

Interdisciplinary Pain Neuroscience Continuing Education in the Veterans Affairs

Live Training and Live-Stream With 1-Year Follow-up

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Objective: Because of the pain and opioid epidemic in the United States, there is a need to update clinician's knowledge, attitudes, and beliefs regarding persistent pain across health care disciplines. The aim of this study was to determine if health care professionals can positively change their knowledge, attitudes, and beliefs regarding chronic pain, following a pain neuroscience education (PNE) lecture and 1 year follow-up.

Materials and Methods: A total of 270 health care providers at the Minneapolis Veterans Affairs Health Care System received a 3.5-hour PNE lecture in person or via live-stream. Primary outcomes were the Neurophysiology of Pain Questionnaire (NPQ) and Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS) measured before, immediately after, and 1 year after the PNE lecture. At 1 year participants were also asked how the PNE lecture affected their practice.

Results: Pain knowledge (NPQ) ($P < 0.01$) and attitudes and beliefs regarding persistent pain (HC-PAIRS) ($P < 0.01$) improved for all providers, with specific improvements across several disciplines. Positive gains in outcomes were equal for in-person attendance, and live-streaming of the lecture. One year later, NPQ and HC-PAIRS gains diminished, yet clinicians reported a large positive impact on daily clinical practice.

Discussion: PNE resulted in a positive clinical impact for health care providers treating patients with persistent pain. The mechanism of this effect may be about healthier attitudes and beliefs regarding persistent pain rather than increased knowledge about pain.

Key Words: pain neuroscience education, interdisciplinary, pain education, physical therapy

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An estimated 126.1 million adults in the United States experience pain over a 3-month period, with 25.3 million reporting daily chronic pain.^{1,2} Americans, 5% of the world's population, consume 80% of the opioids, and 99% of the

hydrocodone globally.³ Given the complexity and epidemic of pain, along with the opioid epidemic, a renewed call for a multidisciplinary approach to treating pain has ensued.^{1,4,5} One segment of the US population affected significantly by chronic pain and opioid use is the Veterans from the Department of Veterans Health Administration (VHA).^{6,7} Eighty percent of VHA visits include pain-related symptoms and musculoskeletal pain conditions are the highest reported issues faced by >2 million Veterans from Operations Enduring Freedom, Iraqi Freedom and New Dawn.^{6–10} Related to the pain and opioid epidemic itself, the VHA additionally faces serious concerns over suicide, posttraumatic stress disorders, depression, and more.^{11–13}

To address this pain epidemic, health care providers should have fundamental knowledge of modern pain science, which has shown significant advances in recent years^{14–16}; yet old theories still prevail.^{17–19} For example, in 1965 the Gate Control theory explained how an interaction of small and large diameter nerve fibers can impede signal transmission in the dorsal horn changing processing and influencing an individual's pain.^{16,20} This revolutionary theory was included in almost every textbook in the biological and medical sciences by the mid-1970s.¹⁶ More than 50 years later, the Gate Control theory is still used to teach pain in medical schools and health sciences,^{17,21,22} despite the original author asking clinicians and scientists to expand their pain knowledge, moving beyond the Gate Control theory.^{17,18} With advances in brain scanning, neuroimmunology, and our understanding of psychosocial contributors, it is reasonable to question if the modern clinician is equipped to deal with the pain epidemic.²³ Various studies dealing with persistent pain demonstrate that clinicians struggle treating this patient population.^{18,23–26} The combination of limited knowledge about pain science, and erroneous attitudes and beliefs regarding chronic pain, pose a significant barrier to effectively treating patients in pain and addressing the opioid epidemic.²⁷

A modern view of pain has led to a neuroscience approach to pain management in physical therapy, which aims to explore a deeper biological and physiological understanding of the pain experience.^{14,15} The clinical application of this model is Pain Neuroscience Education (PNE), whereby this contemporary knowledge of pain is shared with patients to help them reconceptualize their pain.^{28–33} Strong evidence exists for NE to positively influence pain ratings, dysfunction, fear-avoidance behavior, pain catastrophization, movement dysfunction, pain knowledge, and health care utilization.^{30,34}

Part of the evolution of PNE is to use it to increase pain science knowledge. In 2003, Moseley²³ showed a 23% increase

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in pain knowledge in health care providers following a 3-hour PNE lecture and another study showed improvements in pain knowledge in physical therapy students after a 3-hour lecture.¹⁸ Other studies have shown that patients in chronic pain are also able to increase their pain knowledge after a PNE lecture.^{23,35,36} This improved knowledge may be a key aspect of the positive effects of PNE regarding pain and disability.^{23,36} To date, no study has compared various health care professions' pain knowledge gains after a PNE lecture. In the 2003 study, there was no delineation of professions in those who increased their pain knowledge,²³ with the only profession-specific PNE study being conducted on physical therapy students.¹⁸ This study contained 4 aims: the first, and primary aim of the study, was to determine if professions other than physical therapy can increase their knowledge of pain after a PNE lecture. Second, to determine if the PNE lecture resulted in any meaningful clinical changes over the 1-year follow-up period. Third, to determine if the PNE lecture would positively influence health care providers' attitudes and beliefs regarding patients with chronic pain. Lastly, to determine if live-stream PNE delivered to health care providers yielded similar effects as a live presentation of PNE.

MATERIALS AND METHODS

Participants and Recruitment

To improve communication within the multidisciplinary health care staff and with patients with chronic pain, the Minneapolis Veteran's Affairs (VA) Health Care System (HCS) determined that PNE training was needed. The Minneapolis VA HCS serves ~100,000 patients annually throughout Minnesota and parts of northwestern Wisconsin. Institutional Review Board (IRB) approval was obtained from the University of Minnesota, and consent was obtained from each participant before PNE training. The training was determined by the Minneapolis VA Internal Review Board (IRB) to be exempt from formal review, thus exempting the need for VA IRB approval. The VA is an important setting for PNE because of the high prevalence of patients with chronic pain and opioid use, and the VA's national efforts to improve pain care.^{10,37} The PNE lecture was delivered in-person in an auditorium and via live-stream to remote sites within the Minneapolis VA HCS. All VA clinical staff were invited to the lecture. The PNE lecture was given on 2 occasions, allowing clinicians to attend a lecture and fulfill work requirements. Participation was recommended, but not mandatory. To determine the effectiveness of the PNE lecture, participants completed surveys pre-PNE lecture, postlecture and at

1-year postlecture. De-identified survey data were made available to the researchers for analysis and publication.

The study sample included employees eligible to attend the educational session. There were 270 participants (mean age, 43.8 ± 16.5; female, 71.5%; mean years in profession, 16.4 ± 12.5) in this study. See Table 1 for discipline-specific data. Because of small numbers, those classified as chaplains (n=2), physician assistants (n=3), and chiropractors (n=2) were excluded from the analysis. Those classified as other (n=24) were also excluded as they were not a homogenous group; most of those were students and would not be practitioners for the duration of the study. Eighty-two participants (30.4%) returned a follow-up survey at 1-year. To determine if there was bias in those responding at 1-year, we qualitatively compared age (overall, 43.8 ± 16.5; 1-y, 43.5 ± 15.7), sex (overall % female, 71.5%; 1-y, 69.1%), years in profession (overall, 16.4 ± 12.5; 1-y, 16.5 ± 13.2), and profession frequency of the 4 most common responders as a percentage of the sample: nurses (overall, 44.8%; 1-y, 39.0%), physicians (MD/DO) (overall, 21.1%; 1-y, 22.0%), psychologists (overall, 12.6%; 1-y, 6.1%), and physical therapists (overall, 9.3%; 1-y, 17.1%).

Intervention

The content of PNE is well documented and consistent with other studies.^{23,38-40} A 3.5-hour presentation was developed, focusing on peripheral sensitization, central sensitization, bio-psycho-social factors associated with pain, threat appraisal of the brain, nociception, stress and endocrine responses to pain, and various therapeutic endogenous strategies to ease pain.^{23,38-40} Images, metaphors and examples were used,⁴¹ and the presentation did not specifically address any questions contained in the outcome measures. One of the authors (A.L.) delivered the PNE lecture allowing ample time for questions and answers. Participants could receive the PNE lecture in-person or via live-streaming to other locations.

Outcome Measures

Researchers supervised data collection and data coding and entry was done by a blinded research staff member. Two formal outcome measures, the Neurophysiology of Pain Questionnaire (NPQ) and the Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS), were used to examine the attendees' knowledge of, and attitudes and beliefs about chronic pain:

- *Pain knowledge:* pain knowledge was measured using the NPQ which is based on a pain science text⁴² and was used previously measuring the neurophysiology knowledge of patients and health care personnel.²³ The original NPQ was 19 questions requesting "true"; "false"; or "not sure"

TABLE 1. Means and SDs by Health Profession Discipline Except for the Following Which Had Too Few to Calculate Descriptive Data (Radiology Technician, Chaplain, Assistant, and PA)

Profession	Frequency	Age (y)	% Female	Years in Profession	Years at VA
Nurse	121	44.8 ± 18.8	90.4	19.2 ± 12.2	9.1 ± 8.5
Physician	57	50.1 ± 13.8	33.9	18.9 ± 14.0	6.4 ± 6.3
Psychologist	34	38.6 ± 12.0	80.6	7.7 ± 6.3	6.0 ± 6.2
Pharmacist	9	34.1 ± 16.4	66.7	11.5 ± 12.2	4.6 ± 5.7
Social worker	10	36.8 ± 16.6	90.0	14.4 ± 7.2	6.8 ± 4.5
Physical therapist	25	37.4 ± 12.0	76.0	12.2 ± 11.0	6.8 ± 7.3
Occupational therapist	14	44.6 ± 13.4	84.6	15.7 ± 13.8	9.7 ± 8.7

PA indicates physician's assistant; VA, Veteran's Affairs.

answers, with higher scores indicating more correct answers. A subsequent Rasch analysis led to the removal of 6 ambiguous questions, leaving 13 questions (revised NPQ [rNPQ]) in the version used in this study.⁴³ Previous studies have shown an increase in pain knowledge of 23% in health care providers²³ and 46% in physical therapy students after PNE.¹⁸

- **Pain attitudes and beliefs:** attitudes and beliefs regarding chronic low back pain were measured using the HC-PAIRS.²⁵ Specifically designed to assess attitudes and beliefs about chronic low back pain, the HC-PAIRS was used in this study as an assessment of attitudes and beliefs regarding chronic pain, with the low back provided as one example of chronic pain. The HC-PAIRS has 15 questions with responses marked on a 7-point Likert scale anchored on one end with “Completely Disagree” and on the other with “Completely Agree.”^{25,44} When used to measure attitudes and beliefs of health care providers regarding chronic low back pain, this scale has been shown to have high reliability, internal consistency, and discriminant validity.⁴⁴ Scores vary from low (15) to high (105), with a lower total score suggestive of positive beliefs and attitudes that pain complaints do not justify impairments and disability and a high score denoting a strong conviction that pain and physical impairment are strongly linked together.^{25,44-46} The HC-PAIRS has also been shown to be a reliable and valid measure of health care providers’ attitudes and beliefs about the relationship between pain and impairment,⁴⁶ and was previously used with physical therapy and osteopathic medicine students.^{25,45} Some studies have questioned if an adjusted HC-PAIRS, which eliminates 2 items, may be indicated, resulting in an adjusted HC-PAIRS (aHC-PAIRS) score. In this study, both measures (HC-PAIRS and aHC-PAIRS) were analyzed.^{44,46}

Both the NPQ and HC-PAIRS were completed before and immediately following the PNE lecture. They were then

placed into envelopes, sealed and sent to a blinded research assistant for entry into a spreadsheet for analysis. One-year after the PNE lecture an email was sent to attendees requesting them to complete the NPQ and HC-PAIRS, and rate 5 practice-impact statements. These statements were assessed on a 7-point Likert scale anchored on one end with “Completely Disagree” and on the other with “Completely Agree,” and were adapted from an internal VA survey used to explore changes in practice following previous educational sessions:

- I experience less frustration with my patients with persistent pain.
- I find treating patients with persistent pain more helpful and rewarding.
- I changed my treatments for people with persistent pain.
- I think differently about my patients with persistent pain.
- I talk differently about pain with my patients.

Data Analysis

Data were analyzed using SPSS version 24.0 (IBM SPSS Statistics for Windows; IBM Corp, Armonk, NY) and $\alpha=0.05$. Before and after PNE scores on the NPQ and HC-PAIRS were analyzed using a 2 (time: pre and post) \times 6 (health care profession: physical therapist, occupational therapist, nurse, nurse practitioner, physician, psychologist) mixed factorial analysis of variance interactions were broken down with simple main effects of improvements by discipline. Cases where a posttest was missing were not analyzed. To determine the long-term effect of the PNE on the overall sample, a repeated-measures analysis of variance was used on the 3 main measurement points (pre, post, 1-y) for both the NPQ and HC-PAIRS for the 82 participants who returned the 1-year survey. For the post hoc questions about how PNE changed pain management views and practice, frequencies of responses were reported. Because of a smaller number of responses on the 1-year follow-up survey, there was no analysis of these data by health discipline.

TABLE 2. Means, SDs, and *P*-values of the Comparisons of Pre and Post Scores on the NPQ

Profession	N	Mean	SD	<i>P</i>
Nurse				
NPQ pre	113	7.7	2.0	<i><0.001</i>
NPQ post	113	9.2	2.2	
Physician				
NPQ pre	52	8.9	1.6	<i><0.001</i>
NPQ post	52	10.6	1.8	
Psychologist				
NPQ pre	29	8.6	2.3	<i><0.001</i>
NPQ post	29	10.7	1.4	
Pharmacist				
NPQ pre	9	8.8	1.9	0.066
NPQ post	9	10.3	1.2	
Social worker				
NPQ pre	7	7.0	1.8	0.011
NPQ post	7	10.1	2.0	
Physical therapist				
NPQ pre	25	10.4	1.8	<i><0.001</i>
NPQ post	25	11.5	1.3	
Occupational therapist				
NPQ pre	14	10.1	1.8	0.117
NPQ post	14	10.7	1.7	

Statistically significant *P*-values are italicized.
N indicates number; NPQ, Neurophysiology of Pain Questionnaire.

RESULTS

Overall, the NPQ score improved from pre (total correct 8.4 ± 2.2) to immediately post PNE (total correct 10.1 ± 2.1) ($P < 0.001$). Comparisons by discipline revealed that each profession had a significant ($P \leq 0.05$) improvement with PNE except for pharmacists and occupational therapists (Table 2 and Fig. 1).

Overall, the HC-PAIRS score decreased from pre (total 53.0 ± 8.4) to post (total 50.6 ± 7.7), ($P < 0.001$) PNE. Likewise, the adjusted HC-PAIRS (aHC-PAIRS) score decreased for all participants from pre (total 42.1 ± 8.3) to post (total 39.4 ± 7.4), ($P < 0.001$) PNE. Post-PNE comparisons by discipline revealed that only the nurses decreased their perception about the relationship between disability and pain; no other discipline exhibited a significant decrease in this perception (Table 3).

Comparing different health professionals amongst each other on the change between pre and post scores, there were no significant differences among the difference scores for the NPQ ($P = 0.069$) or the HC-PAIRS ($P = 0.240$) (Table 4). There was no difference between live-stream and onsite instruction on the improvement in NPQ scores (live-stream 1.6 ± 2.0 ; onsite 1.7 ± 2.0), ($P = 0.656$); however, there was a significant difference in HC-PAIRS improvement between the 2, with the live-

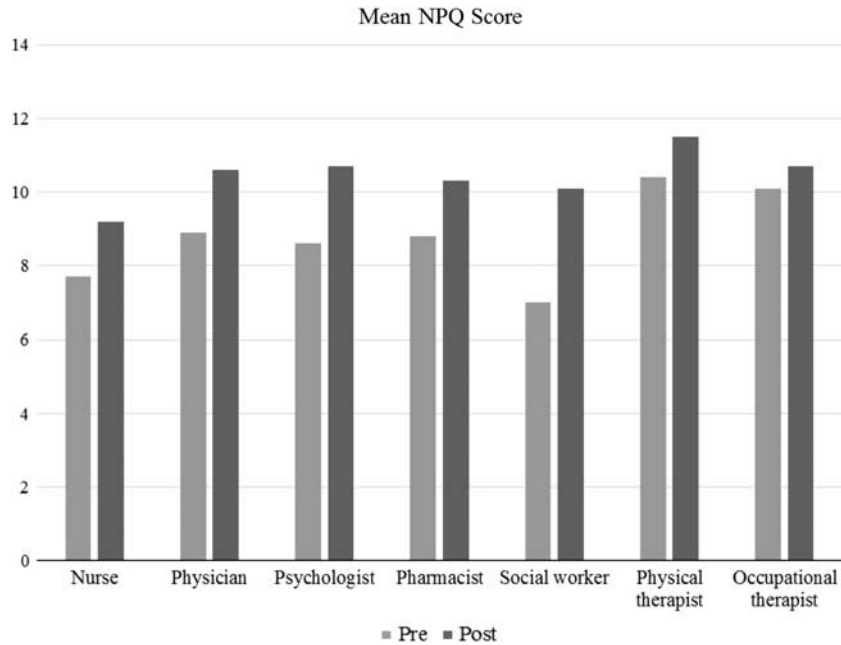


FIGURE 1. Pre and post pain neuroscience education Neurophysiology of Pain Questionnaire (NPQ) scores per profession.

stream demonstrating greater improvement than the onsite (live-stream 5.0 ± 6.3 ; onsite 1.4 ± 7.2) ($P < 0.001$).

Lastly, there was no correlation between the immediate post scores for the NPQ and the HC-PAIRS (Spearman ρ 0.075) ($P = 0.218$), suggesting no relationship between the 2 measures. For the long-term effect of PNE on NPQ scores, there was a statistically significant change over the 3 time points, $F_{(2,162)} = 23.381$, $P < 0.001$ (pre = 9.0 ± 1.9 ; post = 10.3 ± 2.0 ; 1 y = 9.0 ± 2.3). Post hoc analyses revealed a statistically

significant improvement in NPQ scores from pre to immediately post ($P < 0.001$) which significantly declined over the next year ($P < 0.001$) returning to baseline ($P = 0.9156$). There was no significant change in HC-PAIRS over time despite the decrease in scores, $F_{(2,154)} = 3.015$, $P = 0.052$ (pre = 51.4 ± 7.1 ; post = 49.7 ± 7.4 ; 1 y = 49.6 ± 7.0).

The 5, 1-year follow-up clinical-impact statements showed participants to have a mostly positive experience on pain management views from the PNE (Fig. 2). Specifically, a 70.7% of respondents reported being less frustrated

TABLE 3. Means, SDs, and *P*-values of the Comparisons of Pre and Post Scores on the HC-PAIRS

Profession	N	Mean	SD	<i>P</i>
Nurse				
HC-PAIRS pre	109	56.0	8.8	<i>< 0.001</i>
HC-PAIRS post	109	52.4	9.2	
Physician				
HC-PAIRS pre	52	50.4	6.6	0.111
HC-PAIRS post	52	49.0	5.4	
Psychologist				
HC-PAIRS pre	29	47.0	5.5	0.975
HC-PAIRS post	29	47.0	5.0	
Pharmacist				
HC-PAIRS pre	9	51.6	6.7	0.173
HC-PAIRS post	9	49.1	8.3	
Social worker				
HC-PAIRS pre	8	56.9	9.2	0.065
HC-PAIRS post	8	52.8	5.0	
Physical therapist				
HC-PAIRS pre	25	50.3	6.8	0.087
HC-PAIRS post	25	48.0	6.2	
Occupational therapist				
HC-PAIRS pre	13	53.8	7.1	0.196
HC-PAIRS post	13	51.9	7.6	

Statistically significant *P*-values are italicized. HC-PAIRS indicates Health Care Providers' Pain and Impairment Relationship Scale; N, number.

TABLE 4. Means, SDs, and 95% Confidence Intervals for the Difference Scores (Post Minus Pre) by Profession

	Mean	SD	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
NPQ				
Nurse	1.5	2.2	1.1	1.9
Physician	1.7	1.8	1.2	2.2
Psychologist	2.1	2.2	1.3	3.0
Pharmacist	1.6	2.2	-0.1	3.2
Social work	3.1	2.0	1.5	4.8
Physical therapist	1.1	1.1	0.7	1.6
Occupational therapist	0.6	1.5	-0.3	1.5
HC-PAIRS				
Nurse	-3.6	8.4	-5.2	-2.0
Physician	-1.4	6.0	-3.1	0.3
Psychologist	0.0	5.9	-2.2	2.3
Pharmacist	-2.4	5.0	-6.3	1.4
Social work	-4.1	5.3	-8.5	0.3
Physical therapist	-2.3	6.5	-5.0	0.4
Occupational therapist	-1.9	5.1	-4.8	1.1

HC-PAIRS indicates Health Care Providers' Pain and Impairment Relationship Scale; NPQ, neurophysiology of pain questionnaire.

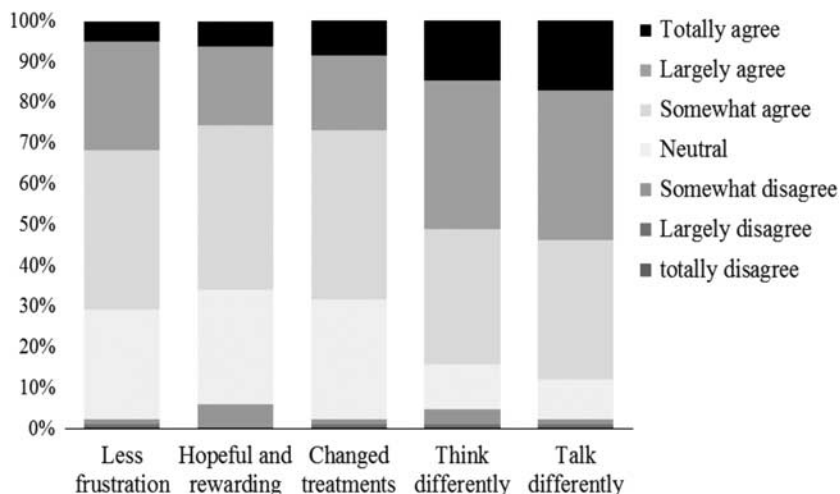


FIGURE 2. Frequencies of response ratings for the 5, 1-year follow-up clinical impact questions.

treating patients with chronic pain and 65.9% also found their care more hopeful and rewarding. A majority of respondents also felt that the PNE influenced their care of people with chronic pain. Specifically, 68.3% of the respondents reported a change in their treatment as a result of the PNE. More impressively, respondents at 1-year reported that they thought (84.1%), and talked (87.8%) about pain differently with their patients.

DISCUSSION

This is the first discipline-specific study assessing pain knowledge and beliefs and attitudes regarding chronic pain post-PNE presentation. This study showed that various professions, other than physical therapy, can increase their knowledge of pain and attitudes regarding chronic pain after a PNE lecture. With no follow-up education, the gains in knowledge and attitudes eroded over time, yet 1-year later health care providers reported a positive clinical influence from the PNE lecture.

In the original PNE study, Moseley²³ showed that health care providers improved their knowledge of pain by 23% (55% to 78%), using the original 19-point NPQ. In this study, using the revised 13-point rNPQ, health care providers improved by 12.3% (64.6% to 76.9%). Although the increase in this study was smaller, health care providers started with a higher knowledge base and ended in the same post-PNE range as the original study.²³ This study, analyzed providers from different disciplines, showing several professions able to positively shift. The largest increase in pain knowledge occurred for registered nurses (19.2%), pharmacists (17.7%), and psychologists (16.9%). There is no information regarding how large a shift on the NPQ or rNPQ is considered important or is needed to impact patient care. The results show that other professions, besides physical therapy (the designers of PNE), can increase their knowledge of pain. Given the complexity of chronic pain, there is a need for patients to have multidisciplinary care from various health care providers such as nurses, psychologists, pharmacists, physician, and others.^{47,48} Providing a uniform explanation of how pain works, may have a significant therapeutic effect.^{49,50} Learning theory and behavioral medicine studies have shown that repeated exposure to a message is needed to cause behavioral change.⁵¹⁻⁵³

Therefore, hearing the same “pain message” from various health care providers may be more powerful in the long run.

The need for repeated exposure to the “pain information” is underscored by the fact that survey scores in this study eroded over the 1-year period. To date, only 2 NPQ studies have examined the “erosion” effect.^{18,36} In a multi-center, patient education study, after a 2-hour PNE session, Louw et al³⁶ showed gains in NPQ which were maintained 3-month later in patients with persistent pain, while Cox et al¹⁸ showed gains in the NPQ were maintained 6-month post-PNE in physical therapy students. Two possible reasons for the erosion are postulated. First, this study’s follow-up was well beyond either of the other long-term studies. Second, the participants were practicing clinicians, and studies show that health care providers lean heavily on their original training throughout their career, indicating a reluctance to shift to new educational material.⁵⁴⁻⁵⁷ One study showed that 90% of clinicians base treatment choices on their original training, versus continuing education.⁵⁴

This study also showed that a PNE lecture can positively change health care providers beliefs and attitudes regarding chronic pain. Although the HC-PAIRS did not show a significant difference at 1-year follow-up, the perceived impact on clinical practice did show an impressive positive change. Various studies have shown that health care providers struggle treating patients with chronic pain.^{18,23-26} In addition, clinicians who treat patients with persistent pain may develop negative attitudes and beliefs toward these patients,²⁵ and treating these more challenging patients has been linked to burnout.⁵⁸⁻⁶² The positive shift in self-reported practice in this study is important as it aligns with research into therapeutic alliance (TA).^{63,64} TA is the working rapport or positive social connection between the patient and clinician and is a complex blend of a clinician’s technical skill, verbal and nonverbal communication, sense of warmth, trust, and collaboration with the patient.⁶⁵ The PNE positively shifting health care providers’ perceptions regarding chronic pain may enhance treatment effects⁴⁹ as supported by clinical studies using PNE for people struggling with chronic pain,^{29,66,67} through a reconceptualization of pain or a reduction in fear-avoidance.^{29,62,63} This study may suggest another mechanism, whereby PNE alters

the clinician's beliefs and attitudes regarding chronic pain, which may enhance the TA.

Finally, this study showed that the live PNE presentation was not superior to live-streaming. This implies that PNE may be equally effective when delivered via technology.^{68,69} With the ever-increasing pain epidemic, comes a need for answers that are both clinically effective and cost-effective.^{1,2} By delivering PNE via live-stream it is possible to use virtual classrooms to teach health care providers in the United States, and internationally.³⁹ For patients, this study presents further opportunities to learn from PNE using telehealth which has previously been done successfully.²⁴

Limitation of this study include the small sample sizes of other health care providers limits the conclusion that all health care providers can be positively influenced by PNE. The reliability of the NPQ is unknown as is what score change may be clinically significant. The small sample size of the 1-year follow-up additionally limits the conclusions made in this study.

CONCLUSIONS

In the short term, a PNE lecture increases pain knowledge and positively shifts various beliefs and attitudes regarding chronic pain in health care providers across disciplines. In the long term, a single-PNE lecture's effect on pain knowledge and attitudes and beliefs erode, yet results in a positive clinical perspective on treating people with persistent pain.

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