

The Impact of Preclinical Preceptorships on Learning the Fundamentals of Clinical Medicine and Physical Diagnosis Skills

Linda Z. Nieman, PhD, Lee Cheng, MD, MSc, Mark Hormann, MD, Mark A. Farnie, MD, Donald A. Molony, MD, and Patricia Butler, MD

Abstract

Purpose

To learn whether preclinical primary care preceptorships resulted in demonstrable clinical performance benefits to medical students.

Method

This was a retrospective cohort study of 267 medical students who elected and 310 students who did not elect to take a four-week primary care preceptorship following the first year of training at the University of Texas Medical School at Houston in 2001–2003. Outcome variables were the students' performances on a written examination testing their integration of basic science and fundamentals of clinical medicine and performances on a comprehensive

objective structured clinical examination (OSCE). After adjusting for factors that might have explained differences in the students' performances, logistic regression models were used to assess the association of the outcome variables with participation in a preceptorship.

Results

Students who participated in any one of the preceptorships performed better on the OSCE and on the fundamentals of clinical medicine examination than students who did not participate ($p < .01$). Students who participated in the family medicine or pediatric preceptorship scored higher on an OSCE (odds ratio [OR], 1.67; 95% confidence interval [CI], 1.01–2.78 and OR, 2.26;

95% CI, 1.18–4.36, respectively) than those students who did not participate in a preceptorship. Students who participated in the internal medicine preceptorship scored higher on the fundamentals of clinical medicine examination (OR, 3.18; 95% CI, 1.92–5.23).

Conclusions

Preliminary evidence indicates that a short preclinical primary care preceptorship can help medical students to consolidate and integrate the fundamental cognitive and clinical skills they will apply during the clinical years of medical training.

Acad Med. 2006; 81:342–346.

For the past two decades, medical school curricula throughout the United States have included an increasing amount of curriculum time and resources devoted to teaching medical students in ambulatory settings where they are supervised by physician preceptors.^{1–4}

Assessment of ambulatory medical education experiences proliferated, especially in the 1990s, when programs sought to graduate more primary care physicians to become generalist ambulatory medical practitioners.^{5–9} Systematic reviews of teaching in ambulatory settings revealed that ambulatory clinics provided more active learning than did inpatient settings and that students were more satisfied with rural as compared to nonrural curricular experiences.¹⁰

Recent curriculum changes have promoted learning clinical skills early in medical school.^{11,12} Preceptorships in ambulatory settings were part of the recognition by medical educators that students needed to practice skills and to correlate what they learned in didactic basic science sessions with early patient care experiences.¹³

Since 1970, the Texas Statewide Family Practice Preceptorship Program (TSFMPP) has matched students from an increasing number of Texas medical schools with volunteer preceptors from communities around the state.¹⁴ The General Internal Medicine and General Pediatrics Preceptorship Programs started in 1995.^{15,16} All three preceptorships now include students from Texas's eight medical schools and receive grant funds from the Texas Higher Education Coordinating Board with formal establishment by state legislation. An eight-year study of Texas's graduates of the TSFMPP indicated that participating in a preclinical preceptorship offered by a primary care specialty was associated with the later

choice of that specialty or another primary care specialty.⁵ Reviews of graduation data gathered by the Texas Higher Coordinating Board also have confirmed this finding for general internal medicine and pediatrics.^{15,16} Preclinical preceptorships may offer participating students more immediate benefits than influencing later specialty choices. We could locate only two studies that used actual academic performance data and rigorous research methods to investigate the relationship between participating in a preclinical preceptorship and the subsequent clinical performance of medical students.^{17,18} In one study, Elnicki and colleagues¹⁷ found that a two-month preclinical preceptorship in internal medicine appeared to benefit students academically as well as to be related to career choices. Rodgers et al.¹⁸ found that placing a decision-making course within a preceptorship was not academically beneficial. Specifically, over a five-year period, students who participated in the course did not receive higher ratings on their problem-solving skills than did a comparison group. In addition, Nieman

Please see the end of the report for information about the authors.

Correspondence should be addressed to Dr. Nieman, The University of Texas Medical School at Houston, 6431 Fannin Street, Suite JLL324, Houston, TX 77030; telephone: (713) 500-7609; fax: (713) 500-7606; e-mail: (Linda.Z.Nieman@uth.tmc.edu).

and colleagues^{19,20} showed that specific preventive and patient education skills could be taught through the preceptorship.

We undertook this study to learn whether a four-week preclinical preceptorship in family medicine, general internal medicine, or pediatrics resulted in demonstrable clinical performance benefits to the students who participated.

Method

Participants

The participants in our study were a retrospective cohort of students who began their medical training at the University of Texas Medical School at Houston in 2001–2003. Academic performance data were available for a total of 577 students from the years 2001 through 2003. Of these students, 277 were women and 300 were men; 267 elected to take a primary care preceptorship and 310 took no preceptorship. The number of students in each preceptorship during each year of study is shown in Table 1. With few exceptions, each preceptor supervised a single student each summer. Preceptorship placements were throughout Texas with the greatest number in the Houston area.

Preceptorship curricula

Written curriculum goals for all three preceptorship programs stated that the students would gain practical hands-on primary care experiences, skills, and objective exposures to a community-based primary care specialty. Another explicit goal for all three preceptorships was to influence students' choices of a primary care specialty upon graduation from medical school. Specific daily objectives were set by the preceptors and

emphasized the particular specialty that they represented.^{14–16}

All preceptorships were under the general leadership of the Texas Higher Educational Coordinating Board and were offered to the students with the cooperation of the three primary care specialty state academies. Medical student participants who were supervised by a preceptor in an urban practice were provided a US \$500 stipend, while students who were supervised by a preceptor in a rural health professional shortage area or medically underserved area of Texas received a US \$1,000 stipend.

Measures and outcomes

Two measures served as independent variables that discriminated among students' performances prior to participating in the preceptorship. The first measure was students' scores on the Medical College Admission Test (MCAT) taken as a requirement of admission to medical school. The second measure was students' scores on the Introduction to Clinical Medicine (ICM) final examination, administered at the end of the first year. The examination tested the following: students' acquisition of knowledge about eliciting a comprehensive database of patient information for patient care; understanding the ethical, psychosocial, and health care contexts; understanding basic concepts of measurement in health and disease; and organizing and communicating medical information effectively in the medical record and/or as a verbal communication.

We designated the final course grade in Fundamentals of Clinical Medicine (FCM) as the outcome variable that measured students' clinical knowledge at

the end of the second year. Taught over two semesters, the course included didactic information as well as problem-based modules that were taught in small-group settings with a group facilitator. At the end of this course, students were expected to demonstrate in a multiple-choice and essay examination that they had acquired the cognitive skills for integrating and applying knowledge of the basic sciences to clinical scenarios, including knowledge of pathophysiology. In the same essay examination, the students were expected to demonstrate their ability to assess the relevance of clinical evidence about patients' medical problems. Specifically, the course percentage grade reflected a comprehensive assessment of the degree to which the student had acquired skills of information integration, application, clinical reasoning, and critical appraisal of new knowledge.

A second outcome was the score that students achieved on the comprehensive objective structured clinical examination (OSCE) administered at the end of a two-semester physical diagnosis course. A ten-station OSCE measured students' history, physical examination, clinical reasoning, and doctor–patient communication skills during encounters with standardized patients who represented common physical findings and problems taught in the physical diagnosis course.

Statistical analysis

We used student's *t* tests to compare average scores by gender and the primary care specialty that sponsored the student's preceptorship. Multiple logistic regression analyses were performed to quantify the relationship between the two outcome measures (FCM and OSCE) and factors that may have contributed to the higher scores received by students who participated in a preceptorship. Specifically, the outcome variables, either the score of physical diagnosis examination or the score of fundamentals of clinical medicine, were regressed for the student's gender, total MCAT score, the ICM score, and preceptorship participation/nonparticipation. We used the median score of either the physical diagnosis OSCE or the FCM of the nonpreceptorship group as the cutoff point to classify the higher and lower performance scores in the logistical regression models. We performed the

Table 1

Distribution of 577 Medical Students between Three Preclinical Primary Care Preceptorships or No Preceptorship at the University of Texas Medical School at Houston between 2001 and 2003

Year	No. (%) students in preceptorships			No (%) with no preceptorship
	Family medicine	Internal medicine	Pediatrics	
2001	28 (14.5)	42 (21.8)	18 (9.3)	105 (54.4)
2002	36 (18.9)	40 (20.9)	18 (9.4)	97 (50.8)
2003	32 (16.6)	29 (15.0)	24 (12.4)	108 (56.0)
Total	96 (16.7)	111 (19.2)	60 (10.4)	310 (53.7)

Table 2

Medical Students' Medical College Admission Test Scores and Course Scores, by Preclinical Preceptorship Specialty, The University of Texas Medical School at Houston, 2001–03

Preceptorship	Mean \pm SD Medical College Admission Test score [†]	Mean \pm SD course score*		
		Introduction to Clinical Medicine	Fundamentals of Clinical Medicine	Physical Diagnosis Examination (OSCE)
No preceptorship (no. = 310)	27.40 \pm 3.56	85.91 \pm 5.00	87.03 \pm 6.30	86.94 \pm 7.57
Any preceptorship (no. = 267)	27.33 \pm 3.54	86.38 \pm 5.77	88.48 \pm 5.05 [‡]	88.48 \pm 5.54 [‡]
Family medicine (no. = 96)	27.27 \pm 3.91	86.30 \pm 6.09	87.60 \pm 5.37	88.33 \pm 5.83
Internal medicine (no. = 111)	27.51 \pm 3.10	86.03 \pm 6.01	89.33 \pm 4.39 [‡]	87.83 \pm 5.42
Pediatrics (no. = 60)	27.08 \pm 3.73	87.18 \pm 4.69	88.31 \pm 5.47	89.92 \pm 5.07 [‡]

* Total score possible is 100.

[†] Total score possible is 43.

[‡] Student's *t*-test; *p* < .01 when compared with score of the students in nonpreceptorship group.

statistical analysis using SAS Version 8.2 (SAS Institute, Inc., Cary, NC). Our institution's institutional review board approved the study.

Results

We found no statistical differences between preceptorship participants and nonparticipants at entry to medical school as measured by the MCAT total score (*p* = .35) or at the end of their first year, prior to the preceptorship, as measured by the final examinations of the ICM course (*p* = .40). Comparisons of the gender differences of medical students upon entry and in later class performance scores showed that male students had a higher average MCAT score (27.72 \pm 3.51) than did female students (26.99 \pm 3.56) (*p* = .01). Female students had a higher average physical diagnosis examination score (88.29 \pm 5.92) than did male students (87.07 \pm 7.38) (*p* = .02). We found no gender differences in test scores on the ICM (*p* = .20) or FCM examinations (*p* = .93).

Medical students who participated in any of the three preceptorships performed better on average on the physical diagnosis OSCE and on the FCM final examination than did those students who did not participate in any of the preceptorships (*p* < .01) (see Table 2). Among the three preceptorships, the students who participated in an internal medicine preceptorship had a higher average score on FCM and students who participated in a pediatric preceptorship had a higher average score on the physical diagnosis OSCE than those

students who did not participate in a preceptorship (all *p* values < .01) (see Table 2).

We used multiple logistic regression models to analyze variables such as the student's gender, cognitive knowledge reflected in the MCAT, basic knowledge of clinical medicine, and the type of preceptorship. These models pinpointed the association of each variable with the FCM examination scores and the physical diagnosis OSCE. A cutoff-point score was used to separate students who performed higher or lower on the two outcome measures. As Table 3 shows, the following students were more likely to receive a higher score on the physical diagnosis OSCE: female students (odds ratio [OR], 1.50; 95% confidence interval [CI], 1.04–2.18), students whose ICM final test score was from the 25th to the 75th percentile (OR, 2.92; 95% CI, 1.87–4.56), students whose ICM score was above the 75th percentile (OR, 8.68; 95% CI, 4.91–15.34), and students who participated in either a family medicine (OR, 1.67; 95% CI, 1.01–2.78) or a pediatrics (OR, 2.26; 95% CI, 1.18–4.36) preceptorship. Students who were more likely to receive a higher score in FCM were those whose ICM score was between the 25th and 75th percentile (OR, 2.64; 95% CI 1.70–4.10), students whose ICM score was above the 75th percentile (OR, 4.60; 95% CI, 2.68–7.88), and those who participated in the internal medicine preceptorship (OR, 3.18; 95% CI, 1.92–5.23).

Discussion

The goal of our study was to evaluate the contribution of three preclinical preceptorships to medical students' performances in the two major clinically related courses in the second year of medical school. Both courses were typical in content to the curricula of many medical schools. We believe that this is the first demonstration that a primary care preceptorship as brief as four weeks can contribute to better subsequent academic performance of preclinical medical students. In general, students who took preceptorships performed better than those who did not. These results were not surprising because the students in the preceptorships had hands-on experiences and time to apply information from the basic science and introductory clinical medicine courses that they had learned in year one of medical school. Although students were placed with many different preceptors who had a wide variety of backgrounds, their practical preceptorship experiences may have contributed to their better performances on clinically relevant courses during their second year of medical training.

One limitation of this study was that the information was collected from one institution. However, students were placed with a large number of preceptors who had a wide variety of training backgrounds and who practiced medicine in many settings throughout Texas. A second limitation was the power of the study to detect significant differences because of the relatively small sample size for each specialty's preceptorship. It

Table 3

Adjusted Odds Ratio (OR) of the Impact of Preclinical Preceptorships on Medical Students' Performances of Physical Diagnosis Examinations and Fundamentals of Clinical Medicine, The University of Texas Medical School at Houston, 2001–03*

Item	Fundamentals of Clinical Medicine		Physical Diagnosis Examination (OSCE)	
	Adjusted OR	95% CI	Adjusted OR	95% CI
Sex				
Male	1.00		1.00	
Female	1.01	0.70–1.45	1.50	1.04–2.18
Medical College Admission Test Score				
<25th percentile	1.00		0.94	0.58–1.54
25th–75th percentile	1.14	0.71–1.85	1.29	0.74–2.27
>75th percentile	1.74	1.01–3.03	1.29	0.74–2.27
Introduction to Clinical Medicine score				
<25th percentile	1.00		1.00	
25th–75th percentile	2.64	1.70–4.10	2.92	1.87–4.56
>75th percentile	4.60	2.68–7.88	8.68	4.91–15.34
Preceptorship				
None	1.00		1.00	
Family medicine	1.04	0.64–1.69	1.67	1.01–2.78
Internal medicine	3.18	1.92–5.23	0.87	0.54–1.40
Pediatrics	1.49	0.82–2.72	2.26	1.18–4.36

* The median scores of Fundamentals of Clinical Medicine and Physical Diagnosis Examinations from the medical students who did not do a preceptorship were defined as the cutoff point for determining lower or higher scores of Fundamentals of Clinical Medicine and Physical Diagnosis Examination (OSCE), respectively, in the multiple logistic regression models.

should also be noted that the students in the preceptorship group chose electively to participate. They were not assigned to the program by random allocation. Medical students could not randomly be distributed or assigned to one of the three preceptorship groups or to the nonpreceptorship group. Instead, the students selected the group to which they belonged. Such self-selection may have introduced selection bias. Students choosing a preceptorship early in their medical training may have been more self-motivated than their classmates to do clinical work and gain clinical knowledge from direct patient care.

An important curriculum reform in the 1990s expanded clinical education into early medical training in order to achieve better preparation for later clinical rotations. Windish and colleagues,²¹ who surveyed primary care and nonprimary care clerkship directors nationally, reported that the directors still did not find students adequately prepared for clinical competencies demanded during clerkship training. A substantial need remained for improving communication/ interviewing, physical examination,

clinical epidemiology, probabilistic thinking, and professionalism. The three primary care preceptorships described here provided an intermediate training step that led to demonstrable skills in each of these identified areas.

In our study, we demonstrated that preclinical preceptorships could lead medical students to achieve higher scores on a practical physical diagnosis examination and on an examination of knowledge of the fundamentals of clinical medicine. We concluded that these achievements could be interpreted best as a benefit from the preceptorships because we controlled by the logistic regression analyses for several potential confounding variables. These variables were the student's gender; the student's undergraduate intellectual achievement, measured by MCAT;²² and their acquired clinical knowledge prior to the preceptorship measured by an ICM examination. We used multiple logistic regression analysis and included in the regression model the students' most clinically relevant performance score (i.e., the ICM score) to reflect clinical knowledge prior to the preceptorship. We recognize

that logistic regression analysis cannot fully eliminate a potential selection bias in this study. Further studies by investigators in other educational settings and with larger sample sizes are needed to fully understand the effect of the preceptorship.

In 1996, Jolly and colleagues²³ reported that performance on the OSCE was weakly associated with the first-year experience of medical students who examined outpatients on their own and the number of clinics they attended. Gupta and colleagues²⁴ observed that the students who worked in primary care settings did better on test questions related to the gathering of patient information and on case presentation during an OSCE than did students who received their clinical training in a hospital. A multi-institutional assessment showed that students who were taught clinical skills in community-based settings (most of which were primary care offices) performed as well as or better than their peers who received their patient experience on hospital wards.²⁵ These authors believed that the students' community-based experiences had contributed positively to their intellectual

skills, critical thinking, and problem-solving skills, while also contributing to clinical skill development. Our findings were similar with more quantitative measures.

That our results were not the same for all three preceptorships is due in part to the fact that each of the preceptorships addressed different specialty areas and had different subsets of objectives. Nevertheless, our findings about students who participated in all three preceptorships extended the earlier finding of Elnicki and colleagues¹⁷ that an internal medicine preceptorship led to improved academic performance in selected clinically related subjects. In sum, we believe that the preclinical primary care preceptorships in family medicine, general internal medicine, and pediatrics enabled students to apply their medical knowledge and clinical skills. What medical students learned in the preceptorship is an example of the importance of the trend to introduce opportunities for students to practice clinical skills early in medical school. The integration of new clinical knowledge and skills should be highly beneficial to medical students as they pursue their clinical education.

Dr. Nieman is professor and vice chair for educational affairs and director of the Joint Primary Care Fellowship, Department of Family and Community Medicine, University of Texas Medical School at Houston, Houston, Texas.

Dr. Cheng is assistant professor, Department of Medical School at Houston, Houston, Texas.

Dr. Hormann is assistant professor and director of medical student education, Department of Pediatrics, University of Texas Medical School at Houston, Houston, Texas.

Dr. Farnie is associate professor in the Departments of Internal Medicine and Pediatrics and residency director, Internal Medicine/Pediatric Combined Residency Program, University of Texas Medical School at Houston, Houston, Texas.

Dr. Molony is professor, Department of Internal Medicine, Division of Renal Diseases and Hypertension, University of Texas Medical School at Houston, Houston, Texas.

Dr. Butler is professor and associate dean, Office of Educational Programs, University of Texas Medical School at Houston, Houston, Texas.

Acknowledgments

The authors would like to thank Phillip Orlander, MD, professor and division director of internal medicine/endocrinology and assistant dean for curricular affairs, Office of Educational Programs, for his assistance with this manuscript.

References

- Fields SA, Usatine R, Steiner E. Teaching medical students in the ambulatory setting: strategies for success. *JAMA*. 2000;283:2362–64.
- Brook RH, Kamberg CJ, McGlynn EA. Health system reform and quality. *JAMA*. 1996;276:476–80.
- Fields SA, Usatine R, Stearns JA, Toffler WL, Vinson DC. The utilization and compensation of community preceptors in US medical schools. *Acad Med*. 1998;73:95–97.
- Kalet A, Schwartz MD, Capponi LJ, Mahon-Salazar C, Bateman WB. Ambulatory versus inpatient rotations in teaching third-year students internal medicine. *J Gen Intern Med*. 1998;13:327–30.
- Nieman LZ, Foxhall LE, Chuang AZ, Cheng L, Prager TC. Evaluating the Texas Statewide Family Practice Preceptorship Program, 1992–2000. *Acad Med*. 2004;79:62–68.
- Fincher RM, Lewis LA, Jackson TW. Why students choose a primary care or nonprimary care career. The Specialty Choice Study Group. *Am J Med*. 1994;97:410–17.
- Herold AH, Woodard LJ, Pamies RJ, et al. Influence of longitudinal primary care training on medical students' specialty choices. *Acad Med*. 1993;68:281–84.
- Wartman S, Davis A, Wilson M, Kahn N, Sherwood R, Norwalk A. Curricular change: recommendations from a national perspective. *Acad Med*. 2001;76 (4 suppl): S140–S145.
- Rabinowitz HK, Diamond JJ, Markham FW, Paynter NP. Critical factors for designing programs to increase the supply and retention of rural primary care physicians. *JAMA*. 2001;286:1041–48.
- Bowen JL, Irby DM. Assessing quality and costs of education in the ambulatory setting: a review of the literature. *Acad Med*. 2002;77:621–80.
- Marcus E, White R, Rubin RH. Early clinical skills training. *Acad Med*. 1994;69:415.
- Lam TP, Irwin M, Chow LW, Chan P. Early introduction of clinical skills teaching in a medical curriculum—factors affecting students' learning. *Med Educ*. 2002;36:233–40.
- Issenberg SB, McGaghie WC. Clinical skills training—practice makes perfect. *Med Educ*. 2002;36:210–11.
- The Texas Statewide Family Practice Preceptorship Program goals and objectives (<http://www.familypracticepreceptorship.org/>). Accessed 15 December 2005. Texas Statewide Family Practice Preceptorship Program, Houston, Texas.
- General Internal Medicine Statewide Preceptorship Program news. (<http://www.taim.org/i4a/pages/index.cfm?pageid=384>). Accessed 15 December 2005. Texas Academy of Internal Medicine, the Texas chapter of the American College of Physicians, Austin, Texas.
- About the General Pediatric Preceptorship Program (<http://www.txpeds.org/precept/about.htm>). Accessed 15 December 2005. Texas Pediatric Society, Texas Chapter of the American Academy of Pediatrics, Austin, Texas.
- Elnicki DM, Halbritter KA, Antonelli MA, Linger B. Educational and career outcomes of an internal medicine preceptorship for first-year medical students. *J Gen Intern Med*. 1999;14:341–46.
- Rogers JC, Sweet DE, Ullian JA. Teaching medical decision making and students' clinical problem solving skills. *Med Teach*. 1991;13:157–64.
- Nieman LZ, Velasquez MM, Groff JY, Cheng L, Foxhall LE. Implementation of a smoking cessation counseling module in a preceptorship program. *Fam Med*. 2005;37:105–11.
- Nieman LZ, Foxhall LE, Groff J, Cheng L. Applying practical preventive skills in a preclinical preceptorship. *Acad Med*. 2001;76:478–83.
- Windish DM, Paulman PM, Goroll AH, and Bass EB. Do clerkship directors think medical students are prepared for the clerkship years? *Acad Med*. 2004;79:56–61.
- Mitchell K, Haynes R, Koenig J. Assessing the validity of the updated Medical College Admission Test. *Acad Med*. 1994;69:394–401.
- Jolly BC, Jones A, Dacre JE, Elzubeir M, Kopelman P, Hitman G. Relationships between students' clinical experiences in introductory clinical courses and their performances on an objective structured clinical examination (OSCE). *Acad Med*. 1996;71:909–16.
- Gupta KL, Gambert SR, Grayson MS, Lugo JJ, Sozzo AM. Comparing the teaching of physical diagnosis in a primary care setting and a hospital setting. *Acad Med*. 1993;68:311.
- Carney PA, Bar-on ME, Grayson MS, et al. The impact of early clinical training in medical education: a multi-institutional assessment. *Acad Med*. 1999;74 (1 suppl): S59–S66.