
 INNOVATIONS IN EDUCATION AND CLINICAL PRACTICE

Improving the Physical Diagnosis Skills of Third-year Medical Students

A Controlled Trial of a Literature-based Curriculum

Mark J. Fagan, MD, Rebecca A. Griffith, MD, Laura Obbard, MD, Carolyn J. O'Connor, MD

OBJECTIVE: To determine if a literature-based physical diagnosis curriculum could improve student knowledge, skill, and self-confidence in physical diagnosis.

DESIGN: Prospective controlled trial of an educational intervention.

SETTING: Required internal medicine clerkship for third-year medical students at Brown Medical School.

PARTICIPANTS: Third-year medical students who completed the internal medicine clerkship during the academic year 1999–2000: 32 students at 1 clerkship site received the intervention; a total of 50 students at 3 other clerkship sites served as controls.

INTERVENTION: Physical diagnosis curriculum based on 8 articles from the *Journal of the American Medical Association's Rational Clinical Examination* series. Intervention students met weekly for 1 hour with a preceptor to review each article, discuss the sensitivity and specificity of the maneuvers and findings, and practice the techniques with an inpatient who agreed to be visited and examined.

MEASUREMENTS AND MAIN RESULTS: Physical diagnosis knowledge for the 8 topics was evaluated using a 22-item multiple choice question quiz, skill was evaluated using trained evaluators, and self-confidence was assessed using an end-of-clerkship survey. Intervention students scored significantly higher than the control group on the knowledge quiz (mean correct score 70% vs 63%, $P = .002$), skills assessment (mean correct score 90% vs 54%, $P < .001$), and self-confidence score (mean total score 40 vs 35, $P = .003$), and they expressed greater satisfaction with the physical diagnosis teaching they received in the clerkship.

CONCLUSION: This physical diagnosis curriculum was successful in improving students' knowledge, skill, and self-confidence in physical diagnosis.

KEY WORDS: physical diagnosis; medical education; clinical examination.

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While concerns about deficiencies in physical diagnosis skill are not new,¹ significant gaps in physical examination skill among medical students and residents² as well as practicing physicians³ have become well documented, leading to widespread calls for improved physical diagnosis teaching.^{4–6} How best to achieve this goal remains unclear. Previous approaches have produced disappointing results. Mangione et al. designed a year-long structured review course in physical diagnosis for medical residents consisting of monthly lectures using visual and audio aids.⁷ Residents who completed the course failed to show improved knowledge or skill compared to controls, leading the authors to suggest that residency may not be the best time to teach these skills. An advanced physical diagnosis course for senior medical students showed demonstrable improvements in skill but was subject to the limitation that it was offered as an elective, possibly attracting particularly motivated students.⁸ Neither of these approaches focused primarily on the diagnostic utility of specific physical examination maneuvers and findings, a framework that may better match the clinical situations that trainees encounter. Medical educators now have available to them a large body of critically appraised information about the test characteristics of specific components of the physical exam. This offers the opportunity to take a multifaceted approach to physical diagnosis teaching, combining evidence with the traditional methods of demonstration and practice.⁹

We designed, implemented, and evaluated a literature-based physical diagnosis curriculum for third-year medical students in an internal medicine clerkship. The objective of our study was to determine if such a curriculum could improve student knowledge, skill, and self-confidence in physical diagnosis.

METHODS

During the academic year 1999–2000, we implemented a literature-based physical diagnosis curriculum at 1 of

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Address correspondence and requests for reprints to Dr. Fagan: Division of General Internal Medicine, Rhode Island Hospital, 593 Eddy St., Providence, RI 02902 (e-mail: MFagan@lifefspan.org).

4 internal medicine clerkship sites used by the Brown Medical School. Assignment of students to clerkship sites was done by a computerized match during the students' second year of medical school, taking into account the students' preferences for sites and sequencing within the academic year. Four clerkship sites were available to students: 1 large academic health center (the intervention site), 1 Veterans Affairs hospital and 2 medium-sized community hospitals with strong ties to the medical school. Past student evaluations of 3 of the 4 clerkship sites, including the intervention site, have been consistently in the good–excellent range. One of the control sites has been rated average–good in some years and good–excellent in others. Students were not aware of the site-specific physical diagnosis curriculum at the time of the clerkship match. The 3 control sites had scheduled physical diagnosis rounds conducted weekly by chief residents in which the group visited inpatients with notable physical findings. The number and type of other teaching sessions and overall clerkship structure were similar at the 4 sites. There were no scheduled group meetings of the students from all sites, but students at the intervention site were not instructed to avoid discussing the intervention curriculum with students from the control sites. Because this was a program improvement undertaken in response to student feedback for more physical diagnosis teaching, informed consent was not obtained from the students.

The curriculum intervention was based on 8 articles chosen from the *Journal of the American Medical Association's* Rational Clinical Examination series.^{10–17} Articles were chosen by the authors, based on each topic's perceived importance and relevance to the internal medicine clerkship's educational goals. At the intervention site, students received a packet of the articles at the beginning of the clerkship. The topics chosen were central venous pressure, carotid bruit, ascites, systolic murmur, deep venous thrombosis, hypovolemia, low back pain, and splenomegaly. Groups of 4 students met weekly for 1 hour with a preceptor (faculty, general internal medicine fellow, or chief resident) for evidence-based physical diagnosis rounds during the 8 inpatient weeks of the 12-week clerkship. For each session, 1 student was assigned the responsibility for presenting the article to the group, emphasizing the examination technique and the sensitivity and specificity of the findings. Following the discussion of the article, the group visited an inpatient, who had been identified by the student and who had agreed to be visited and examined. At the bedside, the preceptor confirmed each student's ability to perform the physical exam maneuvers covered in the article and also confirmed the presence or absence of abnormal findings.

Students' physical diagnosis knowledge was evaluated using a 22-item multiple choice question quiz that was given to all students at the end of the clerkship. Questions were based on the information contained in the 8 Rational Clinical Examination articles. For example, students were

asked to give a true or false response to the following statement: "The crossed straight leg raising sign is more specific for a herniated lumbar disk than the ipsilateral straight leg raising sign." Knowledge scores were calculated as percent correct answers.

Physical diagnosis skill was assessed using fourth-year medical students who were trained as standardized patient-evaluators. Training consisted of reading the 8 articles and reviewing the physical examination maneuvers with preceptors during a one hour training session. The evaluators asked students to perform specific physical examination maneuvers and then used a 22-item checklist to record whether the examination components were performed correctly. For example, the evaluator asked the student to "Demonstrate the straight leg raising test" and then recorded, in a yes or no manner, whether the maneuver was performed correctly. Evaluators used explicit, written criteria, derived from the articles, to determine if maneuvers were performed correctly. All clerkship students completed this skills evaluation exercise at the end of the clerkship. In addition, the intervention group completed this exercise at the beginning of the clerkship, allowing us to compare their pre- and postclerkship scores. Skills scores were calculated as the percent of items done correctly.

Students' confidence in their physical diagnosis skills was assessed using a Likert question survey administered at the end of the clerkship. For each of the 8 topics, students were asked to indicate their confidence in their own skill on a 7-point scale, with 7 indicating "very confident" and 1 indicating "not confident." Confidence scores were calculated as the sum of the responses to the 8 questions. The questionnaire also included questions about whether the students thought that their physical examination skills improved during the clerkship, whether the clerkship emphasized physical diagnosis teaching, whether they received sufficient physical diagnosis teaching during the clerkship, and how many of the Rational Clinical Examination articles they read during the clerkship. Step 1 United States Medical Licensing Examination scores were obtained from the medical school's office of student affairs.

Analysis was performed using Stata, Version 6.0 statistical software (Stata Corp., College Station, Tex). Mean knowledge scores, skills scores, and confidence scores for the intervention and control groups were compared using *t* tests. The intervention group's preclerkship skills scores were compared to the postclerkship scores, also using the *t* test. The distributions of the outcome variables were normal or nearly normal, and the use of nonparametric tests such as the Wilcoxon rank sum test provided essentially the same results as those presented.

RESULTS

During the academic year 1999–2000, 85 third-year students completed the internal medicine clerkship, and 82/85 (96%) completed all of the assessment instruments.

Table 1. Characteristics of the Study Groups

	Intervention Group (N = 32)	Control Group (N = 50)	P Value
Female, %	52	58	.58
USMLE Step 1 Exam (mean score)	221	214	.17
Attended Dartmouth first 2 years, %	25	20	.68

USMLE, United States Medical Licensure Examination.

Of these 82 students, 32 were in the intervention group, and 50 were controls. Sixty-four students had completed their first 2 years of medical school (and Introduction to Clinical Medicine course) at Brown, and 18 students had completed their first 2 years of medical school (and Introduction to Clinical Medicine course) at Dartmouth. There were no significant differences between the intervention and control groups with regard to gender, mean score on Step 1 of the United States Medical Licensing Examination, or percent of students who attended Dartmouth for their first 2 years of training (Table 1).

The intervention group scored significantly higher than the control group on the knowledge quiz (mean correct score 70% vs 63%, $P = .002$), skills assessment (mean correct score 90% vs 54%, $P < .001$), and self-confidence score (mean total score 40 vs 35, $P = .003$; Table 2). The intervention group also showed significant improvement in skill during the clerkship, as assessed through their pre- and postskill assessment scores. At the beginning of the clerkship, the mean skills score of the intervention group was 41% correct, improving to 90% ($P < .001$) at the end of the clerkship.

Students' self-confidence in physical diagnosis was evaluated for physical diagnosis skills in general and for the specific physical diagnosis topics taught in the curriculum (Table 3). The intervention group felt significantly more confident about their physical diagnosis skills in general (mean Likert response 4.6 vs 4.1, $P = .037$). Of the 8 topics taught in the curriculum, the intervention group felt significantly more confident than the control

Table 2. Mean Knowledge, Skill, and Self-confidence Scores for the Intervention and Control Groups

	Intervention Group (N = 32)	Control Group (N = 50)	P Value
Knowledge quiz (% correct)	70	63	.002
Skills score (% correct)	90	54	<.001
Attitude score*	40	35	.003

* Attitude score based on sum of 7-point Likert scales for 8 questions regarding attitudes toward physical diagnosis topics, 7 indicating "very confident" and 1 indicating "not confident." Maximum score = 56.

Table 3. Topic-specific Mean Self-confidence Scores for the Intervention and Control Groups

Physical Diagnosis Topic*	Intervention Group (N = 32)	Control Group (N = 50)	P Value
Overall†	4.6	4.1	.037
Carotid bruits	4.7	4.6	.76
Systolic murmurs	5.5	6.1	.63
Deep-vein thrombosis	4.4	3.9	.032
Ascites	5.6	4.5	<.001
Splenomegaly	4.7	3.6	<.001
Jugular venous distension	5.0	4.5	.07
Low-back pain	5.1	3.1	<.001
Hypovolemia	4.9	4.3	.01

* Participants' confidence assessed for each physical diagnosis skill on 7-point Likert scale, 7 indicating "very confident" and 1 indicating "not confident." Mean scores compared.

† As assessed by response on 7-point Likert scale to the question "In general, how confident are you in your physical diagnosis skills?"

group about 5 topics: deep venous thrombosis, ascites, splenomegaly, low back pain, and hypovolemia (Table 3). Of the 8 topics, the largest difference in confidence between the intervention and control groups was for low back pain (mean confidence score 5.1 vs 3.1, $P < .001$).

In addition, students were asked to evaluate the physical diagnosis teaching they received in the clerkship, using a 7-point Likert scale. Students in the intervention group were more likely than the controls to agree that the clerkship improved their physical diagnosis skills (mean response 6.6 vs 5.4, $P < .001$), that physical diagnosis was emphasized in the clerkship (mean response 6.0 vs 4.1, $P < .001$), and they received sufficient physical diagnosis teaching during the clerkship (mean response 5.8 vs 3.9, $P < .001$). The mean number of Rational Clinical Examination articles read by the intervention group was 6.9, compared to a mean of 0.5 for the control group ($P < .001$).

DISCUSSION

Our results indicate that a multifaceted, literature-based physical diagnosis curriculum was successful in improving intervention students' knowledge, skill and self-confidence in physical diagnosis. Although the magnitude of the improvement in knowledge and self-confidence was modest, the degree of improvement in skill was large.

There are several potential reasons to explain why we were able to demonstrate improved knowledge, skill, and self-confidence where a previous study of a physical diagnosis curriculum was unable to show significant improvement in these domains.⁷ First, our curriculum was addressed to third-year medical students in a required clerkship, rather than residents. Medical students may be more receptive to this content, may have more time to devote to learning physical diagnosis, may start with a lower baseline of physical diagnosis knowledge, and may be more likely to attend physical diagnosis teaching sessions. Indeed, attendance at our sessions was close to 100%.

Second, our curriculum was delivered and our evaluations of students completed over a relatively short period of time, a twelve-week clerkship, rather than over an entire year, as was the case with the previous study. Our students probably had better recall of the content that they received over this shorter time period. Third, our program combined classroom sessions, reading of relevant literature and supervised practice with actual patients. The reading was focused on areas of the physical exam that have been shown to have diagnostic utility, and therefore provided the students with a "bottom line" message that they could apply to future clinical encounters. Applying the content at the bedside by examining patients likely reinforced learning points and made the sessions intrinsically appealing to students.

There are a number of limitations of this study. First, the intervention was carried out at 1 site at 1 medical school, and it is not clear that similar results would be obtained elsewhere. Second, students were not randomly assigned to study groups, but were assigned through a computerized match that takes into account students' preferences for clerkship site and sequence. Although the groups were not significantly different in terms of gender or mean Step 1 United States Medical Licensure Examination scores, it is possible that they differed in other ways, such as interest in physical diagnosis, although this is unlikely. The fourth-year student physical examination skills evaluators, even though they used written, explicit evaluation criteria, could not be blinded to the study groups because of their familiarity with the subjects and sites, and this could have led to bias in their evaluations. We were unable to assess the inter-rater reliability of the evaluators, and it is possible that variation among evaluators could account for some of the observed differences. Such potential bias would not, however, account for the observed differences in the domains of knowledge and self-confidence. The intervention group completed the skills evaluation session both at the beginning as well as at the end of the clerkship, and this may have acted as an intervention in itself, resulting in some of the observed improvement. The participation of faculty and fellows in physical diagnosis teaching at the intervention site may have created an atmosphere of enthusiasm about physical diagnosis that could itself have produced some of the observed improvements. Because our intervention had several components, we are unable to determine which element was most effective: the reading, the student-led discussion of the articles, the interactions with preceptors, or the practice sessions at the bedside. It is possible that the increase in clerkship time devoted to physical diagnosis instruction, apart from the specific curriculum content, could have produced some of the observed improvements.

Despite these limitations, our results offer encouragement for those who seek to revive interest and expertise in

physical diagnosis. By modifying an existing required medical student course, we were able to produce significant improvements in medical student knowledge, skill, and self-confidence in physical diagnosis compared to standard teaching. Students who received the curriculum also expressed significantly greater satisfaction with the physical diagnosis teaching they received in the clerkship. Other clerkship directors and course leaders may want to consider using material from the Rational Clinical Examination series in an effort to improve teaching of this essential clinical skill.

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