The Journal of the American Osteopathic Association

A peer-reviewed osteopathic continuing medical education publication

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The Journal of the American Osteopathic Association

The Journal of the American Osteopathic Association (*JAOA*) encourages osteopathic physicians, faculty members and students at colleges of osteopathic medicine, and others within the health care professions to submit comments related to articles published in the *JAOA* and the mission of the osteopathic medical profession. The *JAOA*'s editors are particularly interested in letters that discuss recently published original research.

Letters must be submitted online at http://www.osteopathic.org/JAOAsubmit and not have been published elsewhere. All accepted letters to the editor are subject to editing and abridgment.

Osteopathic Response to the COVID-19 Pandemic

To the Editor:

This is a time to mobilize the osteopathic medical profession to help fight the coronavirus disease 2019 (COVID-19) pandemic. We have something extra to offer. In 2004, after the updated recommendations for immunizations by the Advisory Committee on Immunization Practices and the announcement that the US Department of Health and Human Services was drafting an influenza preparedness response, *The Journal of the American Osteopathic Association* editor in chief, Gilbert E. D'Alonzo Jr, DO, wrote an editorial titled, "Influenza Epidemic or Pandemic? Time to Roll up Sleeves, Vaccinate Patients, and Hone Osteopathic Manipulative Skills."[1] We are in a similar time, and that something extra is osteopathic manipulative medicine.

We are under the weight of a pandemic that is killing people on a daily basis.[2] There are no effective medications to date to combat this virus, so we are left with supportive care of the patient, which may progress to intubation with ventilator support until the patient recovers or dies. The medical costs of this pandemic are staggering and continue to accumulate.[3] The emotional and physical toll on patients and medical personnel is unrelenting, and the cost to the economy is almost unprecedented.

As osteopathic physicians (ie, DOs), we can make a difference in the care of patients with COVID-19, as was witnessed in the influenza pandemic of 1918-1920. The similarities between that pandemic and the current pandemic are striking in many ways; then and now, no known medications made a significant difference in the course of the disease. Then and now, the type of practicing physician was either a DO or an allopathic physician (ie, MD). However, during the pandemic of 1918-1920, the patients treated by DOs using osteopathic manipulative treatment (OMT) techniques were reported to have a nearly 40 times higher rate of survival compared with those who did not receive OMT.[4] If those statistics are accurate, then the difference in the death rate when using OMT was highly significant.

Although OMT does not fight viruses, the literature supports the use of OMT in patients with respiratory tract infections. As an adjunctive management approach, OMT can enhance patients' innate immune response by delivering more immune cells to the site of infection, improving circulation, and correcting related structural restrictions that impair the optimal functioning of the autonomic nervous system. Herein we elucidate the logic for using OMT as an adjunctive treatment approach for patients with a viral respiratory tract infection in general and COVID-19 in particular.

Movement of Lymph

The lymphatic system, made up of the spleen, thymus, lymph nodes, tonsils, adenoids, and Peyer patches in the small intestines and lymph channels, is an essential part of the immune system. Increasing the rate of flow of lymph through lymphatic channels facilitates the movement of leukocytes and other immunogenic cells to the site of infection. OMT may be especially helpful for patients who are at rest for long periods, during which the flow rate of this immunologically rich fluid is slowed.

Knott et al[5] demonstrated that lymphatic flow in the thoracic duct was significantly increased in real time with the use of the thoracic pump, abdominal pump, and physical activity in canines. Hodge et al[6] reinforced the aforementioned research by demonstrating that a lymphatic pump technique (LPT), specifically the abdominal lymphatic pump (ALP), was able to significantly increase thoracic duct lymph flow in mongrel dogs.

The use of LPT in humans has demonstrated an enhanced immune response.[6,7-9] The most effective of these pump techniques in moving both lymph and immune cells was ALP.[5,6]

During the influenza pandemic of 1918-1920, DOs were using lymphatic techniques, but the specific techniques used are not fully known.[10] The use of the ALP as a separate treatment seems to have its origins at a later date.[11]

Immune Enhancing

The initial findings from the COVID-19 pandemic from Wuhan China and the United States indicated that many patients admitted to the hospital had either leucopenia, lymphopenia, or both, with the worst cases of lymphopenia found in patients who died.[11,12-14]

OMT techniques have been investigated in animal models to assess their effects on immune cell populations. LPT performed on dogs was shown to increase leukocyte count when analyzed by flow cytometry, with similar increases seen in all leukocyte populations.[6] Studies conducted on both dogs and rats showed that LPT enhanced the immune response by mobilizing increased levels of inflammatory cytokines, increasing lymph flow, and increased leukocyte counts in the thoracic duct lymph.[6,15,16] Hodge et al[17] showed that these leukocytes were recruited from the gut-associated lymphoid tissue and were transported in the lymph during the use of LPT, but the effects were transient. This finding is important because this is where 70% to 80% of plasma cells in the human body are normally located. The number of leukocytes went from a resting state of approximately 5 million cells per minute to 150 million cells per minute while the dogs received LPT. Further investigation into these animal models showed that LPT can produce the same beneficial results multiple times, including increased lymphatic flow, leukocyte recruitment, and cytokine/chemokine flux.[18] This movement of immune cells to other areas of the body may help boost insufficient immune responses to fight off viral infections. A study[19] investigating the effect of ALP on the delivery of antibiotics in rats infected with *Streptococcus pneumoniae* demonstrated enhanced delivery and greater effectiveness, with 63% of rats free of disease when OMT was combined with antibiotics vs 25% when antibiotics and saline were administered without OMT. ALP, independent of antibiotics, still had the ability to make 13% of rats disease free at the end of the study when compared with 0% disease-free rats in the control/saline and sham/saline groups.[19]

One major complication of COVID-19 is the long length of hospital stays, with patients who will eventually recover staying a median length of 10 to 13 days.[13,20,21] In a randomized controlled clinical trial conducted by Noll et al,[8] elderly patients treated with OMT for pneumonia had significantly shorter hospital stays and shortened duration of intravenous medication. In another randomized clinical trial, Noll et al[9] found that patients hospitalized with pneumonia and treated with OMT had significantly reduced length of hospitalizations, intravenous antibiotics, mortality, and respiratory failure when compared with conventional care only. This study, however, found no significant differences in intention-to-treat analysis or between light touch and OMT. Unfortunately, neither of these studies used ALP, which is arguably the most effective technique for mobilizing the immune system to mount a more effective response to an invading pathogen.[5,6]

Another unique advantage OMT may have is the ability of the body to respond to a vaccine more effectively. In a clinical trial, Jackson et al[7] saw an increase in hepatitis B titer in patients treated with OMT when compared with a control group (no OMT), who also received the vaccine. This finding suggested improved immune function with OMT, which may be useful when a vaccine is made available to the public.

COVID-19 and OMT

Previous studies elucidated the utility of OMT in a patient population with respiratory tract infections. Evidence to suggest that OMT is a useful treatment option for patients with respiratory tract infections includes animal studies,[5,6,15-19] showing increased movement of lymph and delivery of leukocytes to fight infection, as well as human clinical trial results,[7-9] showing shortened hospital stays and less need for antibiotics. So, the effects of using OMT for the pulmonary-compromised patient minimally includes the following goals and OMT techniques:

1. Significantly increasing the immunocytes being delivered to the lung tissue and enhancement of natural immune response (abdominal lymphatic pump)[6,15-18];
2. Improving pulmonary circulation (rib raising, thoracic diaphragm release)[22];
3. Improving pulmonary function (rib raising, rib articulatory technique)[23];
4. Reducing segmental spinal restrictions to improve autonomic nervous system functioning (rib raising, high-velocity, low-amplitude).[24,25]

Conclusion

We have both the opportunity and obligation to step in to treat COVID-19 patients with OMT, which seems to be underused in the current approach to this pandemic. We may be able to improve the lives of patients with this virus. OMT, especially the ALP technique, can be an adjunct to the standard care of these patients in clinics or hospitals. As these patients are being treated with OMT, several impact markers could easily be collected and evaluated toward a double-blind study to compare participants who receive adjunctive OMT with those who receive usual care only. Important markers would include the need for hospitalization for those receiving outpatient OMT, length of stay for hospitalized patients, the need for ventilator support, and death. While more research is being conducted on COVID-19 and its treatment options, OMT may be a valuable tool to use in this pandemic and warrants further investigation to improve outcomes for patients. (doi:10.7556/jaoa.2020.081)

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Research at University of New England College of Osteopathic Medicine

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The University of New England College of Osteopathic Medicine (UNECOM) is 40 years old and has transitioned from its core mission of building a reputation for innovation in medical education, teaching of anatomy and osteopathic manipulative medicine, training, and professional service to include a further mission that includes an increasingly rich environment for diversified research and scholarship (including the neurosciences and pain). *The Journal of the American Osteopathic Association*'s Engage Initiative allowed us the opportunity to showcase who we are, what we do, and how we are preparing the next generation of the US health care workforce. We have invited UNECOM's outstanding basic scientists, clinicians, and educators to showcase some of our innovative research and scholarly activities.

The first article, "Making the Connection: Using Concept Mapping to Bring the Basic Sciences to the Diagnosis,"[1] illustrates how concept mapping assists students in developing relationships between basic and clinical science. The authors developed a weekly concept mapping activity that connects biomedical principles with the clinical signs, symptoms, and diagnostic laboratory results in a comprehensive clinical case. "Learning Together: Interprofessional Education at the University of New England"[2] highlights interprofessional learning at UNE, providing a significant and valuable experience for students and faculty. The authors describe the development of an interprofessional collaborative learning curriculum, which is now being piloted at all of our clinical clerkship campus sites. Experiences such as Interprofessional Team Immersion provide students with opportunities to learn about the intricacies of the care team, as well as the skills needed to effectively work in teams in advance of their clinical rotations and future profession.

The curriculum at UNECOM was redesigned to include CORE Entrustable Professional Activities (EPAs). The article, "Report on 7 Years Experience Implementing an Undergraduate Medical Curriculum using Entrustable Professional Activities" describes how UNECOM has instituted EPAs as performance benchmarks.[3] Core EPAs provide a set of minimum expected outcomes for medical students based on what makes a competent and safe medical practioner. Integrating anatomy, physical examination, history taking, and other clinical skills used in osteopathic principles and practice and osteopathic manipulative treatment should help to solidify students' osteopathic identity. This article further describes methods for developing and implementing an integrated anatomy and clinical skills course using EPAs.

In "48-Hour Hospice Home Immersion Encourages Osteopathic Medical Students to Broaden Their Views on Dying and Death,"[4] Gugliucci et al highlight an experiential medical education research learning module that immerses second-year medical students into a hospice home for 48 hours to augment learning about interprofessional palliative and end of life care. Medical students learn to trust themselves when handling emotional and challenging situations and gain confidence in their ability to help guide patients through this stage of life.

In "Learning Together: Interprofessional Education at the University of New England," Mokler et al discuss how the University of New England College of Osteopathic Medicine intergrates interprofessional education into the medical school's curriculum. The Interprofessional Team Immersion learning experience consists of case-based learning, experiential and didactic experiences, and collaboratice competencies.

Jane Carriero, DO, the Dean of UNECOM, discusses "UNECOM's Impact in Maine, New England, and Beyond."[6] UNECOM graduates practicing primary care in Maine have an annual economic impact of more than 100 million US dollars on the state. We appreciate the opportunity to show how UNECOM integrates

research and scholarship in medical education. (doi:10.7556/jaoa.2020.082)

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Life vs Loans: Does Debt Affect Career Satisfaction in Osteopathic Graduates?

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Background: The cost of undergraduate osteopathic medical education continues to grow. It is important to understand how the rising cost of matriculation negatively affects training and career satisfaction of entering students.

Objective: To better understand any association between level of educational debt and satisfaction with osteopathic medical education, career choice, and financial services.

Methods: Responses were analyzed from the American Association of Colleges of Osteopathic Medicine survey of pending medical school graduates from 2007 through 2016 regarding indebtedness and specialty selection.

Results: From 2007 to 2016, the mean educational debt level at graduation rose consistently among osteopathic graduates (from $155,698 to $240,331, respectively). In all years, there was no significant effect of debt quartile on satisfaction with choice of osteopathic medicine as a career. Quartile variable with debt did not show a significant effect on satisfaction with education experience in 2010, 2013, and 2016. Top quartile debt was associated with higher satisfaction with financial service departments in all years.

Conclusion: Although debt has consistently increased for osteopathic medical graduates, it does not affect their satisfaction with either their educational experience or their choice of osteopathic medicine as a career.

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Keywords: medical education, student loan debt

Medical education represents a sizable investment to those who pursue it. Students ultimately dedicate years of study, forego years of income, and frequently accrue significant indebtedness in the form of student loans to complete their education endeavors. In 2018, the mean cost of an osteopathic medical education was $254,953; this value is expected to increase as private and for-profit institutions expand into osteopathic medical education.[1-3] For this outlay of time and money, students reasonably expect gainful employment, income security, and a reasonable standard of living. Although a career in medicine was previously thought of as a calling, given the present long-term financial implications, the pursuit of a career in medicine may become an economic and consumer choice as well.

Despite the rising cost of medical education, demand for medical training continues to be strong. Competition around final acceptance can be fierce, as evidenced by the

Table 1.
Osteopathic Student Reported Satisfaction by Year[a]

	Survey year			
Satisfaction	**2007**	**2010**	**2013**	**2016**
Satisfaction with quality of education (total)	2349	2891	3667	4179
Missing	53	17	17	11
Poor, %	4.30	7.51	7.20	8.73%
Average, %	14.6	10.4	11.0	13.2
Good, %	81.1	82.1	81.8	78.0
Enrollment (total)	2135	2890	3663	4164
Missing	267	18	21	26
No medical school, %	5.57	5.54	4.70	5.21
Allopathic, %	20.7	27.3	29.6	34.6
Other COM, %	8.85	11.5	9.17	11.4
Same COM, %	64.9	55.7	56.5	48.8
Career satisfaction (total)	2192	2895	3671	4177
Missing	210	13	13	13
Poor, %	2.42	5.66	4.85	5.20
Average, %	20.9	13.2	14.0	15.4
Good, %	76.6	81.1	81.2	79.4

Abbreviation: COM, college of osteopathic medicine.

increasing requirements for admissions. Competition is not solely on the side of applicants. In the age of Rate My Professors and Facebook reviews, satisfaction rankings of students are not only important as a means for schools to continuously improve the quality of their student educational experience, but also a way to entice applicants. Although the satisfaction of an individual student may influence his or her future financial support of the institution, on a larger scale, more transparent satisfaction rankings may soon come to influence future student recruitment. According to the American Medical College Application Service used by the Association of American Medical Colleges (AAMC) as a centralized allopathic medical school application process, students currently apply to an average of 16 programs.[5] Reputation rankings can be found from several sources, including *U.S. News and World Report's* yearly "Methodology: Best Medical Schools Rankings." Ranking is calculated by a peer assessment score (provided by medical school deans and residency directors, among others), research score, student selectivity, Medical College Admissions Test scores, grade point average, acceptance rate, and faculty resources.[6] Medical schools must therefore invest in their students and programs to preserve satisfaction and appeal to the next generation of talent.

Against the backdrop of rising student indebtedness, a body of literature has appeared that examines its downstream effects. Among graduates of baccalaureate programs, students with higher debt burdens were less likely to endorse program satisfaction or believe that their program was "worth the cost."[7] Similarly, law school graduates with higher debt burdens were less likely to describe their law school experience as "favorable" and more likely to consider a different school if given the option to redo their education.[8] Within the realm of medical school, the influence of debt on risk of burnout,[9] and depression,[10] skepticism regarding policy changes,[11] and medical knowledge[9] is well documented, but the potential role of debt on perceived medical education quality and overall career satisfaction is not understood.

As costs of education rise and debt loads increase, medical students and physicians who enter even the mostly highly rated programs are at risk of becoming less content with their education and career. In this study, the increasing cost of attendance and debt are examined, with osteopathic physicians' outlook on the quality of their education and career selection weighed against the effect of debt load on job satisfaction.

Methods

This study was deemed exempt by the Mayo Clinic institutional review board because no personally identifiable information was used. Data were obtained and analyzed with the permission of American Association of Colleges of Osteopathic Medicine (AACOM). Each year, AACOM invites all accredited colleges of osteopathic medicine to conduct a voluntary survey for graduating students. Similar to AAMC's Graduate Questionnaire,[1] this survey gathers information on demographics, specialty selection, anticipated practice decisions, indebtedness, and other various metrics of undergraduate medical education. Since its introduction, the AACOM survey has evolved to reflect changes in medical education, but questions regarding education and career satisfaction, as well as current level of indebtedness, have remained consistent.[12]

We examined responses to the following AACOM survey questions:

1. "Indicate the dollar amount borrowed to finance your osteopathic medical education."
2. "Please rate your overall satisfaction with the quality of your medical education."
3. "At this time, how satisfied are you that you selected osteopathic medicine as a career?"
4. "If given the opportunity to begin your medical education again, would you prefer to enroll in: the osteopathic medical school from which you are about to graduate, another osteopathic medical school, an allopathic medical school, or would not have gone to medical school at all?"

The surveys from 2007, 2010, 2013, and 2016 were chosen for the analysis.[13] We evaluated national trends in perceived education quality, satisfaction in education quality and career selection, satisfaction with financial aid services, choice of same vs different education, and differences in high- vs low-debt respondents (as determined by lowest and highest quartiles of debt).

The software used for these analyses was SAS Studio (release 3.7, basic edition, SAS Institute Inc). We assessed the univariable associations between the amount of medical school debt and the above questions using the χ^2 test, Fisher exact test with Monte Carlo *P* value, and analysis of variance. We used a multivariable proportional odds ratio (OR) model with logistic regression to assess relationships of interest. $P<.05$ indicated statistical significance. Categorical data are expressed as number and percentage. Deidentified data and analyses were placed in a password-protected Excel (Microsoft Corporation) spreadsheet and stored on a secured institutional network.

Results

The number of survey responses ranged from 2403 in 2007 to 4191 in 2016, respectively, reflecting the increased matriculation rate at osteopathic medical schools nationwide. The response rates for the years studied ranged from 72% to 77%, respectively.

We observed consistent increases in the mean educational debt level at graduation (from $155,698 in 2007 to $240,331 in 2016, respectively). The percentage of respondents graduating without debt declined from 19.3% in 2007 to 6.7% in 2010, respectively, but then increased to 12.3% by 2016.

In 2007, the indebtedness quartile variable with debt had a significant effect on satisfaction with student education outcome ($P=.0001$; using logistic regression analysis). Students with debt in the upper quartile (>75th percentile) were less likely to be satisfied with the quality of their medical education compared with students with indebtedness in the middle debt quartile (25th percentile; $P=.75$; OR [range], 0.677 [0.528-0.868]). These results were significant in 2007, but not in the other years examined. Quartile variable with debt did not show significant effect on satisfaction with education in 2010, 2013, or 2016 ($P=.08$, .16, and .052, respectively).

In all years, there was no significant effect of debt quartile on satisfaction with choice of osteopathic medicine as a career in either the low- or high-debt quartiles (**Table 2**).

Table 2.
Satisfaction Stratified by Educational Debt Quartile Among Osteopathic Medical Graduates[a]

Quartile	Satisfaction level		
	Poor	Average	Good
	2007		
Quality of education			
Q1	3.66	10.63	85.71
Q2 and Q3	4.17	14.37	81.46
Q4	5.24	18.92	75.84
Career			
Q1	2.10	19.66	78.24
Q2 and Q3	2.87	20.27	76.86
Q4	1.83	23.26	74.91
	2010		
Quality of education			
Q1	7.16	8.54	84.30
Q2 and Q3	6.89	10.96	82.15
Q4	9.40	11.08	79.52
Career			
Q1	5.37	14.60	80.03
Q2 and Q3	5.55	12.15	82.30
Q4	6.28	14.11	79.61
	2013		
Quality of education			
Q1	6.99	12.43	80.58
Q2 and Q3	6.56	10.45	82.99
Q4	8.57	10.24	81.18
Career	Poor	Average	Good
Q1	5.34	12.68	81.98
Q2 and Q3	4.22	14.25	81.53
Q4	5.23	14.24	80.53
	2016		
Quality of education			
Q1	10.18	13.21	76.61
Q2 and Q3	7.29	13.23	79.48
Q4	9.63	12.51	77.86

(continued)

Table 2 (continued).
Satisfaction Stratified by Educational Debt Quartile Among Osteopathic Medical Graduates[a]

Quartile	Satisfaction level		
	Poor	Average	Good
Career			
Q1	5.48	17.51	77.01
Q2 and Q3	4.60	14.96	80.44
Q4	5.85	13.78	80.38

[a] Data are given as percentage.

Abbreviations: AACOM, American Association of Colleges of Osteopathic Medicine; COM, college of osteopathic medicine; Q, quartile.

In contrast, indebtedness quartile was found to have a significant effect on satisfaction regarding financial aid administration services in all years (all years, $P<.0001$), with students with lower debt ($P\leq25$) less likely to report a satisfaction rating of "good" in all years (OR, 0.293, 0.480, 0.446, and 0.373, respectively) than those with middle quartile debt (25th percentile, 75th percentile). High debt (>75th percentile) was not associated with consistent differences in satisfaction across years (**Table 2**).

In 2010 and 2016, students with no debt were more likely to report that if they could begin their education again, they would choose an allopathic medical school ($P=.026$ and .0379, respectively) with a mean OR (range) of 1.22 (0.904-1.651) in 2010 and an OR (range) of 1.313 (1.086-1.588) in 2016, respectively.

Discussion

Understanding satisfaction with medical training remains a complicated endeavor given the highly individualized and heterogeneous training experience that medical students undergo through classroom, practical, and clinical experiences. However, given the increasing levels of burnout in trainees[11] and a concerning projected shortage of physicians, comprehension of factors affecting medical education satisfaction is vital.[14]

Despite a consistent increase in median debt over the 10-year period covered in this study, no consistent relationship was found between debt and satisfaction with the choice of osteopathic medical education. One would think that respondents with higher debt burdens graduating after the financial crisis of 2007-2008 would consistently skew toward having a worse experience given interest rate increases and a less than desirable outlook for the economy. Instead, those with higher debt burdens showed no signs of buyer's remorse. Debt does not appear to reliably affect satisfaction with quality of education. This finding would seem to point away from the cost of education being a deciding factor in trainees' perceptions of their education.

Additionally, although there was an intuitive theory that larger amounts of debt burden would translate to decrease in satisfaction with financial aid offices, the exact opposite was found, with students with low debt being less likely to rate financial aid offices as "good." A confounding variable that may have affected this finding is the greater contact that students with financial assistance or scholarships have with financial aid offices. This factor points to a possible different

Table 3.
Medical School Enrollment Among Osteopathic Medical Graduates

Enrollment	No medical school	Allopathic	Other COM	Same COM
2007				
Q1	6.64	18.95	8.40	66.02
Q2 and Q3	4.79	20.83	8.39	65.99
Q4	6.03	22.03	10.36	61.58
2010				
Q1	4.43	29.18	11.07	55.33
Q2 and Q3	6.19	25.95	11.18	56.68
Q4	5.45	28.35	12.85	53.35
2013				
Q1	5.23	31.51	8.57	54.68
Q2 and Q3	4.83	27.89	8.94	58.33
Q4	3.90	31.07	10.02	55.01
2016				
Q1	5.51	38.48	10.43	45.57
Q2 and Q3	5.41	31.98	12.16	50.45
Q4	4.18	34.73	11.34	49.75

[a] Data are given as percentage.

Abbreviations: AACOM, American Association of Colleges of Osteopathic Medicine; COM, college of osteopathic medicine; Q, quartile.

perspective and use of financial aid offices by students with different debt burdens.

In 2 separate years (2010 and 2016), students who had no debt said that they would have preferred to have gone to an allopathic medical school if they were repeating their education again. This is an unexpected finding that warrants further examination. Borrowing a large amount of money to finance education possibly skews an individual's expectation and opinion of his or her training.[15] Students who are required to incur larger amounts of educational debt seem to place a higher value on their education. Additionally, there are a significant number of social, racial, and socioeconomic factors that have been strongly correlated with student loan debt.[16] Examining socioeconomic background and other factors that may independently contribute to educational satisfaction was beyond the scope of this analysis, but may be an avenue for further research.

Several limitations of this study, including a lack of socioeconomic, ethnic, and other background features, may hinder the ability to generalize these findings. However, to date, little research has been done on this topic and, despite an increase in legislative and medical school focus on educational debt, current students do not seem to be affected by it.

Conclusion

With the progressive rise in both trainee burnout and educational debt, the lack of clear association between student loans and educational satisfaction is a welcome

finding. Further research is needed to examine trends in student satisfaction and to help provide support for future medical education policy as a looming physician shortage nears.

Author Contributions

Drs Richards, Scheckel, and Poole provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; Drs Richards, Scheckel, and Newman, and Ms Anderson drafted the article or revised it critically for important intellectual content; Drs Richards, Scheckel, Newman, and Poole, and Miss Anderson gave final approval of the version of the article to be published; and all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Eosinopenia and COVID-19

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Context: Early diagnosis of coronavirus disease 2019 (COVID-19) and patient isolation are important for both individual patient care and disease containment. The diagnosis is confirmed by testing for the presence of nasopharyngeal viral RNA with a polymerase chain reaction assay, which has limited availability, variable turnaround time, and a high false-negative rate. The authors report that a rapid laboratory test, the eosinophil count, readily obtained from a routine complete blood cell count (CBC), may provide actionable clinical information to aid in the early recognition of COVID-19 in patients, as well as provide prognostic information.

Objective: To investigate the diagnostic and prognostic value of eosinopenia in COVID-19–positive patients.

Methods: The eosinophil results of routine CBC from the first 50 admitted COVID-19–positive patients were compared with the eosinophil results of 50 patients with confirmed influenza infection at the time of presentation to the emergency department at Coney Island Hospital in Brooklyn, New York. The number of patients with 0 eosinophils on the day of presentation was also compared between the 2 groups. Furthermore, the eosinophil counts in the 50 COVID-19 patients were reviewed for the first 5 days of their hospital stay and before discharge, along with the outcome (deceased vs discharged), and trends in eosinophil data were compared based on the outcome.

Results: On the day of presentation, 30 patients in the COVID-19 group (60%) and 8 patients in the influenza group (16%) had an eosinophil count of 0. An additional 14 patients in the COVID-19 group had 0 eosinophils during the following 2 days; the total number of patients in the COVID-19 group who had 0 eosinophils on admission or during the ensuing 2 days was 44 (88%). In addition, 18 of 21 (86%) deceased patients in the COVID-19 group who initially presented with eosinopenia remained eosinopenic compared with 13 of 26 (50%) survivors.

Conclusion: The absence of an eosinophil count in a CBC can aid in early diagnosis of COVID-19. It may be a useful tool in deciding whether to promptly isolate a patient and initiate specific therapies while waiting for confirmatory test results. Persistent eosinopenia after admission correlated with high disease severity and low rates of recovery.

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Keywords: coronavirus, COVID-19, eosinopenia, false-negative COVID-19 PCR

Coney Island Hospital, part of the New York City Health and Hospitals system, serves a diverse population in Brooklyn, New York. Brooklyn and the broader New York City metropolitan area experienced a sharp incline in COVID-19 cases during March and April 2020.

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which causes coronavirus disease 2019 (COVID-19), was first noted as a cluster of cases of pneumonia of unknown cause in Wuhan City, Hubei Province, China, in December 2019.[1] The emergence of SARS-CoV-2, following SARS-CoV outbreak in 2002-2003 and Middle East respiratory syndrome (MERS-CoV) in 2012, marked the third introduction of a highly pathogenic and large-scale epidemic coronavirus into the human population in the 21st century. Since then, COVID-19 has spread globally and was declared a pandemic by the World Health Organization on March 11, 2020.[2] Community transmission was first detected in the United States in February 2020, with all 50 states reporting cases of COVID-19 by mid-March 2020.[2] New York City experienced a particularly sharp increase in COVID-19 cases and deaths during March and April 2020.

COVID-19 primarily spreads through respiratory droplets. Common clinical presentations of COVID-19 include fever, cough, dyspnea, myalgia, rhinorrhea, chest pain, and diarrhea.[3] However, in severe cases, the disease can progress to multiorgan dysfunction syndrome, including acute respiratory distress syndrome, acute renal failure, septic shock, coagulopathy, and death.[3,4] The clinical diagnosis of COVID-19 is confirmed by laboratory testing with a reverse-transcription polymerase chain reaction (RT-PCR) assay, which remains a challenge due to limited test availability, variable turnaround time, and the unreliable availability of rapid RT-PCR kits. In many hospitals, test results may take days to return. A recent article in *Annals of Internal Medicine* based on literature review and pooled analysis of 7 previously published studies (n=1330) found that PCR performance varied by time since symptom onset or SARS-CoV-2 exposure using samples from the upper respiratory tract.[5] On the day of symptom onset, typically day 5 after exposure, the median false-negative rate was 38%; this decreased to 20% on day 8 (3 days after symptom onset) and then began to increase again, from 21% on day 9 to 66% on day 21.[5]

Laboratory parameters, such as lymphopenia and elevated concentrations of liver enzymes, C-reactive protein, lactate dehydrogenase, ferritin, and D-dimer, have been associated with COVID-19 and some, such as elevated levels of C-reactive protein and D-dimer, have been linked to the severity of the disease.[3,6,7] One report observed a progressive decline in the lymphocyte count in nonsurvivors compared with more stable levels in survivors.[8]

In our early care of patients with COVID-19, we observed that many manifested low or absent eosinophil counts at the time of admission. We embarked on a study to corroborate this impression, assess its prevalence, and compare it with a viral infection (influenza) that may have a similar presentation to help us determine whether this observation has relevance in classifying patients at the time of presentation with disease that requires hospitalization.

Methods

This study was reviewed and approved by the institutional review board of the Biomedical Research Alliance of New York.

Study Design and Participants

We performed a retrospective medical record review of the first 50 confirmed COVID-19 cases (COVID-19 group) admitted to the hospital, as well as 50 randomly selected patients with confirmed influenza (influenza group [control]). The COVID-19 group consisted of patients who presented to the emergency department with clinical or laboratory abnormalities raising the concern for COVID-19 and who were sufficiently ill to merit hospitalization. All of these patients had a positive PCR test for COVID-19. Patients in the control group tested positive for influenza on PCR testing for

the presence of nasopharyngeal viral RNA during the influenza season (January-March 2020).

Data Collection

We collected the following patient data: age, sex, and eosinophils on the complete blood cell count (CBC) performed at presentation, during the subsequent 5 days, and on the last day of the hospital stay (for patients who required longer hospitalizations). Patients with baseline eosinophilia were excluded from the study. Eosinophils were determined by the Coulter counter. Its lower limit of detection of eosinophils is 0. The accuracy and reproducibility are close to 100% (laser-based SYSMEX machine). In the hospital's laboratory, the normal absolute eosinophil count range is 100 to 400/μL.

For the purpose of this study, we looked at the absolute eosinophil count from the initial CBC count at the time of presentation to the emergency department in the COVID-19 group and the influenza control group to address our primary question, which was whether the absence of eosinophils was predictive of COVID-19 and prognosis. A set of medical records for both groups was generated electronically based on either positive PCR result for COVID-19 or positive rapid influenza swab tests. The CBC results were not part of the selection process in either group.

Statistical Analysis

Categorical variables between groups were compared using the Pearson χ^2 test.

Results

There were 29 men (58%) and 21 women (42%) in the COVID-19 group and 21 men (42%) and 29 women (58%) in the influenza group. The mean ages of patients in the 2 groups were similar (59 and 59.5 years, respectively).

The first CBC obtained on the day of presentation revealed that 30 patients in the COVID-19 group (60%) had absent eosinophils, compared with 8 patients in the influenza group (16%) (P<.001; Table).

Table.
Demographic and Initial Eosinophil Data of Patients in the COVID-19 Group and Influenza Group

Variable	COVID-19 Group (n=50)	Influenza Group (n=50)
Mean age, y	59.0	59.5
Median age, y	64	72
Sex ratio (M:F)	29:21	21:29
Mean eosinophil count on presentation, /μL	35	100
No. (%) of patients with eosinophil count of 0 at presentation	30 (60.0)	8 (16.0)

Abbreviation: COVID-19, coronavirus disease 2019.

In addition to the 30 patients who had 0 eosinophils on the day of presentation, of the remaining 20 patients in the COVID-19 group, 17 demonstrated a low absolute eosinophil count (mean, 23/μL; range, 10-60/μL) on the initial CBC. Two patients (4%) presented with a normal absolute eosinophil count, and 1 patient (2%) presented with an elevated eosinophil count.

Of the 20 patients in the COVID-19 group who had measurable eosinophils on presentation, 14 had 0 eosinophils on a subsequent CBC within the next 48 hours. For these patients, the mean time to an eosinophil count of 0 from presentation to 48 hours was 22.6 hours (range, 11.17-36.73 hours).

In the COVID-19 group, 23 patients (46%) died during hospitalization. The average age of those who died was 68.7 years compared with 56.7 years for those who survived. Of the 30 patients in the COVID-19 group who had a 0 absolute eosinophil count at presentation, 17 (56.7%) died. Of the 17 patients in the COVID-19 group who had a low but detectable eosinophil count at the time of presentation, 4 (23.5%) died.

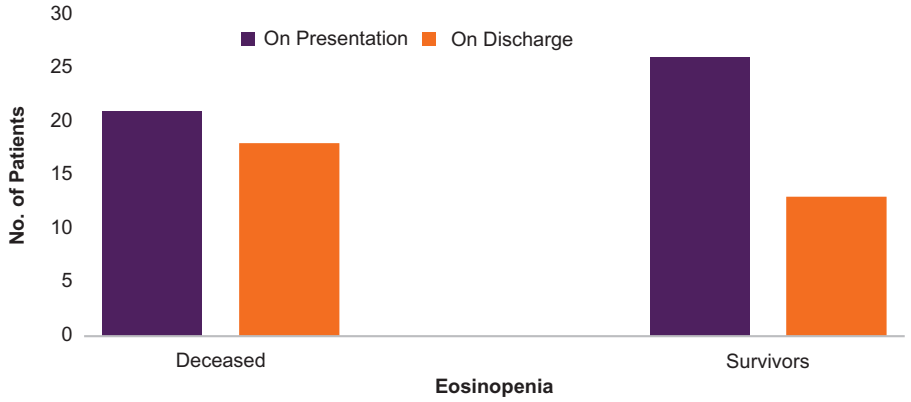

Figure.
Eosinopenia (eosinophil count <100 μL) trend from presentation to final disposition in deceased vs survivor patients with coronavirus 2019.

Next, we evaluated a trend in eosinophil counts in relation to the outcomes. In the COVID-19 group, 21 of 23 deceased patients (91%) and 26 of 27 survivors (96%) had eosinopenia (absolute eosinophil count <100/μL) on presentation. In the deceased group, 18 of 21 (86%) remained eosinopenic before death. In the survivor group, eosinophil counts remained low in 13 of 26 patients (50%) (**Figure**).

Discussion

When we first began caring for patients with COVID-19, the turnaround time for PCR testing was 5 or more days. We noted the presence of an unusual number of patients with absent eosinophils among those who were confirmed to have COVID-19. In the current study, we confirmed our observation, which suggests that while waiting for a PCR report in suspected cases, an absent eosinophil count could identify likely COVID-19–positive cases and, in particular, cases in which there may be a higher risk of mortality.

The pathophysiology for eosinopenia in COVID-19 remains unclear, but it may be multifactorial. Mechanisms may include inhibition of eosinophil egress from the bone marrow, blockade of eosinophilopoiesis, reduced expression of chemokine receptors/adhesion factors, and/or direct eosinophil apoptosis induced by type 1 interferons released during the acute infection.[9]

Whether the acquired eosinopenia associated with COVID-19 directly contributes to the disease course or is a marker of severe disease has not yet been determined, but it is notable that pulmonary eosinophilia is not part of the pathologic findings in the lung so far attributed to SARS-CoV-2.[9]

We found that an absence of eosinophils at the time of presentation was present in 60% of the COVID-19 group and in 16% of the influenza group. In the first 50 admitted COVID-19 patients, 94% displayed eosinopenia on their first CBC. Our findings are consistent with a recent report from China that noted that the rate of eosinopenia in COVID-19–positive patients was 79% compared with 36% in COVID-19–negative patients.[10] Using the results from a routine CBC to help identify COVID-19 hours or days before a confirmatory PCR test is available could be sufficiently reliable to direct early institution of therapy. This could include therapies that prove to be effective in specifically treating patients with this virus, guiding the intensity of isolation strategies, or instituting therapies directed at preventing severe complications, such as anticoagulation therapy.

Eosinopenia is not unique to COVID-19, but we demonstrated that it is more prevalent in COVID-19

than it is in influenza infection. Furthermore, we found an absence of eosinophils in 60% of our COVID-19 patients at presentation. An additional 28% of the COVID-19 group had absent eosinophils on CBC within 48 hours of their presentation. In COVID-19, a disease that has substantial symptom overlap with influenza, eosinopenia could help to distinguish which patients likely have COVID-19 with actionable reliability.

Our data show that persistent eosinopenia correlates with the severity of COVID-19. In our observation, the trend of the eosinophil count may help predict disease severity and the likelihood of recovery. Our data also show that improvement in and recovery of eosinophil counts corresponds to a better prognosis.

Our study is limited by its relatively small sample size and relies on early observational data from a single center. In addition, the majority of patients with influenza did not merit hospital admission, so they reflect a population of lower medical acuity than the study group. Because many patients were not admitted, repeated eosinophil data were limited and, therefore, the ability to compare eosinophil count trends in those patients was limited. This is the second study that we are aware of that calls attention to the presence of low or absent eosinophils in patients presenting with COVID-19 symptoms.[10] Examining other populations of patients with COVID-19 will help validate or refute this observation. Future studies could determine whether strategies to rapidly identify patients with COVID-19 with the goal of early institution of treatments results in improvements in prognosis

Conclusion

The existing COVID-19 PCR diagnostic test has limitations, limited availability, variable turnaround time, and a high false-negative rate. An eosinophil count of 0 in patients requiring hospitalization can assist in the early recognition of COVID-19 and be used to direct therapeutic decisions while confirmatory PCR tests are still in process. These findings may be especially helpful during seasons when influenza infection is prevalent and symptom-based patient classification may lack specificity in diagnosing COVID-19. Poor improvement of eosinophil counts after admission was also correlated with high disease severity and with low rates of recovery.

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Learning Together: Interprofessional Education at the University of New England

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Context: Patient care delivered by well-functioning teams provides integrated and cohesive responses to the patients' needs and is considered more effective than care delivered by independent health professionals. The University of New England (UNE) College of Osteopathic Medicine integrates interprofessional education (IPE) curriculum into each year of its program. The UNE Center for Excellence in Collaborative Education coordinates strategically planned interprofessional learning opportunities.

Objective: To assess the implementation of interprofessional competencies and learning outcomes using the Interprofessional Team Immersion (IPTI) at UNE.

Methods: A team of students from various health profession programs worked on a simulated case with trained actors to learn about the roles and responsibilities of their professions in the optional IPTI. Pre- and postsurveys used the Interprofessional Core Competencies Assessment Scale (ICCAS) and the Interprofessional Socialization and Valuing Scale (ISVS) to evaluate student outcomes.

Results: Fifty-five students from various health profession programs at UNE participated in the IPTI activity in February/March 2018. Forty-four students (80%) responded to the surveys, and 43 (78%) completed both surveys. The mean (SD) total ICCAS score increased from presurvey (122 [27]) to postsurvey (127 [26]) (P=.018). The ISVS mean total scores increased from 48.3 presurvey to 57.9 postsurvey (P<.0001).

Conclusion: The significant differences in the ICCAS and the ISVS scores indicate that the IPTI changed students' attitudes toward IPE and future collaborative practice. Interprofessional learning at UNE is a valuable experience for both students and faculty. UNE College of Osteopathic Medicine continues to develop IPE activities for all 4 years of its programming.

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The Center for Excellence in Collaborative Education, University of New England's (UNE) interprofessional education (IPE) hub, brings students together from osteopathic medicine, dentistry, pharmacy, nursing, physical therapy, occupational therapy, social work, physician assistant, nurse anesthesia, public health, dental hygiene, exercise science, and athletic training. UNE's focus on health includes cross-professional exchange and cultural and biodiverse perspectives.

Patient care delivered by well-functioning teams that provide integrated and cohesive responses for patients, families, and populations is more effective than care delivered by independent health care professionals.[1] Adverse consequences of poorly functioning teams include medical errors and inefficient, unsatisfactory, and diminished quality of patient care, which drives up costs.[2] Team-based competencies and IPE are essential to health professions education,[3] and colleges of osteopathic medicine should capitalize on opportunities for collaborative learning with their colleagues in other health professions.[4]

Learning outcomes, competencies, and accreditation standards across health profession programs mandate that curricula include "knowledge and skills in teamwork, communication, health information systems, quality and process improvement, social determinants of health, and population health."[5] Residencies and employers increasingly seek students graduating from programs that emphasize such skills.[6]

Despite IPE's growing support, debate continues about when and how much to expose students to interprofessional competencies and collaborative practice methods in their preclinical and clinical curricula. Historically, students learned teamwork skills and about the roles and responsibilities of other health professions through naturally occurring interactions in the clinic. Although applied knowledge in clinical settings can cement interprofessional learning, cross-professional interactions that are not intentionally designed may be haphazard in the clinical curriculum. These interactions may not occur in some settings, may not include beneficial debriefing conversations and reflection, and may be influenced by biases, assumptions, and power dynamics that detract from learning about patient-centered care and team efficiency. Explicit preclinical exposure to and integration of interprofessional competencies and practices in health profession education is advised to prepare students for clinical education and workplace success.

Evolution of IPE at UNE

UNE's commitment to IPE began in 2000. The establishment of the IPE Collaborative (IPEC) in 2010 solidified its stake in IPE academic, clinical, and community-based practice education. UNE IPEC provides leadership for and facilitation of a continuum of evidence-based and theoretically informed collaborative programming across UNE and in clinical and community settings. Its mission aims to prepare future health professionals with contextual knowledge, intercultural proficiency, cultural humility, and readiness to participate as members and leaders of interprofessional clinical and community health and social care teams. UNE's cross-professional collegial and collaborative culture benefits faculty. Students observe and experience teamwork in the implicit curriculum, which they can then translate into their roles as health care and service providers and organizational leaders.

Competencies and Common Learning Outcomes

Collaborative learning curriculum and activities at UNE are guided by an integration of competencies and behaviors outlined in the Core Competencies for Interprofessional Collaborative Practice Reports issued by the US IPE Expert Panel,[1,4] the Canadian Interprofessional Collaborative Framework,[7] and the World Health Organization Framework for Action on IPE and Collaborative Practice,[8] which states

> (i)nterprofessional collaborative practice happens when multiple health workers from different professional backgrounds work together with patients, families, caregivers and communities to deliver the highest quality of care. It allows health workers to engage any individual whose skills can help achieve local health goals.

This definition served as a guidepost for the development of curricula and desired learning outcomes for UNE students across the learning continuum.

At UNE, the integration of US and Canadian interprofessional competencies with critical concepts of community, cultural, and public/population health strengthen IPE learning opportunities, readying students for real-world situations that they will encounter in clinical rotations and future practice. Students entering UNE are introduced to IPE competencies and case-based learning methods at orientation. IPE activities are scaffolded, meaning that students are longitudinally exposed to and participate in IPE activities through a developmental continuum of learning activities, including simulation- and community-based immersive activities. This article assesses the implementation of interprofessional competencies and learning outcomes using the Interprofessional Team Immersion (IPTI) at UNE.

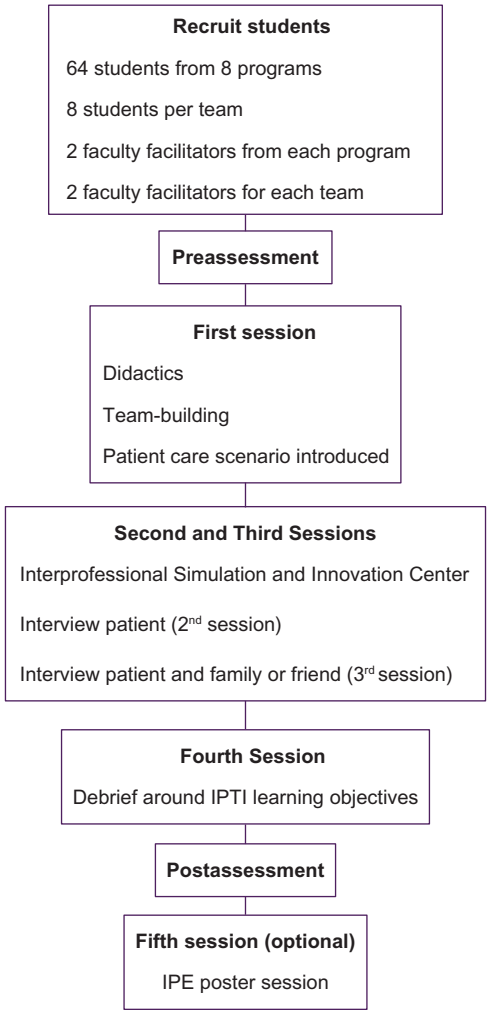

Figure 1.
Timeline of Interprofessional Team Immersion (IPTI) at the University of New England. Fifty-five students participated in the IPTI examined in this study. *Abbreviation*: IPE, interprofessional education.

Methods

This survey-based study used a nonexperimental design with a sample of students from 8 different health profession programs at UNE, including the UNE College of Osteopathic Medicine (UNECOM). Students completed a 4-session IPTI learning activity in 2018 and both pre- and postsurveys. The institutional review board at UNE reviewed this project on January 8th, 2016, and granted exemption status.

Study population

Students from 8 UNE programs participated in a 4-session IPTI (**Figure 1**). Students were divided into 8 teams of 8 students with a representative from each program on each team. Student teams were assigned at least 2 faculty members to facilitate but not lead discussions.

Design

The IPTI began in 2014 as a pilot program designed to enhance students' application and demonstration of the core collaborative practice competencies. Case scenarios were constructed by interprofessional faculty teams to ensure that they were clinically sound and

relevant to a range of professions, roles, and health care settings. For example, a case may have included a difficult conversation about disability and sexuality, end-of-life decision-making, or health care for a patient who was homeless. The coconstructed IPTI design ensured that case-based learning (CBL) across disciplines was realistic, relevant, clinically accurate, relatable, complex, and purposeful. The IPTI goal was to demonstrate collaborative competencies through simulation, experiential activities, and case presentations, posters, or a written product.

CBL and community of practice learning models were used to design the IPTI experience. These theories underscore the importance of curiosity, critical thinking, and openness necessary to learn with and from each other.[10] Trained actors performed the case-based simulations. The IPTI faculty worked together with the actors to make the simulated practice as realistic as possible.[11]

The IPTI included 4 required and 1 optional session. The first session focused on didactics, team-building exercises, and introduction of the patient case scenario. The second session occurred in the Interprofessional Simulation and Innovation Center, and students decided which team members would interview the patient. In the third session, the team interviewed the patient and a family member/friend. The fourth session included a facilitated debriefing session designed around IPTI's learning objectives. In the fifth session, an optional poster session, students showcased what they learned during their IPTI experience.

Data Collection and Analysis

Both quantitative and qualitative data were collected through electronic pre- and postsurveys to measure students' self-reported attitudes and interprofessional competency-based knowledge/skills (**eAppendix 1** and **eAppendix 2**). Quantitative measures for the pre- and postsurvey were the Interprofessional Core Competencies Assessment Scale (ICCAS)[12] and the Interprofessional Socialization and Valuing Scale (ISVS).[13] The ICCAS is based on the US and Canadian IPEC Competencies, with subscales for communication, collaboration, roles and responsibilities, patient-centered approach, conflict management, and team functioning, and the total scores range from 20 to 140. The ISVS is a 9-question Likert-scale survey with 7 response options regarding attitudes and comfort of working interprofessionally, and the total scores range from 9 to 63.

Data were analyzed using SPSS software (IBM) that included descriptive statistics, normality tests, paired *t* tests, and related-samples Wilcoxon signed rank tests. The paired *t* test and Wilcoxon signed rank test were used to find individual student changes from pre- to postsurvey. Change scores consisted of the mean (SD) change of individual pre- and postchange scores. Qualitative questions in the survey included open-ended questions regarding the program's best aspects, any changes the students suggested, and the anticipated influence of participation in IPTI on future practice.

Results

Fifty-five students participated in the IPTI examined in this study. Pre- and postsurveys were completed and successfully paired for 43 students for a response rate of 78%. Response rates among specific professions ranged from a low of 50% for dental hygiene students to a high of 100% for nursing students (**Table 1**). Thirty-three respondents were women (77%) and 10 were men (23%). Twenty respondents were third-year students (46%), 12 were second-year students (28%), and 11 were first-year students (26%). Surveys were excluded on a case-by-case analysis. Three students skipped ICCAS items on pre- or postsurveys, and 1 student skipped an ISVS item on a presurvey.

The individual item and total ICCAS scores (n=40) revealed nonnormal distribution (skewed negative or left and positive kurtosis) of most individual scale items, subscale scores, and total scores (even with extreme outliers removed from analysis). Therefore, nonparametric methods were used to analyze changes from pre- to postsurveys in subscales and total scores. The results in **Table 2** indicate that ICCAS total scores

Table 1.
Response Rates of Students From Various Health Profession Programs Who Participated in the IPTI at UNE From February to March 2018 (N=55)

Health profession program	Total IPTI participants, No.	Participants who responded to linked pre- and postsurveys, No.	Response rate, %
Dental hygiene	4	2	50
Dental medicine	4	3	75
Nursing	12	12	100
Occupational therapy	6	5	83
Osteopathic medicine	5	4	80
Pharmacy	8	5	63
Physical therapy	5	3	60
Physician assistant	6	5	83
Social work	5	4	80
All programs	55	43	78

Abbreviations: IPTI, interprofessional team immersion; UNE, University of New England.

increased from a mean of 121 in the presurvey to 128 in the postsurvey. Related-samples Wilcoxon signed rank results indicated a statistically significant increase (P=.018). Table 2 shows that ISVS total scores (n=42) increased from a presurvey mean of 48.3 to a postsurvey mean of 57.9. Paired t test results indicated that this change was statistically significant (P<.0001). Qualitative results showed that UNECOM students found the IPTI experience to be beneficial (Figure 2).[14]

Table 2.
Total Scores From ICCAS and ISVS Pre- and Postsurveys of Students in Health Profession Programs at UNECOM Who Participated in the IPTI in 2018 (N=55)

Survey	n	Mean	Median
ICCAS[a]			
Presurvey	40	122.4	131
Postsurvey	40	127.3	137
ISVS[b]			
Presurvey	42	48.2	50
Postsurvey	42	57.9	59

[a] Related-samples Wilcoxon signed rank test, P=.018.
[b] Paired t test, t_{41}=−6.48, P<.0001.

Abbreviations: ICCAS, Interprofessional Core Competencies Assessment Scale; IPTI, Interprofessional Team Immersion; ISVS, Interprofessional Socialization and Valuing Scale; UNECOM, University of New England College of Osteopathic Medicine.

Discussion

During the past decade, different models for introducing students to interprofessional learning and collaborative practice have been piloted and tested by UNE IPEC; some were discarded while others thrived. Since 2015, UNECOM has worked to ensure that students engage and actively integrate into UNE's IPE activities. IPTI has had continuous and scalable success. Grounded in CBL, IPTI provides experiential and didactic opportunities for both process and product learning outcomes commensurate with evidence-based and interprofessional theory tenets[15-17] and collaborative competencies.[1,4,7,8]

Findings from the current study suggested that students improved their abilities to communicate with students from other professions and better understood

Deepened understanding of the roles and contributions of other health care professionals
"[My favorite thing about IPTI was] learning about the other health care professionalsand gaining insight into their perspectives and priorities. I now have a more well-rounded understanding of all of the services available for our future patients."
Changing previous perceptions
"I did not feel really as though [any others] had a bias toward me as a DO [student], but instead were inquisitive about my nuanced function and I can say the same about my curiosity about other programs. Never feeling judged was nice."
Influence on future practice
"We communicated very well and could discuss similar topics and bring our unique perspectives to the table. It felt natural once we started and was very enjoyable. Why isn't all of health care like this?"

Figure 2.
Overview and comments from University of New England students regarding the Interprofessional Team Immersion (IPTI) and interprofessional education (IPE) benefits from their IPE experiences.[14] *Abbreviation*: DO, doctor of osteopathic medicine.

each other's respective roles and responsibilities. The survey findings showed statistically significant effects on students' self-reported interprofessional knowledge, attitude, and skills from participation in IPTI. Students seemed appreciative of learning about the depth and scope of other disciplines and how their roles sometimes overlapped. Navigating leadership responsibilities was an area of observed challenge; however, students gained respect for the collaborative enterprise because it served the greater needs of the patient.

Increasing IPE programming to ensure that all students have opportunities to be exposed to and demonstrate collaborative competencies in preclinical and clinical settings remains a challenge. Currently, some UNE programs build IPE into their curricula; others require attendance at certain activities or provide students with a menu of IPE options to earn an interprofessional honors distinction. IPE developers look to find novel curricular methods to embed IPE into existing UNECOM curricula, for example, in shared, asynchronous CBL. A further obstacle is ensuring that all faculty are trained in interprofessional competencies and facilitation skills. Students take the lead from their respective faculty and model their views and actions. Thus, the teaching process is as important, if not more so, than the content and must align with IPE project aims. A considerable challenge still faced is sufficient allotment of faculty time and resources to develop and execute IPE learning activities.

An unintended, yet highly beneficial consequence of IPTI and IPEC at UNE is the camaraderie that has developed among the faculty across programs. These relationships have contributed to inventive programming; for example, asynchronous IPE learning whereby UNECOM and other health professions students share a case and are required by assignment to learn from each other. Mutual investment in IPE has helped build a robust core collective of faculty, professional staff, students, and administrators who work together to implement and prioritize appropriate training and engagement in IPE initiatives.

The limitations of this study included that the competency assessments relied on students' self-report,

and the study lacked a control or comparison group. Additionally, this study focused on only 1 college of osteopathic medicine and short-term outcomes. Future research could include additional IPE programs and measure the effect 6 to 12 months after the experience.

Conclusion

Deliberate curricular and cocurricular infusion of interprofessional interactions in the preclinical years provides osteopathic medical students and their peers from other health profession programs with essential tools to understand and practice in today's complex health care environment. Experiences such as IPTI offer students opportunities to learn about the intricacies of interprofessional health care teams and teach teamwork skills for clinical rotations. We have shown that IPTI has changed students' perceptions of IPE and expanded their knowledge of other health care professionals' roles and responsibilities. We propose the integration of interprofessional, interdisciplinary, and collaborative learning across program curricula.

Author Contributions

All authors provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; all authors drafted the article or revised it critically for important intellectual content; all authors gave final approval of the version of the article to be published; and all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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***JAOA*/AACOM**

48-Hour Hospice Home Immersion Encourages Osteopathic Medical Students to Broaden Their Views on Dying and Death

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To augment learning about interprofessional palliative and end-of-life care, the University of New England College of Osteopathic Medicine immersed 2 second-year osteopathic medical students in an 18-bed acute care hospice home in Scarborough, Maine, for 48 hours. The students worked with an interprofessional staff and independently to provide patient care, family support, and postmortem care. For data collection, students wrote in journals before the immersion experience (prefieldwork), while living in the hospice home (fieldwork), and for 10 days following the immersion experience (postfieldwork). The students recorded their subjective and objective reporting of observations, experiences, feelings, and patient/family encounters. Data analyses included a review of the journals, identifying thematic categorizations, and coding through content analysis. Three themes identified in the students' journals reflected shared experiences: (1) shifting perspectives, (2) path to family acceptance, and (3) emotional journey. The students learned how to converse with patients and families about end-of-life care while ensuring attainment of patients' goals. They also learned about the importance of helping patients enjoy life's simple pleasures like taking them outside to enjoy the sunshine, and they learned to trust themselves when handling emotional and difficult situations. Each student gained confidence in her ability to help guide patients through this stage of life.

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Keywords: end of life care, good death, medical education

"I learned about a lot of things in medical school, but mortality wasn't one of them."
Atul Gawande[1]

Modern medicine embraces technological approaches to care and furthers the use of medical and drug interventions, which has changed the human lifespan (ie, length of time a person functions) and healthspan (ie, length of time a person exhibits good health). Both have aimed to reduce old-age mortality while

Table.
Identifying Features of the Culture of Death Across the Ages[3]

Period of death	Period height	Identifying features
Tame death	900 AD	• The death ritual was organized by the dying person • The bed chamber was public and included children • Rituals of dying were accepted with no great show of emotion and evoked no great fear
One's own death	11th and 12th centuries	• Death takes on a dramatic and personal meaning • It is widely accepted and expected • "Judgment and Resurrection" of the dead becomes popular with life viewed as a "stay of execution" • Each person is judged according to the balance sheet of their lives
Thy death	18th century	• Death takes on a personal meaning; it is now feared • Deathbed is not solemn/tame • Viewed as a "break"; it is dramatized with crying, praying, gesticulating • Children were banned because of hygiene issues (late 18th century) • The will takes a tone of distrust, reduced to a legal document • Bodies were kept visible in great bottles of alcohol
Forbidden death	Second half of the 19th century into the early 21st century	• Death became shameful and forbidden • Relatives no longer had the courage to tell the dying person the truth • Funeral processions, mourning clothes, spread of cemeteries, and visits to tombs come into play • Undertakers are renamed funeral directors, known as "doctors of grief" • Mourning is viewed as repugnant, morbid, solitary, and shameful and must be treated, shortened, erased by the doctor of grief

raising the maximum age at death, which has altered the processes of aging and dying.[2] These processes are often correlated with medical experiences rather than quality of life.[1]

Based on the cultural evolution and societal history of death since medieval times, death, which was once an accepted part of life, is now considered a failure in the current medical culture. The societal beliefs associated with death evolved over 4 documented periods, each with rituals and beliefs considered commonplace (**Table**).[3] For example, the "tame death" period, which reached its height in 900 AD, had features that included having the death ritual organized by the person who was dying. The bedchamber became a public place where children were also present, and rituals of dying were accepted with no great show of emotion or fear.[3] In the "forbidden death" period, which began in the second half of the 19th century and has continued into the early 21st century, death is expected to take place in the hospital,[3] where physicians focus on curing the patient (**Table**). Dying and death evoke strong and unbearable emotions, there is a desire to save the dying person from the gravity of condition, and the dying person defers his or her decision-making to the physicians.

On average, 60% of people in the United States die in acute-care hospitals, and compared with other countries, admissions to hospital intensive care units are twice as common in the United States before death.[4-6] In the United States, 20% of people who die do so in a nursing home environment.[7] Although hospice care is on the rise, increasing 14.85% from 2012 to 2017,[8] relatively few terminal patients enroll in hospice. Often, a physician suggests hospice for patients who are in the last 3 to 4 weeks of life.[4,5]

Our society is slowly shifting to what some call the "good death" period.[1,9] To make this shift, medical

education must be proactive in providing medical students with skills, knowledge, and attitudes about person-centered, end-of-life care for people with terminal illness. Meier et al[9] defined a good death as a lack of pain, religious and emotional well-being, a feeling of life completion, dignity, closeness of family, and quality of life. A good death often includes a strong desire to die at home. In this new period, death would be different for each person, and clear decision-making, preparation for death, and affirmation of the whole person would aid in honoring a person's wishes.[9] Within this scope of a good death, training future physicians in this approach would provide opportunities for their patients to live a good life to the very end.

The National Academy of Medicine (formerly, the Institute of Medicine) recommends that "educational institutions and professional societies provide training in palliative care domains throughout the professional's career."[10] However, education about palliative and end-of-life care remains underrepresented in medical school and residency curricula.[10] Although nearly all US medical schools now offer some integration of death and dying in the required curricula, fewer than 30% of schools offer dedicated courses in end-of-life care.[11,12] In 2016, Schmit et al[13] found that more than half of the residents reported inadequate end-of-life education during medical school, and 88% of medical residents in the study had little to no training for end-of-life care during residency. Content tends to be offered through intermittent lectures, case studies/problem-based learning, and brief preceptorships, which do not provide depth or extended bedside experiences to augment knowledge, skills, and attitudes in palliative and end-of-life medicine.

Hospice Home Immersion Project

The University of New England College of Osteopathic Medicine's (UNECOM) Learning by Living 48-Hour Hospice Home Immersion project (herein referred to as Hospice Home Immersion) provides medical students with avenues for knowledge advancement, skill development, and attitude change about dying and death through a voluntary immersion experience. While living in an acute care in-patient hospice home for 48 hours, medical students learn the philosophy and function of hospice and participate in person-centered care and healing. Understanding and participating in end-of-life care that embraces the art of healing is essential in a society where health care professional training tends to be focused on medical care, rather than whole-patient health care, through high technology and low touch procedures. The first of the 4 tenets of osteopathic medicine states that the body is a unit; the person is a unit of body, mind, and spirit.[14] The immersion program's design and implementation fosters an environment where living, dying, laughing, and crying are all part of person-centered interprofessional care. Students who reside in the hospice home find their "Forbidden Death" views challenged with a new understanding of dying and death.

The UNECOM Hospice Home Immersion project began in December 2014. This project was implemented as an ongoing experiential medical education research learning model by the Director of Geriatrics Education and Research in the Division of Geriatrics.[15] Pairs of medical students volunteer to be immersed at the Gosnell Memorial Hospice House (GMHH) once per month for 48 hours, allowing approximately 24 to 36 students to conduct the immersion per year. GMHH is a not-for-profit, 18-bed acute-care, in-patient hospice home owned by the Hospice of Southern Maine in Scarborough. Patients at GMHH are there for about 5 to 7 days before they either transition home, to another living environment, or die. GMHH has 3 levels of care: (1) general in-patient for acute symptom management, (2) routine care, for stabilizing care once acute symptoms are managed, and (3) respite care, a Medicare benefit whereby hospice patients who live at "home" may stay in the GMHH for 6 days and 5 nights to provide respite time for the family. During their stay at GMHH, the students participate in patient care, family support, and postmortem care either working independently or with interprofessional staff.[15]

Research Design

The Hospice Home Immersion project uses ethnographic and autobiographic research designs, whereby a unique environment or "culture" is observed, and medical students report their experiences through journaling.[15,16] The research questions posed to the medical students who engage in this project include: (1) "What is it like for me to live in this acute care hospice home for 48 hours?," and (2) "How does this contribute to my future as a physician?"[15-18]

2018-2019 Hospice Home Immersion Project

This project was exempt from institutional review board approval as student researchers collected data focused on self-reflection. The Hospice of Southern Maine Ethics Committee approved the implementation of the UNECOM 48-Hour Hospice Home Immersion project.[16-18] This project has been previously reported on.[15,16,19,20]

Participants

During the 2018-2019 academic year, 13 pairs of UNE health professions students conducted this immersion research (11 pairs from UNECOM and 2 pairs from the UNE Masters in Social Work Program). Each pair lived at GMHH for 48 hours and completed journals. However, only 2 UNECOM participants, who were each immersed with a partner on different weekends (August and September 2018), engaged in a comparison of their qualitative outcomes for this article. These medical students, both women, were in good academic standing and volunteered to be participants. Each completed the requirements to conduct the immersion, which included a registration form, a written statement about her interest in the Hospice Home Immersion project, her assumptions of what she expected to encounter during the 48-hour immersion, and a 1-hour orientation 1 week before the immersion. This orientation was provided by the project director to enhance the students' learning about hospice, describe previous student immersion experiences, explain research components, and prepare them for this experience.

Upon entering GMHH, the students were introduced to the hospice home manager, who provided an additional orientation that included information about the acute-care in-patient hospice home, the interprofessional staff, care provision practices, and a tour.[15-18] Students received a GMHH name tag and security fob that provided access to all secure areas except the room where medications were stored. The students were paired with a certified nursing assistant who provided information about each patient and helped the student acclimate to the hospice environment. Students then worked with nurses, nurse practitioners, the chaplain, social workers, volunteers, and on their own or with their student peer. Each student met all patients in the home and learned about their family and social and medical histories. Students answered call bells and assisted staff with direct patient care, including toileting, bathing, repositioning, and feeding. They also engaged with patients and family members, assisted with new admissions, sat with patients who had no family or friends present, and provided postmortem care following a death that included a procession. The procession involved accompanying the family as the deceased person was wheeled on a gurney out of the building to the funeral director's van. For each procession, the decedent was either covered with a flag (veteran) or a homemade quilt. During staff shift changes every 12 hours, students participated in the transition report of patients. Interprofessional staff team meetings occurred each morning of the student's immersion. At night, students shared a room and slept in a bed where many patients had died before.[15-18]

Data Collection

Qualitative research journal writing occurred during all 3 phases of the research project: (1) before entering the hospice home (prefieldwork), (2) during the immersion (fieldwork), and (3) for 10 days following the immersion (postfieldwork). During the prefieldwork period, students wrote their assumptions that included expectations of the immersion or their attitudes about hospice care

and dying. No hypotheses or variables are associated with qualitative research; therefore, their prefieldwork journaling brought to the forefront their beliefs and anticipations that underwent constant self-reflection throughout their immersion at GMHH.[19,20] Journal writing during each phase of the project included in-depth accounts of students' observations, thoughts, experiences, and feelings. The journals were reviewed by the project director to ensure established qualitative journal writing, posing additional questions to move students to more profound reflections, and to check on the students' well-being. The journals were reviewed the last day of the prefieldwork phase, during both nights of the immersion fieldwork, and when the final journal was submitted after the postfieldwork phase.[15-18]

Data Analysis

After the immersion, journals were reviewed and reflected on at least twice by the students and the project director to identify and define themes. A step-by-step deductive formulation of content from each journal was categorized within the appropriately identified themes.[17,18] Revision of themes and associated content continued throughout the analyses to ensure interrater reliability through formative and summative checks, such as reflection and conversations with the project director about each student's experience with death and their personality traits.[19,20] Interpretation of thematic and content analyses culminated in collective final results for these 2 students. [16-20]

Emerging Themes

The analysis resulted in various themes with associated defining quotes. However, 3 themes reflected shared experiences from each student's immersion experiences that inspired their perspectives regarding dying and death. The 3 themes were: (1) shifting perspectives, (2) path to family acceptance, and (3) emotional journey.

Theme 1: Shifting Perspectives

Student 1 (E.S.) felt comforted and put at ease when she arrived. "It almost feels like a hotel, with a welcoming reception desk and all." The notion that hospice and especially dying is depressing is a pervasive one. However, the apparent warmth at GMHH played an important role in changing her perception of what it was like to spend time at a hospice home. "I believed that there would be something sad or unpleasant about hospice before I arrived, so it was surprising to have my perspective change so soon into the immersion."

Student 2 (D.P.) expected the home to be filled with sadness and grief but found that love and hope are also a part of the hospice experience. She noted that her perception of death and dying shifted during the hospice experience and felt that many of the patients' families and friends experienced a change in perspective. Sharing this experience with the patients' families and friends allowed her to recognize the spectrum of emotions when caring for patients. For the daughter of one patient, being a part of her mother's support system helped her decide to pursue a career in medicine to move forward while keeping her mother's life and memory close to her. Student 2 recognized that "even though there is grief and sadness associated with a loved one dying, it also catalyzes change."

The students' changing perspectives about dying and death helped them consider how they would balance their careers and personal lives to maintain wellness. Before entering the hospice home, they assumed that working with patients who were dying would make the staff (and them) unhappy and prone to depression. However, during their immersion in the home, they each realized that the way the staff supported each other, the patients, and their families was unique. Every staff member had their own hospice journey or reason to be drawn to hospice service. Student 1 spoke with a nurse at GMHH who switched to hospice nursing after seeing the amount of burnout in the emergency department and felt that working in hospice care could provide a better work-life balance. Student 2 noted that the staff at GMHH were dedicated and passionate about providing patient-centered care and were supportive of each other. Other health care environments that she had served in seemed to include much

complaining about patients or job-related duties. The staff attributed this unique, supportive environment with helping them process their emotions and increase job satisfaction. The students experienced the rewards of hospice care and recognized the privilege of caring for patients during such an important life transition. The immersion offered fulfillment for the students and shifted their views of dying and death from feeling fearful to feeling a sense of honor about being present during this stage of life. Understanding that death is an important part of life was the ultimate lesson.

Theme 2: Path to Family Acceptance

Student 1 described the power of acceptance when the friends of a patient with cancer compared their current experience with a loss of another friend who had died suddenly from a drug overdose. "Reaching this point of acceptance and peace was important for family, friends, and the patient in hospice care." The nurses talked about a patient being ready to go and explained that some would die surrounded by family and others would wait to be alone.

Student 2 observed that the GMHH staff was honest, clear, and direct when families asked how their loved one was doing. She felt that this was the clarity that families needed when they were dealing with many emotions. She found that today's society emphasized positive outcomes, but she recognized the delicate balance of communicating with patients and their loved ones about their diagnosis, prognosis, and care goals. Being direct helped patients and families process the truth. The hospice immersion showed her the importance of being honest and having direct, yet compassionate, conversations with patients and loved ones. "In this situation, sugar-coating how the patient is doing helps no one and gives families and friends a false sense of hope of how much longer they have with their loved one." She witnessed how patients and families were better able to process and reflect on the information and use the resources available to them, including staff support for loved ones.

Student 1 learned that many patients at GMHH were ready to die and that many families felt the same way. She felt that no one wanted his or her loved one to continue living when life was full of pain or discomfort and was no longer enjoyable. Student 2 wrote that one of the nurses worked with the families to make sure that they took time for themselves during the dying process and helped them not feel guilty about making that time.

Before the immersion, the students acknowledged their belief that death was sad or tragic. After the immersion, the students could honor death and recognize the sadness and tragedy that could be present, but realized that death was inevitable and could be comforting. They each witnessed many patients who transitioned into the dying phase and watched their families and friends accept this. They also recognized that acceptance was a process that takes time. Given society's expectations, it can be difficult for grieving loved ones not to feel guilty about taking time for themselves. It was important for students to see how the staff supported families through these feelings of guilt. As future physicians, the students understood how they could support the person who was dying and their families during this process. The societal taboo of death was overcome when the family expressed they were ready for a loved one to die. Death can be a gateway to end suffering, and it can also be a great comfort to family members. As osteopathic medical students, they valued the team-based care in which the person who was dying and the family were integral to the care plan in the hospice environment.

Theme 3: Emotional Journey

Student 1 felt that participating in the immersion project opened her eyes to different ways to think about death and dying. She found that it was important to reframe her thoughts about the deaths she had experienced in her personal life. "I used to frame my grandfather's death by thinking about all the negatives and how he was in pain. But I didn't take much time to consider the positives. One of which was how much time we spent with him in the last months of his life."

After the immersion, she saw death as a part of life, even though it is a difficult thing to go through when it happens. The immersion experience at GMHH taught her how to accept loss and consider it an opportunity for growth. She learned how she could bring peace, clarity, and acceptance to her future patients. "Death is not this isolated thing, it occurs in the same space as joy and growth…Communicating honestly and expressing that there is no correct way to feel about the dying process are just some of the important principles I will take with me from this research."

Student 2 was physically exhausted and napped to recharge herself within 16 hours of returning home. In hindsight, she realized that her pent up emotions manifested as physical fatigue. As she became more familiar with the environment and reflected on her feelings and emotions through conversations, experiences, and journal writing, she recognized that she was now able to be fully present for patients and families. She felt grateful for the immersion experience because it allowed her to practice talking with patients and families on a more personal level and showed her the importance of honoring her feelings and practicing self-care as a future physician. "Dying doesn't have to be an experience devoid of love and happiness. It can include components of the life that the patient has always loved. In that same way, making sure that patients are keeping up with their self-care and hobbies can be a good way to check in with patients in a nonhospice setting."

Living in the hospice home for 48 hours provided many moments of joy and laughter as well as sadness for the students. They were both surprised that levity could exist and be presented through many different avenues, such as playing with a therapy dog that visited GMHH, conversing with patients who coped with their terminal illness with humor, participating in activities similar to those the patients loved before entering GMHH, and hearing funny family stories. The staff provided mentorship to the students, which included how to help patients enjoy the simple pleasures of life. Students were surprised by the joy of a patient who got a manicure days before dying or was wheeled outside to feel the sunshine each day. The person-centered care that GMHH provided enabled the students to find love and joy in the midst of death.

Conclusion

After the immersion, the students reported that they learned how to have conversations with patients and families about end-of-life care to ensure that the goals of patients were achieved. Additionally, they learned about the healing power of seemingly simple requests, such as letting a patient feel the sun, rubbing lotion on patients' hands, or making a hot fudge sundae for a patient who then decided that seeing it was enough. Above all, they learned to trust themselves when handling difficult and emotional situations and gained confidence in their ability to help guide patients through this stage of life. As future osteopathic physicians, these students will be better able to care for the whole person and their family members by having open and direct conversations about terminal illness, dying, death, and options, such as hospice. They will be able to implement the skills to ensure that patients in their care will have the opportunity to live a good life to the very end.

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Making the Connection: Using Concept Mapping to Bring the Basic Sciences to the Diagnosis

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Although medical education has historically emphasized the role and importance of basic science in clinical reasoning, educators have struggled to teach basic science to optimize its use for students. Concept mapping helps students develop relationships between basic and clinical science, which can enhance understanding of the material. Educators at the University of New England College of Osteopathic Medicine developed a weekly concept-mapping activity connecting biomedical principles with clinical signs, symptoms, and laboratory values from a comprehensive clinical case. This activity elicits cross-disciplinary discussion, illustrates content integration by the students, and enhances faculty collaboration across disciplines.

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Medical education has historically emphasized the role and importance of basic science since the Flexner report[1] was published. However, educators have struggled with how best to teach basic science to optimize its utility for students. The concept of cognitive integration in medicine refers to "the creation of integrated understanding of basic and clinical sciences within the mind of the individual learner."[2] Many studies indicate the importance of integrating the basic and clinical sciences for diagnostic reasoning.[2] Simply integrating the curriculum by teaching basic and clinical sciences next to each other is not sufficient; the integration must occur within each teaching session.[3] To best achieve cognitive integration, the relationships between the basic science and clinical domains need to be explicitly demonstrated to students.[4] Therefore, students should be given strategies to actively integrate and synthesize this information.

Concept mapping, which is "a diagrammatic representation of 'meaningful' relationships between concepts,"[5] helps students develop relationships between the basic and clinical science domains and enhances understanding of the material.[6] Previous studies[6-8] have indicated that concept mapping helps students develop meaningful learning and integrate basic and clinical science information, and these results were demonstrated independent of the students' learning styles. Furthermore, concept mapping facilitates group and collaborative learning when used as a group task.[9-11]

In 2006, we created a course at University of New England College of Osteopathic Medicine that replaced some of the traditional lecture-based educational experiences with more active learning pedagogies to allow students to integrate basic science with clinical sciences. The course was also designed to develop team-building skills to prepare students for the clinical working environment. We adopted a case-based model based on the principles of team-based learning as described by Michaelsen et al.[12] Concept mapping addressed the challenge of developing clinical case-based application exercises that helped to create highly functioning teams and ensured that students made connections between the basic science and clinical concepts.

In 2012, this model was used for a year-long osteopathic medical knowledge course during the first year. The course was taught by basic scientists and physicians using clinical correlations to integrate the basic science disciplines. The curricular framework included weekly clinical case-based concept-mapping exercises similar to those we had developed in 2006. Detailed grading rubrics for the concept maps were created for each case to provide more guidance, informational feedback, and instructor scaffolding for the students.[13,14] For these exercises, students worked in the same group of 6 for the entire year, and almost all of the groups went through the stages of group development described by Tuckman[15] of "forming," "storming," "norming," and most reached the final stage of "performing" as a very effective team.

Designing Concept-Mapping Sessions

The concept mapping exercise helped students visualize how the basic science concepts explained the clinical presentation's pathophysiologic characteristics in a specific case. This approach helped students focus on the patient. Students started and ended their concept map with the patient (**Figure 1**). The map contained basic science concepts that explained the basis of the clinical concepts, which included the clinical

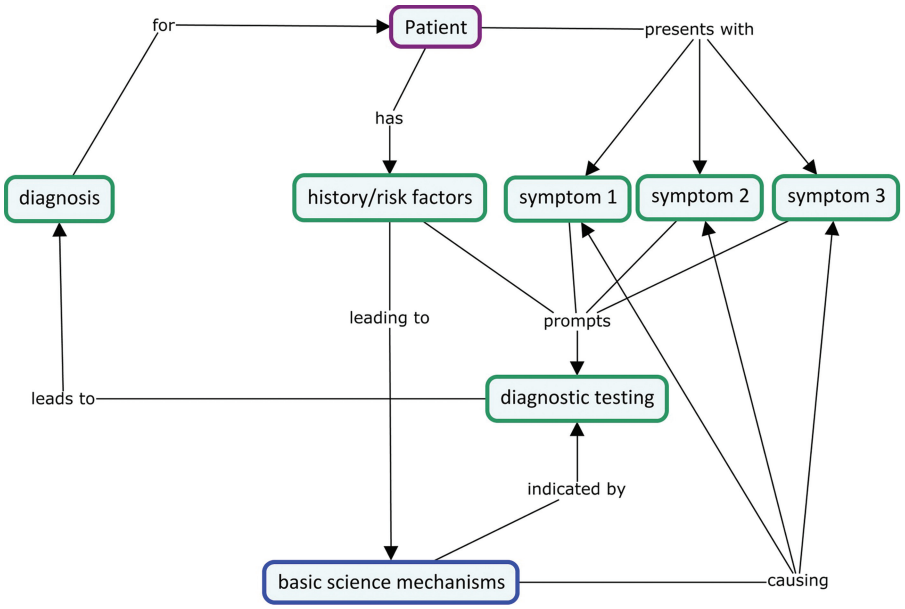

Figure 1.
A simplified concept map exemplifying how students might move from the patient to the clinical signs, symptoms, and history and link the basic science concepts and diagnostic tests to support the diagnosis. Depending on the prompt, treatment and its effects may be linked to these concepts.

symptoms, signs, and the diagnostic test results. The students arranged these concepts by linking terms to create logical connections that could be followed from the patient through every part of the map.

The materials for the case-based learning (CBL) activity were designed through collaboration between basic science faculty and physicians and included the clinical case, prompt, rubric, and an exemplar concept map. The case included a complete history, physical examination, diagnosis, diagnostic tests, and management. The faculty decided on a prompt to limit the scope of the basic science and clinical concepts for the concept map based on the learning objectives for the week. The prompt helped direct the students to explain the underlying pathophysiologic characteristics and defend their primary diagnosis by connecting the key elements of the history, physical examination, and diagnostic tests. In addition, the students used these elements informed their decisions regarding treatment and management as appropriate (**eAppendix 1**). Once the prompt was generated, the faculty developed an example concept map and a rubric that outlined the information on the concept map to help facilitators guide their groups (**eAppendix 2** and **eAppendix 3**).

A meeting was convened a week before each concept mapping session to prepare the faculty facilitators and standardize the experience for each group. In these meetings, a physician presented the case providing a clinical perspective for the facilitators, who were often basic scientists. The basic science and clinical concepts underpinning the patient's clinical presentation were presented by the faculty who generated the rubric and concept map for the case (**eAppendix 2** and **eAppendix 3**). These sessions oriented the facilitators to the content and instructed them on how to guide the students through the session.

Implementation

Each CBL group, which comprised 6 students and a facilitator, met weekly for the 2-hour concept mapping session. Students were provided with the case and prompt ahead of time to prepare for the session. The session began with 1 student giving an oral presentation of the case, which included identification of the key elements of the history, physical examination, and diagnostic tests that informed the diagnosis. This activity required the students to explore the connections between the basic science and clinical domains, which were centered on the patient's clinical presentation and provided an opportunity for students to practice presentation skills.

The students used the prompt to create their concept map using CmapTools (IHMC). The map was projected on a large monitor to allow the whole group to view its construction. The discussion centered on reaching consensus about concept placement and linking terms. The group was required to use all of the terms provided in the prompt on their concept map, and they were encouraged to also add their own concepts to describe certain processes better. Students referred to lectures and other resources from the week, and substantial peer-to-peer teaching occurred. The rubric and exemplar concept map were provided as a resource for the facilitator, whose role was to keep the students focused on the appropriate concepts without being too directive or restrictive. The facilitator also provided guidance on group process as the students engaged in decision-making, task performance, and conflict resolution.

Grading

To provide immediate feedback to the group on their concept map, the faculty-generated rubric and concept map were available to students after completion of their map (**eAppendix 2** and **eAppendix 3**). Before grading, the maps were deidentified and coded to prevent bias. The maps were initially graded by second-year students who used the rubric and exemplar concept map to grade and provide commentary. The final grade was determined by 2 faculty facilitators whose responsibility was to review the maps and standardize the grading process. Facilitators were not assigned to review and grade the map of their own group(s). The activity was designed primarily as an opportunity for learning rather than assessment, so grading was primarily formative,

"I liked that the [concept map] discussion process really allowed us to connect the clinical and basic science courses and helped me think through and clarify with my CBL the information."
"Concept mapping is different from anything that I have done to study in the past but I think it is a creative way to integrate the concepts and see a larger perspective view on how a disease/condition is manifesting and presenting."
"CBL helps my group a lot; we teach each other a lot in each session and talk through big ideas."
"I really enjoy CBL and enjoy that it challenges me to verbalize my understanding of topics while making connections pictorially. I have found that the exercises influence how I take notes as well–everything is much more diagrammatic which engages me in the material better than simply writing notes."

Figure 2.
Comments from first-year students at the University of New England College of Osteopathic Medicine who participated in concept-mapping sessions. *Abbreviation*: CBL, case-based learning.

but with enough weight to be taken seriously. The concept maps were graded using a 20-point scale. A total of 4 points were given for including all of the required basic science and clinical concepts on the map. The remaining 16 points were designated for the content on the map. Rather than assigning specific point amounts for each correct link made, the point distribution was more subjective, with more weight given to important general concepts rather than every specific detail. Identifying the important concepts and realizing that they can be shown in different ways on a concept map took some practice for the student graders. The faculty who supervised them provided feedback, and they soon became adept at grading. Having experienced concept mapping during the previous year, their comments were very relevant and they often identified bridges between the first- and second-year curriculum, as well as the board examinations. First-year students responded to these comments by incorporating the feedback into their subsequent maps.

Before returning the graded concept maps to the groups, the numeric score was converted to an "exceeds expectations" (18-20 points), "meets expectations" (16-<18 points), and "needs improvement" (<16 points). Groups receiving a "needs improvement" grade were required to meet with the faculty member who graded the concept map to review the map, clarify any misconceptions, and edit their map based on the comments.

Benefits

Concept mapping, as described in this article, is a method to integrate basic science concepts with clinical medicine. Since 2014, course evaluations have indicated that at least 80% of students agreed or strongly agreed with the statement, "The Facilitated Case Based Learning activities (CBL)/Concept Mapping provided opportunities to integrate the basic science and clinical science concepts from the objectives." Student comments from the course evaluation suggested that concept mapping helped them to contextualize basic science concepts underpinning clinical medicine (**Figure 2**). The process of discussing concepts to reach a consensus on the map challenged students to defend their understanding and explain their rationale to others. Others have shown that this enhances learning and retention of the material.[6,16] Many students also found the maps to be useful study tools. Additionally, working in these small-group sessions helped students understand the elements of effective team dynamics and reflect on their strengths and weaknesses.

Second-year student graders found the experience helpful for reviewing basic science concepts and appreciated revisiting first-year content as they prepared for

the board examinations. Concept map grading allowed these students to practice assessment and provide constructive feedback.

The collaborative effort to create materials for each concept mapping session brought faculty from different basic science and clinical disciplines together, and basic scientists learned which concepts are critical for application to clinical medicine. These experiences helped faculty to understand the importance of integration and develop new skills to emphasize this in their teaching.

The process of concept mapping can be challenging for both students and faculty. Robust orientation programs to help faculty and students appreciate the value of cognitive integration for developing clinical reasoning skills can help address these challenges. Students and facilitators should be educated about team building and supported throughout the process of team development.

Conclusion

Concept mapping provided rich discussion between students about the basic sciences in a clinical context. Through this interaction, students challenged each other and their perceptions to create an integrated understanding of the basic and clinical sciences. Providing focused prompts and relevant concepts were important to promote a discussion that achieved cognitive integration to enhance clinical reasoning. Our approach of having the same groups of students work together for the entire year gave them the time to work through the different stages of team development and become productive team members. These acquired skills are critical for students in their clinical practice, particularly in the environment of team-based patient-centered care.

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Report on 7 Years' Experience Implementing an Undergraduate Medical Curriculum for Osteopathic Medical Students Using Entrustable Professional Activities

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Calls for changes in undergraduate medical education and the advent of the single graduate medical education accreditation system have challenged the osteopathic medical profession to maintain its identity and distinctiveness while adapting to innovations. For the osteopathic medical profession to thrive, its colleges must provide students with an educational framework that solidifies their osteopathic identity. The authors developed an integrated anatomy-clinical skills course at the University of New England College of Osteopathic Medicine, Osteopathic Clinical Skills, that used the performance benchmarks of the Entrustable Professional Activities and the Osteopathic Core Competencies for Medical Students from the American Association of Colleges of Osteopathic Medicine. A primary tenet of osteopathic medicine is the relationship of structure and function; Osteopathic Clinical Skills fuses anatomical sciences with clinical skills and underscores this tenet in clinical diagnosis and treatment. This article describes the development and implementation of an educational framework that integrates anatomy, physical examination, history taking, and other clinical skills with osteopathic medicine principles and practice and osteopathic manipulative treatment.

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Keywords: osteopathic medical education, osteopathic medical students, osteopathic philosophy

As undergraduate medical education (UME) moves toward competency-based, outcome-oriented models, colleges of osteopathic medicine (COMs) must find ways to innovate in a manner supportive of osteopathic medicine concepts. With the Accreditation Council for Graduate Medical Education (ACGME) single graduate medical education accreditation system implemented on June 30, 2020, residency programs can apply for Osteopathic Recognition.[1] One of the drives for residency programs to seek Osteopathic Recognition will be the demand from osteopathic residents and applicants. To generate this demand, COMs must provide students with a strong foundation in

osteopathic principles and practice (OPP) and a culture cultivating their osteopathic identity. We define osteopathic identity as the knowledge, skills, and attitudes distinctive of an osteopathic physician and embodied in the 4 tenets of osteopathic medicine, as well as the beliefs, practices, and traditions that are passed on through the legacy of osteopathic medicine.[2,3]

We believe that an allopathic-model UME curriculum with a parallel OPP curriculum will fail to cultivate an osteopathic identity because it will not reflect an osteopathic approach to medical practice. Embedding the tenets of osteopathic medicine into a medical student's clinical reasoning will require more time than taking a single OPP course. Incorporating OPP into each learning activity supports the transition to incorporating the tenets of osteopathic medicine in a nonanalytic and routine way through regular, deliberate practice.[4]

The general concept of Entrustable Professional Activities (EPAs)[5] melds well with osteopathic UME. While competency-based assessment measures physician behaviors, EPA-based assessment looks at descriptors of work such as tasks and responsibilities of physicians that, once entrustable, can be executed independently.[5-8] Per accreditation standards,[9] COMs have long used competency-based training in OPP courses to entrust students with accurate osteopathic structural examinations and osteopathic manipulative treatment with growing independence. By using an EPA-based assessment, we can extend our experience entrusting students to perform osteopathic manipulative treatment to other components of the osteopathic UME.

In 2012, the University of New England College of Osteopathic Medicine (UNECOM) created an integrated, competency-based curriculum for EPA-based assessments. This article provides a method of curriculum development using a developmental framework[6] with a backward design (ie, planned backward by starting with goals).[10]

Setting the Framework

Before the 2012 curriculum update, the structure of UNECOM's curriculum was based on the published American Association of Colleges of Osteopathic Medicine (AACOM) Core Competencies.[11] Yet, assessment of student performance was primarily knowledge-based rather than competency-based, and the course content was parallel rather than integrated. In the 2012 curriculum update, UNECOM faculty created a 4-semester course, Osteopathic Clinical Skills (OCS), by merging 3 anatomical science courses and 10 clinical courses (**Figure 1**). The OCS course goal was to prepare students for their first day of clinical clerkships regardless of discipline. Before implementing the new curriculum, faculty sought input from clerkship sites, residents, and medical students to identify 8 descriptors of work, such as tasks and responsibilities for every medical student on the first day of clinical rotations. These shared expectations became the course outcomes of the OCS course, and the 4 tenets[2] of osteopathic medicine were integrated into these UNECOM-developed EPAs (herein referred to as OCS EPAs). The final goals of the OCS course were set primarily by expert consensus because published guidelines for EPAs were not available at the time of development. Our implementation of entrustable behaviors was initiated in 2012, which was before the AAMC's 2014 publication of the Core EPAs for Entering Residency (CEPAER).[5] Our final list of student expectations for the OCS EPAs included 8 of the 13 CEPAERs identified by the AAMC, but the OCS EPAs focused on osteopathic medicine (**Figure 2**). The OCS course has since adopted the language of AAMC's EPAs and the 2016 AACOM Osteopathic Considerations of CEPAER, which incorporated OPP into the EPA wording.[12]

For each OCS EPA, the relevant core competencies (including OPP) were identified as well as the associated knowledge/skills/attitudes (KSA) expected at the start of clerkships were described.[12] Faculty then used a developmental framework and benchmarked the KSA associated with each OCS EPA to intervals in the education process, coinciding with the end of each semester of the first 2 years of the preclinical curriculum. At these points in time, faculty would expect students to meet

specific benchmarks appropriate for that stage in their educational development. Performance indicators and associated competencies changed with subsequent semesters. For example, language introduced in the first semester was initially categorized as medical knowledge competency; in the second semester, that language was associated with interpersonal communication; by the third semester, the language was also associated with patient care and practice-based learning and improvement. Ultimately, the Osteopathic Core Competencies of patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, OPP, and systems-based practice were all integrated.

To best assign performance indicators to competencies, faculty made several consensus assumptions regarding the expression of competencies throughout preclinical training. For example, faculty decided to interpret the practice-based learning and improvement competency as the students' ability to learn from their mistakes. As such, faculty designed assessments to be cumulative and developed a competency-assurance process to assist students who need help meeting benchmarks.

Basic science components	Clinical skills components
• Gross anatomy	• History taking
• Histology	• Physical examination
• Embryology	• Osteopathic principles and practice
	• Differential diagnosis
	• Medical humanities
	• Radiology
	• Geriatrics
	• Clinical experiences
	• Standardized patient experiences
	• Simulation experiences

Figure 1.
The basic science and clinical skills components of the 4-semester Osteopathic Clinical Skills course at University of New England College of Osteopathic Medicine. Figure was made by Oran Suta.

Organizing Course Content

After determining agreed-upon course goals and OCS EPAs, we created a theme of patient-physician interaction to guide the OCS course content. The faculty recognized that a thoughtful approach was needed to optimize integration and resources. Content was organized to mimic the progression of patient-physician interaction and began with physician KSA that required less intimacy or invasiveness and progressed to KSA that required more.

For example, physical examination and gross anatomy have unique challenges related to medical students' neurocognitive development and effective resource management. The physical examination requires that students develop cognitive and visual-motor skills yet maintain an empathetic perspective while touching intimate areas of another person's body. While students might be prepared to start medical school with discussions of cardiovascular disease and cardiac auscultation, most entering medical students are not comfortable with placing their hand near a stranger's breast and leaving it there long enough to count a heartbeat or auscultate a murmur. Asking a new medical student to touch the anterior chest or the bare abdomen of a peer-student is intimidating.

Gross anatomy is unique because after a cadaver is dissected, it is no longer available for observation within the context of the whole patient. Like the physical examination, starting gross anatomy with the thorax can be daunting. Therefore, the OCS course was designed to begin with the upper extremities and then progress throughout the first year to the lower extremities, chest, abdomen, pelvis/perineum, and the head and neck. This sequence helps students develop dissection skills in less personal areas before moving into more sophisticated dissections and body regions with a higher possibility of emotional triggers.

We determined that the OCS course would begin with communication, general observation, and noninvasive touch. The course would progress to more personal verbal and nonverbal information gathering. This

Figure 2.
A combined list of the Entrustable Professional Activities (EPAs) for entering residents identified by the AAMC and UNECOM. The OCS EPAs for UNECOM are shown in bold. Figure was made by Oran Suta. *Abbreviations*: AAMC, American Association of Medical Colleges; OCS, Osteopathic Clinical Skills; UNECOM, University of New England College of Osteopathic Medicine.

sequence would allow the introduction of cultural humility, permission, patient autonomy, and shared decision-making as the students progressed. This structure created a continuum through which students developed more sophisticated skills. As the students gained confidence in professional, empathetic touch, the curriculum's content and expectations progressed into more personal and intimate realms. This sequencing and theme provided a mechanism by which the cadaver laboratory experiences were integrated into the patient-physician interaction and established a foundation for using the structure-function tenet of osteopathic medicine in the course.[2]

Anatomy and Empathy

The UNECOM faculty felt that the dissection experience was critical for the development of empathetic osteopathic physicians. The cadaver was presented as the student's first patient. All learning and teaching during the OCS course considered the cadaver as a patient to reinforce the concept of beginning with the patient and orienting data gathering to the patient rather than anchored to a diagnosis or laboratory value. The dissection process provided the student with a concrete, kinesthetic understanding of disease progression and presentation. This kinesthetic knowledge was carried with the students into the clinical setting, where they interacted with and examined peers and patients with the same structures and functions observed in the cadaver laboratory. Additionally, diseases that were found in various dissections provided a framework for faculty to use a Socratic approach to engage students in deductive reasoning. To guide this reasoning with an osteopathic lens, faculty developed open-ended prompts that illustrated the tenets of osteopathic medicine (eg, "What would have been this patient's complaint?", "How would this have affected the patient's daily activities?", "How would you have examined this patient to find this problem?").

Establishing Performance Indicators

Using a backward design that considered our 8 OCS EPAs, faculty established performance benchmarks throughout years 1 and 2. Third-year students starting a clinical clerkship were expected to gather a patient's history, perform a physical examination, and provide an oral presentation. To prepare students, benchmarks in the final month of year 2 included the ability to begin a respectful conversation with a patient, determine the appropriate questions to ask in the proper manner, determine the correct physical examination to perform and obtain consent to do so, and communicate their findings and impressions to the patient, attending physician, and peers. Faculty then identified specific KSA that would lead the student to this end point and categorized these into 3 tiers. The lowest tier was considered critical/essential, the middle tier was important, and the highest tier was considered aspirational. To

continue or pass the course, students must have met all expectations in the critical/essential tier and most expectations in the important tier. The specific content assigned to the tiers increased throughout the semesters, thus creating benchmarks.

Faculty determined the competencies associated with the benchmarks and used a modified Bloom taxonomy to identify the specific performance indicators needed to assess student progress. For example, recognizing an obvious abnormal vital sign would be a critical/essential skill. For the patient care competency, the third-year student should be able to take an accurate blood pressure (BP) measurement, identify an abnormal BP, relate its significance to the chief complaint, and form a differential diagnosis. From this goal, faculty created a progression in benchmarks for each competency. For example, expectations for the patient care competency for a BP reading in the first semester included identifying and describing relevant anatomy and clinical tools as the critical/essential tier. They progressed to interpreting findings in the context of the chief complaint as the aspirational tier (**Figure 3A**). The progressions for the interpersonal and communication skills competency associated with taking BP were detailed similarly but had a different focus (**Figure 3B**).

Expectations increased for the second semester. This process was used for each competency and OCS EPA. It was also used to determine whether potential course content was essential, important, or aspirational at a given time. By the end of year 2, each student must have demonstrated minimum ability in each competency through multiple interactions with peers, cadavers, standardized and community patients, and simulators. There were many formative and summative steps created to reach this level of competency. Detailed course objectives and rubrics (**Figure 4**) were created to guide the students toward acquiring the expected KSA. Embedded in each objective and rubric were the core competency components that are unique to osteopathic medicine.

Making It Work

Once the course sequence was determined, the content was woven throughout multiple learning environments and directed by the overarching theme, guiding

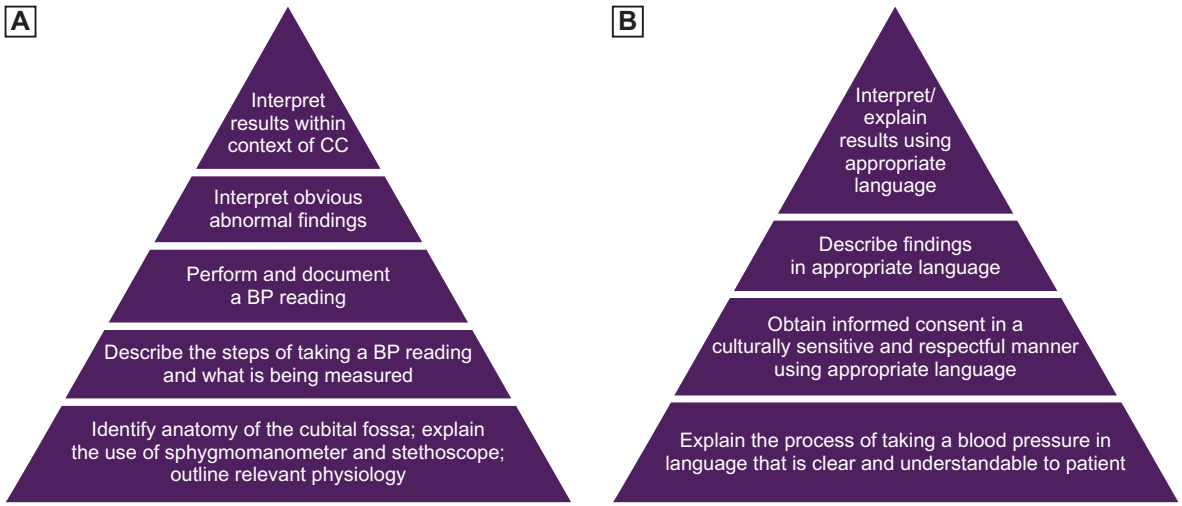

Figure 3.
Expectations for the (A) patient care competency and (B) communication competency for blood pressure monitoring in the first semester of the Osteopathic Clinical Skills course at University of New England College of Osteopathic Medicine. The critical/essential skills tier is on the bottom of the pyramid and the aspirational tier is at the top. Figure was made by Oran Suta. *Abbreviations*: BP, blood pressure; CC, chief complaint.

Integrated Assessment Rubric: Osteopathic Structural Examination of the Knee

EX = Exceeds expectations (All bold and most of non-bold and/or completed fluidly with good rationale)
M = Meets Expectations (All bold completed correctly}
NI = Needs Improvement (Bold partially completed, or partially correct}
U = Unsatisfactory (Minimal to no exam done, dangerous, or unprofessional}

Region: Knee

U	NI	M	EX	Patient care
				• Washes hands prior to exam (may do at beginning of encounter) – hand sanitizer, or at least 20s with soap and water • Exam is done on skin and with appropriate draping • Appropriately communicates to patient the physical exam being done • Appropriately communicates to patient clinical reasoning for physical examination being done • Communicates clinical reasoning for evaluating specific adjacent regions
U	**NI**	**M**	**EX**	**Inspection (TART)**
				Posture, position and skin – anteroposterior/lateral • Posture, alignment and symmetry of axial skeleton and trunk • Evaluates for lower limb postural asymmetries and joint deformities • Evaluates for skin lesions
U	**NI**	**M**	**EX**	**Palpation (TART)**
				Palpatory landmarks of the knee • Evaluates for tenderness to palpation and known regional tender points • Evaluates for asymmetries and tissue texture changes
U	**NI**	**M**	**EX**	**Joint function evaluation (TART)**
				Active range of motion • Evaluates in all planes of motion (flexion, extension, internal and external rotation} • Describes barriers being assessed (anatomic, physiologic, pathologic) • Accurately identifies pathological barriers encountered in exam Passive Range of Motion • KNEE: flexion, extension, internal and external rotation; fibular head: anterolateral and posteromedial • Describes barriers being assessed (anatomic, physiologic, pathologic) • Accurately identifies pathological barriers encountered in exam strength testing • Evaluates and grades in all planes of motion (flexion, extension, internal and external rotation)

If NI or U – Comments MUST be included here:

Figure 4.
Integrated assessment rubric of an osteopathic physical examination of knee for the Osteopathic Clinical Skills course at University of New England College of Osteopathic Medicine. Figure was made by Oran Suta. *Abbreviation*: tissue texture abnormality, asymmetry, restriction of motion, or tenderness

principles, and course goals. We designed 9 distinct, but integrated, learning activities/environments during the first preclinical year and 13 distinct activities in the second preclinical year (**Figure 5** and **Figure 6**). All learning activities had feedforward and feedback processes and were sequenced to build on each other. For example, being in the cadaver laboratory did not preclude a conversation about osteopathic manipulative treatment applied to a dissected muscle, and a session covering gland histology was not exempt from a conversation of structure and function interplay. Framing content in this way allows students to contextualize the tenets of osteopathic medicine[2] in multiple formats, further nurturing the students' osteopathic identity.

The transition from separate courses to an integrated, 4-semester course took place over a single academic year. In the summer of 2012, the faculty agreed on integration, outcomes, overarching principles/themes, and laid out the course progression. The course was implemented in the fall of 2012, and minor changes and corrections were made as the year progressed. Planning, faculty preparation, and communication were the most critical factors needed for success, including administrative coordinators and information technology support. Most of the discipline-specific content did not change with integration. However, the timing and presentation of models did.

After creating online modules, faculty time was spent more on interactive teaching, course sequencing, and standardization of assessments. The student-faculty contact included a flipped-classroom approach, clinical skills practice, knowledge application, peer-to-peer teaching, clinical experiences, and face-to-face formative student assessments.

Curriculum, like a living entity, constantly changes. The degree of change that now occurs is similar to when we had separate courses. Faculty workload associated with this change was hard to assess, as we simultaneously increased the class size in the fall of 2012. The new curriculum necessitated the hiring of 1 additional staff member to assist with scheduling and organization. Considering the increased class size, the additional faculty workload ascribed to this transition was less than 1 full-time equivalent of adjunct faculty.

Assessing Student Performance

Approximately every 6 weeks, the students had a summative assessment in which each competency domain was assessed through multiple methods: clinical demonstration, clinical performance, oral presentation, documentation, short answer, and multiple-choice questions. During the first year, more than 80% of the KSA assessed through each method represented content woven throughout all learning environments. For example, during the "Donor Practical," an anatomical structure was tagged on a cadaver with the prompt "identify an orthopedic test used to assess this structure." In the "Live-Anatomy Practical," students palpated landmarks on a peer or assess somatic dysfunction while describing what they were doing and why. During "Imaging Assessments," students identified the structures or obvious disease process on a radiologic image. In "Clinical Skills Assessments," students performed osteopathic physical examinations, osteopathic manipulative treatment, and orthopedic tests on a peer while describing the relevant anatomy, expected findings, and clinical reasoning for performing an examination or treatment. There were questions about specific diseases that asked about the associated anatomy, diagnostics, and interventions on written assessments. In the second year, faculty designed summative assessments to better resemble patient encounters by using standardized patients with appropriate laboratory and imaging studies.

Students were benchmarked to the defined expectation throughout the course rather than to their peers, and students were required to meet the expected criterion for every performance indicator. The expectations were clearly described and provided to the students each semester. If a student failed to meet expectations for a performance indicator, they received either "needs improvement" or "unsatisfactory." and were required to successfully complete a competency

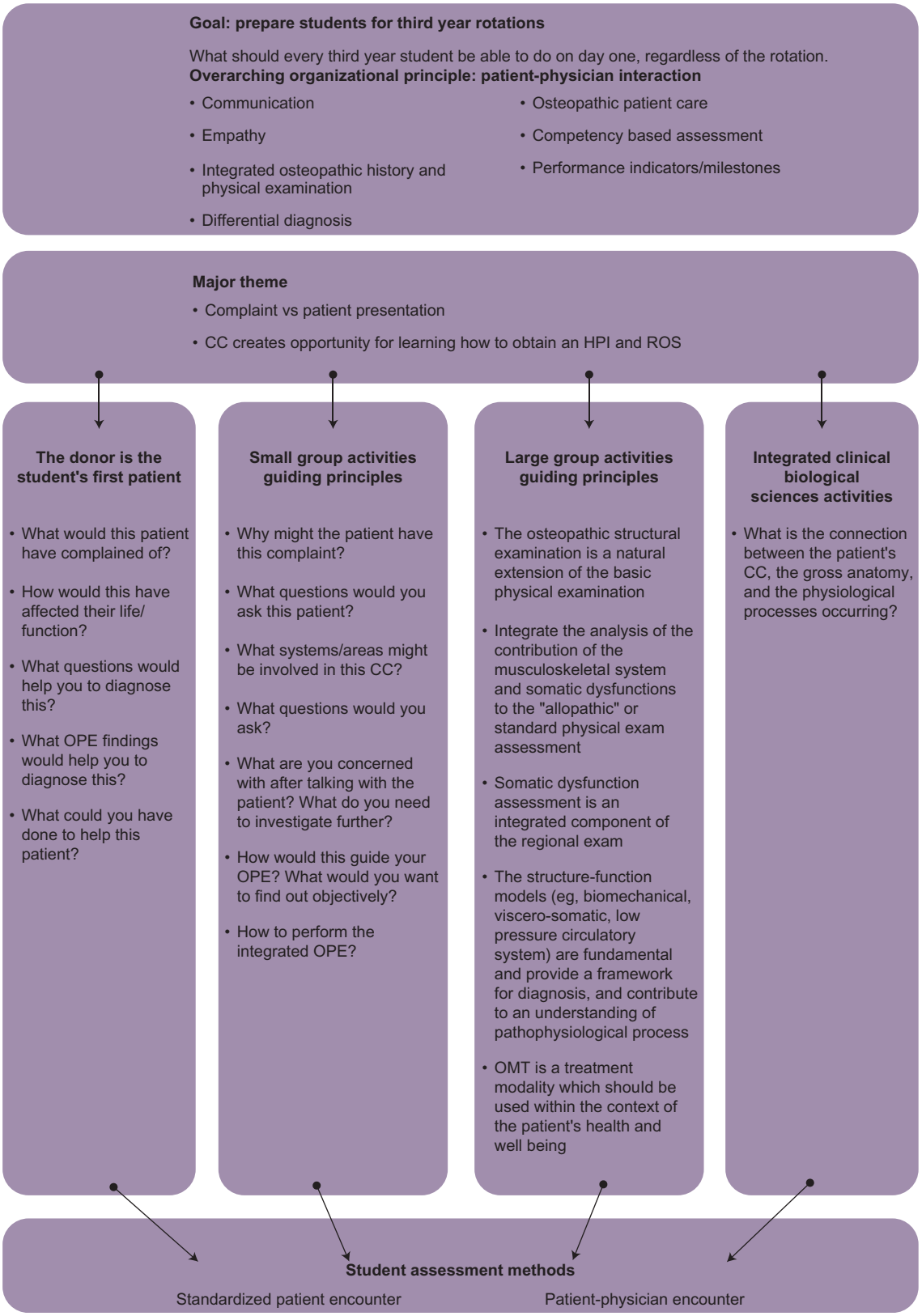

Figure 5.
Guiding principles for the first year of the 4-semester Osteopathic Clinical Skills course at University of New England College of Osteopathic Medicine. Figure was made by Oran Suta. *Abbreviations*: CC, chief complaint; HPI, history of present illness; OMT, osteopathic manipulative treatment; OPE, osteopathic physical examination; ROS, review of systems.

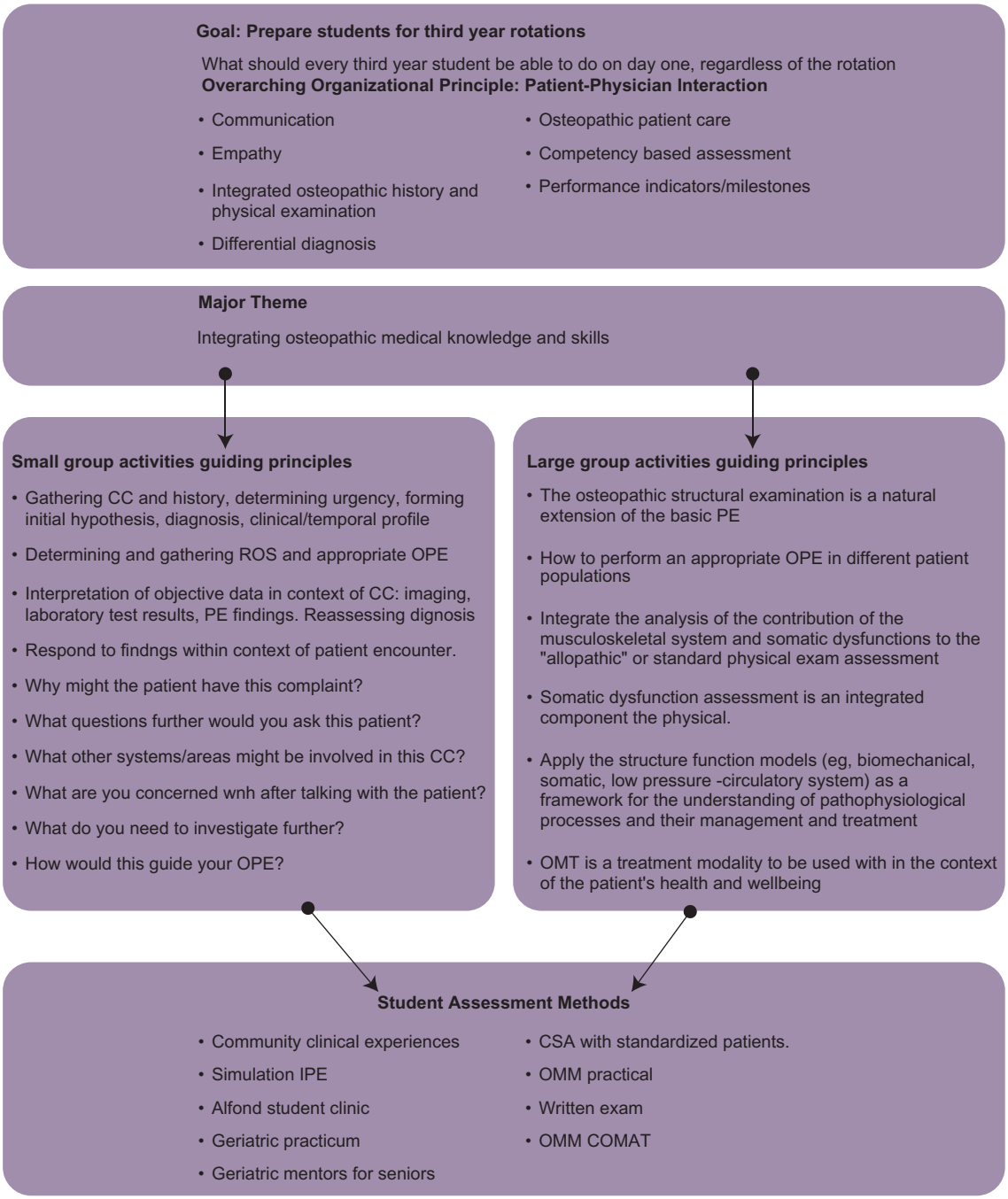

Figure 6.
Guiding principles for year 2 of the 4-semester Osteopathic Clinical Skills course at University of New England College of Osteopathic Medicine. Figure was made by Oran Suta. *Abbreviations*: CC, chief complaint; COMAT, Comprehensive Osteopathic Medical Achievement Test; CSA, clinical skills assessment; IPE, interprofessional education; OMM, osteopathic manipulative medicine; OMT, osteopathic manipulative treatment; OPE, osteopathic structural examination; PE, physical examination; ROS, review of systems.

assurance process (CAP). Each CAP was customized to the indicator in which a challenge was identified. This customization allowed faculty and students to identify and address specific learning challenges and opportunities for improvement. The CAP was not designed as remediation, but as a way to precisely identify underlying causes of deficiency and determine how it can be corrected. Depending on the assessment, the CAP took about 0.25 to 0.5 faculty-hours per student to develop and deliver. Variability existed in the number of CAPs per assessment cycle because of student growth, material complexity, and increased expectations.

Assessing the Course

After 2 years of implementing this course, a survey was sent to clinical faculty to assess the students' performance during the first month of clinical rotations based on core EPAs. Clinical faculty rated UNECOM student performance compared with previous third-year medical students from UNECOM and other colleges on 12 parameters using a Likert scale. Forty-seven assistant deans and clerkship faculty (94%) returned surveys. The survey results showed that 87% of respondents rated student performance as "meets expectations" to "exceeds expectations" in 8 of 12 core EPAs, and by more than 83% of respondents in the remaining 4 areas. While the authors recognize that this survey was not validated and lacks statistical significance, the results reassured us that this undertaking was worthwhile.

During the first 2 years of curriculum implementation, students demonstrated discomfort with the nonnumerical scoring system. Much of this discomfort was because of the perceived lack of interexaminer reliability. An annual standardized assessment training course was developed for faculty that involved scoring video-recorded student performances, group discussion, and analysis for outliers. Additionally, students were encouraged to view their performance videos and challenge an assessment score.

UNECOM faculty are now in our seventh year with this integrated, competency-based course using core EPA benchmarks. Overall, there has been support and enthusiasm from students regarding the integration and methods of delivery. Throughout this curricular change, UNECOM maintained a first-time pass rate on the Comprehensive Osteopathic Medical Licensing Examination of the United States above the national average,[13] although this examination does not capture the breadth of tasks encompassed by the core EPAs. We do not have enough information to determine whether the course has led students to advocate for ACGME programs with Osteopathic Recognition. However, the third-year clinical clerkship faculty reported making adjustments to their curricula because the students were entering with more mature, entrustable skills. We continue to enhance objective metrics to track our curriculum's success and demonstrate that our approach successfully engrains the osteopathic identity.

Conclusion

The goal in creating the OCS course was to create a strong foundation on which a third-year osteopathic medical student entering into a clinical clerkship can develop into an osteopathic physician. We set benchmarks along our 4-semester, integrated preclinical course using backward design and clinical expertise. Our approach to creating EPAs with an osteopathic focus emerged as a logical way to assess whether learners were on track to reach the course targets. An integrated curriculum embeds concepts of osteopathic medicine into all aspects of the course to mimic the "osteopathic lens" through which osteopathic physician's practice. Thus, all of the learning environments and assessments were created with the osteopathic identity in mind. We believe that this is a logical, worthwhile approach to achieve the desired outcomes of an osteopathic medical student.

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Forty Years of University of New England's Research and Scholarship and its Impact in Maine, New England, and Beyond

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The University of New England College of Osteopathic Medicine (UNE COM) was founded by a group of osteopathic physicians who wanted to ensure that the practice of Osteopathic Medicine would endure in northern New England and that patients in the region would continue to receive the best health care possible. UNECOM merged with St. Francis College in 1978 to form the University of New England (UNE).[1] UNE has grown and developed over the years, building on the shared Franciscan and osteopathic traditions of integrating philosophy and intellect. Following the 1996 merger with Westbrook College in Portland, Maine, UNE now comprises 3 campuses, 13 additional health profession programs, 6 Centers of Excellence in Research, and strong undergraduate programs that link the environment, people, and community in a "One Health" concept.

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The University of New England College of Osteopathic Medicine (UNECOM) sits along the rocky coast of southern Maine. UNECOM has graduated more than 3300 physicians who practice throughout the country and around the world. Sixty-two percent of our graduates are in primary care (family medicine, pediatrics, or internal medicine) and more than 26% of all graduates practice in rural and underserved areas. UNECOM's impact on Maine is particularly notable. We are the number-one provider of physicians for the state of Maine. Sixty-one percent of UNECOM alumni practice in primary care, and 40% practice in rural and underserved areas. UNECOM graduates practicing primary care in Maine have an annual economic impact of more than 100 million US dollars on the state.

UNE has significantly grown and developed since its founding and now comprises 3 campuses, 13 additional health profession programs, 6 Centers of Excellence in Research, and strong undergraduate programs that link the environment, person, and community in a One Health concept.[1] This expansive, holistic view of health dovetails with the osteopathic tenets of mind, body, and spirit and permeates everything we do at UNECOM.[2] Our collaboration with UNE's College of Dental Medicine, College of Health Professions, and College of Pharmacy provides a community of health professions with a multitude of immersion experiences and active learning opportunities for interprofessional education using rural immersion, simulation programs, peer teaching, student-run clinics, and clerkship experiences focusing on health care to underserved populations.

UNECOM partners with affiliate health care systems located in rural and underserved areas throughout New England and the Middle Atlantic states. We have found that early student exposure to these communities creates opportunities for personal and professional connections. Ultimately, these partnerships benefit the health systems and people in those communities, providing a pipeline of physicians. We are the only provider of physicians to those health systems with which we have had more than 10 years of partnership, providing twice as many physicians as other medical schools.

The innovative and committed osteopathic physicians who founded UNECOM saw the future clearly and invested in it. Those forward-thinking values are imbued in our faculty, professional staff, and students, who continually look for ways to improve our commitment to health for everyone. Our curriculum was redesigned in 2012 with the "end" (ie, rotations and residency) in mind. In 2011, we surveyed our clinical clerkship sites, asking what skills and behaviors they would like to see in every third-year student. A consensus of 9 activities emerged, which we then integrated with the osteopathic competencies to develop our curricular goals. The Association of American Medical Colleges published the guidelines on CORE Entrustable Professional Activities for Entering Residency in 2014,[3] which included 8 of UNE's 9 consensus expectations (osteopathic philosophy was not included). This terminology was then adopted by the faculty and became the driving force and guiding principle for student outcomes for the curriculum.

The curriculum uses expert faculty presentations with small-group, team-based, and peer teaching to integrate the biomedical and clinical sciences and fuses the study of human anatomy with training in clinical skills. First-time student pass rates for the National Board of Osteopathic Medical Examiners' Comprehensive Osteopathic Medical Licensing Examination of the United States Level 2-CE, and Level 2-PE have typically surpassed the national average over the past 5 years (**Table 1**). UNECOM's first-pass match rates for the National Resident Matching Program have surpassed the national average for all UNECOM seniors (**Table 2**).

UNECOM has been able to make the transition from a mission focused primarily on teaching, training, and professional service to a mission that includes an increasingly rich environment of research and

Table.1.
University of New England College of Osteopathic Medicine First-Time Pass Rates for COMLEX-USA

Testing cycle	First-time pass rate, %	National pass rate, %[4]
First-time pass rates for COMLEX-USA Level 1		
May 2013–April 2014	95.0	92.0
May 2014–April 2015	95.1	93.9
May 2015–April 2016	95.3	92.3
May 2016–April 2017	94.4	92.7
May 2017–April 2018	98.8	96.0
First time pass rates for COMLEX Level 2 CE		
June 2013–May 2014	99.1	92.3
June 2014–May 2015	90.8	92.6
June 2015–May 2016	93.3	92.2
June 2016–May 2017	96.0	93.2
June 2017–May 2018	94.7	92.8
First time pass rates for COMLEX-USA Level 2 PE		
July 2013–June 2014	97.2	92.6
July 2014–February 2015	92.5	92.1
March 2015–February 2016	94.6	93
March 2016–February 2017	94.7	92.9
March 2017–March 2018	92.4	93.2

Abbrevieations: AOA, American Osteopathic Association; ACGME, Accreditation Council for Graduate Medical Education; CE, Cognitive Evaluation; COMLEX-USA, Comprehensive Osteopathic Medical Licensing Examination of the United States; PE, Performance Evaluation.

Table. 2.
University of New England College of Osteopathic Medicine Match Results 2016-2019

	Class year			
Characteristic	**2016**	**2017**	**2018**	**2019**
Class size	124	165	179	178
Number matched, No. (%)	118 (95)	161 (98)	168 (94)	175 (98)
Matches by category, No. (%)				
AOA	32 (27)	57 (35)	35 (21)	23 (13)
ACGME	79 (67)	91 (57)	123 (73)	143 (82)
Military	7	13	10	9 (5)

Abbrevieations: AOA, American Osteopathic Association; ACGME, Accreditation Council for Graduate Medical Education.

scholarship. Every year, our medical students have the opportunity to participate in 3 research symposia. In 2019, our fall research forum attracted more than 400 medical students, faculty, and guests, and 64 medical students were involved in either oral or poster presentations. The Maine Osteopathic Association Midwinter Symposium located in Portland maintains the practice of osteopathic medicine in Maine. Every year, it hosts a research forum with support from UNECOM. The number of medical students presenting poster presentations has been exponentially increasing in size. The Northeast Osteopathic Medical Education Network also has an Annual Research and Scholarship Forum supporting UNECOM's 17 clerkships and has grown to 150 research posters. These opportunities are critical for osteopathic medical students to present their research and be recognized for their work.[5,6]

Community and environment were important to our founders, and they remain the underpinnings of UNECOM today. UNECOM is emblematic of New England values and resources. Our commitment to supporting the mind, body, and spirit of our students, faculty, staff, and community is heartfelt. Our gratitude to those who took a chance on the future is ever-present, as is our sense of responsibility to live up to that vision and trust—to envision the next 40 years and lead the way forward mindfully. Most UNE employees are "lifers," making UNE part of their emotional family: employees do not leave, and graduates return. This sense of community, belonging, and support is one of our proudest achievements, and it is what makes UNECOM, UNECOM.[1]

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Undifferentiated Pleomorphic Sarcoma

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An 86-year-old man presented with an ulcerated plaque on the right antihelix that had been present for several months (image A). Superficial biopsy revealed an atypical spindle cell proliferation, consistent with an atypical fibroxanthoma (AFX). Mohs surgery was performed, and histopathologic analysis showed uniform atypical spindle cells in a storiform pattern filling the dermis to the subcutis, suggesting the diagnosis of an undifferentiated pleomorphic sarcoma (UPS) (image B).

AFXs are uncommon cutaneous neoplasms of pleomorphic myofibroblast-like cells.[1] Whether these lesions represent keratin-positive dermal sarcomas or poorly differentiated carcinomas is debatable. Diagnosis requires exclusion of other undifferentiated spindle and pleomorphic cell neoplasms, such as UPSs, by immunohistochemical analysis.[2] These soft tissue tumors present with AFX-like clinical and pathologic findings, but have higher-grade histologic features with greater rates of local recurrence and metastasis.[2] While evidence indicates that these neoplasms lie on the same clinicopathologic spectrum, diagnostic criteria separating the 2 remains ill-defined.[2] Consequently, clinical experience suggests that such cases should be managed promptly and treated aggressively. Despite clear margins, the tumor recurred in the patient and, ultimately, metastasized. (doi:10.7556/jaoa.2020.089)

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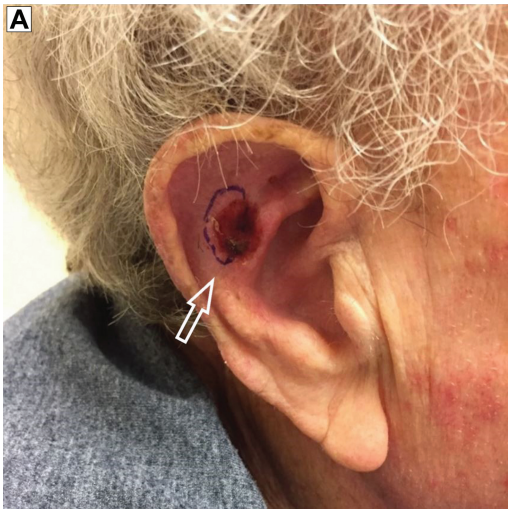

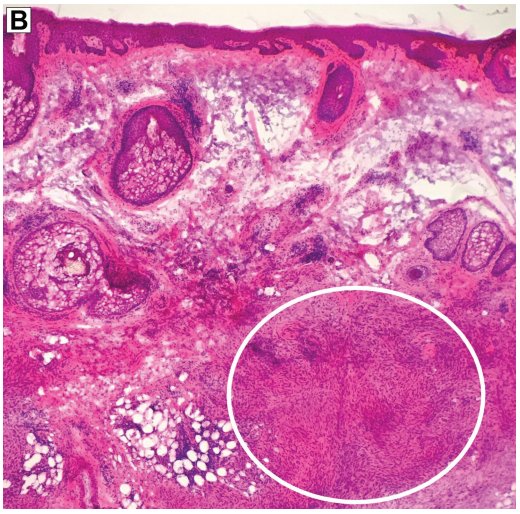

The Journal of the American Osteopathic Association

The purpose of this quiz is to provide a convenient means for osteopathic physicians to assess their understanding of the scientific content in the August 2020 issue of *The Journal of the American Osteopathic Association* (*JAOA*). To apply for 2 Category 1-B continuing medical education (CME) credits, AOA members may take this quiz online at https://aoaonlinelearning.osteopathic.org, where this and other *JAOA* quizzes can be accessed. Quizzes that are completed online will be graded and credited to members' CME activity reports. August quizzes will expire on February 28, 2022.

The correct answers will be published in the September 2020 issue of the *JAOA*.

Life vs Loans: Does Debt Affect Career Satisfaction in Osteopathic Graduates?

Jesse Richards, DO; Caleb J. Scheckel, DO; Alicia Anderson, OMS III; Jessica R. Newman, DO; Kenneth G. Poole Jr, MD, MBA

1. Satisfaction with which area of education was more frequently rated highly in trainees with higher educational debt?

☐ (a) career choice of osteopathic medicine
☐ (b) financial services department
☐ (c) choice of medical school
☐ (d) choice of specialty

2. Among the patients who died approximately what percentage remained eosinopenic until their death?

☐ (a) 50
☐ (b) 57
☐ (c) 86
☐ (d) 24

Eosinopenia and COVID-19

Fahmina Tanni, DO; Eleonora Akker, DO; Muhammad M. Zaman, MD; Nilka Figueroa, MD; Biju Tharian, PharmD; Kenneth H. Hupart, MD

3. In the authors' early care of patients with COVID-19, what component of the complete blood cell count was observed to be low or absent?

☐ (a) neutrophils
☐ (b) lymphocytes
☐ (c) eosinophils
☐ (d) basophils

4. Of the 30 patients in the COVID-19 group who had a 0 absolute eosinophil count at presentation, approximately what percentage died?

☐ (a) 57%
☐ (b) 89%
☐ (c) 14%
☐ (d) 8%

Report on 7 Years' Experience Implementing an Undergraduate Medical Curriculum For Osteopathic Medical Students Using Entrustable Professional Activities

Tristan S. Reynolds, DO; Christopher Frothingham, DO; Jane E. Carreiro, DO; Angela Branda, DO; Mark D. Schuenke, PhD; Kerry L. Tucker, PhD; Frank Daly, PhD; Frank H. Willard, PhD

5. The driving force for creating the Osteopathic Clinical Skills course was which of the following?

☐ (a) residency programs demand better skills training in undergraduate medical eduction
☐ (b) the single accreditation and maintaining osteopathic identity
☐ (c) to move toward an additive model of allopathic curriculum plus OPP
☐ (d) to guide students earlier into specialty-oriented curricula
☐ (e) to get students used to assessments more commonly used in GME

Answers to the July 2020 *JAOA* CME Quiz

Novel Dual-Fluorescent Mitophagy Reporter Reveals a Reduced Mitophagy Flux in Type 1 Diabetic Mouse Heart

Satoru Kobayashi, PhD; Joy Patel, BS; Fengyi Zhao, MD; Yuan Huang, MD; Tamayo Kobayashi, MS; Qiangrong Liang, MD, PhD

1. (c) It is important to remove injured mitochondria from the diabetic heart because injured mitochondria produce too much reactive oxygen species.

Effect of Opioid Prescribing Education for Obstetrics and Gynecology Residents in a Safety-Net Hospital

Casey Evans, MD; Deanna McCullough, MD; Kelly Best, MD; Brian K. Yorkgitis, DO

2. (b) In the Getting it RIGHTT approach to pain management, the "I" stands for insight into pain.

Evaluating Financial Conflicts of Interest Among Contributors to Clinical Practice Guidelines of the American College of Obstetricians and Gynecologists

Micah R. Wright, DO; Lance Frye, MD; Luanne Vo Solis, DO; Jake X. Checketts, DO; Carlos Guevara, DO; Larissa Smith, DO; Matt Vassar, PhD

3. (d) Open Payments is a federal program that requires applicable group purchasing organizations and applicable manufacturers to submit annual payment data or transfers for any value paid to physicians or teaching hospitals greater than $10.

Sister Mary Joseph Nodule in a Patient With Advanced Prostate Cancer

Michael Chahin, DO; William Kogler, DO; Anthony Stack, DO; Brittany Lyons, DO

4. (a) Sister Mary Joseph nodules are most commonly associated with gastrointestinal, gynecologic, and hematologic cancers.
5. (c) A Sister Mary Joseph nodule is best described as a cutaneous, periumbilical nodule that mimics an umbilical hernia.

Manipulative and Psychosocial Management of Dysmenorrhea

Starr Matsushita OMS IV; Bonnie Wong, DO; Raghu Kanumalla, OMS IV, MS; Leonard Goldstein, DDS, PhD

6. (c) Excessive prostaglandin production is a currently accepted pathogenesis of primary dysmenorrhea.