

# Pharmacology Applied Learning Program in Preclinical Years – Student Perspectives

Amudha Kadirvelu, Sunil Gurtu, and Sivalal Sadasivan

**Abstract**—Pharmacology curriculum plays an integral role in medical education. Learning pharmacology to choose and prescribe drugs is a major challenge encountered by students. We developed pharmacology applied learning activities for first year medical students that included realistic clinical situations with escalating complications which required the students to analyze the situation and think critically to choose a safe drug. Tutor feedback was provided at the end of session. Evaluation was done to assess the students' level of interest and usefulness of the sessions in rational selection of drugs. Majority (98 %) of the students agreed that the session was an extremely useful learning exercise and agreed that similar sessions would help in rational selection of drugs. Applied learning sessions in the early years of medical program may promote deep learning and bridge the gap between pharmacology theory and clinical practice. Besides, it may also enhance safe prescribing skills.

**Keywords**—Medical education, pharmacology curriculum, applied learning, safe prescribing.

## I. INTRODUCTION

PHARMACOLOGY, as a basic medical science discipline, provides the scientific basis of therapeutics, i.e. the scientific foundation for safe and rational prescribing of drugs in the treatment of various human ailments and diseases. Learning of pharmacology, being one of the core subjects in the undergraduate medical curriculum, requires a significant integration of basic and applied medical knowledge. It was clearly quoted by Braunwald [1] that “Pharmacology is uniquely positioned among the biomedical sciences. It depends on and contributes to genetics, biochemistry, cell biology, organ physiology and clinical medicine.” While traditionally it has been treated as a pre-clinical/para-clinical subject its relevance to clinical prescribing cannot be overstated. The underlying consideration for pharmacology teaching/learning is to train future medical practitioners with sufficient skills to draw on their theoretical knowledge of basic criteria of efficacy, safety, suitability and economy for sound therapeutic decision making in clinical practice.

Learning pharmacology to choose and prescribe drugs is a major challenge encountered by students [2]. It is generally opined that teaching pharmacology course in medical schools has failed to keep pace with the rapid changes in medical practice [2]. With an explosion in not only the number of drugs and drug classes but also in knowledge base of

mechanisms of drug action (even at the molecular and genomic levels) the medical student of today is confronted with a sea of facts to which he is not able to relate in terms of its utility for his future role as a clinical practitioner. It reduces learning to a mere rote memorizing of facts and drug names for the sole purpose of passing through the assessment process, while on the other hand, it renders the learning process dry, uninteresting and burdensome and reduces it to an ordeal which must be undergone, so as to get through the preclinical years, without being carried forward to later years of the medical curriculum or clinical practice.

Considering that ~50% of all consultations end with a prescription, it is vital that medical doctors have a good understanding of the disciplines of pharmacology, clinical pharmacology, and therapeutics in order to prescribe drugs effectively and safely. However, despite the generally accepted importance of rational prescribing, the teaching of pharmacotherapy to undergraduate medical students is still unsatisfactory [3]. Many graduates reportedly feel underprepared to take on prescribing responsibilities after graduation [4]. Recently Garbutt et al reported that the prescribing performance of house staff and medical students is poor, partly because of inadequate training [5]. These reports are not surprising as in many curricula; teaching in clinical disciplines has been disease-centered focusing on symptoms and diagnosis, with little or no time given to imparting the principles of treatment with drugs. In order to improve rational prescribing, increased attention is being paid to the teaching of pharmacotherapy in many countries [6-9].

It is now known that traditional pharmacology training that takes place by way of didactic lectures does not prepare the students well for rational selection of drugs [10]. Attempts have been made to improve the teaching of pharmacology and therapeutics. It is easier to take a lecture on calcium channel blockers than to teach students how to select one for a particular indication / type of patient. The present day pharmacology course consists of a combination of lectures; problem based learning sessions, clinic-correlated lectures and small group discussions [11]. However, integration of knowledge between disciplines and appropriate of application of theoretical knowledge to clinical practice remains to be a major challenge to most students. It has been shown recently that pharmacotherapy program during the preclinical phase of medical education has a positive effect on improving the cognitive pharmacotherapeutic skills (i.e., the process of selecting the relevant information relating to the patient and choosing a drug treatment regimen) among medical students [12].

This finding is encouraging, but student perspectives of such pharmacotherapy programs in preclinical years are still

Amudha Kadirvelu is with the Tan Sri Jeffrey Cheah School of Medicine and Health Sciences Monash University Sunway Campus, Malaysia (phone: ++(603) 55146316; fax: ++(603) 55146323; e-mail: amudha.kadirvelu@monash.edu).

Sunil Gurtu is with the Tan Sri Jeffrey Cheah School of Medicine and Health Sciences Monash University Sunway Campus, Malaysia.

Sivalal Sadasivan is with the Tan Sri Jeffrey Cheah School of Medicine and Health Sciences Monash University Sunway Campus, Malaysia.

not known. The aim of this study was to develop and implement pharmacology applied learning program and assess the student perspectives regarding the usefulness and effectiveness of the pharmacotherapy program among the preclinical medical students.

## II. METHODOLOGY

In the preclinical years at Monash University Sunway Campus, pharmacology curriculum is predominantly delivered through lectures with some inclusion in problem based learning sessions. A pharmacology applied learning program that required the students to activate their prior theoretical knowledge, integrate and apply it to practical therapeutic problem solving was developed.

The program included realistic clinical case scenarios of graded complexity that had to be solved within a specific timeframe which enforced information seeking and knowledge gathering from multiple resources, critical thinking, peer discussion and decision making. The innovative session was strategically placed at the end of specific systemic modules to enable the students to assimilate knowledge from multiple disciplines and apply it to a single individual to solve medical problems.

All first year medical students (n=136) at the Monash University Sunway Campus were invited to participate in the pharmacology applied learning program that were conducted during the 2<sup>nd</sup> semester of first year medical course.

The first session, in week 5 and the second session in week 12 were based on topics covered during weeks 1-5 (Analgesics and Pharmacokinetics) and weeks 6-12 (Cardiovascular system) respectively. In each of these sessions the students were divided into multiples groups of six to eight and each group was given a different clinical case scenario with a therapeutic problem of graded complexity. They were given 10 minutes to interpret and discuss the problem among themselves followed by problem solving period of 60 minutes (Fig. 1).

The students were allowed to consult their notes, books or online material to come up with their answers and support their reasoning.

At the end of problem solving period, representatives of each group were invited to present their case and solution to the whole class and to answer/ reason any questions/ queries raised by any member of the class. Each group-class discussion was followed by tutor feedback on the students' clinical reasoning and case presentation. At the end of the pharmacology applied learning session the students were asked to evaluate the effectiveness of the session and their perceptions regarding the usefulness of such session for their learning and understanding of practical implications of pharmacology.

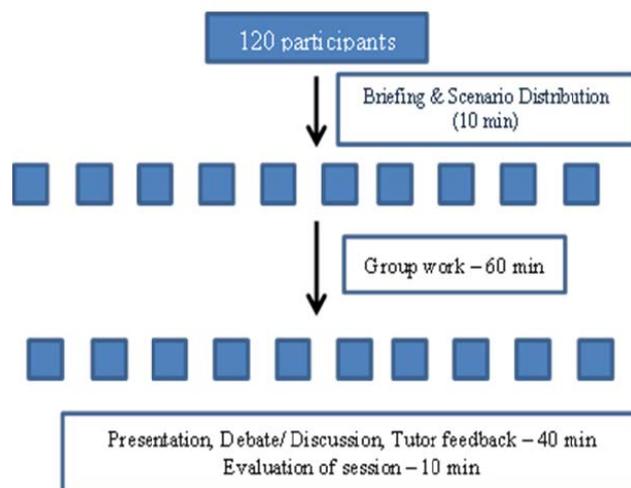


Fig. 1 Flow chart of the pharmacology applied learning session

## III. RESULTS

Of 136 year one students, 120 participated in the project and 105 students returned the completed evaluation forms rating the project from '1'-Strongly disagree to '5' - Strongly agree on different parameters. Items included in the student perception evaluation questionnaire are listed in Table I. Majority (98 %) of the students agreed that the session was extremely useful learning exercise; 96% agreed that similar sessions would help them in rational selection of drugs and 97% felt that the session helped them to appreciate the importance of pharmacology in clinical practice. 89% of the respondents rated the session as interesting and stimulating while 90% stated that such sessions would increase their interest in pharmacology. Overall 93 % students would like to have more of similar sessions in future. The item wise responses to the evaluation questionnaire are depicted in Fig. 2.

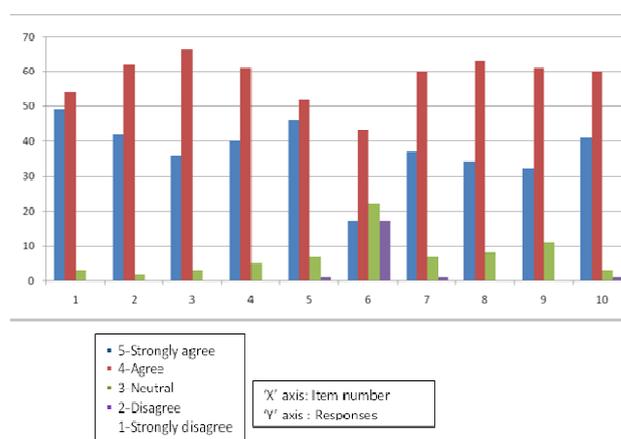


Fig. 2 Response (%) to the evaluation items

TABLE I  
EVALUATION ITEMS

1. Pharmacology applied learning session was a useful learning exercise
2. The session would improve my problem solving and logical reasoning skills
3. The session helped me to improve my understanding of pain management/ cardiovascular disease management
4. Similar applied learning sessions will help me in rational drug selection in the future
5. I would like to have more pharmacology applied learning sessions in the future
6. The time allocated to the session was adequate
7. Tutor feedback was helpful
8. Pharmacology applied learning session was interesting and stimulating
9. Similar sessions would increase my interest in pharmacology and therapeutics
10. The session helped me to understand the importance of pharmacology in clinical practice

#### IV. DISCUSSION

The results of this study clearly indicate that pharmacology applied learning sessions made an impressive impact on the students. Previous studies on pharmacotherapy program for preclinical students evaluated the effect on learning pharmacotherapeutic skills, i.e. choosing a drug treatment and determining patient information [12]. However, student perspectives on such pharmacotherapy programs in the preclinical years are widely reported.

The participants of pharmacology applied learning program found the small group open book discussion sessions stimulating and enjoyable. In view of the students' perceptions regarding the beneficial effects of these sessions on their learning experience it could be useful to introduce more of such small group, problem solving sessions in pharmacology. It would better equip the students to critically analyse and transfer theory into practice, and build their competence for effective and safe prescribing skills. Similar sessions can also be introduced in year 2 and possibly beyond, when greater parts of the curriculum have been covered and students have been exposed to a wider spectrum of clinical conditions. They also found the patient oriented approach as an interesting learning experience of pharmacology which has got the reputation of a content heavy and dry subject. They also appreciate the importance of learning pharmacology to choose and prescribe drugs for competent clinical practice. Majority of students reported the applied learning session to be extremely useful in activating and integrating their prior knowledge gathered from various disciplines. Students have strongly recommended the continuation of the activity as it gave them an idea of the relevance of pre-clinical sciences to actual clinical practice. This session also enabled them to relate theory to real life clinical situation.

Pharmacology training during medical school should translate into competent prescribing practice during clinical

practice. To inculcate prescribing competence, in addition to acquiring knowledge about fundamental principles and facts related to drugs it is necessary that students are exposed to simulated therapeutic problems wherein they are required to use the knowledge to apply to realistic clinical situations. This would reinforce their learning, augment their understanding and emphasize the practical relevance of the learned facts. Besides, it will make their learning process more interesting and enjoyable while equipping them with the ability to make sound therapeutic decisions in their later clinical practice.

#### V. CONCLUSION

Pharmacology applied learning program in the early years of medical program could play an important role in enhancing collaborative learning, critical thinking and clinical problem solving among medical students. Regular applied learning sessions in the foundation years of medical students have the potential to inculcate prescribing competence and equip them with the ability to make sound therapeutic decisions in their future clinical practice.

#### REFERENCES

- [1] Braunwald E. 2005. Foreward. In: Golan DE, editor. Principles of pharmacology. Philadelphia, US: Lippincott Williams and Wilkins. p vii.
- [2] Sudha J. Graduate training programmes in pharmacology in India. Health Administrator Vol XIX; 1:88-91.
- [3] Richir, M.C., Tichelaar, J., Geijteman, E.C. & de Vries, T.P. Teaching clinical pharmacology and therapeutics with an emphasis on the therapeutic reasoning of undergraduate medical students. Eur. J. Clin. Pharmacol. 64, 217-224 (2008).
- [4] Han, W.H. & Maxwell, S.R. Are medical students adequately trained to prescribe at the point of graduation? Views of first year foundation doctors. Scott. Med. J. 51, 27-32 (2006).
- [5] Garbutt, J.M., Highstein, G., Jeffe, D.B., Dunagan, W.C. & Fraser, V.J. Safe medication prescribing: training and experience of medical students and housestaff at a large teaching hospital. Acad. Med. 80, 594-599 (2005).
- [6] De Vries, T.P. Presenting clinical pharmacology and therapeutics: the course in pharmacotherapeutics. Br. J. Clin. Pharmacol. 35, 587-590 (1993).
- [7] Vollebregt, J.A., Metz, J.C., de Haan, M., Richir, M.C., Hugtenburg, J.G. & de Vries, T.P. Curriculum development in pharmacotherapy: testing the ability of preclinical medical students to learn therapeutic problem solving in a randomized controlled trial. Br. J. Clin. Pharmacol. 61, 345-351 (2006).
- [8] Akici, A., Gören, M.Z., Aypak, C., Terzioğlu, B. & Oktay, S. Prescription audit adjunct to rational pharmacotherapy education improves prescribing skills of medical students. Eur. J. Clin. Pharmacol. 61, 643-650 (2005).
- [9] Maxwell, S.R., McQueen, D.S. & Ellaway, R. eDrug: a dynamic interactive electronic drug formulary for medical students. Br. J. Clin. Pharmacol. 62, 673-681 (2006).
- [10] Shankar RP, Dubey AK, Palaian S, et al. Favorable Student Attitudes Towards Pharmacology in a Medical College in Western Nepal. JIAMSSE 2005;15:31-38.
- [11] Li WD, Zhang Y, Zhang CL, Zhang XM. Pharmacology teaching and its reform in China. Acta Pharmacologica Sin 2004; 25: 1233-1238.
- [12] Vollebregt, J.A. et al. Evaluation of a pharmacotherapy context-learning programme for preclinical medical students. Br. J. Clin. Pharmacol. 62, 666-672 (2006).