### Additional File 2: Rationale for interventions, strategies, and objectives included

<table>
<thead>
<tr>
<th>Objective or Treatment strategy</th>
<th>Reason for inclusion</th>
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<tr>
<td><strong>Self-management</strong></td>
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<tr>
<td>Progressive goal setting</td>
<td>Progressive goal setting is an important way to involve the client in their own care. It can improve motivation to adhere to recommendations[1] and is an important component of the chronic care model[2]. Progressive goal setting has been an important component of many self-management programs and can contribute to improvements in adherence and function [3–5].</td>
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<tr>
<td>Graded exposure</td>
<td>Fear of movement and re-injury is associated with increased disability and influences prognosis in people experiencing pain[6–8]. Exposure therapy is a behavioural strategy that involves exposing a person with a fear to a feared stimuli at a low intensity and in a context that is not associated with fear with the aim of reducing or extinguishing the fear. In the context of chronic pain, graded exposure is a strategy aimed at reducing fear of movement or activity by gradually exposing the person to the feared activity in a context which does not evoke a great deal of fear. This approach has been shown to reduce pain related fear and disability[9–11].</td>
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<tr>
<td>Graded activity</td>
<td>Graded increases in activity are not only effective at reducing disability in people experiencing fear of movement and fear of activity. Graded activity and graded exercise approaches have demonstrated positive benefits for others who are experiencing chronic pain as well[11–15]. Gradual increases in activity are a key component of COMMENCE and attention is drawn in the education to the effects of activity on biological, psychological, and social factors associated with pain and related disability.</td>
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<tr>
<td>Activity scheduling and activity log</td>
<td>People with chronic pain often understand that increased activity and exercise participation are beneficial[16]. Many even have a goal to increase activity levels. Unfortunately, there is a gap between motivation to increase activity levels and participation in increased activity due to challenges implementing behaviour changes[17–19]. A strategy that is gaining support for aiding in behaviour change is targeting implementation intentions rather than motivation intentions. Several studies have demonstrated that implementation intention interventions help reduce the gap between a motivation to change activity levels and achieving the behaviour change[17–19]. Having a regular activity schedule may help the participant plan how they will implement the change in activity level. An activity log provides an opportunity for the participant to monitor success of the implementation plan.</td>
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<td>Encourage use of social supports</td>
<td>People with chronic pain who have high levels of social support from others are more likely to experience improvements in pain and disability[20]. While the number of social supports available to an individual may be challenging to modify, the use of the social supports in place is something that could be encouraged in the intervention through activity scheduling. The group setting may provide an opportunity for new social supports.</td>
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<tr>
<td>Education and discussion about healthy sleep patterns and behaviours</td>
<td>Sleep deprivation is a common complaint in people experiencing chronic pain[21]. COMMENCE is a client focused intervention and although most of the treatment strategies included in this intervention aim at increasing activity participation, strategies are provided to address other common complaints that are important to the participants. Strategies included in this education session include education on sleep behaviours, controlling external stimuli, sleep restriction, reducing catastrophic thinking around reduced sleep, and using increases in activity during the day to improve sleep at night[22].</td>
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<tr>
<td>Relaxation strategies</td>
<td>Some relaxation strategies have been shown to reduce pain and improve stress responses[23]. Traditionally, relaxation approaches have been passive in nature. However, there is reason to question whether passive relaxation approaches will have any influence on increased function and participation, which is the focus of COMMENCE. Relaxation strategies, therefore, will be framed as tools to manage symptoms in order to be able to participate in gradual increases in activity.</td>
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<tr>
<td>Self-monitoring and problem solving</td>
<td>Adherence to treatment is integral to the success of treatment[24]. Self-monitoring is introduced from the first day of COMMENCE to encourage active involvement of the participant and ultimately a feeling of self-efficacy. This includes monitoring completion of the activity log and progress towards goals. This monitoring encourages the participant to celebrate successes and problem solve through barriers to progress. Strategies are provided towards the end of the program to monitor progress towards longer-term goals.</td>
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<td><strong>Pain science education</strong></td>
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<td>Pain neurophysiology education</td>
<td>Pain neurophysiology education is included based on its demonstrated ability to reduce pain and improve function in people experiencing pain when applied alongside active rehabilitation. For example, in people with low back pain, intensive education that emphasizes cognitive-behavioural or neurophysiological aspects of pain have demonstrated improvements in pain, disability, health-care utilization, self-efficacy and negative pain cognitions[25, 26].</td>
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<tr>
<td>Education and discussion about biological, psychological, and social influences on pain</td>
<td>A scientific lay explanation of biological, psychological, and social factors associated with pain may help the participant understand some of their symptoms, feel legitimized, and understand the rationale for some of the treatment approaches provided. Epidemiological studies have demonstrated that biological, psychological, and social factors are associated with chronic pain and disability and can predict which patients have a poor prognosis[27, 28]. People with pain are open to discussion of psychological and social influences on pain when they are presented as contributing factors to pain rather than the cause of pain[16]. Education on the many factors that influence pain are important to helping the participant understand the biopsychosocial approach encouraged in this self-management program.</td>
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<tr>
<td>Education and discussion about the lack of a linear relationship between pain and tissue damage</td>
<td>Misconceptions about a close or even causal relationship between tissue damage and pain are common and can contribute to the persistence of pain and disability[29–31]. These misconceptions may lead to fear of movement and activity[29]. The fear avoidance model suggests that fear of movement and activity leads to withdrawal and avoidance of participating in usual activities, which can lead to the development and maintenance of depression and disability[32, 33]. While there are limitations to this model[34], the importance of addressing fear as part of the treatment of chronic pain is evident and providing an accurate understanding of this relationship may contribute to changes in perception of movement and activity.</td>
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<tr>
<td>Education and discussion about neuroplasticity and adaptability of other systems</td>
<td>Higher expectations of recovery following an injury is predictive of better rehabilitation outcomes[35–37]. Teaching people with pain about neuroplasticity and adaptability of other systems may help to increase expectations of positive change through a better understanding of the means through which these changes can occur. Education regarding neuroplasitcism has been a component of many of the effective pain neurophysiology education protocols[25].</td>
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<tr>
<td>Education and discussion about the relationship between stress and pain</td>
<td>Research continues to demonstrate close relationships between stress and pain[38, 39]. For example, presence of post-traumatic stress disorder symptoms is a prognostic indicator of a poor recovery in people with neck pain after a whiplash injury[38–40]. Discussing the relationship between stress and pain may help the participant understand the relationship as well as 'how and why' some of the interventions included in this treatment program, such as stress reduction strategies, can influence pain and disability.</td>
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<tr>
<td>Education and discussion about the relationship between thoughts and pain</td>
<td>The concept that negative cognitions can contribute to the onset or maintenance of the pain experience or associated disability is well established[7, 41, 42]. Helping people understand these relationships is important to helping them reduce negative cognitions that may pose barriers to participation in usual activities. This discussion helps to introduce treatment strategies such as thought monitoring, self-talk and graded exposure.</td>
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<tr>
<td>Education and discussion about the relationship between emotions and pain</td>
<td>The International Association for the Study of Pain (IASP) defines pain as: “an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage[43].” Pain itself is an emotional experience, but there are close relationships between other emotions and pain. Depressive symptoms are commonly associated with chronic pain[44, 45]. Anger and frustration may also be associated with more intense pain and greater disability[46, 47]. Participants are encouraged to identify positive and negative emotions and understand how they can influence pain. Discussion focuses on how they can modify these potential contributing factors through gradual increases in activity and participation.</td>
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<tr>
<td>Use of stories and metaphors</td>
<td>The use of analogies and metaphors as a means of teaching complex science has been discussed for a long time[48]. Only recently has this method of communication been discussed in the area of teaching people about pain. One randomized trial suggests using stories and metaphors to teach people with pain about pain is an effective strategy to change pain related beliefs[49]. The education included in COMMENCE is complex and therefore it is important that the messages are delivered in an engaging and easy to understand way.</td>
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<tr>
<td>Exercise</td>
<td>Move the non-enzymatic effects that may increase pain intensity</td>
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those who are already demonstrating avoidance behaviours. Emphasis, therefore, is placed on increases in activity at a rate and intensity that do not increase symptoms for an extended period after exercise.

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<th>Progressive functional exercises</th>
<th>Progressive exercises have shown consistent increases in function across multiple chronic pain conditions[12–14, 55]. However, current evidence does not provide us with suggestions of the most effective type of exercise, beyond suggesting that it is important for the exercise to be region specific [12, 13, 56]. A hypothesis of COMMENCE is that exercises more specific to the functional goals of the participant will be more effective at improving functional abilities. This hypothesis has two underlying assumptions: specificity principles make goal-specific exercises more effective at changing function and goal-oriented exercises are more meaningful to participants which makes them more likely to be adhered to.</th>
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<td>Aerobic exercise</td>
<td>Aerobic exercise can result in positive physiological changes to the nervous system, motor system, endocrine system, and immune system. Evidence in people with persistent pain suggests regular aerobic exercise can improve function and mood[57]. Also, it is included as a means of developing participant confidence in the ability to perform activities in gradually progressing dosages and for the other health benefits associated with regular aerobic exercise.</td>
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<td>Cognitive behavioural principles</td>
<td>A strong alliance between the health care provider and the patient is an important contributor to the success of rehabilitation interventions[58–60]. Specific focus is placed on developing a strong relationship between the health care provider and the participant in COMMENCE. This is accomplished with effective communication skills, which have been shown to improve patient satisfaction and adherence to behaviour change[58]. Also, health care providers are encouraged to explore their patients’ beliefs, refer to the patients’ beliefs in the education, and checking the understanding of the explanations provided. All of these strategies may help to develop a strong therapeutic relationship.</td>
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<td>Developing a strong relationship between health care provider and patient</td>
<td>Encouraging emotional disclosure has been shown to be effective for heterogenous populations of people with pain[61, 62]. This may be particularly important in people who are catastrophic thinkers. People who score high on measures of catastrophizing have a tendency to increase their communication of the pain experience and pain behaviours until they feel that their message is received[63]. Disclosure is considered important in allowing these participants to focus on increases in activity and progress towards their goals.</td>
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<tr>
<td>Encouraging disclosure</td>
<td>People with chronic pain who have a higher sense of self-efficacy tend to experience better functional outcomes[64, 65]. Self-efficacy can be important to the performance and maintenance of behaviour change in people experiencing pain[66, 67]. The main mechanism through which self-efficacy will be targeted is gradual increases in performance of goal-relevant activities. A number of additional strategies are used in an attempt to maximize self-efficacy: patient-led collaborative goal setting, using activity scheduling and activity logs in order to create a plan of action and self-monitor progress towards goals, reflection on changes in activity accomplished during the program, experience problem solving through barriers to increases in activity, and reflection on independent use of the strategies provided during the program.</td>
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<tr>
<td>Developing self-efficacy</td>
<td>Reflection on changes in activity levels throughout the program</td>
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<td>Thought monitoring</td>
<td>Cognitive behavioural approaches have been demonstrated to contribute to reducing negative cognitions such as catastrophic thinking[68]. People who experience reductions in catastrophic thinking are more likely to improve in response to treatment[69]. It has been suggested that in order to reduce catastrophic thinking, one should first help the person understand that negative thinking can have negative effects on emotions, behaviour, and function. The therapist can help the participant identify when he or she is experiencing negative thoughts that may impact behaviour and help the participant distance him/herself from those negative thoughts[70]. This is encouraged through thought monitoring.</td>
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<tr>
<td>Helpful Self-talk</td>
<td>Changing negative self-talk to positive self-talk and self-reassurance can be a helpful tool to provide positive reinforcement alongside increases in activity. An example of changing self-talk could include shifting from, “This hurts too much, I will never get it done” to “This is getting sore, but I know if I break up the task, I can get it done, and I will feel better having accomplished it.” Another example of self-talk could include shifting from, “This is really painful, something very serious must be going on” to “This is painful, but I know it is safe to continue.”</td>
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References


5. Coppack RJ, Kristensen J, Karageorghis CI: Use of a goal setting intervention to increase adherence to low back pain rehabilitation: a randomized controlled trial. *Clin Rehabil* 2012, 26:1032–42.


69. Burns JW, Kubilus A, Bruehl S, Harden RN, Lofland K: Do changes in cognitive factors influence outcome following multidisciplinary treatment for chronic