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Measurement in pain medicine

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Key points

- Structured pain assessment using a variety of validated measures can be an important aid to assist diagnosis of pain, direct treatment, and evaluate it.
- Assessment of acute pain severity is crucial for effective perioperative management and to reduce risk of chronicity.
- The multidimensional character of chronic pain requires specialized assessment tools for elucidation of sensory components and also cognitive and psychological dimensions.
- Specialized scales can be used in many settings as screening tools to support diagnosis of neuropathic pain, the essential first step in its treatment, and for assessment of pain in very young and elderly patients.

The often complex, multidimensional, and subjective nature of pain makes it very challenging to assess both in terms of intensity and in terms of relief as a response to treatment. It is important for pain assessment in any setting to have scientifically valid tools to determine quality and intensity of pain, aid diagnosis, direct treatment, and evaluate effectiveness after discrete interventions. Valid, reliable, and sensitive tools are required to direct treatment for patient care, and for service provision to evaluate the success of therapy. Pain measurement tools also aid research on mechanisms of pain and outcomes of treatment. A wide variety of validated measures have been conceived and developed over the last 40 yr, and have been instrumental in highlighting the multifaceted complexity of the human pain experience. It is of utmost importance to note that they do not supplant the need to clinically assess pain, but add to the quality of that assessment.

Measurement validity, reliability, sensitivity, and specificity

Validity is the degree to which a test measures either a quantity or hypothetical construct which it is intended to assess. This includes:

- Face validity—what does it appear to measure?
- Content validity—does it cover all relevant items (e.g. symptoms) in a given condition (e.g. depression)?
- Criterion-related validity—predictive of future state, and ability to diagnose existing state.
- Construct validity—degree to which a test measures hypothetical constructs or traits.

Reliability is based on the consistency of a measure across different conditions and time points:

- test–retest reliability (coefficient of stability)—assesses stability of results over time,
- internal consistency—assesses if scale items are measuring the same thing (e.g. anxiety, not unintended measurement of depression) (Cronbach's α),
- interrater reliability (Cohen's κ value).

The sensitivity of a measure is its ability to correctly identify the presence of the condition where it exists. For example, a measure with 80% sensitivity detects the condition in 80% of a population with that condition (true positives), but 20% with the condition are undetected (false negatives).

The specificity of a measure is its ability to correctly identify the absence of the condition where it does not exist. For example,

a measure with 80% specificity detects the absence of the condition in 80% of a population (true negatives), but 20% without the condition are ascribed it (false positives).

Sensitivity to change is indicated by a change in response to an intervention in direction and proportion with good correlation with other measures.

Measurements in acute pain

Assessment of acute pain is crucial to ensure safe and effective management of patients with an acute surgical or medical illness, and as part of routine perioperative care. Most of the scales used in acute pain settings are one-dimensional and designed for the assessment of intensity of pain, degree of pain relief, or other aspects of pain. The visual analogue scale (VAS) and numeric rating scale (NRS) are most commonly used to assess the present intensity of acute pain. They are reliable, valid, sensitive to change, and easy to administer for measurement of severity of pain. The NRS, using an 11-point scale (0—'no pain' to 10—'worst pain', or 'pain as bad as it could be'), is often preferred due to its administration simplicity and reliability.[1] VAS is considered the 'gold standard' technique and is used particularly in pain-related research. It consists of a 100 mm unmarked line with standardized wording: 'no pain' on the left of the line, and 'worst pain imaginable' on the right—the patient then places a mark on the line corresponding to their level of pain. A disadvantage of this scale is that it does not give instant rating as measurement is needed and application of the scale requires explanation to the patient when the level of understanding may be decreased in the early post-anaesthetic period. Categorical verbal rating scale (VRS) uses words to describe the magnitude of pain, for example, none, mild, moderate, severe. VRS is a quick, simple tool with a high validity as an indicator of pain intensity; however, it may be less precise and sensitive than VAS.[2] Language can be a barrier to effective administration.

Although neuropathic pain is commonly related to chronic conditions, it is present in about 3% of all patients with acute pain.[3] The prevalence depends on the type of performed surgery—for example, almost all patients post-inguinal herniotomy describe features of neuropathic pain in the early postoperative period. An awareness of this and early assessment of neuropathic component of acute pain is crucial for appropriate management. One-dimensional scales are inadequate for neuropathic pain assessment which requires specialized scales.[4] There is no consensus which scale [e.g. Leeds Assessment of Neuropathic Symptoms and Signs (LANSS) pain scale, Douleur Neuropathique en 4 questions (DN4), PainDETECT] is best for the assessment of acute post-surgical neuropathic pain. In the acute setting, in a study by Sadler and colleagues,[5] LANSS identified five of 165 patients (3%) as experiencing acute neuropathic pain, whereas DN4 identified seven patients in the same group of 165 individuals (4.2%). Another study by Hayes and colleagues[6] showed that patients with acute neuropathic pain represented only 1.04% of studied group, showing 78% of them had pain at 6 months, and 55% at 12 months.

Measurements in chronic pain

Multidimensional scales

Melzack and Casey suggested that pain has three major dimensions: sensory–discriminative, motivational–affective, and cognitive–evaluative. This led to development of one of the most evaluated multidimensional self-rating scales—the McGill Pain Questionnaire (MPQ) and its Short Form. MPQ consists of 20 subgroups of words describing sensory (subgroup 1–10), affective (11–15), evaluative (16), and miscellaneous components of pain (17–20). Each subgroup has a list of words with a given ranking—the word chosen by the patient with highest ranking is used for scoring. For example, in the assessment of 'Thermal' properties of perceived pain, the word 'searing' has a higher score than 'hot'. The total score—the pain rating index (PRI)—is a sum of ranked scores. In addition, present pain intensity (PPI) is assessed on a six-point scale (i.e. pain from 0 to 5). MPQ has been used in the research of acute and chronic pain due to its high reliability and validity. This questionnaire has been translated into a number of languages without affecting its utility. Outcomes of MPQ can be easily analysed statistically to compare efficacy of treatment methods.

The Brief Pain Inventory (BPI) is another multidimensional tool. Initially developed for cancer pain measurement, it has been validated for assessment of pain in a wide range of chronic syndromes. The BPI is a 17-item self-rating scale. It requests the patient to indicate the site(s) of pain by shading a body diagram. It also uses an 11-point NRS to assess the pain intensity in the preceding 24 h—'most', 'least', 'average', and 'right now', and degree of pain relief from current treatment. In addition, it uses an 11-point NRS of interference in seven domains of usual activities/functions and mood (e.g. work, sleep, mood, relations with other people). It has been validated in 12 languages to date (Fig. 1).

Neuropathic pain scales

Neuropathic pain is typically more distressing and more difficult to control than other forms of pain and is associated with greater health-seeking behaviour. It requires specialized diagnostic skills and specific treatment methods.

Discriminative tools to aid in the diagnosis of neuropathic pain have been developed to support diagnosis and differentiate between types of pain. They can be especially useful in primary care settings—however, they are not designed to replace clinical examination and specialized tests.

Generic tools like the McGill Pain Questionnaire have some discriminative properties but specific scales based on neuropathic descriptors and simple examination findings are preferred to distinguish between nociceptive and neuropathic pain. LANSS pain scale, DN4, PainDETECT, and Neuropathic Pain Score (NPS) are used as screening tools for neuropathic pain—however, there is no conclusion which is best for clinical practice.

The LANSS was the first such scale, which over the years has had validity confirmed in multiple studies.[7] The LANSS consists of seven weighted items: five sensory items and two clinical examination findings (allodynia and pinprick test). More than 12 points out of a maximum of 24 suggest that a neuropathic mechanism is likely to be contributory. It has 80% sensitivity and more than 90% specificity in comparison with expert clinical assessment. Although designed as a screening tool, it has shown sensitivity to treatment effect (reduction in LANSS after treatment) but not to placebo. LANSS takes about 5 min to complete, but it involves a physician's input. Patient self-reported S-LANSS has been developed recently and identifies patients with pain of predominantly neuropathic origin and is particularly useful in prevalence studies[8] (Fig. 2).

The DN4 scale which consists of six items related to symptoms and three physical examination findings identifies neuropathic components of pain with similar sensitivity and specificity to LANSS.[9]

The PainDETECT scale is a self-reported tool originally designed to distinguish neuropathic lower back pain from mechanical back pain.[10]

NPS was the first scale designed to measure severity of neuropathic pain based on intensity of 11 descriptors. NPS shows sensitivity to treatment effect.[11]

Mood and affect

The correlation between pain and psychological factors is well documented. They can influence pain perception, effectiveness of treatment, or even increased risk of chronicity of acute pain after surgery or trauma.[12–15]

Anxiety and depression measurements

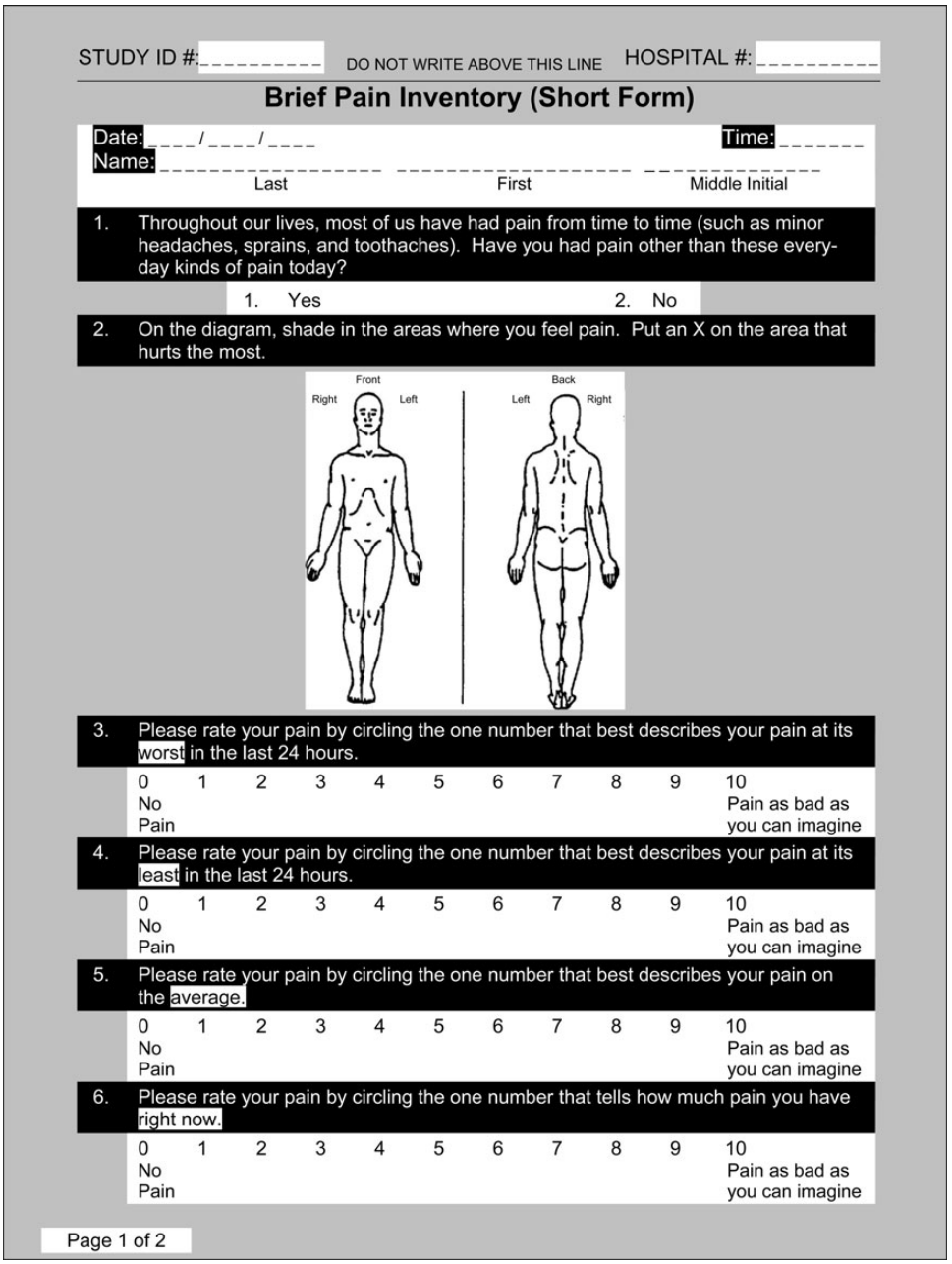
The Hospital Anxiety and Depression (HAD) scale is a highly validated scale across a number of healthcare settings, which assess risk of anxiety and depression in hospital or community. The HAD scale consists of 14 items—seven for anxiety and seven for depression. Each item scores from 0 to 3 points. The item scores are summed—scores of more than eight out of 21 for anxiety and/or depression represent clinically significant risk of these entities, with score-related ranking of severity as mild (8–10), moderate (11–15), and severe (16–21). It has higher sensitivity than specificity.

More recently developed scales, for example, Patient Health Questionnaire (PHQ-9) (for depression) and Generalized Anxiety Disorder 7 (GAD-7), are used increasingly.

Pain beliefs and coping assessment

Pain coping measurements: catastrophizing

Catastrophizing is a negative emotional–cognitive–attitudinal pain perception and leads to over-predictions of pain, increased use of healthcare, and longer hospital stays.[16] High scores are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Brief Pain Inventory (Short Form)

Date: ____/____/____ Time: _____

Name: _____ _____ _____

Last First Middle Initial

1. Throughout our lives, most of us have had pain from time to time (such as minor headaches, sprains, and toothaches). Have you had pain other than these everyday kinds of pain today?

1. Yes 2. No

2. On the diagram, shade in the areas where you feel pain. Put an X on the area that hurts the most.

Front Back

Right Left Left Right

3. Please rate your pain by circling the one number that best describes your pain at its worst in the last 24 hours.

0 No Pain 1 2 3 4 5 6 7 8 9 10 Pain as bad as you can imagine

4. Please rate your pain by circling the one number that best describes your pain at its least in the last 24 hours.

0 No Pain 1 2 3 4 5 6 7 8 9 10 Pain as bad as you can imagine

5. Please rate your pain by circling the one number that best describes your pain on the average.

0 No Pain 1 2 3 4 5 6 7 8 9 10 Pain as bad as you can imagine

6. Please rate your pain by circling the one number that tells how much pain you have right now.

0 No Pain 1 2 3 4 5 6 7 8 9 10 Pain as bad as you can imagine

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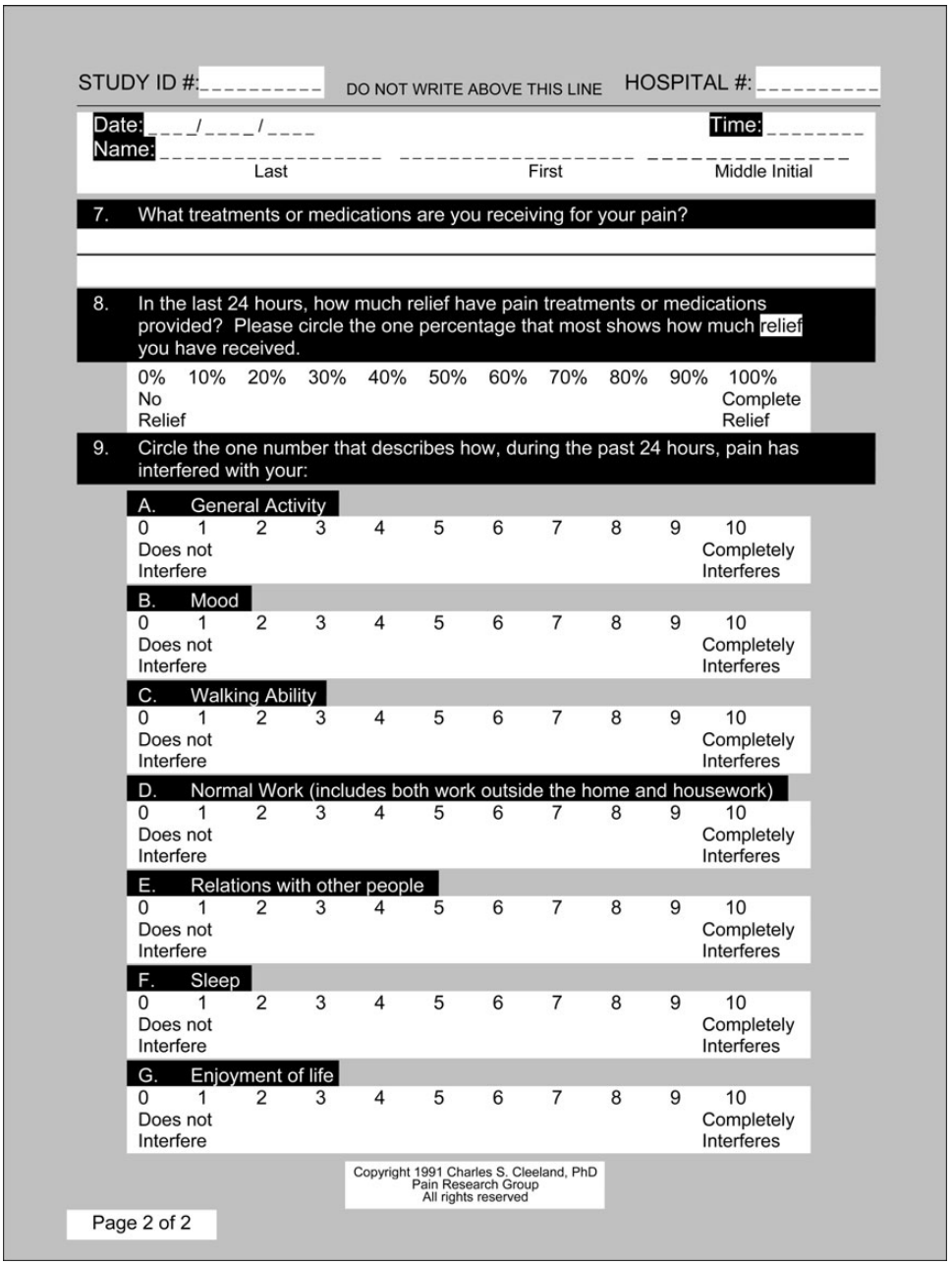
Fig 1 BPI scale. Reproduced with the permission of Charles S. Cleeland, PhD, Pain Research Group.



STUDY ID #:_____ DO NOT WRITE ABOVE THIS LINE HOSPITAL #:_____

Date: ____/____/____ Time: _____

Name: _____ _____ _____

Last First Middle Initial

7. What treatments or medications are you receiving for your pain?

8. In the last 24 hours, how much relief have pain treatments or medications provided? Please circle the one percentage that most shows how much relief you have received.

0% No Relief 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% Complete Relief

9. Circle the one number that describes how, during the past 24 hours, pain has interfered with your:

A. General Activity

0 Does not Interfere 1 2 3 4 5 6 7 8 9 10 Completely Interferes

B. Mood

0 Does not Interfere 1 2 3 4 5 6 7 8 9 10 Completely Interferes

C. Walking Ability

0 Does not Interfere 1 2 3 4 5 6 7 8 9 10 Completely Interferes

D. Normal Work (includes both work outside the home and housework)

0 Does not Interfere 1 2 3 4 5 6 7 8 9 10 Completely Interferes

E. Relations with other people

0 Does not Interfere 1 2 3 4 5 6 7 8 9 10 Completely Interferes

F. Sleep

0 Does not Interfere 1 2 3 4 5 6 7 8 9 10 Completely Interferes

G. Enjoyment of life

0 Does not Interfere 1 2 3 4 5 6 7 8 9 10 Completely Interferes

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Fig 1 Continued

associated with poorer function. The 13-item Pain Catastrophizing Scale lists statements which describe different thoughts or feelings associated with pain, for example, 'I worry all the time about whether the pain will end' or 'I become afraid that the pain would get any worse'.[17] Patients indicate the degree of frequency of those thoughts on a five-point scale. Total score of more than 30 out of 52 indicates clinically significant catastrophizing. Recent research also shows that catastrophizing is a risk factor for severe acute postoperative pain, and development of chronicity.

Measures of pain beliefs and attitudes

A patient's pain beliefs are central to their reporting of their pain experience, and are informed by their understanding of the nature and cause of pain, and the complex interaction of pain on their function and mood. Confidence in the patient's own ability to cope with pain and its impact on daily life is one of the strongest predictors of treatment outcome.[18] The Pain Self-Efficacy Questionnaire assesses patients' confidence in performing daily activity—10 statements related to daily life e.g. 'I can enjoy things or I can do some form of work despite pain'—on a seven-point scale. A total score of more than 40/60 predicts good response to self-management and return to work.

Health-related quality-of-life assessment

Quality-of-life measurement is important in chronic disease states including pain, as it is of paramount importance to the

The Leeds Assessment of Neuropathic Symptoms and Signs (LANSS) Pain Scale

Explain: This pain scale can help to determine whether the nerves that are carrying your pain signals are working normally or not. It is important to find this out in case different treatments are needed to control your pain.

A. PAIN QUESTIONNAIRE

Think about how your pain has felt over the last week. Please say whether any of the descriptions match your pain exactly.

1. Does your pain feel like strange, unpleasant sensations in your skin? Words like pricking, tingling, pins and needles might describe these sensations.

a) NO – My pain doesn't really feel like this..... (0)
b) YES – I get these sensations quite often.....(5)

2. Does your pain make the skin in the painful area look different from normal? Words like mottled or looking more red or pink might describe the appearance.

a) NO – My pain doesn't affect the colour of my skin..... (0)
b) YES – The pain does make my skin look different from normal ..... (5)

3. Does your pain make the affected skin abnormally sensitive to touch? Getting unpleasant sensations when lightly stroking the skin, or getting pain when wearing tight clothes might describe the abnormal sensitivity.

a) NO – My pain doesn't make my skin abnormally sensitive in that area (0)
b) YES – My skin seems abnormally sensitive to touch in that area.....(3)

4. Does your pain come on suddenly and in bursts for no apparent reason when you're still? Words like electric shocks, jumping and bursting describe these sensations.

a) NO – My pain doesn't really feel like this..... (0)
b) YES – I get these sensations quite often ..... (2)

5. Does your pain feel as if the skin temperature in the painful area has changed abnormally? Words like hot and burning describe these sensations.

a) NO – I don't really get these sensations..... (0)
b) YES – I get these sensations quite often..... (1)

B. SENSORY TESTING
Skin sensitivity can be examined by comparing the painful area with a contralateral or adjacent non-painful area for the presence of allodynia and an altered pinprick threshold (PPT).

1. Allodynia
Examine the response to lightly stroking cotton wool across the non-painful area and then the painful area. If normal sensations are experienced in the non-painful site, but pain or unpleasant sensations (tingling, nausea) are experienced in the painful area when stroking, allodynia is present.

a) NO – Normal sensations in both areas ..... (0)
b) YES – Allodynia in painful area only ..... (5)

2. Altered pinprick threshold
Determine the pinprick threshold by comparing the response to a 23-gauge (blue) needle mounted inside a 2 ml syringe barrel placed gently onto the skin in non-painful and then painful areas.

If a sharp pinprick is felt in the non-painful area, but a different sensation is experienced in the painful area, eg. none/blunt only (raised PPT) or a very painful sensation (lowered PPT), an altered PPT is present.

If a pinprick is not felt in either area, mount the syringe onto the needle to increase the weight and repeat.
a) NO – Equal sensation in both areas ..... (0)
b) YES – Altered PPT in painful area..... (3)

SCORING:
Add values in parentheses for sensory description and examination findings to obtain overall score.

TOTAL SCORE: _____ (maximum 24)

If score <12, neuropathic mechanisms are unlikely ***to be contributing to the patient's pain.***
If score ≥12, neuropathic mechanisms are likely ***to be contributing to the patient's pain.***

Fig 2 LANSS scale. Reproduced with permission of M. Bennett. Source: Bennett M, The LANSS Pain Scale: The Leeds assessment of neuropathic symptoms and sign. Pain 2001;92: 147–157.

patient, and can demonstrate the global impact of a condition on the patient's life, and the effect of treatment. The European Quality of Life Instrument (EQ 5D) measures five domains (mobility, self-care, usual activity, pain, and mood) against a five-point descriptor scale of symptom/impact intensity. It also has a measure of overall health with a vertical VAS from 0 to 100—from 'worst health you can imagine' to 'best health you can imagine'. The test is easy to use with wide applicability but may not be sensitive enough to capture subtle changes in response to treatment (especially if QOL is scored low). The scores can be affected by comorbidities, and the scoring system is complex.

Pain-related functional assessment

Pain-related function scales measure disability level and pain interference with daily activity. It is a very important outcome in pain medicine along with pain severity with which it strongly correlates. Most measurement tools assess multiple domains of function like daily activity, work, socializing, but also mood or sleep. Pain Disability Index (PDI) was created for the brief self-assessment of function in a wide range of painful conditions. It consists of seven domains (family/home responsibilities, recreation, social activity, occupation, sexual behaviour, self-care, and life support activity) which are assessed on an 11-point NRS. The PDI has been used to evaluate effectiveness of treatment methods. It is quick to administer and correlates well with other more complex tests like the Multidimensional Pain Inventory, but may have only modest reliability. The Oswestry Disability Index (ODI) is the most commonly used test internationally to measure the degree of disability and to estimate quality of life in low back pain. The current version of the form was described in the *Spine* journal in 2000.[19] The self-completed questionnaire contains 10 topics: intensity of pain, lifting, ability to care for oneself, ability to walk, ability to sit, sexual function, ability to stand, social life, sleep quality, and ability to travel. Each is tested by six statements weighted from 0 to 5 points (0—lack of disability, 5—severe disability). The final percentage of disability is calculated based on a simple formula.

There are many other tools assessing function specific to disease states such as the Oxford Knee Score, and the Roland Morris, but these are beyond the scope of this review.

Clinical trials

The existence of so many measurement scales used in clinical practice makes the evaluation of treatment between centres very difficult. The Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) recommended six core outcome domains:

- pain intensity—assessed by NRS: a 50% reduction is accepted as a substantial improvement,
- physical functioning—assessed by the Multidimensional Pain Inventory or BPI,
- emotional functioning—assessed by the Beck Depression Inventory and Profile of Mood States,
- patient ratings of improvement and satisfaction with treatment—assessed by the seven-point Patient Global Impression of Change scale.

The aim is to achieve consensus as to what domains to measure, and which tools to use, to improve clinical trial methodology. IMMPACT also recommended that two or more different methods should be used to evaluate the clinical importance of improvement or deterioration in participants in chronic pain clinical trials.

Cancer pain

Pain is one of a number of symptoms measured in palliative medicine. Many of the scales above have validation for use in this area. However, there are specific instruments validated for assessing pain, other common symptoms, and functional disabilities in palliative care e.g. the Memorial Symptom Assessment Scale (MSAS) and its Short Form (MSAS-SF).

Pain in extreme of ages

Pain in an ageing population is very common: 40% of those living independently, and 80% of elderly persons living in care homes report pain. Numerical ratings scale and facial pain scales have comparable sensitivity and are associated with a high completion rate, good concurrence, and acceptable reliability. Patients with dementia may lack the capacity to self-report, and the recognition of pain depends on observation of their pain behaviour or facial expression—e.g. the MOBID-2.

Paediatric pain assessment has its own challenges, as neonates, preverbal children, or those with significant handicap may not self-report their pain experience, and behavioural or biological measurements may be used. The PedIMMPACT consensus group recommended the following:

- self-report scales: the Piece of Hurt Scale for children 3–4 yr old; the Faces pain scale for 4–12 yr old; and VAS for older than 8.
- behavioural scales: FLACC (face, leg, activity, cry, and consolability) for postoperative pain and COMFORT scale in critical care settings.

Conclusion

There is a large body of literature concerning validity, sensitivity, and reliability of many scales designed to measure different aspects of the pain experience in every clinical setting. Many have also been validated in different cultures/languages, underscoring their robust utility and applicability. Although context can limit their validity and care should be taken to avoid overinterpretation, correctly used, validated scales are very useful for the measurement of multidimensional facets of pain to support diagnosis e.g. in neuropathic pain, to set a baseline against which to measure treatment success or failure, to guide clinical endeavour at the patient level, and in pain research, where standardization is necessary to allow meaningful comparison between different pain management strategies. Such scales may have further important implications for service improvement, and in health economics.

Declaration of interest

N.P. is the FPM question writer/examiner.

MCQs

The associated MCQs (to support CME/CPD activity) can be accessed at https://access.oxfordjournals.org by subscribers to *BJA Education*.

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