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E-Learning Module on Chronic Low Back Pain in Older Adults: Evidence of Effect on Medical Student Objective Structured Clinical Examination Performance

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Abstract

The Institute of Medicine has highlighted the urgent need to close undergraduate and graduate educational gaps in treating pain. Chronic low back pain (CLBP) is one of the most common pain conditions, and older adults are particularly vulnerable to potential morbidities associated with

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misinformed treatment. An e-learning case-based interactive module was developed at the University of Pittsburgh Center of Excellence in Pain Education, one of 12 National Institutes of Health–designated centers, to teach students important principles for evaluating and managing CLBP in older adults. A team of six experts in education, information technology, pain management, and geriatrics developed the module. Teaching focused on common errors, interactivity, and expert modeling and feedback. The module mimicked a patient encounter using a standardized patient (the older adult with CLBP) and a pain expert (the patient provider). Twenty-eight medical students were not exposed to the module (Group 1) and 27 were exposed (Group 2). Their clinical skills in evaluating CLBP were assessed using an objective structured clinical examination (OSCE). Mean scores were 62.0 ± 8.6 for Group 1 and 79.5 ± 10.4 for Group 2 ($P < .001$). Using an OSCE pass–fail cutoff score of 60%, 17 of 28 Group 1 students (60.7%) and 26 of 27 Group 2 students (96.3%) passed. The CLBP OSCE was one of 10 OSCE stations in which students were tested at the end of a Combined Ambulatory Medicine and Pediatrics Clerkship. There were no between-group differences in performance on eight of the other nine OSCE stations. This module significantly improved medical student clinical skills in evaluating CLBP. Additional research is needed to ascertain the effect of e-learning modules on more-advanced learners and on improving the care of older adults with CLBP.

Keywords

medical student education; older adults; low back pain; objective structured clinical examination

Relieving Pain in America, the Institute of Medicine (IOM) 2011 report dedicated solely to highlighting the healthcare system's deficiencies in managing pain, states that “Effective pain management is a moral imperative, a professional responsibility, and the duty of people in the healing professions.” The IOM report highlights the urgency associated with improving pain education for undergraduate and graduate students.¹ In response to this plea, the National Institutes of Health (NIH) in 2012 designated 12 universities across the United States as Centers of Excellence in Pain Education (CoEPEs), each of which was charged with developing enduring e-learning pain modules for preprofessional students that could be disseminated for use by other health sciences educators nationwide. This manuscript describes the current authors' CoEPE's development of an educational module on evaluation and treatment of chronic low back pain (CLBP) in older adults and the effect of this module on medical student clinical skills at the University of Pittsburgh School of Medicine.

Several considerations affected the focus of this module.

Fiscal Urgency

Costs associated with treating low back pain (LBP) have burgeoned over the past decade, and the patient-related outcomes associated with these costs have not improved.² Treating back problems cost Americans more than \$30 billion in 2007—up from \$16 billion in 1997 (in 2007 dollars).³ Procedures and prescription of opioids, none of which has been guided by strong evidence, but which may be associated with harm, particularly in frail older adults, has been the primary cause of the dramatic rise in LBP-associated costs. During the past decade, the number of lumbar magnetic resonance images increased 307%, Medicare

expenditures for epidural corticosteroid injections increased 629%, expenditures for opioids for back pain increased 423%, and the number of spinal fusion surgeries increased 220%.⁴

Educational Urgency

Investigators have highlighted the gaps in undergraduate medical education about pain evaluation and management.⁵ This dearth of knowledge is often not remediated in residency training programs⁶ and is carried forward by established providers.⁷ Traditional approaches to continuing medical education (CME) are largely ineffective in improving skills and modifying provider behavior.^{8,9} Lack of provider education in rational approaches to evaluation and management coupled with readily available technology-driven interventions (diagnostic and therapeutic) that are wholly spine-focused and do not acknowledge the multifactorial nature of CLBP have, therefore, in part created the costs associated with managing CLBP.

Demographic Urgency

America is aging rapidly. In 2030, an anticipated 20% of the U.S. population will be aged 65 and older. Many older adults function well with chronic pain.¹⁰ For those whose pain is functionally limiting, evaluation and treatment must proceed with a clear understanding of important aging-related problems that complicate pain management, such as how to interpret “abnormal” physical and radio-graphic findings, and changes in pharmacokinetics and pharmacodynamics that heighten the potential for drug–drug and drug–disease interactions.

In response to these urgencies, an interactive e-learning self-study module that focuses on the evaluation (essential components of the history and physical examination), stepped care approach to treatment, and follow-up of community-dwelling older adults with CLBP was developed. It was hypothesized that medical students who completed the module would achieve significantly higher scores on a CLBP objective structured clinical examination (OSCE) than those who had not been exposed to the module.

Methods

Module Development: Focus on Educational Principles

A team of seven faculty with expertise in geriatric medicine (DKW), geriatric psychiatry (JFK), general internal medicine (NEM), chronic low back pain (DKW, MS), educational methods (CW, HS, JGH), and instructional technology (HS) worked together to create the module. Sound educational principles, described here, guided module development.

Identification of Common Errors—Individuals construct learning and understanding from what they already know and believe; new knowledge is built on this preexisting knowledge. When prior knowledge is inaccurate or incomplete, instruction should begin by focusing on activating what students already know. Once people become aware of their misconceptions, the instruction can move on to correcting this knowledge with information that helps students develop a deeper, more-accurate understanding that includes the reasons why their previous knowledge was inadequate.¹¹

Each of the content expert team members compiled a list of common errors made in the evaluation and treatment of older adults with CLBP based upon their clinical and educational experience and knowledge of the literature. The case leader (NEM) then collated these lists, which were then further discussed and refined as a collaborative effort of the entire group. The final list of common errors is shown in Table 1.

Based upon these common errors, the team developed three learning objectives on which the case teaching would focus.

1. Differentiate the Weak Link and the Treatment Targets in Older Adults with CLBP:

A basic tenet of gerontology and geriatric medicine¹² this learning objective highlights, is that there is no shortage of physical pathology in older adults, but often this pathology does not have any direct consequences. Rather, it serves as a vulnerability to other stressors, and therefore, therapy often involves treatment of the other stressors (these are the treatment targets) rather than the pathology itself (the pathology is the weak link). Degenerative disease of the lumbar spine (the weak link) is nearly ubiquitous in older adults^{13,14} and is frequently asymptomatic.¹⁵ Successful treatment of CLBP often involves targeting factors such as hip osteoarthritis¹⁶ and depression¹⁷ rather than focusing on degenerative disc and facet disease.

2. Articulate Realistic Treatment Expectations for Chronic Noncancer Pain: According to the chronic pain literature, individuals of any age with chronic noncancer pain of many varieties (e.g., osteoarthritis, peripheral neuropathy, LBP, fibromyalgia) should expect to experience, on average, 30% pain reduction as a result of treatment.¹⁸ Unrealistic treatment expectations (e.g., complete pain relief) often lead to healthcare provider shopping and exposure to potentially morbid treatments such as nonsteroidal anti-inflammatory drugs, opioid analgesics, and surgery. This may be especially problematic for vulnerable older adults.

3. Describe a Rational Stepped-Care Treatment Approach for Older Adults with CLBP: Stepped-care treatment is used for many chronic illnesses such as diabetes mellitus, hyperlipidemia, and depression.¹⁹ This approach typically employs simpler treatments first and steps up to more-complex or -risky treatments if the desired outcome is not achieved.¹⁹ The stepped-care approach that the module taught for CLBP included non-pharmacological interventions such as education and exercise first, use of other nonpharmacological strategies such as cognitive behavioral therapy along with each of the other steps, and the remaining steps were ordered according to increasing potential risk (e.g., nonopioid analgesics before opioid analgesics).

Interactive Learning—For the purposes of this project, interactive learning is defined as presenting students with questions about recently introduced information and asking them to make a decision about that information. This varies from traditional CMEs, in which content is provided, and students are tested at the end of the instruction. With interactive learning, students receive feedback on their answers within the context of the program, reinforcing or correcting their understanding. Receiving this immediate feedback helps students assess their progress toward the learning goal, resulting in deeper learning.²⁰ Goal-directed practice

coupled with targeted feedback is critical to learning.²¹ Interactive questions were inserted throughout the module. For example, a video clip of the history is shown, and the student is asked to indicate whether the pain history is adequate or inadequate.

Expert Modeling and Feedback—An expert in the content area who teaches in the medical school (DKW) was used for modeling the procedures (history taking, performing a physical examination, prescribing treatment, and evaluating treatment response) and providing the feedback to learners. It has been stated that effective teachers are not only experts in their content area, but also experts in pedagogy because they recognize the process that learners undertake toward mastering specific content.²² Experts approach problems more efficiently than novices and recognize meaningful patterns that novices often overlook.²³ By having experts narrate their thinking, model procedures, and direct attention to important aspects of the physical examination, learners have the opportunity to identify gaps within their own knowledge.

Module Development: Creating the Product

A module mimicking a realistic clinical encounter that was created using a standardized patient (SP) was developed. Brief video clips highlighting important aspects of the encounter and important components of the physical examination using a “bedside teaching” style were inserted throughout the module. Interactive questions and a five-question pre/posttest multiple choice examination were also inserted to help focus learners. The specific steps used in creating the module were as follows.

1. The expert team scripted a mock encounter as a series of PowerPoint slides (PPT; Microsoft Corp., Redmond, WA) addressing all learning objectives. Highlights includes the importance of relying not on imaging to prescribe treatment but on comprehensive assessment that acknowledges chronic pain as a biopsychosocial syndrome, avoiding Beers list medications,²⁴ and the need for providers to reinforce realistic treatment expectations and goals during follow-up visits. Five multiple-choice pretest questions inserted to help students focus on important concepts were reinforced using five posttest questions.
2. The team leader (NEM) used an iterative approach to finalize the PPT script. After the entire team approved the script, it was submitted to the NIH Pain Consortium for review and approval. After minor corrections and revisions, the media specialist team led by HS conducted two video-recording and two audio-recording sessions. An SP performed the role of the patient, and the actual pain expert (DKW) played the pain expert.
3. After the media specialist integrated the PPT slides, video recordings, and audio recordings, it was distributed for internal and then external review. Instructors across the University of Pittsburgh Schools of Medicine, Nursing, Health and Rehabilitation Sciences, and Pharmacy performed internal review and provided feedback, which they delivered to the case creator team. Modifications were made based upon this feedback. The revised case was then submitted for external review to the NIH Pain Consortium, and the case was further refined. The final module can

be viewed on the Web site that is under construction (<http://painconsortium.nih.gov/CoEPEs.html>). The anticipated available date is June 2014.

Module Implementation

The University of Pittsburgh institutional review board approved the protocol as exempt. The course director (DME) required medical students to view the module as part of the 8-week Combined Ambulatory Medicine and Pediatrics Clerkship (CAMPC). Students indicated their assent to participate by checking a box at the beginning of the module.

Two blocks of third-year medical students at the University of Pittsburgh School of Medicine participated. The 28 students in Block 1 were not exposed to the module. The 27 students in Block 2 were exposed to the module. Allocation of students to Block 1 or Block 2 was not random. At the University of Pittsburgh School of Medicine, students are assigned to their clinical rotations as cohesive blocks. To avoid disruption of the curriculum structure, one block of students was exposed to the model, and one block was not.

The text and graphics from each PPT slide and the audio and video were uploaded into vpSim, an online virtual patient player and authoring and administration application for medical education, training, and assessment developed at the University of Pittsburgh School of Medicine (<http://vpsim.pitt.edu/>). Web pages were created that allowed the learners to navigate forward and backward (for review only) through the case. The module was approximately 60 minutes long.

Because the module was an online intervention, students in Block 2 completed it at variable points during the 8-week clerkship. All students were required to complete the module and all other course assignments by the seventh week. Thus, they had completed the module at least 1 week before the OSCE.

Outcomes Assessment

The effect of the module was assessed using an OSCE. SPs were consistent across groups and were masked to whether students had been exposed to the module. The components of the OSCE on which students were tested are described in Table 2. The evaluator scored each component as yes (student performed) or no (student did not perform). The CLBP OSCE was one of 10 OSCE stations in which students were tested at the end of CAMPC, each of which lasted 12 minutes. The other nine stations were palpitations, sinus infection, hypertension treatment, anticipatory guidance, pediatric abdominal pain, angiotensin-converting enzyme inhibitor (medication issues), pediatric prescription writing, pediatric ear examination, and adult abdominal pain. The examination took place in the University of Pittsburgh Wiser Center for simulation. For each station, students were given a focused task involving history taking, physical examination, or documentation. The tasks reflect combined problems in ambulatory internal medicine and pediatrics. Most involved a SP, and at least one station had a faculty member observer. SPs and faculty graded students and provided direct feedback in real time.

The OSCE has three forms (stations in three distinct orders). Two forms were used for the current study; students in Group 1 rotated through the stations in an order different from that

of Group 2. The internal consistency is 0.6–0.7 and has demonstrated construct validity with other examinations, such as the National Board of Medical Examiners Subject Examination.

Statistical Analyses

Raw scores and pass rates were calculated using simple descriptive statistics. The between-group differences were evaluated using the Student *t*-test because scores were parametric in distribution.

Results

Mean scores on the CLBP OSCE station and mean and individual scores on the other nine OSCE stations for students in Group 1 and Group 2 are shown in Table 3. The groups performed comparably on eight of nine non-CLBP stations. Group 1 performed significantly better (approximately 9 points) on the pediatric abdominal pain station. Students in the group exposed to the educational module (Group 2) achieved a mean score of 79.5 ± 10.4 on the CLBP OSCE station, and those who were not exposed to the module (Group 1) achieved a mean score of 62.0 ± 8.6 ($P < .001$). Using a raw pass–fail cutoff score of 60%, 17 of 28 students (60.7%) in Group 1 and 26 of 27 students (96.3%) in Group 2 passed the CLBP OSCE station.

Discussion

To the knowledge of the authors, this is the first study to examine the effect on medical student skills of an e-learning self-study module on CLBP. The effect of this simple intervention was substantial. Only 61% of students not exposed to the module passed the CLBP OSCE, compared with 96% who were exposed. Students in both groups had nearly identical mean scores on eight of the nine non-CLBP OSCE stations, supporting that their overall patient evaluation and management skills in content areas other than CLBP were well matched. The potential downstream effect of this type of education is substantial.

Pain is one of the most common symptoms that people report to their primary care providers, and paradoxically, it is one of the subjects least well taught in medical schools in the United States.⁵ This fact, in combination with mandates (by the Veterans Health Administration of the Department of Veterans Affairs) or recommendations (by The Joint Commission) to measure pain as the fifth vital sign in all patient encounters, has led to a culture of awareness without preparedness and, therefore, frequent pain mismanagement.²⁶

Students exposed to the module performed significantly better than unexposed students on a skills-based outcome measure: the CLBP OSCE. It has been demonstrated in multiple types of learners that self-assessments of competence often do not correlate with observed measures of competence (e.g., the OSCE), and that sometimes those with the least skill report the most confidence.²⁷ This phenomenon has previously been demonstrated in established providers regarding the evaluation and treatment of older adults with CLBP.⁷ The OSCE method is thought to be superior to written examination in measuring clinical competence.²⁸ The OSCE offers the advantage over evaluating learners in a real clinical setting (the criterion standard) of “test material” consistency.²⁹ That is, in a real clinical

setting, different patients pose different learner challenges, and this variability is eliminated with the OSCE. A recent systematic review concluded that OSCEs are feasible, valid, and reliable for measuring clinical competencies of medical students.³⁰ They are now part of the medical licensing process in the United States and Canada.

Although this study had a number of strengths, it also had limitations. Students have free access to a variety of educational materials. It cannot be assumed, therefore, that the better performance of students in Group 2 than of those in Group 1 was solely because of their exposure to the educational module. Second, given the small sample size, the extent to which the findings can be generalized is unknown. Third, only one educational strategy was studied, so the efficacy of the e-learning self-study module cannot be compared with that of other strategies. The extent to which students carry forward the knowledge and skills learned to the clinical setting is also unknown. Finally, in keeping with the format of the other nine OSCE stations, the CLBP OSCE tested fundamental history and physical examination skills. The educational module addressed a number of teaching points related to older adults (e.g., medications on the Beers list, effects of social isolation, the commonplace nature of degenerative pathology and spinal stenosis that may or may not be responsible for symptoms), some of which were not specifically tested.

These findings are encouraging about the potential to develop efficient educational interventions regarding the evaluation and management of CLBP in older adults. Remediation of educational gaps is necessary but not sufficient to improve the care of these individuals. Healthcare systems challenges (e.g., insufficient time allotted to primary care visits, lack of oversight of specialty care) also require remediation to curtail costs and optimize outcomes. Future research should focus on examining the effect of different types of educational strategies and other interventions on improving CLBP management.

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Table 1
Errors Made by Trainees in the Evaluation and Treatment of Older Adults with Chronic Low Back Pain (CLBP) and Associated Teaching Points

Error	Teaching Points Included in Module
Taking the history	
Treatment expectations are not queried	Ask the patient, "What are your goals in coming to see me?" The response to this question can be an opportunity for intervention. For example, if they say "I want you to get rid of my pain," you would want to educate the patient about the difference between acute and chronic pain and about realistic treatment expectations with chronic pain.
Only present pain severity is queried	A more-comprehensive pain history should be obtained that includes present pain, average and worst pain over the past week, and activities with which pain interferes.
When asking about pain location, trainees do not ask patient to demonstrate	When the patient says their back hurts, the trainee should say "Can you put your hand on it and show me?" Lower back pain could mean lumbosacral pain, sacroiliac pain, stenosis pain, among other things.
History focuses on pain alone and does not probe important comorbidities such as sleep disturbance, depression, anxiety	Chronic pain is a multifactorial problem, so important comorbidities should be queried in the context of the main history, not just in the review of systems. There are multiple comorbidities that are mutually exacerbating with pain and pain-associated functional compromise, such as sleep disturbance, depression, and anxiety. These comorbidities must be overtly queried to facilitate identifying all important treatment targets.
History does not explore psychosocial stressors that may be exacerbating pain	Module presents the biopsychosocial model of chronic pain and presents common psychosocial stressors in older adults (e.g., fear-avoidance beliefs, low self-efficacy, catastrophizing, social isolation).
Night pain may be assumed to be an early sign of serious pathology	Sleep disturbance is common in older adults, and the reason for the sleep disturbance must be queried carefully (e.g., nocturia, worrying, depression). Night pain also might be positional, and patients should be asked questions such as, "Do you get the pain when you roll over in bed, sleep on one side, or sleep in a particular position?" "Does the pain go away or get better if you change position or get up and move around?"
Failure to ask whether pain is constant or intermittent	Clarification of pain pattern is important. Pain that is truly 24/7 may indicate serious pathology or central sensitization. If pain is intermittent, additional questions should determine which movements or postures provoke the pain.
Inadequate history taken to ascertain presence of neurogenic claudication in the patient with MRI evidence of lumbar spinal stenosis	Many things can cause back and leg pain. The presence of central canal stenosis on MRI may be incidental. Features of the history that support a clinical diagnosis of stenosis are presented.
Performing the physical examination	
Patient does not disrobe	It is important that the patients disrobe so that subtle biomechanical abnormalities and myofascial pathology can be adequately evaluated. The examination of the SP is performed with the SP wearing a hospital gown.
Muscles are not palpated at all or not palpated firmly enough. Trainees may fear "hurting the patient"	Myofascial pathology exists in the majority of older adults with CLBP. Examination for myofascial pathology (taut bands and trigger points) requires firm palpation perpendicular to the direction of the muscle fibers. Technique is briefly demonstrated.
The hips are not examined	The hips should be routinely examined in individuals with CLBP because hip osteoarthritis can contribute to LBP and leg pain. How to perform internal hip rotation and FABER's test are demonstrated.
Prescribing treatment	
Treatment prescribing focuses exclusively on pain as a way to improve pain and function	Because chronic pain is a biopsychosocial syndrome with multiple contributors and consequences, treatment should include all of the biological, psychological, and social contributors to pain and functional impairment. This comprehensive approach is emphasized in the module.
Medications may be prescribed that should be avoided in older adults, such as nonsteroidal anti-inflammatory drugs	Pain medications included in Beers criteria are reviewed.

Error	Teaching Points Included in Module
Physical therapy is not prescribed because patient indicates that they had it previously and that it was not effective	Trainees need to take a more-detailed history about the specific components of the physical therapy to make sure that the prior treatment was appropriately targeted. For example, if the patient's hip arthritis is thought to mainly be driving the pain and difficulty functioning, prior treatment focused on lumbar spinal stenosis would not be effective. This is emphasized in the module.
Evaluating treatment response	
Follow-up focuses exclusively on pain reduction	At the time of follow-up, the provider should evaluate the other comorbidities and consequences of pain such as depression, fear-avoidance beliefs, and social isolation. These concepts are emphasized in the module.
Trainee assumes that individual has realistic treatment expectations	Long-standing beliefs may require repeated education to modify. The provider may need to reinforce multiple times that complete pain relief is not a realistic goal. This is emphasized in the module.

MRI = magnetic resonance imaging; SP = standardized patient; FABER = flexion, abduction, external rotation.

Table 2
Chronic Low Back and Leg Pain Objective Structured Clinical Examination—Test Items

History—Did the student ask
Duration of pain?
To show the location of pain?
About aggravating factors?
Were there any alleviating factors?
Was there any interference with function?
About any mood changes?
About pain in areas other than the back?
Has this pain affected your sleep?
About your expectation of treatment?
Physical examination ^a —Did the student
Evaluate the spinal alignment?(unties gown and inspects back)
Palpate lumbar paraspinal musculature on both sides?
Use FABER's test?
Palpate sacroiliac region on both sides?
Evaluate hip internal rotation on both sides?
Palpate the piriformis muscle?
Palpate the IT band?
TOTAL: /16

^a Specific instructions and photographs were provided to operationally define correct performance of the individual components of the physical examination.

FABER = flexion, abduction, external rotation; IT = iliotibial.

Table 3
Student Performance on Chronic Low Back Pain (CLBP) and Non-CLBP Objective Structured Clinical Examination (OSCE) Stations

OSCE Station	Group 1 (Not Exposed to CLBP Module) (n = 28)	Group 2 (Exposed to CLBP Module) (n = 27)	P-Value
	OSCE Score (Mean +/- SD)		
CLBP	62.0 ± 8.6	79.5 ± 10.4	<.001
Non-CLBP (average over nine stations)	71.0 ± 4.72	70.0 ± 4.4	.23
Palpitations	84.5 ± 13.1	86.0 ± 14.9	.68
Pediatric ear examination	76.8 ± 13.9	73.3 ± 12.8	.22
Angiotensin-converting enzyme inhibitor	90.0 ± 10.9	91.8 ± 8.3	.48
Sinus infection	90.2 ± 9.4	93.5 ± 8.7	.18
Anticipatory guidance	61.7 ± 20.5	66.0 ± 17.2	.40
Adulticipatory guidance	85.0 ± 15.3	84.8 ± 10.1	.96
Pediatric abdominal pain	78.9 ± 12.9	69.8 ± 13.8	.01
Hypertension treatment	59.3 ± 10.7	58.2 ± 11.0	.71
Pediatric prescription writing	83.0 ± 12.6	76.8 ± 15.7	.34