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7-17-2023

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## **Developing an Objective Measure of Pain**

*Kellan Clausen*

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Pain is a frequent complaint of patients presenting to emergency departments in the United States, whether it is a related symptom, or the chief complaint, with one study claiming that up to 70% of ED visits are related to pain concerns.<sup>1</sup> Once admitted, pain can be an important indicator of illness progression, oftentimes signaling worsening inflammation or tissue injury.<sup>2</sup>

Pain can not only impact a patient's clinical course but also negatively influence physical mobility, mental health, and overall quality of life. Patients can suffer financial consequences due to lost wages and increased healthcare bills.<sup>3</sup> Pain has such a significant impact on a patient's overall recovery and well-being that in 1995, the American Pain Society proposed an initiative to make pain 'the 5th vital sign'.<sup>4</sup> Though this initiative was not ultimately adopted, it highlighted the importance of refining pain assessment and pain control to improve patient outcomes, as well as the need for continuous advancement in pain management.<sup>4</sup>

Current pain assessment tools for conscious patients include the continuous visual analog scale (VAS), numeric rating scale (NRS), and verbal rating scale (VRS).<sup>5</sup> Facial expression and movement have also been explored as potential measures of pain, especially with pediatric patients.<sup>6</sup> Despite the implementation of these tools, pain is often underestimated or ignored, largely due to a discrepancy between patient-reported pain and perceived pain by medical professionals.<sup>3</sup> This can lead to inadequate treatment of pain and overall mismanagement of clinical conditions. In addition to being only partially effective, these scales are not applicable to

unconscious patients, patients who are paralyzed or who have received paralytic agents, patients with certain neurological impairments such as traumatic brain injury, those suffering from chronic or recurrent pain, and several other patient types.<sup>7</sup>

The VAS, NSR, and VSR scales are based on the assumption that the experience of pain and associated behavioral cues are universal, in spite of the fact that the scales are applied to patients of different ages and with a variety of medical conditions from diverse socioeconomic and cultural backgrounds. How, then, might clinicians improve their abilities to objectively assess pain? One such tool relies on biomarkers to assist in the measurement of pain.

Dr. Julia Finkel, M.D., a pediatric anesthesiologist and the director of Pain Medicine Research & Development at the Sheikh Zayed Institute for Pediatric Surgical Innovation at Children's National Hospital, recognized the need for a tool that can objectively and accurately measure pain levels in newborn patients. She developed a non-invasive, handheld device that measures pupillary response to pain. Along with the use of specific, proprietary algorithms, this tool can be used to determine both the level and type of pain and the effectiveness of analgesia.<sup>8</sup> Their research began with assessing the pupillary light reflex response in pediatric patients with Bowel and Bladder Dysfunction (BBD). Measurements were taken before and after voiding and with specific position changes. Data showed a distinct notch in the graph depicting the pupillary light reflex response, which correlated with brief, repeated pupillary constriction. Researchers hypothesize that the pupillary reflex is related to a "characteristic disturbance in the autonomic nervous system," a common disturbance in many cases of BBD.<sup>9</sup> The discovery of this unique 'pupillary signature' is encouraging and can be used as an indicator of pain levels. Though the research team is confident in their objective measurements, they are conducting further research on the impact of the parasympathetic and sympathetic branches of the autonomic nervous system

regarding pupillary response. Their device, [AlgometRX](#) Nociometer, is currently being evaluated by the FDA for use in patients with peripheral neuropathies and fibromyalgia. The company hopes to expand use to include any patient population experiencing pain.<sup>8</sup>

Pupillometry is not the only biomarker being investigated to objectively measure pain. Heart rate, blood pressure, and respiratory rate represent additional objective markers that may be used to measure the pain response. Skin conductance, which increases due to activation of the autonomic nervous system during the pain response, has also been assessed as an alternative objective measure of pain. Biopotentials measured from electrocardiography, electroencephalography, and electromyography have been investigated, as well as the potential use of neuroimaging in the form of magnetic resonance imaging (MRI) and positron emission tomography (PET) scans.<sup>10</sup> Unfortunately, the latter group of tests would be prohibitive to measure pain in the common patient, but research using these diagnostics could lead to other innovative processes. In fact, all of these methods have limitations based on their clinical practicality and costs. The AlgometRX Nociometer is not the first proposed method of its kind, nor will it be the last, but it represents a promising new way to measure pain levels accurately and objectively. In its development, researchers have focused on ease of use and cost, and they hope the device will diminish culture and socioeconomic variables which contribute to our current inaccuracies. While there is still much to learn about the system, AlgometRX and other systems which use biometric data to assess pain could change pain management sooner than anyone anticipates.

*Author has no conflicts to report.*

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