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Improving Pain Management in Patients with Sickle Cell Disease from Physiological Measures Using Machine Learning Techniques

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Abstract

Pain management is a crucial part in Sickle Cell Disease treatment. Accurate pain assessment is the first stage in pain management. However, pain is a subjective experience and hard to assess via objective approaches. In this paper, we proposed a system to map objective physiological measures to subjective self-reported pain scores using machine learning techniques. Using Multinomial Logistic Regression and data from 40 patients, we were able to predict patients' pain scores on an 11-point rating scale with an average accuracy of 0.578 at the intra-individual level, and an accuracy of 0.429 at the inter-individual level. With a condensed 4-point rating scale, the accuracy at the inter-individual level was further improved to 0.681. Overall, we presented a preliminary machine learning model that can predict pain scores in SCD patients with promising results. To our knowledge, such a system has not been proposed earlier within the SCD or pain domains by exploiting machine learning concepts within the clinical framework.

Keywords: physiological sensing, decision support, machine learning, health informatics

1. Introduction

Sickle Cell Disease (SCD) is an inherited blood disorder that affects one in 396 African Americans and one in 1,200 Hispanic Americans in the United States (US) (Lorey et al., 1996). Although medical treatment for SCD has improved dramatically, median survival age for SCD patients is 61 years (Elmariah et al., 2014), significantly lower than for African-Americans without SCD. In SCD, red blood cells (RBCs) become adherent and dehydrated, as well as sickle-shaped when deoxygenated which decreases blood flow and leads to frequent vaso-occlusive painful episodes and chronic organ damage (Schnog et al., 2004). Currently, there is no standard treatment available for pain and patients currently attempt to manage their pain

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