Are Fourth-Year Medical Students Effective Teachers of the Physical Examination to First-Year Medical Students?

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OBJECTIVE: To determine if fourth-year medical students are as effective as faculty in teaching the physical examination to first-year medical students.

DESIGN: Stratified randomization of the first-year students.

SETTING: A public medical school.

PARTICIPANTS: All 100 first-year medical students in one medical school class were randomly assigned (controlling for gender) to either a faculty or a fourth-year student preceptor for the Physical Examination Module.

MAIN RESULTS: The first-year students of faculty preceptors scored no differently on the written examination than the students of the fourth-year medical student preceptors (82.8% vs 80.3%, $p = .09$) and no differently on a standardized patient practical examination (95.5% vs 95.4%, $p = .92$). Also, the first-year students rated the two groups of preceptors similarly on an evaluation form, with faculty rated higher on six items and the student preceptors rated higher on six items (all $p > .10$). The fourth-year student preceptors rated the experience favorably.

CONCLUSIONS: Fourth-year medical students were as successful as faculty in teaching first-year medical students the physical examination as measured by first-year student's performances on objective measures and ratings of teaching effectiveness.

KEY WORDS: education; teaching; physical examination; small-group teaching; preceptors.

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Reform in medical education has led to increasing use of small-group teaching, problem-based learning, and other innovative educational formats. Many of the alternative formats have increased the demands on faculty time.¹ Clinical faculty are also becoming more involved in the basic science courses in order to increase their clinical

relevance.² Concomitantly, clinical faculty are being asked to increase their clinical revenues in order to provide more financial support for their institutions as other means of financial support decrease.³ As demands on clinical faculty increase, institutional leaders and course directors must explore creative alternatives to meet the increased need for faculty teaching.

The University of Kentucky recently underwent curriculum reform with emphasis on active student learning. The use of small-group teaching throughout the preclinical and clinical years, initiation of clinical experiences in the first year, and the use of clinical correlations throughout the traditional basic science courses have increased clinical faculty involvement. As part of the curriculum reform, a new 2-year course for first- and second-year medical students, "Introduction to the Medical Profession," was initiated in the fall of 1992. The course is composed of seven modules. The first year includes the Primary Care Externship, Interviewing and Communication Skills Module, Clinical Decision Making Module, and Physical Examination Module. The second year consists of the Advanced Interviewing and Communication Skills Module, Physical Examination and Diagnosis Module, and Laboratory and Radiologic Skills Module. One hundred faculty are involved in small-group teaching with approximately 1,900 faculty-contact hours. This is an estimated increase of approximately 20% of faculty-contact hours compared with the previous curriculum. The increased demand on faculty created a need to find other resources to teach first- and second-year medical students.

It is common practice for students in nonmedicine doctoral programs to teach more junior students. Senior medical students have been successful at tutoring first- and second-year medical students having academic difficulty in their basic science courses.^{4,5} Senior medical students have also taught physical diagnosis to first-year students participating in an elective at Stanford University,⁶ and seniors in the Clinical Science Program at Case Western Reserve University teach first-year students the "professional role of the physician in dealing with patients and their environment."⁷ In addition, senior medical students have served as patient-preceptors in teaching second-year students physical diagnosis.⁸ The University of Kentucky similarly initiated a program providing fourth-year medical students with teaching experience while helping to meet the increased demand for small-group teaching. To evaluate the success of such a program, research was conducted with the primary hypothesis that first-year students of a fourth-year student preceptor teach-

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ing the physical examination as part of the Physical Examination Module would perform no differently on the final written examination or the standardized patient practical examination than first-year students of a faculty preceptor. We also hypothesized that the two groups of first-year students assigned to either faculty or student preceptors would not differ in their ratings of their preceptors.

METHODS

In the fall of 1992, a select group of fourth-year medical students were invited to serve as preceptors to teach first-year students the physical examination as part of the Physical Examination Module of the "Introduction to the Medical Profession" course at the University of Kentucky College of Medicine. The fourth-year students replaced faculty as preceptors; duties included instruction and evaluation of the first-year students. The criteria for invitation included a grade of A in their Physical Diagnosis course and a 3.4 or higher third-year grade point average. Nine of 24 eligible students in a class of 90 volunteered. Each fourth-year student preceptor received a \$300 honorarium and an engraved plaque after the completion of the course.

The Physical Examination Module began in January. Three or four first-year students met with one preceptor every other week for ten 2-hour sessions. Emphasis was on technique and the normal examination. The first-year students also interviewed and examined five hospitalized patients during the semester. Prior to the Physical Examination Module, workshops were conducted for the preceptors. Faculty preceptors attended a 1-hour orientation to the course including an outline of the course, expectations of the preceptors, and evaluation of the first-year students. The fourth-year student preceptors' orientation was two 1 1/2-hour sessions, including an outline of the course, expectations of the preceptors, a review of physical examination techniques, evaluation of the first-year students, and techniques for providing feedback. To construct our preceptor groups, the 100 first-year students underwent stratified randomization (by gender) into 26 preceptor groups (9 groups with fourth-year medical student preceptors and 17 groups with faculty preceptors). Twenty-two groups consisted of four first-year students. Four of the groups precepted by faculty had three students each. Evaluation of the first-year students included a subjective evaluation by their preceptor, a written examination (66 multiple-choice, 24 extended matching questions, and one essay question worth 10%) and a standardized patient examination. For the examination, the students were given 1 hour to perform a comprehensive physical examination. The standardized patient then completed a 213-item checklist on the physical examination performed.

The students completed an extensive confidential evaluation of their small-group preceptors. Each preceptor was rated on 12 items using a 5-point Likert response option format with 1 = strongly agree to 5 = strongly dis-

agree. The evaluation of the preceptors included assessment of their preceptor's knowledge about the subject, preparedness, teaching skills, and communication skills, as well as an overall rating of their preceptors; also included were subjective comments. The fourth-year student preceptors were surveyed at the end of the course including inquiry into how beneficial the experience was for both them and the first-year students, how comfortable they were at evaluating the first-year student's physical examination skills and knowledge, their overall rating of the experience, and recommendations regarding continuation of the program. The fourth-year student preceptors rated 10 items on a 5-point Likert scale with 5 = strongly agree to 1 = strongly disagree. The fourth-year students were also asked three open-ended questions regarding any positive experiences and frustrating experiences and other comments regarding teaching the first-year students.

Descriptive statistics were generated on first-year students' performances on the written and standardized patient practical examinations, the first-year students' evaluation of their preceptors, and the fourth-year students' evaluation of the experience. Student's *t* tests were used to compare differences between first-year students who had a fourth-year student preceptor versus a faculty preceptor on the two examinations, and the first-year students' ratings of the two groups of preceptors. The open-ended responses of the fourth-year student preceptors were categorized into common themes.

RESULTS

Of the 17 faculty preceptors, 12 were men and 5 were women with a mean age of 37 years. Ten faculty from the Department of Internal Medicine precepted two, each from the Departments of Family Practice and Pediatrics, and one each from the Department of Neurology, Anesthesiology, and Rehabilitation Medicine. By rank there were 1 professor, 3 associate professors, 9 assistant professors, 1 fellow, and 3 chief residents.

The mean grade point average for the nine fourth-year student preceptors was 3.81. Of the nine fourth-year student preceptors, six were men, three were women, and their mean age was 28 years. Their specialty choices following graduation were pediatrics (2), orthopedics (2), medicine/pediatrics (1), anesthesiology (1), obstetrics/gynecology (1), ophthalmology (1), and otolaryngology (1).

The class mean for the written examination was 81.9% (SD 7.1). The mean score for the first-year students of faculty preceptors was 82.8% (SD 6.7), compared with 80.3% (SD 7.6) for the first-year students of fourth-year student preceptors ($t = 1.69$, $p > .09$). For the standardized patient practical examination, the means for the first-year students of faculty and of fourth-year student preceptors were 95.5% (SD 3.5) and 95.4% (SD 3.1), respectively ($t = .09$, $p = .92$). These analyses were also performed with the preceptor as the unit of analysis. As in the above analysis, there were not statistically significant

Table 1. First-Year Students' Ratings of Their Preceptors*

Item	Type of Preceptor		<i>t</i>	<i>p</i> Value
	17 Faculty (<i>n</i> = 59)	9 Fourth-Year Students (<i>n</i> = 34)		
My preceptor for the physical examination module:				
1. Was knowledgeable about the physical examination	1.49	1.61	0.65	.52
2. Was well prepared for each class session	1.75	1.67	−0.45	.67
3. Was enthusiastic about teaching	1.38	1.61	1.49	.14
4. Related to students in ways which promoted mutual respect	1.48	1.50	0.14	.89
5. Gave each student equal opportunities to practice the physical examination	1.57	1.47	−0.50	.63
6. Spent an appropriate amount of time demonstrating the normal examination	2.15	2.00	−0.52	.60
7. Provided adequate feedback on the written presentation	1.36	1.61	1.52	.13
8. Was receptive to questions	1.26	1.25	−0.10	.92
9. Elaborated on topics that needed clarification	1.46	1.53	0.38	.71
10. Provided feedback which helped me better understand how to perform the physical examination	1.62	1.62	0.01	.99
11. Discovered my trouble areas	1.93	1.74	−0.85	.40
12. Is one I would recommend to other students	1.66	1.65	−0.04	.97

*Response: 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree.

differences between students assigned to the two groups of preceptors on the two examinations. In evaluating hypotheses asserting a nonsignificant difference between two groups, it is important to examine the statistical power of the analyses. In this sample, the statistical power of finding a statistically significant difference ($p < .05$) on one outcome measure if the true difference was a moderate effect size was 0.89 (SD 0.6).

Of 99 first-year students who completed the course, 97 completed all or part of the preceptor evaluation. Overall, the preceptors were rated favorably. As shown in Table 1, there were no significant differences in how the students rated the fourth-year student preceptors versus the faculty preceptors. The preceptors also received an overall rating from their students. Eighty-eight percent of the first-year students rated the faculty and 85% rated the fourth-year student preceptors as excellent or good ($\chi^2 = 0.16$, $p = .69$).

Following graduation, all nine of the fourth-year student preceptors completed the survey regarding their experience. Overall they rated the experience very favorably. Scores on the nine specific items ranged from 5.00 (strongly agree) for the statement "A select group of fourth-year students should continue to serve as preceptors for first-year students in the Physical Examination Module of MD811" to 4.00 (agree) for "My first-year students received as good of an experience in MD811 with me as a preceptor versus a faculty member" (Table 2). One item, "Serving as a preceptor interfered with my fourth-year clinical responsibilities," was rated 1.33 (almost "strongly disagree"), a negative rated item but in the expected direction.

Eight of the nine respondents completed at least one of the open-ended questions. There were 23 responses to "My

positive experience(s) serving as a preceptor included" and 10 responses to "My frustrating experience(s) serving as a preceptor included." Six of the fourth-year student preceptors noted the experience improved their own physical examination skills or knowledge, and five commented they enjoyed interacting with the first-year students. Six of the student preceptors noted positive aspects of teaching. Receiving feedback was noted to be a positive experience by four of the fourth-year student preceptors.

The themes regarding the fourth-year student preceptor's frustrating experiences revolved around the logistics of teaching (four preceptors) and global issues with teaching (four preceptors). For example, two of the preceptors perceived they were respected less by their students because they were not faculty.

DISCUSSION

In summary, we found first-year medical students of fourth-year student preceptors for the Physical Examination Module performed as well on the written final examination and standardized patient practical examination as first-year students whose preceptors were full-time faculty. The fourth-year student preceptors were rated as favorably as the faculty by the first-year students on the preceptor evaluation. Also, the fourth-year student preceptors rated the experience positively, with universal endorsement to continue the program.

Fourth-year preceptors can be as effective as faculty preceptors when teaching first-year students even though they may lack the clinical acumen of full-time faculty. At Stanford University, first-year students taking a physical examination elective performed as well as second-year

Table 2. Evaluation by Fourth-Year Student Preceptors (n = 9)*

Item	Mean	SD
1. Serving as a preceptor interfered with my fourth-year clinical responsibilities.	1.33	0.48
2. Serving as a preceptor improved my physical examination skills.	4.44	0.70
3. Serving as a preceptor prepared me to teach medical students or other students as an intern.	4.44	0.50
4. My four first-year students received as good of an experience with me as a preceptor versus a faculty member.	4.00	0.71
5. I was provided adequate information to teach the first-year students at the beginning of the semester.	4.33	0.48
6. By the end of the semester I felt at ease teaching the first-year students in my group.	4.66	0.48
7. I was comfortable evaluating the clinical skills of the first-year students.	4.22	0.66
8. I was comfortable evaluating the first-year students' fund of knowledge.	4.11	0.33
9. A select group of fourth-year students should continue to serve as preceptors for first-year students in the Physical Examination Module.	5.00	0.00
10. Overall I would rate my experience as: 1 = very poor, 2 = poor, 3 = satisfactory, 4 = good, 5 = excellent.	4.55	0.50

*Response: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree.

students taking the standard course on all measures except the vocabulary multiple-choice test.⁶ There are several possible explanations for the success of the fourth-year students at our institution and elsewhere. First, this first-year course focuses on the normal examination. These basic clinical skills can be mastered by fourth-year students. The fourth-year students invited to serve as preceptors were from the top of their class and had done well in their own physical diagnosis class. Thus, they were academically successful and were assumed to have themselves mastered these basic skills. Second, the fourth-year student preceptors participated voluntarily, whereas many of the faculty were assigned by their division chiefs or chairs, many on a nonvoluntary basis. Volunteers tend to be more enthusiastic. Third, fourth-year students received specific financial as well as other rewards; in contrast, the faculty were assigned this responsibility within the myriad of other clinical, teaching, and research responsibilities. Administrative incentives for faculty teaching assignments are generally modest to nonexistent at this institution as well as at other universities.⁹ Finally, fourth-year students are likely to relate better to the first-year students than faculty, as they are closer in age and training. The traditional mentor-student relationship in this case is in part a peer-peer relationship. This setting may foster more open communication between the first-year students and their fourth-year student preceptor,⁷ and the first-year students may be more comfortable in this setting.¹⁰

There are several limitations to our study. First, the study was done at a single institution, which could limit the generalizability. All medical schools teach the physical examination; however, this instruction begins anywhere from the first year to just before the third year. Also, emphasis of the course and material taught may vary from institution to institution. More complex material such as differential diagnosis or physical examination abnormali-

ties may be more difficult for senior medical students to master and to teach to less-experienced students. Second, an academically select group of fourth-year students were invited to participate. This study does not address the likelihood of success of fourth-year students with average or below-average academic records. Third, the lack of a difference between the faculty and fourth-year student-led groups on the standardized patient practical examination could have been the result of a ceiling effect (the mean for the class was 95.4%). Also, one could question the reliability of a 1-hour standardized patient examination testing clinical skills.¹¹ However, the mean on the written examination was 81.9%, and the reliability of the examination was 0.77 (Cronbach's α). One must also consider that several faculty were reluctant assignees to the course, and their lack of interest may have negatively impacted their students' performance on the two examinations. However, the relatively equal standard deviations on the standardized patient practical and written examinations by the two groups of first-year students, and the positive evaluations, suggest this was not a likely explanation. And finally, interactions between first-year students in the two groups could have reduced any differences secondary to the type of preceptor; however, there was no evidence this occurred.

An added benefit of this experience may be the impact on the fourth-year students. Many fourth-year students enter their residency training with little or no teaching experience, and are soon placed in teaching and supervisory roles. A structured teaching experience during the fourth year of medical school may lead to improved teaching by residents. The overwhelmingly positive response by the fourth-year student preceptors suggests the program may be serving an important role in the professional growth and development of these students. The fourth-year student preceptors in our study highly endorsed the continuation of the program, similar to the

recommendations of student-preceptors in other studies.^{7,8,12} Also, by self-report this endeavor did not interfere with the clinical duties of the fourth-year students. Obviously, it would be unwise to implement a program that had a negative effect on the training of senior medical students. If the program differed, in either required hours of the preceptors or use of fourth-year medical students with a wider range of academic abilities, this issue would require further scrutiny.

Curriculum reform is occurring at many medical schools throughout the United States. Reform often emphasizes active learning and problem solving, requiring an increase in small-group teaching. At the same time, funding for research is decreasing, and the managed care environment is causing many academic medical centers to restructure clinical activities, thus increasing the demands on faculty. Alternative resources for teaching are often needed. Two traditional alternatives are housestaff and community physicians. Given reductions in graduate medical education funding and limitations on housestaff workload, it is unlikely interns and residents can serve as additional resources. The financial pressures on ambulatory medical practices confront community physicians just as they confront academic physicians. When medical school faculty struggle to fulfill teaching responsibilities because of clinical service demands, it is unlikely community physicians will increase uncompensated student teaching.

Using a select group of senior medical students to teach less experienced medical students is a successful alternative requiring few added resources. Our experience suggests fourth-year medical students are an effective alternative to faculty teaching first-year medical students the physical examination. On the basis of this program's success, plans are under way to use only fourth-year medical students as preceptors teaching first-year stu-

dents the physical examination. We anticipate the use of fourth-year medical students as preceptors for the entire module will be as successful as in this current study. Senior medical students can be a valuable resource to a medical school for teaching basic clinical skills to first-year students.

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