RESEARCH PAPER

Impact Of A Clinical Pharmacology And Therapeutics Workshop On Prescription Errors Among Medical Interns

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ABSTRACT

Introduction: Writing a medication order is an important task that any doctor is entitled with. It is highly important for medical students to attain necessary prescribing competencies before individual practice. However, it is noted that maximum medication errors are committed by junior doctors due to lack in essential clinical pharmacological and the applied knowledge. Introducing educational interventions that helps the students achieve necessary prescribing competencies is the need of the hour.

Methods: A 3 day interactive workshop on clinical pharmacology and therapeutics module was conducted for medical students before starting internship. A pre test and post test was conducted before and after the workshop to assess the effect of workshop on their clinical and pharmacological skills.

Result: A pre test was conducted on all the students followed by a 3 day interactive workshop by experienced faculty members. At the end of the workshop, a post test was conducted. The result was evaluated using students paired t test. The mean test score significantly improved from 5.47 ± 1.9 [pre-test mean] to 7.63± 1.75[post-test mean] ($p < 0.01$)

Conclusion: Lack in essential medical competencies amongst the junior doctors is the most common cause of medication errors. Educational interventions like interactive workshop on clinical pharmacology and therapeutics can be help improve their prescribing competencies and help decreased medication errors. However, larger studies involving larger study population focussing on longer effect of the intervention are needed to come to a final conclusion.

Keywords: medical education; workshop; prescription errors; clinical pharmacology and therapeutics; educational intervention

How to cite this article: Ansari A, Shivasakthy M, Hasan K. Impact of a Clinical Pharmacology and Therapeutics Workshop on Prescription Errors among Medical Interns. Int J Drug Deliv Technol. 2026;16(2): 599-606. DOI: 10.25258/ijddt.16.2.64

Introduction:

Prescribing medications is an important task for any doctor. It involves understanding the patient's condition, finalizing a suitable treatment based on the patient's condition, and weighing it based on benefit versus harm. It is an integral part of the health care system that not only affects the patient's health but also the health care system and cost of the health care. Prescription errors occur as a result of a defect in prescription writing process or a wrong prescribing decision. This can not only result in an unintentional and significant reduction in the effective treatment but also increases the risk of harm to the patient.[1] These errors can occur at any stage like by the prescribing physician, by the dispensing pharmacist by the caretaker, or by the patient himself. Most important and dangerous of all are those that are conducted at the level of the prescribing physician or the practicing doctor. Several scholarly articles have shown that maximum errors in the prescription are being made by junior doctors.[2,3,4] More than half of the hospital prescriptions are being prescribed by junior doctors, interns, and 1st year postgraduate students. But, important to notice is that prescription errors are being committed twice more than that of the senior doctors or consultants.[5]

The cause of prescription errors can be due to one of the following reasons: the prescriber's therapeutic training, drug knowledge, and experience, knowledge of the patient, perception of the risk and their physical

and emotional health, the patient's characteristics and the complexity of the individual clinical case.[6] A study conducted by Alanazi[4] MA on junior doctors has shown that prescribing errors occur due to knowledge-based mistakes, rule-based mistakes, and execution failures like slips, lapses, violations and communication errors. Amongst these, the maximum was related to knowledge-based followed by ruled-based mistakes. Many studies have focussed on the incidence and types of prescription errors but very few studies have focussed on the solution dealing with these issues. Many models were used to classify the causes of prescribing errors, understanding which helps to develop strategies and techniques to reduce errors. Reasons model of accident causation[7] is the most common model that is used to classify prescribing errors. It also incorporates error-causing conditions that predispose a doctor to cause an error.

A study was conducted on interns focussing on the incidence and types of prescription errors, followed by feedback by the interns relating to the cause of prescription errors, and the methods to improvise it[8]. It showed that the major cause of prescription errors was a lack of clinical pharmacological knowledge related to the current medications commonly encountered during routine clinical practice. The attitudes of the students towards prescription writing had an important effect on the incidence and prevalence of prescription errors. It was important to introduce a medical education-related workshop for the final year students about to enter internship, with regards to clinical pharmacology and therapeutics, to decrease the incidence of medication errors. Keeping in mind the above causes and conditions, a module was developed named “Clinical Pharmacology and Therapeutics” to decrease prescription errors.

Therefore, this study aimed to develop and evaluate a 'Clinical Pharmacology and Therapeutics' workshop for medical interns and assess its impact on their knowledge of prescription principles and error prevention.

Methods:

The quasi-experimental study was conducted on medical students who have completed their final year exams and have started internships. The study was conducted on 100 medical interns (minimum sample size of 80,calculated by Yamane’s formula[9], with a population size of 100, population proportion 50% , margin of error 5 and confidence level of 95%), selected by purposive sampling, at a recognized medical college in South India. Students who failed in their final year exams, students transferred from other institutions and students who already had CPT training before the start of the study were excluded from the study. The institutional Ethics committee approved the study. (Approval Number: No.18/AES/AIMS/ECC/2022/05). Confidentiality of all the subjects was maintained throughout the study.

A workshop was conducted for the medical interns for 3 days from 02/06/2022 to 04/06/2022 involving different sessions. A pre-test assessment was conducted on the subjects before the start of the workshop to assess the pre-existing practical knowledge regarding clinical pharmacology, prescription errors, and their importance involving questions dealing with major medical specialities, case scenarios and daily clinical situations. Test format included 4 short answers, 4 multiple choice questions, 2 extended matching items and 2 script concordance test. Questions were framed after identifying most common type of prescription errors based on literature review and published research. Focus group discussions were conducted with post graduate students and other doctors practising in the hospital to ensure the ground reality of the situation which helped us in preparing a questionnaire design. Questions were framed in a clear and understandable manner and later validated by a panel of experts involving Assistant and Associate professors working in the department of medicine. Changes were made based on the expert’s opinion. This was followed by testing the draft questionnaire with a sample of target respondents and reviewing their views and interpretation. Any points of confusion were adjusted based on their feedback. Pilot testing of the questionnaire was finally done to check for its reliability and validity and the final questionnaire was ready after refining it based on the pilot test results. One of the sample question included in the questionnaire was “A 50 yr old male hypertensive patient is on treatment with Ramipril and Spironolactone. Now he presents with fatigue and palpitations. ECG shows tall T waves in V1-V3. What is the cause and next step in management?” This question presents a clinical scenario that tests the clinical knowledge of the students and drug interactions. It emphasises on

understanding the effect of drugs and how drugs should be selected in different patients based on clinical signs and symptoms. Management of such patient explores cognitive and affective domains, where the doctor acknowledges the medication error and takes a step to improve patient's safety.

Purpose of the workshop

This workshop explores the extent of medication errors done by undergraduates during their final year of medical school. A workshop is conducted on the Clinical Pharmacology and Therapeutics module that aims to train future medical practitioners in minimizing the incidence of medication errors. It involved more experimental learning about prescribing, emphasizing the outcome-based curriculum. Although the underlying principles of why an error occurs are universal, a basic revision of the pharmacological principles just before entering clinical practice might be helpful.

Learning objectives

By the end of this workshop, participants should:

1. Be introduced to an understanding of why errors occur

2. Begin to understand which actions can be taken to improve patient safety

3. Be able to describe why there should be greater emphasis on patient safety in hospitals

4. Identify local policies and procedures to improve the safety of care for patients

Objectives of CPT Module:

1. Knowledge of the Mechanism of Action of commonly used drugs to extrapolate the likely effects of drugs and their combinations.
2. Knowledge of pharmacological principles to use Appropriate Dosing regimens to optimize drug effects.
3. Rational prescribing of the medicines by choosing the correct indicated drug and its route of administration
4. Knowledge of Pharmaco-epidemiology affecting the drug utilization.
5. Knowledge of Common and severe Adverse Drug Reactions, their identification and management.
6. Knowledge of Drug Errors, their identification and correction.
7. Knowledge of Drug Overdose of commonly used medicines.

An important key factor in the successful completion of the workshop involved the enthusiastic and active involvement of the faculty members in the development of the curriculum and training of the staff for conducting the workshop. The concerned faculty members were trained for sufficient time to help students achieve the learning objectives. It involved active discussion and training about recent developments in the field of medical education, having an impact on the learning and understanding of the students. Case studies were developed by different faculty members keeping in view the common clinical cases and their treatment and related relevant information. Emphasis was laid on commonly encountered cases and common mistakes made by the junior doctors.

The workshop first involved an introduction regarding prescriptions and their importance by the researcher. The details regarding the rational treatment, general principles of prescribing, how to write an ideal prescription, different drug forms, and how to monitor treatment were explained. These were conducted keeping in view educational theories like behaviourism, cognitive thinking, and constructivism. Vocal praise and reward points are used as a behaviorist approach during the workshop, allowing the students to strive for the better. Constant feedback or reinforcement is observed during the workshop to understand whether the students are being benefited or not from the workshop. We have used real life case scenarios during the workshop, which are then discussed and solutions are searched to help students develop cognitive thinking. The Students construct knowledge adding on prior experience. In the workshop, students are allowed to work individually as well as in groups, encouraging discussion and sharing of ideas. This helps the students gain knowledge, not only from the books, but also from the experience of the teachers and the co – students. It involved active discussion, assertion and reasoning, and query raising and clearing by the active involvement of the participants. It was followed by an introduction to prescription errors, their incidence, the different types, and factors causing them, and how to tackle them. The contents were organized using lectures, whiteboards, small group discussions, case-based studies, and also activity involving active questioning, assertion, reasoning, and understanding by the participants. It was followed by a brief discussion on common medical conditions and drugs used in cardiology, haematology, pulmonology, gastroenterology, neurology, nephrology, infectious

disease, orthopaedics, and rheumatology. Common cases encountered in these specialties by the medicine intern, mostly prescribed medications, their interactions, and contraindications were discussed in an interactive session. Students were involved in active Case studies by forming small groups followed by constructing new ideas by discussing amongst their peers and developing cognitive thinking. After the end of the 3-day workshop, a post-test was conducted to assess the performance of the students. Also, a feedback form was given to the students related to the workshop and how to improve it

Results:

This study was conducted on 100 medical students who have completed their final year medical exams and are about to start their internship.

Table 1: Demographic Data of Participants

Characteristics	Categories	Number (n)	Percentage (%)
Completed Age	22 years	3	3%
	23 years	52	52%
	24 years	39	39%
	25 years	6	6%
	Mean Age ± SD	23.48 ± 0.65	
Gender	Male	56	56%
	Female	44	44%
Final years Marks %	≥75%	06	6%
	60% - 75%	35	35%
	<60%	59	59%

Before the start of the study, a pre-test was conducted on the students to assess their pre-existing knowledge. It formed the basis to compare the knowledge of the students after the workshop. The pre-test had 12 questions covering different clinical scenarios from different specialties with equal marks weight. The students were given around 15 minutes to answer the questions. The answer sheets were collected and marks were awarded as per the set criteria ranging from 1-12. The data was spread on the Excel sheet and saved for future reference. The content description of the assessment form is shown in Table 2

Table 2: Assessment Content

S.NO	Content	Type of Question	Marks
1	Medication Error	Short Answer	1
2	Medication Error Management	Extended Matching	1
3	Cardiovascular	Short Answer	1
4	Respiratory	Script concordance	1
5	Gastroenterology	Multiple choice	1
6	Nephrology	Short Answer	1
7	Endocrine	Multiple choice	1
8	Rheumatology	Extended Matching	1
9	Haematology	Multiple Choice	1
10	Musculoskeletal	Multiple Choice	1
11	Psychiatry	Short Answer	1
12	Electrolyte imbalances	Script Concordance	1
	Total score		12

After the pre-test, a workshop on clinical pharmacology and therapeutics was conducted for 3 days, which involved interactive sessions, discussions, assertion and reasoning, case studies, small group studies, and activities. After the end of the session, a post-test evaluation form was given to the students, which had the same questions as in the pre-test. They were given 15 minutes to answer the post-test. The evaluation forms were collected and evaluated based on the set criteria. The data was spread on the Excel sheet and compared with the results of the pre-test to know the effect of the workshop. The marks percentage obtained by the students in pre-test and post-test evaluation is shown in Figure 1.

Fig 1: Score Distribution Before and After Workshop

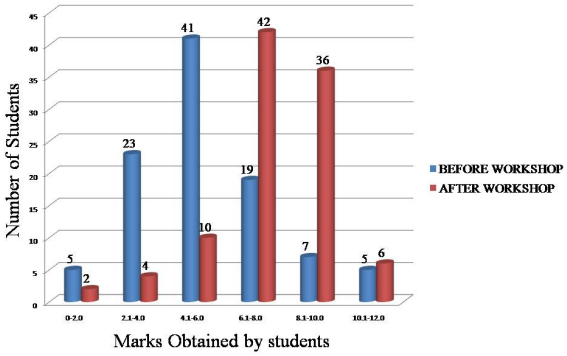

Figure 1: Percentage of marks obtained by students in pre-test evaluation before workshop and post-test evaluation after workshop. Score ranged from 0-12 with 0 minimum and 12 being maximum. 41 students obtained score range 4.1 to

6.0 before workshop whereas 42 students obtained score range 6.1 to 8.0 after workshop

It is observed that maximum students scored around 4.1-6.0 score in the pre-test which shifted to 6.1-8.0 bar during the post-test showing an evident improvement. There was no significant difference observed in the very low-scoring or very high-scoring group. The percentage of student's performance based on questions and content is shown in the scatter diagram in Figure 2. The percentage of students answering particular questions improved after the workshop although variations exist in the percentage over different specialties.

Fig 2: Content wise Score Distribution Before and After the Workshop

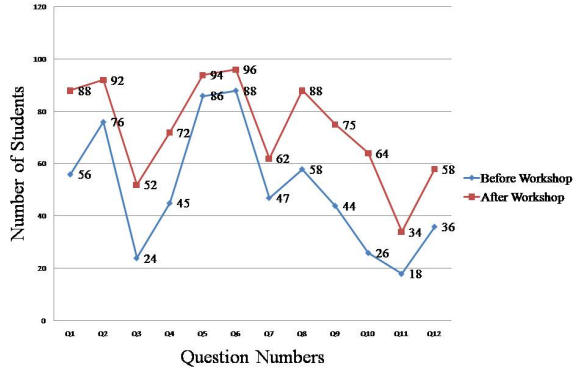

Figure 2: Content wise Score distribution before and after the workshop

While these figures give an idea of improved performance, a comparison of means and standard deviation gives a better idea about the performance difference. The mean, standard deviation, and standard error of means of the pre-test and post-test are tabulated in Table 3. The mean of the test is 5.47 ±1.9 whereas the mean of the post-test is 7.63 ± 1.7.

Table 3: Paired Statistics

	Mean	Number of Samples	Standard deviation
Pre-test	5.475	100	1.934
Post Test	7.638	100	1.752

To have a result that is statistically accepted, both groups were compared using students paired t-tests. The result obtained t(df)=15.725 p=0.001showing that the intervention-based workshop was statistically significant.

Table 4: T test result

	Mean	t	Standard error of the difference	Confidence interval for the mean difference	P value
Pre-test - post test	-2.0151	15.725	0.125	-0.05 to -3.97	0.001

Based on the marks obtained in the assessment, the data was classified into pass or fail based on the percentage of correct answers. A score of >6.0 (50%) was considered pass and a score of ≤6.0 (≤50%) was considered fail. Table 5 shows the percentage of pass and fail variable in pre test and post test.

Table 5: Percentage of Pass and Fail Variable in pre test and post test

	Post Test Pass	Post Test Fail
Pre Test Pass	31	0
Pre Test Fail	53	16

Discussion:

Undergraduate medical education has been undergoing continuous changes to respond to the concerns related to the lack of the different competencies supposed to be achieved by medical students by the end of their final year.[10] The present study aims at improvement of undergraduate medical education related to prescription writing not only byintegration of the medical curriculum such as learning system-wise by integrating the anatomy, physiology, pharmacology, and clinical and medical aspects but also by including modern methods of teaching like problem-based learning, case studies, small group discussions rather than didactic lectures. Very few recognised courses and assessments has been developed in this area , resulting in the lack of essential prescribing competencies.[11]Medical students themselves have expressed their concern over the competencies gained at their medical schools, especially related to clinical pharmacology related to prescribing.[12,13]Few of the medical schools have called on some pharmaceutical company support for teaching[14].This study focuses on the impact of workshop related to clinical pharmacology and therapeutics and how this can affect the prescribing competencies of the medical students.

Several studies have shown that due to a lack of essential prescribing competencies, several medication errors are committed by junior doctors,[15,16] which need to be addressed efficiently and urgently. The present study focuses on how students acquire the needed pharmacological skills via revision of essential

points through workshop with modern educational methods. The workshop was based on the educational theory of behaviourism, which reflects an observational change in the behaviour of the students due to actions by the teaching faculty like motivation, reward and feedback. The workshop also focussed on Cognitivism, a way of learning where the students use their brain effectively, hence is more active and long lasting. It is not about repeating or memorising. It focuses on understanding the concept and applying in the clinical scenario. It is about learning how to learn. This is extremely important in medical education that makes future doctors and health care professionals.

The causes of these errors were multi-factorial but failure in the dissemination of drug knowledge accounted for maximum cause[17.] The lack of enough information related to medications has led to the need of supervising junior doctors.[18] It is observed that knowledge of medicines and prior training related to commonly encountered medications is important for the prevention of such errors. Continuous training of the medical students in pharmacology can help solve this problem and help students easily prescribe medications without committing a medication error. During the workshop, the Students construct knowledge adding on to their prior experience, based on the educational theory of constructivism. Teacher presents a real life case scenario during the workshop and engages students in activities, where students explore particular area under study. They use their pre existing knowledge to explain the ideas and expand their horizons based on discussions and thereby construct new knowledge

There is conflicting evidence for whether educational interventions alone can decrease such errors and have a significant impact on the outcome. It might be due to a lack of research relating prior knowledge gained and subsequent errors committed during clinical practice[19,20.] Several studies have shown that educational interventions for medical students can help improve prescribing[21,22.] However, the available data has shown that more intensive educational interventions and better studies are needed to support this finding.

Several factors that can be questioned are whether any benefit of the performance exists after the training period, and if so, is it applicable to the clinical practice, and if yes, does it have an impact on reducing medication errors? Another important factor to consider is deciding the time for the training, as undergraduate training is a long-duration course.

The present study was conducted on medical students who have passed their final year exams and are about to enter internship so that students may have a revision of the existing knowledge and may also gain knowledge from their peers and experience. Students would be more enthusiastic and more ready to learn at this stage, as they are now in a stage where they realize the importance of prescription and also they are not burdened with the fear of qualifying for an examination. A study conducted in Iran on 100 medical students showed that continuing clinical pharmacology education for medical students, especially the interns, can solve most of the prescription errors.[23]

Next in the discussion is the mode of education and training. Several methods like problem-based learning, case studies, and e-learning have emerged as newer and better forms compared to didactic lectures. A study was conducted on junior doctors where 1 week training module was conducted consisting of problem based learning related to medication problems , which has resulted in significant improvement of the prescribing skills of the medical students. [24] However, one study has shown that problem-based learning had no benefit over the traditional didactic lecture.[25]A study conducted by Raghu G et al on medical students evaluated the effect of hands on training on prescription writing skills and found that lacunae in the prescriptions could be effectively overcome by including a training on pharmacology for the medical students.[26]

The present study has shown that there was a significant improvement in the prescribing knowledge of the students post the workshop. However, how this workshop will affect the clinical practice and reduction in prescription errors need to be evaluated.

Limitations of the present study include a small number of students, no long and detailed follow-up, no proper prescription-based error detection, and no measuring of the quality of prescriptions. The assessment was done early after intervention and under controlled conditions rather than hospital outpatient department or ward, which may result in biased results. Future research should include a long-term follow-up assessment and an objective measurement of error rates in clinical practice

Conclusion:

Medical education has been ever-changing to overcome the challenges faced by junior doctors. However, students are still lacking in their clinical pharmacology and therapeutics knowledge and there has been no effective and specified course that

emphasizes this area. It is often believed that students will learn on their own as exposed to the clinical environment and experience. However, this has been proved to be false by several studies. Learning in this field needs careful planning, implementation, and continuous revision of important common clinical-based topics to achieve reduced medication errors. This study supports the implementation of structured workshops at the beginning of internship that focus on common clinical cases and practical applications, with special emphasis on patient safety and medication error. This should be followed by regular interactive sessions to reinforce key concepts and emerging clinical challenges. Collaborative discussions and decision making in clinical settings should be encouraged to enhance practical knowledge. Learning materials should be periodically updated that includes latest research and guidelines, with training specifically targeted at junior doctors for adapting to rapidly and ever changing clinical conditions.

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