DEPARTMENT OF INTERNAL MEDICINE
COLLEGE OF MEDICINE

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: 03/01/2023

PROJECT TITLE: **Where does all the oxygen go? Computational modeling to support heart therapies.**

Kevin Haworth
College of Medicine
231 Albert Sabin Way
Cardiovascular Research Center, 3939
Cincinnati, OH 45267
hawortkn@ucmail.uc.edu
Phone: 513.558.3536

Project Description

GOAL: The goal of this UPRISE project is to develop a computational model for the amount of oxygen that can be scavenged from whole blood. The model will support of a project using ultrasound to develop improved treatments for patients suffering from a heart attack.

PROJECT DESCRIPTION: Lack of blood flow to the heart due to a blockage in a blood vessel causes damage known as a myocardial infarction (aka a heart attack). Nowadays, physicians can administer a variety of treatments to restore the blood flow (and therefore oxygen supply) to the heart, and these approaches have saved thousands of lives. Although these techniques are life-saving, they cause alternate forms of damage to the heart that can play a significant role in the quality of life of the patient following the treatment of their heart attack. Paradoxically, a key reason for these alternate forms of damage is the rapid re-introduction of oxygen. Our laboratory has demonstrated that when oxygen is slowly re-introduced to the heart, it has an improved recovery. To move this finding toward a clinical application, we have also developed an ultrasound-based technique for sequestering oxygen in fluids (such as water or blood). We have developed an analytic model based on conservation of mass that accurately predicts the amount of oxygen that will be sequestered from water. To further translate these studies to the clinic we need to adapt this model to work in whole blood. Whole blood presents unique challenges for modeling because oxygen is not just dissolved in the liquid phase of the blood, but it is also chemically bound to hemoglobin molecules in red blood cells and how much is bound depends on a number of parameters, including the amount of oxygen in the liquid phase.

This UPRISE project will focus on developing a model in whole blood based on our existing model and incorporating empirical equations for the amount of oxygen bound to hemoglobin. The UPRISE student will be able to test the accuracy of their model by comparing it to experimental measurements. This project provides the opportunity for students to develop numerical modeling skills, participate in biophysics and biomedical engineering research, and interact with a highly disciplinary group (including biologists, physicians, engineers, and physicists).