Case-oriented Self-learning and Review in Pharmacology Teaching

Siying Li, MD, Baoping Yu, PhD and Jiang Yue, PhD

Abstract: *Background:* To cultivate students' ability to use the pharmacology principles in medical practice, case-oriented self-learning and review has partly replaced lecture-based teaching in our pharmacology course. The aim of this study is to investigate the effects of an innovative teaching model in pharmacology teaching on the performance of medical undergraduates. *Methods:* A total of 185 third-year medical students participated in the study in 2011 and 2012. The students were randomized into the study group (case-oriented self-learning and review) and control group (traditional lecture-based teaching). Examination performances between the students in the 2 groups were compared, and questionnaires were designed for both the students participating in the study group and the teachers to assess the new teaching method. *Results:* Mid-term examination performances in 2011 and 2012 were significantly better for the students in the study group than those in the control group ($P < 0.01$). On the final examination in 2011, significantly more students received an assessment of "excellent" in the study group than in the control group ($P < 0.05$). Moreover, students in the study group performed better than those in the control group on the final examination in 2012. The data from the questionnaires indicated that both teachers and students in the study group generally held positive attitudes toward the innovative teaching model. *Conclusions:* Case-oriented self-learning and review can improve students' internalization of basic pharmacological principles and provide a greater opportunity for self-study and collaborative study. The examination composition can affect the efficacy of the assessment of problem solving abilities.

Key Indexing Terms: Case-oriented self-learning and review; Pharmacology. **[Am J Med Sci 2014;348(1):52–56.]**

Pharmacology is the science of drugs that primarily concerns the interactions between drugs and the living systems. A pharmacology curriculum has 2 striking characteristics: applicability and changing periodicity. Most pharmacology textbooks that are used in medical colleges are drug oriented and are organized by body system; however, drug management in clinical practice is disease oriented. Appropriate drug application requires the internalization of pharmacological principles; yet, internalizing pharmacological principles is a considerable challenge for both students and teachers. Pharmacology course in medical school aspires not only to impart pharmacological knowledge to students but also to cultivate students' ability to put the principles of pharmacology to use in medical practice.

From the Health Sciences Center, Wuhan University Medical School (SL, BY), Wuhan, China; and Department of Pharmacology (JY), Basic Medical School of Wuhan University, Wuhan, China.

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The first two authors contributed equally to this work.

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Correspondence: Jiang Yue, PhD, Department of Pharmacology, Basic Medical School of Wuhan University, Wuhan 430071, China (E-mail: yuejiang@whu.edu.cn).

Traditional lecture-based teaching is an effective way of delivering knowledge but limits the independent thinking and learning space of students.[1] Converting knowledge to application is difficult for students who receive traditional lecture-based instruction. Medical students often perceive a separation between theory and practice in clinical education on drug management. Thus, educators have to find practical instructional methods to promote critical inquiry and sustainable self-directed learning.[2] Over the past few decades, many innovative methods have been adopted in medical education, including problem-based learning, case-based learning (CBL) and the patient-oriented problem-solving system.[2–5] The common feature of these methods is the application of clinical problems, and such application has been proved to be effective in improving students' analytical skills and problem-solving abilities, promoting students' self-directed life-long learning and reinforcing students' collaborative and communication skills.[4,6,7] But in developing countries especially in China, the application of these methods is limited due to reasons like faculty shortage and lack of resources.[4]

CBL is a long-established pedagogical method that focuses on case study teaching and inquiry-based learning; thus, CBL is on the continuum between structured and guided learning.[8] CBL was 1st introduced by James Lorrain Smith, a pathology professor at the University of Edinburgh, as the "case method of teaching pathology" in 1912.[9] CBL functions as a bridge between learning/knowledge and working life,[8,10] strengthening the link between theory and practice[11,12] and mirroring the decision-making process of the workplace.[12]

Drawing on the experience of CBL, an innovative teaching model that is designed for large student cohorts was applied in our pharmacology course. The lecture hours for the traditional topics were reduced by 30%, and 2 new topics were added in the course. We designed and prepared cases over the entire course. Two topics were chosen for case-oriented self-learning by the course director and the senior teachers based on an analysis of the teaching content in pharmacology and 3 case-oriented review sections were arranged during the course.

Previous studies have shown that students' reactions to CBL are overwhelmingly positive in pharmacology teaching; however, the effects of some similar methods on students' academic performance were controversial.[13–17] The effects of CBL on students' academic performance in pharmacology teaching have rarely been evaluated in developing countries.[18] In this study, a controlled and randomized study was conducted to assess the innovative teaching model in pharmacology teaching by analyzing students' academic performance on examinations and data from questionnaires designed for both the participating students and teachers.

METHODS

Basic pharmacology has traditionally been taught in the 5th semester of the 5-year medical program at Wuhan University. In all, 103 and 82 third-year medical students volunteered to participate in the study in 2011 and 2012,

respectively. The Excel software program was used to generate random numbers that were assigned to each student. Then, the students were randomized to either the study group (49 in 2011 and 47 in 2012) or the control group (traditional lecture-based teaching) (54 in 2011 and 35 in 2012).

The course scheme for the study group has been developed by the course director and senior teachers. The reform plan was approved by the Health Science Center of Wuhan University. In the study group, the students received 44 hours of case-oriented lectures (including 4 hours of lectures concerning the toxicology and pharmacology of the immune system that were not given in the control group), 4 hours of case-oriented discussion and 6 hours of review (Table 1). In the control group, the students received 57 hours of lectures in basic pharmacology. In the study group, the students were divided into 10 small teams (4–5 students on each team) and were asked to work as a team throughout the semester.

To facilitate students' critical thinking toward pharmacological principles in medical practice, we designed and prepared cases that demonstrate a number of key issues over the entire course. During lectures, teachers provided 1 or 2 cases with questions for each chapter, which will guide the students to study the new topic.

The students were required to learn selected chapters ("Factors affecting the drug effect" and "Rational use of antimicrobial drugs") from a pharmacology textbook by themselves before the scheduled case-oriented discussion, and the related cases with questions were distributed to the class 2 weeks before the class discussion. During these 2 weeks, the students had to search for and read related references and discuss the applicable pharmacological theory and questions within their team. In class, each group explained their understanding of the cases and responded to criticisms from other students of their analysis of the cases. During the discussion, the teachers (1 teacher for 5 groups) were required to make no comments. At the end of the discussion, the teachers provided a brief summary of the important issues in the case. Therefore, the students led the class discussion.

Case-oriented review sections were arranged to enhance students' understanding of the key principles and their capability of applying these principles in clinical practice. In review classes, the teachers led the class discussion, providing a considerable number of clinical questions concerning the topics that were discussed in previous courses to help students adapt to professional working conditions and to strengthen students' understanding and application of the knowledge.

During the semester, the students took a mid-term examination and a final examination. These examinations covered the topics learned by both groups. The mid-term and final examinations were, respectively, designed by the course director and a senior teacher. The examinations were not made available to the teachers before they were administered to the students. Before grading the students' examination papers, all of the teachers (8 people) who participated in this study met to discuss the answers of the short-answer questions and to create an answer key. The short-answer questions in the paper were graded by several teachers, and each short-answer question was graded by a single teacher to ensure consistency. Teachers scoring the examinations were blinded as to the identity and group of the students.

The mid-term examination was designed to evaluate the learning process by encouraging students to use their knowledge to solve problems rather than to just recall their knowledge of the subject. The final examination was based on the Chinese Medical License Examination. The mid-term examination was more difficult than the final examination. Both examinations were worth 100 points. Comprehensive problems were worth 50 to 60 points on the mid-term examination and 20 to 30 points on the final term. In 2011, the students in both groups took the same mid-term examination, which had 30 multiple-choice questions and 2 short-answer questions, and the same final examination, which had 60 multiple-choice questions and 6 short-answer questions. In 2012, the students were required to take a mid-term examination, which had 40 multiple-choice questions and 3 short-answer questions, and a final examination, which had 60 multiple-choice questions and 9 short-answer questions. Based on the examination score, the students were categorized into 4 performance ranges: (1) excellent (scoring 86–100); (2) very good (scoring 76–85); (3) good (scoring 60–75) and (4) insufficient (failing the examination).

Questionnaires were designed for both the students in the study group and the teachers who participated in the study in 2011 (Tables 2 and 3).[15,16,19] Answers were provided on 5-point Likert-type scales ranging from 1 (strongly disagree) to 5 (strongly agree).

TABLE 1. Topics for 2 groups

Topics	Traditional lecture-based teaching (57 h)	Case-oriented self-learning (54 h)
1	General principles (8 h)	General principles (6 h)
2		*Toxicology (2 h)*
3		*(Discussion) Factors affecting the drug effect (2 h)*
4	Peripheral neuropharmacology (10 h)	Peripheral neuropharmacology (6 h)
5		*Review (2 h)*
6	Cardiovascular pharmacology (8 h)	Cardiovascular pharmacology (6 h)
7	Anticoagulants (2 h)	Anticoagulants (2 h)
8	Central neuropharmacology (10 h)	Central neuropharmacology (8 h)
9		*Review (2 h)*
10	Endocrine pharmacology (6 h)	Endocrine pharmacology (4 h)
11	Chemotherapy drugs (13 h)	Chemotherapy drugs (8 h)
12		*Pharmacology of the immune system (2 h)*
13		*(Discussion) Rational use of antimicrobial drugs (2 h)*
14		*Review (2 h)*

The content added in the new teaching model is marked as the italics.