.**

After extensive review of the quality and services offered, we hired a local supplier to provide mannequins within the stipulated time. The models obtained were from Laerdal Medical, Gatesville, Texas venipuncture model and intramuscular IM buttock model and Limbs and Things Ltd, Bristol, UK Intradermal ID and subcutaneous SC injection model. The number of models required were estimated based on the time required for individual training of 150 students which will be divided into 3 main batches of 50 students each. Two hours of practical session

per week per batch was assigned as per the present curriculum. After 30 minutes of debriefing and demonstration session by the faculty, students were given 90 minutes to practice on their own. Assuming two routes of administration would be trained per day, 25 students were be given 45 minutes time at one station. As we had purchased five number of models for each route, one student received an average 9 minutes to get familiarized with the protocol and self-practice. We also delegated non teachings staffs for the proper maintenance and cleaning of the models before and at the end of the practical sessions. The methodology of setting up is given briefly in Figure 1.

We equipped our lab with five sets each of IM, SC and ID and five models for IV drip setting. The total investment for the entire set up was 1322680 Indian Rupees exclusive of taxes. The cost of individual sets is given in table 1.

## RESULTS

With the National Medical Council's implementation of a competency-based curriculum for MBBS education for a competent Indian medical graduate, it is critical to have a performance-based assessment of skills.

**Table 1: Cost of different simulation models.**

S. no.	Item	Quantity	Price per quantity	Total
1.	Advance venipuncture and injection arm	5	52390	261950
2.	Intramuscular injection model	5	190298	951490
3.	Subcutaneous and intradermal injection model	5	21848	109240
<b>Total Indian Rupee</b>				<b>1,322,680</b>

With the use of mannequins and models for practice of parenteral drug administration and IV drip setting, the students could practice these skills with confidence without having the fear of performing on a patient. It also gives them the freedom to practice several times till they become confident with the technique. It also easy to identify the mistakes committed by the student during practice sessions by the faculty and suggest immediate remedial measures. It was also observed that the students exhibited more interest in experimental pharmacology and

showed greater tendency to repeat practice. Provided the faculties adhere to the time allotted for each student (approximately 9 minutes per student) for individual training, this method is ideal to be followed compared to traditional method of video lectures and practicing on smiley balls for intramuscular route and cotton filled glove (for intravenous route).

Even though the use of mannequin is feasible from both the student and faculty point of views, considering the huge initial investment and recurring cost of replacing the sheaths which have wear and tear due to repeated injections, it might not be feasible for all colleges to set up labs using such sophisticated mannequin models. Cost effective measures can be adopted to assemble locally available items to develop similar models, which is again labor intensive and time consuming. This method of skill lab training also requires sufficient number of faculties and demonstrators to monitor the students individually and also for group training and demonstrations.

The students gave us positive feedback on these simulated sessions. These trainings have enlivened the experimental pharmacology understanding on drug administration routes, and it was a unique experience for both faculty and students.

## DISCUSSION

The conventional method of teaching parenteral routes of administration in our pharmacology department was using smiley balls and cotton filled gloves as mentioned above. Even though it involved both cognitive, psychomotor and affective domain, the difficulties in explaining the importance of the anatomical landmarks and identifying them was a major limiting factor and also the students didn't get the feeling of doing it in a patient setting.

With the use of mannequin models, the students could perform repeated hands-on practice for skill development. We have a standardized assessment protocol for parenteral drug administration using OSPE which have been in use since 2015. Because they are made aware of the task's steps and the standards required for proper performance, the students not only "know how", but can also "show how" to perform an injection in a model. Moreover, individual steps could be well demonstrated because of use of blood-like aspirate, for example- pulling back the plunger to see bloody aspirate before injecting medication.

The teaching and learning techniques used determine the success of knowledge dissemination.<sup>8</sup> As a result, performance-based teaching techniques have been used in health care education for several decades. Hence the assessment methods for these teaching techniques, as well as their psychometric characteristics, have been established and thoroughly evaluated.<sup>9</sup> Written clinical simulations, computer-based clinical simulations, oral examinations, standardized patients, and mannequin-based patient simulators are among the few commonly

used teaching methods.<sup>10</sup> With the rapid advancement of electronic and computer technologies, these techniques are rapidly evolving. As a result, traditional teaching methods such as didactic lecture are becoming less popular. More colleges and universities prefer to convey information through student-centered approaches or performance-based learning. These teaching methods are thought to boost student motivation and self-learning strategies.<sup>11,12</sup> As a result, these will have a direct impact on the success of knowledge transmission. In medical undergraduate education, simulator-based learning has been considered as a powerful educational tool.<sup>13,14</sup> Simulation-based learning allows students to put their theoretical knowledge into practice in a nearly realistic scenario.

Several studies conducted in the past has reinforced simulation as a better choice in learning experimental pharmacology compared to traditional methods, both computer as well as patient simulation.<sup>15,16</sup> The study conducted by Arcoraci et al has substantiated that simulation when incorporated in teaching pharmacology resulted in more effective learning and long-lasting retention compared to lecture alone.<sup>16</sup> Similar results were pointed by Lavanya et al regarding mannequin based learning.<sup>17</sup> The medical students have also come forward with the suggestions that more such simulation based learning can be incorporated into the curriculum for better training of psychomotor and affective domains.

However, the major impeding factor in the establishment of skill labs in several institutions is the cost factor. These require an initial high investment and a certain recurring amount for maintenance with continuous use. Hence it is critical to implement cost effective measures. Mani et al has demonstrated a cost-effective method of setting up mannequin models for different parenteral routes in her research.<sup>18</sup>

## CONCLUSION

As students are provided with more opportunities to develop their competencies, we've noticed a rising trend towards self-directed learning and self-efficacy. Aseptic practices, sterile technique, and infection control methods are all practiced, performed, and evaluated in the skill lab. Hence a good understanding of simulation technology and cost-effective purchases can help in establishment of skill labs in all medical colleges cost effectively as per the new competency-based curriculum. The skill lab training can also be utilized for nursing and other paramedical students to develop their competency.

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