

## EFFECTIVENESS OF LABORATORY PROCESS FLOW BASED EARLY CLINICAL EXPOSURE IN BIOCHEMISTRY FOR FIRST YEAR MEDICAL UNDERGRADUATES

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### Abstract

**Background:** Early clinical exposure (ECE) aims to recognize the relevance of basic sciences in diagnosis, patient care, treatment and to provide a context to enhance the basic science learning. The aim of this study was to evaluate the effectiveness of basic science ECE - laboratory process flow of the patient sample from preanalytical, analytical and postanalytical phases in first year medical undergraduates. **Materials and Methods:** In this research conducted on I year medical undergraduates, lesson plan for laboratory-based ECE was framed, and pre-briefing session, ECE involving all phases of clinical laboratory and debriefing were done. Effectiveness of ECE was assessed by pretest and post-test method, assessing feedback of students and reflections. **Result:** There was an improved performance in post-test which was statistically significant. Most of the students opined that the ECE session helped them to gain new clinical knowledge and to understand the concepts better and helped them gained confidence in their learning and acquisition of skills by ECE. **Conclusion:** ECE protocol was perceived very well by the students, and it helped in improvement of knowledge and to understand the relevance of laboratory work process flow.

## INTRODUCTION

Early clinical exposure (ECE) is one of the novel proposals of National medical council of India in the competency-based medical education (CBME) implemented in the year 2019.<sup>[1]</sup> This teaching-learning approach is proposed to foster exposure of medical students to patients as early as the first year of medical college, in a social or clinical context that enhances learning of health, illness or disease, and the role of the health professional.<sup>[2]</sup> Previous research studies investigated the outcome of ECE sessions and observed that ECE motivates the medical student in various ways making their academic strength, improve clinical skills, and improve communication skills and making them confident. In the medical curriculum, ECE makes an overall impact on student's performance and confidence.<sup>[3]</sup> Though there are few studies on effectiveness of ECE in general, there is paucity of

studies on laboratory-based ECE in first year medical undergraduates especially in India.<sup>[4]</sup>

Laboratory plays a vital role in patient care, and the quality of laboratory work process is important for correct diagnosis, prognosis and follow up of treatment of various clinical conditions.<sup>[5]</sup> Laboratory work process includes preanalytical, analytical and post analytical components. Introduction to the laboratory work flow and exposure to the processes involved in three phases promotes understanding of the testing process, interpretation of results and role of clinician in total quality management of laboratory services, thereby contributing to excellent patient care. First year of the medical course is the right time to get exposed to laboratory work flow as the students learn basic of biochemistry and application of biochemical tests in clinical practice during this professional year. As per the guidelines given by NMC, laboratory-based ECE is a component of basic ECE for which twelve hours specified in the curriculum of biochemistry. Hence, we implemented

laboratory-based ECE for our first year MBBS students and assessed its effectiveness in learning and feedback from learners.

## MATERIALS AND METHODS

**Source of Data:** First year undergraduates of a medical college

**Study Duration:** Two months

**Study Design:** Prospective, analytical study

**Sampling:** Purposive

**Sample Size:** All the consenting students of I MBBS (N=150)

### Ethical Issues

The research was approved by Institutional Ethics Committee (Letter No, FMIEC/CCM/246/2022 Dated 22/04/2022). Voluntary informed consent was obtained from all study subjects

### Inclusion Criteria

First year medical undergraduates

### Exclusion Criteria

Incomplete pretest-post test data and feedback

### Method of Data Collection

A protocol of ECE for laboratory work process flow was prepared. The standard operating procedures, primary sample collection manual and quality system procedures of Clinical Biochemistry Laboratory were the reference documents. The protocol was subjected to validation by experts of Biochemistry Department. Pretest, Posttest, feedback questionnaire was prepared and peer validated. All the staffs participating in the ECE were sensitized about the session. First year MBBS undergraduates were informed and sensitized about the ECE and after consenting were enrolled for the study. The flowchart of methodology is illustrated in [Figure 1].

The ECE session was totally for three hours including briefing, ECE per se (visit of students to the laboratory and the learning there) and debriefing [Table 1].

### Statistical Analysis

Percentage of students answering each question correctly in pretest and posttest were compared. Scores of students in Pretest and Posttest graded as Excellent (91-100%); Very Good (76- 90%); good (66-75%); satisfactory (51-65%); average (41-50%) and below average ( $\leq$  40%). Significance of difference between Pre and post test scores was assessed by Wilcoxon signed rank test. Student feedback to specific statements via Likert scale was assessed as percentage of students giving their opinions under the categories of strongly disagree, disagree, neutral, agree, and strongly agree.

Effectiveness of ECE was assessed by Kirkpatrick model at level 1 (reaction) and level 2 (learning). Reaction was assessed by five-point Likert's scale questionnaire and thematic analysis of reflections given by students on open ended questions. (Figures 2,3 and 4). Reflections of students were recorded. Reflections were written by students to the open-ended questions what happened? so what? what next? format (table 4) and analyzed by thematic analysis. Learning was analyzed by pretest-posttest.

## RESULTS

Results of this study are presented in [Table 2-4 & Figure 2-4]

Out of the total 150 students who underwent simulation based ECE, only 109 students completed the pre-test, post-test, and feedback. Pretest score of students was  $6.4 \pm 1.96$  (mean  $\pm$  SD). The posttest score was  $8.7 \pm 1.45$  (mean  $\pm$  SD). Assessment of learning using pre-test and post-test revealed that the median score in the post-test was significantly higher than the pre-test [Table 2]. In the post-test, most of the students scored "excellent" and "very good" while in the pre-test, 15.5% of the students scored "below average" while 12.8% scored "average" [Table 3].

To summarize the results depicted in [Figure 2], most of students agreed that ECE session helped them to gain new clinical knowledge, understand concepts better compared to didactic lectures, retain the relevant points of learning, gain confidence in their learning and acquisition of skills, understand laboratory process flow. Majority of the students agreed that they had spent adequate and appropriate time in early clinical exposure, that initial briefing was useful to introduce the learning objectives and provided direction. Students also expressed lack of time and wanted a hands-on experience. As per the perceptions of the students, ECE was helpful in attaining non-technical skills such as leadership, team work, communication, decision making, and realizing importance of process flow in laboratory [Figure 2-4].

The main themes identified to open ended question "what happened (what did you see/do/ experience, a description of the event, facts) so what (an analysis, interpret, opinion, feeling, what did you learn) what next (bigger picture, proposed actions, plan, applying the learning) were "very informative session," "solidified the theoretical knowledge," "better team work "exciting experience," [Figure 5]. Thematic analysis is shown in [Table 4 & Figure 5].

**Table 1: The ECE session is elaborated in table**

The phase of the ECE session	Components
Pre-briefing 1 hour	Pretest google form link was sent • Phlebotomy video link: <a href="https://youtu.be/4TFB-3gDrPs">https://youtu.be/4TFB-3gDrPs</a> • Sample rejection criteria video link: <a href="https://youtu.be/rxjS0x2fydQ">https://youtu.be/rxjS0x2fydQ</a>
Briefing session 15 min	Specific learning Objectives and expected outcomes were re-emphasized. Students were divided into batches
ECE session	Visit to sample collection section to observe and note on following

1 Hour	<ul style="list-style-type: none"> <li>• Observe phlebotomy • Note different vacutainers • Note different specimen collected • Note patient identification • Note different Test requisition form • Observe transport Visit to lab</li> <li>• Observe sample receiving • Note sample rejection criteria • Observe sample processing/centrifugation • Observe analysis in analyzers • Observe sample storage • Observe result entry and verification</li> </ul>
Debriefing 30 min	Administered post-test, collected feedback from students and reflection writing

**Table 2: Comparison of pre-test & post-test scores by Wilcoxon Signed ranks test.**

Percentage score	Median, n=109	IQR	P value
Pre-Test	70	50,80	<.001
Post-Test	90	80,100	

P value <.001- highly significant

**Table 3: Percentage of students scoring different grades in pre-test and post-tests (Number is given in parenthesis). The total number of students=109.**

Grade	Pre-test % score [No. of students]	Post-test % score [No. of students]
Excellent	6.4% [7]	36.6% [40]
Very good	25.6% [28]	30.2% [33]
Good	23.8% [26]	12.8% [14]
Satisfactory	15.5% [17]	5.5% [6]
Average	12.8 [14]	5.5% [6]
Below average	15.5% [17]	9.17% [10]

**Table 4: Themes derived from the student's reflection and the reflection comments by the students on the Session**

Themes	Codes	Student's Reflection
Knowledge	1.Need for basic science	S71 Application of learning in phlebotomy technique; Detection of blood vessels for sample collection (Medial Cubital Vein) in those patients who do not have it visible superficially Application of learning in reducing or minimising errors. S34 To read more about analytical studies, phlebotomy and lab processes Realized the importance of being precise and accurate and carry forward the learnt knowledge to practical use. It was very detailed and informative and helped solidify the theoretical aspects.
	2.Application of basic science in clinical learnings	S41 This ECE helped me appreciate the clinical applications of theoretical biochemistry m I understood the importance of having a strong theoretical knowledge in order to be able to interpret the values on the final lab report.
	1.Affective domain	S61The feeling was soo good. It was soo happy to see the procedure which were used in lab. S93 We were taken to hospital that itself was a great feeling for medical students. these classes help in improving our practical skills S66 It was a very interesting and informative session S68 It was a exciting experience for us, which made our zeal to be a doctor, more strong.
Professionalism and importance of team dynamics	2. Teamwork	S57 I learned that in order to run a hospital efficiently, we need to acquire the skills of leadership and teamwork as this is a collective effort of clinical staff of multiple departments and administrative workers. S73 The procedure shows the importance of teamwork in the hospital. The above process is completed within the TAT because of the coordination between the different sectors of the hospital.
	3.Communicatin	S66 I learnt the how important patient communication is while reporting their details, how blood is being drawn and how blood samples differ vividly. S56 I understand the importance of proper communication, concentration, empathy, seriousness and will try my best to implement them in my life.
	1.confidentiality	S23 Ground rules were told like maintaining the confidentiality of a patient.
Personal development	1.ECE session	S41 This ECE helped me appreciate the clinical application of theoretical biochemistry m I understood the importance of having a strong theoretical knowledge in order to be able to interpret the values on the final lab report S67 In short, this ECE is a gift to students as it creates awareness and acknowledge certain important things in advance.
	2.Learning environment	S11 It was a better way of learning concepts. We got to see the lab during the working hours so a better understanding was instilled. S68 In addition new methods will be developed by the upcoming generations for sure as they are moving ahead of time in their clinical learnings and knowledge.

## DISCUSSION

We assessed effectiveness of early clinical exposure in learning laboratory process flow. In this study, we have seen improved performance of students in post-test after ECE on laboratory work process flow when compared to pretest. Exposing medical students to the patients or community at the very first year is the need of current scenario. In the present study students should know the importance of sample collection, transport, sample acceptance and rejection criteria and the analytical part of the laboratory work process flow to yield the final value which is very important for the diagnosis and treatment of the disease. The percentage of students scoring “excellent” and “very good” was significantly higher in the post-test than pre-test. This demonstrated an improved understanding of the concept with early clinical exposure. Previous research by Shivkar et al showed improved performance of students in the post test in an ECE on diabetes mellitus.<sup>[6]</sup> As per the findings of a study by Piyali et al ECE was an effective technique to supplement didactic lectures to improve learning.<sup>[7]</sup>

As per the feedback of learners, our ECE session helped them to gain new clinical knowledge, gain confidence in learning and attain non-technical skills. The percentage of learners who strongly agreed or agreed positively for the effectiveness of ECE was above 90%. The findings of our study were in accordance with Kumar et al, who observed that 96.4% students gave an overall positive rating for the ECE. They also mentioned that after ECE sessions, the interest for their subjects increased.<sup>[8]</sup> A study by Deolalikar et al concluded that ECE helped to bridge the gap between preclinical and clinical subjects and made learning more interesting.<sup>[9]</sup>

The main themes identified in our study were “very informative session,” “solidified the theoretical knowledge,” “better team work “exciting experience,” Our study was in compliance with the study conducted by Gupta et al, who identified the main themes in open ended question “Enlist any two good things about feedback session” in the student feedback questionnaire were “improvement in knowledge,” “application of knowledge in clinical setup,” “student centric,” “effective learning tool,” “enhanced motivation,” and “enjoyable learning” .

The predominant teaching given to the medical undergraduates is either in practical hall or classroom or bedside teaching. Although laboratory is a major area of evidence generation for a sound clinical decision making, hardly any teaching occurs in the laboratory for medical undergraduates. ECE to medical students with the laboratory process has shown effectiveness and is supported by student’s positive feedback on this teaching learning method. Limitations in our study was only short-term outcome was evaluated. We plan to evaluate intermediate and long-term outcomes in future. Laboratory process flow involves preanalytical, analytical and post



Figure 1: Flowchart of methodology

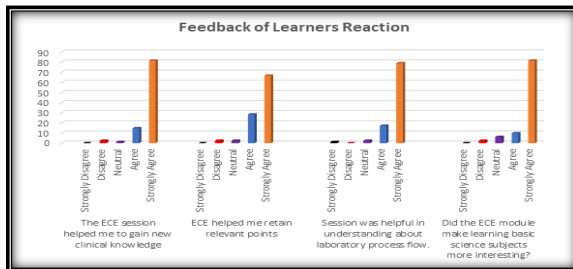


Figure 2: Feedback on Learner’s Reaction

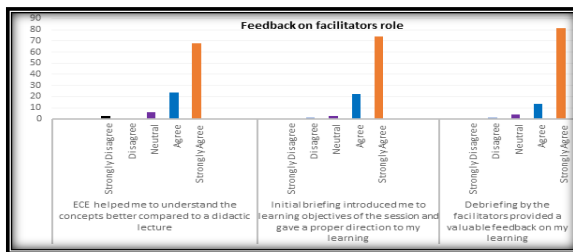


Figure 3: Feedback of learners on the facilitator role

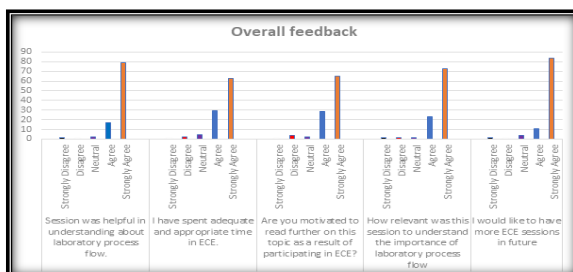


Figure 4: Overall feedback on the ECE session



Figure 5: Thematic analysis

analytical phases which requires adequate time and logistics for executing this teaching learning methodology. In Students feedback also revealed that lack of adequate time was one of the challenges.

## CONCLUSION

Currently, the exposure of first year medical undergraduates to laboratory medicine is limited to class room-based teaching. In the era of evidence-based medicine and CBME, an in-depth appreciation of laboratory process flow by is the first step towards making I year medical undergraduate competent and aid in clinical decision making in future. Early clinical exposure in laboratory work process flows improved interest of students in the topic making learning more interactive which helped them in understanding basis and rationale of laboratory medicine with its application in practical medicine.

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