



May 18th, 5:00 PM - 7:00 PM

An ODE model for predicting pediatric patient pain in SCD based on patient sleep data

Quindel Jones

Virginia Commonwealth University, jonesq2@vcu.edu

Rebecca Segal

Virginia Commonwealth University, rasedal@vcu.edu

Angela M. Reynolds

Virginia Commonwealth University, areynolds2@vcu.edu

See next page for additional authors

Follow this and additional works at: <https://scholarscompass.vcu.edu/bamm>



Part of the [Applied Mathematics Commons](#), [Life Sciences Commons](#), and the [Medicine and Health Sciences Commons](#)

<https://scholarscompass.vcu.edu/bamm/2022/wed/46>

This Event is brought to you for free and open access by the Dept. of Mathematics and Applied Mathematics at VCU Scholars Compass. It has been accepted for inclusion in Biology and Medicine Through Mathematics Conference by an authorized administrator of VCU Scholars Compass. For more information, please contact libcompass@vcu.edu.

Presenter Information

Quindel Jones, Rebecca Segal, Angela M. Reynolds, Cecelia Valrie, and Reginald McGee

An ODE model for predicting pediatric patient pain in SCD based on patient sleep data

Quindel Jones

Abstract

Sickle Cell Disease (SCD) is a family of genetic blood disorders that affects over 20 million people worldwide, whose prevalent complication is pain. Pain crises in SCD are strongly linked to mortality morbidity and increased medical costs. The study in Valrie et al. 2019 revealed a correlation between sleep and pain using actigraphy and patient reported sleep quality and pain in 88 pediatric SCD patients and we use this data to inform our model. Our model reflects that sickle cell pain in childhood presents differently than adulthood, without chronic pain, and that poor sleep quality is correlated with increased SCD pain. In this study, we investigate this sleep pain connection using mathematical tools that incorporate a dynamical systems approach. Based on the results in Clifton et al 2017 and Yang et al 2019, we created a hybrid statistical and mechanistic ODE model for predicting subjective pediatric patient SCD pain levels based on patient data. Our initial model fit of the patient data had significant discrepancies but was improved by statistical parameter estimation for each patient. We then refined the model by incorporating accumulating time windows into the predictive component of the model via machine learning techniques. Our model aims to be a warning system for upcoming pain events for pediatric SCD patients, given the proper pain and sleep data. This is advantageous in the digital age as noninvasive monitoring will allow physicians to treat chronic pain in patients anywhere based on personalized, data-driven recommendations.