Does That Hurt?

Assessing a person's pain in a subjective way causes many complications for healthcare workers. An objective approach could tackle these issues

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Assessing pain is challenging. In some cases, patients cannot describe what they are feeling – if they are anesthetised, demented or too young, for example – or may report it in a way that does not accurately reflect their pain, leading to harmful side effects from overdose or under-use of pain medications. The introduction of a real time objective tool could drastically improve clinical outcomes.

Objective Assessment

Globally, pain affects over 1.5 billion people, with associated annual healthcare costs estimated at over $600 billion each year in the US alone (1,2). Treating pain is an essential role for every doctor, with unmanaged pain known to delay recovery, increase morbidity and mortality, as well as overburden healthcare resources.

However, despite the clinical importance of pain, assessing it remains challenging. Unlike other physiological parameters such as blood pressure, heart rate and temperature, the experience of pain is subjective to each patient. This makes it extremely difficult to accurately and consistently assess, diagnose and treat it, tragically emphasised by the global opioid crisis, in which nearly 70,000 people died from opioid overdose in 2014 (3). The introduction of a real time objective tool to monitor the physiological representation of pain could drastically change this and help improve patient outcomes, by providing clinicians with quantifiable data to optimise pain mediction aligned with a patient's 'true' physiological response to pain.

Modern Assessments

Currently, the diagnosis of pain levels and recommendations on management strategies are largely based on patients' subjective reports. For conscious patients, self-reporting tools (see Figure 1, page 16) – such as the visual analogue scale (VAS) from 0-10 or the Wong-Baker Faces Pain Rating Scale – remain the gold standard in pain assessment (4,5).

Patients can report their sensory feelings using these scales, but this may not accurately or consistently reflect their actual pain. What one person might categorise as severe pain can vary between subjects depending on their cultural, social and health background. This makes deciding on the most appropriate and optimised pain management strategy extremely challenging for physicians.

In other instances, patients are unable to describe their pain, such as when under anesthesia during surgery or in critical care. In these situations, it is assessed through indirect physical measures, including changes in blood pressure and heart rate, as well as clinical signs such as sweating and tearing (6,7). However, these factors may be unreliable and hampered by observational bias, leading to significant complications such as

further pain, delayed recovery and increased hospitalisation time and costs (8,9). Developing an objective method of pain assessment, sensitive and specific to pain, would enable healthcare professionals to provide personalised and effective care.

An Unbiased Measurement

Pain is defined as "an unpleasant sensory and emotional experience, associated with actual or potential tissue damage" (10). The sensation is an extremely complex interaction of biological, cognitive, behavioural, cultural and environmental factors. Yet, when it comes to 'actual or potential tissue damage' that is injury or noxious stimulus (acute pain), the reaction of the body or the pain response is first and foremost a physiological response, in which the autonomic nervous system activates several mechanisms that react through changes in a variety of physiological signals (11).

Currently, five main research strategies have been identified for the development of objective assessment of pain or 'nociception' (1). Changes in single parameters derived from the autonomic nervous system (2); biopotentials (electroencephalogram and electromyograph) (3); neuroimaging; biomarkers (4); and composite algorithms (5). The role of the latter is considered one of the leading approaches to assess the pain response (7).
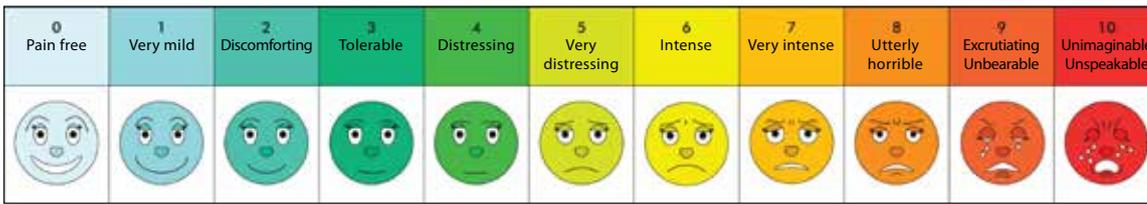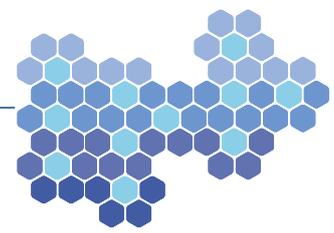
Keywords

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Composite Algorithms

Composite algorithms are based on the idea that combining multiple physiological parameters, considered validated markers of pain (nociception), will better reflect the complex nature of pain. They use statistical modelling and data analysis to create indexes and provide a quantitative and fairer indication of a patient's pain response (7). The leading example of using composite algorithms is the nociception level index, which evaluates heart rate variability, pulse wave amplitude, skin conductance level, number of skin conductance fluctuations, temperature, movement and their derivatives.

To date, this composite algorithm, which uses multiple physiological parameters, provides superior indications of the presence and severity of pain versus individual parameters alone, such as changes in heart rate and blood pressure (5). The technology has been validated, with successful clinical studies in world-class hospitals

involving hundreds of patients (5,9,12). The technology is already commercialised and being used to assess acute pain in the critical care setting, where patients under anesthesia are unable to communicate. Using these kinds of tools will enable physicians, particularly critical care teams, to optimise and personalise analgesic treatment, avoiding over- or under-use of analgesic medication, which can result in significant complications (13,14). On regaining consciousness after surgery, common complications resulting from opioid administration include nausea, vomiting, respiratory depression, constipation and hyperalgesia (15,16).

Future Changes

Physicians currently assess pain level and evaluate treatment effectiveness based on subjective and indirect personal information, which can have detrimental clinical and economic consequences.

The introduction of objective pain assessment could drastically improve this, providing valuable insights throughout the pain management process. For patients suffering from chronic pain – defined as any physical suffering that lasts longer than six months – the potential health and financial benefits of objective assessments are substantial.
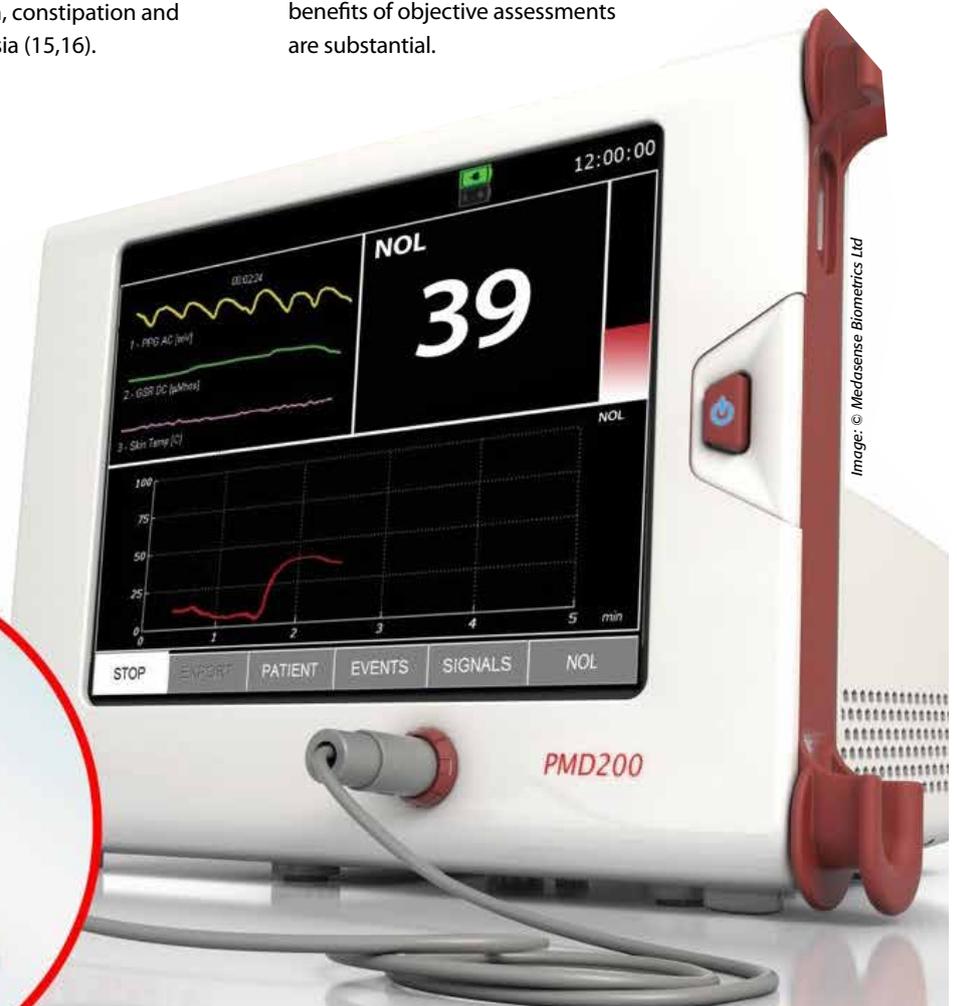

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The advent of assessing chronic pain, alongside other biometric data such as heart rate, through personal wearables and medical devices is the future of pain management. In the next decade, both patients and physicians will gain the capability to objectively assess and review pain levels anywhere at any time. These new insights will enable healthcare providers to proactively optimise and personalise each patient's pain treatment strategy, drastically improving clinical outcomes and lowering costs.

Objective pain assessment will also reinvigorate pain research. Researchers will gain new insights into pain mechanisms, conditions and possible new clinical treatments to optimise pain management. Furthermore, the continuous big data digital capture, analysis and evaluation of objective data and its associated physiological parameters will provide huge, untapped clinical value, beneficial to patients, physicians and researchers in the entire pain management network.

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