The Comprehensive Osteopathic Medical Licensing Examination–USA (COMLEX–USA) is a three-part examination used for licensing osteopathic physicians. The relationship between performance on this examination and prior student academic performance has been unclear. This study explores the relationship between COMLEX–USA level 2 scores and student academic performance at Oklahoma State University College of Osteopathic Medicine (OSU-COM). All first-time examination candidates from OSU-COM had a formal, weeklong board review in March 2000, and all passed the examination.

Predictions about COMLEX–USA scores generated by the academic dean’s office at OSU-COM underestimated student examination performance; results suggest a significant correlation between level 2 performance with (1) level 1 performance (.751); (2) grade point average (GPA) in basic science (.659); (3) total GPA (.672); and (4) Medical College Admission Test (MCAT) scores (.406). The correlation of level 2 scores to clinical GPA (.269) was lower but still significant.

Results of this study suggest that performance on COMLEX–USA level 2 is strongly correlated with prior student academic performance in this population.

Patient management topics related to clinical care situations.

Level 2 of the examination—first given in 1997—may only be taken by students in colleges of osteopathic medicine, as its content incorporates not only basic medical education topics but also questions regarding osteopathic manipulative treatment and osteopathic principles and practice. Osteopathic principles emphasize that the body is integrally related as a whole, that the body has the ability to heal itself, and that proper structure is related to proper function.

There are two dimensions that are followed as a continuum throughout the three levels of the examination. Dimension I consists of patient encounters and health care delivery. Dimension II consists of patient history and physical examination, diagnostic technology, management, disease mechanisms, health promotion and disease prevention, and health care delivery issues. Differing percentages of each dimension II category of the examination for each level are outlined in Table 1.

Currently, COMLEX–USA serves two important roles. The first role is as a requirement for licensure of osteopathic physicians by state medical licensing boards. Designed to assess knowledge of osteopathic medical school curriculum, COMLEX–USA includes questions on basic science, clinical science, and patient management, similar to the knowledge base tested by the United States Medical Licensing Examination (USMLE). The COMLEX–USA differs from the USMLE in several aspects, however, having a primary care focus and incorporating osteopathic manipulative treatment and osteopathic principles and practice as an integral part of the examination. All states recognize a diplomate of the NBOME as a qualified candidate for licensure to practice medicine.

The COMLEX–USA also serves as a requirement for promotion or graduation in many colleges accredited by the American Osteopathic Association. For the study group, all 19 colleges of osteopathic medicine required passing COMLEX–USA level 1 for promotion to third-year status. Eighteen colleges of osteopathic medicine required students to take COMLEX–USA level 2 before graduation, and nine colleges of osteopathic medicine required passing
COMLEX–USA level 2 to graduate (Table 2). Therefore, satisfactory completion of each level of the examination is important in progressing through osteopathic medical school, as well as in qualifying for licensure.

Despite the examination’s importance, there has been a lack of convincing predictive validity studies for medical licensure examinations, including the COMLEX–USA level 2.

This article details the relationship between COMLEX–USA level 2 scores and prior academic performance for students in the class of 2000 at Oklahoma State University College of Osteopathic Medicine (OSU-COM).

Oklahoma State University College of Osteopathic Medicine
The Oklahoma State University College of Osteopathic Medicine has a reputation of producing quality primary care physicians for Oklahoma. Currently, there are 352 students in undergraduate medical education at OSU-COM. All are required to pass COMLEX–USA level 1 before promotion to the third year and must take level 2 to qualify for graduation.

To practice medicine in Oklahoma, graduates must complete 1 year of graduate medical education (internship). Most graduates also complete residency training. Training for students in undergraduate and graduate medical education is accomplished at OSU-COM and in affiliated teaching hospitals in the Osteopathic Medical Education Consortium of Oklahoma, the osteopathic postdoctoral training institute for the state, and in other medical clinics and offices. Graduates of OSU-COM are eligible to seek graduate medical education from other programs in Oklahoma and around the United States.

To meet the mission of the OSU-COM of producing quality primary care physicians for Oklahoma, the medical curriculum is designed to emphasize primary care education.

The curriculum is organized in the traditional 4-year fashion, with the first 2 years consisting of classroom studies in basic sciences and introductory clinical science, and the third and fourth years consisting of clinical clerkships in hospitals and outpatient clinics.

For grade point average (GPA) determination in the study group, basic science includes first-and-second-year classroom courses in anatomy, histology, biochemistry, microbiology and immunology, neuroscience, embryology, physiology, pharmacology, behavioral sciences, clinical problem-solving, pathology, and osteopathic clinical skills. Clinical problem-solving is a modified, 1-year, problem-based course that uses case-based modules. Osteopathic clinical skills are taught as a 4-course series that includes osteopathic principles and practice, patient history and physical examination skills, and clinical procedures.

The clinical science curriculum includes 22 months of clinical clerkships in the third and fourth years that consist of rotations in family medicine, internal medicine, general surgery, pediatrics, obstetrics and gynecology, psychiatry, emergency medicine, primary care electives, and specialty care electives. Clerkships progress from teaching basic skills in inpatient and outpatient areas to more advanced electives. In the third year, students have 4 months of inpatient rotations consisting of 2 months of general internal medicine, 1 month of general surgery, and 1 month of obstetrics and gynecology. The remainder of the clinical clerkships are divided into required primary care rotations in both urban and rural family medicine clinics, community hospital rotations, and approved specialty care electives. For the study group, grades for clinical science were collected through December 1999.

Study Objectives
Considering the importance of COMLEX–USA in the educa-
Is COMLEX–USA a valid and reliable indicator of candidate knowledge of basic science, clinical science, and patient management?

Is this examination related to other indicators of performance?

Are students who are at risk for poor performance on COMLEX–USA identifiable on the basis of prior academic performance?

This study is the third in a series of reviews designed to answer these questions. Earlier studies examined the relationship of academic achievement to performance on the USMLE\textsuperscript{7} and to performance on the COMLEX–USA level 1.\textsuperscript{8,9} This study examines the relationship between prior academic achievement and performance on COMLEX–USA level 2 of students at OSU-COM who first took the examination in March 2000.

We compared the relationships between COMLEX–USA level 2 performance and (1) COMLEX–USA level 1; (2) GPA in basic science; (3) GPA in clinical science; (4) total GPA; (5) performance on the Medical College Admission Test (MCAT); and (6) predictions of performance by the dean’s office at OSU-COM before the examination.

**Methods**

This study is similar in methodology to one by Baker et al\textsuperscript{8} that examined preadmission variables and academic achievement in relationship to performance on the COMLEX–USA level 1. As this study concerned level 2 scores only, clinical GPA and COMLEX–USA level 1 scores and their relationship to COMLEX–USA level 2 scores were added. This section describes subject inclusion, academic measures, prediction measures, and comparisons to COMLEX–USA level 2 results.

**Subjects**

Eligibility for this study was limited to first-time COMLEX–USA takers who had participated in the standard curriculum at OSU-COM. Seventy-eight OSU-COM students from the class of 2000 took the COMLEX–USA level 2 in March 2000. Information about the gender and ethnicity of participants is not available.

### Table 3

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mean Score</th>
<th>Passes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest 5% (n = 4)</td>
<td>516.8</td>
<td>100</td>
</tr>
<tr>
<td>Next lowest 15% (n = 11)</td>
<td>489.5</td>
<td>100</td>
</tr>
<tr>
<td>Middle 60% (n = 47)</td>
<td>546.6</td>
<td>100</td>
</tr>
<tr>
<td>Upper 20% (n = 16)</td>
<td>620.9</td>
<td>100</td>
</tr>
</tbody>
</table>

OSU-COM indicates Oklahoma State University College of Osteopathic Medicine.

### Table 4

<table>
<thead>
<tr>
<th>Group</th>
<th>Rated (%)</th>
<th>Mean Score</th>
<th>Passes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concerns (n = 4)</td>
<td>5.1</td>
<td>516.8</td>
<td>100</td>
</tr>
<tr>
<td>Borderline (n = 11)</td>
<td>15.4</td>
<td>489.5</td>
<td>100</td>
</tr>
<tr>
<td>Sure pass (n = 63)</td>
<td>79.5</td>
<td>565.5</td>
<td>100</td>
</tr>
</tbody>
</table>
MEDICAL EDUCATION

Course Performance—Grade Point Average
The Oklahoma State University College of Osteopathic Medicine records grades for medical students on a 4-point scale: A, 4.0 (90% to 100%); B, 3.0 (80% to 89%); C, 2.0 (70% to 79%); D, 1.0 (65% to 69%); and U, 0 (64% and below). Students must receive a C or better to pass a course. Grade point average is calculated by dividing the total grade points earned by the total number of credit hours attempted for which a permanent grade has been assigned. Total GPA for this study reflects the overall GPA at the end of the seventh semester of study.

Preadmission Data
The American Association of Colleges of Osteopathic Medicine Application Service provided MCAT scores to the office of admissions at OSU-COM. The highest average score for bio-logic sciences, physical sciences, and verbal reasoning was used for each student.

Predictions
Based on a procedure described by Swanson et al., an academic dean at OSU-COM predicted COMLEX–USA performance before the examination. Test takers were divided into four categories based on academic performance in medical school. The highest 80% of the class were labeled sure pass. The lowest 5% were called concerns. The students above the bottom 5% but below the top 80% (ie, 6% to 20%) were called borderline. Placement in each group could be modified by the dean based on knowledge of individual factors that might influence predicted performance on the examination.

Results
Correlation coefficients with COMLEX–USA level 2 scores were determined for each of the variables. The statistical software package (SPSS version 10, SPSS Inc, Chicago, Illinois) was used to calculate correlations and significance levels. Seventy-eight students took the COMLEX–USA level 2 for the first time in spring 2000. Of those students, 75 provided complete data by reporting a valid score for each variable studied. A score of 400 was required to pass.

All OSU-COM candidates in the study group passed the examination. Mean score for the 78 OSU-COM students was 552.26, with a standard deviation of 75.82. The national mean for first-time test takers was 529.58, with a standard deviation of 87.96. The national pass rate was 93% for the 1577 first-time test takers.

The lowest 5% of the class scored a mean of 516.8, the next lowest 15% scored a mean of 489.5, the middle 60% scored a mean of 546.6, and the upper 20% scored a mean of 620.9. These results are summarized in Table 3. Those students assigned to the concerns category scored a mean of 516.8, those assigned to the borderline category scored a mean of 489.5, and those assigned to the sure-pass category scored a mean of 565.5. These results are summarized in Table 4. Correlations of each variable with COMLEX–USA level 2 scores for the 75 that had complete data are illustrated in Table 5. Each variable correlated with COMLEX–USA level 2 at a statistically significant rate of $P < .05$.

Discussion
The highest correlation was with COMLEX–USA level 1 scores. The lowest correlation to COMLEX–USA level 2 performance was with clinical GPA. Correlation of level 2 performance with level 1 performance appears to be logical. First, the question format is similar in the two examinations, thus giving candidates a familiar style of questions, particularly those related to osteopathic principles and practice. Second, success on level 1 would indicate mastery of the examination style, and success on level 2 would be a logical extension of this concept.

<table>
<thead>
<tr>
<th>Variable correlated to COMLEX–USA level 2</th>
<th>Correlation (SD)</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total GPA</td>
<td>0.672 (0.2808)</td>
<td>0.000</td>
</tr>
<tr>
<td>Basic science GPA</td>
<td>0.659 (0.4033)</td>
<td>0.000</td>
</tr>
<tr>
<td>Clinical GPA</td>
<td>0.269 (0.1708)</td>
<td>0.012</td>
</tr>
<tr>
<td>MCAT</td>
<td>0.406 (1.1806)</td>
<td>0.000</td>
</tr>
<tr>
<td>COMLEX–USA level 1</td>
<td>0.751 (69.9800)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

OSU-COM indicates Oklahoma State University College of Osteopathic Medicine; GPA, grade point average; MCAT, Medical College Admission Test.
Level 2 performance was also strongly correlated with basic science GPA. First- and second-year course examinations rely on questioning formats that incorporate NBOME-type multiple-choice questions. Familiarity may also explain this relationship and the small difference in the two results: .751 for level 1 with level 2 and .659 for basic science GPA and level 2. Total GPA was a combination of four semesters of basic science and three semesters of clerkship grades.

Medical College Admission Test scores were less strongly correlated with COMLEX–USA level 2 scores than were COMLEX–USA level 1 scores. The composition of the MCAT may be one reason for this, as the MCAT mainly tests physical science and verbal reasoning and does not include clinical questions. The MCAT also includes an essay question, which is not used on any COMLEX–USA level.

Scores from the COMLEX–USA level 2 correlated least with clinical GPA. Theoretically, these should be most strongly correlated, given that the examination was designed to measure this area of the curriculum. Exact reasons for this discrepancy are unclear, with a number of potentially influential factors exclusive to OSU-COM.

Clerkship grades were higher on average (3.813) than basic science grades (3.347) (Table 6) and, thus, may reduce the discrimination between top-level achievement and average achievement. No clerkships at the college currently give NBOME or USMLE shelf examinations, thus decreasing exposure of students to this potential influence on clerkship scores. Formal testing is a smaller percentage of the clerkship grade than is assessment by clinical faculty. In past assessments, global rating scales by attending physicians have been unreliable. Whether the relationships between faculty assessment and clerkship grades at OSU-COM are similar to relationships at other colleges of osteopathic medicine is unknown.

The prediction by the academic dean’s office at OSU-COM regarding examination performance was not accurate, as even the bottom 5% of students who were labeled concerns passed the examination. Those between the lowest 5% of the class and the next lowest 15% (6% to 20%) in the dean’s predictions performed opposite to what was expected, scoring 516.8, compared with 489.5 (Table 4). These results suggest little difference between the two groups. Thus, the discrimination between them may be artificial in relation to actual competence. The middle and upper groups showed increasing examination performance, consistent with the achievement in higher academic activities (546.6 and 620.9, respectively).

Predictions for at-risk students (ie, those labeled concerns and borderline) were also inaccurate, as all students passed the examination (though this event may be a one-time phenomenon). Without multiple-year groups to compare, trends cannot be studied. However, predicting at-risk candidates would be useful so these students could receive additional assistance (eg, board review courses, tutoring, directed reading programs) in preparing for the examination.

As none of the study group other than that the dean’s office underestimated the level of examination performance. Therefore, this method of predicting poor examination performance appears to be of limited use. A comparison with other osteopathic medical schools’ candidates and their performance may shed light on these questions. Although OSU-COM provides a board review course before the examination and students are scheduled away from clinical rotations to attend, evaluating the impact of this additional preparation on performance requires comparisons with other schools. Whether the results were attributable to superior curricular design, caliber of students, board review sessions, or other variables is unknown.

Comparison of COMLEX–USA Level 2 to USMLE Step 2

Studies relating academic performance to USMLE results were done after the new format for USMLE was adopted in 1991. In the first study to look at USMLE step 1, Swanson et al found that even the lowest 5% of students in schools studied had an 80% pass rate, and 81.3% of the marginal candidates passed. Thus, dean’s offices were overly harsh in predicting failures.

In a later study of USMLE step 2, this was still the trend, as Case et al reported that the lowest 4% of the class in a 20-school study had a 44% pass rate; correlations of USMLE step 2 to clinical GPA were .64. This was higher than the .269 at OSU-COM for COMLEX–USA level 2. Yet in a study at the University of New England College of Osteopathic Medicine (UNECOM), the correlation was .26, similar to the correlations found at OSU-COM. The reason for this could be a result of differences in curriculum and grading of the schools Case et al studied when compared to OSU-COM or UNECOM.
Many medical schools give USMLE shelf examinations as part of the grade in clerkships, thus testing the same skills as those on the examination. In addition, clerkship grades include other noncognitive skills, such as psychomotor and interpersonal skills, which further explains the imperfect relationship. Moreover, many of the undifferentiated patient items on both COMLEX–USA level 2 and USMLE step 2 questions require clinical judgments that cover clerkship training knowledge only learned in more than one type of experience. Studies have also shown that faculty ratings are less reliable than basic science grades in medical school. Thus, UNECOM studies may produce the potential for a wider correlation.

Limitations
Numeric grade reports from the West Virginia School of Medicine were compared with GPAs from OSU-COM. Although both schools started with percentage grades, differences in converting these may have led to inaccuracies and the assumption that one school’s grade was identical to the other’s. Likewise, the studies by Swanson et al and Case et al compare grade reports from different schools that may raise similar concerns. The current study differed from the Baker et al study in not comparing preadmission GPA in science and nonscience courses, which might have been useful. Medical College Admission Test scores were reported as an average of total performance and were not subdivided into science and nonscience categories.

Conclusion
Students at OSU-COM taking COMLEX–USA level 2 for the first time had significant correlations between performance on this examination and academic performance. The strongest correlation was found between COMLEX–USA level 2 and level 1 scores, and the lowest correlation was between COMLEX–USA level 2 performance and clinical GPA. All measured academic performance indicators were significant. Whether the results for OSU-COM may apply to other colleges of osteopathic medicine is unknown. Further research is needed to clarify the relationships of these performance variables to COMLEX–USA level 2 for other colleges of osteopathic medicine.

Acknowledgments
The authors thank Charles E. Henley, DO, MPH, Shannon Turner Daleiden, PhD, Thomas R. Pickard, DO, and Helen H. Baker, PhD, MBA, for manuscript review; Ms Julie Rice and Ms Cathy Ramsey for typing and proofreading support; and Ms Zachary Kuhldmann for data entry support. This project was funded by a grant from the Oklahoma State University College of Osteopathic Medicine.

References