

STUDENT-CENTERED APPROACHES TO TEACHING INJECTION SKILLS: INTEGRATING COMMUNICATION, VIDEO DEMONSTRATIONS AND MANNEQUIN PRACTICE

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ABSTRACT

Objectives: The objective of the study was to assess the effectiveness on video-based demonstration of injection procedural skills (Intramuscular [IM], Intravenous [IV], Intradermal [ID]) using mannequin and the performance of Phase II MBBS students.

Methods: Phase II MBBS Students were taught about the steps in skill development of injection techniques (IM, IV, ID). Video demonstration of the injection procedure was done initially following which the facilitator demonstrated the same using the mannequins and students were allowed to practice individually under the guidance of facilitator. In internal assessment examination (IAE) 1 direct observation of procedural skills (DOPS), injection techniques (IM, IV, ID) were evaluated by the facilitator using data collection form and to analyze the effectiveness of the video-based demonstration feedbacks were also collected from the students. Remedial actions were taken based on the performance of students and feedback collected. Then, DOPS was evaluated again during IAE 2 and IAE 3 by the facilitator using a data collection form.

Results: One-way analysis of variance analysis showed that there is a statistically significant improvement in the scores of the second and third practical internal assessment with the $p < 0.001$.

Conclusion: This study has shown that the video-based demonstration and recommendations implemented had helped the students in overcoming the mistakes and had shown improvement in their performance.

Keywords: Students-centered, Communication, Mannequin injection procedure, Intramuscular, Intravenous, Intradermal, Video demonstration, Phase II MBBS students, Direct observation of procedural skills, Competency-based medical education.

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INTRODUCTION

Mannequin-based simulation training is an established healthcare technique that has been in use for almost 2 decades, but its integration into medical school curriculum as a major part has started recently when competency-based medical education (CBME) came in play [1]. The Medical Council of India/National medical commission (NMC) regulations on Graduate Medical Education, the curriculum is made competency-based and is implemented in all medical colleges of India from August 2019 [2].

In the current CBME curriculum with lots of modifications in the curriculum, it is mandate to make the MBBS students a competent Indian medical graduate [3]. CBME curriculum has curated various competencies to be attained in the particular phases of the undergraduate (UG) curriculum. Acquiring basic procedural skills is one such competency required for a phase II medical graduate to ensure patient safety.

The competency mentioned is "Describe various routes of drug administration, for example, Oral, Subcutaneous, Intramuscular (IM), Intravenous (IV), Sublingual (PH1.11)" Although oral drug delivery remains the most common and preferred route for delivery of many drugs, it suffers from several important drawbacks such as enzymatic degradation along the gastrointestinal tract, first-pass metabolism, delayed onset of absorption and sometimes poor absorption. These defects necessitate the importance of designing alternative dosage forms to be administered through alternative routes [4]. The route of drug administration plays a major role in the attaining appropriate therapeutic concentration. The drug concentrations in the blood are determined by the amount of medicine delivered into the circulation from the delivery mechanism [5].

In the new CBME, skill performance using mannequins has been added as mandatory by the NMC. Acquiring basic procedural skills is one of the competencies required of a medical graduate for ensuring patient safety [6]. A mannequin simulation is an easiest and safest way to learn and practice different routes of parenteral administration without harming human volunteers [7]. Our department of pharmacology and therapeutics teaches and assesses the skill performance using mannequin in the students for the past 5 years. Mannequin-based simulation training may help in the developing procedural skills and better understanding of the skill. We also used video-based demonstration of the injection procedure for better understanding of the students. This study is to ensure whether the Phase II MBBS students perform all the steps of the injection procedure (IM, IV, Intradermal [ID]) in the mannequin skill station (direct observation of procedural skills [DOPS]) using a pre-validated checklist and analyze the effectiveness on video-based demonstration and injection procedure skill using mannequin as a teaching-learning method from the student perspective using feedback questionnaire.

METHODS

A Prospective study with a study period of 6 months (June-Nov 2023) including 257 Phase II MBBS students attending practical internal assessment examinations (IAE) in PSG IMSR, Peelamedu, Coimbatore. Permission to conduct this study will be obtained from Institutional Ethics Committee and the head of the institution (Approval No: 23/256).

Phase II MBBS Students will be taught about the steps in skill development of injection techniques (IM, IV, ID) using mannequins as a part of UG curriculum. During the practical hours, the students

appeared in 4 batches of 60–65 in each batch (A, B, C, D). Initially, students documented the steps of injection techniques (IM, IV, ID) in their practical records. Following which video demonstration of the injection techniques was done, and then facilitator also demonstrated the same using the mannequins. Then students were allowed to practice individually under the guidance of the facilitator to get familiarized with the steps for all three injection procedures.

During the first internal assessment before the DOPS examination, informed consent regarding the study on video-based demonstration and performance of skill development using mannequins was obtained from the students. All students were assessed for the performance of mannequin skill station for all three injection procedures randomly during the DOPS examination using the pre-validated checklist by the examiners. After their first practical IAE 1, feedbacks from the students on video video-based demonstration were collected using the validated questionnaire. Based on their performance and the feedback consolidations from the student's perspective on the video-based learning technique on mannequin skills, various remedial actions were initiated.

Following which, in successive second and third practicals, IAE 2 and 3 Phase II MBBS students were evaluated for performance on injection procedural skills (IM, IV, ID) using mannequin. The data of all three practical internal examination scores were entered in the Excel sheet and analysis was done using one-way analysis of variance (ANOVA) to find the statistical significance.

RESULTS

In one-way ANOVA method, it was found that statistically significant improvement was obtained in the scores of second and third practical internal assessments with $p < 0.001$ (Table 2) The mean with standard deviations of IAE 1, 2, and 3 are 8.06 ± 2.25 , 8.95 ± 2.12 , and 9.20 ± 1.38 , respectively.

DISCUSSION

In this study, video-based demonstration and performance of skill development using mannequin in Phase II MBBS students were assessed in the Practical IAE 1. The performance of the students in demonstrating the steps in the DOPS was assessed individually by the Facilitator using the Data Collection Form. The data were documented in Excel and were analyzed by suitable statistical method.

From the analysis, Out of 249 attended, 39% of students were able to perform all the steps correctly and 61% were unable to perform all the steps correctly, 91% of students were able to perform the step 1 correctly and 9% were unable to perform the step 1 correctly. About 91% of students were able to perform the step 2 correctly and 9% were unable to perform the step 2 correctly. About 86% of students were able to perform the step 3 correctly and 14% were unable to perform the step 3 correctly. About 82% of students were able to perform the step 4 correctly and 18% were unable to perform the step 4 correctly. About 66% of students were able to perform the step 5 correctly and 34% were unable to perform the step 5 correctly.

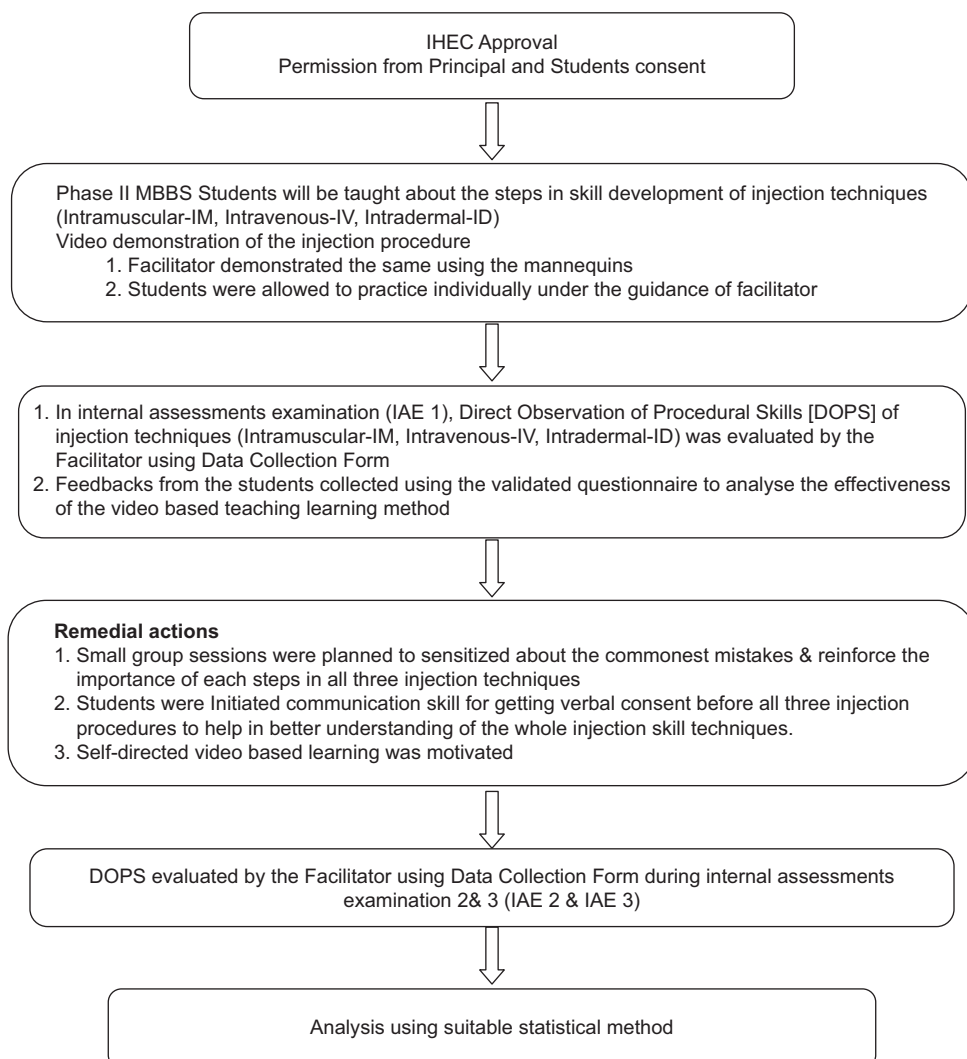


Table 1: Feedback analysis of learning through video-based mannequin techniques on injection procedures from student perspective

Sl. No	Feedback questions	Very highly effective (%)	Highly effective (%)	Moderately effective (%)	Least effective (%)	Not effective (%)
I	Teaching					
1	Clarity of the video content used for teaching	51	42	6	0.8	0.4
2	Organization and alignment of the content	57	34	5	0.8	0
3	Key steps were emphasized during the session	67	30	13	0.4	0
II	Understanding					
4	Able to remember the steps in checklist with the video demonstration correctly	63	29	7	1	0
5	Able to understand the choice of anatomical site suited for the specific route of drug administration	67	27	5	2	0
6	Able to understand the angulation of the needle suited for the specific route of drug administration	67	26	6	0.8	0
III	Performance					
7	Able to follow the steps in sequence from video demonstration while performing on the mannequin	61	32	6	1	0
8	Able to locate and select the correct anatomical site for the injection	65	27	8	0.4	0
9	Able to perform the injection procedure with accurate angulations of the needle for the specific route of administration	58	29	10	2	0
IV	Overall					
10	Rate the overall effectiveness of Video based learning method for skill demonstration in mannequin	64	29	6	0.4	0
11	Rate the extent to which the difficulty level in performing the skill is reduced by video demonstration of the technique	47	41	6	4	3
12	Rate how confident are you in performing this skill in actual patient setup	37	45	14	3	1

Table 2: One-way ANOVA of internal assessment scores

ANOVA					
Source of variation	Sum of squares	df	Mean square	F	Sig.
Between groups	183.326	2	91.663	23.992	<0.001
Within groups	2934.226	768	3.821		
Total	3117.551	770			

ANOVA: Analysis of variance

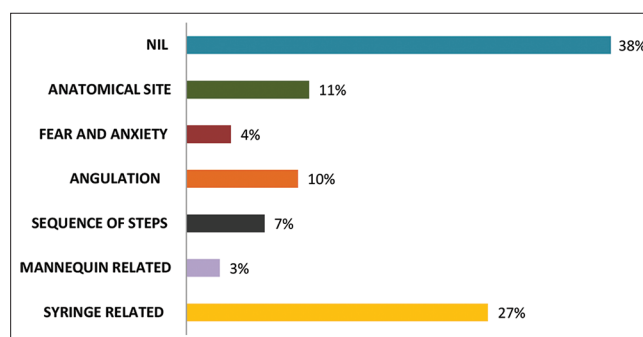
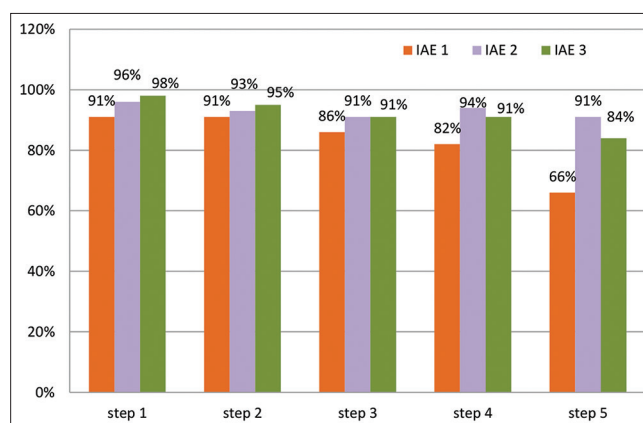
The commonest mistakes encountered in step 1 are aseptic precautions were not followed, air bubbles were not checked before injecting, 1 mL of drug was taken for ID injection (9%), in step 2 anatomical site identification was not done properly (9%), in step 3 angle was not correct (14%), in step 4 of IV injection withdrawing the plunger to check if it is in vein was not done (18%), in step 5 of ID injection circle mark around the injection site was not done. Feedback from the students for video-based demonstration as teaching method was collected to assess the effectiveness of the teaching method (Table 1).

From the analysis, it was found that the students were not able to perform the fine skills like (Fig. 1).

- IM, IV, ID: Angulations technique, removing air bubbles before injection, demonstration of anatomical site
- ID: Withdrawal of appropriate volume of drug from the vials, circle mark around the injection site as the last step
- IV: Withdrawal of the plunger to check for the backflow of the blood to confirm the needle in plane.

To overcome all these mistakes and to improve the performance of the students recommendations were included as mentioned below.

1. Small group sessions were planned to reinforce the importance of each steps in all three injection techniques
2. Students were sensitized about the commonest mistakes (not following aseptic precautions) that they have done during the practical examination
3. Interactive session was followed with the students to know their perspectives

**Fig. 1: Difficulties perceived by the students which contributed to the initiation of remedial****Fig. 2: Stepwise performance of Phase II MBBS students in injection procedures (Intramuscular-IM, Intravenous-IV, Intradermal-ID) in first, second, and third practical internal examination in %**

4. Initiated communication skill for getting verbal consent before all three injection procedures to address the students attitude aspects

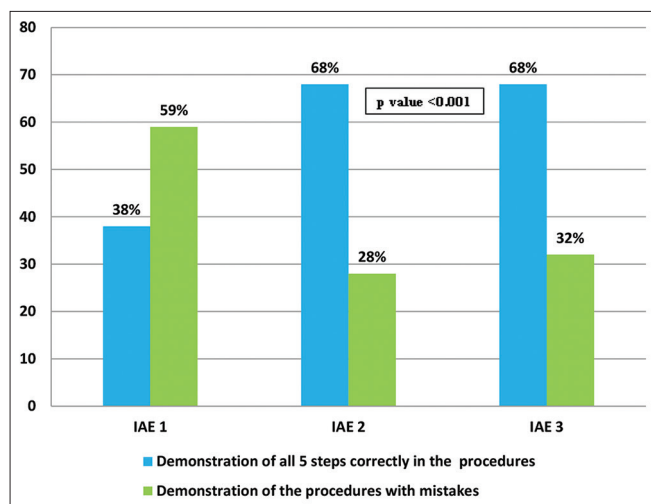


Fig. 3: Phase II MBBS student's performance of all steps of the injection procedures using mannequin skill station (direct observation of procedural skills [DOPS]) in the first, second, and third practical internal examination

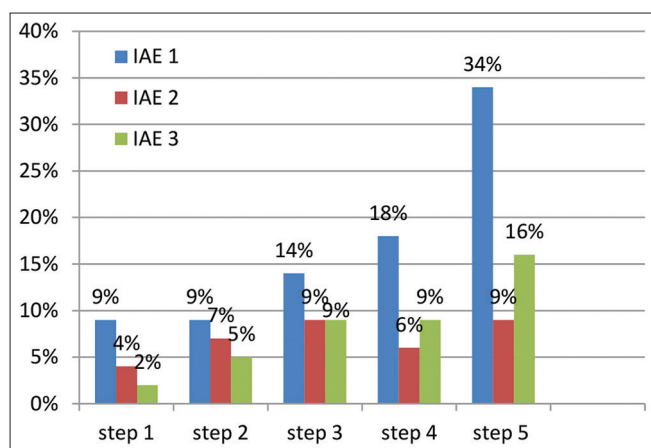


Fig. 4: Students improvement in each step of directly observed procedural skill (DOPS) using mannequin conducted during IAE1, 2, and 3. IAE: Internal assessment examination

which contributed in understanding of the whole injection skill techniques

- Self-directed video based learning of all three injection techniques were conducted for all batches in small group to overcome the students inability in performing fine skills. They were allowed to practice individually under the guidance of the facilitator
- Department also ensured that revision on injection techniques will be conducted before every internal assessment.

Since this skill-based training in pharmacology is a useful tool for the students to understand the various route of administration of a drug and injection procedure techniques, these recommendations were implemented and the progress of the student's performance was evaluated in the successive practical IAE 2 and IAE 3. From the evaluation in successive practical examinations, it was found the

recommendations had helped the students in overcoming the mistakes and had shown improvement in their overall and stepwise performance (Fig. 2).

The percentage of mistakes had reduced in each step which showed overall improvement in their performance in injection procedures. In IAE 2, after the implementation of recommendations, the performance of students in injection technique procedure had shown overall improvement in the performance (Fig. 3) and decrease in the stepwise mistake is depicted in the bar graph (Fig. 4). And also, IAE 3 was evaluated to check for the long-term effectiveness of video-based demonstration of injection technique procedures and the performance of students. It had also shown appropriate results were the percentage of mistake in the injection technique (IM, IV, and ID) procedure was reduced.

CONCLUSION

Thus, video-based demonstration of injection procedural skills (IM, IV, ID) using mannequin, along with implementation of communication and appropriate remedial actions has shown to be effective in the performance of Phase II MBBS students.

AUTHOR CONTRIBUTION

All the Authors contributed equally to the study.

CONFLICTS OF INTEREST

No conflicts of interest.

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IHEC APPROVAL CERTIFICATE NO

23/256.

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