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Clinical Reasoning and Improvement in the Quality of Medical Education

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Background: "Clinical reasoning" is the key skill in medical practice, and well beyond mere medical knowledge. However, regarding the current medical school curriculums, little attention has been paid to develop such skills. It might be the reason why diagnostic errors are still the major causes of the patients' harm.
Objectives: The purpose of this study was to investigate the effect of teaching clinical reasoning skills (problem-based training in small groups) on improvement of the clinical performance of medical interns.
Materials and Methods: This quasi-experimental study was conducted from September 2012 to September 2013. All of the interns entering the Pediatrics Department of Hamadan Medical Faculty (4 three-month courses) were enrolled. Courses were assigned alternately as intervention and control. Interns in the control group had conventional training but for intervention group, a clinical reasoning workshop was held in addition to the conventional education. To assess both groups, the Clinical Reasoning Problem (CRP) test was used as the pretest and posttest. Data were analyzed with t test and paired t test.
Results: Out of 62 participants, 30 (48%) were in the control group and 32 (52%) in the case group. Two groups were similar in baseline characteristics such as age and sex ($P > 0.05$). There was no significant difference between the scores of the two groups' pretests ($P > 0.05$). The mean pretest and posttest scores of the control group had no significant difference ($P > 0.05$), but comparison of the mean pretest and posttest scores of case group represented significant difference ($P < 0.05$).
Conclusions: Clinical reasoning workshop will probably have a positive impact on upgrading clinical problem-solving skills.

Keywords: Medical Education; Problem Solving; Workshop

1. Background

"Clinical reasoning" or its related concepts such as problem solving, decision making, or judgment is the key skill for medical practice; however, in the current medical school curriculums, little attention has been paid to developing these skills (1). It might be the reason why diagnostic errors are still the major causes of the patients' harm. Clinical reasoning is a rational thought process that leads the doctor to take wise and purposeful steps at diagnosis and treatment. It is present at all stages of dealing with the patient, from the initial stages of taking history up to the completion the treatment and follow up (2). The general process of clinical reasoning involves collecting information, making hypotheses, and evaluating them. The initial collected data leads to a hypothesis (or hypotheses). Constructed hypotheses should be evaluated, based on new information of the patient, to obtain a final hypothesis. Researches have shown that many physicians use this multistep clinical reasoning method, even when the final diagnosis is obvious. The general form of the reasoning is pretty similar, despite the variety of patients' problems or physicians from different medical specialties (3, 4).

The general opinion is that clinical reasoning skills should be taught to medical students, and then evaluated (5). This training should be based on two major principles: first, adequate attention to the problem as well as student-based training; and second, teaching clinical reasoning (as much as possible) in real situations, as experience is an authentic and important element in the medical practice (6). To reach closer to the real clinical situations, the best method of education is case-based training; using the "scenario of patients" is the cornerstone of teaching and assessment of the clinical reasoning. In addition, the most appropriate environment for teaching clinical reasoning is learning in small groups (5 to 10 students), with the help of a teaching assistant (tutor), and focusing on problem solving methods. The aim is to teach clinical reasoning to the students along with practicing these skills on real scenarios, which enhances clinical reasoning during their education. Also

metacognitive thinking will be transferred to students in this way (6, 7).

Assessment of clinical reasoning is a qualitative evaluation, which must be done in the context of reasoning process and focusing on the final goal, which is the clinical diagnosis and management. A variety of tests have been designed and used to assess clinical reasoning, called "Alternative Assessments". Alternative assessments are intended to assess the students' knowledge and skills with making the assessment situations simulating the real ones. One of the most important points in the qualitative assessment is the flexibility of the responses. Unlike quantitative methods, qualitative methods of evaluation are done by a team and the test answers are prepared based on detection of an expert panel (6).

According to the available studies, an increasing number of experts believe that the clinical reasoning skills not only need training, but their training also varies with conventional medical education; it is a kind of active learning (student-centered), and notably through training workshops (7-9). Furthermore, they believe that assessment of clinical reasoning skills is not possible through conventional tests, therefore alternative methods of assessment have been designed and employed (6, 7).

2. Objectives

In this study, we intended to teach clinical reasoning skill to interns, (with an approach to pediatrics) and to investigate its impact on their problem solving skills.

3. Materials and Methods

According to the current curriculum of Medicine Faculty, interns spend a 3-month period in Pediatrics Department to become familiar with diagnostic measures and case managements, mainly through inpatient and outpatient visits, morning rounds and bedside teaching. At the end of this period, they are evaluated by a multiple-choice questions (MCQs) test and an Objective Structured Clinical Examination (OSCE).

In this quasi-experimental study, from September 2012 to September 2013, all of the interns training the Pediatrics Department of Hamadan Medical Faculty (in 4 3-month courses) were enrolled. Each course was considered as a sample unit and by random method we assigned the category arm of intervention (experimental or control group) for the first course. Then, other courses allocated alternately to control or experimental group, so that in the end we had two experimental and two control groups. The interns in the control group passed their course with the conventional method. But for the interns in the intervention group, in addition to the conventional training in pediatrics, a one-day workshop on clinical reasoning education was held, which consisted of theory pats and practical exercises.

This one-day workshop of clinical reasoning education was problem-based, conducted in small groups, and using the patient scenarios. At first, the basic components of clinical reasoning such as definition of the clinical reasoning and its methods, information resources and their degree of reliability, and methods of data collection were described. Then, the principles of postulating a hypothesis such as forward reasoning, backward reasoning, and rule of parsimony were taught, and finally the principles of evaluating the hypotheses were discussed. At the end of each stage, some scenarios of the common children diseases were given to the students for group work and they practiced making and evaluating hypotheses in small groups. The bulk of the workshop time was spent on group work. One of the faculty members with expertise in clinical reasoning attended the group as the coordinator and some of pediatric residents as teaching assistants (tutors).

At the beginning and the end of 3-month pediatrics courses, all interns (intervention and control groups) underwent a special test for assessment of clinical reasoning skills. In this study, we used Clinical Reasoning Problem (CRP) test. In this test, a scenario was posed whose information was neither low enough to conclude any diagnosis nor so much to reach just one solution. Six possible diagnoses were raised for each scenario (at least two correct differential diagnoses must be present among the options). In the first question, interns were asked to choose one of the present diagnostic options. In the second question, from some findings that each one has an observer in the scenario, interns should choose a maximum number of five choices, related to the selected diagnosis, and give them positive or negative signs. The positive sign was in favor of the selected diagnosis (confirmation), whereas the negative sign was against the selected diagnosis. The next two questions were similar to the first two ones, but another diagnosis should be selected. The priority of selected diagnoses was not important (6).

In our study, CRP test contained five scenarios of common diseases in children, with a total response time of 75 minutes. The maximum score for each scenario was 12. At the beginning of each test session, interns were given necessary explanation about the method to answer the questions. To obtain the key (answer) of the test, questions were sent for 15 pediatric faculty members in Tehran, Shahid Beheshti, Guilan, Kermanshah, and Hamadan Universities of Medical Sciences (as the expert panel) via email and were asked to answer the questions. For each question, the more selected options by the expert panel, were elected as the correct answers. Using the SPSS 19 software, after reassuring normal data distribution in two groups (using histogram and box plots), scores of both intervention and control groups were compared using t test. Then, the pretest and posttest scores of each group were compared using paired t test. The level of significance was determined as $P < 0.05$.

4. Results

Out of 62 interns participated in this study, 32 (52%) and 30 (48%) interns were assigned to case and control groups, respectively. Mean ± SD of participants' age was 25 ± 1.3 y. Sixty-five percent of participated interns (40) were female and 35 % (22) were male. Table 1 shows age and sex distributions in two groups. For all participated interns, it was the first time to pass the pediatrics course. Comparison of the pretest scores of two groups showed no significant difference (P > 0.05). This confirms that the two groups did not differ significantly in terms of clinical reasoning ability before the intervention (Table 2). The comparison between pretest and posttest scores of control group showed that there is no significant difference between them (P > 0.05) but a significant difference was found between pretest and posttest scores of case group (P < 0.05). This significance demonstrates the effectiveness of our conducted intervention. Table 3 shows the mean ± SD scores of pretest and posttest in both case and control groups.

Table 1. Age and Sex Distribution in the Study Population

Group	Intervention	Control	P Value
Age [a]	25.2 ± 2.6	24.8 ± 1.8	0.083
Gender (male) [b]	35	38	0.11

[a] Data are presented as mean ± SD.
[b] Data are presented as %.

Table 2. Pretest Scores in Case and Control Groups [a]

Group	Score	P Value
Case	4.93 ±1.38	< 0.05
Control	5.05 ±1.40	

[a] Data are presented as mean ± SD.

Table 3. Scores of Pretest and Posttest in Case and Control Groups [a]

Group	Pretest	Posttest	P Value
Case	4.93 ± 1.38	5.80 ± 1.22	< 0.05
Control	5.05 ± 1.40	5.52 ± 1.41	> 0.05

[a] Data are presented as mean ± SD.

5. Discussion

"Clinical Reasoning" is a relatively new topic in the field of medical education. There is less than half a century of experience in the field of clinical reasoning; searching resources and databases confirms that little research has been done in this field. On the other hand, given the novelty of this topic, the majorities of present resources are descriptive or review articles and interventional studies are rarely found in this area. Perhaps this fact is a strength point for our study.

Our intervention in this study was a one-day workshop. The other studies using workshop to teach clinical reasoning have also acted more or less in the same way as ours. In a study at the University of Hong Kong, a 3-hour workshop was held using illness scripts for teaching clinical reasoning for the case group (10). Also a 3-hour workshop, with similar format to ours, has been held in the study of Rajabi et al. (2013), but Jafari et al. (2011) have designed and implemented a 2-day workshop (total 12 hours) to teach clinical reasoning (11, 12). Among the Iranian and non-Iranian studies done in this field, Jafari and Rajabi studies are the most similar ones to ours. However, the main difference among these studies is that their study populations are medical students (stagers), whereas we have studied the interns (11, 12). It seems that better orientation of interns with clinical conditions and environment has made our training and evaluation more closely to the real situation.

When students' errors in information, judgment, and reasoning, were immediately recognized and discussed, its effects will strengthen the clinical memory and reasoning strategy (13). Therefore, our workshop was held as exercises and interactive dialogues, based on real pediatric cases. Many of other studies have used illness script, based on real patients' conditions too (1, 9-12). So far, several tests have been designed and applied to assess clinical reasoning such as Diagnostic Thinking Inventory (DTI), information gathering, key features (KF), integrated puzzles, and hypothesis formation tests; however, most of studies used Clinical Reasoning Problem (CRP) test (6, 10-12, 14). This test is appropriate to evaluate various aspects of clinical reasoning. The findings of Groves et al. study at the University of Queensland (2002) showed that CRP is an easy to use test with high reliability and validity for assessing clinical reasoning, which can carefully monitor the progress of students' skills through a training course (14). In this study, we used CRP test at the discretion of the authorities, with regard to the level of skills and knowledge of study population.

Although the case and control groups in our study were randomly selected, the findings of study showed that pretest scores of the two groups were not significantly different. It emphasizes the sameness of the two groups before the intervention and makes the conclusion about the impact of workshop more accurate.

While comparison of pretest and posttest of control group showed no significant difference, this difference was statistically significant between the mean scores of pretest and posttest in case group. Considering the sameness of two groups, it can demonstrate the positive impact of this intervention (workshop) in improving clinical reasoning skills of interns. Holding clinical reasoning workshops also had promoted reasoning skills in medical students reported in studies of Jafari et al. and Lee et al. (10, 11). In these studies, the main tool of evaluation was CRP test, too.

In Eva et al. study on undergraduate psychology students at McMaster University; it has mentioned that combined reasoning strategies (analytic and non-analytic) can result in improved diagnostic accuracy (15). Also in Round study, a controlled observational study at the University of Bristol, performed on 4th year medical students, the effects of a brief teaching intervention on clinical reasoning skills was measured. The final results showed that students participating in the teaching intervention performed significantly better on the diagnostic thinking inventory than control students (16). However, Rajabi et al. found no significant difference between the scores of CRP before and after the intervention (12). In another randomized controlled trial, which performed by Anna Lee et al. at Chinese University of Hong Kong, a 3-hour workshop on clinical reasoning was conducted on 4th year medical students and the results showed that, post-intervention scores were similar between two groups although the total score were higher in the intervention group compared to the control group (10).

Overall, the findings of this study show that problem solving skill can be upgraded in interns by teaching them the clinical reasoning. Perhaps this research paves the way for new methods of medical education, which besides theoretical learning; introduce clinical reasoning skills to medical students.

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Authors' Contributions

Study concept, design, and acquisition of data: Iraj Sedighi and Mohamad Matinpour; Analysis and interpretation of data: Mohamad Matinpour, Iraj Sedighi and Alireza Monajemi; Drafting of the manuscript and critical revision of the manuscript for important intellectual content: Mohamad Matinpour and Iraj Sedighi; Statistical analysis: Alireza Monajemi and Mohamad Ali Seif Rabiei; Administrative, technical, and material support: Farshad Jafari and Emad Momtaz H; Study supervision: Iraj Sedighi.

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