

APPENDIX: Statements gaining consensus from Delphi study of experienced and expert clinicians

Table 1		Assessment & management of rowing-related low back pain – statements gaining consensus for each phase of recovery			
		M		SD	
		R2	R3	R2	R3
Initial Triage – first presentation					
Assess	The acute assessment of a rower with low back pain can be performed by a Physiotherapist or Doctor experienced with seeing rowers.	8.9	9.5	1.7	0.8
	The rower should be questioned to establish the type of pain presentation to classify into; non-specific somatic pain with/without somatic referral and/or radicular pain with/without radiculopathy and/or inflammatory pain and/or atypical pain presentation that needs red flag exclusion.	9.3	9.4	1.5	1.6
	The rower should be questioned to determine the history of this episode, past history, pain intensity & quality, pain behaviour & 24 hr picture, aggravating & easing factors, other symptoms such as changes in sensation, motor control and bladder & bowel function.	9.7	10.0	0.9	0.0
	When the athlete first presents it is important to understand their previous low back pain history.	9.5	10.0	0.8	0.0
	At the time of initial triage the therapist must understand how the rower's sleep is disturbed due to their low back pain.	8.3	8.6	1.4	1.4
	Establish the occurrence of pain during activities of everyday living including sitting, standing, walking & night pain.	9.1	9.8	1.8	0.6
	Establish risk factors including previous episode of similar pain, technical issues in boat, change of water conditions or seat position, change in training load, gym load, cross training load, increased rowing training age and time at this level of rowing.	9.0	9.6	1.6	0.9
	Red flags include cauda equina signs, peripheral neurological signs or systemic cancer signs such as weight loss, night pain & sweats.	9.8	10.0	0.6	0.0
	Yellow flags include catastrophising, increased anxiety, significant upcoming performance event, life stressors or known mental health disease.	8.1	9.5	2.2	0.8
	I assess every new presentation of low back pain for neural compromise & seek this clinical sign to assist in early referral.	9.2	8.8	1.2	2.9
	A management aim for the rower presenting with neurological dysfunction is to investigate this thoroughly & treat to restore.	8.5	9.3	2.0	1.3
	Test reflexes, strength & sensation of the lower limb when radicular pain and/or sensory change and/or strength change is reported.	9.0	9.7	2.3	0.6
	How the athlete is moving during activities of everyday life, such as sit to stand & walking, need to be assessed at initial triage.	8.8	9.5	1.3	0.9
	Pain responses to active lumbar spine motion need to be assessed.	9.0	9.8	1.0	0.4
	The primary management focus at initial triage is to gain early & effective pain relief.	8.2	8.1	1.6	1.6
	Manual therapies are an appropriate early intervention in the triage stage of low back pain in rowers.	6.8	7.3	2.1	1.8
	At initial triage a management aim should be to restore function for activities of daily living.	7.8	8.6	1.8	1.3
	A rower that presents on the first occasion with severe low back pain should be removed from on water and ergometer rowing.	7.7	8.4	2.3	1.9
	Move	If the rower is able to sit without pain, they can start stationary bike riding. If unable to sit, the rower should to remain active e.g. walking.	7.2	7.6	1.9
The rower should be encouraged to walk. The duration & whether to include hills & steps will be dictated by the severity of symptoms.		7.1	7.7	2.5	1.4
If a rower is able to row on water and/or on the ergometer without pain or muscle guarding, they should be allowed to do so.		7.6	8.3	2.2	1.7
Educate	The rower should be educated & re-assured about their presenting low back condition, it is especially relevant to alleviate fears.	8.2	8.9	1.7	1.0
	Medical staff should begin conversations about identified 'yellow flags' including stress & its effect on pain.	7.3	8.1	1.9	1.4
	In the initial triage the rower should be educated about the injury & included in the decision making of the initial plan.	9.2	10.0	1.0	0.0
	A rower should be encouraged to see a psychologist if they have a regular person they interact with or if there is a specific need.	6.8	7.5	2.4	1.3
	It is important to manage a coach and athlete's expectations at the initial triage.	9.3	9.9	1.0	0.3
It is important to involve the coach from the outset & allow them to contribute their ideas about why the injury may have occurred.	8.3	8.2	1.6	1.2	
Acute Phase – first week of pain					
Assess	The response to rest and activity modification are important indicators of prognosis over the first week.	8.5	9.1	1.4	1.0
	Improvement of symptoms experienced in everyday life are considered good indicators for prognosis in the first week.	7.8	9.1	1.2	0.7
	A good sign of recovery is a rower expressing confidence in the improvement of their low back pain & function in the first week.	8.3	8.5	1.1	1.1
	Over the first week of presentation the therapist should continue to monitor the rowers sitting tolerance.	8.3	7.5	1.5	1.7
	Over the first week of presentation, monitoring pain response to lumbar range of motion is an important indicator of progress.	7.8	7.7	1.2	1.1
	The therapist should continue to monitor the rower's ability to complete their usual activities of daily living.	8.8	9.5	1.2	0.7
	Rowing specific ranges must be assessed, specifically hip flexion & hamstring range that can affect how the pelvis & low back moves in the boat.	8.1	8.4	1.9	1.9
	Improvement towards rowing specific range of motion is desirable.				
	In the initial week of management control of pain continues to be a management focus.	8.6	9.2	1.1	1.0
	The use of manual therapies, such as Physiotherapy or soft tissue treatment in the region is appropriate.	8.5	8.6	1.5	1.6
Manage	Focus on re-establishing normative movement, rowing specific range of motion & progression towards spinal load requirements for rowing.	7.8	8.3	1.7	1.6
	The acute phase is the time to commence a functional exercise rehabilitation program.	7.0	7.9	2.3	1.6
	In the initial week, management focus should be on what the rower can do to maintain fitness but not exacerbate low back pain.	8.7	9.5	1.1	0.8
	Continuation or graduation of cardiovascular training program within limits of injury.	8.9	9.9	1.1	0.3
Exercise	During the first week, as the rower can tolerate sitting, stationary bike training can commence.	8.6	9.1	1.1	0.9
	During the first week the rower can be encouraged to swim or perform exercises in the water.	8.0	8.5	1.3	1.1
	During the first week the rower can use walking as a form of training & add hills & stairs to increase the training intensity.	7.8	8.8	1.3	0.6
Educate	A cross-training alternative is elliptical training, especially if sitting is not being tolerated. As sitting is tolerated, stationary bike can commence.	7.1	8.1	1.3	0.5
	If a successful rowing ergometer trial is conducted, the rower can progress to a short duration on water row of less than 10km.	7.1	7.5	1.3	1.0
	Rower should be involved in treatment planning, they should be empowered to assist in guided decision making & educated about their injury.	7.8	9.1	2.6	1.0
	Yellow flags include; stressors in life or sport, poor sleep, fear avoidance, pressure from coach / selection / upcoming performance.	8.1	9.0	1.3	0.9
	Yellow flags include a stress response to injury which may manifest as poor sleep, lowered mood or fear avoidance behaviours.	8.0	8.5	1.2	0.9
Strategies for controlling stress include; use of psychology services, coach support, using mindfulness techniques or family & friends support.	7.3	8.5	1.5	0.5	
Sub-Acute Phase – return to rowing					
Assess	No pain during activities of daily living & no pain with other cross training modalities are good signs of progression.	8.3	9.5	1.4	0.7
	A reduction in morning stiffness is a good sign of progression.	7.3	8.1	1.1	0.9
	A reduction in medication along with reducing symptoms is a good sign of progression.	8.4	8.9	1.1	1.1
	Red flags should continue to be monitored for in this phase & should raise the concern for non-musculoskeletal diagnoses.	8.6	8.8	2.0	1.8
	Low levels of pain during rowing, pain that is not getting worse when rowing & no pain after rowing are good indicators of progression.	8.7	9.0	1.2	0.9
	A good sign is a rower who rates themselves as being confident to progress & heading progressively towards 100% recovery.	7.1	8.6	2.7	0.9
	Continued re-assessment of significant objective findings should occur throughout the sub-acute phase.	8.4	9.2	1.7	1.2
	When considering return to rowing, the motion of the hamstrings & hip & the ability to sit & load the lumbar spine should be assessed.	8.2	9.5	1.5	0.7
	Trailing an ergometer row & assessing the response should be completed before returning the rower to training.	7.6	8.2	1.6	1.3

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	A trial on water row should be completed before scheduling a return to rowing training.	7.8	8.9	1.5	0.9
	When the rower begins to return to the boat, tolerance to sitting should continue to be monitored.	8.4	8.8	1.7	1.4
	When the rower returns to the boat, pain in activities of daily living should continue to be monitored.	8.5	8.7	1.2	0.9
	When the rower returns to the boat, pain when rowing should be well understood and continually monitored.	8.9	9.5	1.0	1.0
Manage	As soon as athlete is able to row without pain & with their normal movement patterns they should be returned to on water rowing.	7.2	8.5	2.6	0.7
	Biomechanical assessment & technical coaching is an important part of the return to rowing phase for an athlete with low back pain.	7.7	8.7	1.6	1.3
	In the initial return to rowing phase, technical issues that are likely contributing risk factors for low back pain should be addressed.	8.5	9.5	1.6	0.8
	When considering a return to on water training, the management aims need to include restoration of rowing specific range of motion.	8.6	9.4	1.2	1.0
	When considering a return to on water training, the management aims need to consider the ability of the spine to be loaded.	9.0	9.7	1.2	0.6
	Maintenance or improvement of mobility is a key component of the return to rowing phase.	7.8	8.6	1.5	1.2
	Management must focus on a return to rowing protocol with a gradual re-loading program agreed on by the rower, medical and coaching staff.	9.3	9.7	1.1	0.6
	When prescribing return to row consider: 8-10km in single ≠ 8-10km in eight, stability of boat returning to & weather. Set athlete up for success.	8.6	9.7	3.2	0.5
	In the initial return to rowing phase, medical staff should work closely with coaches to plan load progressions and monitor actual load.	7.9	10.0	0.9	0.0
	A Medical Practitioner's involvement is often necessary in the return to rowing phase of rehabilitation from low back pain.	9.0	9.7	1.7	1.7
Training	On water & rowing ergometer should progressively increase in intensity & time as pain allows. Prioritise building on water rowing first.	7.7	8.1	1.7	1.5
	The rowing ergometer should be used when the water is rough or the weather is not conducive to on water rowing.	7.1	7.0	2.5	0.6
	As sitting tolerance increases, as can time on a stationary or road bike. The bike can be used to 'top up' training load at the end of a rowing session.	8.5	9.3	1.2	0.8
	If pain with sitting persists, the use of upright exercise for training can be considered; elliptical training, running, hill walking and/or ski ergometer.	7.2	7.8	2.6	1.3
	Swimming can be used as a form of increasing training load. Care to not increase shoulder load quickly as this may contribute to shoulder injury.	8.1	8.1	1.1	0.5
	Involvement of a strength & conditioning coach in the rehabilitation phase of the rower with low back pain is important.	7.3	7.5	1.7	1.4
	Tolerance of land based training is important in this phase.	7.8	8.0	1.0	0.8
	Strength, gym & core muscular training are essential parts of the sub-acute management of the rower with low back pain.	7.1	8.3	1.8	1.8
	Exercises should be prescribed to ensure appropriate movement control, stability and strength is gained for performance of the rowing stroke.	8.7	9.1	1.8	1.0
	Medical staff & strength & conditioning staff shoulder work together to construct an appropriate program of exercises individual to the rower.	9.1	9.7	1.1	0.6
Educate	Yellow flags are important to recognise & monitor e.g. fear avoidance behaviour & catastrophising - they may be heightened at competition time.	8.3	9.4	1.4	0.8
	It is important for the rower to avoid developing a fear of specific movement patterns. A cognitive functional therapy approach or a confidence with movement approach can be helpful. Splinting or overprotective movements should be discouraged.	7.8	8.2	2.0	1.8
	If a rowers has access psychological services, this should be continued through the sub-acute phase.	7.0	7.2	1.3	1.1
	If a rower is finding it difficult to cope or their progression is not as expected, psychological consultation may be considered.	7.9	8.5	1.4	1.1
	The return to rowing phase must include self-management advice & self-empowerment for the rower with low back pain.	8.3	9.3	1.2	0.8
Rehabilitation Phase – return to normal training load					
Assess	It is important to continue to re-assess significant findings throughout the return to rowing period.	8.9	9.1	1.1	1.2
	When the rower has returned to rowing, their everyday life pain should also be monitored, especially pain immediately after rowing.	8.7	9.1	1.4	0.9
	When the rower is increasing their rowing load it is important to review them & ensure their main objective findings are continuing to improve.	8.6	9.2	1.2	1.0
	Being able to row with no pain or no increase in symptoms is essential for progressing training load.	7.7	8.3	2.6	2.0
	Rowing with quality movement patterns, achieving usual power & tolerating different stroke pressures and rates are very good signs of recovery.	8.7	9.8	1.3	0.4
	Tolerating changing water conditions, changes in rowing rate & change in seating in the boat are all good indications of recovery.	8.8	9.4	1.2	0.8
	The response to progressively increasing rowing & ergometer work load should be continually monitored.	8.8	9.5	1.0	0.7
	Athletes with red flags should not be progressed to this stage.	9.1	9.9	1.4	0.3
	Yellow flags may also be a recurrent history of failing to progress & having symptoms in excess of the clinical presentation.	7.0	8.6	1.3	0.9
	Medical staff should communicate with the coach about management expectations & address risk factors for low back pain the rower.	9.4	9.5	0.7	0.5
Manage	Coaches' observations should be integrated in the rehabilitation stage.	9.1	9.1	1.0	0.8
	Ensuring the athlete & coach are working on causative factors for the specific incidence of low back pain is imperative at this stage.	8.8	9.1	1.4	1.4
	Emphasis should be placed on restoring the rower's usual biomechanics & addressing risk factors identified to prevent re-occurrence.	8.8	9.7	1.3	0.5
	In the final phase I always ensure the rower has corrected any identified movement or strength deficiencies.	8.1	8.5	1.8	1.5
	A key component of the rehabilitation of a rower is the graduation of an individualised strength & mobility program.	8.4	9.1	1.4	0.9
	The creation of a maintenance exercise & mobility program is essential for rowers in the final phase of rehabilitation.	7.8	8.6	1.6	1.2
	Work with coaching staff to ensure the rehabilitation program translates into on water and gym changes to protect from further injury.	8.6	8.6	1.0	0.7
	A strength & conditioning coach is an important contributor to the final rehabilitation phase of low back pain in rowers.	7.5	7.8	1.3	1.0
	A return to full training should include a planned program of increasing distance & intensity on the water as well as progressive increases in ergometer rowing, cross training & strength & conditioning work.	8.8	9.5	1.5	1.2
	Gradually build on water volume & intensity, based on pain response, up to full training load. Time to do this is individual & based on the severity of the initial injury & the improvement in the individual's condition over time.	9.1	10.0	1.3	0.0
Training load	The priority in a return to rowing program should always be on water training. The ergometer may need to be used due to weather conditions.	8.5	8.9	1.4	0.9
	The return to rowing program should be agreed upon by both medical & coaching staff. A clear schedule should be set out that can be adjusted as the response to increasing on water and/or ergometer time is assessed.	8.8	9.8	1.3	0.4
	During a return to full training, less cross training is performed as more on water & rowing ergometer training is completed.	8.4	9.0	2.2	0.6
	The stationary bike or road bike can be used to 'top up' training load as on water and ergometer rowing are increasing.	8.8	8.8	1.3	0.9
	Converse with the coach or observe on water training to ensure the rower is returning to normal movement patterns & force production.	8.9	8.8	0.9	0.9
	Strength & conditioning training can be introduced but high loads should be avoided until a full on-water training load has been achieved.	7.4	8.8	2.4	1.3
	Strength & conditioning sessions should progressively introduce more loaded exercises & progress towards a rower's usual program.	8.2	9.5	2.7	0.7
	The medical and strength & conditioning staff should work together to return the rower to their usual strength & conditioning program.	8.5	9.2	2.7	0.6
	Ensure an athlete centred & coach supported approach. It is important that the athlete does not become dependent on medical staff for specific	8.2	9.5	2.8	1.2
	Continued use of a sports psychologist if the rower believes this is beneficial or the medical staff believe this could provide ongoing support.	7.7	8.1	1.2	0.9
Educate	Encourage discussion regarding athlete self-management during the rehabilitation phase.	9.2	10.0	0.8	0.0
	Continual education, re-assurance & explanation should occur throughout the return to rowing phase.	8.2	8.8	1.5	0.9

R = round, M = Mean, SD = Standard Deviation, Mo = Mode

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Box 1 Important considerations – novel response statements gaining consensus
Creating a culture of early recognition and management of low back pain in the training environment optimises management and improves learning and performance. (M: R2 8.8, R3 9.5, SD: R2 2.5, R3 1.9)
Identifying radicular pain early (with or without sensory and/or motor change) is essential and management must involve medical assessment as soon as possible. (M: R2 9.0, R2 9.5, SD: R2 1.9, R3 1.3)
There are gender differences in the causal factors for low back pain in rowers - males are at risk due to reduced hip flexion, females are at risk due to reduced trunk strength. (M: R2 6.1, R3 7.2, SD: R2 2.5, R3 1.9)

M = Mean, R = round, SD = Standard Deviation

Table 2		M		SD	
Assessment of rowing-related low back pain – statements gaining consensus relating to all phases of recovery		R 2	R 3	R 2	R 3
Imaging					
Imaging is not required nor recommended as a routine part of the rehabilitation process.		6.6	9.2	3.1	1.0
Risk Factors					
Training load is a key factor to understand to determine if it contributed to the development of low back pain in the rower. A steep increase in training load or a reduction in load followed by an increase in load are specific risk factors that should be understood.		9.0	9.7	1.1	0.6
Psychological stress is a key factor to understand early in the assessment process, this may include; fear of movement, selection pressure, worry about having low back pain for first time, worry about a subsequent episode of low back pain & increased stress related to being close to a key event.		6.9	7.6	1.6	1.2
Technique (e.g. posture) or technical (e.g. boat set-up) issues are key factors to address during rehabilitation.		8.0	9.1	1.8	0.7
Of the following specific risk factors, rate your agreement with each as a risk factor for rowing-related low back pain;					
Training	change to training intensity (e.g. increase in power strokes or athlete training outside prescribed or intended training zone)	8.2	8.5	1.2	1.2
	illness or another injury prior to this injury causing a reduced training load	7.9	8.5	1.3	0.5
	ability to complete high level of training volume over a longer period of time (3months is protective for injury)	7.9	8.1	1.2	0.9
On-water	having a young training age	6.8	7.4	1.1	1.4
	changes in crew increasing load on injured rower	6.8	7.1	1.3	1.7
	recent change in boat set up	7.0	7.0	1.8	1.2
Physical & movement	rough water	7.2	7.5	1.7	1.0
	increased lumbar flexion range during rowing	7.5	7.3	1.6	1.6
	getting to end of range lumbar flexion during rowing	7.5	7.1	2.0	1.8
	reduced hip flexibility <130degrees	7.1	8.7	2.1	0.9
	reduced hamstring flexibility	7.2	7.6	1.9	1.8
	hip motion & hamstring flexibility once pain reduced (may not be accurate indication in the presence of pain)	7.3	7.1	1.5	1.1
	reduced knee flexion range	6.4	7.2	2.0	1.5
	reduced posterior chain endurance (erector spinae thoracic and lumbar)	7.7	8.5	1.4	0.8
	reduced abdominal endurance	7.5	7.2	1.7	2.0
	muscular control of deep squat	7.2	7.3	1.5	1.4
Other	control deficits when lifting weights	7.7	7.4	1.2	0.8
	previous history of low back pain	9.5	10.0	0.8	0.0
	>30min on ergometer during one session	6.6	7.0	2.7	2.0
	poor nutrition or reduced energy intake	7.3	7.4	1.7	1.1
	poor sleep habits	7.1	7.5	1.7	1.6
Outcome Measures					
Using outcome measures or scales is important for analysing the severity of a rower's pain and/or disability & being able to monitor this over time.		6.5	7.5	2.2	1.4
Consider specific outcome measure, rate how useful when managing a rower with low back pain (1=useful, 2=undecided, 3=not useful)		R2 Mo		R3 Mo	
Visual / verbal analogue scale /10		1		1	
Patient Specific Functional Scale		1		1	
Orebro Musculoskeletal Pain Screening Questionnaire		2		1	
A simple function specific question - e.g. is the pain great enough to stop you rowing?		1		1	

R = round, M = Mean, SD = Standard Deviation, Mo = Mode

Table 3		M		SD	
Specific rowing-related low back pain considerations for developing and masters rowers – statements gaining consensus		R 2	R 3	R 2	R 3
Developing Rowers					
A priority in the management of the developing rower with low back pain is the engagement of their parents & coach.		9.2	9.5	0.8	0.5
A priority in the management of the developing rower in the subacute phase is education about their injury.		9.1	9.6	0.8	0.5
A key for understanding for successful management is understanding the rower's rate of growth & flexibility as contributing factors.		8.5	9.2	1.4	1.3
I have a more conservative rehabilitation plan for developing rower than elite rowers throughout their management and rehabilitation.		8.2	8.5	1.3	1.4
Masters Rowers					
I prioritise the assessment of medical co-morbidities in a masters rower when compared to an elite.		6.9	8.3	2.7	1.0
Some biomechanical & movement restrictions may not be amenable to change due to underlying degenerative processes & should be assessed & accommodated as part of the rehabilitation program.		7.9	8.8	2.2	1.3

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