

Evaluation of impact of teaching clinical pharmacology and rational therapeutics to medical undergraduates and interns

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ABSTRACT

Objectives: To find out the impact of teaching clinical pharmacology and rational therapeutics (CPT) to medical undergraduates (UGs) and interns. **Materials and Methods:** This cross-sectional, prospective study was conducted on three UGs batches and interns using two pretested validated structured questionnaires, modified from the work of Tobaiqi *et al.* The study was approved by the Institutional Ethics Committee. ANOVA and Chi-square test were used for statistical analysis. The value of $P < 0.05$ was considered statistically significant. **Results:** A total of 379 UGs and 96 interns participated in this study. Mean knowledge score of interns was significantly reduced as compared to UGs ($P < 0.0001$). A significant increase in confidence for unsupervised prescribing of nonsteroidal anti-inflammatory drugs (99%), oral rehydration salt, iron salts was perceived among interns as compared to UGs ($P < 0.05$). However, 63.5% confessed problems in selection of drugs, drug–drug interactions, prescribing in special patient population. Although they were confident prescribing fixed dose combination for adult patients (89.5%), majority were hesitant to prescribe opioids (77%), steroids (76%), vaccines (75%), and antihypertensives (62%). **Conclusion:** The theoretical CPT teaching transfers knowledge to UGs; however, it is not retained in internship and does not adequately prepare interns to prescribe safe and rational drugs.

Key words: Clinical pharmacology teaching, interns, medical undergraduates

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INTRODUCTION

The rational prescribing of drugs is an essential skill that requires sound knowledge of clinical pharmacology and therapeutics. Many medical graduates are insufficiently prepared to assume prescription responsibilities after graduation and are likely to cause prescribing errors.^[1,2] In addition, during internship, a period of medical apprenticeship, the intern is expected to

demonstrate the knowledge and skills of selecting right drug for right patient, identify and report adverse drug reaction, and should have the sound knowledge and skills of rational pharmacotherapeutics and Essential Medicines. However, it has been reported that medical students and interns lack the confidence of prescribing and their training in pharmacology is inadequate.^[3,4] This is due to the general perception that pharmacology course in medical schools has failed to keep pace with the rapid changes and requirements of clinical practice.^[5] Traditional pharmacology teaching which focuses more on factual information with little emphasis on

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clinical and rational therapeutics has been considered to be responsible.^[6]

In India, undergraduate (UG) medical course consists of 4½ years (9 semesters) followed by 1 year of compulsory rotating internship. The students are taught pharmacology in II MBBS (3–5th semester). The Medical Council of India proposes Graduate Medical Education Regulations for each discipline and regularly updates the recommendations. These regulations describe UG pharmacology curriculum with a clear emphasis to teach essential skills that will help the students select the medicines safely and effectively throughout their professional life.^[7]

An attempt was made to revise pharmacology curriculum with special emphasis on the WHO guidelines to good prescribing that help the students to select the medicines safely and effectively. In addition, other clinical pharmacology exercises such as evaluation of fixed-dose combinations (FDCs), sources of drug information, dosage calculation, evaluation of drug promotional literature, and adverse drug reaction (ADR) reporting for rational prescribing were also introduced as pharmacology practical exercises. While these exercises sensitize the students for a rational use of drugs, it is not known to what extent they improve the prescribing skill. Unfortunately, these skills are not reinforced during clinical terms and so their practical application remains incomplete. The present educational research was undertaken to find out the impact of teaching clinical pharmacology and rational therapeutics (CPT) with respect to the knowledge and attitude of UG medical students and interns and to determine whether teaching CPT has prepared fresh medical graduates (interns) to prescribe safely and rationally.

MATERIALS AND METHODS

A prospective, cross-sectional study was conducted on medical UGs and interns at B. J. Medical College, Ahmedabad. UGs 2nd year MBBS III term (II/III), 3rd year MBBS Part I (III/I) and part II (III/II) and interns who had completed clinical rotation in major subjects and learnt CPT by lectures, practicals in II MBBS were included in the study. The study was approved by the Institutional Ethics Committee and prior informed consent was obtained (Reference no. EC/Approval/150/2014). Pretested validated structured questionnaires, modified from the work of Tobaiqy et al.^[3], with 16 questions for UGs, 22 for interns were used.

The knowledge component was assessed by written clinical case scenario of malaria, drug–drug interaction (DDI) by case scenario of tuberculosis, identifying rational/irrational FDCs. Their attitude was assessed by their perceptions,

characteristics, and advantages of various clinical pharmacology exercises and confidence in prescribing selected drugs from the given list.

For UGs, the practice element was evaluated by questions related to sources of drug information used and reporting of ADRs. Whereas the intern's questionnaire had questions related to prescribing practices, especially their confidence in prescribing selected drugs, prescribing in special patient population, specific problems encountered while prescribing, commonly prescribed FDCs, ADR observed and reported, etc., In addition, feedback of UGs and interns was obtained.

Data were entered into Microsoft Excel and analyzed using ANOVA test and Chi-square test. $P < 0.05$ was considered statistically significant.

RESULTS

A total of 379 medical UGs and 96 interns participated in the study. Out of 379 UGs, 121 were from the second MBBS III term (II/III), 124 III MBBS Part I (III/I), and 134 III MBBS Part II (III/II) students. The majority of UGs (373, 98%) accepted having received CPT training in II MBBS. However, only 209 (55.1%) UGs rated their CPT knowledge as good and 116 (31%) as average. Of 96 interns, the majority (93, 96%) accepted having received CPT training in II MBBS and rated their CPT knowledge as good (51, 53%) and average (31, 32%).

Undergraduates

Second year MBBS III term (II/III, 5th semester)

Of 121 2nd year students, 21 (17.3%) correctly answered written case scenario of *Plasmodium vivax* malaria. However, the majority of students (72, 59.5%) could not identify DDI. Second, only 43 (35.5%) could identify two out of four irrational FDCs and 34 (28%) could enlist three rational FDCs [Table 1]. Surprisingly, the majority of the students correctly answered questions related to P-drug (69, 57%) and

Table 1: Assessment of clinical pharmacology and rational therapeutics knowledge among undergraduate students (n=379)

Questions	II/III (n=121)	III/I (n=124)	III/II (n=134)	Intern (n=96)
Correctly answered case scenario (malaria) (%)	17	1.6	33.5	13.5
Drug-drug interaction not identified (TB) (%)	60	53	63	39
Irrational FDCs identified (%)	35.5	37	37.7	-
Mentioned three rational FDCs (%)	28	33.8	29	40.6
Listed two banned drug in India (%)	57	41.1	27.6	46.8
Average score (mean±SD)	6.15±3.18	6.39±2.48	6.4±2.41	4.73±2.3*

* $P < 0.0001$ as compared undergraduate students. SD: Standard deviation; FDCs: Fixed dose combinations; TB: Tuberculosis

drugs banned due to ADRs (60, 49.5%). The average knowledge score was 6.15 ± 2.7 [Table 1].

Out of six clinical pharmacology exercises, P-drug (80, 66.1%) was considered to be most useful followed by ADR reporting (39, 32.2%) among II MBBS students [Figure 1]. Secondly, majority (52, 42.9%) believed they could comfortably prescribe analgesics without supervision [Figure 2]. In addition, majority of students considered efficacy 64 (52.8%) as an important characteristic in choosing P-drug and availability of drugs will be an advantage of prescribing from the Essential Medicines List (EML) (71, 58.6%). Interestingly, majority of students 117 (96.6%) considered ADR reporting is important; however, 70 (57.8%) stated only serious ADR should be reported.

Majority of students 106 (87.6%) used textbooks followed by the internet (43, 35.5%) as a source of drug information. While none of the students witnessed any ADRs during the clinical postings.

Third year MBBS III/I term (7th semester) and III/II term (9th semester)

Of 124 III/I and 134 III/II students, only 2 (1.6%) and 45 (33.5%) could correctly answer written case scenario of *P. vivax* malaria, respectively. However, majority of III/I (66, 53.2%) and III/II (84, 62.6%) could not identify DDI and only 46 (37%) III/I and 50 (37.3%) III/II students could identify two out of four irrational FDCs. Surprisingly, 42 (33.8%) III/I UGs could mention all three rational FDCs which was even less (39, 29%) in III/II students. Moreover, majority 98 (79%) III/I and 95 (70%) III/II correctly answered P-drug concept. While 51 (41.1%) III/I and 37 (27.6%) III/II students listed two drugs banned due to ADRs.

Interestingly, both the groups mentioned P-drug (73, 58.8% and 78, 58.2%) as the most useful clinical pharmacology exercise followed by evaluation of FDCs by III/I students (56, 45.1%) and ADR by III/II students (64, 47.7%) [Figure 1]. Majority

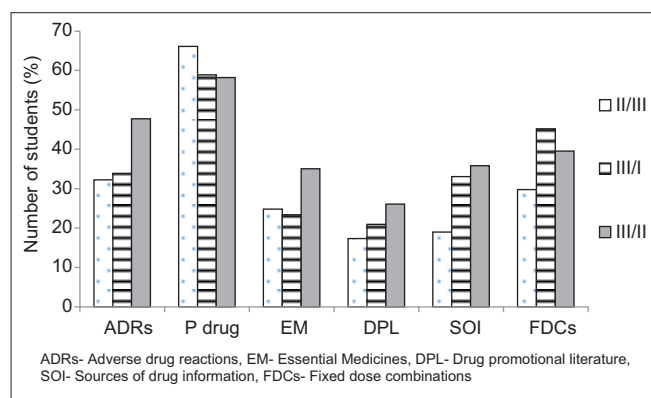


Figure 1: Attitude of undergraduates towards various clinical pharmacology exercises

of the students in both the groups affirmed comfortably prescribing nonsteroidal anti-inflammatory drugs without supervision (91, 73%; 106, 79%) [Figure 2]. Similarly, majority of the students in both the group labeled efficacy as the most important characteristic of the drug for choosing P-drug (65, 52%; 79, 58.9%). Moreover, both the groups confirmed that the availability of drugs would be the advantage while prescribing drugs from EML (75, 60%; 92, 68.6%). Further, majority of students (122, 98.3%, 129, 96.6%) considered ADR reporting is important; However, 85 (68.5%) and 80 (59.7%) stated only serious ADR should be reported.

Majority of III/I students (110, 88.7%) and III/II (114, 85%) refer textbooks followed by the internet (70, 56.4%; 78, 58.2%) as sources of drug information. While none of the students witnessed any ADRs during their clinical postings.

Interns

It was observed that 13 (13.5%) interns correctly answered written case scenario of *P. vivax* malaria. However, majority of interns 37 (38.5%) could not identify DDI and only 39 (40.6%) interns could mention two rational FDCs. Surprisingly, almost half of the interns 49 (51%) could not answer question related to P-drug. While 45 (46.8%) could answer two drugs banned due to ADRs. A significant reduction in knowledge score was observed (4.73 ± 2.3 , $P < 0.0001$) as compared to UGs [Table 1 and Figure 3].

Majority interns (95, 98.9%) acknowledged comfortable prescribing of analgesics followed by antacids (78, 81.2%) without supervision. Similarly, majority of the interns believed efficacy as the most important characteristic of the drug for choosing P-drug (47, 48.9%) and availability of drugs would be the an advantage while prescribing drugs from EDL (42, 43.7%). Moreover, majority of interns (86, 89.5%) considered ADR reporting is important; however, 59 (61.45%) interns stated only serious ADR should be reported while 20 (20.8%)

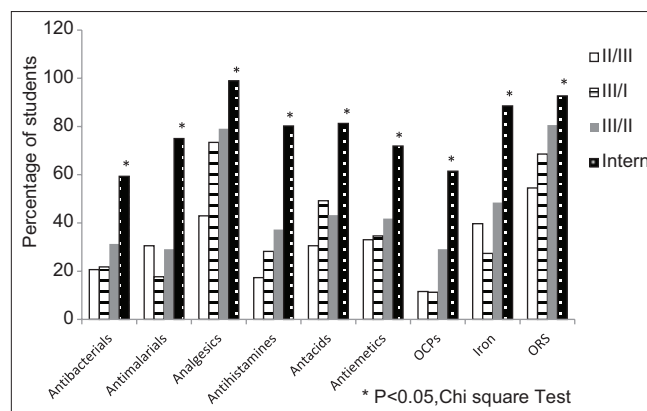


Figure 2: Perception of undergraduates and interns for comfortable prescribing without supervision

interns believed that ADRs related to the new drug should be reported.

Surprisingly, the internet significantly (72, 75%) topped the list for seeking drug information followed by textbooks (70, 72.9%) by interns as compared to UGs ($P < 0.05$) [Figure 3]. In addition, 40 (41.6%) interns seek drug information from senior colleagues, and 13 (13.5%) relied on medical representatives (MRs). Interestingly, majority of interns (61, 63.5%) confessed prescribing problems in special group of patients (34, 35.4%) and selection of drug (32, 33.3%). Although majority agreed to be confident in prescribing for adult patients (86, 89.5%), they were hesitant to prescribe opioids (74, 77%), steroids (73, 76%), anti-hypertensives (60, 62.5%). Moreover, the interns referred source of information before prescribing (72, 75%) for details of drug administration (32, 33.3%). Majority of interns had prescribed multivitamins (81, 84.3%), co-amoxiclav (80, 83.3%), cough mixtures (70, 72.9%) during internship [Table 2]. However, majority had not applied P-drug concept (64, 66.6%), or reported ADR (90, 93.7%) during internship.

Feedback

Majority of UG students (75%) and interns emphasized teaching on drug selection (49%) followed by dosage schedule (45%) and drug interaction (38.25%), while 61% of interns emphasized teaching on dosage schedule followed by prescribing in special patient population (51%) and drug selection (47%).

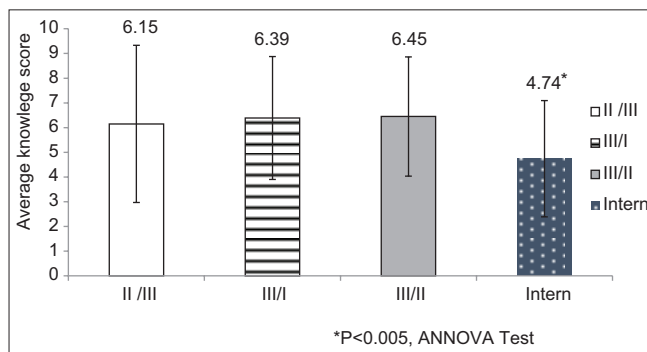


Figure 3: Comparison of knowledge score among undergraduates and interns

Table 2: Prescribing practices of fixed dose combination among interns (n=96)

Name of FDCs	Interns (%)	Rational/irrational
Ibuprofen + paracetamol	55 (57.2)	Irrational
Co-amoxiclav	80 (83.3)	Rational
Ciprofloxacin + tinidazole	31 (32.2)	Irrational
Cotrimoxazole	59 (61.4)	Rational
Cough mixtures	70 (72.9)	Irrational
Multivitamin	81 (84.3)	Irrational
Diclofenac + serratiopeptidase	26 (27)	Irrational

FDCs: Fixed dose combinations

DISCUSSION

Effective teaching and training in CPT is the backbone to inculcate a rational and scientific basis of prescribing. WHO-6 step method has been proved to be effective for drug selection in medical students.^[8,9] In view of the above, this cross-sectional study was conducted among UG students and interns who learnt CPT based on WHO model along with other clinical pharmacology exercises in 2nd year MBBS. The objective of this study was to find out the impact of teaching and its retention in fresh medical graduates.

This study observed that CPT teaching is effective in the transfer of knowledge to UGs, unfortunately, its retention was poor after graduation, i.e., in internship as evidenced by a significant reduction in knowledge score. In addition, the application of principles of CPT while prescribing such as the process of selection of drugs, identification of rational/irrational FDCs, and ADR reporting were not followed.

A significant proportion of UGs and interns agreed being taught the rational use of drugs and CPT in 2nd year MBBS. Despite this, half of them rated their knowledge as good and half as average and poor. This observation is similar to a study by Islam *et al.*^[10] Moreover, the UG knowledge was significantly reduced by the time the student completes internship. This finding indicates that knowledge was not retained until internship and in fact, it was significantly reduced as compared to UGs. The knowledge questions were pertaining to common clinical problems such as malaria and tuberculosis, identifying rational/irrational FDCs, etc., This observation is alarming and indicates that classroom teaching of clinical pharmacology and therapeutics is not sufficient but needs to be aligned with clinical teaching during MBBS and reinforced during internship.

Although P-drug along with evaluation of FDCs and ADR reporting was considered to be most useful exercises among UGs, it was seldom followed in clinical practice. Probably, this exercise involved the active participation of students in practical class and brought them close to real life situation. However, application and implementation of these P-drug concept and rational FDC in internship was lacking. It has been reported by Rahaman *et al.* that “exercise on the selection of P-drug” improves the performance of the students in clinical pharmacology case report.^[11] Evaluations of FDCs are important in country like India where a good number of irrational FDCs are aggressively promoted and freely available in the Indian market. Moreover, substantial number of UGs and interns believed that ADR reporting is important, but it was not reported or witnessed in internship. Conversely to our observation, a higher rate of ADR reporting among

Table 3: Comparison of practices of clinical pharmacology and rational therapeutics among interns with other studies

Parameter	Our study (n=96) (%)	Tobaiqy et al. 2007 (UK) (n=71) (%) ^[3]	Oshikoya et al. 2009 (Nigeria) (n=100) (%) ^[4]	Zakirul Islam et al. 2014 (Bangladesh) (n=191) (%) ^[10]
ADR reporting	6	74	66	61
Sources for drug information used	Internet (75) Textbook (72)	-	Formulary (NA) EDL (NA)	Textbook (43) Formulary (21)
Confident in prescribing unsupervised	NSAIDs (99) ORS (93) Iron (88)	Laxatives (100) Analgesic (92) Antacids (91)	Antimalarial (96) Vitamins (89) Antibiotics (88)	Vitamins (85) Antacids (80) Antihistaminics (64)

EDL: Essential drug list; ADR: Adverse drug reaction; NSAIDs: Nonsteroidal anti-inflammatory drugs; ORS: Oral rehydration salt; NA: Not available

interns has been observed by Tobaiqy et al., Oshikoya et al., and Zakirul Islam et al. [Table 3].^[3,4,10] This can be attributed to the lack of spontaneous ADR reporting by clinicians and lack of awareness in spite of increase efforts by Pharmacovigilance Programme of India. This is also a good example of “Teach what you preach”. If ADR reporting is taught in CPT, but not preached by doctors, the students will not form a habit and the impact will be less or negligible. This indicates need to increase awareness of ADR reporting and surveillance among the health-care professionals.

Interestingly, textbook and internet were the most common source of drug information. This is similar to Bangladesh study where interns rely on text books (72% vs. 43%).^[10] Interestingly, Oshikoya et al. showed that interns use national formulary as most common source for drug information [Table 3].^[4] This is an important step to reduce prescribing errors and ADRs, while this study showed that interns also relied on senior colleagues and MR for source of drug information. This is alarming and can be attributed to their clinical exposure, observation of day-to-day practices followed by health-care professionals in hospital setup and influence of external environment on their practice.

A substantial number of interns perceived themselves sufficiently prepared to prescribe a variety of drugs unsupervised. However, these findings did not correlate with their CPT knowledge which was reduced to a great extent. It seems that the selection of drugs reflects their observation of most commonly prescribed drugs during clinical rotation rather than their actual knowledge of drug safety. Our observation is synonymous with Tobaiqy et al., who also found that interns were confident in prescribing laxatives and analgesics including opioids and nonopioids, and antacids. Islam et al. have reported that interns were confident in prescribing vitamins, drugs for peptic ulcer, and anti-histaminics. Oshikoya et al. showed that interns were confident in prescribing anti-malarials, vitamins, and antibiotics [Table 3]. These findings show the fresh medical graduates develops the general perception about safe drugs from day-to-day prescribing practices and over prescribing rather than a true appreciation of risk-benefit ratio. However in this study, interns were hesitant to prescribe opioids,

corticosteroids, anti-hypertensives, and oral contraceptive pills. Probably this was due to high prevalence ADRs and abuse liability associated with these drugs. Around 63% of interns found problem in prescribing like drug interaction, and selection of drug. They were confident in prescribing in adult and elderly but not in patient with liver disease and renal disease. Our findings are supported by Tobaiqy et al. This indicates that interns are not confident prescribing in special conditions, especially where the selection of drug and dose is difficult and requires sound knowledge. It can be stated that student must be taught clinical pharmacology by various case base scenarios which focus on this special condition.

Like any other study, there were also limitations. For example, it was a single center study; the prescribing skills were assessed using written case scenario and not actually observing interns in simulated cases or clinical setup. In addition, the confidence of unsupervised prescribing was self-rated and may not necessarily be translated into actual rational practical prescribing. The variation in the background knowledge, clinical exposure, and activities of different UGs and interns are also likely to affect their perceptions of CPT teaching. However, the data generated lead to some important conclusion and useful information for undertaking corrective measures for improving prescribing skills. The class room and sequential CPT teaching, where the learning and the application of knowledge are separate is not sufficient to make UGs and interns rational prescribers. Gaining knowledge and simultaneously allowing students to put into practice with real patients under appropriate supervision is essential for learning complex task of prescribing skill. This would substantially allow students to work in context and carry out prescribing skills and prepare better for future practice.

CONCLUSION

It can be concluded that theoretical and sequential CPT teaching do not adequately prepare UGs and interns to prescribe safe and rational drugs. There is a need to strength CPT teaching by providing opportunities to practice practical skills during training and reinforce principles of CPT in internship.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Richir MC, Tichelaar J, Geijteman EC, de Vries TP. Teaching clinical pharmacology and therapeutics with an emphasis on the therapeutic reasoning of undergraduate medical students. *Eur J Clin Pharmacol* 2008;64:217-24.
2. Ross S, Ryan C, Duncan EM, Francis JJ, Johnston M, Ker JS, *et al.* Perceived causes of prescribing errors by junior doctors in hospital inpatients: A study from the PROTECT programme. *BMJ Qual Saf* 2013;22:97-102.
3. Tobaiqy M, McLay J, Ross S. Foundation year 1 doctors and clinical pharmacology and therapeutics teaching. A retrospective view in light of experience. *Br J Clin Pharmacol* 2007;64:363-72.
4. Oshikoya KA, Senbanjo IO, Amole OO. Interns' knowledge of clinical pharmacology and therapeutics after undergraduate and on-going internship training in Nigeria: A pilot study. *BMC Med Educ* 2009;9:50.
5. Dikshit RK. Rational education for rational therapy. *World Health Forum* 1992;13:151-3.
6. Desai M. Changing face of pharmacology practicals for medical undergraduates. *Indian J Pharmacol* 2009;41:151-2.
7. Medical Council of India Graduate Medical Education regulations (Internet). New Delhi: Medical Council of India. Available from: http://www.mciindia.org/Rules-and-Regulation/GME_REGULATIONS.pdf. [Last accessed on 2015 Oct 25].
8. deVries TP, Henning RH, Hogerzeil HV, Fresle DA. *Guide to Good Prescribing. A Practical Manual*. Geneva: World Health Organization Action Programme on Essential Drugs; 1994.
9. Keijsers CJ, Ross S. A pharmacological approach to education. *Br J Clin Pharmacol* 2015;80:329-30.
10. Islam Z, Rahman F, Mossaddek AS, Rozario RJ, Iftexhar AF, Akhter S, *et al.* Assessment of Bangladeshi interns' knowledge of pharmacology and therapeutics for prescribing. *J App Pharm Sci* 2014;4:43-51.
11. Rahaman S, Kamal AA, Chaudhary S. Exercise on selection P drug: Preliminary evaluation of newer method of pharmacology teaching in Bangladesh. *Banglad J Physiol Pharmacol* 2000;16:50-4.