Active Rehabilitation of Work-Related Low Back Conditions

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Purpose and Intended Use

This resource was developed by the Industrial Insurance Chiropractic Advisory Committees (IICAC) of the Washington State Department of Labor & Industries. It provides concise summaries of published literature regarding rehabilitation for low back conditions stemming from work injuries. This practice resource does not change L&I coverage or payment.

A comprehensive search of available scientific literature on active rehabilitation procedures for low back conditions was conducted by the Policy, Practice, and Quality (PPQ) Subcommittee of the IICAC and L&I staff during Fall 2010 and literature published after that date was searched in Fall 2016. Literature was reviewed and assessed for relevance and quality by two different individuals. Summaries of the relevant evidence were drafted by consensus of the subcommittee with expert content input from consultants and reviewers during Spring 2017. The draft was distributed for public comment in March 2017. An updated draft was approved for distribution by IICAC and L&I in April 2017. This resource is expected to be updated periodically. Interested parties are encouraged to submit new published reports for consideration for future revisions.

This and other practice resources are in the public domain and are available for download at the State of Washington Department of Labor & Industries website. Contact information for public input and submission of studies for future revisions is available there.

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RESOURCE SUMMARY

- Incrementally increasing activity is important.
- Less intense rehabilitation is usually better for acute and subacute back pain. More intense programs should only be considered with chronic situations (typically those persisting beyond 3 months' duration).
- Any oversight, such as activity diary or in-office performance of exercises, is more effective than advice or consultation alone.
- Any activity, such as walking, is better than doing nothing.
- No particular exercise regime has been shown to be any more effective than another.
- Addressing psychosocial concerns improves outcome regardless of the rehabilitation activities utilized

Work-Related Low Back Conditions

Low back pain (LBP) accounts for the majority of occupational injury claims. This resource focuses on rehabilitation options for low back pain of "mechanical" origin (e.g., soft tissue strains and sprains, non-specific low back pain, and back pain accompanied by leg pain). It does not address particular diagnostic or pathophysiological/pain generator models. Proper clinical assessment to rule out serious non-mechanical causes of back pain should be completed prior to considering active rehabilitation.

Note: This resource does not comprehensively summarize evidence on other management therapies (e.g. passive modalities, mobilization, ergonomic interventions) beyond reporting results when they were included in intervention/comparison groups in active rehabilitation trials.

Case Definitions

Work-related low back conditions typically are causally linked to a specific triggering mechanical event, task, or activity at work. This resource assumes the back condition has been accepted as occupationally related.

Evaluation Summary

- Reasonable rehabilitation approaches are rarely contraindicated with work-related back pain. Rule out history of cancer, unexplained weight loss, immunosuppression, prolonged use of steroids, intravenous drug use, urinary tract infection, pain that is increased or unrelieved by rest, fever, significant trauma, bladder or bowel incontinence, and urinary retention (with overflow incontinence), saddle anesthesia, loss of anal sphincter tone, substantial and/or progressive motor weakness in lower extremities, unremitting vertebral tenderness, and neurologic findings persisting beyond one month.

Intervention Summary

- Most acute and sub-acute back conditions resolve successfully within days to weeks. Less intensive rehabilitation interventions (e.g., in-office exercise coaching, short duration PT referrals) are preferred initially for individuals at low risk of developing chronicity (e.g., availability of modified work, good recovery expectations, willingness to increase activity levels and return to normal activities including work, good response to conservative interventions). Studies indicate that intensive programs requiring prolonged patient attendance (e.g., work hardening) may hinder recovery during this period.
- Chronic back pain (e.g., persisting beyond 10-12 weeks' duration) appears to be most responsive to various combinations of motivation, exercise, and pain control. A large variety of exercise approaches have been shown to be useful as has cognitive self-management and spinal manipulation.

Improvement Progress

Achieving and monitoring functional progress is central to rehabilitation. Better long term outcomes are associated with consistent, incremental increases in functional ability (e.g., mobility, return to usual activities including work).

Typical Active Rehabilitation Interventions and Response Thresholds

1-2 weeks	3-6 weeks	7-8 weeks	Beyond 8 weks
• Emphasize that increasing activity a little each day speeds recovery. • Identify & address concerns about performing work activities. • Assess baseline functional status with standardized questionnaire. • Prescribe specific activities using a goal-oriented weekly activity diary. • Consider prescribing a specific exercise program, even walking.	• Improvement is best assessed by increased function, including ability to perform work activities. • Most low back conditions should achieve good functional and symptomatic response within this time frame. • Inadequate improvement is reflected primarily by inability to return to normal activities and work. If not achieved, consider more intensive supervised exercise. Screen for potential psychosocial concerns (e.g., fear avoidance, anxiety, depression).	• Good Improvement: Return to light to regular work. Progressing in function, mastering in-clinic & home exercises. Effectively implementing prescribed task/ergonomic changes. • Inadequate improvement: Inability to return to light/regular work. Consider specialist referral for clinical or occupational concerns.	• Good Improvement: Return to normal activities & function. Progressing back to full or near full duty work activities. • Inadequate improvement: Inability to return to modified or regular work. Consider consultation with occupational health specialist.

KEY MESSAGES ABOUT REHABILITATION FOR CLINICIANS TO CONVEY

Staying Active

- "Activity is necessary for recovery."
  - Try to resume all your normal activities as soon as you can; Resuming your regular activities will actually help your body recover faster.
  - Start with "baby steps"; even the easiest activity speeds recovery (walking, getting up and down, gently moving the injured part).
  - The most successful and sustainable gains start small and build over time.
- "Do just a little bit more each session (an extra 5 minutes, an extra 5 repetitions, lift just a couple extra pounds)."
  - Set specific goals to reach (a weekly activity diary is helpful for this).
  - Focus on doing your normal routine.
- "Recovery takes time and requires effort on your part, but you can do it."

Prioritize Exercise & Establish a Routine

- "Exercise is important for your recovery."
- "Prioritize doing your exercises by making it a routine part of your schedule."
- Address barriers to exercise with a motivational interviewing approach to explicitly involve them in making it part of their routine.
  - "If you were to do the exercises at home, what would that look like? (e.g., what time of day; where would you do them; what could you do to make the environment conducive to getting them done?)"
  - "What can you imagine doing to address [perceived barrier(s) to following through on exercises]?"
  - "What would be a first step toward the goal to exercise that you could accomplish today?"

Tips for Improved Compliance with Exercise

- Patients are more compliant with exercise if they do it with someone else who might hold them accountable. This could be a group class, a team sport, or exercising with others.
- The exercise should be enjoyable. Advising someone to do a type of exercise they don't enjoy is likely to lead to non-compliance.
- Keep exercise goals realistic. A non-runner cannot be reasonably expected to compete in a marathon with a few weeks of training. Encourage reasonable increases in load as the patient's conditioning improves.
- When prescribing unsupervised exercise, have them demonstrate performance in the office. When following up, ask them to again demonstrate several. Inquire about specific details including what time of day they do them, how many repetitions of each they did, and what modifications they may have made to be able to perform them, etc.

Addressing Suspected or Observed Psychosocial Issues

- Address psychosocial issues in a way to facilitate your patient's engagement.
- If worker has concerns that activities will aggravate their problem, ask questions like:
  - "Periodic increases in pain are normal and doesn't mean tissue is being damaged. It just means "be careful."
  - "What activities are the most difficult? What might you do to work around any discomfort?"
- Offer specific ideas about how to do work/life activities that are uncomfortable:
  - "Let's talk about exactly how to get out of bed in the morning."
- For concerns that they may not get better, discuss what recovery looks like:
  - "Ups and downs are usual with recovery from your condition."
- Provide a clear outline of the care plan, emphasizing that gradually increasing what they can do is the most important thing:
  - "The best recoveries occur with baby steps."
- Address unfounded concerns or incorrect beliefs about their injury:
  - "Let's talk about your coworker who injured his back and underwent surgery."
  - "The fact that you feel (pain, tingling, etc.) typically means the nerves are working and that's a good sign for recovery."

Progress Checklist

(Voluntary educational / practice aid. This is not an L&I documentation requirement.)

Baseline | 1-2 weeks | 3-6 weeks | 7-8 weeks | Beyond 8 weeks

Assessment / Progress

Baseline	1-2 weeks	3-6 weeks	7-8 weeks	Beyond 8 weeks
Date:	Date:	Date:	Date:	Date:
Pain Below Knee ☐ Yes ☐ No	*Pain Below Knee* ☐ Yes ☐ No	*Pain Below Knee* ☐ Yes ☐ No	*Pain Below Knee* ☐ Yes ☐ No	*Pain Below Knee* ☐ Yes ☐ No
Function Score Baseline: _____	*Function Score* Progress: _____	*Function Score* Progress: _____	*Function Score* Progress: _____	
Pain Interference 0 1 2 3 4 5 6 7 8 9 10 *None* … *Unable to do any activities*	Pain Interference 0 1 2 3 4 5 6 7 8 9 10 *None* … *Unable to do any activities*	Pain Interference 0 1 2 3 4 5 6 7 8 9 10 *None* … *Unable to do any activities*	Pain Interference 0 1 2 3 4 5 6 7 8 9 10 *None* … *Unable to do any activities*	
Self-control of pain 0 1 2 3 4 5 6 7 8 9 10 *Complete control of pain* … *No control of pain*	Self-control of pain 0 1 2 3 4 5 6 7 8 9 10 *Complete control of pain* … *No control of pain*	Self-control of pain 0 1 2 3 4 5 6 7 8 9 10 *Complete control of pain* … *No control of pain*	Self-control of pain 0 1 2 3 4 5 6 7 8 9 10 *Complete control of pain* … *No control of pain*	
Work Status ☐ Full Duty ☐ Modified ☐ None	Work Status ☐ Full Duty ☐ Modified ☐ None	Work Status ☐ Full Duty ☐ Modified ☐ None	Work Status ☐ Full Duty ☐ Modified ☐ None	

Intervention Options

Function Score
- *Standard scale (e.g. ODI, RMDQ).*

Pain Interference
- *'In the past week, how much has pain interfered with your daily activities?'*

Self-control of pain
- *'In the past week, how much have you been able to control/help/reduce your back pain on your own?'*

Discuss Recovery
- Most recover in days to weeks.
- Address concerns with work activity.

Address Activity
- Avoid prolonged rest, sitting.
- Activity Diary – prescribe specific goals, exercises.

Assess Functional Recovery
- Assess compliance with activity diary goals weekly. Make modifications as needed.
- Recheck function score, pain interference, and ability to control back pain. These scores are sensitive to overall change/improvement.

Incrementally Increase Activity
- Goal to maintain normal activities & routines (including work).
- Revise goals on Activity Diary – increase intensity, frequency, duration as appropriate.
- If referral is made for PT/OT, communicate regularly with therapist to assure care minimizes passive approaches and emphasizes active ones.

Good Improvement
- Progression of uncomplicated low back problems is typically ~50% improvement in pain and function within first 2 weeks and fully resolved within 8 weeks.
- Should approach pre-episode capacities.

Inadequate improvement
- If progress is less than optimal consider more intensive active rehabilitation including supervised exercise.
- Poor/worsening self-control scores may reflect underlying psychosocial concerns – screen for PDIRs, anxiety, depression, etc.
- Assess potential cognitive barriers (e.g. catastrophizing, significant fear avoidance, low recovery expectation, depression) and consider appropriate intervention options such as activity coaching or structured multidisciplinary programs that emphasize activation.
- Consider specialist consult for apparent low grade traumatic injuries if only minimal improvement is seen within first month.
- Reassessment for red flags, further diagnostics, and specialist consultation if warranted in non-responding cases.

Roland-Morris Disability Questionnaire (RMDQ)

(Voluntary educational / practice aid. This is not an L&I documentation requirement.)

Patient Name_____

Claim # _____ Date: _____

When your back hurts, you may find it difficult to do some things you normally do. This list contains sentences that people have used to describe themselves when they have back pain. When you read them, you may find that some stand out because they describe you today.

As you read the list, think of yourself today. When you read a sentence that describes you today, put a check in the box next to it. If the sentence does not describe you, then leave the space blank and go on to the next one. Remember, only check the sentence if you are sure it describes you today.

- ☐ I stay at home most of the time because of my back.
- ☐ I change position frequently to try and get my back comfortable.
- ☐ I walk more slowly than usual because of my back.
- ☐ Because of my back I am not doing any of the jobs that I usually do around the house.
- ☐ Because of my back, I use a handrail to get upstairs.
- ☐ Because of my back, I lie down to rest more often.
- ☐ Because of my back, I have to hold on to something to get out of an easy chair.
- ☐ Because of my back, I try to get other people to do things for me.
- ☐ I get dressed more slowly than usual because of my back.
- ☐ I only stand for short periods of time because of my back.
- ☐ Because of my back, I try not to bend or kneel down.
- ☐ I find it difficult to get out of a chair because of my back.
- ☐ My back is painful almost all the time.
- ☐ I find it difficult to turn over in bed because of my back.
- ☐ My appetite is not very good because of my back pain.
- ☐ I have trouble putting on my socks (or stockings) because of the pain in my back.
- ☐ I only walk short distances because of my back.
- ☐ I sleep less well because of my back.
- ☐ Because of my back pain, I get dressed with help from someone else.
- ☐ I sit down for most of the day because of my back.
- ☐ I avoid heavy jobs around the house because of my back.
- ☐ Because of my back pain, I am more irritable and bad tempered with people than usual.
- ☐ Because of my back, I go upstairs more slowly than usual.
- ☐ I stay in bed most of the time because of my back.

Score:_____

(Scoring instructions on page 29 Minimal Clinical Improvement is reported to be 3-5 points)

Modified Oswestry Low Back Disability Index (ODI)

(Voluntary educational / practice aid. This is not an L&I documentation requirement.)

Please mark only one box in each section that most closely describes your current condition.

Patient Name_____

Claim # _____ Date: _____

Pain Intensity

- ☐ I can tolerate the pain I have without having to use pain medication.
- ☐ The pain is bad, but I can manage without having to take pain medication.
- ☐ Pain medication provides me with complete relief from pain.
- ☐ Pain medication provides me with moderate relief from pain.
- ☐ Pain medication provides me with little relief from pain.
- ☐ Pain medication has no effect on my pain.

Personal Care (e.g., Washing, Dressing)

- ☐ I can take care of myself normally without causing increased pain.
- ☐ I can take care of myself normally, but it increases my pain.
- ☐ It is painful to take care of myself, and I am slow and careful.
- ☐ I need help, but I am able to manage most of my personal care.
- ☐ I need help every day in most aspects of my care.
- ☐ I do not get dressed, I wash with difficulty, and I stay in bed.

Lifting

- ☐ I can lift heavy weights without increased pain.
- ☐ I can lift heavy weights, but it causes increased pain.
- ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if the weights are conveniently positioned (e.g., on a table).
- ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.
- ☐ I can lift only very light weights.
- ☐ I cannot lift or carry anything at all.

Walking

- ☐ Pain does not prevent me from walking any distance.
- ☐ Pain prevents me from walking more than 1 mile. (1 mile = 1.6 km).
- ☐ Pain prevents me from walking more than 1/2 mile.
- ☐ Pain prevents me from walking more than 1/4 mile.
- ☐ I can walk only with crutches or a cane.
- ☐ I am in bed most of the time and have to crawl to the toilet.

Sitting

- ☐ I can sit in any chair as long as I like.
- ☐ I can only sit in my favorite chair as long as I like.
- ☐ Pain prevents me from sitting for more than 1 hour.
- ☐ Pain prevents me from sitting for more than 1/2 hour.
- ☐ Pain prevents me from sitting for more than 10 minutes.
- ☐ Pain prevents me from sitting at all

Standing

- ☐ I can stand as long as I want without increased pain.
- ☐ I can stand as long as I want, but it increases my pain.
- ☐ Pain prevents me from standing for more than 1 hour.
- ☐ Pain prevents me from standing for more than 1/2 hour.
- ☐ Pain prevents me from standing for more than 10 minutes.
- ☐ Pain prevents me from standing at all.

Sleeping

- ☐ Pain does not prevent me from sleeping well.
- ☐ I can sleep well only by using pain medication.
- ☐ Even when I take medication, I sleep less than 6 hours.
- ☐ Even when I take medication, I sleep less than 4 hours.
- ☐ Even when I take medication, I sleep less than 2 hours.
- ☐ Pain prevents me from sleeping at all.

Social Life

- ☐ My social life is normal and does not increase my pain.
- ☐ My social life is normal, but it increases my level of pain.
- ☐ Pain prevents me from participating in energetic activities (e.g., sports, dancing).
- ☐ Pain prevents me from going out very often.
- ☐ Pain has restricted my social life to my home.
- ☐ I have hardly any social life because of my pain.

Traveling

- ☐ I can travel anywhere without increased pain.
- ☐ I can travel anywhere, but it increases my pain.
- ☐ My pain restricts my travel over 2 hours.
- ☐ My pain restricts my travel over 1 hour.
- ☐ My pain restricts my travel to short necessary journeys under 1/2 hour.
- ☐ My pain prevents all travel except for visits to the physician / therapist or hospital.

Employment / Homemaking

- ☐ My normal homemaking / job activities do not cause pain.
- ☐ My normal homemaking / job activities increase my pain, but I can still perform all that is required of me.
- ☐ I can perform most of my homemaking / job duties, but pain prevents me from performing more physically stressful activities (e.g., lifting, vacuuming).
- ☐ Pain prevents me from doing anything but light duties.
- ☐ Pain prevents me from doing even light duties.
- ☐ Pain prevents me from performing any job or homemaking chores.

Score: _____pts / 50 x 100% = _____

(Scoring instructions on page 29; Minimal Clinical Improvement is reported to be 4-16 points)

Weekly Incremental Activity Diary

(Voluntary educational / practice aid. This is not an L&I documentation requirement.)

Week _______________ **Name**____________________________ **Claim #**____________________________

	Day 1:	**Day 2:**	**Day 3:**	**Day 4:**	**Day 5:**	**Day 6:**	**Day 7:**	**Notes:**
Planned Activity ☐ Walk ☐ Swim ☐ Stationary Bike ☐ Other:	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	
Specific Exercises ☐ Flexibility ☐ Stabilization ☐ Strength ☐ Additional	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	***Goal:*** _____ times/day _____ total mins ***Completed:*** _____ times/day _____ total mins	
Other Activities	***Goal:*** ***Completed:***	***Goal:*** ***Completed:***	***Goal:*** ***Completed:***	***Goal:*** ***Completed:***	***Goal:*** ***Completed:***	***Goal:*** ***Completed:***	***Goal:*** ***Completed:***	

HISTORY & EXAMINATION

The routine patient health history generally is not affected for conditions where activity, exercise, and rehabilitation may be intervention considerations, thus the attending provider's standard approach to history based on patient presentation, condition and provider's specialty can be utilized. However, several factors captured in a patient history may help inform the patient's prognosis and identify possible contraindications to certain rehabilitation approaches. Some patient characteristics and findings from provocative testing may also assist with determining who may be good candidates for various rehabilitation approaches.

Active performance of physical tasks and exercise are central to most rehabilitation. A number of factors may predict a patient's ability to engage in active approaches including their psychologic state, general level of conditioning, characteristics of the back condition (e.g., prior episodes, degree of chronicity, structures involved).[1]

Prognostic Factors for Recovery

In general, several psychosocial factors predict higher disability risk from work-related low back injuries, particularly low recovery expectations, activity avoidance (fear-avoidance behavior), catastrophic thinking, and high levels of perceived injustice.[2-4] Literature is mixed on the ability of historical factors or examination findings to identify best candidates for a rehabilitation program, but a history of being moderately active, self-reliant, and a back problem without radiculopathy have been associated with speedier recoveries and greater likelihood of remaining and becoming active during recovery.[5, 6] They do not appear to predict how well a patient can perform physical tasks however.

- A 2017 secondary analysis of the STarT Back trial identified treatment effect modifiers at 4-month follow-up (n = 688).[7] Treatment response was measured using the Roland-Morris Disability Questionnaire (≥7). Socioeconomic status (SES) was identified as an effect modifier for disability outcomes (odds ratio [OR] = 1.71, P = .028). High SES patients receiving prognostic stratified care were 2.5 times less likely to have a poor outcome compared with low SES patients receiving best current care (OR = .40, P = .006). Education level (OR = 1.33, P = .109) and number of pain medications (OR = .64, P = .140) met criteria for effect modification (.20 > P ≥ .05).
- A 2016 study investigates: 1) which patient characteristics were associated with chiropractors' expectations of outcome from a low back pain episode; 2) if clinicians' expectations correlated with actual outcome; 3) how accurate clinical predictions were as compared to those of the STarT Back Screening Tool (SBT); and 4) if accuracy was improved by combining clinicians' expectations and the SBT.[8] Outcomes were measured as LBP intensity (0-10) and disability (RMDQ) after 2-weeks, 3-months, and 12-months. The course of LBP in 859 patients was predicted to be short (54%), prolonged (36%), or chronic (7%). Clinicians' expectations were most strongly associated with patient's education level, LBP history, radiating pain, and neurological signs at baseline and related to all outcomes. Predictions made by clinicians (AUC .58-.63) and the SBT (AUC .50-.61) were comparable and low. No substantial increase in the predictive capability was achieved by combining clinicians' expectations and the SBT. In conclusion, chiropractors' predictions were associated with well-established prognostic factors but not simply a product of these. Chiropractors were able to predict differences in outcome on a group level, but prediction of individual patients' outcomes were inaccurate and not substantially improved by the SBT.
- A 2014 case series of 1076 consecutive low back pain patients were followed to determine the association between potential prognostic variables and outcomes (clinically relevant pain reduction, self-reported improved function, and successful return to work six months after rehabilitation.[9] Shorter duration (OR 1.89), lower baseline pain (OR 1.19), younger age (OR 0.98), directional preference for extension (OR 1.45), and a history of spine surgery (OR 1.38) were associated with clinically relevant improvements. Factors related to return to work included availability of a job (OR 2.36), directional preference for extension (OR 1.78), being female (OR 1.79), and pain that was intermittent rather than continuous (OR 1.48).
- An analysis in 2013 on 488 patients consulting a physician about LBP found higher pain intensity experienced during consultation, and perception about whether their back pain will persist, were significant predictors of poor outcome at 6 months and at 5 years.[10] Clinically significant pain and disability was defined as a score of 2, 3, or 4 on the Chronic Pain Grade. Relative risks (RRs 95% CI) were calculated for 32 potential predictive factors, organized into domains (demographic, physical, psychological, and occupational). Baseline pain intensity conferred a 12% increase in risk (RR = 1.12, 95% CI = 1.03-1.20), and patients' belief that their LBP would persist conferred a 4% increase in risk (RR = 1.04, 95% CI = 1.01-1.07) for poor outcome at 6 months. Outcome at 5 years was best predicted by a model with the same factors as in the 6-month model: pain intensity increased risk by 9% (RR = 1.09, 95% CI = .997-1.20), and a belief that their LBP would persist increased risk by 6% (RR = 1.06, 95% CI = 1.03-1.09). Baseline pain intensity and expectations regarding recovery may be important targets for initial interventions.
- A 2013 cohort study of 315 occupational low back patients in New Zealand identified risk factors for persistent LBP at 6 months included resigned attitude towards the job (OR 1.73; 95 % CI 1.16–2.59), social support at work (OR 0.54; 95 % CI 0.32–0.90), functional limitation (OR 1.05; 95 % CI 1.01–1.10), and duration of LBP (OR 1.04; 95 % CI 1.02–1.06).[11]
- A 2010 systematic review of individual risk factors associated identified in 20 prospective studies of 10,842 people with less than 8 weeks of back pain assessed the development of persistent, disabling back pain. (Chou 2010). Low levels of fear avoidance (median [range] LR, 0.39 [0.38-0.40]) and low baseline functional impairment (median [range] LR, 0.40 [0.10-0.52]) were the most useful items for predicting recovery at 1 year. Presence of nonorganic signs (median [range] LR, 3.0 [1.7-4.6]), high levels of maladaptive pain coping behaviors (median [range] LR, 2.5 [2.2-2.8]), high baseline functional impairment (median [range] LR, 2.1 [1.2-2.7]), presence of psychiatric comorbidities (median [range] LR, 2.2 [1.9-2.3]), and low general health status (median [range] LR, 1.8 [1.1-2.0]) were the most useful predictors of worse outcomes at 1 year.

- In a 2006 randomized trial, 123 acute and subacute low back pain patients were assigned to four weeks of manipulation, core stabilization exercise, or specific directional exercise using disability (Oswestry) as the primary outcome measure at 4 and 52 weeks.[12] Before treatment was initiated, patients were also categorized by subgroups according to a LPB subclassification strategy believed to assist in targeting intervention: a) onset within 16 days and no pain below knee for manipulation; b) 3 out of 4 of straight leg raise >90 degrees, positive prone instability test, positive aberrant movements, or < 40 years old for core stabilization exercise; c) Leg pain that centralizes with a direction movement on two trials (e.g., extension) or centralizes on one direction and peripheralizes on the opposite direction.[13] Participants who were assigned to a group that matched their subclassification had 6.6 points better Oswestry scores at 4 weeks and 8.3 points better 1 year scores. The classification scheme has also been validated for inter and intra rater reliability.[13, 14]
- In a cross-sectional study of 221 patients with non-specific CLBP, cardiovascular capacity, pain intensity, and personal factors (e.g., fear of injury, catastrophizing, depression) had only limited impact on ability to perform various capacity tasks. Leg pain, age and duration of complaints had no impact on ability to perform tasks.[15]
- In patients with acute low back pain, psychological factors were useful in predicting disability, but did not predict patients' responses to physiotherapist-guided exercise and/or advice. Psychological factors tested include: catastrophizing, coping, pain self-efficacy, fear of injury/movement, depression, anxiety, and stress.[16]
- A qualitative report of retrospective chart reviews from a years' worth of occupational low back pain patients presenting to an occupational and sports medicine clinic reported on types of low back conditions diagnosed by collaborative evaluation by an occupational medicine physician and chiropractor. The effort was preparatory work for a clinical trial to standardize how patients would be categorized and to develop standard treatment protocols and expected durations of care involving combined passive and active approaches. Conditions were categorized by discogenic (with neurogenic signs –radiculopathy below knee, motor weakness) and without neurogenic signs (sensory distribution only, antalgia without radiation) and non-discogenic (joint and muscle findings only). Protocols based on clinic experience for treatment durations and intervention frequency indicated that duration of condition prior to presentation, true radiculopathy and minimal response to initial passive treatment were associated with slower recover and longer care duration. Soft tissue involvement and/or joint dysfunction diagnoses by themselves, as well as significant initial response to passive care were associated with more rapid recovery.[17]

Contraindications to rehabilitation

Incrementally increasing activity within patient tolerance following joint and soft tissue injuries would not generally be contraindicated. Significant cardiovascular conditions (e.g. myocardial infarction, unstable angina, uncontrolled arrhythmias, severe aortic stenosis), pulmonary infarction or embolus are typically contraindicated for physical activity and exercise.[18] Additionally, asthma, hypertension (>180 systolic or 100 diastolic), significant osteoporosis and other severe diseases (e.g., cancer, infection, unexplained dizziness or fever) are flags for restricting activity and exercise.

- A 2006 study of 53 chronic low back pain patients with MRIs compared pathoanatomic findings with outcomes from a 3-month rehabilitation program involving low back exercise.[19] Roland-Morris Scale was assessed at baseline, therapy completion, and 1 year. The cohort's MRI findings showed 89% had severe disc degeneration (grade 4 or 5), 74% had disc bulges, 60% had high intensity zones, and 62% had endplate/bone marrow changes in at least 1 lumbar segment. Only 11% patients had none of these changes at any level. The MRI abnormalities showed only minimal association with baseline symptoms. In multivariate regression analyses, in which age, gender, and baseline symptoms were controlled for, only 1 significant association between the MRI variables and outcome was observed: the presence of a high intensity zone in any vertebral segment was associated with lower average pain at the 12-month follow-up (standardized beta -0.376, P = 0.006, 16.5% variance accounted for). The presence of common "structural abnormalities" on MRI had no significant negative influence on the outcome after exercise therapy.

- Other than muscle soreness, no adverse effects of exercise have been reported in any reasonably well done published exercise trials to date.[20]

Provocative Testing

- In a test-retest study of 53 patients with non-specific CLBP, performance on six tasks was compared over repetitions of task performance.[21] Prior task experience did not affect test-retest validity. Five-minute walking and one-minute stair climbing were determined to be clinically useful. Progressive lifting was not. Increases in pain prior to task performance were not associated with reduced task performance.[21]

WORKERS' COMPENSATION ISSUES

Clear documentation of work-relatedness of a condition by providers at initial health encounters speeds allowance of claims and reduces potential adversity. Work injuries are typically directly linked on an identifiable workplace event. Documentation of chronic exposures leading to development of low back pain are frequently inadequate to justify work-relatedness.[22, 23] IICAC's comprehensive best practices resource for Washington workers' compensation documentation is available online: www.Lni.wa.gov/IICAC.

Causation & Work Relatedness	**Back problems that result from a triggering work event are the most straightforward** from a claim administration and allowance perspective. Specific requirements must be met for conditions attributed to cumulative workplace exposures. • In Washington State, occupational conditions that may be a result of cumulative workplace exposure across multiple employers may have claim and experience costs apportioned to both former and current employers. Worker and employer appeals rights can factor into adjudication decisions and contribute to delays which are associated with worse outcomes.[24] • Exceptionally clear medical justification for specific work exposure(s) is essential for fair and timely decisions. Delayed adjudication and development of adversity in work-related carpal tunnel cases has been associated with poor outcomes.[25]
Work Accommodation	• In a Cochrane review, work-related programs, supervised by a PT or multidisciplinary group, that include cognitive behavioral approaches and physical conditioning (e.g. aerobic capacity, muscle strength and endurance, coordination) seem to be effective in reducing sick days in some workers with chronic low back pain CLBP. There is no evidence of efficacy for ALBP.[26] • Attending providers are in a key position to address work modification and facilitating a positive vocational relationship between the worker and employer. Employing occupational health practice strategies involving early communication with employers and clear capabilities of what workers can do during recovery when work restrictions are expected has been shown to improve outcomes.[27-30] • Multimodal care (e.g., incorporation of conservative and manual methods with patient self-efficacy and active care approaches) that incrementally increases what the low back pain patient can do appears to be the key to successful recovery, more so than any particular treatment approach.[20]

GENERAL APPROACHES TO ACTIVE REHABILITATION

Overall, effective rehabilitation may best be approached by balancing active, passive, and cognitive interventions in a way to maximize a patient's engagement in their own recovery – including emphasizing return to normal activities and work. Studies demonstrate effectiveness for individual active, passive and cognitive approaches, as well as various combinations of them.[20] However, comparative trials generally do not suggest any particular exercise or passive approach is superior to comparators. Patient engagement in any activity, and, addressing coping skills for individual factors may be important. Thus, options that are best suited to provider skills and patients' preferences and abilities to comply may warrant as much or greater consideration than any particular exercise method or passive pain control approach. Additionally, if meaningful functional gains are not attained with about two weeks of one approach, a trial of an alternate approach should be considered.

Psychosocial factors (e.g., activity avoidance, low recovery expectations, inadequate coping skills) are associated with prolonged disability from work injuries. Screening, addressing, and/or triaging for support in these areas should be considered if functional improvement or return to work is inadequate or stalls.

Return to work interventions (e.g., setting expectations and motivation towards returning to the workplace, job accommodations, gradual return to usual work tasks) have strong evidence for reducing sick days, for both subacute and chronic low back pain patients.[31] Physical and manual interventions that adhere to best practices guidelines have been shown to reduce downstream utilization of additional health care resources.[32] Early chiropractic management has also been associated with both lower health care utilization and lower work injury-related disability, as well as effectiveness comparable to exercise and other PT approaches.[33-37]

Pain intensity was the most commonly reported outcome in studies of rehabilitation, followed by back-specific function.[20] When present, observed benefits for pain were generally in the small (5 to 10 points on a 0- to 100-point visual analogue scale or 0.5 to 1.0 points on a 0- to 10-point numerical rating scale) to moderate (10 to 20 points) range. Outcomes were mostly measured at short-term (up to 6 months) follow-up. Effects on function were generally smaller than effects on pain; additionally, few studies measured function only.

In 2017, The American College of Physicians Clinical Guidelines Committee published a comprehensive set of recommendations for noninvasive treatment for acute, subacute, and chronic low back pain based on a systematic review of randomized trials published through November 2016.[38] Their findings and recommendations were consistent with the US Agency for Health Care Research and Quality's 2016 comparative effectiveness review.[20]

Patient Selection for Rehabilitation

Incremental increases in activity within a patient's ability to tolerate and comply should not rule out any injured worker from participation in rehabilitation unless substantial concurrent disease is present (e.g., cardiovascular, pulmonary, bone demineralization disorders). High baseline pain intensity, low recovery expectation, high activity avoidance behavior, and lower socioeconomic status are associated with poorer outcomes and greater chronicity. Thus screening for and refining rehabilitation interventions to address such psychosocial factors is important. L&I's Psychosocial Determinants Influencing Recovery resource reviews evidence, summarizes best practices and management options when psychosocial factors may impede recovery.[39]

General Considerations

Placebo and nocebo effects – The interconnectedness of psychological and physiological drivers of nocebo and placebo response appears to make a strong case for patient education and provider attention to the worker's engagement and expectation-setting in their own recovery. All interventions appear to be subject to placebo (positive therapeutic outcome from an inert treatment) and nocebo (negative therapeutic outcome from an inert treatment) effects, however effect sizes attributed to placebo/nocebo are highly variable, and any neurobiological and psychological mechanisms are poorly understood.[40] There is a relationship to the patient's expectations surrounding a treatment (e.g. a belief that activity will cause harm) and outcomes that are achieved. Some individuals have greater susceptibility and the same people are susceptible to either a positive or negative effect. Additionally, biologically active treatment (i.e., medication or other interventions with predictable physiologic effect) may magnify effects. While there are useful tools for screening and addressing specific psychosocial factors that influence recovery, there is inadequate understanding regarding which individuals may have greater placebo/nocebo responses.[39]

Patient engagement – Rehabilitation by its nature implies the patient is an active participant in recovery from musculoskeletal injuries such as back strain. Sports and occupational medicine fields have increasingly recognized the importance of conditioning of both

healthy and injured tissue to attain functional goals with the recognition that pain relief may need to follow functional improvement, not simply the other way around.

Medication management – Granted that chiropractors as members of the committee spearheading this resource have predilections toward avoiding medications that mask symptoms, legitimate concerns exist regarding excessive focus on pain (as compared to functional ability for example) and dependency on symptomatic relief. Further, adverse effect profiles from prolonged use of pain and anti-inflammatory drugs, particularly opioids, underscore the appropriateness of alternative approaches, if not as a total substitute, certainly as a primary focus of conservative care. This has been reinforced in the current recommendations from the American College of Physicians.[38] In general, activation and conditioning should facilitate self-reliance and avoidance or diminishment of prolonged medication use.

Acute/Subacute LBP without pain below the knee

Various exercise approaches have been associated with lower long term disability. However, differences in short & intermediate term pain & function do not favor any particular approach.[20] Superficial heat appears helpful in reducing acute or subacute low back pain, perhaps related to muscle relaxation. Massage and other various soft tissue work may be helpful. Emphasis on normal recovery, engaging in activity and incrementally increasing it is important. Early use of an activity diary, [jump to page 7] explicitly negotiating even baby-steps that increase a little bit every day has both physiologic (e.g., tissue healing under normalizing stresses) and psychological (overcoming fear avoidance behavior, enhancing recovery expectations and locus of control) effects. The American College of Physicians 2017 evidence-based guideline also recommends nonpharmacologic options including heat, massage, acupuncture, or spinal manipulation, nonsteroidal anti-inflammatory drugs or skeletal muscle relaxants.[38]

Acute/Subacute LBP with pain below the knee

Numerous exercise approaches have demonstrated small favorable effect over usual care for low back conditions associated with leg pain. Centralization of leg pain with sustained trunk positions (directional preference) appears to predict which patients may benefit from directional preference exercise. Patient engagement in any activity appears to be important for early recovery. An activity diary, [jump to page 7] focusing on activities within the worker's tolerance and incrementally increasing is recommended. Interventions that assist in relaxing muscles and facilitating movement of the back and lower extremities may be helpful, but whatever approaches are utilized should carefully monitor for functional progress. The American College of Physicians 2017 evidence-based guideline also recommends nonpharmacologic options including heat, massage, acupuncture, or spinal manipulation, nonsteroidal anti-inflammatory drugs or skeletal muscle relaxants.[38]

Chronic LBP with or without leg pain

Motor control exercise (MCE) studies report greater reductions in short and intermediate term pain compared to general exercise. Individualized walking programs have been shown to be as effective as usual PT care or group exercise classes. Differences in long term pain have not been reported, however slightly better long term function may be associated with MCE. Experimentally robust comparisons between different types of exercise are not available. Moderate quality evidence is available for various kinds of exercise in the treatment of chronic back pain. Acupuncture, spinal manipulation, and multidisciplinary rehabilitation also have moderate quality evidence demonstrating effectiveness for achieving pain and functional improvement with chronic low back problems. The American College of Physicians 2017 evidence based guideline recommends using non-pharmacologic approaches initially including exercise (motor control, yoga, tai chi), multimodal rehabilitation, stress reduction (mindfulness approaches), progressive relaxation, operant or cognitive behavioral therapy, or spinal manipulation. For non-responders, nonsteroidal anti-inflammatory medication should be a first-line option with tramadol or duloxetine as second line drugs. Only consider opioid medications for those failing other methods, and only after careful consideration and discussion with patients regarding risks.[38]

OVERSIGHT APPROACHES – For Active Rehabilitation

Any meaningful oversight of low back patients' exercise and self-management regimen is more effective than advice or consultation alone. Oversight strategies may range from simple advice, demonstration and/or teach-back for home exercise and activity to structured exercise programs (individual or group) to intensive, therapist supervised and tailored exercise sessions and extended multi-hour work hardening programs. Home exercise seems to be the most commonly implemented approach and can be effective as long as compliance is not an issue. Individualized walking programs for chronic back pain patients have been shown to be as effective as usual PT or group exercise classes but at lower cost and with greater patient adherence.[41]

Supervised oversight and hardening programs are not as commonly described in the reviewed literature. Among other patient populations, however, these approaches have been found to be effective. Group exercise for work hardening programs proves to be low cost compared to individual care. Additionally, group exercise can increase a patient's self-confidence. However, more intensive programs appear to be helpful for only in specific situations several weeks into recovery such as when the job of injury has been lost, or an employer is unable to accommodate work modifications. Such programs may be counter-productive if begun too early, particularly if they require being done during time where the worker could be doing light duty in the workplace.

In general, trials evaluating more intense multidisciplinary rehabilitation programs (coordinated physical and psychosocial components provided by at least two different specialties) for chronic low back pain have shown mixed results with a trend toward short term benefit in pain reduction, pain duration, and disability.[20] Comparisons have included usual care, no multidisciplinary program, and regular physical therapy. Multidisciplinary rehabilitation for chronic low back pain appears moderately more effective than usual care or no multidisciplinary intervention at reducing pain and improving function in the short term, including return to work. Effects on pain and function over the long term also favored multidisciplinary programs, but effects were smaller. When behavioral approaches are incorporated with incrementally increasing activity, return to work appears to occur sooner.[31] Overall, more intense programs should be reserved for individuals for which functional gains have not occurred with less intense rehabilitation efforts.

Type of Instruction (e.g. home exercise, supervised instruction, hardening/intensive programs)

- A 2013 systematic review of factors evaluating adherence to exercise in chronic LBP identified that increased adherence to exercise was associated with higher levels of the patient's engagement in their general health (locus of control), exercise supervision, participation in an exercise program, and participation in a general behavior change program incorporating motivational strategies.[42]
- A 2016 Irish trial recruited 246 chronic back pain patients form outpatient physical therapy settings randomizing patients into an individualized walking program, group exercise class, and usual PT care.[41] All groups improved on function (Oswestry Disability Index), pain scale, fear avoidance, and general health (EuroQol 5D3L), however no significant between group differences were reported. However, the walking group had the lowest cost and greatest adherence.
- A 2011 trial randomized 301 chronic back pain patients to either high-dose, supervised low-tech trunk exercise, chiropractic spinal manipulative therapy, or a short course of home exercise and self-care advice for the treatment of LBP.[43] Patients who underwent supervised trunk exercise reported most satisfaction and better gains in trunk strength, they did not significantly differ from other groups in pain or patient related individual outcomes at short or long term (12 and 52 weeks).
- In a 2014 Cochrane review of biopsychosocial rehabilitation interventions for chronic back pain patients, 16 trials of moderate quality were pooled suggesting that multidisciplinary biopsychosocial rehabilitation (MBR) interventions were more effective than usual care in reducing pain and disability.[44] However, there was no evidence of better work outcomes. Nineteen trials comparing MBR to physical treatments suggested that it was somewhat more effective for self-reported pain and disability as well as work outcomes, however it is unclear if the difference were clinically meaningful.
- Function-centered rehabilitation (activity emphasis, strength and endurance training, cardiovascular conditioning, and work simulation) was compared to pain-centered rehabilitation (pain control and joint mobilization) were compared in a 2007 randomized trial of 174 low back pain sufferers with at least 6 weeks of sick leave due to the problem.[45] At one year follow up, the function-centered group had substantially more work days (mean =118 vs. 74). However, no significant differences were reported in compensation for disability or unemployment.
- A systematic review from 2012 identified four studies meeting quality criteria addressing interventions for psychosocial risk factors with persistent, nonspecific low back pain.[46] Graded activity plus Treatment Based Classification targeted people with high movement-related fear was more effective than Treatment Based Classification at reducing movement-related fear at 4 weeks. Active rehabilitation (physical exercise classes with cognitive-behavioral principles) was more effective than usual GP care at reducing activity limitation at 12 months, when targeted to people with higher movement-related pain.

EXERCISE STRATEGIES – Neuromuscular Re-education

Neuromuscular re-education exercises involving improved coordination, balancing, and reflex muscle relaxation appear to be useful with non-specific low back pain. A variety of approaches exist geared toward training trunk and extremity muscles to function together in coordinated fashion. The approach does not focus on stretching, flexibility or strengthening per se, however, such exercise may facilitate strength and flexibility. Further, many rehabilitation protocols incorporate multimodal exercises and conditioning strategies. Typically, these approaches are initially guided by a provider to practice normal use of the muscles during simple tasks. As the patient's skill increases the exercises are progressed to more complex and functional tasks involving the muscles of the trunk and limbs with an aim toward self-reliance.

Motor Control Exercise

Coordination Balance Proprioception

Motor control exercise is a popular form of neural re-education exercise that aims to restore coordinated and efficient use of muscles that control and support the spine. There is significant variation in application by different providers, however, several commonalities include beginning in a relaxed state, remaining aware of peripheral sensations, maintaining neutral spine positions, and engaging in various simple tasks and activities (guided by a therapist) that stimulate coordination and balance. Various other balance/proprioceptive approaches are also commonly seen (e.g., simply standing on an irregular or soft surface like a balance ball while maintaining a neutral spine position).

- A 2016 Cochrane review identified three randomized trials addressing motor control exercises for acute non-specific low back pain involving 197 subjects.[47] Low quality evidence indicates that there is no clinically important difference between spinal manipulation and motor control exercise for short and long term pain and function measures. Low-quality evidence also suggests no clinically important differences between MCE and other forms of exercise for pain at short or intermediate term and for disability at intermediate term or long term follow-up. Moderate-quality evidence shows no clinically important differences between MCE and other forms of exercise for disability at short term follow-up. Finally, very low-quality evidence indicates that addition of MCE to medical management does not provide clinically important improvement for pain or disability at short term follow-up. For recurrence at one year, very low-quality evidence suggests that MCE and medical management decrease the risk of recurrence by 64% compared with medical management alone.
- In a systematic review of 14 randomized controlled trials, motor control exercises, when performed alone or in conjunction with another form of therapy (e.g. education, general exercise, manual therapy, physical therapy, CBT), significantly reduced pain and disability in patients with persistent non-specific LBP. It is unclear whether motor control exercises are more effective than manual therapy, other forms of exercise, or surgery.[48]
- In meta-analysis examining motor control exercises reducing pain and disability in LBP,[49] follow-up of studies ranged from 6 weeks to 36 months and found that pooled results favor MCE compared to general exercise in regards to disability at all time periods. Also found that compared with spinal manual therapy MCE was superior at all time periods. MCE was also superior to minimal intervention at all time periods.
- The participants were 172 patients with chronic (>12 weeks) nonspecific low back pain.[50] Patients were randomly assigned to receive either motor control exercises or graded activity. A linear mixed models analysis showed that there were no significant differences between treatment groups at any of the time points for any of the outcomes studied.
- A 2015 meta-analysis included 39 trials examining strength, coordination, cardiovascular and combine exercise programs for patients with chronic low back pain.[51] Combined meta-analysis revealed significantly lower chronic low back pain with intervention groups using exercise compared to a control group or other treatment group. Secondary subgroup analysis showed a significant effect for strength/resistance and coordination/stabilization programs suggesting a beneficial effect for strength/resistance and coordination/stabilization exercise programs over other interventions. Cardiorespiratory and combined exercise programs appear to not be effective for chronic low back pain.
- An unblinded randomized trial of 172 chronic back pain patients from 2012 assessed 14 supervised sessions of graded activity vs. specific trunk motor control exercise.[50] Average pain over the previous week (numeric rating scale) and function (Patient-Specific Functional Scale) were primary outcomes. Secondary outcomes were disability (24-item Roland-Morris Disability Questionnaire), global impression of change (Global Perceived Effect Scale), and quality of life (36-Item Short-Form Health Survey questionnaire [SF-36]). Outcome measures were collected at baseline and at 2, 6, and 12 months after intervention. A linear mixed models analysis showed that there were no significant differences between treatment groups at any of the time points for any of the outcomes studied suggesting that motor control exercises and graded activity have similar effects for patients with chronic nonspecific low back pain.
- In a systematic review of randomized clinical trials for proprioceptive training, conclusions (based on low quality evidence) found that proprioceptive exercises may be more effective than not intervening, may be no more effective than conventional physiotherapy, and may be inferior to educational and behavioral approaches.[52]

Muscle Energy – Contract-Relax Exercise

Muscle energy techniques (MET) are essentially isometric exercises aimed at contracting various muscles against resistance. Typically applied along various places throughout a normal range of joint motion, or guided with manual resistance through an arc of normal motion, the aim is to trigger reflex relaxation of taut muscles and provide a proprioceptive load to joints and muscles that affects neurologically sanitized pathways (e.g., pain gates, muscle spasm). It is frequently employed as an alternative to manipulation when it is not tolerated or is contraindicated. No well-done studies are available on low back pain.

- A 2015 Cochrane review identified 12 randomized trials of low quality that provided 14 comparisons across 500 subjects that compared muscle energy techniques (MET) to alternatives.[53] The authors were able to do statistical pooling for a variety of homogenous comparisons (e.g., acute vs chronic LBP, types of MET utilized). Studies were generally small and at high risk of bias due to methodological deficiencies. Generally, the authors suggested that low-quality evidence supports that MET is not effective for patients with LBP. However, they emphasized there is not sufficient evidence to reliably determine whether MET is likely to be effective in practice. Large, methodologically-sound studies are necessary to address the question.
- In patients with ALBP, with leg pain, manipulation (lumbar oscillatory rotation, 3x/wk) was found superior to conventional therapy (heat, short wave diathermy) 20 min, followed by gentle isometric exercise (classic pelvic tilt type of the back and abdominal involving ten contractions with each contraction held for 5 seconds with 10 seconds relaxation between contractions, 3x/wk) in treatment of symptoms.[54] Both groups showed significant differences pre vs. post treatment in flexion and extension. Manipulative group significantly differed in treatment time (160 min vs. 121 min.) Manipulative group had significantly fewer patients returning for treatment after 3 months (11.5 % vs. 28%).

EXERCISE STRATEGIES - Stretching

Stretching exercise does not appear to be a particularly effective approach for rehabilitation of acute and subacute low back pain per se. Back, pelvic and lower extremity muscle groups are frequently tight, and sometimes in spasm with low back pain conditions. Stretching exercise is frequently employed to relieve pain and increase mobility which may be helpful in facilitating incremental increasing activity. However, some sustained approaches involving patient self-efficacy (e.g. yoga) do appear to have substantial short term befit on functional improvement and pain severity with chronic, non-specific low back pain.

Passive Stretch/ Movement

Passive stretch classically involves the provider performing lengthening movements with a patient's muscle. The goal is to increase the mobility and pliability of muscles for both direct lengthening of contractile tissue as well as stimulation of stretch receptors in non-contractile structures to trigger reflex muscle relaxation. Typically associated with "longer lever" movements such as stretching hamstring muscles via hip flexion and knee extension, numerous passive interventions done by providers (e.g., myofascial work, cross friction tendon stimulation) are aimed at achieving similar effects. See Integration of Active & Passive Intervention [jump to page 22] section below.

- In patients with subacute LBP with or without leg pain, routine physiotherapy (60 min exam to determine type of treatment- any combo of joint mobilization and manipulation; soft tissue techniques including stretching, spinal mobility and strengthening exercises; heat or cold treatments; and advice for duration of 30 min/session for 5 sessions) seemed to be no more effective than one session of assessment and advice from a physiotherapist (1 session, up to 60 min; exam and advice to remain active as specified in the advice booklet) after one year.[55]

Active Movement

Active movement involves the patient engaging in activities, positions and activities to lengthen and/or relax contractile tissues. Exercise approaches such as yoga typify this strategy. There are also "assisted" procedures such as contracting a muscle against resistance (e.g. isometric) to stimulate relaxation, then taking it through a full range of active movement and/or performing stretching exercises. Studies particularly in sports medicine have demonstrated increased range of motion and flexibility but specific to recovery from low back condition, the literature is insufficient.

- A 2013 meta-analysis of eight randomized trials with a total of 743 patients evaluated efficacy of yoga for functional improvement with chronic low back pain patients.[56] Yoga showed significant medium to large effects post treatment on both function and pain outcome scores. However follow-up effect sizes were smaller and more variable, but remained significant. Post-treatment, yoga had a medium to large effect on functional disability (d=0.645) and pain (d=0.623), indicating a medium effect size. At follow-up, effect size was smaller for functional disability (0.486) and pain (0.397) indicating that the benefits are likely not long term.

Directional Preference (centralization of leg symptoms)

Directional preference (DP) approaches have emerged to address low back conditions associated with leg pain. The provider determines which sustained postures (e.g., passive end range extension of the lumbar spine in a prone position) cause the leg pain to centralize toward the lower back. The patient is then instructed to repetitively alternate between these positions and a neutral position with the goal of reducing the leg symptoms and in some cases the low back pain itself.

- McKenzie directional preference exercises (12 sessions over 8 weeks) were compared to motor control exercises on trunk muscle recruitment in a randomized trial of 70 people with chronic low back pain classified with a directional preference.[57] Outcomes (physiologic muscle measures, pain, function, and global perceived effect) were collected at baseline and at 8-week follow-up. No significant between-group difference was found for trunk

muscle thickness of the transversus abdominis (-5.8%; 95% confidence interval [CI]: -15.2%, 3.7%), obliquus internus (-0.7%; 95% CI: -6.6%, 5.2%), and obliquus externus (1.2%; 95% CI: -4.3%, 6.8%). Perceived recovery was slightly superior in the McKenzie group (-0.8; 95% CI: -1.5, -0.1) on a -5 to +5 scale. No significant between-group differences were found for pain or function (P = .99 and P = .26, respectively).

- A 2016 randomized trial examined the effectiveness of mechanical traction in 121 patients with lumbar nerve root compression recruited from physical therapy clinics.[58] Patients were stratified at baseline and randomized to an extension-oriented treatment approach with or without the addition of mechanical traction for up to 12 visits over a 6-week period with outcomes of pain and disability collected at 6 weeks, 6 months, and 1 year. The mean ± SD age of participants was 41.1 ± 11.3 years, median duration of symptoms was 62 days, and 57% were male. No significant differences in disability or pain outcomes were noted between treatment groups at any time point, nor was any interaction found between subgroup status and treatment indicating no advantage of including traction with extension directional preference therapy.
- In a 2012 systematic review to determine the efficacy of directional preference exercise with low back pain patients having a directional preference identified six trials.[59] Outcomes for pain, back specific function, and work participation were extracted, however, clinical heterogeneity prevented meta-analysis. Results were mixed but no trial found directional preference therapy to be less effective than comparison treatments.
- A 2012 secondary analysis of data from a multicenter randomized trial sought to determine if pain intensity and neurologic status predicted outcomes from directional preference therapy.[60] Seventy-one of 80 subjects with acute to chronic low back pain, and with and without radicular leg pain, and with or without mild neurologic deficit, were found at baseline to have a directional preference and were then treated for two weeks with directional exercises that matched their directional preference. Across all pain duration, location and neurological status categories over 90% reported improvement, however baseline pain duration, location or neurologic status did not correlate with various degrees of pain and function outcomes suggesting that directional preference should be the primary determinant for directional preference exercise.
- A 2010 systematic review assessed efficacy of targeted treatments with adult nonspecific low back patients.[61] Four high-quality (Cochrane criteria) randomized controlled trials of targeted manual therapy and/or exercise met the inclusion criteria. One study showed statistically significant effects for short-term outcomes using McKenzie directional preference-based exercise. Research into subgroups requires much larger sample sizes than traditional two-group trials and other included studies showed effects that might be clinically important in size but were not statistically significant with their samples sizes. The authors' clinical implications were that very cautious evidence supports treatment targeted to nonspecific low back pain subgroups (e.g., directional preference) may improve patient outcomes. The inconsistent results and sample sizes of the studies precluded strong recommendations.
- For mixed back pain patients, both manual therapy (3–5 home-exercises to actively mobilize the low back, 2–3 sets of 15–20 reps for each, and lumbar stabilization exercises with 10 repetitions of 10 sec, and stretching exercises once a day for 45–60 sec) and directional preference therapy (education, active therapy with exercise instruction, 10-15 reps every 1-2 hours with or without sustained end-range position) appeared marginally more effective, in improving VAS and ROM at 6 and 12 months, than advice only.[62]
- A 2004 multicenter study randomized 230 low back pain and low back pain with sciatica patients with a directional preference into three groups: directional preference exercise that matched their directional preference; exercises that were opposite to their directional preference, and non-directional exercise.[63] Directional preference therapy reduced pain and improved function more effectively than opposite directional preference therapy or general exercise. Additionally, no matched subject withdrew from the trial while a third of both the opposite, and general exercise groups had withdrawn by 2 weeks because of lack or improvement or worsening.

EXERCISE STRATEGIES – Conditioning & Strengthening

Multiple approaches to both general and specific low back conditioning exercise have been shown to be more effective than no treatment. Although many studies have been conducted on various exercise approaches, results overall have been mixed. In general, exercise may be the most helpful with chronic low back conditions, however studies comparing different approaches do not appear to confer greater effectiveness to any particular approach.[20] A possible exception may be Motor Control Exercises (MCE) which essentially focus on coordination. Additionally, the severity of the low back condition, or presence or absence of leg pain do not appear to be useful for discriminating which kinds of exercise approaches will be most helpful. It may be that engagement in most any kind of activity, and incrementally increasing amount and intensity of activity may be an important therapeutic effect. This may yield greater leeway for provider skill sets and patient preference in determining what kinds of exercise and activity to utilize. For normative data around physical capacity measurement, see Appendix on Physical Capacity Measures.

General Aerobic Exercise

Lower aerobic fitness has been observed in chronic low back pain sufferers compared to the general population. Aerobic exercise is geared toward increasing cardiovascular fitness through any number of excursion approaches of various intensity (e.g., bicycle, running, treadmill, elliptical, walking). Comparative trials suggest that aerobic exercise has similar effectiveness to strengthening exercise in reducing chronic low back pain symptoms, as well as being comparable to spinal manipulation with chronic pain.

- Chronic low back pain patients have been shown to have lower levels of aerobic fitness than people without back pain.[64] However, lower levels of aerobic fitness do not appear to be associated with higher levels of activity avoidance behavior due to their pain.[16]

- Physiotherapy (30 min, 2x/wk for 3 mo; individual treatment with PT focusing on strengthening coordination and aerobic exercise), muscle reconditioning (60 min, 2x/wk for 3 mo; small class used exercise equipment, aerobic warm-up and stretching cool down), and aerobics (low impact aerobics class for 60 min, 2x/wk for 3 mo) significantly improved pain intensity for patients with chronic low back pain (with or without leg pain) after 3 months. Self-reported disability decreased among muscle reconditioning and aerobics groups.[65]
- In patients with non-specific low back pain, an exercise program of aerobic and coordination exercises and instruction (30 min/session, 5 sessions), helped to decrease absenteeism at work, lowered pain intensity, and increase back muscle strength.[66]

General Physical Conditioning

General conditioning approaches target large muscle groups throughout the body (as opposed to targeting specific low back and supportive musculature).

- Active physical exercise (30 min bicycle, 5-minute stretch, 15 min trunk leg strengthening to fatigue), instruction on graded activity, or combinations of both all reduce pain and improve function (questionnaire & observation) better than no treatment. No differences observed between groups (individually or in combination). This trend sustained in 1 year follow-up.[67, 68]
- Review of RCTs of exercise for CLBP (SR): In general, when all types of exercise are analyzed, small, but significant reductions in pain and disability are observed compared with minimal care or no treatment. Despite many possible sources of heterogeneity in exercise trials, only dosage was found to be significantly associated with effect sizes.[69]
- In non-specific CLBP patients, 10 weeks of APT (aerobic training, extensor strengthening) versus graded activity coaching with problem solving versus combined, there was no difference in Roland scores at 1 year, although self-perceived improvement was better in either individual treatment compared to combine treatment.[67]
- In mixed chronic back and leg pain patients, endurance and lumbar muscle strength increased similarly with individual PT-supervised exercise (30 min session of strengthening, aerobic, coordination 2x/wk, 3 mo), small group exercise equipment (1 hr 2-3/wk for 3 mo with aerobic warm up) or low impact aerobics class (1 hr 2x/wk for 3 mo).[65]
- Examination, information, and recommendations to remain active (advice to stay active, take daily walks, and stretch at home) can have a significant effect in reducing sick leave for patients with subacute LBP compared to no recommendations to remain active at one year.[70] The number of reported sick days for the intervention group was not significantly different than the number reported for the control group at years 2 and 3.[71]
- In patients with CLBP, function-centered treatment (work simulation, strength and endurance training through isokinetic exercise, cardiovascular training performed by walking and water aerobics, sports therapy, and self-exercise; 4 hr/day, 6days/wk, 3 weeks) increased work days (10 days), decreased work-related disability, and significantly decreased pain intensity compared to pain-centered treatment (individually selected passive and active mobilization, stretching, strength training, and a mini back school; 2.5 hrs/day, 6 days/wk for 3 weeks) at 3 month and 1 year.[45, 72]
- At 1 year, both group exercise (10 patients/class, 8 1-hr sessions for 2 months) and individual exercise (8 30-minute sessions for 2 months) were effective in the management of CLBP disability. Group exercise significantly increases patients' confidence and is 40% less costly than individual care.[73]
- 234 chronic disabling LBP patients randomized to 1) mailed educational packet with 6 weekly 1-hour sessions of general exercise and cognitive behavioral therapy (encouragement, coaching on importance of activity) and 2) mailed self-management educational packet. The PT administered group had a small additional benefit in improved pain (VAS) and function (RMDQ) at 6 month follow up.[74]
- A small 2003 controlled trial randomized patients to 16 sessions of manual PT administered low and high velocity manipulation with individual home exercise versus 16 session PT administered supervised 45-minute exercise sessions (10 min warm-up bike, 35 min individualized strengthening, stretching, mobilizing, coordination, and stabilizing exercises for the abdominal, back, pelvic, and lower limb muscles, suited to the clinical findings) and the same individualized home exercise program. Both groups improved, but the manual therapy approach resulted in significantly greater improvements than exercise therapy of spinal range of motion (Schobers), pain (VAS), function (Oswestry), general health (COOP) and sick leave (self-report) which was sustained at 1 year.[75]
- 235 subjects with CLBP were randomized to either 4 weeks of DC-administered flexion-distraction manipulation or 4 weeks of a PT administered exercise program (general strengthening, flexibility, aerobic) in a 2006 study. At 1 year, both groups demonstrated meaningful decreases in pain (VAS) and disability (RMDQ), with the FD group demonstrating significantly greater pain reduction.[76]
- A well-designed prospective 4 arm trial randomized 1,334 patients to 12 weeks of either usual medical care, manipulation, exercise, or exercise/manipulation combination. The study concluded that manipulation followed by exercise and manipulation alone both provided a moderate benefit at three months and small benefit at 12 months but exercise alone provided only a small benefit at 3 months and no benefit at 12 months. Although, essentially a clinical trial in design, the effort was a pragmatic policy exercise designed to make coverage recommendations. The study concluded that manipulation alone offered the best cost per quality adjusted life year over a one-year period.[77, 78]
- A 2005 Cochrane review of the literature assessing the effectiveness of exercise therapy for non-specific LBP for pain intensity, functional status, overall improvement, and return to work. 61 randomized, controlled trials of all types of exercise therapy for individuals with acute (<6 wks), subacute (6-12 weeks) and chronic (> 12 weeks) non-specific LBP. Studies of specific low back conditions (e.g. radiculopathy) were excluded.[79]
  - In ALBP, exercise does not appear to be more effective than other conservative treatments. Meta-analysis showed no advantage over no treatment for pain and functional outcomes over short or long-term follow-up specific follow-up ranges were not reported.

- Graded-activity exercise programs (gradually increasing intensity) appear to improve outcomes for subacute occupational low back conditions. The effectiveness for other types of exercise therapy in other populations is not clear from existing studies.
- Evidence strongly suggests that exercise is at least as effective as other conservative treatments for CLBP. Individually designed strengthening or stabilizing programs seem to be effective in health care settings with meta-analysis indicating small but statistically significant improvements in pain and function measures both short and long term.

- For 256 patients with chronic back or neck pain (lasting for more than 6 weeks) were randomized into manipulative therapy, physiotherapy (exercise electrotherapy & ultrasound), general practitioner care (medication, advice, home exercise) and placebo (exam followed by detuned shortwave diathermy (10 min) and detuned ultrasound (10 min), 2x/week for 6 weeks). At 3 month follow up, both manipulative care and physiotherapy groups improved significantly. Manipulative therapy was slightly better than physiotherapy after 12 months and the number of treatments was much lower for manipulative therapy than physiotherapy.[80]
- High velocity low amplitude manipulation (daily, 6 days/wk, 2 weeks) is more effective in pain and function improvement for subacute (defined as >7wks) LBP patients compared to a sham treatment or a back education program.[81]
- A Cochrane review of the literature comparing the effectiveness of physical conditioning programs (e.g., work conditioning, work hardening, or function restoration/exercise programs) in reducing time lost from work for workers with back pain. Twenty-three RCTs that studied workers with work disability related to back pain were referenced.[82] Findings included:
  - Positive effect of interventions with workplace involvement.
  - Light physical exercise had no significant effect on chronic or subacute pain in workers.
  - Physical conditioning programs probably have a small effect on return to work with chronic back pain workers.
  - Conflicting results for intense physical conditioning to other exercise therapy in the first 2 years of sick leave.
  - No difference in effect was found between a light or an intense physical conditioning program.
  - Time-loss (sick leave) appeared to be decreased in workers with chronic back pain with the implementation of physical conditioning programs.

Specific Strengthening
Trunk Flexion / Extension

Trunk and extensor strengthening exercise has been a traditional element of athletic conditioning. By default, flexor and extensor exercise was frequently incorporated into approaches for back pain. More sophisticated strategies addressing entire trunk and leg musculature have emerged and are addressed in the section below on Core Strengthening.

- A total of 39 high quality randomized trials addressing exercise (strength/resistance, motor control, and cardio respiratory) vs. control or comparative treatment for chronic low back pain were identified in a 2015 meta-analysis.[51] Strength/resistance showed a small significant effect, however, moderate heterogeneity and some lack of proper reporting of results were noted. Motor control exercise also showed benefit. Cardiorespiratory exercise and combined programs did not show benefit.
- After two months, an intervention for acute and subacute low back pain that included one session of individualized physical treatment or injection and a simple back program (McKenzie technique carried out for an average of 10 reps, 3-4x/day and group exercise for 1 hr, 3 x/ wk in a gym for 1-2 weeks) combined with a package of information and advice resulted in a quicker return to work than intervention that provided information, advice, and the normal route of care.[83]
- Manipulation with stabilizing exercises (4x/wk for 4 wks, patients also received a 25-page educational booklet on basic anatomy and physiology of the spine, principles of ergonomics for LBP patients, and instructions on how to exercise and cope with the acute phase of LBP) was more effective in reducing pain intensity and disability than the physician consultation (patients received same 25 page educational booklet, the patients received individual instruction regarding their posture and 3 to 4 exercises aiming to increase their spinal mobility, muscle stretch, and/or trunk muscle stability, also advised to avoid long standing static work by performing several counter movements alone, for patients with CLBP (with and without leg pain).[84]
- Active manipulation (patients treated according to a pre-planned 30-day protocol with a number of sessions that depended on pain relief of up to a maximum of 20 sessions scheduled 5 days/ wk for 5 min) had more effect than simulated manipulation (patients received soft muscle pressing apparently similar to manipulations but not following any specific patterns and not involving rapid thrusts. Each participant was treated according to the same pre-planned 30-day protocol as the active treatment group) on pain relief for acute back pain and sciatica after 180 days. Patients in the active manipulation group spent fewer days with moderate-to-severe pain and consumed fewer drugs for pain control.[85]
- Mobilization (all patients were instructed to do two simple extension exercises, 3-5x with gradual increase of extension. After a short break the procedure was to be repeated 4-6x. The patients were instructed to perform these exercises as often as possible during the day and at least 1x/hr) is effective in reducing pain for patients with CLBP, with or without leg pain. The addition of manipulation before mobilizing extension exercises does not increase benefit of mobilization.[86]
- In patients with sub-acute non-specific LBP, manipulation followed by general lumbar ROM (side posture SI joint manipulation performed moving the SI A/P 3x/wk) was more effective than extension-oriented exercise and a postural program (McKenzie method) in improving function (Oswestry). Manipulation may produce a short-term effect of increasing ROM and decreasing pain-allowing patient participation in an exercise program.[87]
- Systematic review of RCTs (11 included) of clearly defined supervised lumbar extensor strengthening in adults with CLBP. Published systematic reviews were also considered (e.g. Cochrane) but all were too broad in scope of exercise type, or too general in their assessments conclusion to inform lumbar extensor strengthening.[88]

- Short term lumbar extensor strengthening (alone or with co-interventions) is more effective than no treatment or passive treatment in improving pain & disability. There is no clear benefit of lumbar extensor strengthening compared to other exercise programs. The role of exercise intensity is unclear and hyper-extension during dynamic lumbar strengthening exercise does not offer additional benefit.

- In patients with recurrent non-specific LBP, a general exercise program (exercises activating the extensor (paraspinals) and flexor (abdominals) muscle groups; 45-60 min, 2x/wk, 8 weeks) reduced disability in the short term (<3 mo) to a greater extent than a stabilization-enhanced exercise approach (low-load activation without movement with minimal loading positions progressing to increased holding time and number of contraction repetitions, instruction of avoidance of incorrect muscle activation, integration with dynamic function (spinal or limb movements) through the incorporation of stabilizing muscles; 45-60 min, 2x/wk, 8 weeks).[89]

Core Strengthening

Core strengthening approaches address balancing and strengthening all trunk musculature, including the supporting pelvic and lower extremity muscle groups. Many different approaches are available in the fitness arena at large (e.g., Pilates, Hatha Yoga, core training) and in core stabilization programs in physical therapy and rehabilitation clinic settings. Generally, such approaches perform better on self-reported pain and function compared to 'care as usual' (typically advice and medication) or no-treatment alternatives, but perform similarly to comparisons of other active care approaches and overall, study quality is low.

- A 2017 systematic review with a meta-analysis of randomized controlled trials examined the efficacy of stabilization exercises compared to general exercises or manual therapy on pain, disability, and function in patients with low back pain.[90] Weighted mean differences (WMD) and 95% confidence intervals were calculated. Eleven studies met the inclusion criteria (413 stabilization exercises patients, 297 general exercises patients, and 185 manual therapy patients). Stabilization exercises may provide greater benefit than general exercise for pain reduction and improvement in disability. Stabilization exercise improved pain with a WMD of -1.03 (95% CI: -1.29 to -0.27) and improved disability with a WMD of -5.41 (95% CI: -8.34 to -2.49). There were no significant differences in pain and disability scores among participants in the stabilization exercise group compared to those in the manual therapy group. Stabilization exercises were as efficacious as manual therapy in decreasing pain and disability and should be encouraged as part of musculoskeletal rehabilitation for low back pain.
- A 2014 systematic review of core stability exercises for athletes with low back pain (LBP) identified 5 studies of which two were randomized trials.[91] The quality of evidence was deemed to be low overall, with only 1 non-RCT having a moderate quality score, and 1 RCT having a lower risk of bias. Four studies reported statistically significant decreases in back pain intensity in their core stability intervention group. To date, the studies have been conducted on small and heterogeneous populations using interventions that vary drastically with only mixed results and short-term follow-up precluding any strong conclusions regarding core stability exercises for treating LBP in athletes.
- A 2014 Systematic review and meta-analysis of stabilization exercises for low back pain included 29 studies. In 22 studies of stabilization for pain reduction, standardized mean difference (SMD) was significant for stabilization exercises compared to alternative treatments/controls at short, medium, and long term follow-up but the difference was not clinically significant. In 24 studies of the effect of stabilization on disability SMD was significant for stabilization exercises compared to alternative treatments/controls at short, medium, and long term follow-up but the difference was not clinically significant. There is strong evidence that stabilization exercises are not more effective than any other form of active exercise in the long term.[92]
- A 2012 meta-analysis of 28 trials comparing effects of core stability exercise for patients with chronic low back pain identified 5 studies involving 414 participants meeting inclusion quality criteria.[93] Compared to general exercise, core stability exercise was more effective in decreasing pain, and may improve physical function in patients with chronic LBP in the short term. However, no significant long-term differences in pain severity were observed between patients who engaged in core stability exercise versus those who engaged in general exercise.
- In a 2011 randomized comparative trial (n=301) of spinal manipulation, home exercise and supervised trunk strengthening exercise for chronic low back pain, all three groups improved equally at 12 and 52 weeks on pain, disability, general health status, medication use, and global improvement.[43] The high-dose, supervised truck exercise group reported higher satisfaction scores and had greatest gains in trunk strength and endurance.
- Mixed LBP (w/wo leg pain) randomized to Pilates (n=21) & usual care (n=18; PCP care as usual with continue normal activity). Pilates did better on self-report pain (NRS-101) & function (RM) scores at 3, 6, 12 mos.[94]
- Four sessions of isometric core strengthening exercise combined with muscle energy manipulation and physician consultation encouraging activity and reassuring recovery is more effective at improving self-reported pain (VAS) and function (Oswestry) than physician consultation with an instruction booklet alone. Differences persisted at 5 months and 1 year (questionable clinical meaningfulness) but diminished at 2 year follow up. Both groups improved significantly and cost analysis suggested that physician consult was more cost effective. There was higher satisfaction in the combination group.[84, 95] A secondary study evaluated relationship of dysfunctional psychological profile to recovery and found that such profiles predicted more sensitive response to treatment in both groups.[96]
- A spinal stabilization program (functionally progressive exercise class, 10 1-hour sessions, 10wks; followed by back school) is more effective than manually applied therapy (physical therapy without exercise followed by back school) or an education booklet (followed by back school) in treating chronic low back disorders at 24 months. Both manual therapy and the spinal stabilization program are significantly effective in pain reduction in comparison to an active control.[97]

- Based on a 2009 Cochrane review, evidence strongly suggests that exercise is at least as effective as other conservative treatments for CLBP. Individually designed strengthening or stabilizing programs seem to be effective in health care settings with meta-analysis indicating small but statistically significant improvements in pain and function measures both short and long term.[79]
- Chronic low back pain patients compliant with an exercise program which improved lumbar stability and coordination (stretching and relaxation was applied after each specific lumbar exercise, and functional muscle and coordination exercises (e.g. sit-ups) had better pain and work absentee outcomes than those who were non-compliant.[98] One hundred twenty-five patients with low back pain, who had participated in a 12-week active low back rehabilitation program, were asked about subjective pain and disability on the average of 14 months after the treatment. The outcomes were defined as a recurrence of persistent pain and work absenteeism, and a survival or failure analysis was performed between those who had continued exercising and who had been physically inactive. Recurrences of persistent pain during the follow-up period were fewer (P = 0.03) among those who had maintained regular exercise habits after the treatment than among those who had been physically inactive. Similarly, work absenteeism was less (P < 0.01) among physically active than among physically inactive persons. However, patients with good outcome in pain reduction after low back pain rehabilitation were more likely to participate in physical exercise.

Incrementally Increasing (Graded) Exercise

Regular, gradual progressive increases in activity and exercise intensity, frequency, and/or duration appear to be more useful than quantity targets (e.g. numbers of minutes or repetitions). Exercise directed specifically towards activities and tasks the patient may be avoiding due to their condition appears to be superior to just general incremental increases in activity levels.

- 2016 systematic review and meta-analysis found that graded activity was significantly more effective than a usual care control group for improvements in disability in the short term (three studies: n=254, SMD=20.3, 95% CI 20.55 to 20.05, P=0.02) and long term (two studies: n=238, SMD=20.53, 95% CI 20.79 to 20.27, P < 0.0001).[99] Graded activity (positive reinforcement of the patient engaging in general daily activities) was significantly less effective than graded exposure (exposure to specific situations and tasks the patient fears engaging in) for the improvement of disability in the short term (two studies: n=105, SMD=0.39, 95% CI 0.003–0.78, P=0.048). General graded activity was also less effective in improving catastrophizing in the short term (two studies: n=105, SMD=0.48, 95% CI 0.09–0.87, P=0.02).
- A 2016 retrospective, observational case series reported on 201 CLBP patients undergoing 90-minute work hardening style program (twice per week for 8 weeks) including behavioral education, stretching, aerobic exercise, progressive resistance exercise, isotonic strengthening and functional bending lifting tasks.[100] Statistically significant improvement in function (Oswestry disability Index) was reported (13.2% ± 14.0, p< 0.001). Statistical and clinically meaningful improvement in flexibility, VAS, functional lifting tasks (p< 0.001), and lumbar extension strength (p= 0.01) at 8-week follow-up was also noted. Follow-up mailed questionnaires had a 21% return rate indicating sustained improvements at 6 and 12 months.
- A 2015 report detailed 66 chronic low back pain patients randomized to graded activity (12 sessions over 6 weeks of moderate treadmill, brief education & strengthening) vs. PT conditioning (strengthening, stretching, motor control).[101] After six weeks, significant improvements were observed in all outcome measures of both groups, with a non-significant difference between the groups. For intensity of pain (mean difference = 0.1 points, 95% confidence interval [CI] = -1.1 - 1.3) and disability (mean difference = 0.8 points, 95% confidence interval [CI] = -2.6-4.2). No differences were found in the remaining outcomes. Results suggested that graded activity and physiotherapy conditioning have similar effects for patients with chronic nonspecific low back pain.
- A multicenter randomized trial of 106 chronic, non-specific low back pain patients compared general exercise vs specific movement control exercise (balancing) in 2015.[102] Both pain and function (Roland-Morris Disability Questionnaire, Patient-Specific Function Scale) improved similarly and significantly in both groups with sustain improvement at 6 and 12 months. No differences were seen between groups.
- An unblinded trial of 172 CLBP patients randomized into 14 supervised sessions of graded activity vs. specific trunk motor control exercise.[50] Average pain over the previous week (numeric rating scale) and function (Patient-Specific Functional Scale) were primary outcomes. Secondary outcomes were disability (24-item Roland-Morris Disability Questionnaire), global impression of change (Global Perceived Effect Scale), and quality of life (36-Item Short-Form Health Survey questionnaire [SF-36]). Outcome measures were collected at baseline and at 2, 6, and 12 months after intervention. A linear mixed models analysis showed that there were no significant differences between treatment groups at any of the time points for any of the outcomes studied suggesting that motor control exercises and graded activity have similar effects for patients with chronic nonspecific low back pain.
- In a 2012 systematic review; five RCTs involving 680 patients were identified that address the effects of graded activity on disability and return to work with non-specific low back pain patients.[103] The best-evidence synthesis revealed that there was no or insufficient evidence for a positive effect of graded activity on pain, disabilities and return to work for patients with non-specific LBP.
- A 2010 systematic review of graded activity and exposure for persistent, non-specific low back pain identified 15 trials with 1,654 patients and adequate power to pool six trials comparing graded activities to minimal or no treatment.[104] In the short and intermediate term, graded activity was slightly more effective than a minimal intervention, but not more effective than other forms of exercise.
- After 8 weeks, graded lumbar stabilizing exercises with low-load endurance, seemed to provide greater reduction in pain (SF-36) in both short and long term (1yr) and in disability (Oswestry) in the short term and improved perceived physical health and self-efficacy (SF-36) for patients with non-specific recurrent low back pain over daily walking program (30 min. daily walk, as fast as possible without pain).[105]

- A subgroup analysis was conducted on data from a previous randomized controlled trial of 134 Dutch airline workers, which found that a behaviorally-oriented graded activity intervention was more effective than usual care in stimulating return to work.[106] Statistically significant interactions were found for disability, fear-avoidance beliefs about physical activity, and fear-avoidance beliefs about work. No indication was found that the reduction in pain-related fears in the graded activity group mediated more favorable return-to-work results in this group. Workers who perceive their disability to be moderate and workers with moderate scores for fear-avoidance beliefs return to work more rapidly as a result of the graded activity intervention than workers with higher scores. The return to work for those receiving graded activity may be independent from reductions in pain-related fears due to this intervention.
- A trial comparing a group functional restoration program (FRP) (supervised 5-week group exercises with increasing intensity for each participant weekly culminating in work hardening activities) versus individual 5-week active PT care (agreed exercise program initially supervised and prescribed for home, including flexibility, jogging, stretching, endurance) reported that pain, self-reported resumption of work activity and trunk strength improved similarly in both groups. Endurance improved in FRP.[107]
- Non-specific CLBP patients were randomized into one of three groups: supervised active physical treatment (APT) (aerobic 30 min bike; trunk and leg strengthening), cognitive behavioral treatment (CBT) (life goals, increased activity coaching, problem solving, modification of dysfunctional beliefs, <12 hrs total), combined treatment of APT and CBT (CT) and a waiting list control (WL). At the end of 10 weeks, significant functional improvement, pain reduction and higher satisfaction was observed in all three treatments compared to WL. Physical performance improved in APT and CT over WL and CBT. There was no clinical difference between combined and single treatments.[68]
- In a well done case series of 95 chronic (> 8 wk duration) low back pain patients (categorized as specific, non-specific, and widespread CLBP), pain and disability improved significantly using an intervention that included a cognitive behavioral approach (3 weeks of inpatient program consisting of daily 6-8 hours of activities, including cognitive behavioral approaches and physical training - exercises of low intensity and many repetitions).[108]
- In non-specific CLBP patients, 10 weeks of APT (aerobic training, extensor strengthening) versus graded activity coaching with problem solving versus combined, there was no difference in Roland scores at 1 year, although self-perceived improvement was better in either individual treatment compared to combined treatment.[67]
- Behaviorally oriented graded activity interventions were assessed on 134 workers eligible for sick leave from low back pain. Workers were randomly assigned to graded activity intervention (n = 67) or usual care (n = 67) and followed-up for 12 months.[31] The graded activity group returned back to work faster (54 days compared to 67 days) The graded activity intervention was more effective after approximately 50 days post-randomization (HRR = 1.9, CI = 1.2-3.1, p = 0.01). Differences between the groups in number of recurrent episodes, total number of days of sick leave due to low back pain, and total number of days of sick leave due to all diagnoses, were in favor of the graded activity group, although not statistically significant. However, no effects of the graded activity intervention were found for functional status or pain. It should be noted that the graded activity intervention was part of an optimal mix exercise, educational and ergonomic measures and it is not clear from the study the role various components may have contributed to effectiveness.
- In a Cochrane review, graded-activity exercise programs (gradually increasing intensity) appear to improve outcomes for subacute occupational low back conditions.[79]
- CLBP patients (n=59) were randomized to an active rehabilitation program (24 PT supervised 90 min small group graded exercise sessions with behavioral support over 12 weeks) and a control program (4 sessions of passive thermal treatment and massage over 4 weeks - intended as a placebo). Active rehabilitation was more effective in reducing pain (VAS) and functional disability (Pain and Disability Index) that was sustained at 1-year follow-up. Lumbar endurance (extensor strength/fatigue) improved after treatment in the active rehab group but differences disappeared at 6 months and 1-year follow-ups.[109]
- A 2003 randomized study of 163 workers with sub-acute back pain evaluated a mini-intervention (clinical exam, information, support and advice plus exercise) administered by a PT and a physician specialized in back pain versus a mini intervention plus a worksite visit, versus usual care.[110] Reduced daily symptoms, lower sickness absenteeism and better treatment satisfaction and adaptation to pain were reported for the mini-intervention groups. A work site visit did not appear to add any benefit to the mini-intervention. A subsequent report looked at 2-year follow-up and reiterated the initial findings noting that perceived risk of not recovering was the strongest modifier of treatment effect.[111] For pain alleviation, the intervention was most effective among the patients with a high perceived risk of not recovering.
- An RCT including patients with non-specific low back pain, a graded activity program (measurements of functional capacity, work-place visit, back school education, and individual, submaximal, gradually increased exercise), with an operant-conditioning behavioral approach, was significantly more effective in returning patients to work when compared to a control. The graded activity program increased occupational function as measured by return to work and significantly reduced long-term sick leave.[112]
- Patients with nonspecific LBP who enrolled in a graded activity program with a behavioral therapy approach returned to work earlier than patients in a control group. Graded activity significantly increased mobility, strength, and overall fitness. Spinal rotation, abdominal muscle endurance time and lifting capacity were significantly correlated to rate of return to work. The graded activity program in this trial proved to be a successful method of restoring occupational function and facilitating return to work in subacute low back pain patients.[113]

INTEGRATION OF ACTIVE AND PASSIVE APPROACHES

Many different activation and manual interventions appear to facilitate pain reduction and functional recovery better than usual care or symptom control alone.[20] Increasingly, recent studies and systematic reviews support the contention that flexibility based on provider skill areas and patient preferences can guide rehabilitation strategies, so long as the patient is actively engaged in doing activities and incrementally increasing what they do. Simple walking has been shown to be as effective as PT supervised rehabilitation, and more cost-effective, so long as the patient remains adherent to the activity.[41] Chiropractors have historically incorporated combining both active and passive approaches in care of patients with back pain[17, 114, 115] and recent trials are increasingly supporting passive manual approaches such as spinal manipulation and myofascial therapies alone or in combination are as good or better than exercise alone although sustained patient satisfaction may be superior with supervised exercise.[43, 116, 117] Although not experimentally tested, it may be a reasonable proposition that multimodal approaches of chiropractic care (early activation, spinal manipulation, and patient engagement related to psychosocial factors) may account for lower rates of long-term disability in workers seeking DCs as first physician.[37]

Integration and Adherence

- A retrospective review of 753,450 patients presenting to a primary care setting with a new complaint of LBP assessed the effect of early and guideline adherent physical therapy on utilization and costs within the Military Health System.[32] Descriptive statistics, utilization, and costs were examined on the basis of timing of referral to physical therapy and adherence to practice guidelines over a 2-year period. Utilization outcomes (advanced imaging, lumbar injections or surgery, and opioid use) were compared using adjusted odds ratios with 99% confidence intervals. Total LBP-related health care costs over the 2-year follow-up were compared using linear regression models. 122,723 of the patients received PT, with 17,175 of those receiving early physical therapy that was adherent to recommendations for active treatment. Early referral to guideline adherent physical therapy was associated with significantly lower utilization for all outcomes and 60% lower total LBP-related costs.
    - Across interventions, pain intensity was the most commonly reported outcome, followed by back-specific function.
    - When present, observed benefits for pain were generally in the small (5 to 10 points on a 0- to 100-point visual analogue scale or 0.5 to 1.0 points on a 0- to 10-point numerical rating scale) to moderate (10 to 20 points) range.
    - Outcomes were mostly measured at short-term (up to 6 months) follow-up.
    - Effects on function were generally smaller than effects on pain; additionally, fewer studies measured function only.

Soft Tissue Interventions

Myofascial therapies

- Effects of an active neurodynamic mobilization program on pain, neurodynamics, perceived health state, and fatigue in 48 patients with fibromyalgia syndrome were assessed in a trail randomizing subjects into an active neurodynamic mobilization program or a control group.[118] The intervention was performed twice a week (need duration). Brief Pain Inventory and Pain Catastrophizing Scale were used to assess pain, Health Assessment Questionnaire Disability Index scores evaluated function and the Fatigue Severity Scale measured fatigue level. Significant (P<.05) between-groups differences were found in the values of pain, function, and fatigue. Also, significant pre- to post-intervention within group differences were found in the intervention group, whereas no significant changes were found in the control group
- A 2015 systematic review evaluated 10 randomized trials addressing the efficacy of neural mobilization techniques for a variety of musculoskeletal conditions.[119] Study quality was low overall and a quantitative meta-analysis could not be performed, although the identified trials provided limited support for pain reduction with the procedure.
- Sixty chronic low back pain subjects with S1 radiculopathy were randomized to a neural mobilization group and conventional rehabilitation group, and a conventional only group in a 2016 Egyptian study.[120] Participants were suffering from varying degrees of unilateral pain and paresthesia in the lumbosacral region and lower limb associated with L5-S1 level. The experimental group involved neural mobilization, infrared, ultrasound and general exercises that involved stretching and strengthening exercises for the back muscles for 6 weeks while the control group did not receive neural mobilization. Outcomes were H-reflex latency, amplitude, and H/M ratio for assessing S1 nerve root function, visual analog scale for assessing pain level, and Oswestry Disability Index for assessing functional disability. All the participants were evaluated pre and post 6 weeks of treatment. Both groups showed significant improvements in all measured variables after 6 weeks, but the neural mobilization group showed greater effects and statistical significance effect ($p < 0.01$) in all measured variables than the control group.
- In a 2015 randomized study comparing fascial manipulation associated with a physiotherapy program versus a physiotherapy program alone, subjects (N=24) were randomized into two groups receiving 8 treatments over 4 weeks, with outcomes measured at baseline, 1 month, and 3 months follow-up.[121] Results showed that patients receiving fascial manipulation showed statistically and clinically significant improvements at the end of care for all outcomes, in the short (RMDQ, VAS, BPI) and medium term for VAS and BPI compared to manual therapy.
- A 2015 narrative literature review summarized available studies on neural mobilization techniques for lumbar or cervical radiculopathies.[122] A variety of approaches exist for these mobilization techniques but all essentially use nerve tension movements to assess for exacerbation of the radiculopathy and use these increasing movements at one joint in combination of tension loosening movement at adjacent joints or structure with the aim of facilitating the nerve to better glide though the fascia it traverses. Use of oscillation and soft tissue pressures are also incorporated in various approaches. A number of low quality studies to date suggest promise for the approach with lumbar radiculopathies. In seven of eight identified reports, when neural mobilization approaches were applied for radiculopathies that were peripherally sensitive to mechanical tension during assessment, good outcomes (symptom reduction, self-report, and tension sign retest) were reported. Other treatment groups, or studies that did not base application on peripheral sensitivity testing did not appear to be effective.

Manipulation and Mobilization

- In a 2014 trial of subacute and chronic back-related leg pain, 191 patients were randomized to spinal manipulation therapy (SMT) and home exercise advice (HEA) or home exercise alone.[117] Spinal manipulation plus home exercise was more effective than home exercise alone after 12 weeks, but the benefit was sustained only for some secondary outcomes at 52 weeks. Outcomes were patient-rated leg pain, self-reported low back pain, disability, global improvement, satisfaction, medication use, and general health status using validated instruments. Of the 192 enrolled patients, 191 (99%) provided follow-up data at 12 weeks and 179 (93%) at 52 weeks. For leg pain, SMT plus HEA had a clinically important advantage over HEA (difference, 10 percentage points [95% CI, 2 to 19]; P=0.008) at 12 weeks but not at 52 weeks (difference, 7 percentage points [CI, -2 to 15]; P=0.146). Nearly all secondary outcomes improved more with SMT plus HEA at 12 weeks, but only global improvement, satisfaction, and medication use had sustained improvements at 52 weeks.
- In a 2016 systematic review, 9 trials met inclusion criteria (including Cochrane Back Review Group Risk of Bias Tool) with 4 trial allowing data pooling for a meta-analysis.[123] Participants in the spinal manipulation groups had improved symptoms compared with participants receiving sham treatment (standardized mean difference = - 0.36; 95% confidence interval, - 0.59 to - 0.12). The majority of studies were of low risk of bias; however, several of the studies were small, the practitioner could not be blinded, and some studies did not conduct intention-to-treat analysis and had a high level of dropouts.
- A 2011 randomized trial compared supervised exercise, spinal manipulation, and home exercise for 301 chronic low back pain patients.[43] For all three treatment groups, outcomes improved during the 12 weeks of treatment. Those who received supervised trunk exercise were most satisfied with care and experienced the greatest gains in trunk muscle endurance and strength, but they did not significantly differ from those receiving chiropractic spinal manipulation or home exercise in terms of pain and other patient-rated individual outcomes, in both the short- and long-term. Although the short- and long-term differences between groups in patient-rated pain, disability, improvement, general health status, and medication use consistently favored the supervised exercise group, the differences were relatively small and not statistically significant for these individual outcomes.

Acupuncture

- A 2009 randomized trial of three types of acupuncture needling (individualized using meridian assessment, standardized on typical meridians, or simulated using sham points) were compared to usual care for low back pain in 638 adults.[124] Each acupuncture group received 10 treatments total, given twice weekly for three weeks, and then weekly for 4 weeks. At 8 weeks, unadjusted mean dysfunction scores on the Roland Morris Disability Questionnaire for the individualized, standardized, and simulated acupuncture groups improved 4.4 to 4.5 points, compared with 2.1 points for those receiving usual care (P<0.0001). However, no significant differences between acupuncture groups were seen after adjustment. At 52 weeks, the usual care group had greater dysfunction than the real or simulated acupuncture groups (P=0.001). At all assessment intervals (8, 26, and 52 weeks), the proportion of participants improving at least 3 points on the Roland scale was about 60% in the real and simulated acupuncture groups, compared with only 39% in the usual care group (P<0.001). Needling using a meridian system was no more effective than sham, but both were superior to usual care. Possible explanation may be that needling anywhere causes superficial stimulation leading to a physiological response, and/or non-specific effects could result from patient and provider beliefs.
- A 2007 randomized controlled trial compared Verum acupuncture to sham acupuncture (superficial needling at non-acupuncture points) in 387 patients and guideline-based conventional therapy (combination of drugs, physical therapy, and exercise).[125] Treatment success was defined as 33% improvement or better on 3 pain-related items on the Von Korff Chronic Pain Grade Scale or 12% improvement or better on back-specific functional status measured by the Hanover Functional Ability Questionnaire (HFAQ) at 6 months. No significant differences were seen at 6 months between Verum and sham acupuncture (p=0.39) however both Verum and sham acupuncture were significantly better at achieving successful HFAQ outcomes (72.6% with Verum acupuncture; 64.9% with sham acupuncture) compared to conventional therapy with 50.4% achieving success.

Lifestyle Interventions
Nutritional approaches

- A cohort of 122 patients aged between 18 and 75 years were randomized in a 2016 study to 1 of 3 groups: Theramine, an amino acid blend 68405-1 (AAB) which is a physician-prescribed only medical food alone; ibuprofen alone; and co-administration of AAB and ibuprofen.[126] Primary end points included the Roland Morris Disability Questionnaire (RDQ) and Oswestry Disability Index (ODI). In addition, C-reactive protein, interleukin 6, and plasma amino acid concentrations were measured at baseline and 28-day time points. After treatment, the ODI worsened by 4.52% in the ibuprofen group, improved 41.91% in the AAB group, and improved 62.15% in the combination group. The RDQ worsened by 0.73% in the ibuprofen group, improved by 50.3% in the AAB group, and improved 63.1% in the combination group. C-reactive protein in the ibuprofen group increased by 60.1%, decreased by 47.1% in the AAB group, and decreased by 36% in the combination group. Similar changes were seen in interleukin 6. Arginine, serine, histidine, and tryptophan levels were substantially reduced before treatment in the chronic pain syndrome and increased toward normal during treatment. There was a direct correlation between improvement in amino acid concentration and treatment response. Treatment with amino acid precursors was associated with substantial improvement in chronic back pain, reduction in inflammation, and improvement in back pain correlated with increased amino acid precursors to neurotransmitters in blood.
- Sixty female patients complaining of LBP lasting more than 3 months were clinically studied rheumatologically and neurologically to evaluate risk factors associated with vitamin D deficiency.[127] Biochemical assays of serum calcium, phosphorus, alkaline phosphatase (ALP), parathormone (PTH), and 25-hydroxyvitamin D (25 OHD) were also performed and compared to those of 20 matched healthy controls. The determinants of vitamin D levels in patients were examined by stepwise regression. Patients with LBP had significantly lower 25 OHD levels ($p < 0.05$) and significantly higher PTH ($p < 0.05$) and ALP ($p < 0.001$) than controls, although there were no significant group differences in calcium and phosphorus. Hypovitaminosis D (25 OHD < 40 ng/ml) was found in 49/60 patients (81%) and 12/20 (60%) of controls, with an odds ratio of 2.97. Although this correlation does not establish

causation, the possibility exists that vitamin D supplementation may be worthwhile for patients with low back pain. It should also be noted that many rival explanations could explain lower levels, for example being more sedentary due to pain, thereby reducing exposure to sun.

BEHAVIORAL AND SELF-MANAGEMENT APPROACHES

Current research is increasingly underscoring a significant role for patient self-efficacy and behavioral approaches in recovery from low back conditions, particularly among those at higher long term disability risk. Psychosocial determinants of activity avoidance, recovery expectations, catastrophic thinking, and perceived injustice appear to be among the most common psychosocial issues that contribute to poor recoveries from work injuries. Causes of and contributors to them are many, and may vary greatly by individual. Successful engagement in physical activity appears to reduce catastrophic thinking, help overcome fear avoidance behavior, and foster improved recovery expectations. Addressing a patient's self-efficacy is increasingly being demonstrated as an essential active ingredient for all rehabilitation approaches. Routine screening for common psychosocial issues in patients with work injuries is considered a best practice. An occupational health best practice resource for identifying and managing Psychosocial Determinants Influencing Recovery (PDIR) has been published by L&I.[39]

There are many approaches to addressing psychosocial and psychological issues, many addressed in the PDIR resource. Overall, many straightforward strategies are within the routine skill sets of most attending providers. Additional psychosocial and psychological factors may also impede recovery and reduce the effectiveness of typical rehabilitation approaches. The US Agency for Healthcare Research and Quality (AHRQ) 2016 report Noninvasive Treatments for Low Back Pain: Current State of the Evidence provides a comprehensive overview of research to date on all of the approaches covered in this resource as well as other passive and pharmaceutical interventions.[20]

Activity Avoidance
Fear Avoidance Behavior

- A 2014 study reported that evidence suggests that fear avoidance beliefs predict poor outcome in subacute low back pain (between 4-12 weeks duration).[128] Four cohort studies, conducted by disability insurance companies in the United States, Canada, and Belgium, included 258 to 1,068 patients mostly with nonspecific LBP. An increased risk for not returning to work or more sick days was reported for those with elevated FABQ scores. The odds ratio (OR) ranged from 1.05 (95% confidence interval [CI] 1.02-1.09) to 4.64 (95% CI, 1.57-13.71). The highest OR was found when applying a high cutoff for FABQ Work subscale scores. This may indicate that the use of cutoff values increases the likelihood of positive findings. High fear avoidance beliefs in very acute LBP (<2 weeks) and chronic LBP (>3 months) was not predictive.
- A 2005 systematic review and meta-analysis of randomized controlled trials using motivational interviewing as an intervention for patient engagement and lifestyle modification in a variety of health conditions concluded that motivational interviewed was more effective than simple advice.[129] Motivational interviewing employed by psychologists and physicians appears to be more effective than when employed by other providers. Increased face to face contact time during encounters was associated with greater effect.
- A Cochrane review of 10 trials comparing advice to rest and advice to remain active reported that two high quality trials demonstrated that advice to remain active resulted in small, consistent improvement in pain relief and functional status with acute low back pain patients while groups advised to rest led to significant increases in sick days during the first 12 weeks.[130] However no differences between groups were noted for sciatica patients.
- Risk of potentiating chronicity and fostering physician dependence is believed to result from over-utilization of passive means of treatment – this is a critical time during which many patients begin to exhibit signs of inappropriate illness behavior and other signs of chronicity and pending chronicity.[81]
- In patients with CLBP, with and without leg pain, changes in cognitive factors were not significantly associated with changes in pain intensity. Significant reductions were observed in disability. A reduction in fear avoidance beliefs about physical activity and about work, plus an increased perception of control over pain were related to decreased disability. A decrease in catastrophizing and an increased perception of control over pain were not associated with reductions in disability.[131, 132]

Recovery Expectations

- A 2014 prospective study in Europe involved 1,169 participants completed questionnaires at their first primary care consultation due to low back pain.[133] A total of 78% of the cohort were followed for 3 months reporting baseline recovery expectations on an anchored 0-10 scale. Recovery expectations were associated mainly with low back pain history and were generally, but not consistently, similar to an empirically predicted prognosis. Expectations were significantly associated with outcome. Outcome measures were self-reported intensity and global perceived effect. Recovery expectations were associated with known prognostic factors, mainly back pain history, but were only partly explained by measured factors. Expectations had statistically significant associations with both outcomes after adjusting for other baseline factors, but explained only a little of the variance. Correlations between predicted expectations and predicted outcome were strong.
- A 2013 cohort study found baseline perception by the patient that his or her pain will last a long time was strongly associated with clinically significant LBP at 6 months (RR = 1.04, 95% CI = 1.01–1.07), and at 5 years per unit change on the scale score (RR = 1.06, 95% CI = 1.03–1.09).[134]
- In patients with CLBP, treatment expectancy and credibility was associated with the outcomes of various treatment interventions (active physical therapy (APT), cognitive behavioral therapy (CBT), or a combination of both (CT)). Expectancy was significantly associated with disability (Roland-Morris) and satisfaction. Credibility was significantly associated with patient-specific symptoms (VAS) and satisfaction.[135]
- A review of numerous trials from 2006 looking at attitudes and expectations noted strong correlations between patient expectation and credibility regarding their care and improvement and returning or staying at work.[5] When patients work toward performing their normal activities, they tend to do

better, while those who avoid activity due to concerns it could worsen their injury, did worse. There does not appear to be an association between improvement and how many different interventions are incorporated. This tends to reinforce the idea that making the patient a partner in his/her own care and safe, incremental exposure to activity should be prioritized in any rehabilitation effort.

- A randomized controlled trial of chronic low back pain patients compared active physical therapy (APT) group, cognitive behavioral therapy (CBT) group, or a combination (CT) group to assess the effects of expectancy and credibility.[68] Lower levels of credibility of the treatment were associated with higher pain-related fear and lower internal control of pain. Lower levels of recovery expectation were associated with higher pain-related fear and no radiculopathy. Higher treatment credibility was associated with greater satisfaction and predicted better outcome with active exercise.

Catastrophic Thinking

- In a sample of 80 work-disabled individuals with major depressive disorder (MDD) attending occupational rehabilitation, catastrophic thinking contributed significant variance to the prediction of self-reported occupational disability, beyond the variance accounted for by depressive severity alone.[136] Participants completed measures of depressive symptom severity, catastrophic thinking and occupational disability at admission and termination of a rehabilitation intervention. Return-to-work outcomes were assessed 1 month following the termination of the rehabilitation intervention. Prospective analyses revealed that reductions in catastrophic thinking predicted successful return to work following the rehabilitation intervention, beyond the variance accounted for by reductions in depressive symptom severity. This suggests that screening and addressing catastrophic thinking may help promote occupational re-integration in individuals with debilitating mental health conditions.
- A 2010 study profiled physical and psychosocial changes that occur in physiotherapy intervention when patients also participate in a psychosocial intervention designed to target catastrophic thinking, fear of pain, perceived disability, and depression.[137] A sample of 48 individuals referred for rehabilitation of disabling back pain enrolled half in physiotherapy only and half into physiotherapy plus a psychosocial intervention. The two treatment groups did not differ significantly on measures of pain severity, physical function, or self-reported disability, however, patients who participated in the combined group showed significantly greater reductions in pain catastrophizing, fear of movement, and depression which contributed to reduced use of the health care system, reduced use of pain medication, and improved return-to-work outcomes.
- A 3-year follow-up on active physical exercise (30 min bicycle, 5 min stretch, 15 min trunk leg strengthening to fatigue), instruction on graded activity, or combinations – focused on the role of pain catastrophizing. All 3 interventions reduced catastrophizing compared to control.[21, 67, 68]

Perceived Injustice

Perceived injustice can be defined as a patient's perception regarding the severity of their loss as a result of their injury associated with elements of blame, unfairness, and irreparability of the situation.[138] High perceptions of injustice correlate with catastrophizing, activity avoidance, and depression.

- A 2016 study of 66 patients enrolled in a multidisciplinary rehabilitation program assessed participants' self-reports of perceived injustice, pain intensity, disability, anger intensity and regulation style, depressive symptoms, and a measure of the working alliance with their principle rehabilitation clinician.[139] Each participant's principal clinician also completed the working alliance measure. Greater perceptions of injustice were associated with poorer client ratings of the working alliance. Results also showed that anger expression mediated the association between perceived injustice and the working alliance. Perceived injustice is negatively associated with the quality of the partnership between the clinician and patient. From the standpoint of reducing risk of chronicity and disability, a provider's engagement should address the working relationship they have with the patient as well as the conditioning and rehabilitation strategies employed

Other Psychosocial & Psychological Interventions

- The US Agency for Healthcare Research and Quality (AHRQ) 2016 report Noninvasive Treatments for Low Back Pain: Current State of the Evidence provides a comprehensive overview of research to date on psychological therapies for low back pain.[20] Overall, trials to date have had mixed results. It should be noted that heterogeneity of patient conditions and variability in intervention approaches may contribute to masking effects. In general, further high quality studies are needed, particularly with attention to how brief psychological and psychosocial intervention may add benefit to concurrent rehabilitation best practices. Nearly all available studies on psychological approaches like cognitive behavioral therapy address only chronic back pain. Key findings included:
    - Progressive relaxation is superior to waiting list controls for short term pain intensity and functional status.
    - Electromyography biofeedback and operant conditioning were associated with lower post treatment pain intensity but offered no effect on function.
    - Cognitive behavioral therapy and other combined psychological therapies were associated with post-treatment pain reduction compared to waiting list controls, but impact on function was small and not statistically significant.
    - No clear differences have been reported between psychological therapies and exercise therapy, or between psychological therapy plus physiotherapy versus physiotherapy alone for pain intensity, although one small trial reported small post treatment effects on pain and function.
    - No differences between various behavioral approaches have been reported in multiple trials.

- In a 2010 Cochrane review on psychological interventions for chronic low back pain, moderate quality evidence was supportive that in the short-term, operant therapy is more effective than waiting list control and cognitive behavioral therapy (CBT) is more effective than usual care for pain relief, but no specific type of CBT is more effective than another. In the intermediate- to long-term, there is little or no difference between CBT and group exercises

for pain or depressive symptoms. Further research is likely to have an important impact on our confidence in the estimates of effect and may change the estimates.[140]

Active Rehabilitation Concepts

Rehabilitation Terminology

Aerobic – Exercise that increases heart and respiration rates. Typically aimed at increasing metabolism and fat burning.

Anaerobic – Exercise that exceeds the body's capacity to oxygenate tissues and may refer to maximal exertion such as may be seen in power lifting and sprinting.

Cross-training – Refers to doing more than one kind of exercise aimed at enhancing tolerance and capacity under different circumstances (load, position, mixes of aerobic and loading).

Graded activity/exercise – Refers to systematically increasing the amount of exercise (e.g., repetitions, duration, intensity, frequency), usually daily.

Interval training – Refers to short bursts of high intensity exertion alternated with lower intensity exertion for the duration of the exercise (e.g., 20 minutes of running that alternates between 1 minute of sprint and 3 minutes of jogging).

Isometric exercise – Involves muscle loading that maintains the muscle at a given length. Examples include some yoga positions.

Low back pain (LBP) – May be classified as acute (ALBP) typically less than 2-3 month; chronic (CLBP) typically of longer duration than 2-3 months; or mixed (MLBP). The term mechanical low back pain means the source of the problem may be in the spinal joints, discs, vertebrae or soft tissues.

Psychosocial Determinants Influencing Recovery (PDIR) – Non-biological factors such as low recovery expectations, fear avoidance behavior, coping abilities, catastrophic thinking, perceived injustice, and maladaptive behaviors that have been associated with prolonged disability from work injuries.

Exercise Oversight Approaches

Home exercise prescription/casual prescription/instruction – Exercises are described to patient; printed materials are provided with general guidance, prescription for frequency, duration, etc. A common first step in general practice, but compliance may be challenging.

Passive stretch/movement – Provider administers stretching of body parts (patient is passive during procedure). May be considered a soft tissue technique, however; muscle stretching is induced.

ROM (range of motion) end range – Patient performs sustained stretch aimed at reaching end ranges of movement. May involve sustaining position at end range or involve just patient controlled movement to joint/structure end range. Does not include any therapist assisted movement such as mobilization/manipulation.

Exercise Types – Conditioning/Strengthening

General aerobic conditioning – Aerobic exercise (induces temporary increases in respiration and heart rate e.g. running, walking, swimming). Not targeted at specific low back conditions.

General physical conditioning – Refers typically to anaerobic-like exercise that involved 'bursts' of exertion followed by rest. Examples include weight lifting, sprinting, crunches. This is differentiated from specific conditioning in that tissues and muscle groups being targeted are not selected based on the low back condition.

Specific physical/strength training: core strengthening – A systematic approach of strengthening trunk muscles under different loading conditions (e.g. using gym balls, different positions, some coordination variation, e.g. symmetrical vs. asymmetrical repetitions)

Specific physical/strength training: trunk flexion/extension – Refers to targeted anaerobic-like muscle strengthening directed at trunk flexors and extensors (e.g. sit-ups, crunches, extension strengthening). May involve weights.

Exercise Types – Motor Control Exercise (Neumuscular Re-education)

Coordination/balance/proprioception training – Therapeutic technique that is used to improve balance, coordination, posture, kinesthetic sense and proprioception. Examples include one-legged standing, progressive use of a wobble board.

Supervised instruction – In addition to a home exercise prescription, an effort is made to include demonstration and coaching of patient in performances of exercises until provider is confident that patient can do them. There may be some time set aside in-office for performance of certain exercises, but the majority of implementation is still by patient on their own.

Hardening/intensive rehabilitation programs – Time is scheduled for patient to perform full exercise routine at clinic/rehab facility with provider coaching and supervision (e.g. classes, work hardening programs, etc.)

Exercise Types - Stretching

Active stretch/movement – Patient performs specific exercises, sustained positions to induce stretching of muscles. Many yoga techniques fall in this category.

Directional Preference Therapy (DPT) – This refers primarily to sustained trunk ROM end range movement but is targeted to positions that cause any leg pain to 'centralize' that is when in a certain position such as extension (lying prone arching back by propping up on one's hands), the patients leg pain reduces in the peripheral area of the leg but may continue to be uncomfortable in the low back. McKenzie techniques are an example of this approach.

Muscle energy/contract-relax procedures – Therapeutic technique that typically involves contracting muscles against resistance throughout various ranges of motion with the intent of normalizing motor firing patterns and muscle relaxation.

Additional Exercises

- ***Walking*** – Include 20 minutes of walking at a comfortable pace to start, progressing with both time and intensity to tolerance.
- ***Enhance Balance*** – Incorporate a balance component into both the stabilization and functional/strengthening exercises by including at least one point of weight bearing contact on a wobble board, BOSU, foam pad, etc. This typically be will be dependent on the nature of injury and subsequent patient progress.

Office-Based Exercise Education Examples

Office-based exercise and /or rehabilitation focuses on what can be done ***within tolerance and active range of motion***. Maintaining a neutral spine position (normal curves and posture) throughout execution is the goal. Patient and provider preference can help determine which type of exercise is best. Providers may want to be versed in several types of exercise to accommodate patient preference and facilitate compliance. Allow time to demonstrate and observe proper performance and use 'teach-back' (have the patient demonstrate how to perform the exercise) to facilitate patient engagement.

Recent studies suggest that the specific kind of exercise may not be as important as "just doing anything" other than being sedentary – therefore, a provider has more flexibility and greater numbers of options for facilitating recovery from work-related back conditions. For most workers, simple understandable options they can readily perform and adhere to are best, whether done in the office or prescribed for home or work. The following are examples of low-tech approaches that most patients at various stages of recovery can employ.

Initial Rehabilitation Phase (within first two weeks) – General/normal movements and activities involving the injured area, within patient tolerance and under low stress. An activity diary is particularly helpful. A key strategy is to incrementally increase repetitions or duration a small amount every day. Examples include:

- ***Walking*** – Start with just a few minutes (up to 20) on a level surface, at a pace that is tolerable.
- ***Directional Preference Stretching –*** If radiculopathy is present and centralizes when in a directional end range (often extension) lie in a neutral position to (e.g. prone) which facilitates alternating with the end range position (e.g. extension). Each position is held for 30-60 seconds within tolerance.
- ***Gluteal/Lumbopelvic Flexion Stretch –*** Lie on back, raise one leg at a time bending the knee, reaching with the hands around the bent leg below the knee. Use slow, light pulling pressure bringing knee toward chest. Hold stretch a minimum 8-10 seconds. Perform 10 times on each leg, then with both legs.

physical activities. Coordination and balance (e.g., motor control exercise) may be considered during this time frame. Typically, some mobility activities such as those from the initial phase would also continue. The following examples represent low-tech core strengthening options to consider based on the patient's condition and capabilities

- ***Hip Hinge –*** Stand with legs shoulder width apart, toes pointed slightly outward, maintaining a slight (lordotic) arch in the low back. With arms extended, grasp a counter top or chair back for balance and slowly squat, bending both knees as far as 90° holding for 5 seconds, return to original standing posture maintain normal spine curves throughout. Repeat 10 times.
- ***Modified Side Bridge*** – In a side-lying posture, prop upper body on bent elbow (~90°) directly under shoulder with the forearm positioned in front. Raise hips and thighs upward creating a "bridge" between the elbow and knee. Keep the spine in a neutral posture, maintaining a normal (lordotic) curve. Hold for 5 seconds, return to resting posture for 5 seconds. Repeat 10 times on both sides depending on tolerance.
- ***Modified plank*** – Get on all 4's using elbows/forearms (shoulder width apart) and knees. Straighten out trunk in order to lift stomach and thighs off floor into straightened "wooden plank" position between elbows and knees. Maintain position for 8-10 seconds and repeat 10 times depending on tolerance.
- ***Bird-dog*** – Get on all 4's with hands shoulder width apart and knees directly under hips. Keep spine in the neutral position, while simultaneously lifting one leg and the opposite arm off the ground creating a 2-point stance. Hold for 5 seconds, then return to 4-point stance. Alternate with opposite arms and legs repeating 10 times.

Functional/Strengthening Phase (incorporated as condition improves and previous activities are mastered) – Incremental progression from stabilization activities introducing increased weight bearing and resistance without support through an increased range of motion.

- ***Cat/Cow –*** Get on all 4's with hands shoulder width apart and knees directly under hips. Alternate arching the back upward with head and neck moving toward floor

- ***Hamstring Stretch*** – On back; raise one leg at a time keeping knee straight. Use hands around knee area (or a towel around ankle), apply light pulling pressure to flex straight leg toward 90°. Hold stretch minimum 8-10 seconds; 10 repetitions/leg.
- ***Enhanced Gluteal Stretch*** – On back, raise one leg bending the knee to about 90°, rotating ankle in (like crossing one's leg). Reach hands around knee pulling towards center of chest to stretch buttocks on the side of the bent knee. Hold stretch minimum 8-10 seconds; 10 repetitions/leg.
- ***Trunk Stretching on Gym Ball –*** Hold each position to tolerance (20-30 seconds), returning to neutral position. Repeat 3 times.
  - ***Anterior –*** Prone on appropriate size gym-ball with both hands and knees on ground. Relax musculature to slowly 'melt' over gym-ball stretching back.
  - ***Posterior*** – Supine with both hands and feet contacting the ground for balance and support, relax into ball curvature gradually extending back.
  - ***Lateral*** – Lay on one side over gym-ball, with down side hand and both feet on ground for balance and support (three-point contact). Raise the up side arm and hand overhead while relaxing the trunk over the curvature of the gym-ball to put a lateral) stretch into the spine.

Stabilization/Coordination Phase (incorporated during weeks 2-12 depending on response) – Facilitate good spinal posture during weight-bearing and throughout (camel) with lifting head and neck toward ceiling while dropping stomach and spine toward floor (cat). Hold each position for 5 seconds and repeat 10 times.

- ***Side Bridge/Plank/Side Bridge*** – Alternate between Full Side Bridge (between elbow and ankle) and Full Plank (similar to a starting position for doing a push up). In a side lying position, coming to a full bridged posture, hold for 3 seconds, then rotate entire body a quarter turn into the full plank (push-up) position with points of contact on both elbows/forearms at shoulders width, and on the toes, hold for 3 seconds. Continue rotating the body another quarter turn into a side bridge position on the other side. Repeat 5 times. Maintain neutral spine position throughout.
- ***Abdominal Bracing with Resistance*** – Best accomplished with resistance bands (either of graded resistance or using longer levers by holding the bands close, then at the length of the forearm, then with arms extended fully straight in front). In a standing position, tighten abdominal muscles (bear down, Valsalva maneuver). While holding the resistance band at the prescribed length or intensity, fully rotate the torso to the right then left, against the resistance. Keep spine in neutral (normal upright). Repeat 10 times each side.
- ***Enhance Balance*** – Incorporate a balance component into both the stabilization and functional/strengthening exercises by including at least one point of weight bearing contact on a wobble board, BOSU, foam pad, etc. This typically be will be dependent on the nature of injury and subsequent patient progress.

Self-Management Strategies

Common Questionnaires and Scoring

Chronicity and Self-Management – A minority (<10%) of workers ever become chronically disabled from a work-related low back injury; however, back conditions account for the over half of those. Early recognition of attributes a patient may have that reflect, or are pre-disposing, to development of chronic pain behavior can help tailor interventions to prevent or mitigate progression to chronicity. The 'lowest hanging fruits' in this regard include facilitating the patient's engagement in their own recovery, setting expectations for taking 'baby steps' to incrementally increase activity on a daily basis, educating about normal recovery and pain coping strategies, and facilitating maintenance of a positive vocation connection with the workers' employer. L&I Resources for Psychosocial Determinants Influencing Recovery and Options for Documenting Functional Improvement provide more in-depth information.

- **Assessment**: Routine intake should involve psychosocial history that ascertains the workers' life and work obligations, workplace environment, social support structure, and their beliefs about their ability to handle everything on top of the injury. Additional psychosocial screening (e.g., WHODAS 2.0, PHQ-4) may be considered initially if the worker feels overwhelmed by it all. Otherwise best-practice care as usual is indicated. However, if meaningful functional gains are not attained within a week or two screening for low recovery expectations and fear avoidance behaviors (e.g., should be done if the worker has not returned to work in some capacity).
- **Management:** Common psychosocial issues in workers at chronicity risk that attending providers may need to address include low recovery expectations, fear or avoidance of activity, deconditioning, loss of a positive vocational connection, catastrophic thinking, and perceived injustice. Attending providers usually address many of these, but dedicated attention to them, and consideration for referral for specialty care may be needed.
  - **General advice –** Providing information and reassurance about condition, recovery and activity (e.g., bed rest is harmful, activity promotes recovery, recovery over time is normal and expected).
  - **Activity Diary–** A weekly activity diary [jump to page 7] negotiating incrementally increasing 'baby steps' to do a little more each day is extremely helpful for patient engagement, overcoming activity avoidance, self-management and pain control through pacing.
  - **Progressive Goal Attainment Program (**PGAP Referral**) –** A comprehensive activity coaching program available through the claim manager which screens for recovery barriers and includes up to 10 weekly sessions to train workers to become active and address skill development to manage pain and overcome common maladaptive behaviors.
  - **Early Return To Work (**ERTW Program**) –** Vocational services, therapists, and nurse consultants are available to work directly with employers and workers to develop accommodations for work restrictions and facilitate assistance and incentives for employers to keep an injured worker on the job.
  - **Cognitive behavioral therapy (CBT)** – Behavioral health interventions that address maladaptive thoughts and beliefs and utilize goal-oriented approaches to develop more function behaviors. Brief CBT-based approaches are especially useful for developing coping skills.

Disability & Psychosocial Risk Screening – L&I Resources

Administer appropriate scale on intake when flags exist in a worker's psychosocial history (e.g., overwhelmed by situation as a result of injury) or if expected functional improvement (including return to work) is not achieved within 2-4 weeks of injury).

Functional Recovery Questionnaire (FRQ) – Items 1-3 determine positive risk: FRQ + means person has not worked for pay due to injury **and** pain interference ≥ 5/10, **and** pain in 2 or more body areas. Items 4-6 identify vocational connection, fear-avoidance, and recovery expectations which strongly correlate with risk.

World Health Organization Disability Assessment Scale (WHODAS 2.0) – 12 items each scored 0 (none) to 4 (severe) then summed. Total score suggests: No disability risk (0-5) Mild risk (6-10); Moderate risk (over 10).

StarTBack Scale (STartBack) – Nine items scored 0-1. Total score ≤ 3 reflects low risk. Total score ≥ 4 is sub stratified based on subscore of Q5-9 ≤ 3 being medium risk and ≥ 4 being high risk for developing disability.

Fear Avoidance Beliefs Questionnaire (FABQ) – Scored using 2 subscales; one relating to physical activity and the other to work. Some items do not contribute to the overall score. A higher score represents elevated fear avoidance beliefs.

Patient Health Questionnaire 4 (PHQ-4) – Consists of 4 items scored 0 to 3 based on how often patient has experienced problems in the last 2 weeks. Scores are rated as normal (0-2), mild (3-5), moderate (6-8), and severe (9-12).

Functional Progress Scales – Implementation & Scoring Instructions

Administer at baseline, then every 2-4 weeks. Scores should reduce over time. Clinically meaningful changes have been reported to be between 4-16 on the Modified Oswestry Disability Index[141-143] and 3-5 on the Roland Morris Questionnaire.[142]

Modified Oswestry[141] – First box in each section = 0 pts, next = 1,2,3,4,5 points etc. Add total points from all sections; divide by 50 and multiply by 100%. Higher percentage score reflects higher level of disability.

Roland-Morris[144] – The score of the RDQ is the total number of items checked – i.e. from a minimum of 0 to a maximum of 24.

PHYSICAL CAPACITY MEASUREMENT

Physical Performance Testing (PPT) Measurement Summary

- PPT may help assess/track conditioning particularly when recovery is not evident by 4-6 weeks.

Physical Performance Tests (PPT) typically include strength, coordination, and endurance tests that can be easily performed in office settings. The batteries and tests included here are simple to administer requiring only chairs, exam/treatment tables, some form of strapping or supportive restraint, a goniometer, and a stopwatch. Normative data is included in general terms based on published reports where available and if highly variable by age or gender, is indicated as such. This serves as a guide for what to expect, but it should be noted that even though data may be reported in fine measures like seconds or fractions of seconds, there is great variation across individuals. The most important feature of these tests is the ability to assess recovery (or lack thereof) when a patient's performance improves (or stagnates/worsens) over time. Like most clinical examination procedures, very few physical performance tests have been adequately validated, thus they should not be considered precise tools. As a rule, baseline performance testing (for outcomes tracking) might be considered if recovery is not meaningfully evident. In typical work injury situations, they should be only be considered after at least two weeks following initiation of a care program. Generally, PPTs can help identify underlying conditioning issues that not only impede recovery but may be worth addressing to facilitate injury/aggravation-free return-to-work. See Appendix

This resource does not specifically address treatment issues; however, activity is important in nearly all musculoskeletal injury recovery. Active care should include incrementally increasing daily activities as soon as they can be tolerated with more emphasis on specific exercises as recovery occurs. Referral for more structured exercise/conditioning programs typically would not be considered before 4-6 weeks of home-based exercises and/or, when clinically meaningful improvement in outcomes assessment measures is not obtained. An IICAC Conservative Care Practice Resource is available for rehabilitation of work-related low back conditions which reviews and summarizes relevant evidence: https://www.lni.wa.gov/patient-care/advisory-committees/_docs/2017ActiveRehabilitationforWorkrelatedLBConditionsFinalapproved_042825.pdf

- **Back Physical Peformance Battery (BPPB)-** No formal structured "battery" of in-office physical performance tests for common work injuries has been validated in the literature. However, several individual tests for back strength and endurance have been described and are commonly used in rehabilitation settings. Assessing physical function and which basic activities associated with back strength may provoke symptoms are worth documenting and measuring, especially if higher frequency care is continuing beyond 4 weeks and/or return to work is not imminent by that time. In general, tests can be performed in-office with minimal equipment and are scored by time or repetitions as described below. Improvement may be graded and assessed by increasing capacity as measured by time and/or repetition scores, however an 85% pass-fail approach provides a simple method to document performance. As an option, consider lowering the cut-off to 70% (or less) for those >50 years old, and/or significantly debilitated / deconditioned at any age.

    - ***Static Back Endurance (SBE) –*** The patient lies prone, trunk extended off the edge of a bench with anterior superior illiac spines on the table edge. Arms remain at sides with ankles, thighs and buttocks strapped to the bench. The patient should hold the static, neutral, horizonal position until fatigue or 240 seconds (whichever comes first). There are several minor variations for performing SBE as well as different strategies for scoring and interpretation. The pass-fail method is recommended.
        - **Pass – Fail Method:** Based on average normative data,[118] middle-aged working males should be able to hold postion for 97 $\pm$ 53 seconds and middle-aged working females for 87 $\pm$ 59 seconds. Using an 85% of norm as passing for under 50 years old and 70% for over 50 years old, the following cutoffs are recommended:

Age	Male	Female
Norm	97	87
< 50	82 secs	74 secs
> 50	68 secs	61 secs

For low back conditions, static extensor endurance tests appear to be the most useful in terms of sensitivity, specificity, and predictive value for low back conditions.[119-121] Poor static endurance (less than 58 seconds in both males & females) appears to be associated with increased risk of low back pain at 1 year follow-up.[118] Additionally, decreased extensor endurance is associated with back pain in workers and otherwise healthy individuals.[122-125]

- ***One Leg Balance (Proprioception Test) –***The patient stands on one leg with eyes open. Time is measured in seconds for a maximum of 30 seconds or when the patient loses balance (reaches out, hops, touches floor with non-weight-bearing foot). The test is repeated with eyes closed. Based on normative data by age[126] and using an 85% cuttoff, the test can also be scored as pass-fail:

Age	Eyes Open	Eyes Closed	Pass (85%)
20-59	30 secs	25 secs	21 secs
60-69	22 secs	10 secs	8.5 secs
70-79	14 secs	4 secs	3 secs

- ***Side Bridge –*** Patient lays on their side propped up on one elbow with top ankle crossed in front of bottom ankle. Hips are then lifted up and held in alignment so that the weight is supported only by the feet and elbow. The length of time the position is held is recorded. This test assesses the core stabilization strength of primarily the quadratus lumborum muscles. In normal individuals, the position should be able to be held for more than 95 seconds in men and 75 seconds in women on each side without difficulty.[127] Using an 85% of norm as passing for under 50 years old and 70% for over 50 years old, the following cutoffs are recommended:

Age	Male	Female
Norm	95 sec	75 sec
< 50 (85%)	81 secs	64 secs
> 50 (70%)	67 secs	53 secs

- ***Trunk Stabilizer Strength*** – Both squatting and abdominal strength reflect important aspects in core or trunk stability. Squatting assesses hip, knee and ankle mobility as well as strength, endurance and coordination of hip and knee extensors. Sit-ups primarily assess some basic lumbar mobility and strength and endurance of the rectus abdominal muscles. Some authorities recommend performing both squatting and sit up tests, but performing only one will provide a sense of trunk stabilizer condition and may be preferable in certain patients.

    - **Repetitive Squat:** Patient stands with feet 15 cm apart and squats down until the thighs are parrallel to the floor, then returning to the upright position in a 2-3 second cycle. Squats are repeated until fatigue or about 50 repetitions are achieved and the number is recorded. Fatigue may be considered reached when difficulty to complete cycle impacts quality of movements. Based on normative data,[128] middle aged males should be able to complete 37 repetitions and females should be able to complete 21. Using an 85% of norm as passing for under 50 years old and 70% for over 50 years old, the following cutoffs are recommended:

Age	Male	Female
Norm	37 reps	21 reps
< 50 (85%)	31 reps	18 reps
> 50 (70%)	26 reps	15 reps

- **Repetitive Sit-up:** In a supine, knees flexed 90 degrees position with ankles supported, the patient performs a partial sit-up (reaching with arms extended until the thenar pad approximates the superior pole of the patella) over a 2-3 second cycle time. The test is performed until fatigue or 50 repititions is achieved. Based on normative data, middle aged men should be able to perform 27 and woman 19 repetitions. Using the 85% pass approach, passing for men can be considered 23 and 16 repetitions for women.

Age	Male	Female
Norm	27 reps	19 reps
< 50 (85%)	23 reps	16 reps
> 50 (70%)	19 reps	13 reps

- ***Hamstring Length (Straight Leg Raising)* –** This test assesses both mobility of the hip joint and flexibility (length and/or tenstion) of the hamstring muscles of the upper leg. Flexibility and/or of these muscles may indicate overall conditioning and stability of the lower extremity and trunk core. This test is performed passively with the examiner supporting the lower leg and raising the straight leg to the point of knee flexion (on the raised leg) or when the pelvis or opposite knee begin to move. The distance the raised leg moves is recorded in degrees (using an inclinometer zeroed out on the table and measured on the mid-tibia. Average flexion has been reported to be about 80 degrees.[129] Using an 85% of norm as passing for under 50 years old and 70% for over 50 years old, the following cutoffs are recommended:

Age	Male	Female
Norm	95 degrees	75 degrees
< 50 (85%)	81 degrees	64 degrees
> 50 (70%)	67 degrees	53 degrees

- **Short Physical Performance Battery (SPPB) –** Three well-validated timed tests aimed at assessing basic function in older patients. They are easily performed in office settings and include the following: Sequential Balance Tests; Gait Speed Test; Chair Stand Test. They require a stop watch, a marked 4 meter straight walking course, and a straight backed chair placed against a wall. Total score is the sum of each individual test for a maximum of 12 points.[126]

  - ***Sequential Balance Tests* –** These assess the patient's three basic standing positions with the eyes open:
    - Side-by-side stand (stand with feet side by side for 10 seconds). If successful, score 1 point and move on to:
    - Semi-tandem stand (stand with inside heel of one foot next to inside of big toe on opposite foot for (10 seconds). If successful add 1 additional point and move on to:
    - Full tandem stand (heel of one foot is placed fully in front of toes of opposite foot for 10 seconds). Add 2 points for patients holding this position for 10 full seconds; 1 point for 3-9.9 seconds; no additional points for <3 seconds.
  - ***Gait Speed Test* –**The patient is timed twice, walking at usual speed for 4 meters. The faster time is used for scoring; >8.20 seconds = 1 point; 6.21-8.20 seconds = 2 points; 4.82-6.20 seconds = 3 points; <4.82 seconds = 4 points
  - ***Chair Stand Test* –** This assesses the patient's ability to rise from a chair with arms folded across chest. If the patient cannot perform, the score is zero. If it can be performed, the patient should perform five complete rises and reseatings as quickly as he can. Time is measured from command to stand to last rise; 16.70-60 seconds = 1 point; 13.7-16.69 seconds = 2 points; 11.20-13.69 = 3 points; < 11.20 second = 4 points.

- **Static Neck Endurance –** The patient lays supine with knees bent. Patient tucks chin towards chest and lifts head off table 1 inch holding until fatigue (dropping of head). The time in seconds is recorded. Neck flexor muscle endurance was reported to be both statistically and clinically greater in subjects without neck pain than those with neck pain.[130] Neck endurance also appears to a predictor of future neck pain.[122, 123, 131] There are published variations of this test, including using sphygmomanometers to measure force of cervical flexion, however, timed static testing is simplest for routine in-office use. Based on unpublished normative data, males without neck pain should be able sustain flexion for 85 seconds until fatigue and females should be able to hold the position

for 39 seconds.[132] Using an 85% of norm as passing for under 50 years old and 70% for over 50 years old, the following cutoffs are recommended:

Age	Male	Female
Norm	85 secs	39 secs
< 50 (85%)	72 secs	33 secs
> 50 (70%)	60 secs	27 secs

Physical Capacity Testing Instruments/ System	Using higher technology physical capacity measurement does not appear to offer any advantages over self-administered functional scales and low-tech physical performance for assessing improvement in the early phases of injured worker care. Further, a Cochrane Library review was unable to find any studies comparing re-injury rates for workers receiving functional capacity evaluation to workers not having the intervention.[133]

ADDITIONAL RESOURCES

L&I Provider Resources

Provider Information: https://lni.wa.gov/patient-care/treating-patients/treatment-guidelines-and-resources/
IICAC Best Practice Resources: https://www.lni.wa.gov/patient-care/treating-patients/treatment-guidelines-and-resources/#practice-resources-for-attending-providers
Early Return To Work: https://lni.wa.gov/patient-care/treating-patients/treatment-guidelines-and-resources/
Physical and Occupational Therapy: https://lni.wa.gov/patient-care/treating-patients/treatment-guidelines-and-resources/
Activity Coaching: https://lni.wa.gov/claims/for-vocational-providers/transitioning-back-to-work/activity-coaching

Systematic Reviews - Low Back Treatments

US Department of Health & Human Services Agency for Healthcare Research and Quality (AHRQ):
https://effectivehealthcare.ahrq.gov/products/back-pain-treatment/clinician
American Academy of Physicians (AAP):
https://www.acpjournals.org/doi/10.7326/M16-2367

General Rehabilitation Resources*

Basic 15-minute back flexibility and strengthening exercise examples (Mayo Clinic):
http://www.mayoclinic.org/healthy-lifestyle/adult-health/multimedia/back-pain/sls-20076265?s=1

Directional exercise information (North American Spine Society) :
http://www.knowyourback.org/Pages/Treatments/Nonsurgical/DirectionalExercises.aspx

Build a custom program for rehab exercises - various body areas (HEP2go): https://www.hep2go.com/

Examples (videos and handouts) for multiple exercises – various body areas (CyberPT): http://www.cyberpt.com/cptvidlist.asp

Overview of rehab approaches and options (Physical Therapy Health Center): http://www.spine-health.com/treatment/physical-therapy

Exercise and rehabilitation videos (Michael Maxwell, DC) https://www.youtube.com/user/maxwellmp1/feed

* Disclaimer: External links are provided to illustrate on-line resources available for active rehabilitation exercise. Their inclusion here does not constitute endorsement by IICAC or L&I. All links were working at time of publication

Intervention/Experimental Studies

Randomized Controlled Trial (RCT) – A study that randomly allocates patients to treatment groups, usually blinding patients, therapists and/or study evaluators. Typically, of high quality as randomization assures similarities of subjects within treatment groups.

Observational Studies

Cohort design – Cohort (retrospective or prospective) – A study that follows patients who self-allocate to treatment groups through the course of their care for a given occurrence of a condition. Larger, well-designed cohort studies may be of good quality, but lack of randomization predisposes to heterogeneity issues within groups, some of which may be able to be adjusted for with statistical methods.

Cross sectional – Involves observing a population to measure disease and exposure status. It is usually thought to be a "snapshot" of the frequency and characteristics of a disease in a population at a specific given time.

Case control – Is a study that compares patients who have an outcome (cases) of interest with patients who do not have the disease or outcome (controls). The study may retrospectively compare how frequently the exposure was present in a group to determine risk factors.

Case series – Is a study that describes a series of patients with an outcome of interest, may be of variable quality. Better designs use consecutive patients and include robust baseline and follow up outcome measures.

Case reports – Describes an individual case, typically only achieving publication if it represents a unique or unusual clinical experience.

Blinding

Blinding minimizes potential bias. Typically, three levels of blinding are sought: patient, treating provider and evaluator. Many conservative interventions do not allow for patient blinding (e.g. someone is likely to know if they received a splint or a pill). At a minimum, single blinding of the evaluator as to what group a subject was in is expected.

Literature Reviews

Quantitative systematic reviews – Studies that review previously published clinical trials that include quantitative comparisons (e.g. meta-analyses). Systematic reviews should have rigorous and comprehensive methodology to identify relevant published research and include appraisal of study quality. Cochrane reviews frequently are of this type.

Qualitative systematic reviews – Similar to quantitative reviews but without systematic quantitative comparison or data pooling.

Narrative literature reviews – Such reviews typically do not include rigorous study selection methodology and may be subject to significant author bias.

Literature Retrieval and Review

1. **Initial systematic searches** of electronic databases (e.g. PubMed). Search terms used typically included MeSH terms for tests and interventions with conditions being addressed. Follow-up searches also included population attributes (e.g., workers' compensation, occupational).
2. **Abstract screening** for relevance.
3. **Original paper retrieval** with review for relevance, quality, outcome meaningfulness, and effect magnitude.
4. **Additional studies identified** through clinical summaries (e.g., reviews, texts), citation tracking, and feedback from public.

About Evidence for Physical Examination and Conservative Interventions

Conservative musculoskeletal care is typically care of first resort based on long standing practices. Typically, 'low tech,' low cost, with minimal and rare side effects, it is frequently delivered in primary care settings, and by various health providers. The rigor and quality expected of high cost, higher risk, emerging, and tertiary interventions is less common for many routine physical examination procedures and conservative interventions. Much of the evidence summarized here would be considered Class "C" or "III" in ratings systems. Thus, the committee has not presented explicit *recommendations*, rather, *evidence summaries* guided by expert consensus to assist in formulating care options. Further, significant emphasis is made regarding tracking and documenting meaningful functional improvement with patients. Study attributes most likely to strengthen or limit confidence are characterized in the evidence descriptions.

Assessing Study Methodologic Quality

Attributes of study methodology quality vary according to the clinical procedure (e.g., diagnostic, therapeutic intervention) looked at, and specific research questions being studied. The American Academy of Neurology's Clinical Practice Guideline Process Manual [145] offers a comprehensive guide to systematic evidence review, quality attributes and consensus process that generally serves as the approach taken by IICAC.

General attributes identified when extracting evidence from studies include identification of population, the intervention and co-interventions and outcomes being addressed in each study. The clinical questions addressed such as diagnostic accuracy, therapeutic effectiveness, or causation are determined. Studies are extracted into evidence tables including quality attributes and/or ratings which are reviewed both by department staff and committee members (usually 2 per study).

Specific quality attributes include: Diagnostic Accuracy – design, spectrum of patients, validity and relevance of outcome metric; Therapeutic Interventions – comparison groups (no treatment, placebo, comparative intervention), treatment allocation, blinding/masking (method and degree: single, double, independent), follow-up (period and completion), and analysis (statistical power, intent-to-treat). Specific attention is paid to several factors including reporting of outcomes (primary vs. secondary), relevance of outcome (e.g., function vs. pain), and meaningfulness (clinically important change vs. minimally detectable change).

Synthesizing Evidence

Consideration of study quality (class), significance (statistical precision), consistency across studies, magnitude of effect, and relevance to populations and procedures were taken into account in preparing draft summaries. Special attention was given to clarifying conclusions related to the clinical questions of interest. Evidence, particularly with low tech and highly diffused examination and conservative procedures addressed here, is rarely truly "definitive," even when multiple studies exist. Inconsistent conclusions typically reflect error (systematic, random) and/or bias in studies. Data pooling via meta-analysis is useful to reduce random error when studies are of sufficient power and methodologic strength. Larger meaningful effect size may increase confidence in findings.

1. Cancelliere, C., et al., *Factors affecting return to work after injury or illness: best evidence synthesis of systematic reviews.* Chiropractic & Manual Therapies, 2016. **24**(1): p. 32.
2. Turner, J.A., S. Holtzman, and L. Mancl, *Mediators, moderators, and predictors of therapeutic change in cognitive–behavioral therapy for chronic pain.* Pain, 2007. **127**(3): p. 276-286.
3. Smeets, R.J., et al., *Do psychological characteristics predict response to exercise and advice for subacute low back pain?* Arthritis Care & Research, 2009. **61**(9): p. 1202-1209.
4. Chou, R. and P. Shekelle, *Will this patient develop persistent disabling low back pain?* Jama, 2010. **303**(13): p. 1295-1302.
5. Smeets, R., *Active rehabilitation for chronic low back pain: cognitive-behavioral, physical, or both?* 2006.
6. Mootz, R.D. and K.A. McCarthy, *Sports chiropractic*. 1999: Jones & Bartlett Learning.
7. Beneciuk, J.M., et al., *Identifying Treatment Effect Modifiers in the STarT Back Trial: A Secondary Analysis.* The Journal of Pain, 2017. **18**(1): p. 54-65.
8. Kongsted, A., et al., *Prediction of outcome in patients with low back pain--A prospective cohort study comparing clinicians' predictions with those of the Start Back Tool.* Man Ther, 2016. **21**: p. 120-7.
9. Gregg, C., et al., *Prognostic factors associated with low back pain outcomes.* Journal of primary health care, 2014. **6**(1): p. 23-30.
10. Campbell, P., et al., *Prognostic indicators of low back pain in primary care: five-year prospective study.* The journal of pain, 2013. **14**(8): p. 873-883.
11. Melloh, M., et al., *Prognostic occupational factors for persistent low back pain in primary care.* Int Arch Occup Environ Health, 2013. **86**(3): p. 261-9.
12. Brennan, G.P., et al., *Identifying subgroups of patients with acute/subacute "nonspecific" low back pain: results of a randomized clinical trial.* Spine, 2006. **31**(6): p. 623-631.
13. Fritz, J.M., et al., *An examination of the reliability of a classification algorithm for subgrouping patients with low back pain.* Spine, 2006. **31**(1): p. 77-82.
14. Henry, S.M., et al., *Reliability of a treatment-based classification system for subgrouping people with low back pain.* journal of orthopaedic & sports physical therapy, 2012. **42**(9): p. 797-805.
15. Smeets, R.J., et al., *Physical capacity tasks in chronic low back pain: What is the contributing role of cardiovascular capacity, pain and psychological factors?* Disability and rehabilitation, 2007. **29**(7): p. 577-586.
16. Smeets, R.J., K.D. van Geel, and J.A. Verbunt, *Is the fear avoidance model associated with the reduced level of aerobic fitness in patients with chronic low back pain?* Archives of physical medicine and rehabilitation, 2009. **90**(1): p. 109-117.
17. Mootz, R. and V. Waldorf, *Chiropractic care parameters for common industrial low back conditions.* Chiropr Technique 1993a, 1993. **5**(3): p. 119-25.
18. Metkus, T.S., K.L. Baughman, and P.D. Thompson, *Exercise prescription and primary prevention of cardiovascular disease.* Circulation, 2010. **121**(23): p. 2601-2604.
19. Kleinstück, F., J. Dvorak, and A.F. Mannion, *Are "structural abnormalities" on magnetic resonance imaging a contraindication to the successful conservative treatment of chronic nonspecific low back pain?* Spine, 2006. **31**(19): p. 2250-2257.
20. Chou, R., et al., *Noninvasive treatments for low back pain.* 2016.
21. Smeets, R.J., et al., *The usability of six physical performance tasks in a rehabilitation population with chronic low back pain.* Clinical Rehabilitation, 2006. **20**(11): p. 989-997.
22. Greenberg, E.L. and R. Leopold, *Performance measurement in workers' compensation managed care organizations.* Occupational medicine (Philadelphia, Pa.), 1998. **13**(4): p. 755.
23. Harris, J.S., *Occupational medicine practice guidelines: evaluation and management of common health problems and functional recovery in workers*. 1998: OEM Press.
24. Franklin, G., M. Kliot, and L. Robinson. *Carpal tunnel syndrome: Advanced*. in *American Association of Neuromuscular and Electrodiagnostic Medicine 54th Annual Meeting*. 2007.
25. Bonfiglioli, R., et al., *Relationship between repetitive work and the prevalence of carpal tunnel syndrome in part-time and full-time female supermarket cashiers: a quasi-experimental study.* International archives of occupational and environmental health, 2007. **80**(3): p. 248-253.
26. Schonstein, E., et al., *Work conditioning, work hardening and functional restoration for workers with back and neck pain.* The Cochrane Library, 2003.
27. Frank, J., et al., *Preventing disability from work-related low-back pain. New evidence gives new hope--if we can just get all the players onside.* Canadian Medical Association Journal, 1998. **158**(12): p. 1625-1631.

28. Kyes, K.B., et al., *Evaluation of the Washington State Workers' Compensation Managed Care Pilot Project I: Medical Outcomes and Patient Satisfaction.* Medical Care, 1999. **37**(10): p. 972-981.
29. Wickizer, T.M., et al., *Improving quality, preventing disability and reducing costs in workers' compensation healthcare: a population-based intervention study.* Medical care, 2011. **49**(12): p. 1105-1111.
30. Loisel, P., et al., *A population-based, randomized clinical trial on back pain management.* Spine, 1997. **22**(24): p. 2911-2918.
31. Hlobil, H., et al., *Effectiveness of a return-to-work intervention for subacute low-back pain.* Scandinavian journal of work, environment & health, 2005: p. 249-257.
32. Childs, J.D., et al., *Implications of early and guideline adherent physical therapy for low back pain on utilization and costs.* BMC health services research, 2015. **15**(1): p. 150.
33. Fritz, J.M., J. Kim, and J. Dorius, *Importance of the type of provider seen to begin health care for a new episode low back pain: associations with future utilization and costs.* Journal of evaluation in clinical practice, 2015.
34. Blanchette, M.-A., et al., *Effectiveness and Economic Evaluation of Chiropractic Care for the Treatment of Low Back Pain: A Systematic Review of Pragmatic Studies.* PloS one, 2016. **11**(8): p. e0160037.
35. Dagenais, S., S. Haldeman, and P. Manga, *A systematic review comparing the costs of chiropractic care to other interventions for spine pain in the United States.* BMC health services research, 2015. **15**(1): p. 474.
36. Busse, J.W., et al., *Association of worker characteristics and early reimbursement for physical therapy, chiropractic and opioid prescriptions with workers' compensation claim duration, for cases of acute low back pain: an observational cohort study.* BMJ open, 2015. **5**(8): p. e007836.
37. Turner, J.A., et al., *ISSLS prize winner: early predictors of chronic work disability: a prospective, population-based study of workers with back injuries.* Spine, 2008. **33**(25): p. 2809-2818.
38. Qaseem, A., et al., *Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of PhysiciansNoninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain.* Annals of Internal Medicine, 2017.
39. Washington State Department of Labor & Industries Industrial Insurance Medical Advisory Committee and Industrial Insurance Chiropractic Advisory Committee, *Psychosocial Determinants Influencing Recovery*. 2016, Washington State Department of Labor & Industries: Tumwater, Washington.
40. Dodd, S., et al., *A Review of the Theoretical and Biological Understanding of the Nocebo and Placebo Phenomena.* Clinical Therapeutics, 2017.
41. Hurley, D.A., et al., *Supervised walking in comparison with fitness training for chronic back pain in physiotherapy: results of the SWIFT single-blinded randomized controlled trial (ISRCTN17592092).* Pain, 2015. **156**(1): p. 131-147.
42. Beinart, N.A., et al., *Individual and intervention-related factors associated with adherence to home exercise in chronic low back pain: a systematic review.* Spine J, 2013. **13**(12): p. 1940-50.
43. Bronfort, G., et al., *Supervised exercise, spinal manipulation, and home exercise for chronic low back pain: a randomized clinical trial.* The spine journal, 2011. **11**(7): p. 585-598.
44. Kamper, S.J., et al., *Multidisciplinary biopsychosocial rehabilitation for chronic low back pain.* The Cochrane Library, 2014.
45. Kool, J., et al., *Function-centered rehabilitation increases work days in patients with nonacute nonspecific low back pain: 1-year results from a randomized controlled trial.* Archives of physical medicine and rehabilitation, 2007. **88**(9): p. 1089-1094.
46. Kent, P. and P. Kjaer, *The efficacy of targeted interventions for modifiable psychosocial risk factors of persistent nonspecific low back pain - a systematic review.* Man Ther, 2012. **17**(5): p. 385-401.
47. Macedo, L.G., et al., *Motor control exercise for acute non-specific low back pain.* The Cochrane Library, 2016.
48. Macedo, L.G., et al., *Motor control exercise for persistent, nonspecific low back pain: a systematic review.* Physical therapy, 2009. **89**(1): p. 9.
49. Bystrom, M.G., E. Rasmussen-Barr, and W.J. Grooten, *Motor control exercises reduces pain and disability in chronic and recurrent low back pain: a meta-analysis.* Spine (Phila Pa 1976), 2013. **38**(6): p. E350-8.
50. Macedo, L.G., et al., *Effect of motor control exercises versus graded activity in patients with chronic nonspecific low back pain: a randomized controlled trial.* Phys Ther, 2012. **92**(3): p. 363-77.
51. Searle, A., et al., *Exercise interventions for the treatment of chronic low back pain: a systematic review and meta-analysis of randomised controlled trials.* Clin Rehabil, 2015. **29**(12): p. 1155-67.

52. McCaskey, M.A., et al., *Effects of proprioceptive exercises on pain and function in chronic neck- and low back pain rehabilitation: a systematic literature review.* BMC Musculoskelet Disord, 2014. **15**: p. 382.
53. Franke, H., et al., *Muscle energy technique for non-specific low-back pain.* Cochrane Database Syst Rev, 2015(2): p. Cd009852.
54. Nwuga, V., *Relative therapeutic efficacy of vertebral manipulation and conventional treatment in back pain management.* American journal of physical medicine, 1982. **61**(6): p. 273-278.
55. Frost, H., et al., *Randomised controlled trial of physiotherapy compared with advice for low back pain.* Bmj, 2004. **329**(7468): p. 708.
56. Holtzman, S. and R.T. Beggs, *Yoga for chronic low back pain: a meta-analysis of randomized controlled trials.* Pain Res Manag, 2013. **18**(5): p. 267-72.
57. Halliday, M.H., et al., *A randomized controlled trial comparing the McKenzie method to motor control exercises in people with chronic low back pain and a directional preference.* Journal of Orthopaedic & Sports Physical Therapy, 2016. **46**(7): p. 514-522.
58. Thackeray, A., et al., *The effectiveness of mechanical traction among subgroups of patients with low back pain and leg pain: a randomized trial.* journal of orthopaedic & sports physical therapy, 2016. **46**(3): p. 144-154.
59. Surkitt, L.D., et al., *Efficacy of directional preference management for low back pain: a systematic review.* Physical therapy, 2012. **92**(5): p. 652.
60. Donelson, R., et al., *Influence of directional preference on two clinical dichotomies: acute versus chronic pain and axial low back pain versus sciatica.* PM&R, 2012. **4**(9): p. 667-681.
61. Kent, P., H.L. Mjøsund, and D.H. Petersen, *Does targeting manual therapy and/or exercise improve patient outcomes in nonspecific low back pain? A systematic review.* BMC medicine, 2010. **8**(1): p. 22.
62. Paatelma, M., et al., *Orthopaedic manual therapy, McKenzie method or advice only for low back pain in working adults: a randomized controlled trial with one year follow-up.* Journal of rehabilitation medicine, 2008. **40**(10): p. 858-863.
63. Long, A., R. Donelson, and T. Fung, *Does it matter which exercise?: A randomized control trial of exercise for low back pain.* Spine, 2004. **29**(23): p. 2593-2602.
64. Smeets, R.J., et al., *Do patients with chronic low back pain have a lower level of aerobic fitness than healthy controls?: are pain, disability, fear of injury, working status, or level of leisure time activity associated with the difference in aerobic fitness level?* Spine, 2006. **31**(1): p. 90-97.
65. Mannion, A., et al., *Comparison of three active therapies for chronic low back pain: results of a randomized clinical trial with one-year follow-up.* Rheumatology, 2001. **40**(7): p. 772-778.
66. Gundewall, B., M. Liljeqvist, and T. Hansson, *Primary prevention of back symptoms and absence from work: a prospective randomized study among hospital employees.* Spine, 1993. **18**(5): p. 587-594.
67. Smeets, R.J., et al., *Chronic low back pain: physical training, graded activity with problem solving training, or both? The one-year post-treatment results of a randomized controlled trial.* Pain, 2008. **134**(3): p. 263-276.
68. Smeets, R.J., et al., *Active rehabilitation for chronic low back pain: cognitive-behavioral, physical, or both? First direct post-treatment results from a randomized controlled trial [ISRCTN22714229].* BMC Musculoskeletal disorders, 2006. **7**(1): p. 5.
69. Ferreira, M.L., et al., *Can we explain heterogeneity among randomized clinical trials of exercise for chronic back pain? A meta-regression analysis of randomized controlled trials.* Physical therapy, 2010. **90**(10): p. 1383.
70. Hagen, E.M., H.R. Eriksen, and H. Ursin, *Does early intervention with a light mobilization program reduce long-term sick leave for low back pain?* Spine, 2000. **25**(15): p. 1973-1976.
71. Hagen, E.M., A. Grasdal, and H.R. Eriksen, *Does early intervention with a light mobilization program reduce long-term sick leave for low back pain: a 3-year follow-up study.* Spine, 2003. **28**(20): p. 2309-2315.
72. Kool, J., et al., *Increasing days at work using function-centered rehabilitation in nonacute nonspecific low back pain: a randomized controlled trial.* Archives of physical medicine and rehabilitation, 2005. **86**(5): p. 857-864.
73. Lewis, J.S., et al., *A randomized clinical trial comparing two physiotherapy interventions for chronic low back pain.* Spine, 2005. **30**(7): p. 711-721.
74. Johnson, R.E., et al., *Active exercise, education, and cognitive behavioral therapy for persistent disabling low back pain: a randomized controlled trial.* Spine, 2007. **32**(15): p. 1578-1585.
75. Aure, O.F., J.H. Nilsen, and O. Vasseljen, *Manual therapy and exercise therapy in patients with chronic low back pain: a randomized, controlled trial with 1-year follow-up.* Spine, 2003. **28**(6): p. 525-531.

76. Cambron, J.A., et al., *One-year follow-up of a randomized clinical trial comparing flexion distraction with an exercise program for chronic low-back pain.* Journal of Alternative & Complementary Medicine, 2006. **12**(7): p. 659-668.
77. UK BEAM Trial Team, *United Kingdom back pain exercise and manipulation (UK BEAM) randomised trial: effectiveness of physical treatments for back pain in primary care.* Bmj, 2004. **329**(7479): p. 1377.
78. UK BEAM Trial Team, *United Kingdom back pain exercise and manipulation (UK BEAM) randomised trial: cost effectiveness of physical treatments for back pain in primary care.* Bmj, 2004. **329**(7479): p. 1381.
79. Hayden, J., et al., *Exercise therapy for treatment of non-specific low back pain.* The Cochrane Library, 2005.
80. Koes, B.W., et al., *Randomised clinical trial of manipulative therapy and physiotherapy for persistent back and neck complaints: results of one year follow up.* Bmj, 1992. **304**(6827): p. 601-605.
81. Triano, J.J., et al., *Manipulative therapy versus education programs in chronic low back pain.* Spine, 1995. **20**(8): p. 948-955.
82. Schaafsma, F., et al., *Physical conditioning programs for improving work outcomes in workers with back pain.* The Cochrane Library, 2010.
83. Wright, A., et al., *Individual active treatment combined with group exercise for acute and subacute low back pain.* Spine, 2005. **30**(11): p. 1235-1241.
84. Niemistö, L., et al., *A randomized trial of combined manipulation, stabilizing exercises, and physician consultation compared to physician consultation alone for chronic low back pain.* Spine, 2003. **28**(19): p. 2185-2191.
85. Santilli, V., E. Beghi, and S. Finucci, *Chiropractic manipulation in the treatment of acute back pain and sciatica with disc protrusion: a randomized double-blind clinical trial of active and simulated spinal manipulations.* The Spine Journal, 2006. **6**(2): p. 131-137.
86. Rasmussen, J., et al., *Manipulation does not add to the effect of extension exercises in chronic low-back pain (LBP). A randomized, controlled, double blind study.* Joint Bone Spine, 2008. **75**(6): p. 708-713.
87. Erhard, R.E., A. Delitto, and M.T. Cibulka, *Relative effectiveness of an extension program and a combined program of manipulation and flexion and extension exercises in patients with acute low back syndrome.* Physical Therapy, 1994. **74**(12): p. 1093-1100.
88. Mayer, J., V. Mooney, and S. Dagenais, *Evidence-informed management of chronic low back pain with lumbar extensor strengthening exercises.* The Spine Journal, 2008. **8**(1): p. 96-113.
89. Koumantakis, G.A., P.J. Watson, and J.A. Oldham, *Trunk muscle stabilization training plus general exercise versus general exercise only: randomized controlled trial of patients with recurrent low back pain.* Physical therapy, 2005. **85**(3): p. 209.
90. Gomes-Neto, M., et al., *Stabilization exercise compared to general exercises or manual therapy for the management of low back pain: A systematic review and meta-analysis.* Physical Therapy in Sport, 2017. **23**: p. 136-142.
91. Stuber, K.J., et al., *Core stability exercises for low back pain in athletes: a systematic review of the literature.* Clin J Sport Med, 2014. **24**(6): p. 448-56.
92. Smith, B.E., C. Littlewood, and S. May, *An update of stabilisation exercises for low back pain: a systematic review with meta-analysis.* BMC Musculoskelet Disord, 2014. **15**: p. 416.
93. Wang, X.Q., et al., *A meta-analysis of core stability exercise versus general exercise for chronic low back pain.* PLoS One, 2012. **7**(12): p. e52082.
94. Rydeard, R., A. Leger, and D. Smith, *Pilates-based therapeutic exercise: effect on subjects with nonspecific chronic low back pain and functional disability: a randomized controlled trial.* Journal of orthopaedic & sports physical therapy, 2006. **36**(7): p. 472-484.
95. Niemistö, L., et al., *Cost-effectiveness of combined manipulation, stabilizing exercises, and physician consultation compared to physician consultation alone for chronic low back pain: a prospective randomized trial with 2-year follow-up.* Spine, 2005. **30**(10): p. 1109-1115.
96. Riipinen, M., et al., *Psychosocial differences as predictors for recovery from chronic low back pain following manipulation, stabilizing exercises and physician consultation or physician consultation alone.* Journal of rehabilitation medicine, 2005. **37**(3): p. 152-158.
97. Goldby, L.J., et al., *A randomized controlled trial investigating the efficiency of musculoskeletal physiotherapy on chronic low back disorder.* Spine, 2006. **31**(10): p. 1083-1093.
98. Taimela, S., et al., *The role of physical exercise and inactivity in pain recurrence and absenteeism from work after active outpatient rehabilitation for recurrent or chronic low back pain: a follow-up study.* Spine, 2000. **25**(14): p. 1809-1816.
99. Lopez-de-Uralde-Villanueva, I., et al., *A Systematic Review and Meta-Analysis on the Effectiveness of Graded Activity and Graded Exposure for Chronic Nonspecific Low Back Pain.* Pain Med, 2016. **17**(1): p. 172-88.

100. Ogston, J.B., R.D. Crowell, and B.K. Konowalchuk, *Graded group exercise and fear avoidance behavior modification in the treatment of chronic low back pain.* J Back Musculoskelet Rehabil, 2016.
101. Magalhães, M.O., et al., *The short-term effects of graded activity versus physiotherapy in patients with chronic low back pain: A randomized controlled trial.* Manual therapy, 2015. **20**(4): p. 603-609.
102. Saner, J., et al., *A tailored exercise program versus general exercise for a subgroup of patients with low back pain and movement control impairment: A randomised controlled trial with one-year follow-up.* Man Ther, 2015. **20**(5): p. 672-9.
103. Van der Giessen, R., C. Speksnijder, and P. Helders, *The effectiveness of graded activity in patients with non-specific low-back pain: a systematic review.* Disability and rehabilitation, 2012. **34**(13): p. 1070-1076.
104. Macedo, L.G., et al., *Graded activity and graded exposure for persistent nonspecific low back pain: a systematic review.* Physical therapy, 2010. **90**(6): p. 860.
105. Rasmussen-Barr, E., et al., *Graded exercise for recurrent low-back pain: a randomized, controlled trial with 6-, 12-, and 36-month follow-ups.* Spine, 2009. **34**(3): p. 221-228.
106. Staal, J.B., et al., *Graded activity for workers with low back pain: who benefits most and how does it work?* Arthritis Care & Research, 2008. **59**(5): p. 642-649.
107. Roche, G., et al., *Comparison of a functional restoration program with active individual physical therapy for patients with chronic low back pain: a randomized controlled trial.* Archives of physical medicine and rehabilitation, 2007. **88**(10): p. 1229-1235.
108. Wormgoor, M.E., et al., *The impact of aerobic fitness on functioning in chronic back pain.* European Spine Journal, 2008. **17**(4): p. 475-483.
109. Kankaanpää, M., et al., *The Efficacy of Active Rehabilitation in Chronic Low Back Pain: Effect on Pain Intensity, Self-Experienced Disability, and Lumbar Fatigability.* Spine, 1999. **24**(10): p. 1034-1042.
110. Karjalainen, K.A., et al., *Multidisciplinary biopsychosocial rehabilitation for subacute low-back pain among working age adults.* The Cochrane Library, 2003.
111. Karjalainen, K., et al., *Mini-intervention for subacute low back pain: two-year follow-up and modifiers of effectiveness.* Spine, 2004. **29**(10): p. 1069-1076.
112. Lindström, I., C. Ohlund, and C. Eek, *The effect of graded activity on patients with subacute low back pain: a randomized prospective clinical study with an operant-conditioning behavioral approach.* Phys Ther, 1992. **72**: p. 279-93.
113. Lindström, I., et al., *Mobility, Strength, and Fitness After a Graded Activity Program for Patients with Subacute Low Back Pain: A Randomized Prospective Clinical Study with a Behavioral Therapy Approach.* Spine, 1992. **17**(6): p. 641-652.
114. Cook, R.D. and R.D. Mootz, *Determining appropriateness of exercise and rehabilitation for chiropractic patients.* Sports Chiropractic, 1999: p. 78.
115. Nelson, D., *Assuring quality in the delivery of active & passive care.*, in *Sports Chiropractic*, M. RD and M. KA, Editors. 1999, Aspen Publishers: Gaithersburg, MD.
116. Lawrence, D.J., et al., *Chiropractic management of low back pain and low back-related leg complaints: a literature synthesis.* Journal of manipulative and physiological therapeutics, 2008. **31**(9): p. 659-674.
117. Bronfort, G., et al., *Spinal Manipulation and Home Exercise With Advice for Subacute and Chronic Back-Related Leg PainA Trial With Adaptive AllocationSpinal Manipulation and Home Exercise With Advice for Back-Related Leg Pain.* Annals of internal medicine, 2014. **161**(6): p. 381-391.
118. Torres, J.R., et al., *Results of an active neurodynamic mobilization program in patients with fibromyalgia syndrome: a randomized controlled trial.* Archives of physical medicine and rehabilitation, 2015. **96**(10): p. 1771-1778.
119. Ellis, R.F. and W.A. Hing, *Neural mobilization: a systematic review of randomized controlled trials with an analysis of therapeutic efficacy.* Journal of manual & manipulative therapy, 2008. **16**(1): p. 8-22.
120. ELDesoky, M.T.M. and E.E.M. Abutaleb, *EFFICACY OF NEURAL MOBILIZATION ON LOW BACK PAIN WITH S1 RADICULOPATHY.* INTERNATIONAL JOURNAL OF PHYSIOTHERAPY, 2016. **3**(3): p. 362-370.
121. Branchini, M., et al., *Fascial Manipulation® for chronic aspecific low back pain: a single blinded randomized controlled trial.* F1000Research, 2015. **4**.
122. Efstathiou, M.A., et al., *Effectiveness of neural mobilization in patients with spinal radiculopathy: a critical review.* Journal of bodywork and movement therapies, 2015. **19**(2): p. 205-212.

123. Ruddock, J.K., et al., *Spinal Manipulation Vs Sham Manipulation for Nonspecific Low Back Pain: A Systematic Review and Meta-analysis.* Journal of Chiropractic Medicine, 2016. **15**(3): p. 165-183.
124. Cherkin, D.C., et al., *A randomized trial comparing acupuncture, simulated acupuncture, and usual care for chronic low back pain.* Archives of internal medicine, 2009. **169**(9): p. 858-866.
125. Haake, M., et al., *German Acupuncture Trials (GERAC) for chronic low back pain: randomized, multicenter, blinded, parallel-group trial with 3 groups.* Archives of internal medicine, 2007. **167**(17): p. 1892-1898.
126. Shell, W.E., et al., *Reduction in pain and inflammation associated with chronic low back pain with the use of the medical food theramine.* American journal of therapeutics, 2016. **23**(6): p. e1353.
127. Lotfi, A., et al., *Hypovitaminosis D in female patients with chronic low back pain.* Clinical rheumatology, 2007. **26**(11): p. 1895-1901.
128. Wertli, M.M., et al., *The role of fear avoidance beliefs as a prognostic factor for outcome in patients with nonspecific low back pain: a systematic review.* Spine J, 2014. **14**(5): p. 816-36.e4.
129. Rubak, S., et al., *Motivational interviewing: a systematic review and meta-analysis.* Br J Gen Pract, 2005. **55**(513): p. 305-312.
130. Dahm, K.T., et al., *Advice to rest in bed versus advice to stay active for acute low-back pain and sciatica.* The Cochrane Library, 2010.
131. Woby, S.R., et al., *Are changes in fear-avoidance beliefs, catastrophizing, and appraisals of control, predictive of changes in chronic low back pain and disability?* European Journal of Pain, 2004. **8**(3): p. 201-210.
132. Woby, S.R., et al., *Adjustment to chronic low back pain—the relative influence of fear-avoidance beliefs, catastrophizing, and appraisals of control.* Behaviour research and therapy, 2004. **42**(7): p. 761-774.
133. Kongsted, A., et al., *Expectation of recovery from low back pain: a longitudinal cohort study investigating patient characteristics related to expectations and the association between expectations and 3-month outcome.* Spine (Phila Pa 1976), 2014. **39**(1): p. 81-90.
134. Campbell, P., et al., *Prognostic indicators of low back pain in primary care: five-year prospective study.* J Pain, 2013. **14**(8): p. 873-83.
135. Smeets, R.J., et al., *Treatment expectancy and credibility are associated with the outcome of both physical and cognitive-behavioral treatment in chronic low back pain.* The Clinical journal of pain, 2008. **24**(4): p. 305-315.
136. Adams, H., et al., *The Relation Between Catastrophizing and Occupational Disability in Individuals with Major Depression: Concurrent and Prospective Associations.* Journal of Occupational Rehabilitation, 2016: p. 1-8.
137. Sullivan, M.J. and H. Adams, *Psychosocial treatment techniques to augment the impact of physiotherapy interventions for low back pain.* Physiotherapy Canada, 2010. **62**(3): p. 180-189.
138. Sullivan, M.J., W. Scott, and Z. Trost, *Perceived injustice: a risk factor for problematic pain outcomes.* The Clinical journal of pain, 2012. **28**(6): p. 484-488.
139. Scott, W., et al., *The relationship between perceived injustice and the working alliance: a cross-sectional study of patients with persistent pain attending multidisciplinary rehabilitation.* Disability and rehabilitation, 2016. **38**(24): p. 2365-2373.
140. Henschke, N., et al., *Behavioural treatment for chronic low-back pain.* The Cochrane Library, 2010.
141. Firtz, J.M. and J.J. Irrgang, *A comparison of a modified Oswestry low back pain disability questionnaire and the Quebec back pain disability scale.* Physical therapy, 2001. **81**(2): p. 776.
142. Lauridsen, H.H., et al., *Responsiveness and minimal clinically important difference for pain and disability instruments in low back pain patients.* BMC musculoskeletal disorders, 2006. **7**(1): p. 82.
143. Vianin, M., *Psychometric properties and clinical usefulness of the Oswestry Disability Index.* Journal of chiropractic medicine, 2008. **7**(4): p. 161-163.
144. Roland, M. and R. Morris, *A study of the natural history of back pain: part I: development of a reliable and sensitive measure of disability in low-back pain.* spine, 1983. **8**(2): p. 141-144.
145. Neurology, A.A.o., *Clinical Practice Guideline Process Manual* 2011.