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Hands-On And Mobile App-Based Training Of Second Phase MBBS Students Regarding Blood Sample Collection For Routine Tests And Culture

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Abstract
Background
Aseptic measures during blood sampling should be strictly enforced as identification of the true pathogen can act as life-saving measure in patients. Contamination during collection can produce erroneous results which can lead to unnecessary antibiotic usage. Thus, adequate training must be imparted so that the MBBS students can learn the correct technique and develop appropriate skills. This pre-post interventional study thus assessed the students' and faculties' perception on venous blood sampling through hands on exercises on a simulated model and learning through digital module among MBBS students.
Methodology
The knowledge of the students was assessed through a questionnaire while practical skills through OSPE using a pre-validated checklist in the pre-intervention phase. The intervention comprised of students being trained in small batches regarding blood sample collection on a mannequin followed by biomedical waste disposal and spillage management. A digital intervention module for self-directed learning was shared with the students to reinforce their learning. This was followed by post interventional assessment of theoretical knowledge and practical skills.
Results
Paired sample t-test showed a statistically significant improvement in the knowledge scores and OSPE skills in the post-intervention phase. About 91% students opined that they were well trained. All the faculty opined that this training was immensely useful to students for future practical applications.
Conclusion
The current study demonstrated effectiveness of intervention among the medical students under the new curriculum through hands-on and digital module-based training on accurate blood sampling procedure.
Keywords: *Blood collection, OSPE, Mobile app-based training, MBBS students, interventional study*

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I. Introduction

Blood sample collection is an important procedure for performing routine investigations and blood culture procedure for the diagnosis of septicaemic conditions. Medical interns are at the forefront of collecting blood samples in various clinical wards during their MBBS tenure. Although, learning the correct technique for blood sample collection is essential for them. training of the students on this aspect is not routinely imparted in

the curriculum. Hands-on training in a laboratory on a mannequin and reinforcement of training through mobile apps must be introduced to the students. The different steps if not learnt properly, can increase the risk of needle stick injuries which in turn can lead to grave consequences on the part of the collector. In addition, aseptic measures should be strictly enforced during blood sample collection as identification of the true pathogen could help to save the life of the patient. Contamination during collection can produce erroneous results causing unnecessary antibiotic usage.[1] It might prolong the length of patient's stay and likely to increase patient morbidity and treatment costs. Thus, the importance of correct technique and steps for blood sample collection should be emphasized in the curriculum.

Venous blood sampling is probably the most common invasive procedure in health care. However, there is a potential risk for the safety of the patients too during this manoeuvre.[2,3,4] Blood sample collection needs accuracy, responsibility, and necessary manual skills. Good theoretical knowledge is a must for all medical students before undertaking this invasive procedure as the errors committed during blood sample collection can often go unnoticed as these are latent and distant from the direct control.[5,6] So, the procedure needs to be taught appropriately so that the students are able to implement it successfully.

Blood culture is still the gold standard for the diagnosis of blood stream infections (BSI). The diagnostic outcome depends on some clinical and technical factors which has impact on sample collection and transportation. Monitoring the entire pre-analytical procedure from blood collection to transportation to the microbiological laboratories is vital. BSI is a potentially life-threatening condition where the case fatality rate may be as high as 30%–40%.[7,8] Rapid and accurate diagnosis of is a necessity to start appropriate antibiotic therapy (within 24–48 hours). This produces positive effects on the patient outcomes as it helps to reduce mortality and treatment costs. It may even prevent the development of antimicrobial resistance which is a burning issue nowadays.[9] The entire procedure of blood sample collection, especially regarding blood culture collection, must be carefully standardized. A complete checklist of items related to the pre-analytical steps must be pre-defined. A contamination rate of 3% is generally considered the maximum acceptable value for blood culture sample collection.[10] Proper hand hygiene must be ensured using a hydro-alcoholic preparation to reduce the risk of contamination.

The total procedure of blood sample collection from preparation of the patient before collection to disposal of biomedical wastes following collection and blood vial/ culture bottle preservation needs to be discussed under small group discussion. There is integration of Affective, Cognitive and Psychomotor domains in implementing this procedure under the new medical curriculum.[11] Inadequate management of waste produced in health care facilities causes direct health hazards on the public, the health care workers and on the environment. There is an obligation for the supervision of biomedical waste to abate the risk of contamination outside the hospital for waste handlers, scavengers and those living in the locality of hospitals. Management is also required due to the risk of air, water, and soil pollution. Poorly handled and discarded sharps – needles, scalpels, used glass plates – can cause serious injury and spread pathogens, including potentially serious infections like Hepatitis B, Hepatitis C, HIV, MRSA and other antibiotic-resistant strains. So, the MBBS students should be made aware of proper segregation and disposal of biomedical wastes at the point of generation to avoid the associated health hazards and protection of community.[12]

II. Objectives

1. To conduct training of second phase MBBS students regarding blood collection technique through hands-on exercises on mannequins.
2. To develop a digital module for learning blood sample collection techniques
3. To assess students and faculty perceptions about the learning using digital module
4. To record the perceptions of the students and faculties involved in the training activities, regarding the training package.

III. Methodology

This single arm pre-post interventional study was conducted among second phase MBBS students of College of Medicine and Sagore Dutta Hospital situated in Kolkata, West Bengal. Participants who did not give written informed consent were excluded from the study.

Sampling

There were 130 MBBS students who were studying in second phase of MBBS curriculum in the study institution. All the MBBS students who were studying in the second phase MBBS curriculum in the selected institution were included in the study. Thus census (complete enumeration) method was applied to the study

Data collection, study procedure and parameters used

Participation in the study was voluntary for the students. Students gave written informed consent before the sensitization session. The training was imparted by the researchers so that all the students were uniformly exposed to the same trainer.

At first, the knowledge regarding blood collection technique was assessed by a pre-designed, pre-tested and validated questionnaire. The mode of testing the theoretical knowledge was through MCQ based questionnaire, carried out online through a Google form. The skills regarding blood sample collection were assessed with the help of an objective structured practical examination (OSPE) by the faculties with the help of a checklist. The items in the OSPE were developed in concurrence with an expert group in the field of study.

During the intervention, the students were trained with the help of a predesigned module through small group discussion in five batches of 25 students in each batch to impart theoretical knowledge. Then the hands-on practical training on a mannequin in a skill lab was imparted in even smaller batches of 12 – 13 students in each batch. The detailed steps were demonstrated twice by the researcher on the mannequin. Then, the students were asked to show the procedure one by one under the guidance and supervision of the faculty members. The practical knowledge of the students was reinforced through mobile app delivered digital module (containing the venepuncture module; one video demonstrating venous blood sample collection on simulated patient for routine tests and culture and another video on spillage management) for self- directed learning. This module was accessed digitally by each student.

Following completion of the training package, the skill level of the students was assessed by administering the same questionnaire (for assessing theoretical knowledge), simultaneously to all the students online within definite timeframe through a Google form. OSPE framework (practical knowledge) was assessed by core group faculties with the checklist provided to them for evaluating the post-intervention knowledge. Thus, affective domain, knowledge and skill was evaluated separately before and after intervention. The measurements were subjected to a pre-post comparison in order to understand the effect of the intervention proposed.

Lastly, feedback was taken from both the students as well as the faculty involved in the whole training process. The feedback was obtained with the help of a structured feedback form prepared on a four-point Likert-type scale.

Ethical issues

The study was approved by the Institutional Ethics Committee of the College of Medicine and Sagore Datta Hospital, Kolkata. Written informed consent were taken from the study participants prior to the conduction of the study. They were assured that data collected from the participants would be kept confidential.

Data analysis

Statistical data analysis was performed with the help of Microsoft Excel (v.2019) and SPSS (v. 16 IBM Corp. USA). Appropriate descriptive statistics were used as applicable. Continuous variables were described as mean (± standard deviation) or median with interquartile range. Chi-square test was utilized to find the difference in the pre-test and post intervention of knowledge categories, Paired t-test was utilized to find the differences in the pre and post intervention scores in the knowledge as well as the OSPE domains.

IV. Results

The mean scores in the knowledge section in the pre-intervention phase was found to be 8.39 ± 2.04 while that in the post-intervention phase was found to be 9.40 ± 1.87 which show that there was a statistically significant improvement (t-test=4.026, df=244, $p<0.001$) in the knowledge scores among the study participants. Few of the responses showed significant results notably - Blood sample for blood culture is done in which media – (p value< .01), How to dispose syringe-needle – (p value 0.000) and Sample for Serological test should be collected in - (p value <0.01) [Table 1]

The mean total scores in the OSPE analysis in the pre-intervention phase was 17.17 ± 1.51 and the post-intervention scores showed a mean value of 17.57 ± 1.54. There was a statistically significant improvement in the OSPE scores after the intervention. (t-test= 2.95 $p<0.005$) Some of the responses showing significant p value were – Adequately expose the patient's arms for the procedure, Cleansing in a circular fashion, beginning at the site and working outward, Donning gloves (not latex), Disposing of the needle into a sharps container after cutting the needle & syringe in a needle & syringe cutter and Explaining to the patient that the procedure is now complete and that they should seek review if the venepuncture site becomes painful or inflamed

Student feedback on the digital module:

The overall score came as 68.69% in Likert scale 4, 28.37% in Likert scale 3, 3% in Likert scale 2 and 0.3% in Likert scale 1. So, the overall positive feedback given by the students is 97.06%. The students (99.1%) perceived that the contents of the module are appropriate. The digital module would help students to take proper

aseptic measures especially for collection of culture samples as revealed by 94.6%students. The blood collection steps conveyed proper knowledge in 99.1% students. About 91% students were confident with their training skills. [Table 2]

Faculty feedback on the digital module

The overall score came as 83.33% in Likert scale 4 and 16.66% in Likert scale 3. The contents of the digital module was appropriate as expressed by 100% faculty. They (71.4%) have perceived that digital module would help students to take proper aseptic measures especially for collection of culture samples. About 71.4% faculty revealed that blood collection steps discussed in the module would convey proper knowledge to the students. The training package would go a long way to make good IMG as expressed by 100% faculty. [Figure 4]

V. Discussion

Blood sampling is probably the commonest invasive procedure in health care.[13] This required using the correct technique, learning the appropriate steps and skill on the part of the health care professionals. Adequate training must be imparted so that the MBBS students are able to implement it successfully. The diagnostic outcome especially for blood culture depends on the accuracy of sample collection and transportation.[14] Proper precaution should be ensured to prevent contamination [1] during collection and prevent needle stick injury on the part of the sample collector. There is an integration of affective, cognitive and psychomotor domains in implementing this procedure under the new medical curriculum. [11]

The objective of this study was to assess the students and faculty perception on venous blood sampling through hands on exercises and learning through digital module. The theoretical knowledge of the students was assessed through questionnaire shared through Google link and practical knowledge through OSPE with a pre-validated checklist as a part of pre-intervention study. A digital module on venipuncture consisting of two videos; one on venipuncture on simulated patient and another one on spillage management; the third one was a module to learn the theoretical aspects of venipuncture; the links for the above three was shared to the participating students. The students were trained in small batches regarding blood sample collection on a mannequin followed by biomedical waste disposal and spillage management also. The study results showed that there was a significant improvement in the theoretical knowledge and the OSPE scores upon giving the training intervention

Students commented that the total module imparted good knowledge and helped them to learn the accurate steps of venipuncture. They liked the following components of the module namely -hand hygiene part, steps of the procedure, spillage management, biomedical waste disposal, prevention of needle stick injury and correct order of blood drawing for different tests. They remarked that they have learnt the infection control methods and guidelines for trouble shooting which they liked. The diagrammatic representation and the videos have cleared their doubts and helped them in better understanding of the procedures. They have also learnt the ethics and professionalism by knowing to greet the patient and considering them as a family. Some students even perceived the whole module as very useful without any suggestive modifications.

Few students remarked that the sound quality of the video was not so good and there was the issue of echoing. Few students wanted more sessions especially on real patients instead of mannequins. Few students expressed that venipuncture on babies should have been elaborated. Overall, the students felt better equipped to address patient needs. They also felt that their fears are allayed during such practical procedures on patients.[15] Students showed improved performance in terms of correctness and professionalism in the procedural delivery of blood sampling. Similar study had been reported by Nagy *et al* in their pre-post communication and procedural skill training during blood sampling on mannequin to simulate real life clinical procedure.[16] The students showed marked improvement in the pre-post difference analysis following intervention. There was another study on pre-post vaccination safety perception among students which showed significant improvement post intervention ($p<0.001$).[17]

Faculties perceived that the total procedure in step wise manner was well explained in the module. They all opined that this training would immensely help the students for future practical applications. One faculty said that the quantity of blood required for individual tests should have been mentioned. Still others commented that no further improvement was required for the module. Faculty' perception of utilization of learning resource material in a study by Parvati Patel *et al* showed that majority of faculty said that course content of e-learning module was informative and logically structured (100.0%), clearly explained and consistent with the learning objectives (93.8%) and could achieve the stated learning objectives (93.8%).[18]

VI. Limitations

Due to unavailability of multiple venipuncture models and less time available to conduct more sessions within limited time, it was not practically possible to conduct more hands-on training for the students. Another limitation was the quality of sound in the videos which was not very good as perceived by few of the students. Better equipment would have helped but could not be arranged that due to monetary reasons.

VII. Conclusion

The current study demonstrated effectiveness of intervention study among the medical students under the new curriculum through hands-on and digital module-based training on accurate blood sampling procedure. The students (99.1%) perceived that the contents of the module were appropriate and the digital module would help them (94.6%) to take proper aseptic measures. The students conveyed that blood collection procedure imparted proper knowledge in 99.1% students. About 91% students were confident with their training skills. There was improved knowledge, skills, and attitude of the medical students in this pre-post intervention study with long term benefits. Thus, the simulation-based exercises on different aspects of medical curriculum would encourage the undergraduate students for better participation with good knowledge retention. There would be integration of affective, cognitive and psychomotor domains in implementing these skill-based exercises under the new medical curriculum. This would produce good IMG who can perform and practice better in their professional career with confidence in real life scenarios which is the essence of the new CBME curriculum.

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Tables

Table 1: Paired t-test showing difference of knowledge scores in the pre and post intervention phases

Domain	Observation	N	Mean	Std. Deviation	t	df	p-value
Knowledge	Pre-intervention	128	8.39	2.04	-4.026	244	**0.000**
	Post-intervention	118	9.40	1.87			
OSPE	Pre-intervention	130	17.17	1.51	-5.494	258	**0.000**
	Post-intervention	130	17.57	1.54			

Table 2: Responses of the students' feedback.

S. No	Topics	4	3	2	1
01	Do you think that the digital module provided is important to you?	**96 (86.5%)**	**15 (13.5%)**	**0**	**0**
02	Are the contents of the module appropriate?	**95 (85.6%)**	**15 (13.5%)**	**1 (0.9%)**	**0**
03	Is the booklet interesting enough for you to read through it thoroughly?	**61 (55%)**	**45 (40.5%)**	**4 (3.6%)**	**1 (0.9%)**
04	Is the information provided comprehensive to you?	**84 (75.7%)**	**27 (24.3%)**	**0**	**0**
05	Do you find that the contents in the digital module will help you to take proper aseptic measures especially for collection of culture samples?	**66 (59.5%)**	**39 (35.1%)**	**6 (5.4%)**	**0**
06	Do you think this module will help you to take proper precaution during sample collection?	**68 (61.3%)**	**38 (34.2%)**	**5 (4.5%)**	**0**
07	Do the blood collection steps convey proper knowledge to you?	**87 (78.4%)**	**23 (20.7%)**	**1 (0.9%)**	**0**
08	Do you think that this module is useful to learn proper disposal of biomedical wastes following blood sample collection?	**94 (84.7%)**	**16 (14.4%)**	**1 (0.9%)**	**0**
09	Are you confident to do spillage management after going through this module?	**65 (58.6%)**	**44 (39.6%)**	**2 (1.8%)**	**0**
10	Does it motivate you to draw blood sample appropriately?	**83 (78.4%)**	**24 (21.6%)**	**2 (1.8%)**	**2 (1.8%)**
11	Are you confident with your training skill?	**40 (36%)**	**61 (55%)**	**9 (8.1%)**	**1 (0.9%)**
12	Does any of the content appear confusing to you?	**76 (68.5%)**	**31 (27.9%)**	**4 (3.6%)**	**0**
	Total Score	**915 (68.69%)**	**378 (28.37%)**	**35 (3%)**	**4 (0.3%)**

Figures

Figure 1: Design of intervention used in the study

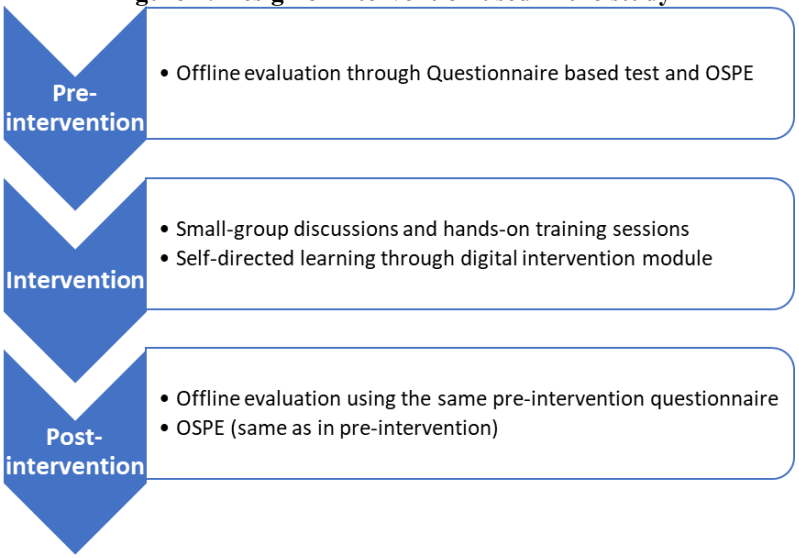

Figure 2: Pre-intervention and post-intervention knowledge scores

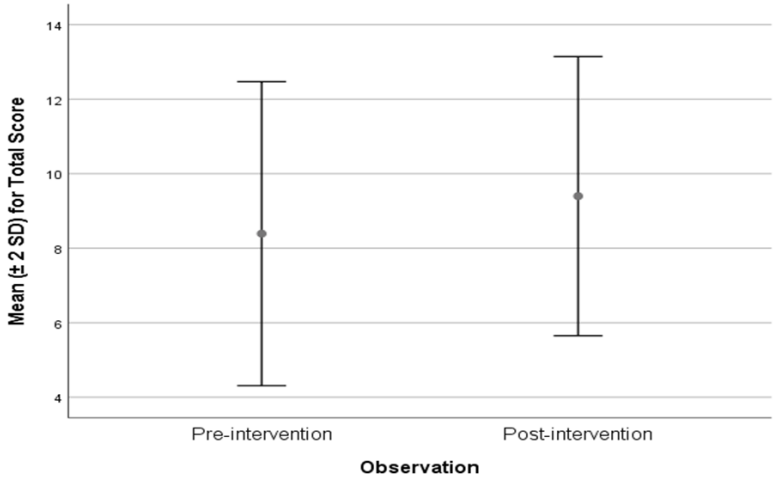

Figure 3: Pre and post intervention OSPE scores

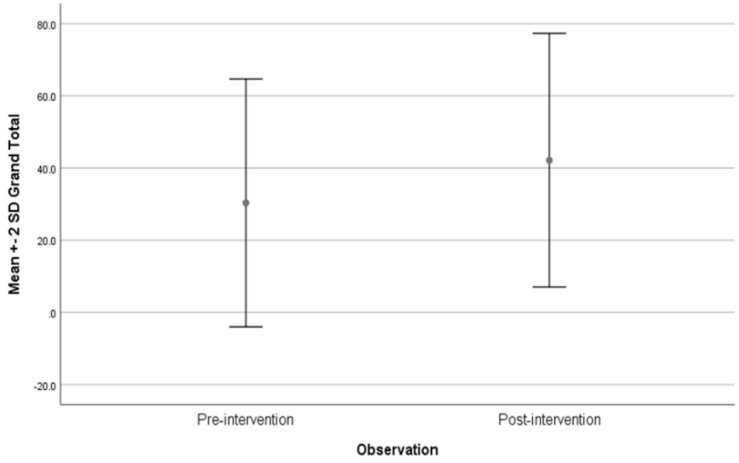

Figure 4: Reponses on the faculty feedback