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Hybrid Approach to Treatment Tailoring for Low Back Pain: A Proposed Model of Care

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In a perfect world, a treatment for low back pain (LBP) would have a large effect size—that is, it would be effective for most patients—and could be applied simply and cheaply. Though such treatments have been identified for some conditions, few have been identified for LBP. When applied generically to individuals with LBP, exercise,[61] manual therapy,[12] psychology-based treatments,[21] pharmacological agents,[63] and surgery[29] have a small to no effect size. There are 3 options for progress: we can accept a small effect size and continue with nontargeted treatments; we can continue to search for the elusive treatment that will be effective for most patients; or we can accept that LBP is a complex condition and test methods with potential to optimize the allocation of treatments to improve the effect size.

Low back pain is a complex and heterogeneous condition that has considerable variation in its presentation and the underlying mechanisms of symptom development and progression. An enormous body of literature describes biological, psychological, and social features that explain some individual variation. In the biological domain, variation in tissue pathology,[53] tissue loading by strategies of motor control (posture/alignment, movement, and muscle activation),[62] pain neurobiology (eg, central and peripheral sensitization),[44] immune system responses,[34] changes in brain structure and behavior,[43] and so on have been implicated. In the psychological domain, there is equivalent diversity of presentation, with variation in features such as pain coping,[42] self-efficacy,[11] pain catastrophization,[54] fear avoidance,[4] kinesiophobia,[73] depression,[42] anxiety,[37] distress,[37] and pain behavior,[37] and all have different implications for treatment. The social domain is equally diverse, including features such as job satisfaction[28] and social support.[42]

From one perspective, this diversity invites great optimism, as many features are identifiable and potentially modifiable, providing potential for intervention tailoring. From another, such variation encourages considerable doubt, as comprehensive assessment across all domains would be time consuming, cumbersome, and unworkable. One path is to identify and test methods to simplify and target this decision-making process. Methods to target care have been presented, but none alone has yet achieved large effect

SYNOPSIS: Various approaches have been used to guide the treatment of low back pain. These approaches have been considered in isolation and often tested against each other. An alternative view is that a model of care that involves a hybrid approach may benefit patients with low back pain. This commentary considers the potential benefits of a sequentially applied hybrid approach for treatment tailoring to optimize resource allocation to those most likely to require comprehensive care, and then decision making toward treatment paths with the greatest potential for success. In a first step, a prognosis-based approach, such as the Subgroups for Targeted Treatment Back Screening Tool (STarT Back), identifies individuals likely to require greater resource allocation. Although a clear path is indicated toward simple and psychologically informed care for the low- and high-risk groups, respectively, there is limited guidance for the large medium-risk group. For that group, the hybrid model provides a stepwise path of additional methods to guide treatment selection. This includes subgrouping based on pain mechanism to guide priority domains for the next phase, which includes tailoring of psychological and movement-based approaches. Motor control approaches to exercise would be indicated for individuals with medium risk and a nociceptive pain mechanism, with treatment guided by detailed assessment via one of several paradigms. Psychologically informed treatments are tailored to those with medium risk and a predominantly central pain mechanism, guided by detailed assessment of psychosocial features. A hybrid approach to a model of care could simplify treatment selection and take advantage of the benefits of each method in a time- and cost-efficient manner. *J Orthop Sports Phys Ther 2019;49(6):453-463. Epub 13 Feb 2019. doi:10.2519/jospt.2019.8774*

KEY WORDS: *low back pain, model of care, motor control training, pain, stratified care mechanism*

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sizes. The objective of this commentary was to propose a model of care for LBP that includes a hybrid of several methods to target treatments. The proposed model of care includes stratification to guide the overall strategy and intensity of care, identification of the pain mechanism to guide physiological/psychological targets for management, and subgrouping based on movement and/or psychology to guide detailed components of care, when appropriate.

Models to Guide Treatment Allocation

Two primary models have emerged to guide allocation of treatment, and these have generally been considered in isolation. These models are broadly defined as (1) methods to stratify care based on prognosis (identification of prognostic variables), and (2) methods to allocate treatments based on subgroups expected to respond to specific treatments (identification of treatment moderator variables).[24] For the former, questionnaires such as the Subgroups for Targeted Treatment Back Screening Tool (STarT Back)[23] and the Örebro Musculoskeletal Pain Screening Questionnaire[38] have been used. For the latter, methods have been proposed to subgroup patients based on predicted response to specific treatments,[13] underlying pain mechanisms,[64] features of movement/posture/muscle activation,[27] and pathology/diagnosis.[53] Although some research shows that treatment targeting can reduce costs (STarT Back) and improve outcomes when specific groups are compared,[71] it has not yet achieved substantial gains when applied to a general LBP group. It is the premise of this commentary that although each alone has strengths and limitations, significant gains may be achieved by combining these treatments into a hybrid model of care. Consideration of this hybrid model requires understanding the separate approaches to treatment targeting.

Stratified Care for LBP One approach to simplify treatment selection involves stratification of patients into groups that require more or less comprehensive treatment, such that most treatment resources are allocated to those with greatest need. This is the basis of the STarT Back approach (**TABLE 1**).[23] This questionnaire is derived from initial work that identified features related to poor prognosis, with preference for simple assessments of potentially modifiable features.[23] Individuals allocated to the group with "low risk" for a poor prognosis receive minimal care, based on reassurance and advice regarding activity (**TABLE 1**). The group at "high risk" for a poor prognosis (primarily based on negative psychological features) receives intensive psychologically informed treatment. Individuals in the "medium-risk" group are allocated to multimodal physical therapy, which the scheme argues should be applied according to clinical practice guidelines[48,56] at the discretion of the treating clinician.

Care applied according to this approach is more cost-effective (greater mean health benefit of 0.039 additional quality-adjusted life-years), but effect sizes remain small.[25] This approach has potential to guide treatment to those who need it most, with some guidance for the type and amount of treatment, but there are limitations. Although the STarT Back tool's accuracy for prognosis has been challenged,[33] a greater concern is the limited clear guidance regarding decision making for the medium-risk group, whose members make up approximately 46% of patients.[25] For this group, the question remains: "What is the best way to guide tailoring of intervention?"

Treatment Subgroups in LBP Treatment tailoring to subgroups assumes that patients with similar presenting features can be identified and that treatments can be guided with a high probability of efficacy

TABLE 1 Suggested[25] Interventions Prescribed According to STarT Back Subgroups*

Subgroup	Treatment
Low risk: single session for reassurance and advice	Promotion of appropriate levels of activity, including return to work Reassurance to address concerns related to back pain and any resulting loss of function Address uncertainty about medication, further investigations, prognosis Video and book to reinforce messages Advice about local exercise venues and self-help groups
Medium risk: standardized physical therapy to address symptoms and function using evidence-based treatments	Restore function and target physical characteristics to reduce back-related disability Address moderate levels of psychological prognostic indicators Included interventions: advice and explanation, reassurance, education, exercise, manual therapy, and acupuncture Excluded interventions: bed rest, traction, massage, and electrotherapy
High risk: psychologically informed physical therapy to address physical symptoms and function and psychosocial obstacles to recovery	Cognitive behavioral principles to address unhelpful beliefs and behaviors Physical treatment modalities (exercise and manual therapy) integrated with psychologically informed techniques to provide a credible explanation for symptoms, reassurance, education, and collaborative goal setting Problem solving, pacing, graded activity, and relaxation Focus on low mood, anxiety, pain-related fear and catastrophizing Promotion of appropriate levels of activity, return to normal activities, and management of future back pain recurrences Address patient expectations about prognosis and implications for function Emphasis on self-management Advice about sleep and work Return-to-work plan

Abbreviation: STarT Back, Subgroups for Targeted Treatment Back Screening Tool.
**The initial clinical session for all groups included assessment of potential serious pathology (red flags); neurological examination (reflexes, sensation, and muscle power); symptom history, concerns, and treatment expectations; and a brief examination of back pain movements and a screen for hip pathology.*

to those subgroups. It is generally considered that subgroups must (1) be definable/identifiable, (2) have mutually exclusive categories, (3) have improved outcomes when treatments are applied according to subgroups, and (4) be simple to implement or have high benefit if implementation is more costly and/or complicated.[15]

Several methods to subgroup patients have been proposed. These emphasize the biological features of LBP, specifically physical features (eg, provocation or relief by specific movements), with varying degrees of validation and differences in underlying philosophy (**TABLE 2**). Treatment-based classification identifies individuals predicted to respond to 1 of 4 treatments.[13] Randomized clinical trials (RCTs) have shown that individuals allocated to a particular subgroup have better outcomes if they receive the aligned rather than the nonaligned treatment.[6] Mechanical Diagnosis and Therapy evaluates the response to repeated loading and uses this information to allocate patients to different subgroups.[46] Randomized clinical trials show better outcomes for matched treatments.[66] Movement system impairment proposes that pain is caused and maintained by suboptimal tissue loading from postures and movement patterns.[60] A recent RCT showed better outcomes with matched treatment than with general exercise.[70] Cognitive functional therapy began with identification of movement patterns in LBP[51] and has evolved to include increasing focus on behavioral psychology.[52] An RCT showed that treatments aligned to some subgroups are more effective than control interventions for specific presentations of LBP.[71] Motor control training involves individualization of treatment based on features identified in the assessment, using a clinical-reasoning approach.[27] Randomized clinical trials show that baseline clinical features can predict patients with greater response.[14,41,69]

Another biological feature used to subgroup patients involves identification of the underlying pain mechanism.[35,49,64,75] Despite some divergence in opinions, there is broad consensus that 3 primary mechanism classes underlie pain presentations: pain maintained by "nociceptive," "central," or "neuropathic" inputs. Key characteristics, presumed mechanisms, and potential differences in treatment are presented in **TABLE 3**. Although there may be overlap between pain classifications (eg, combined nociceptive and central sensitization mechanisms), most aim to identify the predominant mechanism.

Subgrouping approaches have also been proposed to consider differences in psychosocial features. These methods include subgrouping based on the West Haven-Yale Multidimensional Pain Inventory,[8,68] features such as fear avoidance and distress profiles,[3] and clusters based on latent class analysis.[57]

Limitations of Isolated Application of a Subgrouping Method From an optimistic perspective, the various subgrouping methods to assist clinical decision making regarding treatment planning provide movement toward treatment tailoring and away from the oversimplified view of LBP as a homogeneous condition. Numerous studies confirm that with sufficient training, clinicians can identify subgroups,[20] and some treatments are efficacious when matched to specific subgroups.[9] For example, for patients with pain provoked by postures/movements, tailoring treatment to modify specific features of posture/movement is effective.[71] Patients allocated to a subgroup respond better to a matched than to an unmatched intervention: the odds of a successful outcome among patients who were positive on a prediction rule and allocated the selected treatment were 60.8 (95% confidence interval [CI]: 5.2, 704.7) and only 2.4 (95% CI: 0.83, 6.9) for those who were negative on the prediction rule.[9] Patients who respond favorably to repeated loading respond better to matched than to unmatched intervention (standardized mean difference for reduction of back pain, 1.0; 95% CI: 0.6, 1.3).[66]

Yet, other studies show no benefit. Patients received no greater benefit from matched versus unmatched psychologically informed treatments.[3] From another perspective, stratification has reduced costs, but with small effect sizes. Thus, although subgrouping methods are identified as a research priority and several are promising, outcomes are not yet ideal for several reasons.

First, most methods fall short of consideration of the multidimensional nature of LBP. An increasingly diverse array of factors is linked to the development and persistence of pain. Many may be critical for LBP management but are not yet considered in subgrouping methods. Examples include sleep quality[67] and comorbidities.[19]

Second, and related to the first, most approaches are primarily monodimensional or place limited emphasis on issues outside the primary domain. Patients within a subgroup may be similar with respect to physical features of their presentation but differ in other domains (eg, psychosocial features, pain mechanism). For instance, patients in the treatment-based classification stabilization subgroup have fear-avoidance beliefs that range from very low to high.[32] Different treatment strategies may be required despite allocation to the same subgroup. This implies that patients require separate subgrouping for each domain. If subgroups are to be mutually exclusive, each combination would be a separate subgroup, multiplying the number of subgroups.

Third, a recent study that classified people according to multiple schemes observed that although some individuals are clearly aligned to the defined subgroups in a scheme, others are not because they have features of multiple groups.[30] For instance, overlap between subgroups is considerable when categorizing based on pain mechanism; features of central sensitization are common in most individuals with persistent pain, including those with nociceptive or neuropathic features. Perhaps it is neither possible nor necessary for groups to be mutually exclusive.

Fourth, although some subgroups have effective treatments (eg, directional

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TABLE 2 Subgrouping/Treatment Allocation Methods That Include Consideration of Movement

Approach	Foundation	Treatment Allocation/Subgroups
Motor control training[27,59]	Clinical-reasoning approach that aims to train optimal control (balance between movement and stiffness) of the lumbopelvic region, primarily for individuals considered to have pain with ongoing nociceptive input. Training uses motor learning principles to address motor control features related to suboptimal tissue loading	Allocation of treatment based on assessment of • Posture/alignment • Movement • Muscle activation Consideration of • Breathing/pelvic floor function • Sensory function • Adjacent joints • Psychosocial features • Strength/endurance/cardiovascular fitness
Treatment-based classification[13]	Aims to allocate patients to subgroups based on predicted response to treatments	Specific exercise • Flexion • Extension • Lateral shift/sidegliding Manipulation Stabilization Traction
Mechanical Diagnosis and Therapy[46]	Aims to determine whether symptoms can be abolished or reduced through application of direction-specific, repeated lumbar spine movements or sustained postures. Syndromes differ by hypothesized explanation for symptoms/development	Derangement syndrome • Central and symmetrical • Unilateral and proximal to knee • Unilateral and distal to knee Dysfunction syndrome • Flexion • Extension • Lateral shift/sidegliding • Adherent nerve root Postural syndrome Other • Stenosis • Hip • Sacroiliac joint • Mechanically inconclusive • Spondylolisthesis • Chronic pain state
Movement system impairment[60]	Aims to identify the direction of alignment, stress, or spinal movement that elicits or increases symptoms based on the kinesiopathologic model, which hypothesizes that precision of joint movement is altered by repeated movements and prolonged postures associated with daily activities	• Rotation with extension • Rotation with flexion • Rotation • Extension • Flexion
Cognitive functional therapy[51,52]	Aims to identify underlying mechanisms that are considered to drive pain. Differentiation between specific and nonspecific conditions is based on radiological evidence. Differentiation is made between central (central sensitization) and peripheral (mechanical) pain mechanisms. For those with a peripheral pain mechanism, the relationship to movement is identified. Identifies psychosocial and/or lifestyle factors that contribute	Specific versus nonspecific Peripheral versus central pain mechanism Control disorder (pain provocation) • Multidirectional • Flexion • Lateral shift • Active extension • Passive extension Movement disorder (pain avoidance) • Flexion • Extension • Flexion with rotation/sidebending • Extension with rotation/sidebending Pelvic girdle pain • Form closure • Force closure

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preference in Mechanical Diagnosis and Therapy[66]), others do not. Most methods include at least 1 subgroup with little guidance for treatment or poor prognosis.[30]

Taken together, these limitations suggest that a fresh approach is needed. A model of care for LBP based on a hybrid approach may be the solution.

Potential Benefit From Combining Approaches

The potential solution to many of these issues is to combine approaches into a single model of care. Some work has been done to this end, with some success. As an example, it is plausible that underlying pain mechanisms would influence the potential responsiveness to treatments that address movement/posture/muscle activation, as advocated by several subgrouping methods (**TABLE 2**). Movement-based treatments that aim to optimize tissue loading would be expected to have the most impact on pain maintained by an ongoing nociceptive input from suboptimal tissue loading. In contrast, when pain is maintained by central sensitization, there might still be gains from movement training—to provide healthy movement experience and to reinforce healthy behaviors—but specific modification of a movement/loading pattern would be less relevant. Thus, combined consideration of "motor control" and "pain mechanism" for treatment selection could improve treatment matching.

Preliminary evidence from 2 recent RCTs supports combined approaches.[41,71] In both trials, patients were managed with a movement-based approach to optimize tissue loading based on assessment, and both considered pain mechanism. One trial had a large effect (eg, improvement on the Oswestry Disability Index of 13.7 points; 95% CI: 11.4, 16.1 points) but only included patients with a clear relationship between pain and movements/postures.[71] The second trial did not select participants on the basis of pain mechanism, but baseline assessments were conducted for planned post hoc analysis of effect modification.[41] Although there was no difference in overall outcome between patients managed with tailored motor control training intervention and those

TABLE 3 Classification by Pain Mechanism

	Nociceptive	Neuropathic	Central/Central Sensitization
Definition[49,64,75]	Pain maintained by ongoing nociceptive input from the peripheral nociceptive neurons. May be provoked by mechanical loading (postures, movements, muscle activation), chemical, or thermal stimuli	Pain associated with a lesion or dysfunction of neural structures (central or peripheral)	Pain maintained by neurophysiological processes associated with amplification of neural signaling
Key features[64]	• Localized to a specific body region • Responds in a predictable manner to postures and movements • Provoked pain proportional to tissue loading • Usually intermittent and sharp	• History of nerve/neural injury or pathology • Pain provoked by movements and postures that compress/move/tension a nerve • Dermatomal distribution of pain • Pins and needles/numbness • Muscle weakness • Burning, shooting, electric-like pain	• Diffuse area of pain/tenderness • Inconsistent relationship to movement and postures • Intensity disproportionate to provoking posture/movement • Disproportionate to that expected from injury mechanism • Association with maladaptive psychological features
Questionnaires include	...	• painDETECT[16] • ID Pain[55] • LANSS[2] • Neuropathic Pain Scale • Neuropathic Pain Questionnaire[36] • DN4[5]	• Central Sensitization Inventory[45] Assessments for psychological features • DASS-21[39] • FABQ • PCS[65] • CES-D[58]
Clinical examination	• Subjective examination of pain features • Response to tests of movement and posture	• Subjective examination of pain features • Tests to confirm nerve/neural pathology • Nerve conduction tests • Imaging • Neurological examination: reflexes, sensation, muscle strength • Neurodynamic tests: assess loading of neural tissues and their relationship to postures and movements	• Subjective examination of pain features • Quantitative sensory testing • Temporal summation • Conditioned pain modulation • Pain thresholds • Nociceptive withdrawal reflexes

Abbreviations: CES-D, Center for Epidemiologic Studies-Depression Scale; DASS-21, 21-item Depression, Anxiety and Stress Scales; DN4, Douleur Neuropathique 4; FABQ, Fear-Avoidance Beliefs Questionnaire; LANSS, Leeds assessment of neuropathic symptoms and signs; PCS, Pain Catastrophizing Scale.

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managed with behavioral therapy (graded activity), when baseline features were considered, patients who scored high on a questionnaire regarding features that provoke and relieve pain responded better to motor control training, and those with a low score had a better outcome with graded activity.[41]

Taken together, these studies illustrate that a multicomponent (multistep) subgrouping approach might improve decision making and outcomes. Similar gains may be made from detailed assessment for individuals where it is warranted, based on other biological, psychological, and social features. Although one might argue that this consideration of multiple domains in treatment selection is simply good clinical reasoning, the alternative view is that formalizing the process into a model of care with structured decision steps would aid implementation, teaching, and consistency.

Proposed Model of Care Based on a Hybrid Subgrouping Approach

If no single approach provides the answers, one strategy would be to undertake a separate assessment of all domains and then disentangle the likely effective treatment plan. This is not feasible (in terms of time or resources), is unwarranted for many patients, and is too complex to implement. The alternative is to combine approaches into a stepwise model of care that includes an initial step to stratify individuals in order to allocate time and resources to those who are likely to require more intensive care (and simple care to the low-risk group), with several layers of assessment within the mid- and high-risk groups to provide more comprehensive decision making that combines features of multiple subgrouping methods in parallel and in series, and to guide treatment selection based on biological, psychological, and social features. The **FIGURE** presents such a proposed model of care to guide management of LBP.

Stratification to High, Medium, and Low Risk The first step involves identification of the risk profile to triage patients into low-, medium-, and high-risk groups. The STarT Back tool[23] provides an evidence-based model to undertake this step, although other options are available.[38]

Low-Risk Group: Treatment Path—Reassurance, Education, and Staying Active As advocated by the STarT Back tool, the low-risk group is managed with a brief intervention that includes advice and education to reassure patients that LBP is a "normal" part of life with a high likelihood of recovery (**TABLE 1**, **FIGURE**). Advice to stay/become active is provided, along with reinforcement of healthy behaviors. Care may be facilitated with the use of web resources tailored for this purpose, such as www.MyBackPain.org.au, which aims to empower individuals to make informed decisions about care and provides resources to engage in such aspects as pain coping skills training and treatment choices.

High-Risk Group: Treatment Path—Psychologically Informed Care Patients are allocated to the high-risk group based on psychosocial features that indicate unhealthy pain beliefs, attitudes, cognitions, and behaviors that must be addressed with treatment.[23] A comprehensive assessment of psychosocial features guides treatment (**TABLE 1**). Psychological treatments can include behavioral therapies (to modify behaviors), cognitive behavioral therapies (to address cognitions about pain), or acceptance-based therapies that encourage return to function despite pain.[72] Treatments have been specifically developed to address features such as fear avoidance,[21] pain coping skills,[1] and education regarding pain physiology/neurobiology.[47] Movement training would be relevant for this group as a component of physical activation to reinforce healthy behaviors, but with care regarding language to ensure that explanations do not contradict the objectives of the psychologically informed treatment (eg, "stabilize" and "protect" would reinforce the biomedical explanation for LBP). Consideration of pain mechanism (see following section) would inform whether nociceptive mechanisms remain relevant. In that case, modification of movement/posture/muscle activation may require consideration.

Medium-Risk Group—Detailed Assessment of Pain Mechanism to Guide Treatment Allocation to the medium-risk group indicates that detailed assessment is required to guide treatment. For this group, the potential benefits of hybrid subgrouping are most apparent. As a first step, clinical interpretation of the primary pain mechanism (nociceptive, neuropathic, or central sensitization) underlying the maintenance of pain is required (**TABLE 3**, **FIGURE**). This step provides guidance regarding which domains should be prioritized in assessment/treatment.

In the absence of a gold standard, the primary pain mechanism is identified based on clinical characteristics of pain. Work is progressing for tools to undertake this step.[49,64] Most advocate a combination of interview and questionnaires, with clinical examination of pain system function advocated by others (eg, quantitative sensory testing, temporal summation, conditioned pain modulation[18]). Questionnaires for identification of central sensitization[45] and neuropathic pain[16] have been developed. Although sensitive to detection of these pain mechanisms, they include questions related to features such as severity of pain that are not specific and are unlikely to aid differential diagnosis. This may explain the suspiciously high prevalence of neuropathic pain in some musculoskeletal conditions (eg, osteoarthritis[26]). The alternative interpretation is that these studies identify a group with more severe pain or features of central sensitization.

A difficulty with differentiation of pain mechanisms is that they overlap; for example, most individuals with prolonged nociceptive or neuropathic pain would have central sensitization. Thus, biologically, pain mechanism groupings are not mutually exclusive. This does not limit the utility of this approach; however, overlap between mechanisms would influence some elements of treatment selection.

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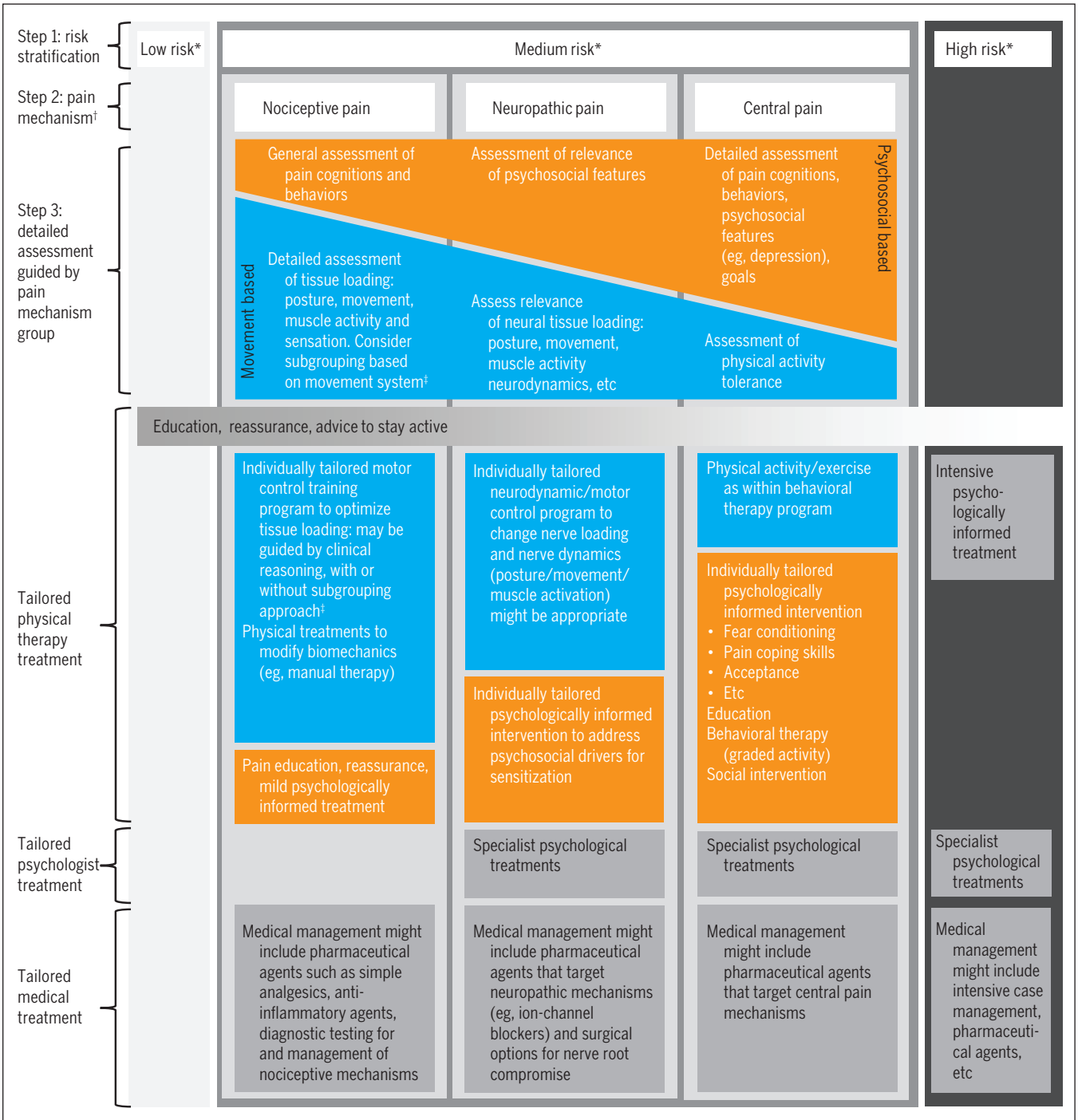

FIGURE. Proposed model of care for management of low back pain based on a hybrid of subgrouping methods. The initial step involves stratification/subgrouping using a risk prognosis method (eg, STarT Back). Treatments for low- and high-risk groups are implemented according to this allocation. For the medium-risk group, further assessment identifies the predominant pain mechanism to guide balance of movement versus psychosocial-based assessment and treatment selection. Treatments are tailored to the individual based on assessment. For each pain mechanism category within the medium-risk group, the suggested assessment and treatments are highlighted by their organization to columns under the pain mechanism title. The link between assessment and treatment is highlighted by use of similar colors. The relative bias toward assessments and treatments is indicated by the space allocated (eg, decreasing space allocated to assessment of movement when moving from nociceptive to central sensitization pain). Integration with medical and psychological management can also be guided by subgrouping. *Guidance for content of treatment allocated by risk group, with clear guidance for low- and high-risk groups, is presented in **TABLE 1**. †Suggested criteria for differentiation of pain mechanisms are presented in **TABLE 3**. ‡Possible methods for assessment and individualization of treatment based on motor control features are presented in **TABLE 2**. Abbreviation: STarT Back, Subgroups for Targeted Treatment Back Screening Tool.

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How could recognition of pain mechanism guide treatment selection? In a multidisciplinary framework, this information can guide allocation of treatments as diverse as pharmacological management (many drugs have effects that are specific to pain mechanisms[10]), psychological interventions (eg, fear conditioning, pain coping skills), tailored pain education, and physical interventions across a spectrum from general physical activity to individualized motor control training. As a general guide, treatments and assessments would have different biases for each pain mechanism group; for example, nociceptive pain would imply greater bias toward assessment of physical features, and central pain would imply a bias toward assessment in the psychological domain (**FIGURE**). **TABLE 1** includes consideration of management by medical and psychology disciplines to provide context for where their expertise may be most critical, as well as some suggestions for tailoring. This table is not intended to provide comprehensive guidance for these roles.

Central Sensitization When pain is primarily maintained by central sensitization, existing theory (and some evidence) argues for an approach biased toward psychologically informed treatments,[50] similar to that advocated for the high-risk group, to desensitize and activate the patient. Psychological features may regulate/moderate the biological processes that underlie central sensitization, but the mechanisms by which psychological management reduces sensitization are diverse. Psychologically based treatments may require involvement of a psychologist or physical therapist with training in this area. Movement training as an element of a behavioral intervention may be important to changing behavior and cognitions about pain (graded activity[40]). The goal in such an intervention may be to provide healthy movement experience and aid return of function. Attention to other lifestyle interventions, such as sleep hygiene, may be required. For medical management, certain classes of drugs are advocated[50] but may not be the only or best solution.

Nociceptive Pain There is considerable debate regarding the relevance of ongoing nociceptive input. There is not a one-to-one relationship between nociceptive input and pain[74]; this is not how pain is experienced. Pain is a product of the nervous system, generated based on all information received as well as other cognitive, emotional, and biological processes. It is well known that nociception is neither required nor sufficient to explain pain.[74] Yet, it is reasonable to expect that for at least some individuals with ongoing pain, the pain experience may be maintained by ongoing nociceptive input. This is not to say that pain can simply be relieved by removal of the nociceptive input, but that this is likely to be an important element of recovery in those individuals. Studies that have successfully reduced pain by application of local anesthetic provide some support,[17] but this must be considered with respect to the potential beneficial effects of simply "taking action" to relieve pain, which may explain the relief of pain from peripheral analgesia. Recent work shows that people report reduced pain despite no reduction of nociceptive input when they "take action" to protect that painful part (Bergen et al 2018, unpublished data). If a nociceptive element is presumed (**TABLE 3**), then a detailed assessment of how the person uses his or her body and how this affects the pain experience is likely to be required to identify relevant movement/posture/muscle activity. Psychological features also require consideration, but generally with less emphasis (**FIGURE**).

The identification of suboptimal tissue loading strategies is likely to be most relevant to individuals in the medium-risk group with nociceptive pain. An underlying assumption of motor control approaches is that pain is maintained by ongoing nociceptive input from loading of tissues[27] (other than neural tissue; see below). This would be expected to be highly individual. As such, patients would require detailed assessment of how they use their body to identify features of motor control that might be related to suboptimal tissue loading. Comprehensive assessment would require consideration of movement/posture/muscle activation.[27] As discussed above, multiple schemes aid this assessment (**TABLE 2** presents several options; it is not the intention of this commentary to recommend one over another, but there may be value to drawing principles from several approaches because an individual may present in a manner that suits one approach more than another[30]). It is at this point that it makes sense to consider movement-based subgrouping and clinical-reasoning methods to aid the identification of relevant motor control features to target treatment.

Each movement-based subgrouping approach involves patient interviews and a series of specific postural assessments and movement tests to identify the features that provoke and relieve symptoms.[22,31] As described above, each approach has a different foundation and applies a different method to identify the features that are considered relevant for the clinical presentation and may become the targets for treatment (**TABLE 2**). There is convergence and divergence between approaches.[22] In brief, most include a component of cognitive modification of movement/posture/muscle activation, with differing emphasis, to modify the strategy of tissue loading (**TABLE 2**). Some suggest passive treatments[9] or repeated movements,[66] whereas others have a stronger bias to optimize posture/movement/muscle activation.[27] As yet, there is no clear basis to use one method over another. A recent review suggests that an approach that combines schemes is likely to be helpful, as some patients cannot be clearly categorized within one scheme or fail to respond as expected to the aligned treatment.[30]

Ultimately, the choice of a subgrouping or clinical-reasoning model depends on the skills, training, and preference of the clinician and the preference of the patient. Ideally, clinicians would have experience with multiple systems so that

they would possess the flexibility to adapt the assessment and training to match the individual.

As mentioned above, many individuals allocated to the primary nociceptive pain group will also present with some signs of central sensitization or neuropathic mechanisms. In those cases, consideration of features such as psychological elements may be required, as described earlier.

Neuropathic Pain For individuals presumed to have pain maintained by ongoing neuropathic mechanisms, treatment selection can be multifactorial and requires a balanced consideration of physical and psychological features (**FIGURE**). As with individuals with central sensitization, psychological/education interventions aimed at desensitization would be helpful. This approach might be combined with pharmacological management.[50] Training of posture/movement/muscle activation may be relevant for individuals with peripheral neuropathic pain, where pain is provoked by nerve loading. Neurodynamic assessment may reveal specific features to address and guide treatment selection.[7]

Critical Appraisal of a Hybrid Model of Care

The proposed hybrid approach combines several subgrouping methods for treatment selection using a method that applies them in a stepwise manner (eg, identify risk; if allocated to the medium-risk group, then identify the underlying pain mechanism; if allocated to the nociceptive pain group, then identify the "movement" subgroup). Although the hybrid approach is logical and evidence has been presented for some of its components, it cannot be assumed to be more effective than standard care or the separate application of any of its combined approaches. High-quality RCTs are required to test the model. This could take several forms, such as a head-to-head comparison of the hybrid model of care versus 1 element of the approach or versus standard care. Alternatively, it could involve a complex design that compares approaches of differing levels of complexity.

Further development is required to refine and validate differential diagnosis of primary pain mechanisms. The final model might include a combination of clinical pain features, psychological features, quantitative sensory testing, and response to a simple physical examination (eg, movement or posture).

There may be value gained from further refinement and, perhaps, hybridization of the subgrouping and clinical-reasoning models for identification of loading features related to pain presentation. Likewise, refinement of optimal methods for modification of motor control is needed. A major issue in any exercise intervention is adherence to training. Use of behavior-change methodology is likely to be required, but this involves training of clinicians and development of tools for assessment of individual needs to adopt a behavior, as well as methods to address them.

The potential implications for health service utilization and workforce issues require consideration. A major intention of the model is to allocate more comprehensive services to those who need them, thus avoiding overtreatment of individuals who can be treated with a less intensive approach. Costs savings would be predicted based on previous data[25] but require evaluation. For the workforce, the major implication is adequate training to implement the steps in assessment and treatment and the opportunity for interdisciplinary involvement, as required and recommended by the model.

CONCLUSION

This commentary aimed to bring together several contemporary models that have been devised and applied to simplify the task of decision making in the management of LBP. Rather than advocate for a single approach, the purpose of this paper was to highlight the logic behind stepwise application of several methods to identify patients who would benefit from approaches targeted to different domains. Critically, the approach highlights the path of decision making that would lead to the decision to apply a movement-based approach.

Each method combined into the hybrid model has pros and cons, and this model of care has been developed in an attempt to take advantage of the most promising aspects of each and combine them into a model that guides allocation of more comprehensive management to patients who need it the most, followed by guidance related to priorities for assessment and management. The proposed model addresses key issues that challenge existing methods, such as the allocation of time-consuming comprehensive care that would not be feasible (and would probably be unnecessary) to apply to all, examines mechanisms to consider multidimensional aspects of presentation and non–mutually exclusive groups, and provides balanced consideration of the biological and psychosocial aspects of an individual's presentation. There appears to be sufficient foundation to consider testing such a model of care.

ACKNOWLEDGMENTS: *The forum on which this body of research was based, "State-of-the-Art in Motor Control and Low Back Pain: International Clinical and Research Expert Forum," was supported by the National Health and Medical Research Council of Australia, in collaboration with the North American Spine Society. The forum was chaired by Dr Paul Hodges.*

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