



Implementation and Evaluation of a Structured Pharmacology Research Training Model for Phase II MBBS Students

*Dr Archana Dhavalshankh¹, Dr Meeta Burande²

1. MD Pharmacology, Professor & Head, Department of Pharmacology, D Y Patil, Medical College, Kolhapur, Maharashtra, India.

2. MD Pharmacology, Professor, Department of Pharmacology, D Y Patil, Medical College, Kolhapur, Maharashtra, India.

*Corresponding author's E-mail: archana9595@yahoo.com

Received: 16-02-2026; Revised: 28-04-2026; Accepted: 05-05-2026; Published online: 20-05-2026.

ABSTRACT

Background: Competency-based medical education emphasizes early exposure to research methodology and applied clinical skills. However, structured frameworks integrating research training into undergraduate pharmacology teaching remain limited.

Objectives: To implement and evaluate a structured pharmacology research training model integrated into clinical postings for Phase II MBBS students.

Methods: This prospective educational interventional study was conducted over three months among Phase II MBBS students at a tertiary care teaching hospital in India. Students underwent structured training in prescription analysis, research methodology, ethical data handling, and standardized data recording. Prescription-writing competency was assessed using a checklist-based scoring system (maximum score 20) through pre- and post-tests. Student perception of learning outcomes was measured using a Likert scale. Data were analyzed using descriptive statistics and Chi-square test, with $p < 0.05$ considered statistically significant.

Results: out of 150 enrolled students, 143 (95.3%) completed all activities. Mean prescription-writing scores improved from 11 to 17 after intervention. The number of students demonstrating competency increased from 73 to 130 for prescription accuracy, 65 to 125 for completeness, 81 to 138 for confidence, and 73 to 132 for applied pharmacology understanding. Perception scores improved significantly from 2.19 ± 0.55 to 3.90 ± 0.39 ($\chi^2 = 229.58$, $p < 0.001$).

Conclusion: Structured pharmacology research training integrated into clinical postings significantly improves prescribing competency, confidence, and applied pharmacology understanding among undergraduate medical students. The model is feasible, scalable, and suitable for incorporation into competency-based medical curricula.

Keywords: Pharmacology education; Undergraduate research; Prescription writing; Medical students; Competency-based education.

INTRODUCTION

Pharmacology is a core discipline in undergraduate medical education that provides the scientific foundation for rational therapeutics, safe prescribing, and evidence-based clinical decision-making. Despite its importance, traditional pharmacology teaching has historically relied on didactic lectures and theoretical examinations, which may not sufficiently develop clinical reasoning or practical prescribing skills. Several studies have highlighted deficiencies in prescribing competence among medical students and recent graduates, suggesting that conventional instructional approaches alone are inadequate for preparing learners for real-world clinical responsibilities.¹ Educational reforms therefore emphasize the need for structured and competency-oriented teaching strategies that integrate knowledge with application.

Recent innovations in medical education advocate active learning approaches to enhance student engagement and skill acquisition. Technology-enhanced modules and simulation-based teaching have demonstrated improvements in learner participation, conceptual understanding, and retention of pharmacological principles.² Similarly, interactive instructional strategies such as role-play and scenario-based training have been

shown to positively influence student attitudes toward pharmacology and improve academic performance.³ These findings support the shift from passive content delivery toward learner-centered pedagogies that foster critical thinking and clinical application.

However, multiple reports indicate that undergraduate students often experience difficulty translating theoretical pharmacology knowledge into practical prescribing decisions. Challenges frequently cited include poor understanding of drug selection principles, uncertainty regarding dosage calculations, and limited confidence in prescription writing.⁴ Such gaps highlight the need for structured educational models that provide guided clinical exposure and opportunities for supervised practice. Integrating experiential learning into pharmacology teaching may help bridge this gap by allowing students to apply theoretical concepts in authentic clinical contexts.

Phase II of the MBBS curriculum represents a crucial stage for introducing applied pharmacology training because students begin clinical postings while still consolidating foundational pharmacological knowledge. Educational research suggests that collaborative and team-based learning approaches improve knowledge retention, problem-solving ability, and application of pharmacological



concepts.⁵ Embedding structured research activities within clinical training can further strengthen these outcomes by promoting analytical thinking, data interpretation skills, and familiarity with research methodology. Early exposure to research processes has also been associated with improved scientific reasoning and a greater appreciation of evidence-based medicine.

In line with competency-based medical education frameworks, there is growing recognition that undergraduate training should not only impart knowledge but also develop practical skills, professional attitudes, and research literacy. Structured research-oriented learning models that integrate clinical exposure, supervised data collection, and performance assessment may therefore represent an effective strategy to enhance pharmacology competency. The present study was undertaken to implement and evaluate a structured pharmacology research training model for Phase II MBBS students and to assess its impact on prescription-writing performance, learner perception, and applied pharmacology understanding.

MATERIALS AND METHODS

Study design and setting

This prospective educational interventional study was conducted over three months in the Department of Pharmacology at D. Y. Patil Medical College & Hospital, Kolhapur, Maharashtra, India.

Participants

All Phase II MBBS students posted during the study period were included. As the activity formed part of routine curriculum implementation, no sampling was performed. Out of 150 enrolled students, 143 completed all components.

Intervention

A structured pharmacology research training framework was developed to provide hands-on exposure to research methodology and applied pharmacology. The intervention included:

- Orientation sessions on prescription writing and audit
- Training in basic research methodology
- Ethical principles of clinical data handling
- Use of standardized data collection templates

Faculty supervised all activities to ensure uniformity and adherence to protocol.

Data collection

Students collected anonymized prescription data from admitted patients across clinical departments. Recorded parameters included diagnosis, drug name, dose, route, frequency, duration, and documentation of adverse drug

reactions where applicable. Standardized formats ensured consistency of data recording.

Outcome assessment

Prescription-writing competency was evaluated using a structured checklist-based scoring system. The maximum possible checklist score was 20 points, with higher scores indicating better performance. Students completed pre-test and post-test prescription exercises, and performance improvement was determined by comparing mean scores before and after the intervention. Student perception of learning outcomes was assessed using a Likert scale (1–5), and changes in score distribution were analyzed.

Data analysis description

Student performance and perception data were compiled in a master dataset. Improvement in performance was assessed using mean score differences, while changes in perception score distribution were evaluated using Chi-square testing.

Ethical considerations

The study involved anonymized data collected as part of an educational activity with no patient identifiers recorded. Institutional Ethics Committee review determined the study to be exempt from formal approval.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using descriptive and inferential statistics. Continuous variables were expressed as mean \pm standard deviation, and categorical variables as frequencies and percentages. Pre- and post-intervention score distributions were compared using the Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 150 students were enrolled, of whom 143 (95.3%) completed all study components (Table 1).

Table 1: Participant Flow

Variable	n (%)
Enrolled	150
Completed	143 (95.3)
Not completed	7 (4.7)

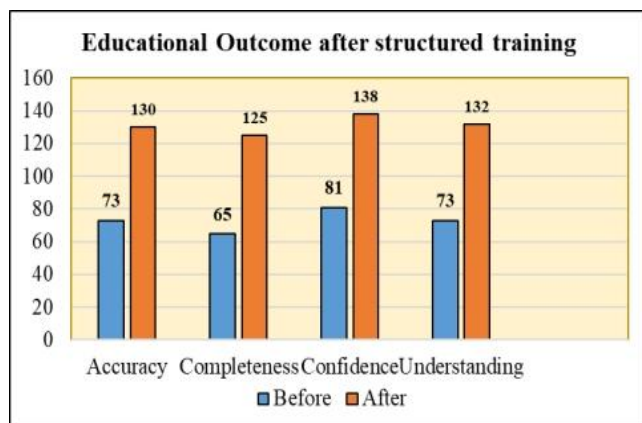
Mean prescription-writing scores improved from 11 in the pre-test to 17 in the post-test, indicating substantial improvement in prescribing competency (Table 2).

Table 2: Prescription Writing Scores Before and After Intervention

Assessment	Mean Score
Pre-test	11
Post-test	17
Mean difference	+6



All assessed domains demonstrated improvement following training (Graph 1).



Graph 1: Comparison of educational outcomes before and after structured pharmacology training. All parameters show marked improvement following intervention.

The number of students demonstrating competency increased from 73 to 130 for prescription accuracy, 65 to 125 for completeness, 81 to 138 for confidence, and 73 to 132 for understanding of applied pharmacology.

Students showed progressive improvement in documentation during supervised exercises. Feedback indicated that most participants perceived the activity as beneficial for understanding clinical pharmacology, prescription structure, and research methodology. (Table 3)

Table 3: Comparison of Student Perception Scores Before and After Training

Assessment	Mean \pm SD	Statistical Test	p-value
Before training	2.19 \pm 0.55	$\chi^2 = 229.58$	<0.001
After training	3.90 \pm 0.39		

Scale: Likert score (1–5); higher score indicates better perception.

Distribution of perception scores differed significantly before and after the intervention (Chi-square test, $\chi^2 = 229.58$, $df = 4$, $p < 0.001$), demonstrating statistically significant improvement in student confidence and understanding following structured pharmacology research training.

DISCUSSION

The present study demonstrated that implementation of a structured pharmacology research training model integrated into clinical postings significantly improved prescription-writing competency and student perception of applied pharmacology. Educational interventions involving structured prescribing exercises have previously shown improvement in prescribing knowledge and confidence among undergraduate students.^{1,6}

The improvement observed in mean prescription scores suggests that experiential participation in supervised clinical data collection enhances understanding of rational

pharmacotherapy. Studies evaluating hands-on prescribing interventions similarly report significant gains in student competence and clinical reasoning ability⁶. Baseline deficiencies in prescription-writing skills among medical students have also been documented, emphasizing the need for structured training during undergraduate education.⁷

Perception scores in the present study improved significantly after intervention, indicating enhanced confidence and engagement. These findings are consistent with literature showing that active learning strategies such as role-play and team-based learning improve student attitudes and academic performance in pharmacology.^{3,5} Technology-enhanced or structured clinical modules have likewise been shown to increase learner motivation and competency development.²

The high completion rate observed suggests that integrating research-oriented learning into routine curricula is feasible and acceptable. Educational studies indicate that when applied learning is embedded within formal curricula rather than offered as optional activities, participation and outcomes improve significantly.⁸ Addressing student-reported difficulties in pharmacology learning is essential for improving educational effectiveness, and structured experiential models may help overcome these barriers.⁴

A major strength of this study is inclusion of the entire student cohort rather than a selected volunteer group, improving generalizability and real-world applicability. However, the single-institution design and short duration may limit broader extrapolation. Future multicentric and longitudinal studies could evaluate long-term retention of prescribing skills and impact on clinical practice.

Overall, the findings support integration of structured research-based learning into undergraduate pharmacology curricula. Such approaches align with contemporary educational frameworks emphasizing competency development, evidence-based practice, and research literacy.

CONCLUSION

A structured and supervised pharmacology research training framework integrated into clinical postings significantly enhances prescription-writing competency, research awareness, and applied pharmacology understanding among undergraduate medical students. The model is feasible, scalable, and suitable for incorporation into competency-based medical curricula.

Source of Support: The author(s) received no financial support for the research, authorship, and/or publication of this article

Conflict of Interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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