Original Article
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Medical Journal of the Islamic Republic of Iran (MJIRI)
Iran University of Medical Sciences

The effect of short-term workshop on improving clinical reasoning skill of medical students

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Received: 25 April 2015 Accepted: 4 April 2016 Published: 12 July 2016

Abstract

Background: Clinical reasoning process leads clinician to get purposeful steps from signs and symptoms toward diagnosis and treatment. This research intends to investigate the effect of teaching clinical reasoning on problem-solving skills of medical students.

Methods: This research is a semi-experimental study. Nineteen Medical student of the pediatric ward as case group participated in a two-day workshop for training clinical reasoning. Before the workshop, they filled out Diagnostic Thinking Inventory (DTI) questionnaires. Fifteen days after the workshop the DTI questionnaire completed and "key feature" (KF) test and "clinical reasoning problem" (CRP) test was held. 23 Medical student as the control group, without passing the clinical reasoning workshop DTI questionnaire completed, and KF test and CRP test was held.

Results: The average score of the DTI questionnaire in the control group was 162.04 and in the case group before the workshop was 153.26 and after the workshop was 181.68. Compare the average score of the DTI questionnaire before and after the workshop there is a significant difference. The difference between average KF test scores in the control and the case group was not significant but between average CRP test scores was significant.

Conclusion: Clinical reasoning workshop is effectiveness in promoting problem-solving skills of students.

Keywords: Clinical reasoning, Student, Problem solving, Pediatric medicine.

Cite this article as: Yousefichaijan P, Jafari F, Kahbazi M, Rafiei M, Pakniyat AG. The effect of short-term workshop on improving clinical reason-ing skill of medical students. *Med J Islam Repub Iran* 2016 (12 July). Vol. 30:396.

Introduction

Medical Science universities intend to graduate students who help maintain and improve the social health as a health team. They will produce knowledge (Basic and clinical science), apply it (clinical decision making) and manage health and society to keep up and improve people's health (health system management) (1).

Medical Science universities have few programs to improve problem-solving skill in the health system and focus on individual memories, though the first goal of any educational system is to transfer learners from mere memorizing level to reasoning and problem-solving level (1).

Common educational methods provide individual with plenty of theoretical information who may sometimes be unable to solve small problems. In fact, traditional educational method provides students with a combination of information and concepts but leaves them alone in prioritization and organization of new knowledge analysis which is necessary to critical thinking and results in effective learning (2).

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Clinical reasoning is the key skill in practice and worthiness of clinical reasoning skill should be considered as one of the most important skills that a physician needs (1). The reasoning is a mental procedure in which primary terms are transformed into secondary or desirable terms. Thus, reasoning is a conclusion based on primary terms. The reasoning is a transmission from what we see and a try to give them meaning and concept (3).

In medicine, reasoning is getting patient's medical history, finding out signs and symptoms and by passing through them by conclusion you get to a clinical diagnosis. So, clinical reasoning is a mental procedure which helps physicians to cross from signs and symptoms to clinical reasoning and treatment (2).

General clinical reasoning procedure consists of information gathering, proposing hypothesis and hypothesis evaluation. The first principle of clinical reasoning is gathering valid, accurate and reliable information from the patient. The patient is an information source from which physician tries to obtain useful and relevant information and form a diagnostic hypothesis based on self-knowledge. Then, the physician evaluates hypothesis and for this new information from the patient is required. If physician happened to understand patient's problem, they could enter clinical counsel which requires further information gathering for hypothesis design and evaluation. Studies have shown that most physicians, even when the diagnosis is clear, use multi-level clinical reasoning and their general clinical reasoning does not vary based on different patient problems or different medical specialties (3,4).

Since the most important step of clinical reasoning is data gathering, the physician should be able to obtain a medical history from the patient or any other source through a purposeful medical interview using communication skills. Then they should be able to get to a differential diagnosis. Physicians face some patient complaints in the work life which show that their experience and skills do not seem satisfactory. Thus, the ability to deal with such situations with appropriate medical reasoning approaches should be developed in physicians (5).

Getting medical history and communication and effective interpersonal skills are some basic clinical capabilities which medical students and residents should learn. Proper communication requires practicing and special attention. Often success in managing a disease is dependent on getting history, proper and rapid communication with patient and gathering data from different sources (6).

The base of health surveillance is the communication between physician and patient. An appropriate communication leads to greater success in achieving a correct diagnosis and performing suitable medical services. To use communication skills in the workplace, a physician should first understand their concept then practiced them enough. In many curriculums not adequate attention has been devoted to communication skills and faculty members use quantitative methods and strategies for teaching and evaluation of this skill (7).

On the other hand, in pediatric medicine communication, getting a medical history and data gathering has its own properties. Students of medicine should get familiar with special points in pediatric medicine communication skills other than general communication skills to succeed in information gathering which is the most important step of medical reasoning. Many signs in pediatric medicine are different from adult medicine, and their interpretation requires special precision. The physician should be able to interpret signs which are stated by parents. Parent's anxiety and sensitivity about their kids make the examination difficult.

This research is intended to teach medical reasoning to students with a special attention to pediatrics medicine and measure its effect on their problem solving's ability. In the educational phase, data gathering is based on special communica-

tion skills in pediatrics medicine and all signs and symptoms of pediatric diseases. In the evaluation phase, students' medical reasoning is measured according to available tests and widespread pediatric diseases. The applicable result of this research would be the design of a new educational course in the pediatric department for medical students.

Additionally, since an area of national medical students' scientific Olympiad which has been held annually in medical science universities since 2010, is evaluation of medical students' reasoning skill, performing this project is helpful for preparation and practice of students of Arak medical university to achieve great results for the university.

Methods

In a case-control study, Forty-two students investigated. Sampling volume was calculated with the formula below, and students were put into case and control group.

$$n = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2 * (\delta_1^2 + \delta_2^2)}{(\mu_1 - \mu_2)^2}$$

Where α equals 0.5, β equals 0.9 and δ equals 3 (range divided by 6). The minimum significant difference between case and control group is 3 points (of 20 points) and the minimum sample is 20 for each group.

According to university's educational schedule, stagers stay in pediatric department of Amir Kabir Hospital for 3 months. They were divided into different sections, getting medical history from inpatients and outpatients and getting familiar with diseases and diagnosis and therapeutic methods. Theory classes were held every day and main pediatric diseases were described to stagers (undergraduate medical students). At the end of the course a multiple-choice written test and an oral exam were taken from the stagers.

In this study, three periods of courses were taken into account. Stagers of one period were put into the case group and stagers of the two other periods were put into the the control group. The control group consisted of stagers who passed their pediatric course with the traditional method including no clinical reasoning instruction as indicated above. At the end of the course, instead of an oral exam, these stagers take clinical reasoning tests: Diagnostic Thinking Inventory (DTI), Key Features (KF) and Clinical Reasoning Problem (CRP).

Since the numbers of students in each period of this course were below 20, two periods of this course were used as control group. Case group passed a 2-day workshop on clinical reasoning 15 days left to the end of course and taken clinical reasoning tests. Exam questions for both case and control groups were the same.

Arrangement for the two days of the workshop was done with the help of the pediatrics group of the medical school. Main topics of the workshop were:

1. Instruction of communication skills in pediatric medicine
2. Instruction of data gathering
3. Instruction of hypothesizing
4. Instruction of analytical reasoning approach
5. Instruction of nonanalytic reasoning approach
6. Instruction of changing clinical reasoning approach in problem-solving

It was a student-based workshop and practice on common pediatric diseases in small groups. All contexts were presented by the power-point software (appendixes 2 to 6). Five cases of pediatric diseases in addition to other pamphlets were provided and copied.

The workshop was held in Amir Kabir Hospital conference hall. The duration of the workshop was 12 hours in 2 days, and 19 medical stagers (case group) took part in the workshop. Before getting to the topics of the workshop, participants were asked to fill the DTI (Diagnostic Thinking Inventory) questionnaire. This questionnaire consisted of 41 questions with six

answers which was designed for evaluation of the quality of medical reasoning.

In the first day of the workshop, generalities of clinical reasoning in medicine were discussed and participants got familiar with its primary concepts. Data gathering was introduced as first and most important step of clinical reasoning. In the open discussion, participants get to ways to accredit information and pediatric medicine properties. Due to importance of communication with patients, Calgary-Cambridge interview guidance was practiced. Then hypothesizing step was discussed. Two patient illness scripts was given to the participants for workshop practice and home use.

In the second day, after reviewing previous day's topics and presentation of home problems, bugs were fixed. Then hypothesis evaluation methods in clinical reasoning were discussed. Afterward, two new illness scripts besides previous illness scripts were discussed. Finally, after summarizing the topics presented at the workshop, satisfaction questionnaires were completed by participants. 15 days after the workshop, DTI (Diagnostic Thinking Inventory), KF (Key Features), and CRP (Clinical Reasoning Problem) clinical reasoning tests were taken from the case group.

Ten questions of common pediatric issues were designed for both KF and CRP tests (see them in the appendix). To design the answer-key of the tests, five residents of pediatrics was asked to answer the questions. For any question of the KF test 7.5 points was considered which made 75 points in total. For each question of CRP test 12.5 points was considered which makes 125 points in total. Consequently, KF and CRP tests reached 200 points together. Since any question had six choices and the number of DTI questionnaire's questions, minimum and maximum scores were 41 and 246, respectively.

Stagers who did not participate for any reason were omitted from the study. DTI, KF and CRP tests were taken from both case and control groups and were scored. Data was analyzed using central tendency test and t-test. SPSS software was used. $p<0.05$ was considered as statistically significant.

This research has been approved by ethics committee of research in the Arak medical faculty under number 90-115-1. This research was observed by the ethics committee in all steps.

Results

Forty-two stagers investigated in this research. 19 were in the case group (36.8% male and 63.2% female), and 23 were in the control group (43.5% male and 56.5% female).

According to the questionnaire, participant's satisfaction level was good. All participants indicated that educational methods of the workshop were appropriate to the goals. About 85% (n=36) of them stated that the workshop could make the concept "clinical reasoning" clear to them and 72.7% (n=30) told they were satisfied with time and place of the workshop (Table 1).

Mean of grade point average for the case and control groups were 15.4±2.4 and 15.0±2.6 respectively which is not significantly different ($p>0.05$).

Statistical analysis of Diagnostic Thinking Inventory (DTI) (Total points=246):

- In the control group, mean DTI score of 162.04 and 170.2 with standard deviations of 18.3 and 19.5 was calculated before and after workshop respectively (pretest and posttest).
- In the case group, mean DTI scores of 153.26 and 181.68 with standard deviations of 13.6 and 21.9 was calculated before and after workshop respectively (pretest and posttest).

❖ Comparing mean pretest DTI score of the control group with case group did not show a significant difference ($p>0.05$).

❖ Comparing mean DTI score of the control group with case group (Posttest DTI) showed a significant difference ($p<0.05$).

Table 1. Frequency Distribution of Participants' opinion on clinical reasoning Workshop (n(%))

Topic	Totally agree	Agree	No comment	Disagree	Totally disagree
Workshop goals were specified	17 (41.1)	20(47.4)	5(11.9)	0	0
Attracted participants	16(38)	22(52.5)	4(9.5)	0	0
There was ample opportunity to practice on the issues raised	7(16,6)	24(58)	11(26.1)	0	0
The workshop was able to clear the "clinical reasoning" to me	15(35.7)	24(57.1)	3(7.2)	0	0
Workshop was appropriate methods for achieving its objectives	18(42.8)	24(58)	0	0	0
Teaching aids used in the workshop was appropriate	18(42.8)	20(47.6)	4(9.5)	0	0
Teaching skills was appropriate for the presentation	18(42.8)	24(57.1)	0	0	0
Workshop instructors dominated the scientific content	11(26.1)	24(57.1)	7(16.6)	0	0
Schedule to be suitable.	20(47.6)	17(40.4)	5(11.9)	0	0
The workshop time was appropriate	13(30.9)	17(40.4)	12(28.5)	0	0
Location of the workshop was appropriate	13(30.9)	18(42.8)	11(26.1)	0	0

Table 2. Mean KF and CRP Test scores in case and control group

Group	KF + CRP			CRP Test			KF Test		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
Control	118.75	87.25	102.85	77.25	40.5	54.6	58.5	40	48.23
Case	137.25	78	110.97	77.25	37.5	60.5	60	40	50.47

❖ Comparing mean DTI score of pretest and posttest in the case group showed a significant difference ($p<0.001$).

❖ Comparing mean DTI score of pretest and posttest in the control group did not show a significant difference ($p>0.05$).

Statistical Analysis of KF (Key Features) and CRP (Clinical Reasoning Problem) tests showed in Table 2.

- Comparing mean KF scores in the case and control groups did not show a significant difference ($p>0.05$).
- Comparing mean CRP scores in the case and control groups showed a significant difference ($p>0.05$).
- Comparing mean total scores in the case and control groups showed a significant difference ($p>0.05$).

Discussion

Learning clinical reasoning like any other skills needs practice more than knowledge. Thus, enough attention must be paid to problem-oriented and student-oriented teaching as two principles. To have a closer contact with real clinical environment, a best educational method is case-based learning (8). Using patient's medical history as a scenario is the cornerstone of learning and evaluation of clinical reasoning. Consequently, 30 medical scenarios of pediatrics' disease were used in this research. Desig of these medical scenarios proper to the scientific level of participants was time-consuming and sensitive. Ten different histories were used for KF test, CRP test, and workshop's practices. The best learning environment for clinical reasoning is small groups which are based on problem solving. So the followings were prepared for this research:

1. Illness scripts of common pediatrics diseases to be used in workshops and tests
2. Test questions and the keys

3. Designing an educational course based on workshop's plan
4. Preparing booklets and pamphlets to be used in workshop
5. Preparing power point presentation for workshop's lectures

In this research, the workshop was held in 2 days including 12 hours of clinical reasoning course which is a proper time compared with similar studies. In a study at Hong Kong University in 2007, a workshop was held for the case group only 3 hours long using illness scripts (11). When informational, judgmental and reasoning errors of individuals are detected and discussed, its effect on clinical medicine memory and clinical reasoning strategy is reinforced (9). Because of this, the workshop was planned to be based on practicing illness scenarios of real patients with emphasis on pediatric medicine. In most studies, using illness scripts which are patient's real medical history have been recommended (1,10).

Evaluation of clinical reasoning is different from other medical instructions. Evolution of clinical reasoning is somehow evaluation of medical skills and as a result has special tests. Clinical reasoning tests are designed to investigate its different principles. For evaluation of clinical reasoning, three skills should be investigated, account to give a complete picture: data gathering, hypothesizing and hypothesis evaluation. Thus, clinical reasoning exam is designed as a test set. Tests which can be used for this purpose include (8):

- ✓ Information gathering test
- ✓ Key features
- ✓ Hypothesis formation test
- ✓ Clinical reasoning problem
- ✓ Integrated puzzles
- ✓ Diagnostic Thinking Inventory

After consultation with expert faculty, key feature, clinical reasoning problem and diagnostic thinking inventory, which provide a great variation compared with other tests, were selected to be used in this research (9,10).

To check the case and control groups' likeness, mean grade point of stagers was used which showed no significant difference. Also, when DTI questionnaire score of the control group and the case group before workshop was compared there were no significant difference. Thus, the conclusion was more scientific and accurate.

The workshop was held 15 days before the end of the pediatric course to be far away from the exam time. DTI test was taken from participants before and after the workshop. A significant difference was observed which showed the effect of clinical reasoning workshop. This means that the workshop was successful in teaching primary concepts of clinical reasoning to the participants. KF and CRP tests were taken 15 days after the workshop. Although mean KF score of the case group was higher than the control group, it did not show any significant difference. It can demonstrate the nil impact of this intervention (workshop) in improving KF Score and this workshop is too short to influence the KF score, but mean CRP and the total score showed a significant difference which means that clinical reasoning has a long-term effect on the problem-solving ability of stagers. Since no significant difference has been observed in one of the tests and some DTI questionnaire questions, it can be inferred that the in some aspects of clinical reasoning, the workshop has been more effective.

Students who are familiar with the clinical reasoning skills as well as the theatrical knowledge, will be more successful in analyzing, prioritizing, and knowledge organizing to solve health problems. Since medicine learning issues are paid attention in the whole world, we ought to teach and use new techniques to have something to say with these rapid advances in medicine and medical education.

Barbara Goss et al. suggested the impact of both the developmental effect and the curriculum effect on the development of diagnostic reasoning skills (11). Common errors in clinical reasoning muse be

recognized and teachers provide guidance on the cognitive processes involved in making diagnostic decisions (12). Study of Bian Wu et al. showed that the learning of clinical reasoning in both problem solving and knowledge construction would be developed using computer-based cognitive representation approach (13).

Martine Chamberland et al. concluded that Self-explanation seems to be an effective technique to help medical students learn clinical reasoning. Its impact is increased significantly by combining it with examples of residents' SEs and prompts (14). Eva et al. study and also Round AP. showed that clinical reasoning strategies can result in improved diagnostic thinking inventory (15,16). However, Rajabi et al. found no significant difference between the scores of CRP before and after the intervention (17). Anna Lee et al. showed that there is no difference between post-intervention scores of the two groups although the total score was higher in the intervention group compared to the control group (18).

Conclusion

This research showed that stagers' problem-solving skill can be improved by teaching clinical reasoning; and widespread theoretical issues can be provided as illness scripts to improve clinical reasoning skill of stagers. This workshop can be performed in all department of Arak medical faculty and other medical sciences university of the country.

Acknowledgement

Thanks to the Deputy of Arak University of Medical Sciences and research students who participated in this study.

Conflict of interest

All authors declare that they have no conflict of interest.

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