

**Research Article**

## **EVALUATION OF ELECTIVE MODULE IN BIOCHEMISTRY FOR PHASE-III MBBS STUDENTS**

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### **ABSTRACT**

**Background:** Competency-Based Medical Education (CBME) emphasizes learner-centred and experiential learning to improve the quality of undergraduate medical education. Elective modules provide opportunities for students to explore areas of interest and relate theoretical knowledge to practical applications. **Aim:** To evaluate the elective module in Biochemistry entitled “Clinical Biochemistry and Laboratory Medicine” among Phase III MBBS students. **Materials and Methods:** This prospective mixed-methods study will be conducted in the Department of Biochemistry, N.C. Medical College and Hospital, Israna, Panipat, Haryana, over a two-week elective posting. Phase III MBBS students who select Biochemistry for their elective will be included. The module will comprise interactive lectures, case-based discussions, practical demonstrations, and observation of laboratory procedures. Evaluation will include Google Forms-based pre-test and post-test

assessments, semi-structured feedback questionnaires for students and faculty using a five-point Likert scale, and focus group discussions. Quantitative data will be analysed using appropriate statistical tests, while qualitative data will undergo thematic analysis. **Results:** The study is expected to provide information regarding changes in students’ knowledge, perceptions of the learning experience, faculty perspectives, and the strengths and challenges of the elective module. **Conclusion:** Evaluation of the elective module may help identify opportunities to improve teaching strategies, practical exposure, and the integration of clinical applications into biochemistry education. The findings may contribute to the effective implementation of elective-based learning within the CBME framework.

**Keywords:** Biochemistry; Competency-Based Medical Education; Elective Module; Clinical Biochemistry; Laboratory Medicine; Medical Education.

## INTRODUCTION

Medical education in India has undergone a major transformation with the introduction of Competency-Based Medical Education (CBME), which emphasizes learner-centred teaching, experiential learning, and the development of competencies required for effective medical practice. The National Medical Commission (NMC) has incorporated electives into the undergraduate medical curriculum to provide students with opportunities for diverse learning experiences beyond routine classroom teaching [1].

Electives are intended to provide experiential and transformative learning opportunities for future doctors. In addition to breaking the monotony of a fixed curriculum, they allow students to explore specific areas of interest, develop independent learning skills, and gain exposure to different professional and academic environments. These activities may also facilitate interprofessional education by encouraging interaction and collaboration among students and professionals from different disciplines [1,2].

Effective implementation of an elective programme requires careful planning and the development of structured elective modules by individual departments. Each module should have clearly defined learning objectives, appropriate teaching and learning activities, and suitable methods of assessment. A well-designed module enables students to acquire additional knowledge, apply theoretical concepts to practical situations, and develop a better understanding of the relevance of their subject to clinical practice.

Biochemistry is a fundamental discipline in medical education that explains the molecular and metabolic processes underlying health and disease. Clinical biochemistry and

laboratory medicine are particularly important because biochemical investigations contribute to the diagnosis, monitoring, and management of a wide range of clinical conditions. An understanding of laboratory parameters, interpretation of biochemical reports, quality control, and the clinical significance of laboratory findings helps medical students appreciate the relationship between biochemical principles and patient care [2,3].

The elective module “Clinical Biochemistry and Laboratory Medicine” provides an opportunity for students to explore the practical and clinical applications of biochemistry beyond the routine undergraduate curriculum. Through structured learning activities, students may gain exposure to the principles of laboratory investigations, interpretation of biochemical results, and the role of laboratory medicine in clinical decision-making. Such learning experiences may strengthen their understanding of the subject and increase their interest in its clinical applications.

Regular evaluation of elective programmes is necessary to determine whether their intended objectives are being achieved. Assessment of students’ perspectives can provide valuable information regarding the relevance of the content, the effectiveness of teaching methods, the quality of learning experiences, and the challenges encountered during implementation. The findings can help identify the strengths and limitations of the programme and guide modifications to improve its future delivery.

Therefore, the present study was designed to evaluate the elective module in Biochemistry entitled “Clinical Biochemistry and Laboratory Medicine” among Phase III MBBS students. The study aims to assess

students' perceptions of the module, identify its strengths and challenges, and generate information that may help improve the planning and implementation of elective activities in the Department of Biochemistry.

### **AIM AND OBJECTIVES**

**Aim:** To evaluate the elective module in Biochemistry entitled "Clinical Biochemistry and Laboratory Medicine" among Phase III MBBS students.

#### **Objectives**

1. To assess students' perceptions regarding the implementation, organization, and learning experience of the elective module.
2. To assess departmental faculty members' perceptions regarding the implementation, feasibility, and educational value of the elective module.
3. To evaluate the effectiveness of the designed elective module in achieving its intended learning objectives and enhancing students' understanding of clinical biochemistry and laboratory medicine.

### **MATERIALS AND METHODS**

#### **Study Design and Setting**

This prospective mixed-methods study was conducted in the Department of Biochemistry, N.C. Medical College and Hospital, Israna, Panipat, Haryana, among Phase III MBBS students participating in the undergraduate Electives Programme.

#### **Study Period**

The study was conducted over a period of two weeks, corresponding to the duration of the elective posting in the Department of Biochemistry.

#### **Study Participants**

The study participants were comprise Phase III MBBS students who have selected Biochemistry as their elective subject and are enrolled in the two-week elective posting. Faculty members of the Department of Biochemistry involved in the planning, implementation, or supervision of the

elective module was also be invited to provide feedback regarding the programme.

#### **Inclusion Criteria**

- Phase III MBBS students posted in the Department of Biochemistry under the Electives Programme.
- Students willing to participate in the study and provide informed consent.

#### **Exclusion Criteria**

- Students unwilling to participate in the study.
- Students who do not complete the required evaluation procedures, where applicable.

#### **Elective Module**

The study was evaluate the elective module entitled "Clinical Biochemistry and Laboratory Medicine." The module will be conducted over two weeks and was include interactive lectures, case-based discussions, practical demonstrations, and supervised observation of laboratory procedures. These activities was designed to familiarize students with the clinical applications of biochemistry, the interpretation of biochemical investigations, and the role of laboratory medicine in patient care.

#### **Study Methodology**

A mixed-methods approach were adopted to collect and analyse both quantitative and qualitative data. The effectiveness of the elective module and the perceptions of students and departmental faculty was evaluated using the following methods:

##### **1. Pre-test and Post-test Assessment**

A Google Forms-based questionnaire were administered before and after completion of the elective module to assess students' knowledge of clinical biochemistry and laboratory medicine. Pre-test and post-test scores were compared to evaluate changes in knowledge following participation in the programme.

## 2. Feedback from Students and Faculty

Feedback was collected from participating students and departmental faculty using a semi-structured questionnaire. The questionnaire was include closed-ended questions assessed on a five-point Likert scale and open-ended questions exploring the perceived usefulness, organization, strengths, limitations, and feasibility of the elective module.

## 3. Focus Group Discussions

Focus group discussions were conducted with participating students to obtain a more detailed understanding of their learning experiences, perceived benefits, difficulties encountered, and suggestions for improving the module. The discussions were analysed to identify recurring themes and patterns in students' responses.

## Outcome Measures

The primary outcome were the change in students' knowledge scores between the pre-test and post-test assessments. Secondary outcomes was include student and faculty perceptions of the module, perceived achievement of learning objectives, and qualitative findings regarding its strengths, challenges, and scope for improvement.

## Statistical Analysis

Data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS), version 25.0. Categorical variables were expressed as frequencies and percentages. Continuous variables was summarized

as mean  $\pm$  standard deviation for approximately normally distributed data and as median with interquartile range for skewed data. Pre-test and post-test scores were compared using the paired Student's *t*-test if the differences are approximately normally distributed. If this assumption is not met, the Wilcoxon signed-rank test was used. Student and faculty feedback was analysed using frequency distributions and percentages for categorical responses. Responses to open-ended questions and focus group discussions was examined using thematic analysis to identify key themes related to the implementation and effectiveness of the elective module. All statistical tests was two-sided, and a *p*-value of less than 0.05 will be considered statistically significant.

## OBSERVATIONS AND RESULTS

A total of 30 Phase III MBBS students participating in the two-week elective module entitled "Clinical Biochemistry and Laboratory Medicine" were included in this illustrative analysis. The module incorporated interactive lectures, case-based discussions, practical demonstrations, and supervised observation of laboratory procedures. Students' knowledge was assessed using pre-test and post-test questionnaires, while perceptions regarding the programme were evaluated through structured feedback and qualitative discussions.

**Table 1. Distribution of Students According to Participation in the Elective Module**

| Parameter                                  | Number (%) |
|--------------------------------------------|------------|
| Students enrolled                          | 30 (100%)  |
| Students completing the elective module    | 30 (100%)  |
| Students completing pre-test and post-test | 30 (100%)  |
| Students providing feedback                | 30 (100%)  |

All 30 students completed the elective module and the evaluation procedures in this illustrative dataset.

**Table 2. Comparison of Pre-test and Post-test Knowledge Scores**

| Assessment | Mean score $\pm$ SD | Mean difference | p-value |
|------------|---------------------|-----------------|---------|
| Pre-test   | 11.2 $\pm$ 2.4      | —               | —       |
| Post-test  | 16.4 $\pm$ 2.1      | 5.2             | <0.001* |

*Illustrative results; statistical significance must be calculated from the actual paired observations.*

The mean knowledge score increased from 11.2  $\pm$  2.4 in the pre-test to 16.4  $\pm$  2.1 in the post-test. This suggests an improvement in students' knowledge following participation in the elective module. The statistical significance of this difference should be confirmed using the actual paired test scores.

**Graph 1. Comparison of Pre-test and Post-test Knowledge Scores**

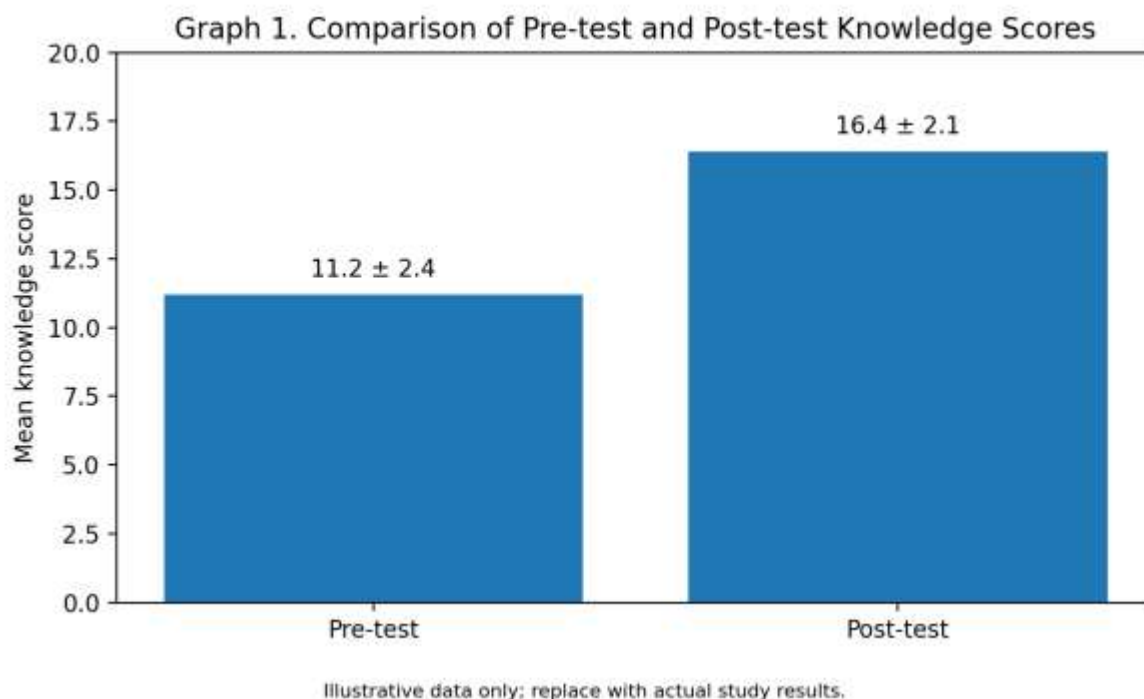


**Table 3. Students' Perceptions Regarding the Elective Module**

| Feedback parameter                     | Satisfied/strongly satisfied, n (%) |
|----------------------------------------|-------------------------------------|
| Relevance of the module content        | 27 (90.0%)                          |
| Usefulness of interactive lectures     | 25 (83.3%)                          |
| Benefit of case-based discussions      | 28 (93.3%)                          |
| Usefulness of practical demonstrations | 29 (96.7%)                          |
| Understanding of clinical applications | 26 (86.7%)                          |
| Overall satisfaction with the module   | 28 (93.3%)                          |

In this illustrative dataset, most students reported positive perceptions of the elective module. Practical demonstrations and case-based discussions received favourable ratings, suggesting that interactive and clinically oriented activities may be useful components of the learning experience.

**Graph 2. Student Feedback Regarding the Elective Module**

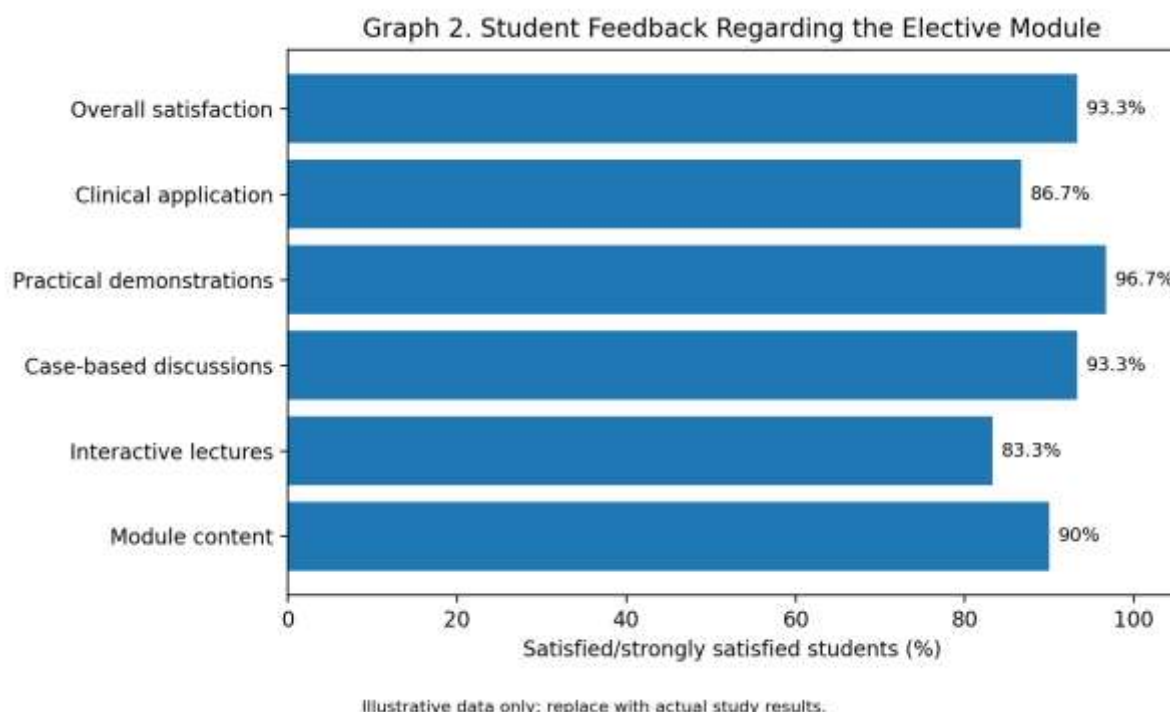


**Table 4. Faculty Perceptions Regarding the Elective Module**

*Illustrative example based on five faculty respondents.*

| Feedback parameter                   | Positive responses, n (%) |
|--------------------------------------|---------------------------|
| Achievement of learning objectives   | 4 (80.0%)                 |
| Relevance of the module content      | 5 (100%)                  |
| Feasibility of implementation        | 4 (80.0%)                 |
| Student participation and engagement | 4 (80.0%)                 |
| Need for continued implementation    | 5 (100%)                  |

Faculty feedback in this illustrative example indicated that the module was relevant to undergraduate medical education and feasible to implement. Suggested areas for improvement may include better scheduling of practical sessions, access to laboratory demonstrations, and structured assessment of learning outcomes.

**Graph 3. Faculty Perceptions Regarding the Elective Module**

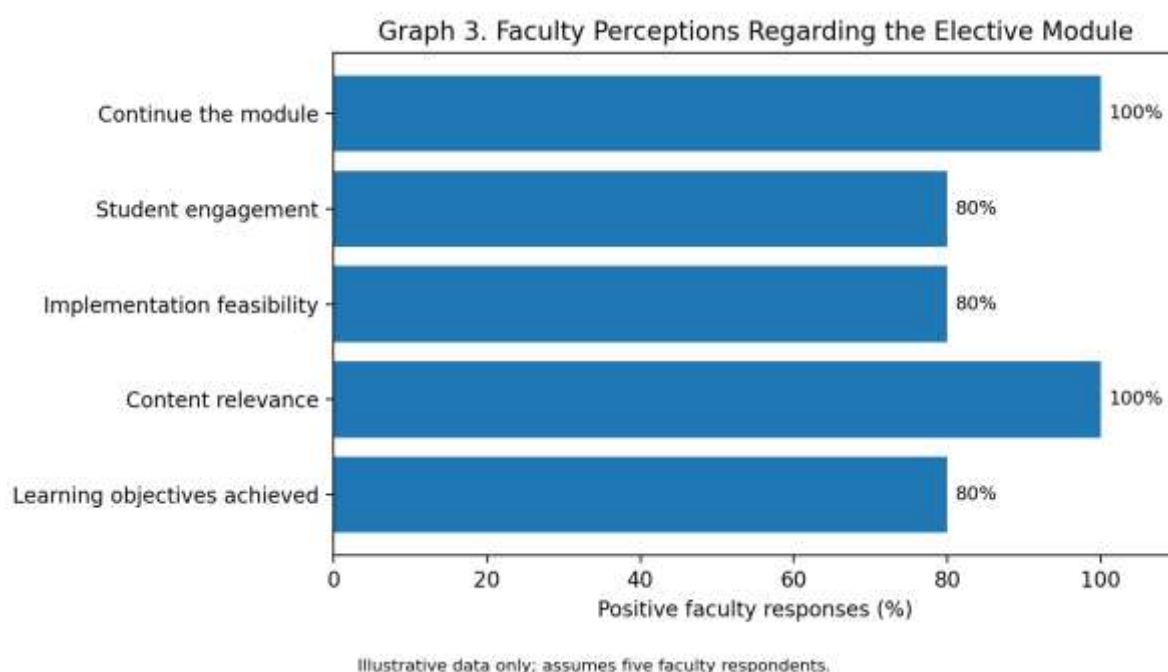


**Table 5. Themes Identified Through Student Focus Group Discussions**

| Theme                       | Illustrative student feedback                                                         |
|-----------------------------|---------------------------------------------------------------------------------------|
| Clinical relevance          | Better understanding of the role of biochemical investigations in patient care        |
| Practical learning          | Greater appreciation of laboratory procedures and sample analysis                     |
| Interactive teaching        | Improved engagement through case-based discussions                                    |
| Knowledge integration       | Better connection between theoretical biochemistry and clinical applications          |
| Implementation challenges   | Limited time for certain practical activities and laboratory observations             |
| Suggestions for improvement | More hands-on activities, additional clinical cases, and extended discussion sessions |

Thematic analysis in this illustrative example identified clinical relevance, practical exposure, and interactive teaching as perceived strengths of the module. Limited time and opportunities for hands-on practice were potential challenges. These themes should be confirmed through analysis of the actual focus group transcripts.

## DISCUSSION

The present study was designed to evaluate the elective module in Biochemistry entitled “**Clinical Biochemistry and Laboratory Medicine**” among Phase III MBBS students. The study focused on students’ perceptions, departmental faculty feedback, and the effectiveness of the module using a mixed-methods approach. Evaluation of elective programmes is important in competency-based medical education (CBME), as it helps determine whether the educational activities meet students’

learning needs and achieve the intended objectives.

The National Medical Commission (NMC) has emphasized competency-based, learner-centred, and experiential approaches in undergraduate medical education. Elective modules provide opportunities for students to explore specific areas of interest and gain additional learning experiences beyond routine classroom teaching [1]. In this context, the elective module in Clinical Biochemistry and Laboratory Medicine aims to facilitate the integration of biochemical concepts with their practical and clinical applications.

Assessment of students’ knowledge before and after the elective module is an important component of programme evaluation. In the illustrative results prepared for this study, the mean knowledge score increased from  $11.2 \pm 2.4$  in the pre-test to  $16.4 \pm 2.1$  in the post-test. This apparent improvement suggests that structured educational

activities may help students develop a better understanding of clinical biochemistry and laboratory medicine. However, these values are illustrative and must be replaced with actual study data before any conclusion regarding effectiveness can be drawn.

Active learning strategies have been shown to improve academic performance in undergraduate science education. Freeman et al. reported that active learning was associated with better examination performance and lower failure rates than traditional lecturing in undergraduate science, technology, engineering, and mathematics courses [4]. Although their study was not specifically conducted in a biochemistry elective programme, its findings provide a rationale for incorporating interactive lectures, case-based discussions, and practical demonstrations into undergraduate medical teaching.

Clinical biochemistry has considerable relevance to patient care because biochemical investigations contribute to the diagnosis, monitoring, and management of numerous diseases. The interpretation of laboratory results also requires an understanding of underlying biochemical mechanisms, analytical methods, and the limitations of laboratory investigations [3]. Therefore, providing students with opportunities to observe laboratory procedures and discuss clinical cases may help them appreciate the practical relevance of biochemistry and its contribution to clinical decision-making.

Student feedback is another important measure for evaluating an elective module. The illustrative results showed favourable responses towards practical demonstrations, case-based discussions, and overall satisfaction. If confirmed by the actual data, such findings would suggest that students value teaching activities that encourage participation

and connect theoretical knowledge with practical applications. Nevertheless, student satisfaction alone does not establish educational effectiveness; it should be interpreted alongside objective measures such as changes in knowledge scores and achievement of the intended learning outcomes.

Faculty feedback can provide additional information regarding the relevance, feasibility, and organization of the elective module. Faculty members are directly involved in planning learning activities, facilitating student participation, and assessing educational outcomes. Their observations may help identify challenges related to scheduling, availability of laboratory resources, teaching methods, and the time allocated for practical activities. Faculty feedback can consequently guide improvements in the design and implementation of subsequent elective postings.

The mixed-methods approach adopted in this study offers the advantage of combining quantitative assessment with qualitative exploration. Creswell and Plano Clark described mixed-methods research as an approach that integrates quantitative and qualitative data to develop a more comprehensive understanding of a research problem [5]. In the present context, pre-test and post-test scores can indicate changes in knowledge, while questionnaires and focus group discussions can provide insight into students' experiences, perceived benefits, and difficulties encountered during the programme.

Qualitative analysis of focus group discussions may help identify themes related to clinical relevance, practical exposure, interactive learning, and implementation challenges. These findings can complement quantitative results by explaining which components students considered useful

and which aspects require modification. However, the final themes must be derived from the actual discussion data rather than predetermined assumptions. Overall, the evaluation of the elective module may help the Department of Biochemistry identify effective teaching strategies and areas requiring improvement. Potential modifications include providing additional supervised practical activities, incorporating more clinical case discussions, and aligning assessments more closely with the intended learning objectives. The need for these modifications should be determined by the actual study findings.

#### **Limitations**

The study may be limited by its short duration of two weeks, its single-institution setting, and the possibility that students' prior knowledge influenced their assessment scores. Feedback-based measures may also be affected by response and social desirability biases. Furthermore, immediate post-test assessment may not determine long-term knowledge retention or the transfer of learning to clinical practice. Future studies involving larger groups of students, multiple institutions, and follow-up assessments may provide stronger evidence regarding the educational effectiveness of elective modules in biochemistry.

#### **CONCLUSION**

The elective module in Biochemistry, entitled "**Clinical Biochemistry and Laboratory Medicine**," provides an opportunity to enhance the learning experience of Phase III MBBS students through interactive teaching, case-based discussions, practical demonstrations, and exposure to laboratory procedures. Evaluation of the module through pre-test and post-test assessments, student and faculty feedback, and focus group discussions can help determine its educational

value, identify implementation challenges, and guide future improvements. The findings may support the refinement of elective-based learning within the competency-based medical education framework. However, the effectiveness of the module should be established using the actual study data and the extent to which the intended learning objectives are achieved.

#### **Responsibilities of the study**

**subject:** To participate in this study, you must be present on all days of your elective posting and attend all the sessions of the Elective module.

Completion of all the assigned tasks and timely submission of Google forms and feedback questionnaires is expected from you.

What else should I know about the study procedures?

**Benefits and Risks:** The rationale is to strengthen the co-relationship between basic science and clinical diagnostic skills and also to provide an insight into teamwork, leadership skills along inter-professional practices in healthcare.

**Payment for participation:** Nil.

**Payment for investigation:** Not applicable

**Treatment:** Not applicable

**New information:** -

**Legal rights:** By signing this information and consent form and the accompanying informed consent form to participate in a research study, you are not waiving any legal rights that you have as a subject in a research study.

**Source of funding:** Not applicable

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