



## Assessment of knowledge and perspectives of medical students and teachers on physiology electives: a mixed-method survey study in a rural medical college of West Bengal.

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### ABSTRACT

#### Introduction

Elective modules have become a pivotal component of the medical curriculum, enhancing problem-solving skills, self-directed learning, and clinical competence. In India, the National Medical Commission (NMC) introduced electives in 2019 as part of the Competency-Based Undergraduate Curriculum. This study aimed to assess the understanding of medical students and faculty regarding Physiology electives (Electrocardiogram or ECG and Pulmonary function test or PFT) and to evaluate their impact on students' knowledge acquisition.

#### Methods

A mixed-methods study was executed at Rampurhat Government Medical College, West Bengal, involving 30 MBBS students from the 2022 batch who chose either ECG or PFT AS electives. Data collection encompassed pre- and post-tests, Likert-scale-based perception review, and two focused group discussions. Quantitative data were assessed using paired t-tests, and qualitative data were thematically analysed.

#### Results

There was a statistically significant advance in post-test scores correlated to pre-test scores in both ECG and PFT groups ( $p < 0.05$ ), insinuating substantial knowledge gain. Students reported positive discernment, mentioning hands-on clinical exposure, improved diagnostic skills, and optimised communication aptitudes. Faculty reverberated this perspective, acclaiming students' commitment and the academic utility of the modules. Pivotal limitations included the short duration of the module. Recommended amelioration included extended module duration and more case discussions.

#### Conclusion

Physiology electives, when organized, significantly intensify students' knowledge and clinical readiness. Both students and faculty admitted their educational value. The study supports continued inclusion and expansion of such electives in the undergraduate medical curriculum.

**Key Words:** *Physiology electives, perception by students and faculty, impact on knowledge gain.*

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#### Introduction

The idea of electives dates as early as 1819 when it was first introduced by the University of Virginia in the United States of America. An elective or 'optional' course is generally a short-duration course, which is not compulsory, and in which the student has the chance to 'elect' (select), depending on his/ her interest, from numerous accessible options of courses. Elective courses are fundamental to the medical curriculum in many universities worldwide. Many studies have proclaimed the benefits of electives like enhanced knowledge and skills, escalated critical thinking and problem-solving skills, ameliorated communication and

teamwork skills, augmented self-confidence and motivation, a more versatile education, opportunity for investigative learning, lateral thinking, immersive learning, and progress of the spirit of inquiry 2- 7. Electives have been presumed to promote trans- formative learning<sup>8</sup>. Transformative learning is a two-phase process encompassing instrumental and communicative learning. Whereas the foremost aim of instrumental learning is on 'learning through task-oriented problem solving and determination of cause-and-effect relationships', communicative learning concentrates on the 'understanding how others communicate their feelings, needs, and desires with another person'. Clinical skills are



strengthened by instrumental learning, and it also entrenches critical thinking. The preferment of transformative learning needs to be probed through electives.

Electives permit students to get a flavour of a future career; they also encourage them to seek academic interests, do projects, and work in dissimilar environments. These encounters outside the conventional horizon of the basic program allow students to review, target, and develop their careers. They also allow students to commence the process of professional networking proximately. It has been observed that permitting the students to elect some of the topics intensifies the level of interest of the students in the program and helps them to develop personal skills<sup>10</sup>. Students in elective programs have often pronounced electives as being ingenious and attractive. Besides breaking the tediousness of regular teaching in a fixed curriculum, electives furnish multidimensional and various learning experiences, making inter-professional education conceivable. Electives are favoured by students since they feel more pledged when they decide the topics themselves<sup>11</sup>.

Therefore, the incorporation of electives in medical degree curricula is of flourishing significance. National Medical Commission (NMC), India, is a body that plans the curriculum for undergraduate medical students of India. A new Competency-Based Undergraduate Curriculum for the undergraduate medical students has been ushered in by NMC since 2019. In this new curriculum, NMC has initiated an Elective module for the first time in India. The objective of Elective modules is mentioned as “a learning experience created in the curriculum to provide an opportunity for the learner to explore, discover, and experience as or streams of interest. “By the NMC guidelines, an Elective is a zone or a course that, as a specialty, will allow the students to learn and explore something unique. Even super-specialty departments (which are not involved in undergraduate teaching) can contribute to Electives. The total duration of the Elective is one month, divided into two blocks (Block 1 and Block 2), each having a duration of fifteen days.

Students will have to opt for one of the Electives offered by pre- and Para-clinical departments (Anatomy, Physiology, Biochemistry, Pathology, Microbiology, Pharmacology, Forensic Medicine, and Toxicology) in Block 1 and Clinical (broad speciality), Super-speciality departments, and Community clinics (rural/urban) in Block 2. Presently, MBBS students go through four Phases while enduring their training. Phase I (pre-clinical) starts with the entry to the medical college, followed by Phase II, Phase III (Part I), and finally Phase III (Part II). Electives are imparted at the end

of Phase III (Part I) and before the beginning of Phase III (Part II). The integrated list of Electives being rendered by the institutes is furnished to all the students well in advance. Every Elective requires specific learning objectives, an organized plan of its implementation, a logbook, and an assessment at the end. Every elective can have only a fixed number of students who can be trained in that Elective. This number is to be settled by the Elective specialty offering. Students have to choose Electives from the list provided. The additional method of assigning Electives to the students is to be determined by the institute. Electives can also be chosen in an outside Institution<sup>12</sup>.

In the United States of America, after the introductory two-year course in pre- and paraclinical sciences, the final 2 years are divided into two parts: Required sequence blocks and Optional sequence blocks (synonymous to Electives). Required sequence blocks are those defined as essential, to be done by every student to meet the minimum expectations, while the optional sequence blocks permit students to self-elect<sup>13</sup>.

Mithalynk et al in the study done at the University of British Columbia, observed that many medical students contemplate career choice decisions as a process to be endeavoured in medical school. The free choice clerkship was delineated not only as a worthwhile, highly esteemed learning experience, but also as a main feature of the educational process of decision-making, including explaining decisions about both future education and career choices.

Reed et al, in their review of medical education, demonstrated “Exploring the complex, developmental nature of the speciality choice process is key to both understanding how speciality decisions are made and ultimately improving the decision-making process. Because this is an area that has not been researched widely, there is ample opportunity for researchers to fill this gap in our knowledge”.

Basic science and clinical syllabi both prevail as the strongest basis of the medical curriculum. But little is known about the concerns of students about the electives allotted to basic science departments like Physiology.

The Department of Physiology in our institute was allotted two elective topics. 1. Pulmonary function test and 2. ECG or Electrocardiography.

Aim: To evaluate the impact of Physiology electives on knowledge enhancement among MBBS students, and to explore perceptions, strengths, limitations, and improvement strategies from both students and faculty through a mixed-methods approach.

### Objectives:

Quantitative Objectives: To measure the change in students' knowledge through pre- and post-test scores.



<b>P (population):</b>	MBBS students (n=30) of the 2022 batch who opted for the Physiology elective at Rampurhat Government Medical College
<b>I (intervention):</b>	Participation in 2-week Physiology elective modules, including pre-/post-tests, clinical exposure, and structured teaching
<b>C (comparison)</b>	Pre-test knowledge scores and perception before the electives
<b>O (Outcome):</b>	Improvement in knowledge scores (post-test), Positive perception of the electives by students and faculty (measured by Likert scale and thematic analysis), Identification of strengths and suggestions for improvement in the module

### Qualitative Objectives:

- To explore in-depth perceptions of students and faculty regarding the educational value, relevance, and implementation of the electives.
- To identify perceived strengths, limitations, and barriers associated with the ECG and PFT modules.
- To gather suggestions for improving the structure and content of the Physiology electives
- To integrate findings through methodological triangulation of quantitative and qualitative data for comprehensive insight.

### Methods

The present study was carried out in a medical college of West Bengal, amongst 30 MBBS students of the 2022 batch (admission year 2022), the third batch that underwent the new addition in the MBBS curriculum, i.e., the electives program, who took PFT (n=15) and ECG (n=15) as their electives. This study was sanctioned by the institutional ethics committee.

### Research Question

Does participation in Physiology electives improve knowledge gain among MBBS students, and how do students and faculty perceive the strengths, limitations, and areas of improvement of these electives?

Null Hypothesis (H<sub>0</sub>): Implementing a PFT and ECG elective module has no significant effect on the knowledge gain of undergraduate medical students, and perceptions and practices of clinical skill have no impact. Teachers' perception is also skeptical.

Alternative Hypothesis (H<sub>1</sub>): Implementing a PFT and ECG elective module significantly improves the knowledge gain of undergraduate medical students, and perceptions and practices of clinical skill have a robust impact. Teachers' perception is also positive.

Following the expounding of the purpose of the study and obtaining informed consent, a pretested, self-administered

questionnaire with both open and closed-ended questions was used for data collection.

### Study Design

This is a mixed-method, questionnaire-based study. The current study followed a parallel mixed method design (15, 16) with an initial quantitative survey of pre-test/post-test scores and a study of perception using a pre-validated questionnaire, followed by a qualitative study by focused group discussion (FGD). This approach helps to guide the discussion questions for the focus group and corroborate the findings of the survey, thus providing for the methodological triangulation and greater rigor to the study<sup>17,18</sup>.

### Study duration

November 2014 to September 2025

### Study area/ setting

Physiology department, Rampurhat Govt. Medical college

### Study population

Whole 30 students who took PFT and ECG as an elective

### Inclusion criteria

All 30 students who took PFT and ECG as an elective

### Exclusion criteria

If any student does not give consent or is absent

### Sampling technique

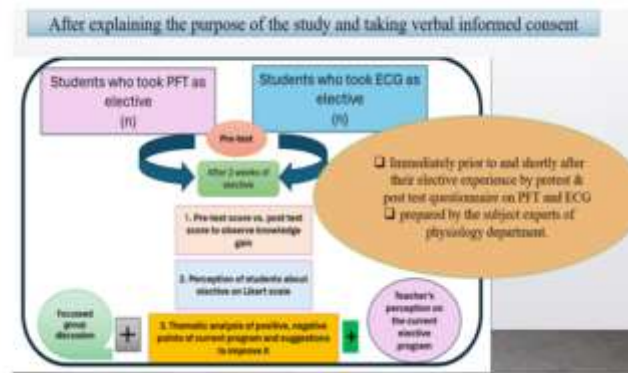
Sample size formula is  $n = (Z^2 * p * (1-p)) / d^2$ , where 'n' is the required sample size, 'Z' is the Z-score (e.g., 1.96 for 95% confidence), 'p' is the estimated prevalence, and 'd' is the desired margin of error.

- Based on a 5% margin of error, a 95% confidence level, and a 1% outcome response, the estimated sample size was 16 students, where the population was 3000 students. (Total number of students under WBUHS eligible for electives, including rural and urban medical colleges)

Sample size of the present study: 30

### Study Design

#### RESEARCH DESIGN



#### Study module:

ECG Programme schedule	
WEEK 1	WEEK 2
<ul style="list-style-type: none"> <li>• Pre-test</li> <li>• ECG introduction</li> <li>• LEAD PLACEMENT</li> <li>• Doing ECG on healthy subjects (Correct lead placement and Attitude and communication with subject)</li> <li>• Privacy of female patients</li> </ul>	<ul style="list-style-type: none"> <li>• Doing ECG and interpret PR interval, Heart rate, Axis Overview of arrhythmia and abnormal ECG</li> <li>• Post-test</li> </ul>

Students have to maintain a logbook and details of patients on which they will perform PFT by their own.

PFT Programme schedule	
WEEK 1	WEEK 2
<ul style="list-style-type: none"> <li>✓ Pre-test</li> <li>✓ PFT-Theory introduction</li> <li>✓ Observation of patient Explain the patient about the procedure, weight &amp; height measurement,</li> <li>✓ Data entry</li> </ul>	<ul style="list-style-type: none"> <li>✓ Perform on patient under supervision (at least 2/each student)</li> <li>✓ Reversibility test</li> <li>✓ Interpretation of 5 spirometry result</li> <li>✓ Post test</li> </ul>

Students have to maintain a logbook and details of patients on which they will perform PFT by their own.

Each group gave a PowerPoint presentation, and scoring will be given as part of formative assessment. After explaining the purpose of the study and taking informed consent, an online survey was conducted. It was done with a validated questionnaire, which was developed by the author after a series of students' and staff focus group discussions. It was validated by three experts in the field of medical education. The questionnaire was sent to the students who took part in the 2-week electives in 2025 via Google Docs.

Focus Group Discussion (FGD) – To further strengthen the findings of the study, two FGDs – one for each batch – were also conducted. Informed consent was obtained from each of them before the start of FGD.

#### Study instrument for recording knowledge gain by students on completion of 4 weeks of electives:

The students were assessed immediately before and shortly after their elective experience by a pretest & posttest questionnaire on PFT and ECG as prepared by the subject experts of the physiology department. This assessment was done to compare the knowledge gained by the students after doing 2 weeks' electives in the Physiology department.

#### Study instrument for recording perception on electives:

To study the perception of students and teachers on electives, an online survey with validated questionnaires (validated by three experts in the medical education field) was used. The questionnaire was sent to the students who



took part in the 2-week electives in 2025 via Google Docs. The survey was instituted in collaboration with experts in medical education and medical students involved in the elective.

The anonymous, self-administered, English-language questionnaire was used with 12 survey items for gathering the participants' answers. Out of the total 12 items, there was 2 items, for demographics; 10 items seeking students' responses on a 5-point Likert scale from strongly agree to strongly disagree, 1 item concerning mainly about reason they took PFT and ECG as elective; and, 3 items was open-ended question, asking participants for their opinion on strength and weakness of this program and their suggestions to improve it. An online Google form was used to create the questionnaire, and all participants were sent the link via email and a WhatsApp group. All academic members who answered the questionnaire had their answers used for data analysis.

To further strengthen the study, two FGDs – one for each batch – were carried out to gather qualitative data using open-ended questions. Focus groups were formed randomly with 10 students each from the ECG and PFT electives. Discussions for each group were scheduled as separate one-hour sessions. At the time of focus group discussions, we avoided questioning the participants and letting them reply to the questions one by one. We made our participants easy-going to non-concur with each other (if any) and voice their convictions through group discussions. We aimed to create reciprocity among the participants. The final questioning route comprised the following questions:

- What are your feelings related to elective modules during your training days?
- What are the impediments rooted in the modules?
- Are there any ways to surmount these difficulties?

The session was audio-recorded and decoded by one of the members of the research team. The analytical process started by using verbatim transcription and recognizing the participants' impressions. Participants were informed of the session being recorded, and verbal informed consent to the audiotaping was procured from all participants. They were fully autonomous and had the liberty to leave the study as they preferred. The objectives of the focus group were explicated at the commencement of the session. Participants were assured that the procured information would not be used for any purpose except the research, and their identification would remain private. Two such focused group discussions were conducted, by which time the data saturation point was reached, and no further new concepts and ideas appeared in the responses of participants<sup>19</sup>

A qualitative content analysis was executed according to Graneheim and Lundman<sup>23</sup>. In this context, the transcript was read meticulously and repeatedly to attain an overview

of what was talked over during the discussions and accentuate the similar phrases or words associated with the study objective (identifying units of data). The unit of analysis, which is crucial in a content analysis, is a “segment of text that is comprehensible by itself and contains one idea or piece of information”<sup>24</sup>. Subsequently, each data unit was condensed and allocated a code. Similar and different codes were labelled and amalgamated, if practicable. Then, categories arose by grouping the codes (meaningful units), stating similar or different ideas. At last, we employed a general theme for the resulting categories. All transcripts were autonomously coded by two researchers, administering as many codes as feasible for each data segment. All coding and categories recognized were arranged with research members to confirm inter-rater reliability. Any obscurity or conflict concerning the coding was fixed through exchange between two coding researchers, and in the case of not reaching unanimity, a third member of the research team mediated.

As with every qualitative research study, our study reinforces and complies with quality criteria of credibility, transferability, dependability, and confirmability. To meet credibility, researchers had diverse field experience and sustained commitment in all processes of the study. In addition, the procedure of data collection and analysis was scrutinized and reviewed by the research team. Concerning transferability, researchers attempted to furnish a full narrative of the context of the study. We also undertook to have sufficient talk regarding the outcomes with already published works. It should be observed that examining several frames of reference and the handling of direct quotations during the delineation of observations all assisted with the transferability of the study. For dependability, we followed the code re-coding approach. From this perspective, we coded our data twice by two members of the research team. We then matched data to see if any disparities were recognized. As regards confirmability, a qualitative research specialist was solicited to check the coding and analysis processes.

Data triangulation was achieved through multiple data sources. Investigator triangulation will occur because of the incorporation of different disciplinary perspectives into the data analysis. Member checking was conducted at the end of each focus group by checking our perceptions of the main points of the session with participants.

### Data analysis

Microsoft Excel 2007® was used for data entry and statistical analysis. Thematic analysis was used to examine the qualitative data, and proportions were reported as percentages.



Data analysis of FGD - Every member of the analysis unit reviewed each group transcript separately and noted key words, phrases, and major themes, both in response to the specific questions asked and as they spontaneously emerged from student comments.

The responses were then entered into an Excel database, with each sheet in a file being used for each question of the FGD. The coding column was filled during the next phase of analysis, where the categories will be synthesized both by deductive and inductive processes.

## Results

Out of 30 students who took ECG and PFT as electives, 14 were male (46.66%) and 16 (53.33%) were female. Mean±SD of their age was 23 ±1.18 years. Their attendance was 100%. ECG and PFT were their 1st choice among all Block 1 topics in 26 (86.66%) students and were 2nd choice in 4 (13.33%) students. This demographic pattern was depicted in Table 1.

Figure 1 shows the pre-test and post-test score distribution of both ECG and PFT. The Q-Q plot, Shapiro-Wilk test (p value 0.1422), and Kolmogorov-Smirnov test (K-S test statistics D 0.16) results indicate that both pre-test and post-test scores are normally distributed ( $p > 0.05$ ). Therefore, the appropriate statistical test for comparing the means between these two independent groups is the Independent Samples t-test.

Table 2a demonstrates the t-test result of combined ECG and PFT scores. It depicts a significant increase in knowledge of students in both ECG and PFT after completion of electives, with a p-value of 0.0014\*. Table 2b shows the individual comparison between pre-test and post-test scores of the ECG module. Likewise, in this case, a too-significant p-value of 0.0038 was obtained, which illustrates knowledge gain. Table 2c exemplifies the comparison between pre-test and Post-test scores of the PFT module. A p-value of <0.05 (0.000016) signifies substantial knowledge gain in this regard as well.

Figures 2a, 2b, and 2c show the comparison between the pre-test and post-test scores of the students.

Majority of students of both ECG and PFT electives agreed that the objectives of the elective modules were clear to them in advance, the program met their academic needs, they had adequate supervision and hands-on clinical training, appropriate amount of communication skill with patient, peers and clinical staffs, how to maintain privacy while doing clinical test and it met their expectations. (Table 3). Figure 3 depicts the graphical pattern of the perception of students on ECG and PFT electives on a Likert scale.

Thematic analysis of the open-ended question to explain the reason behind choosing ECG and PFT as electives, 48.28% remarked that they wanted to learn the topic as it would help

them to become a good clinician in the future. 37.93% chose it due to its clinical relevance, and 6.9 % replied they were interested in the topics. (Table 4). Figure 4 shows the graphical pattern of this thematic analysis.

Thematic analysis of the responses regarding positive points of the electives identified five themes, e.g., clinical exposure, diagnostic skills, knowledge expansion, practical skills, and overall general positivity. (Table 5) The maximum students pointed out gaining diagnostic skills (34.48%) and expansion of their knowledge (31.03%) as the most admired points of these modules.

Thematic analysis of the reactions regarding negative points of the electives identified five sub-themes. (Table 6) More exposure to clinical cases (46.43%) and shorter duration (only 15 days) (26.66%) were referred to as the adversity of this program.

Table 7 demonstrates suggestions referred by the students to improve the elective module. The majority of Students' (43.33%) inference was that the program was excellent and nothing to suggest. 32.14% students concluded that at least 1month duration is needed for such modules. 17.87% suggested that more case discussions of abnormal ECG and PFT are required to have a sound grip on the subject.

The predominant response from the faculty indicates that the objectives of the elective module were predominantly achieved. A considerable number of faculty members expressed that students demonstrated receptiveness to their educational needs and proactively engaged in the elective activities, as summarized in Table 6.

Furthermore, a majority of the faculty concurred that the elective served as a commendable academic endeavour, with an appropriate time duration allowing for the display of creativity, lateral thinking, and collaborative teamwork. The whole experience of the electives was predominantly rated as good, very good, or excellent by most faculty members, as outlined in Table 8. While the elective provided a new perspective on preclinical subjects, some concerns were raised about the administrative burden of endorsing numerous signatures in the logbooks, as documented in Figure 5.

Faculty participants highlighted several advantages associated with electives, including the prospect of refreshing clinical understanding, developing new clinical abilities, acquiring additional knowledge, and cultivating new skills, thereby gaining enhanced exposure to patients. The supportive nature of fellow faculty members emerged as a notable strength of the program, as delineated in Table 8.

Despite the positive feedback, a notable proportion of faculty members acknowledged that the program implementation did not meet their expectations, attributing this deviation to their demanding schedules, as detailed in

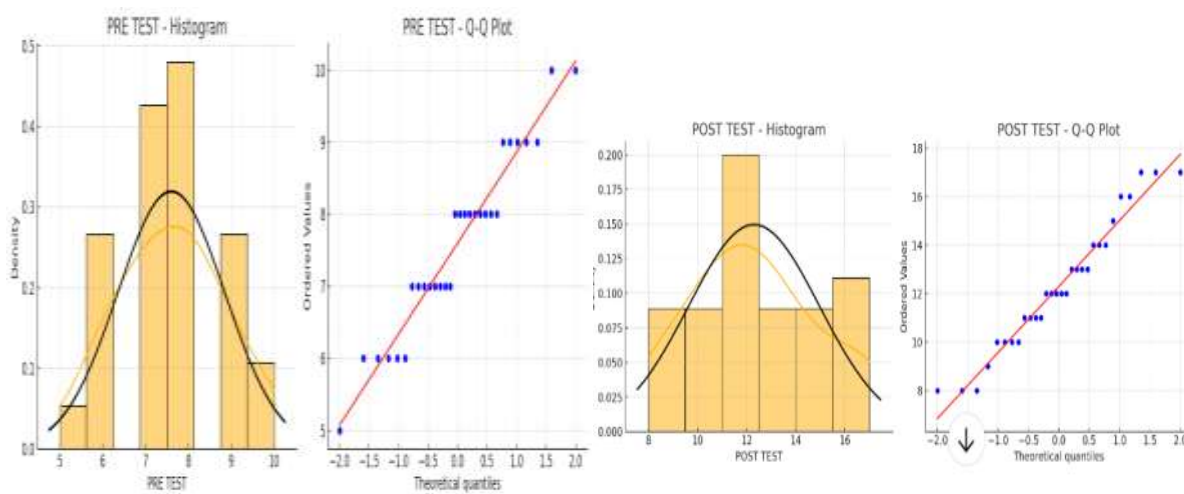
Table 6. Additionally, faculty members provided valuable suggestions for program improvement, as outlined in Table 8.

**Table 1: Demographic pattern of students who choose ECG and PFT electives:**

	ECG and PFT
Total number	30 Male:14 (46.66%), Female: 16 (53.33%)
Average age (Mean± SD)	23±1.18 years
Attendance	100%
Choice of electives in block 1	ECG and PFT were 1 <sup>st</sup> choice- 26 (86.66%) 2 <sup>nd</sup> choice -4 (13.33%)

**Figure 1: Q-Q plot, The Shapiro-Wilk test and Kolmogorov-Smirnov test results indicate that both pre-test and post-test scores are normally distributed ( $p > 0.05$ ).**

Therefore, the appropriate statistical test for comparing the means between these two independent groups is the Independent Samples t-test.



Shapiro-Wilk test	P value: .1422
Kolmogorov- Smirnov test	K-S test statistic (D) is .16107.

**Table 2a: Pre-test vs Post-test score of electives:**

	Mean± SD (n=30)	Degree of Freedom	95% Confidence interval difference	P value
Pre test	10.003± 2.55	58	0.95 to 3.59	0.0014*
Post-test	12.31±2.67	58	0.95 to 3.59	

*The t-value is -5.1113. The p-value is <.00001. The result is significant at  $p < .05$*

**Table 2b: Pre-test vs Post-test score of ECG:**

	Mean± SD (n=30)	Degree of Freedom	P value
Pre test	9.68± 2.67	15	0.0038*
Post-test	12.5±2.89	15	

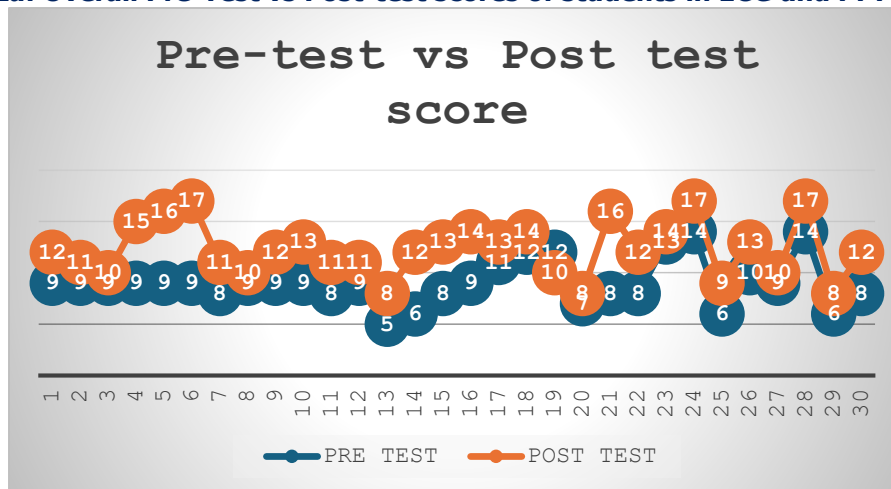
*The t-value is -2.85176. The p-value is .003898. The result is significant at  $p < .05$ .*

**Table 2c: Pre-test vs Post-test score of PFT:**

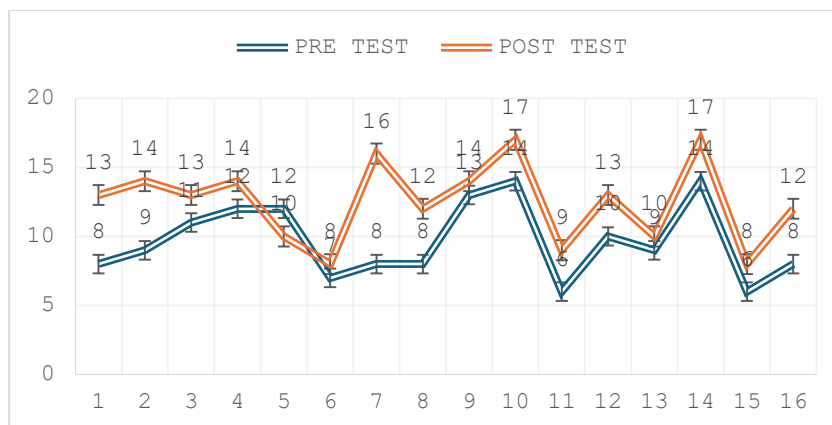
	Mean± SD (n=30)	Degree of Freedom	P value
Pre test	8.35± 1.27	15	.000016*
Post-test	12.07±2.46	15	

*The t-value is -5.00727. The p-value is .000016. The result is significant at  $p < .05$ .*

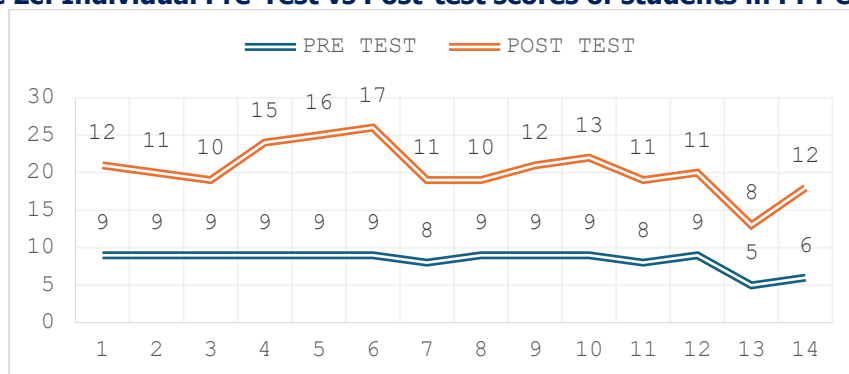
**Figure 2a: Overall Pre-Test vs Post-test scores of students in ECG and PFT electives**



**Figure 2a: Individual Pre-Test vs Post-test scores of students in ECG electives**



**Figure 2c: Individual Pre-Test vs Post-test scores of students in PFT electives**



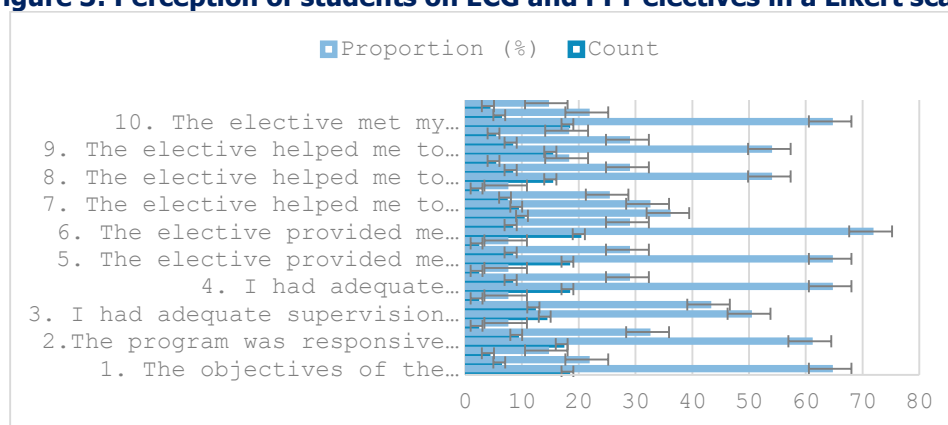
**Table 3: Perception of students on ECG and PFT electives in a Likert scale**

Questions	Response	Count	Proportion (%)	Likert scale score
1. The objectives of the electives were clear to me in advance.	Agree	18	60	4.07
	Strongly Agree	6	20	
	Neutral	6	20	
2. The program was responsive to my needs (both academically and socially)	Agree	17	56.66	4.18
	Strongly Agree	9	30	
	Disagree	4	13.33	
3. I had adequate supervision during training.	Agree	14	46.66	4.35
	Strongly Agree	12	40	
	Neutral	4	13.33	
4. I had adequate opportunities for hands-on clinical work	Strongly Agree	18	60	4.57
	Agree	8	26.66	
	Neutral	4	13.33	
	Agree	18	60	



5. The elective provided me with an appropriate amount of communication skills with patients	Strongly Agree	8	26.66	
	Neutral	4	13.33	
6. The elective provided me an active learning through discussion/ participation	Agree	20	66.67	<b>4.28</b>
	Strongly Agree	10	33.33	
7. The elective helped me to learn how to deal with a different culture and how to maintain the privacy of patients while performing clinical tests	Agree	1	3.33	<b>4.28</b>
	Strongly Agree	20	66.67	
	Neutral	9	30	
8. The elective helped me to learn how to communicate with patients	Agree	15	50	<b>4.10</b>
	Strongly Agree	10	33.33	
	Neutral	5	16.67	
9. The elective helped me to learn how to deal with co-workers and non-clinical staff in a working environment	Strongly Agree	15	50	<b>4.10</b>
	Agree	10	33.33	
	Neutral	5	16.66	
10. The elective met my expectations	Agree	18	60	<b>4.07</b>
	Strongly Agree	8	26.67	
	Neutral	4	13.33	

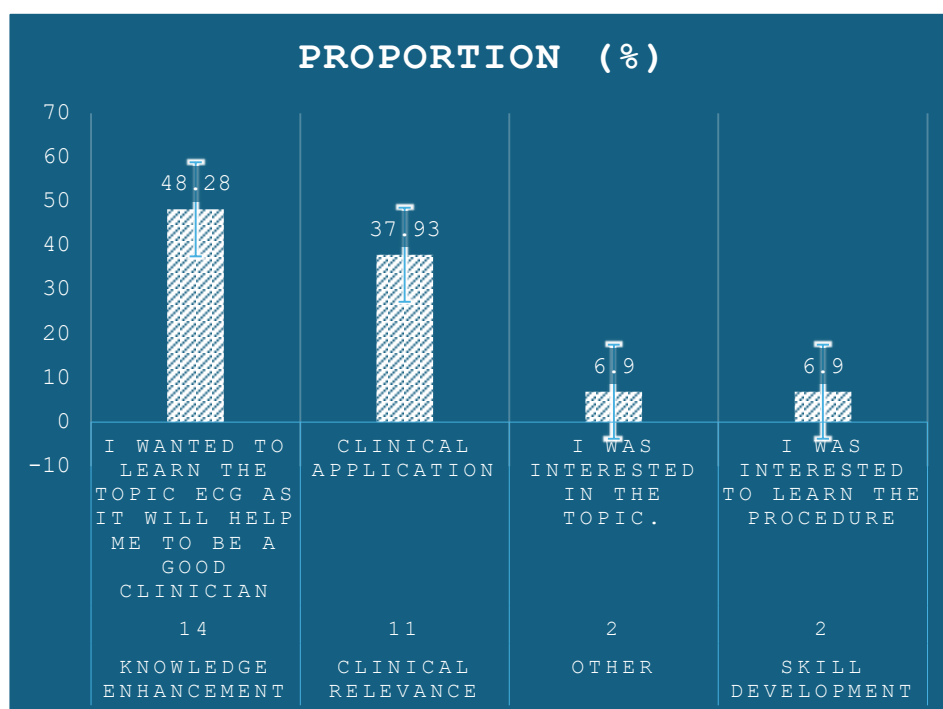
**Figure 3: Perception of students on ECG and PFT electives in a Likert scale**



**Table 4: Typical Responses to the open-ended questions by Students (Why you have chosen these electives?): (Thematic analysis)**

Theme	Count	Example	Proportion (%)
Knowledge Enhancement	14	I wanted to learn the topic as it will help me to be a good clinician	48.28
Clinical Relevance	11	Clinical application	37.93
Other	5	I was interested in the topic.	6.9

**Figure 4: Reason to choose ECG or PFT as electives:**





**Table 5: Positive points about the electives (Thematic analysis)**

Theme Positive points about electives	Sub-themes	Number	Proportion (%)	Examples
1	Clinical Exposure	3	10.34	'Clinical application'
2	Diagnostic Skills	10	34.48	'I wanted to learn the topic as it will help me to be a good clinician', 'It is an essential skill to diagnose patients'
3	General Positive	4	13.33	'To have a hand on practice how to do spirometry on the clinical scenario',
4	Knowledge Expansion	9	31.03	'I want to learn that. It is important.'
5	Practical Skills	5	17.24	'I wanted to learn about the procedure and interpretation of ECG as it is of great importance in clinical practice and has many diagnostic values'

**Table 6: Negative points about the electives (Thematic analysis)**

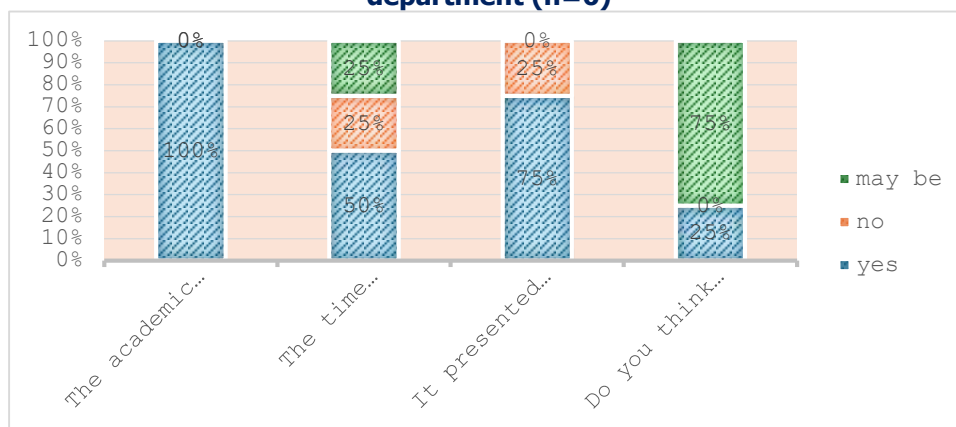
Theme Negative points about electives	Sub-theme	Number	Proportion (%)	Examples
1	Content Overload	3	10.71	Abnormalities of ECG &PFT were tough
2	General Issue	13	46.43	Needed a few more seatings.
3	Insufficient Classes	3	10.71	'If more classes could have been arranged.',
4	No Negative Feedback	3	10.71	'I want to learn that. It is important.'
5	Short Duration	8	26.66	'The time duration of the elective should have been a bit longer to learn more about the interpretation of the ECG', 'Only 14 days is very short for learning.'

**Table 7: Suggestions to improve in the future (Thematic analysis)**

Theme Positive points about electives	Sub-theme	Number	Proportion (%)	Examples
1	General Suggestion	13	43.33	'Nothing to suggest. It was excellent'
2	Increase Duration	9	32.14	'The duration of the elective should be at least 1 month, as it is not possible to learn ECG in 15 days, and it requires more practice.' 'The time duration for

				the elective should be at least 1 month'
3	More Classes	5	17.86	'Required more class on abnormalities of ECG and PFT'
4	No Suggestion	3	10.71	'Not such'

**Figure 5: Perception of medical teachers on electives ECG and PFT at the Physiology department (n=6)**



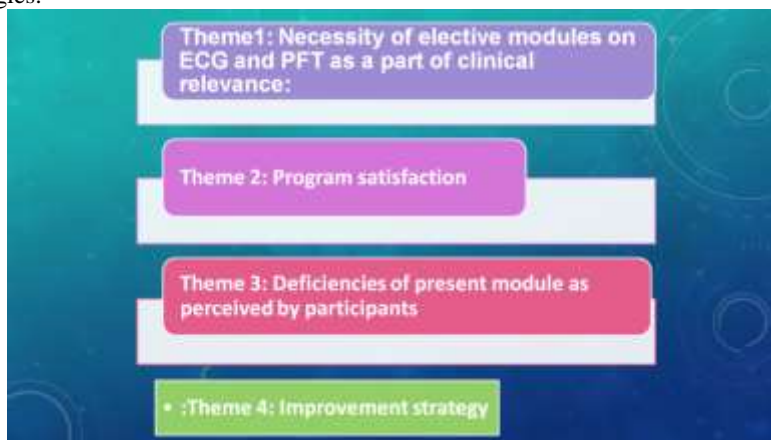
**Table 8: Typical Responses to the open-ended questions by Teachers:(Thematic analysis)**

Positive points	n	%
The strength lies in individual interactions of teacher and student since the number of students is small. Every student gets an equal opportunity to clear misconceptions and understand the subject matter better. Performing the procedure on their own under the supervision of a teacher gives confidence to the student to face real-life situations demanding the manoeuvre later on.	4	66.66
It will help students to have a taste of their area of interest. Also, it will increase students' confidence	3	50
In-depth study of the modules and a hands-on approach	1	16.66
Negative points	n	%
Duration was limited to get full confidence or control over the test	6	100
Integration with clinical faculty is lacking, and this can be considered a weakness	2	33.33
The infrastructure of all medical colleges is not uniform. So, students of rural medical colleges like us are getting less exposure to super-speciality departments	1	16.66

**Focus group discussion with the participants**

The qualitative analysis of the focus group discussion revealed four themes.1) Necessity of elective modules on ECG and

PFT as a part of clinical relevance) Program satisfaction 3) Deficiencies of the present module as perceived by participants  
4) Improvement strategies.



### Theme 1: Necessity of elective modules on ECG and PFT as a part of clinical relevance:

Students believed that ECG and PFT should be included as elective modules. Student 24 pointed out, "I wanted to learn the procedure as it is of great importance in clinical practice and has many diagnostic values." Student 25 felt, "I wanted to learn the topic as it will help me to be a good clinician". Student 17 pointed out, "I wanted to have a hands-on practice so that it will help me in a clinical scenario". Student 16 depicted "I wanted to have hands-on training and the ability to interpret the result, as it will be helpful for me in the future".

### Theme 2: Program satisfaction

Student 1 stated, "I had opportunities to perform the test on my own and got a chance to communicate with the patient". Student 8 described, "It was an interactive session, and I had opportunities for hands-on clinical work". Student 4 remarked, "Basic concepts were clear with clinical interpretation". Student 9 pointed out, "Learned the concepts behind waves and gained knowledge". Student 6 felt "Learning cardiac abnormality curve made me more confident." Student 15 suggested "The program was excellent."

### Theme 3: Deficiencies of the present module as perceived by participants

The majority of the students felt the time duration of this module was inadequate. Student 2 stated, "Only 14 days is very short to learn such clinical procedures in detail." Student 23 pointed out "More theory classes are needed to understand abnormal ECGs. Students 20 felt 'I would like more days of hands-on experience'"

### Theme 4: Improvement strategy:

All that a good elective module like ECG and PFT requires is fostering more clinical exposure and hands-on practice. This was reflected in the students' discussion. Although 10 students stated, 'There is nothing to suggest, it was excellent', student 2 felt "The time duration for the elective should be 1 month at least. Student 4 suggested 'Better time management and effective distribution of topics taught every day can be done better.'" Interestingly, one student suggested, "There should be arrangements for refreshment on the day of presentation. Student 11 felt "There should be more classes on abnormal ECG interpretation".

Theme	Responses
<b>Theme 1: Necessity of elective modules on ECG and PFT as a part of clinical relevance:</b>	<i>"I wanted to learn the procedure as it is of great importance in clinical practice and has many diagnostic values." "I wanted to have a hands-on practice so that it will help me in clinical scenario"</i>
<b>Theme 2: Program satisfaction</b>	<i>"I had opportunities to perform the test on my own and got chance to communicate with patient". Basic concepts were clear with clinical interpretation"</i>
<b>Theme 3: Deficiencies of present module as perceived by participants</b>	<i>"Only 14 days' time is very short to learn such clinical procedures in detail" "More theory classes are needed to understand abnormal ECGs"</i>
<b>Theme 4: Improvement strategy</b>	<i>"The time duration for the elective should be of 1 month at least". "There is nothing to suggest, it was excellent". "There should be arrangement for refreshment on the day of presentation"</i>

### Discussion:

There is no single teaching-learning method that is suitable for all students. Thus, there is an extreme requirement to revamp teaching/learning experience to each student, which substantiates the essence of electives in pre-graduated curricula.<sup>15, 16</sup>Hence, as instructed by the National Medical Commission (NMC) of India (Medical Council of India, 2020), the elective module was administered in our medical college for MBBS students of batch 2021.

All the students actively took part in the electives module. Most students said that the elective program met their expectations. They had adequate opportunities for hands-on clinical work and also had sufficient supervision during their training. Electives helped them to secure proper communication skills with patients, to learn how to deal with co-workers and other staff in working environments, and to work as a team. Students' perception was very optimistic regarding the elective module. This agrees with the studies done by Couper et al in 2015 and Ahsin et al. in 2016<sup>16,17</sup>. Students' apprehension was very encouraging regarding the elective module. Most of the students appraised the total experience of electives as 'good' or above. Students acknowledged that it was an excellent academic activity. Also, it provided them with a chance to demonstrate their

ingenuity and lateral thinking, and to function as a member of the healthcare team. They achieved a new outlook on preclinical subjects. This result is from the studies done by Van den Broek et al<sup>17</sup>.

All 30 students stated they chose ECG or PFT as they wanted to know more about the topics. 11of them felt the need for clinical application of these procedures in the future. Almost the same result was obtained by Kalpesh Vidja<sup>18</sup> et al in their study performed in a medical college of Gujarat.

Regarding the positive notes of the program, students mentioned that electives gave them an opportunity to gain practical application of knowledge, to develop interpersonal skills, and direct exposure to patients. They felt active learning through discussion would be helpful for the conditioning of the final professional exam.

Regarding the implausibility of the program, most students responded that there were none. However, some said that it was not as expected due to the busy schedules of the faculty members. Harvey et al., Ramalho et al., van den Broek, Wu & Greenberg<sup>and</sup>, reported identical findings in their studies <sup>3,17,19,20</sup>.

Students gave some important recommendations regarding the program, too. Most of them propounded that increasing



the duration of electives would be more effective. During the interview, almost all students acknowledged they had gained erudition on the topics, and this upgraded their ability to interpret the results of ECG and PFT in a clinical setting. Our quantitative analysis of the pre-test and post-test scores also depicted that students have gained statistically significant knowledge after the completion of the module.

The overall notion of faculty toward the elective module was primarily favorable, with a convincing proportion rating the experience as 'good' or higher. Faculty conceded the module as appreciable academic activity, with the supremacy of this program lying in individual interactions of teacher and student, since the number of students is small. They agreed that every student gets an equal chance to clear misconceptions and understand the subject matter better. Performing the procedure on one's own under the supervision of the teacher gives confidence to the student to face real-life situations demanding the maneuver later. They also noted that electives would help students to have a taste of their area of interest and would increase students' confidence. Teachers suggested that a deep study of the modules and a hands-on approach is the essence of the elective.

Faculty members recognized electives as a means of expanding one's knowledge base, honing one's skill set, and getting hands-on experience with patients while discussing the program's merits. Past studies done by Neel et al<sup>21</sup> and Drum et al<sup>22</sup> reported similar findings.

While most faculties perceived no weaknesses in the program, some noted that the duration was limited to gain full confidence or control over the procedure. Some of them also pointed out that integration with clinical faculty is lacking, and this can be considered a weakness.

### Strengths, Weaknesses, Opportunities, and Challenges analysis

#### Strength:

1. Mixed-method design combining quantitative (pre-post-test, Likert scale) and qualitative (FGDs, open-ended responses) furnishes robust triangulation.
2. Statistically significant enhancement in knowledge shown by t-test ( $p < 0.05$ ).
3. 100% attendance and high engagement of students.
4. Positive perception from both students and faculty toward hands-on experience and skill development.
5. Validated tools and ethical clearance assure study quality.
6. Integration of focus group discussions augments the depth of insight

#### Weakness

1. Small sample size ( $n=30$ ), limits generalizability.
1. Single-institution study reduces external validity.

2. Short duration (15 days) is perceived as inadequate by both students and faculty.

3. Infrastructure limitations in rural medical colleges are mentioned.

4. Lack of integration with clinical departments is cited by faculty.

#### Opportunities

1. Scalable model for implementing electives across other preclinical departments.

2. Improvement suggestions (e.g., longer duration, more clinical case discussions) can guide future modules.

3. Faculty development and interdisciplinary integration could enhance effectiveness.

4. Can inform policy changes in NMC elective implementation.

#### Challenges

1. Faculty time constraints and administrative burdens (e.g., logbook signing).

2. Non-uniform infrastructure across colleges might hinder replication.

3. Possible resistance to curriculum change or elective expansion without institutional support.

4. Risk of electives being treated as a formality without adequate supervision and feedback mechanisms.

#### Conclusion

This study depicted a successful implementation of electives in the Physiology department, emphasizing the potential of pre-clinical subjects as a topic for electives. Students' positive perception impels us to promote and expand. The faculty's insight offers constructive recommendations for improving the upcoming execution of the elective module.

#### Limitation

The study was done at a single medical college and with a single batch of MBBS students. Including more batches and a greater number of medical colleges will give a better view of the research hypothesis.

#### Translatory component actualized in the study

**Educational Problem Identified:** Incorporation of ECG and PFT electives into the MBBS curriculum as hands-on, skill-based modules.

1. **Knowledge Application:** Statistically significant improvement in pre- and post-test scores (e.g., ECG:  $p = 0.0038$ ; PFT:  $p = 0.000016$ ). Therefore, it is illustrated that structured electives intensify students' clinical knowledge.



2. **Student-Centered Learning:** High levels of contentment and worthwhile perception from students (Likert scale > 4.0 across responses). It highlights active learning, self-directed practice, and student-led presentations.
3. **Skill Translation:** Students delineated increased diagnostic skills, communication, privacy maintenance, and teamwork. Hence, direct clinical skill-building and communication competence are executed through supervised hands-on sessions.
4. **Curricular Integration:** NMC-mandated electives (2 weeks) assessed through formative and summative tools. In this study, Logbook, assessments, and FGD are combined as part of the customary curriculum.
5. **Feedback Loop for Curriculum Improvement:** Feedback from students and faculty on short duration and sparse integration with clinical departments. This study gives propositions for increasing the duration to 1 month and escalating interdepartmental collaboration.
6. **Faculty Development:** Faculty acclaimed upgraded teacher-student interactions and the need for interdepartmental integration. Hence, this study acknowledged the need for institutional support, time, and interdisciplinary teaching.
7. **Research into Practice:** Mixed-methods research initiated actionable insights. So, Methodology and findings can be recreated in other institutions for similar outcomes.
8. **Capacity Building:** Teachers and students were inculcated to co-develop, assess, and refine electives. Consequently, building enduring modules for future groups with possibilities for professional networking.

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### Conflict of interest

None declared

### Ethical approval

YES

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