# Appendix tables:

*Table 2- Validation in the axis of demographic information and clinical and psychological history*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Main category | Num | Data elements | Mean | % |
| Demographic information |  | Name | 4.69 | 91.78 |
|  | National code | 4.74 | 91.78 |
|  | Age | 5.01 | 98.33 |
|  | Gender | 4.98 | 98.37 |
|  | BMI | 4.84 | 96.70 |
|  | Education | 4.78 | 91.70 |
|  | Job | 4.90 | 95.08 |
| Clinical and psychological history |  | Reason for referral and complaint | 4.96 | 96.79 |
|  | Signs and symptoms of the disease based on the patient's statements | 4.78 | 93.38 |
|  | Duration of pain (less than two weeks - more than two weeks) | 4.95 | 95.02 |
|  | Intensity of pain (0-10) | 5.01 | 98.35 |
|  | The progression of the pain (pain has become very severe - the pain has become relatively intense - the pain has remained unchanged - the pain has improved a little - the pain has improved relatively) | 4.99 | 98.32 |
|  | What were you doing when you first noticed the symptoms? (Rest – Walking – Driving – Stairs – Pulling or pushing a thing – Lifting an object – Exercise – Other) | 4.87 | 95.08 |
|  | What condition aggravates your symptoms? (Stairs - Driving - Lifting off the shelf - Exercise - Other) | 4.83 | 95.07 |
|  | What condition helps to alleviate the symptoms? (Relaxing - bending...) | 4.94 | 95.05 |
|  | Treatments carried out (exercise exercises - surgical interventions - manual therapies - drug treatments - other therapeutic approaches to physiotherapy - no treatment) | 4.93 | 95.04 |
|  | Is the patient able to carry out daily tasks? (Almost - but not quite) | 4.93 | 96.77 |
|  | Is the patient able to execute work-related tasks? (Almost, but not quite.) | 4.78 | 93.39 |
|  | Depression | 4.91 | 95.08 |
|  | Anxiety | 4.96 | 96.75 |
|  | Distress | 4.89 | 96.71 |
|  | Sleep problems | 4.97 | 95.04 |
|  | Abuse, both sexual and physical | 4.88 | 95.05 |
|  | Additional mental health conditions | 4.78 | 93.35 |
| Total Mean | | | **4.90** | **95.33** |

*Table 3- The results of validation in the axes of Clinical content for teaching diagnosis, treatment, and sports exercises*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Main category | Subcategory | Num | Data elements | Mean | % |
| Back pain red flags | Intervertebral disc | 1 | Centralization of symptoms | 4.63 | 91.76 |
| Sacroiliac joint | 2 | No centralization of symptoms | 4.33 | 85.03 |
| 3 | Dominant pain in the SIJ without the tuber area | 3.88 | 76.80 |
| 4 | 3 positives out of 5 physical examination findings: distraction, compression, thigh thrust, Gaenslen test, sacral thrust | 4.79 | 93.31 |
| Disc herniation with nerve root involvement | 5 | Straight leg raises test positive for referred leg pain | 4.65 | 91.77 |
| 6 | 3 positives out of 4 history or physical examination findings: Dermatomal pain location in concordance with a nerve root, and corresponding sensory deficits, reflexes, and motor weakness | 4.86 | 96.74 |
| 7 | Supplementary physical examination findings: Crossed straight leg raise test positive, then disc herniation with nerve root involvement | 4.84 | 95.03 |
| Spinal stenosis | 8 | 3 positive out of 5 history findings: age more than 48 years. Bilateral symptoms, leg pain more than back pain, pain during walking/standing, or pain relief upon sitting | 4.37 | 86.70 |
| 9 | Supplementary physical examination finding: improved walking tolerance with the spine in flexion or relief by forward bending | 4.83 | 95.03 |
| Spondylolisthesis | 10 | Intervertebral slip by inspection or palpation | 4.81 | 95.04 |
| 11 | Segmental hypermobility by use of manual passive physiological intervention motion test | 4.40 | 88.39 |
| 12 | Supplementary physical examination findings in the elderly spondylolisthesis | 4.78 | 93.34 |
| 13 | Supplementary physical examination finding: improved walking tolerance with the spine in flexion or relief by forward bending | 4.61 | 91.77 |
| Cauda equina syndrome | 14 | Severe or progressive bilateral neurological deficit of the legs, such as major motor weakness with knee extension, ankle eversion, or foot dorsiflexion. | 4.80 | 95.01 |
| 15 | Recent-onset urinary retention (caused by bladder distension because the sensation of fullness is lost) and/or urinary incontinence (caused by loss of sensation when passing urine). | 4.86 | 95.03 |
| 16 | Recent-onset faecal incontinence (due to loss of sensation of rectal fullness). | 4.71 | 93.33 |
| 17 | Perianal or perineal sensory loss (saddle anesthesia or paresthesia). | 4.71 | 93.33 |
| 18 | Unexpected laxity of the anal sphincter. | 4.80 | 95.09 |
| Spinal fracture | 19 | Sudden onset of severe central spinal pain, which is relieved by lying down. | 4.90 | 98.30 |
| 20 | A history of major trauma (such as a road traffic collision or fall from a height), minor trauma, or even just strenuous lifting in people with osteoporosis or those who use corticosteroids. | 4.72 | 93.35 |
| 21 | Structural deformity of the spine (such as a step from one vertebra to an adjacent vertebra) may be present. | 4.88 | 96.72 |
| 22 | There may be a point of tenderness over a vertebral body. | 4.63 | 91.72 |
| Cancer | 23 | The person is 50 years of age or older. | 4.42 | 88.35 |
| 24 | Gradual onset of symptoms. | 4.87 | 95.02 |
| 25 | Severe unremitting pain that remains when the person is supine, aching night pain that prevents or disturbs sleep, pain aggravated by straining (for example, at stool, or when coughing or sneezing), and thoracic pain. | 4.44 | 88.39 |
| 26 | Localized spinal tenderness. | 4.68 | 91.73 |
| 27 | No symptomatic improvement after four to six weeks of conservative low back pain therapy. | 4.67 | 91.74 |
| 28 | Unexplained weight loss. | 4.65 | 91.79 |
| 29 | History of cancer — breast, lung, gastrointestinal, prostate, renal, and thyroid cancers are more likely to metastasize to the spine. | 4.73 | 93.39 |
| Infection | 30 | Fever | 4.75 | 93.39 |
| 31 | Tuberculosis, or a recent urinary tract infection. | 4.67 | 91.76 |
| 32 | Diabetes | 4.33 | 86.79 |
| 33 | History of intravenous drug use | 4.67 | 91.72 |
| 34 | HIV infection, use of immunosuppressants, or the person is otherwise immunocompromised | 4.78 | 93.35 |
| Neck pain red flags | GENERAL | 1 | Fever | 4.74 | 93.30 |
| 2 | Generalized neck stiffness | 4.82 | 95.08 |
| 3 | Lymphadenopathy | 4.82 | 95.05 |
| 4 | Nausea or vomiting | 4.89 | 95.00 |
| 5 | Pain that is increasing, is unremitting, or disturbs sleep | 4.61 | 91.73 |
| 6 | Severe neck tenderness | 4.65 | 91.74 |
| 7 | Skin erythema, wounds, or exudate | 4.68 | 91.74 |
| 8 | Unexplained weight loss | 4.73 | 93.38 |
| 9 | Altered cognitive status | 4.65 | 91.72 |
| 10 | Altered muscle tone | 4.75 | 93.31 |
| 11 | Ataxia | 4.71 | 93.38 |
| 12 | Babinski's sign: up-going plantar reflex, hyper-reflexia, clonus, spasticity | 4.69 | 91.76 |
| 13 | Gait disturbance, clumsy or weak hands, or loss of sexual, bladder, or bowel function | 4.71 | 93.32 |
| 14 | Hoffman's sign | 4.74 | 93.35 |
| 15 | Incontinence | 4.73 | 93.34 |
| 16 | Lhermitte's sign: flexion of the neck causes an electric shock-type sensation that radiates down the spine and into the limbs | 4.34 | 85.04 |
| 17 | New or severe headache | 4.84 | 96.76 |
| 18 | Photophobia or phonophobia | 4.66 | 91.78 |
|  | Visual loss | 4.44 | 88.39 |
| 19 | Weakness involving more than one myotome or loss of sensation involving more than one dermatome | 4.61 | 91.75 |
| Age-related factors for people aged under 20 years | 20 | Altered hair distribution | 4.90 | 95.06 |
| 21 | Birthmarks | 4.90 | 95.04 |
| 22 | Congenital abnormalities | 4.82 | 95.06 |
| 23 | Family history | 4.67 | 91.76 |
| 24 | Infections related to substance misuse | 4.69 | 91.73 |
| 25 | Skin tags | 4.66 | 91.74 |
| Age-related factors for people aged over 50 years | 26 | History of cancer | 4.64 | 91.73 |
| 27 | Vascular disease | 4.63 | 91.71 |
| Other red flag features | 28 | A history of inflammatory arthritis, cancer, tuberculosis, immunosuppression, drug abuse, AIDS, or other infections | 4.68 | 91.75 |
| 29 | A history of violent trauma (for example, a road traffic accident) or a fall from a height or minor trauma in a person at risk of osteoporosis (especially in post–menopausal women) | 4.60 | 90.05 |
| 30 | Minor trauma may fracture the spine in people with osteoporosis | 4.79 | 93.34 |
| 31 | Risk factors for osteoporosis. For more information, see the CKS topic on Osteoporosis - prevention of fragility fractures | 4.72 | 93.31 |
| Neck pain diagnosis | Neck pain with mobility deficit | 1 | Central and/or unilateral neck pain | 4.67 | 91.74 |
| 2 | Limitation in neck motion that consistently reproduces symptoms | 4.61 | 91.78 |
| 3 | Associated shoulder gridle or upper extremity pain may be present | 4.76 | 93.38 |
| 4 | Limited cervical ROM | 4.84 | 95.02 |
| 5 | Neck pain is reproduced at the end range of active and passive motion | 4.70 | 93.36 |
| 6 | Restricted cervical and thoracic segmental mobility | 4.76 | 93.31 |
| 7 | Intersegmental mobility testing reveals characteristic restriction | 4.78 | 93.38 |
| 8 | Neck and referred pain reproduced with provocation of the involved cervical or upper thoracic segments or cervical musculature | 4.75 | 93.35 |
| Neck pain with movement coordination impairment (wad) | 9 | Mechanism of onset linked to trauma or whiplash | 4.75 | 93.34 |
| 10 | Associated (referred) shoulder gridle or upper extremity pain | 4.64 | 91.72 |
| 11 | Associated with varied nonspecific concussive signs and symptoms | 4.79 | 93.30 |
| 12 | Dizziness/nausea | 4.64 | 91.73 |
| 13 | Headache, concentration, or memory difficulty, confusion, hyper-sensitivity to mechanical, thermal, acoustic, odor, light stimuli, heightened affective distress | 4.64 | 91.79 |
| 14 | Positive cranial cervical flexion test | 4.71 | 93.34 |
| 15 | Positive neck flexor muscle endurance test | 4.79 | 93.36 |
| 16 | Strength and endurance deficit of the trochlear muscle | 4.73 | 93.39 |
| 17 | Neck pain with mid-range motion that worsens with end-range position | 4.78 | 93.39 |
| 18 | Point tenderness may include a myofascial trigger point | 4.80 | 93.37 |
| 19 | Sensorimotor impairment may include altered muscle activation patterns, proprioceptive deficit, postural balance, or control | 4.70 | 93.33 |
| 20 | Neck and referred pain reproduced by provocation of the involved cervical segments | 4.73 | 93.31 |
| Neck pain with headache (cervicogenic) | 21 | Noncontinuous, unilateral neck pain and associated headache | 4.75 | 93.40 |
| 22 | A headache is precipitated or aggravated by neck movement or sustained position/posture | 4.59 | 90.07 |
| 23 | Positive cervical flexion rotation test | 4.51 | 90.06 |
| 24 | A headache is reported with provocation of the involved upper cervical segments | 4.74 | 93.37 |
| 25 | Limited cervical ROM | 4.76 | 93.36 |
| 26 | Restricted upper cervical segmental mobility | 4.70 | 93.37 |
| 27 | Strength, endurance, and coordination deficit of the neck muscle | 4.76 | 93.31 |
| Neck pain with radiation pain (radicular) | 28 | Neck pain with radiating (narrow band of lancination) pain in the involved extremity | 4.72 | 93.31 |
| 29 | Upper extremity dermatomal paresthesia or numbness and myotomal muscle weakness | 4.74 | 93.32 |
| 30 | Neck and neck-related radiating pain reproduced or relieved with radiculopathy testing, positive test cluster includes upper limb nerve mobility, Spurling test, cervical distraction, cervical ROM | 4.76 | 93.40 |
| 31 | May have upper extremity sensory, strength, or reflex deficits associated with the involved nerve roots | 4.67 | 91.80 |
| Back pain treatment-based algorithm | Nerve compress | 1 | Does the patient have symptoms distal to the buttock and signs of nerve root compression? | 4.55 | 93.39 |
| Traction | 2 | Peripheralize with extension movement? | 4.71 | 93.39 |
| 3 | Have a positive SLR test? | 4.75 | 93.30 |
| 4 | Peripheralization of symptoms, with no ability to centralize with movement | 4.72 | 93.34 |
| Specific Exercise | 5 | Centralized with 2 or more movements in the same direction (ie, flexion or extension)? | 4.80 | 93.36 |
| 6 | Centralize with movement in one direction and peripheralize with opposite movements | 4.73 | 93.31 |
| 7 | Directional preference for extension or flexion | 4.71 | 93.33 |
| 8 | Centralization with motion testing | 4.75 | 93.35 |
| 9 | Peripheralization in a direction opposite to centralization | 4.71 | 93.35 |
| Manipulation | 10 | Have the duration of symptoms of <16 days? | 4.78 | 88.39 |
| 11 | No symptoms distal to the knee? | 4.49 | 93.34 |
| 12 | Hip medial (internal) rotation ROM > 35° | 4.75 | 93.31 |
| 13 | Hypomobility with testing | 4.75 | 93.31 |
| Stabilization | 14 | Average SLR ROM >91 °? | 4.75 | 93.31 |
| 15 | Positive prone instability test? | 4.76 | 91.71 |
| 16 | Positive aberrant movements? | 4.66 | 93.32 |
| 17 | Age <40 years? | 4.71 | 93.37 |
| 18 | Hypomobility with spring testing | 4.78 | 93.34 |
| 19 | Increasing episode frequency | 4.73 | 93.34 |
| 20 | 3 or more prior episodes | 4.76 | 91.78 |
| Factors traction  Agains | 21 | Low back pain only (no distal symptoms) | 4.61 | 93.32 |
| 22 | No sign of nerve root compression | 4.71 | 95.04 |
| Specific exercise factors against | 23 | Low back pain only (no distal symptoms) | 4.89 | 93.36 |
| 24 | Status quo with all movements | 4.71 | 93.31 |
| Factors against manipulation | 25 | Symptoms below the knee | 4.72 | 91.77 |
| 26 | Increasing episode frequency | 4.70 | 90.07 |
| 27 | Peripheralization with motion testing | 4.54 | 90.01 |
| 28 | No pain with spring testing | 4.59 | 91.74 |
| Stabilization  Factors against | 29 | Discrepancy in SLR ROM | 4.64 | 93.40 |
| NECK pain treatment | Neck pain with mobility deficit | **Acute** | | | |
| 1 | Thoracic manipulation | 4.76 | 93.36 |
| 2 | Cervical mobilization or manipulation | 4.77 | 93.36 |
| 3 | Cervical ROM, stretching, and isometric strengthening exercise | 4.79 | 93.36 |
| 4 | Advice to stay active, plus home cervical ROM, and isometric exercise | 4.77 | 93.38 |
| 5 | Supervised exercise: including cervico-scapulothoracic and upper extremity stretching, strengthening, and endurance training | 4.77 | 93.38 |
| 6 | General fitness training (stay active) | 4.72 | 95.01 |
| **Subacute** | | | |
| 7 | Cervical mobilization or manipulation | 4.76 | 93.30 |
| 8 | Thoracic manipulation | 4.85 | 93.39 |
| 9 | Cervical ROM, stretching, and isometric strengthening exercise | 4.78 | 93.38 |
| **Chronic** | | | |
| 10 | Thoracic manipulation | 4.72 | 95.04 |
| 11 | Cervical mobilization | 4.78 | 91.73 |
| 12 | Combined cervico-scapulothoracic exercise plus mobilization | 4.83 | 95.06 |
| 13 | Mixed exercise for cervico-scapulothoracic Regine - neuromuscular exercise: coordination, proprioception, and postural training, stretching, strengthening, Endurance training, aerobic conditioning, and cognitive affective element | 4.68 | 95.01 |
| 14 | Supervised individual exercise | 4.86 | 91.79 |
| 15 | Stay active with lifestyle approaches | 4.86 | 93.33 |
| 16 | Dry needling, low-level laser, Pulsed or high-power ultrasound, intermittent mechanical traction, repetitive brain stimulation, TENS, Electrical muscle stimulation | 4.67 | 93.31 |
| 17 | Thoracic manipulation | 4.79 | 95.03 |
| Neck pain movement coordinate impairment (WAD) | **Acute** | | | |
| 18 | Education: Advise to remain active, act as usual | 4.70 | 95.02 |
| 19 | Home exercise: pain-free cervical ROM and postural element | 4.85 | 93.33 |
| 20 | Monitor for acceptable progress | 4.85 | 90.07 |
| 21 | Minimize collar use | 4.76 | 91.71 |
| **Subacute** | | | |
| 22 | Education: Activation and counseling | 4.52 | 93.31 |
| 23 | Combined exercise: active cervical ROM and isometric low-load strengthening, plus manual therapy (cervical mobilization), plus physical agent: Ice, heat, TENS | 4.65 | 96.76 |
| 24 | Supervised exercise: active cervical ROM or stretching, strengthening, endurance, neuromuscular coordination, and stabilization elements | 4.76 | 91.78 |
| **Chronic** | | | |
| 25 | Education: prognosis. Encouragement, reassurance, and pain management | 4.89 | 93.30 |
| 26 | Cervical mobilization plus individual progressive exercise: low-load cervico-scapulothoracic strengthening, Endurance, flexibility, functional training using cognitive behavioral therapy principles, vestibular rehabilitation, eye, head, neck coordination, and neuromuscular coordination elements | 4.69 | 93.36 |
| Neck pain with headache (cervicogenic) | **Acute** | | | |
| 27 | Exercise c1-2 self-SANG | 4.74 | 91.71 |
| **Subacute** | | | |
| 28 | Cervical manipulation and mobilization | 4.71 | 91.73 |
| 29 | Exercise:c1-2 self-SANG | 4.62 | 91.71 |
| **Chronic** | | | |
| 30 | Cervical manipulation | 4.66 | 91.75 |
| 31 | Cervical and thoracic manipulation | 4.73 | 93.31 |
| 32 | Exercise for cervical and scapulothoracic region: strengthening and endurances exercise with neuromuscular training, including motor control and biofeedback elements | 4.82 | 95.03 |
| 33 | Combined manual therapy(mobilization or manipulation) plus exercise (stretching, strengthening, and endurance training elements) | 4.74 | 93.31 |
| Neck pain with radiation pain (radicular) | **Acute** | | | |
| 34 | Exercise: mobilization and stabilization elements | 4.72 | 93.34 |
| 35 | Low-level laser | 4.78 | 93.34 |
| 36 | Possible short-term collar use | 4.88 | 95.05 |
| **Chronic** | | | |
| 37 | Combined exercise: stretching and strengthening elements plus manual therapy for the cervical and thoracic regions: mobilization or manipulation | 4.77 | 93.32 |
| 38 | Educational counseling to encourage participation in occupational and exercise activities | 4.76 | 93.31 |
| 39 | Intermittent traction | 4.81 | 96.79 |
|  |  | **Total mean** | | **4.72** | **92.76** |

Table 4- *The results of validation in the axes of features and exercises*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Category** | **Num** | **Data elements** | | **Mean** | **%** |
| Register a new patient |  | Registering data related to the national code and name, and other important items | | 4.83 | 96.72 |
|  | Registration of demographic information, clinical and psychological records (optional) | | 4.87 | 95.07 |
|  | Presenting red flags of back pain and neck pain using rules (if-then) to train students | | 4.86 | 96.75 |
|  | Using rules (if-then) for decision support systems | | 4.96 | 98.33 |
|  | Providing guidance messages to continue the management or referral process | | 4.88 | 96.73 |
|  | The possibility of creating two separate cases based on the type of disorder (back pain and neck pain) | | 4.82 | 96.73 |
|  | Using animation to show sports exercises | | 4.82 | 96.79 |
|  | Text and audio file to explain how to do the exercises | | 4.94 | 98.35 |
|  | Playing background music while doing exercises | | 5.00 | 98.34 |
| Management patient |  | Record information related to diagnosis and treatment | | 4.85 | 96.79 |
|  | Recording information about the patient's condition at the onset of pain | | 4.97 | 98.37 |
|  | Record information about pain intensity | | 4.92 | 98.31 |
|  | The possibility of changing the diagnosis and treatment if needed | | 4.84 | 96.78 |
|  | Record a note to schedule an appointment and provide additional information | | 4.96 | 98.36 |
| Exam |  | Providing specialized questions separately | | 4.84 | 96.73 |
|  | Providing multiple-choice questions to challenge students' knowledge | | 4.98 | 98.38 |
|  | Recording test results based on the number of correct and incorrect answers, and providing a report card | | 4.91 | 98.35 |
| Reports |  | Providing a report on the number of patients according to the type of selected back pain treatment | | 4.84 | 96.79 |
|  | Providing a report on the number of patients according to the type of selected neck pain diagnosis | | 4.82 | 96.72 |
|  | Providing a report on the number of patients according to the number of patients with back pain and neck pain | | 4.88 | 96.77 |
|  | Willingness to report the number of patients by gender | | 4.82 | 96.72 |
|  | Providing a report on the number of patients by age | | 4.94 | 98.32 |
| General |  | Access to the application with username and password | | 4.95 | 98.32 |
|  | Provide the username and password to students via SMS | | 4.90 | 96.74 |
|  | Bilingual application | | 5 | 100 |
| **Title** | | | **Description** | **Mean** | **%** |
| **Exercise** |  | Back pain exercise 1 | Strengthen the less-used abdominal muscles. | 5 | 100 |
|  | Back pain exercise 2 | Simultaneous stretching of muscles and nerves & Painless walking & Strong and short stretching of the low back muscles, & Improving the range of motion towards the front of the waist. | 5 | 100 |
|  | Back pain exercise 3 | Strong contraction of the abdominal muscles | 5 | 100 |
|  | Back pain exercise 4 | Stretch on the bar & Increase the forward range of motion of the pelvis - Reduce the deflection of the front of the pelvic plate | 5 | 100 |
|  | Back pain exercise 5 | Strengthen the weak serine muscles (A group of three muscles that make up the buttocks) | 5 | 100 |
|  | Back pain exercise 6 | Strengthen the muscles of the legs with special emphasis on the muscles of the front of the thighs (quadriceps muscles), & Strengthen the muscles (buttocks) of the serine | 5 | 100 |
|  | Back pain exercise 7 | Strong and short low back muscles stretch & improve the forward range of motion of the waist. | 5 | 100 |
|  | Back pain exercise 8 | Strengthen leg muscles with special emphasis on front thigh muscles (quadriceps muscles) & Strengthen the serine muscles | 5 | 100 |
|  | Neck pain exercise 1 | Lying on the back and moving the neck | 5 | 100 |
|  | Neck pain exercise 2 | Sitting on a chair and hanging the neck forward, and moving the head to the sides | 5 | 100 |
|  | Neck pain exercise 3 | Sit on all fours and move your head to the sides in a hanging position | 5 | 100 |
|  |  | **Total mean** | | **4.90** | **98.20** |