Chapter 7
Management of Chronic Pain: Nonpharmacological and Multidisciplinary Approach

Bonnie Huang Hall

Introduction

Besides prescribing medication, one of the key roles of the primary care provider is the coordination of specialists and nonpharmacological aspects of care. Management of the patient with chronic pain requires a multidisciplinary approach. Key aspects that require managing include goal setting, exercise and physical therapy, psychological and social factors, specialists and interventional pain procedures.

Goal Setting

Setting appropriate goals and expectations of treatment is included in the CDC Guideline for prescribing opioids for chronic pain [1]. Usually this centers around what is important to the patient. Many suggested goals, examples of which

B. H. Hall (✉)
UCSF, Department of Family and Community Medicine, Fremont, CA, USA

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can be found at "mytopcare.org [2]," center around patient activities of daily living and function. Mytopcare.org is a free website with various resources on opioid prescribing. It was founded by Leibshutz and others at Boston Medical Center in order to facilitate safe and effective opioid prescribing in primary care.

Currently, however, there is limited evidence or instruction on how to set goals with patients with chronic pain. One study elicited outcomes important to patients with chronic pain, as if they were participating in an experimental study on a new pain medication. Most of the commonly cited endpoints were decrease pain, decrease opioid dose, decrease frequency of scheduled doses, increased ability to function, and improved sleep [3]. Another interesting study focused on soliciting two to five behavioral goals (as opposed to pain relief goals) from patients and categorizing them [4]. This study on veterans found that the more goals patients accomplished, the less they rated their pain intensity and depressive symptom severity. It suggested that perhaps if patients had more easier goals to accomplish, they would perhaps experience less pain and depression. It found the most common goal was improving the physical activity of walking. It also used a standardize script to help patients formulate their behavioral goals:

> We would like you to set some goals that you can work toward over the next few weeks. These should be goals that you can reasonably achieve over the course of therapy. Goals can be any positive behavior that you would like to increase. For example, they can be something you have done in the past but would like to do more often, something you have been meaning to do but have been putting off, or something you have never done, but would like to try. Use the goal setting form below to come up with at least 2 goals for treatment.

In this study, cognitive behavioral therapists worked with patients to ensure that their goals were:

1. a behavior within the participant's control
2. goal was measurable
3. not primarily focused on pain reduction (i.e., reduce pain totally or by a specific amount)

Consequently, a take home point is to make practical goals, which are measurable. These goals often specify an action and frequency:

- Being able to do one load of laundry once a week
- Being able to walk 10 minutes 3× a week
- Take grandkids to the park for 30 minutes once per week

However, decreased pain is still a significant goal, especially in the context of chronic opioid therapy, given the risks involved. Risks of oversedation, overdose, and death are a reality for those on chronic opioid therapy (COT). In order to determine if opioid therapy is meeting goals, goals must be specific and measurable. Many studies use pain relief of 30% (moderate pain relief) and 50% (substantial pain relief) to determine if pain therapy is effective [5–7]. Interesting to note that clinical pain relief does not entail the complete eradication of pain. Currently, complete pain relief in those with chronic pain appears to be an unrealistic goal. Proper goal setting involves the expectation that pain, unfortunately, cannot be eliminated, but rather, managed in order to accomplish patient goals. It is helpful therefore to quantitatively assess pain before and during treatment in order to determine if pain relief goals are being met. For those on any therapy including opioids, if treatment is not successfully providing pain relief, dosages should be modified or stopped. The fact that ineffective therapies (where benefits do not outweigh risks) will be tapered should also be emphasized in the goals and expectations of treatment.

That being said, lately, there has been a trend towards making behavioral or functional goals as opposed to pain intensity goals [8, 9]. This is because there is often a disconnect between pain intensity and pain pathology. At the same time, there is a correlation of patients with high pain intensity scores and feeling overwhelmed and unable to cope [8]. Returning the ability to enjoy life by restoring function, despite pain, seems to be an important outcome to these patients. It may even lead to reduction in pain intensity in the end [4].

Exercise and Physical Activity

As part of the comprehensive pain management plan, the primary care provider can also incorporate exercise suggestions. A recent Cochrane review in 2017 found evidence that exercise seems to be beneficial to adults with chronic pain with little adverse effects [10]. Indeed, exercise has recently been recommended as first line therapy (even before medication) for acute and chronic low back pain by the American College of Physicians [11]. Generally exercise has been found to improve function, disability, and sometimes decrease pain scores. Methods in which the primary care provider can encourage exercise include "behavioral control techniques." These include teaching and demonstrating exercise, promoting self monitoring techniques, and goal setting [12]. Certain conditions may benefit more from exercise or physical activity such as osteoarthritis and low back pain [13–17]. So far, no studies have conclusively shown that one method of exercise is superior to another.

The American Academy of Orthopaedic Surgeons supports the website, "https://www.orthoinfo.org/". This free website contains ready to print patient handouts on home exercises for various conditions affecting, for instance, the shoulder, hip, knee, and spine. It also contains helpful patient handouts on preventing low back pain.

There are various types of exercise therapy that may be considered in the treatment of chronic pain. Detailed discussion can be found in Chap. 16.

Diet

Currently there is not much evidence to support a certain diet for those with chronic pain. There is evidence that those with chronic pain often do not eat a healthy diet rich in fruits and vegetables [18]. Those with chronic pain often have cardiovascular risk factors which need to be modified [18, 19].

Whether or not correcting their diet will help their pain and function is still in question. Currently there is research interest in anti-inflammatory or plant based diets and their role in reducing pain and improving function [20–22]. Seaman, a supporter of anti-inflammatory diet for chronic disease and pain, makes an interesting observation that NSAIDs (nonsteroidal anti-inflammatory drugs) are often used in treatment of chronic pain, and hence infer that an anti-inflammatory diet can also be used to treat chronic pain. Again, there needs to be more evidence before diet can be regarded as an effective treatment for chronic pain.

Heat

Heat (as opposed to cold) therapy has been found to be beneficial in subacute low back pain [23, 24]. There are some small studies showing that superficial heat with or without additional modalities such as exercise and ultrasound, can show promise in improving chronic low back pain and chronic knee pain [25–28]. Heat wraps are a relatively inexpensive and easy to implement with few adverse effects when used correctly. Because patients can easily implement this therapy on their own, they may feel more self-efficacious and have less negative thought patterns (such as catastrophizing) [27].

Biopsychosocial Management

The biopsychosocial model is a framework that can be used to comprehensively treat chronic pain. It suggests that pain is not just biological or physical, but also that psychological and social factors contribute to chronic pain [29, 30]. When all three realms have been addressed, studies have shown it has been used successfully to manage many chronic pain conditions such as arthritis, fibromyalgia, chronic low back pain, sickle cell, etc. [29, 31] Often termed multidisciplinary rehabilitation, or biopsychosocial rehabilitation, it has been found

to be effective in a 2015 Cochrane review for chronic low back pain [32]. Although often requiring a team of specialists from physical therapists, psychologists, etc., the primary care provider can indeed be instrumental in beginning to address the psychological and social aspects of chronic pain [33]. Fully addressing the psychological and social aspects of chronic pain often involves cognitive behavioral therapy. Cognitive behavioral therapy (CBT), a treatment often employed by psychologists or psychiatrists, enables patients to correct negative thinking patterns and thus change behavior. A 2012 Cochrane review concluded that cognitive behavioral therapy is a useful approach to chronic pain [34]. Based on data from 35 randomized controlled trials, this review found that cognitive behavioral therapy can improve mood, weakly improve pain compared to no treatment, has small effects on pain related disability, and decrease negative thought patterns such as catastrophizing. (Studies on psychological therapies for neuropathic pain, however, were few. Consequently a 2015 Cochrane review did not find enough evidence to support use of CBT or psychotherapy for neuropathic pain [35].)

Biopsychosocial Management: Positive Affect Interventions

What can the primary care provider do? Besides educating the patient on the biological aspects of chronic pain and their specific disease, primary care providers can acknowledge the co-existence of negative mood states such as depression, anxiety, emotional distress, etc. Screen chronic pain patients for these comorbidities and treat them. Inform patients that these negative affects have been associated with more pain and disability than those with positive affects. Some studies even show that fostering a positive affect allows decrease in pain intensity and disability [36, 37]. These “positive affect interventions” are activities that primary care providers can easily direct patients to perform in a journal. Some example interventions used are seen in Table 7.1 [36].

Table 7.1 Positive affect interventions primary care providers can use to improve pain and disability. Adapted from Hausman [36]

Intervention name	Explanation of how to perform
Three good things	Write down three things that went well each day and why they happened
Strengths	Make a complete list of strengths Make sure to use a strength each day
Gratitude visit	Write a thank you letter to someone you know. Read it aloud to them.
Savoring	Spend time focusing on a positive experience, 2–3× a day
Active-constructive responding	When someone shares good news, practice responding positively
Life summary	Reflect and write a summary of how one desires to be remembered

Biopsychosocial Management: Correct Solicitous Relationships

Another aspect of the biopsychosocial model of pain that the primary care physician can explore is social aspects of pain. Questions to explore include [29]:

1. How has pain changed lifestyle/roles at home/employment?
2. What is the level of social support?
3. Any "solicitous" social interactions?

Solicitous interactions are social interactions in which another person potentially disables the patient by being overly concerned or anxious about the patient's pain and consequences of pain. They may say things such as, "Don't go to the party, it's too exhausting for you and will make your pain worse." Or they may spend more time helping the patient unnecessarily, "Let me get you the remote control, you can't be walking around the house in your condition."

Studies show that these relationships can cause the patient to respond by increasing disability, using more opioids [38], and experiencing more pain [39–42].

These negative interactions can be addressed by involving the spouse in the cognitive behavioral treatment plan. There is some evidence that couple interventions may be effective in reducing pain intensity [43].

Biopsychosocial Management: Minimize Catastrophizing

In addition, the primary care provider can identify catastrophizing thoughts. Catastrophizing is a cognitive and emotional response to pain consisting of three parts [30, 44]:

1. Magnification: "I keep thinking the pain will get worse"
2. Rumination: "I can't stop thinking about how much it hurts"
3. Helplessness: "I can't do anything to make it better", "I don't think it will ever get better"

Again, catastrophizing is a type of negative thinking that significantly worsens pain and disability. Some say it is the single most important factor that impairs the effectiveness of pain relieving treatments in certain musculoskeletal conditions [45, 46]. Correction of these negative thoughts includes cognitive behavioral therapy (CBT) and acceptance and commitment therapy (a variation of CBT). In addition, physical therapy has been shown to reduce catastrophizing [47]. There is evidence to suggest that a reduction in catastrophizing precedes improved pain outcomes [44]. Catastrophizing can be measured with the Pain Catastrophizing Scale (PCS) [48]. It is a 13 item questionnaire which is available online http://sullivan-painresearch.mcgill.ca/pdf/pcs/Measures_PCS_Adult_English.pdf.

Biopsychosocial Management: Enforce Positive Expectations and Teach Self-Efficacy

On the other hand, expectations of getting well, or being optimistic about treatment and pain, does decrease pain intensity and increase effectiveness of treatment (or placebo). If the primary care provider and patient expects there to be improvement with treatment, then the patient will more likely make progress [30]. Similarly, if patients can do more for themselves, ("self-efficacy") and feel more capable of tackling pain and achieving certain pain related goals, then they also experience improvements in pain and disability. Increasing self-efficacy can also be mediated through CBT [30]. As primary care providers, we can teach patients how to treat acute pain flareups to improve their self-efficacy [29]. This includes utilizing heat or cold packs, positional changes, massage, or exercise.

Manage Consultants

Another component of pain management is effective involvement of specialists [1]. Experts can not only provide insight on conditions causing pain, but also perform pain management therapies that require special training. For instance, urologists may offer specialized treatments such as DMSO (dimethyl sulfoxide) instillation and bladder hydrodistension for interstitial cystitis. Orthopedic surgeons can offer therapeutic joint injections or surgery.

Interventional Pain Management

Pain specialists, often neurologists, interventional radiologist, or anesthesiologists, can also provide pain relieving procedures targeted at the nervous system. Referrals to these spe-

cialists are often made after various treatments recommended by primary care physicians have failed or the patient's pain and disability is severe. The mechanisms of how these interventions work on a molecular level can be complex, but at the heart of these is that nerve function is altered. Pain is no longer perceived in the same way after these interventions. There are various techniques used to alter nerve function, also known as neuromodulation. These techniques alter the sensation of pain by affecting nerve activity through various stimuli.

There are so many methods to alter nerve function and thus change the conduction of pain signals. The primary care provider can be daunted with the complexity and diversity of these interventions. However, any intervention for pain can be thought of as a combination of three components: a stimulus that alters nerve function, a delivery method, and a nervous system target (Fig. 7.1).

The following is a brief overview of a few types of methods to deliver substances or energy to alter pain sensations. Some are more invasive and thus are surgical procedures, whereas others are noninvasive and not typically thought of as a "procedure."

One of the more common interventions for pain is injections of various compounds such as anesthetics and steroids. These include epidural injections and other spinal injections [49], intercostal nerve blockage, and other peripheral nerve injections. These injections often use anesthetics to block pain signals and steroids to reduce inflammation with reliable short term relief. Evidence for long lasting effects of pain injections for low back pain is, however, lacking [50]. In addition, literature is mixed on the efficacy of these injections on spinal stenosis, and other conditions associated with back pain [50, 51].

Other methods include sympathetic nerve blocks. This technique is typically used to treat phantom limb, complex regional pain syndrome, and pain syndromes of the head and neck [52].

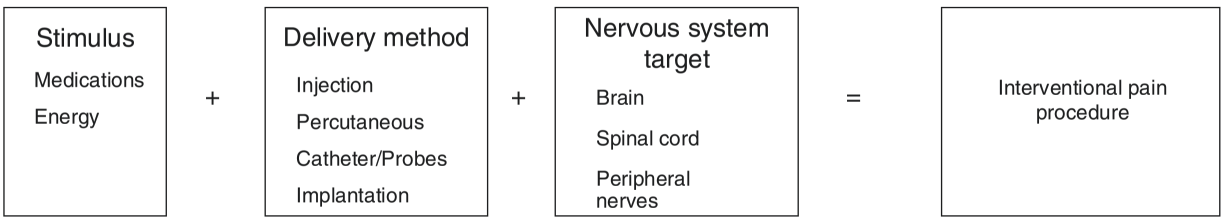

FIGURE 7.1 An interventional procedure for pain is essentially a summation of three components: a stimulus, a delivery method for the stimulus, and a nervous system target. Stimuli modify nerve function. They include both medications and various forms of energy. Medications include anesthetics, toxins, steroids, and opioids. Various forms of energy include heat, cold, magnetic fields, electrical current, ultrasound, etc.

Botulinum toxin is a neurotoxin that is best known for inhibiting muscle contraction for the treatment of wrinkles. It has also been useful for the treatment of chronic migraine. A recent review discusses the myriad of pain diagnoses that may benefit from botulinum toxin [53]. Temporal mandibular joint disorders, myofascial pain, neuropathic pain, trigeminal neuralgia are just a few conditions in which botulinum toxin has been used to ameliorate chronic pain [53].

Injection of neurolytic substances have also been documented to treat chronic pain conditions. Such substances include adriamycin (a chemotherapeutic agent), alcohol, glycerol, etc.

Lastly, there is intrathecal drug delivery, so called, "pain pumps". These are surgically implanted devices that allow for the continuous delivery of morphine, baclofen, zicotinide (an analgesic acting on the calcium channel blocker) and other compounds to the spinal cord.

Radiofrequency ablation or denervation, another interventional technique used for the treatment of chronic pain, delivers thermal energy to block sensory nerves innervating the area of pain [54–56]. For instance, for knee pain, the genicular nerves are targeted. Electrical current is delivered to the tip of an insulated needle directed at the peripheral nerve. An electric field is produced at the tip of the needle which causes molecular movement and heat. At a certain temperature, the heat will cause a lesion in the nerve and is thought to be responsible for disruption of the pain signal. It has been used in conditions such as chronic low back pain, knee pain, trigeminal neuralgia, and other conditions. There is some evidence suggesting the effectiveness of these techniques in various chronic low back pain conditions and knee pain [55–57]. There are also cryoablative methods as well [58].

Invasive Neurostimlation Techniques

Invasive neuromodulating techniques include deep brain stimulation [59], spinal cord stimulation [52, 60], and periph-

eral nerve stimulation [61]. Deep brain stimulation is an invasive neurosurgical procedure where electrodes are implanted in various brain structures. Pain is replaced often by pleasant paraesthesia or warming sensation and analgesia depending on which brain structures are targeted [59]. It can be used for post-stroke syndrome. Spinal cord stimulation uses implanted electrodes to provide electrical stimulation to the spinal cord. It replaces pain with paraesthesia. It is commonly used in failed back surgery syndrome and neuropathic pain. Peripheral nerve stimulation is direct electrical stimulation of named nerves that send pain signals from the region of pain. It also requires the use of electrodes surgically implanted next to the nerve and is commonly used to treat postherpetic neuralgia, neuropathies after surgery or trauma, complex regional pain syndrome, and various migraine and headache syndromes [61].

Noninvasive Neurostimulation

Noninvasive neurostimulation techniques act on the nervous system externally. These include transcranial current or magnetic stimulation [59] for the brain, and transcutaneous electrical nerve stimulation (TENS) for the peripheral nerves. A recent Cochrane review concluded that there is very low quality evidence that transcranial magnetic stimulation and transcranial direct current stimulation may affect chronic pain and improve quality of life in the short term, but measured effects were minimal [62]. As for TENS, electrodes are applied via adhesives to the skin so that pulsed electrical stimulation can be delivered to the area of pain. Although often used as an adjunctive to the treatment of chronic pain, a recent Cochrane review was unable to find conclusive evidence that TENS is harmful or beneficial to people with chronic pain [63]. Lastly, there is ongoing research into different methods for neuromodulation including the use of ultrasound on both the brain and peripheral targets.

Conclusion

In conclusion, the primary care provider can offer so much more than prescription drugs for chronic pain. In every office visit, the primary care provider can reassess goals and expectations, encourage positive affects, and identify negative affects. They can also encourage self-efficacy and correct negative affects and social interactions via referral to a specialist trained in CBT. Teaching exercises or referral to physical therapy is another aspect of care the primary care provider can manage. In addition, the primary care provider can also coordinate care with specialists that can provide pain relieving interventions.

References

1. Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain — United States, 2016. MMWR Recomm Rep. 2016;65(RR-1):1–49. https://doi.org/10.15585/mmwr.rr6501e1.
2. http://mytopcare.org/prescribers/talking-to-patients-about-opioid-therapy/
3. Casarett D, Karlawish J, Sankar P, Hirschman K, Asch DA. Designing pain research from the patient's perspective: what trial end points are important to patients with chronic pain? Pain Med. 2001;2(4):309–16.
4. Heapy AA, Wandner L, Driscoll MA, et al. Developing a typology of patient-generated behavioral goals for cognitive behavioral therapy for chronic pain (CBT-CP): classification and predicting outcomes. J Behav Med. 2018;41:174. https://doi.org/10.1007/s10865-017-9885-4.
5. Derry S, Bell RF, Straube S, Wiffen PJ, Aldington D, Moore RA. Pregabalin for neuropathic pain in adults. Cochrane Database Syst Rev. 2019;(1):CD007076. https://doi.org/10.1002/14651858.CD007076.pub3.
6. Wiffen PJ, Derry S, Bell RF, et al. Gabapentin for chronic neuropathic pain in adults. Cochrane Database Syst Rev. 2017;6(6):CD007938. Published 9 Jun 2017. https://doi.org/10.1002/14651858.CD007938.pub4.

7. Skljarevski V, Zhang S, Iyengar S, et al. Efficacy of duloxetine in patients with chronic pain conditions. Curr Drug Ther. 2011;6(4):296–303. https://doi.org/10.2174/157488511798109592.
8. Ballantyne JC, Sullivan MD. Intensity of chronic pain — the wrong metric? N Engl J Med. 2015;373:2098–9.
9. Turk DC, Dworkin RH, Revicki D, Harding G, Burke LB, Cella D, et al. Identifying important outcome domains for chronic pain clinical trials: an IMMPACT survey of people with pain. Pain. 2008;137:276–85.
10. Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, Smith BH. Physical activity and exercise for chronic pain in adults: an overview of Cochrane reviews. Cochrane Database Syst Rev. 2017;4(4):CD011279. Published 24 Apr 2017. https://doi.org/10.1002/14651858.CD011279.pub3.
11. Qaseem A, Wilt TJ, McLean RM, Forciea MA, Clinical Guidelines Committee of the American College of Physicians. Noninvasive treatments for acute, subacute, and chronic low back pain: a clinical practice guideline from the American College of Physicians. Ann Intern Med. 2017;166(7):514–30. https://doi.org/10.7326/M16-2367. Epub 14 Feb 2017.
12. Marley J, Tully MA, Porter-Armstrong A, et al. The effectiveness of interventions aimed at increasing physical activity in adults with persistent musculoskeletal pain: a systematic review and meta-analysis. BMC Musculoskelet Disord. 2017;18(1):482. Published 22 Nov 2017. https://doi.org/10.1186/s12891-017-1836-2.
13. Latham N, Liu CJ. Strength training in older adults: the benefits for osteoarthritis. Clin Geriatr Med. 2010;26(3):445–59.
14. Hernández-Molina G, Reichenbach S, Zhang B, Lavalley M, Felson DT. Effect of therapeutic exercise for hip osteoarthritis pain: results of a meta-analysis. Arthritis Rheum. 2008;59(9):1221–8. https://doi.org/10.1002/art.24010.
15. Uthman OA, van der Windt DA, Jordan JL, et al. Exercise for lower limb osteoarthritis: systematic review incorporating trial sequential analysis and network meta-analysis. BMJ. 2013;347:f5555. Published 20 Sep 2013. https://doi.org/10.1136/bmj.f5555.
16. van Tulder M, Malmivaara A, Esmail R, Koes B. Exercise therapy for low back pain: a systematic review within the framework of the Cochrane Collaboration Back Review Group. Spine (Phila Pa 1976). 2000;25(21):2784–96.
17. Hayden J, van Tulder MW, Malmivaara A, Koes BW. Exercise therapy for treatment of non-specific low back pain.

Cochrane Database Syst Rev. 2005;(3):CD000335. https://doi.org/10.1002/14651858.CD000335.pub2.
18. Vandenkerkhof EG, Macdonald HM, Jones GT, Power C, Macfarlane GJ. Diet, lifestyle and chronic widespread pain: results from the 1958 British Birth Cohort Study. Pain Res Manag. 2011;16(2):87–92.
19. Kauppila L. Review: atherosclerosis and disc degeneration/low-back pain – a systematic review. Eur J Vasc Endovasc Surg. 2009;37:661–70.
20. Towery P, Guffey JS, Doerflein C, Stroup K, Saucedo S, Taylor J. Chronic musculoskeletal pain and function improve with a plant-based diet. Complement Ther Med. 2018;40:64–9.
21. Seaman DR. The diet-induced proinflammatory state: a cause of chronic pain and other degenerative diseases? J Manip Physiol Ther. 2002;25:168.
22. Bjørklund G, Chirumbolo S, Dadar M, Pen JJ, Doşa MD, Pivina L, Semenova Y, Aaseth J. Insights on nutrients as analgesics in chronic pain. Curr Med Chem. 2019;26:1.
23. Qaseem A, Wilt TJ, McLean RM, et al, for the Clinical Guidelines Committee of the American College of Physicians. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians. Ann Intern Med. 2017;166:514–530. https://doi.org/10.7326/M16-2367.
24. French SD, Cameron M, Walker BF, Reggars JW, Esterman AJ. A Cochrane review of superficial heat or cold for low back pain. Spine (Phila Pa 1976). 2006;31(9):998–1006.
25. Zati A, Cavazzuti L, Colori BCM, Benedetti MG. Deep heating therapy via MF radiowaves versus superficial heating therapy in the treatment of nonspecific chronic low back pain: a double blind randomized trial. J Back Musculoskelet Rehabil. 2018;31(5):963–71. https://doi.org/10.3233/BMR-170944.
26. Filiz MB, Firat SC. Effects of physical therapy on pain, functional status, sagittal spinal alignment, and spinal mobility in chronic non-specific low back pain. Eurasian J Med. 2019;51(1):22–6. https://doi.org/10.5152/eurasianjmed.2018.18126.
27. Lewis SE, Holmes PS, Woby SR, Hindle J, Fowler NE. Short-term effect of superficial heat treatment on paraspinal muscle activity, stature recovery, and psychological factors in patients with chronic low back pain. Arch Phys Med Rehabil. 2012;93(2):367–72. https://doi.org/10.1016/j.apmr.2011.08.043.

28. Petrofsky JS, Laymon MS, Alshammari FS, Lee H. Use of low level of continuous heat as an adjunct to physical therapy improves knee pain recovery and the compliance for home exercise in patients with chronic knee pain: a randomized controlled trial. J Strength Cond Res. 2016;30(11):3107–15.
29. Cheatle MD. Biopsychosocial approach to assessing and managing patients with chronic pain. Med Clin N Am. 2016;100(1):43–53, ISSN 0025-7125, ISBN 9780323413404. https://doi.org/10.1016/j.mcna.2015.08.007.
30. Meints SM, Edwards RR. Evaluating psychosocial contributions to chronic pain outcomes. Prog Neuropsychopharmacol Biol Psychiatry. 2018;87(Pt B):168–82. https://doi.org/10.1016/j.pnpbp.2018.01.017.
31. Kamper SJ, Apeldoorn AT, Chiarotto A, Smeets RJ, Ostelo RW, Guzman J, van Tulder MW. Multidisciplinary biopsychosocial rehabilitation for chronic low back pain. Cochrane Database Syst Rev. 2014;(9):CD000963. https://doi.org/10.1002/14651858.CD000963.pub3.
32. Kamper SJ, Apeldoorn AT, Chiarotto A, et al. Multidisciplinary biopsychosocial rehabilitation for chronic low back pain: Cochrane systematic review and meta-analysis. BMJ. 2015;350:h444. Published 18 Feb 2015. https://doi.org/10.1136/bmj.h444.
33. van Erp RMA, Huijnen IPJ, Jakobs MLG, Kleijnen J, Smeets RJEM. Effectiveness of primary care interventions using a biopsychosocial approach in chronic low back pain: a systematic review. Pain Pract. 2019;19(2):224–41. https://doi.org/10.1111/papr.12735. Epub 2 Dec 2018. PMID:30290052.
34. Williams AC, Eccleston C, Morley S. Psychological therapies for the management of chronic pain (excluding headache) in adults. Cochrane Database Syst Rev. 2012;11(11):CD007407. Published 14 Nov 2012. https://doi.org/10.1002/14651858.CD007407.pub3.
35. Eccleston C, Hearn L, Williams AC. Psychological therapies for the management of chronic neuropathic pain in adults. Cochrane Database Syst Rev. 2015;(10):CD011259. Published 29 Oct 2015. https://doi.org/10.1002/14651858.CD011259.pub2.
36. Hausmann LR, Parks A, Youk AO, Kwoh CK. Reduction of bodily pain in response to an online positive activities intervention. J Pain. 2014;15:560–7.
37. Müller R, Gertz KJ, Molton IR, et al. Effects of a tailored positive psychology intervention on well-being and pain in individu-

als with chronic pain and a physical disability: a feasibility trial. Clin J Pain. 2016;32:32–44.
38. Cunningham JL, Hayes SE, Townsend CO, Laures HJ, Hooten WM. Associations between spousal or significant other solicitous responses and opioid dose in patients with chronic pain. Pain Med. 2012;13:1034–9. https://doi.org/10.1111/j.1526-4637.2012.01434.x.
39. Pow J, Stephenson E, Hagedoorn M, DeLongis A. Spousal support for patients with rheumatoid arthritis: getting the wrong kind is a pain. Front Psychol. 2018;9:1760. Published 20 Sept 2018. https://doi.org/10.3389/fpsyg.2018.01760.
40. Lousberg R, Schmidt AJ, Groenman NH. The relationship between spouse solicitousness and pain behavior: searching for more experimental evidence. Pain. 1992;51:75–9.
41. Romano JM, Turner JA, Jensen MP, et al. Chronic pain patient-spouse behavioral interactions predict patient disability. Pain. 1995;63:353–60.
42. Flor H, Kerns RD, Turk DC. The role of spouse reinforcement, perceived pain, and activity levels of chronic pain patients. J Psychosom Res. 1987;31:251–9.
43. Smith SM, Li R, Wolfe H, Swanger-Gagne MS, Bonham AD, Kreher DA, Poleshuck EL. Couple interventions for chronic pain: a systematic review. Clin J Pain. 2019;35:916. https://doi.org/10.1097/AJP.0000000000000752. [Epub ahead of print].
44. Quartana PJ, Campbell CM, Edwards RR. Pain catastrophizing: a critical review. Expert Rev Neurother. 2009;9(5):745–58. https://doi.org/10.1586/ern.09.34.
45. Hill JC, Lewis M, Sim J, Hay EM, Dziedzic K. Predictors of poor outcome in patients with neck pain treated by physical therapy. Clin J Pain. 2007;23:683–69.
46. Karels CH, Bierma-Zeinstra SM, Burdorf A, Verhagen AP, Nauta AP, Koes BW. Social and psychological factors influenced the course of arm, neck and shoulder complaints. J Clin Epidemiol. 2007;60:839–48.
47. George SZ, Zeppieri G Jr, Cere AL, et al. A randomized trial of behavioral physical therapy interventions for acute and subacute low back pain (NCT00373867). Pain. 2008;140(1):145–57. https://doi.org/10.1016/j.pain.2008.07.029.
48. Sullivan MJL, Bishop SR, Pivik J. The pain catastrophizing scale: development and validation. Psychol Assess. 1995;7(4):524–32.
49. Iannuccilli JD, Prince EA, Soares GM. Interventional spine procedures for management of chronic low back pain-a primer.

Semin Intervent Radiol. 2013;30(3):307–17. https://doi.org/10.1055/s-0033-1353484.
50. Chou R, Hashimoto R, Friedly J, et al. Pain management injection therapies for low back pain [Internet]. Rockville: Agency for Healthcare Research and Quality (US); 2015. Available from: https://www.ncbi.nlm.nih.gov/books/NBK285206/.
51. Manchikanti L, Knezevic NN, Boswell MV, Kaye AD, Hirsch JA. Epidural injections for lumbar radiculopathy and spinal stenosis: a comparative systematic review and meta-analysis. Pain Physician. 2016;19(3):E365–410.
52. Smith H, Youn Y, Guay RC, Laufer A, Pilitsis JG. The role of invasive pain management modalities in the treatment of chronic pain. Med Clin N Am. 2016;100(1):103–15. ISSN 0025-7125, ISBN 9780323413404. https://doi.org/10.1016/j.mcna.2015.08.011.
53. Sandrini G, De Icco R, Tassorelli C, Smania N, Tamburin S. Botulinum neurotoxin type A for the treatment of pain: not just in migraine and trigeminal neuralgia. J Headache Pain. 2017;18(1):38. https://doi.org/10.1186/s10194-017-0744-z.
54. Gupta A, Huettner DP, Dukewich M. Comparative effectiveness review of cooled versus pulsed radiofrequency ablation for the treatment of knee osteoarthritis: a systematic review. Pain Physician. 2017;20(3):155–71.
55. Leggett LE, Soril LJ, Lorenzetti DL, et al. Radiofrequency ablation for chronic low back pain: a systematic review of randomized controlled trials. Pain Res Manag. 2014;19(5):e146–53. https://doi.org/10.1155/2014/834369.
56. Maas ET, Ostelo RWJG, Niemisto L, Jousimaa J, Hurri H, Malmivaara A, van Tulder MW. Radiofrequency denervation for chronic low back pain. Cochrane Database Syst Rev. 2015;(10):CD008572. https://doi.org/10.1002/14651858.CD008572.pub2.
57. Jamison DE, Cohen SP. Radiofrequency techniques to treat chronic knee pain: a comprehensive review of anatomy, effectiveness, treatment parameters, and patient selection. J Pain Res. 2018;11:1879–88. Published 18 Sep 2018. https://doi.org/10.2147/JPR.S144633.
58. Koethe Y, Mannes AJ, Wood BJ. Image-guided nerve cryoablation for post-thoracotomy pain syndrome. Cardiovasc Intervent Radiol. 2014;37(3):843–6. https://doi.org/10.1007/s00270-013-0718-8.
59. Farrell SM, Green A, Aziz T. The current state of deep brain stimulation for chronic pain and its context in other forms of

neuromodulation. Brain Sci. 2018;8(8):158. Published 20 Aug 2018. https://doi.org/10.3390/brainsci8080158.
60. Wong SS, Chan CW, Cheung CW. Spinal cord stimulation for chronic non-cancer pain: a review of current evidence and practice. Hong Kong Med J. 2017;23(5):517–23. https://doi.org/10.12809/hkmj176288.
61. Slavin KV. Peripheral nerve stimulation for neuropathic pain. Neurotherapeutics. 2008;5(1):100–6. https://doi.org/10.1016/j.nurt.2007.11.005.
62. O'Connell NE, Marston L, Spencer S, DeSouza LH, Wand BM. Non-invasive brain stimulation techniques for chronic pain. Cochrane Database Syst Rev. 2018;(3):CD008208. https://doi.org/10.1002/14651858.CD008208.pub4.
63. Gibson W, Wand BM, Meads C, Catley MJ, O'Connell NE. Transcutaneous electrical nerve stimulation (TENS) for chronic pain – an overview of Cochrane reviews. Cochrane Database Syst Rev. 2019;4(4):CD011890. Published 3 Apr 2019. https://doi.org/10.1002/14651858.CD011890.pub3.