BIOMEDICAL ENGINEERING
COLLEGE OF ENGINEERING AND APPLIED SCIENCES

RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: February 8, 2026

PROJECT TITLE: NeoWarm: Kangaroo Mother Care with Integrated Thermal Management and Vital Signs Monitoring

Physical Requirement :
Must be able to work in person

Project's Technical Skills Requirement :
wet lab skills, chemical analysis, spectrophotometry, electrical circuit design, microcontroller programming, MATLAB, Python, C, C++

Project's Available Positions : 1

Orlando S. Hoilett, Ph.D.

Assistant Professor of Biomedical Engineering
College of Engineering and Applied Science
University of Cincinnati

B01 Bioscience Center
3159 Eden Avenue
Cincinnati, OH 45219

Email: hoiletos@ucmail.uc.edu
Phone: 513-556-7839
Fax: 513-556-4162

Project Description

Worldwide, premature birth accounts for 30% of all neonatal deaths in children under the age of five. Neonatal hypothermia is one of the most common complications of premature birth, as newborns are unable to regulate their body temperature. Hypothermia is an especially devastating complication of premature birth in low-resource settings. Over 80% of deaths due to premature birth occur in low and middle-income countries (LMICs) due to a lack of access to incubators that are critical for managing hypothermia. Furthermore, LMICs lack the necessary tools to regularly monitor the baby’s vital signs, which is critical for managing complications due to premature birth. Deaths from sudden infant death syndrome (SIDS) and accidental suffocation are silent and go unnoticed without continuous vital sign monitoring. Kangaroo mother care (KMC) is a proven intervention for combating neonatal hypothermia and involves skin-to-skin contact between the caregiver and the newborn. However, KMC places a high demand on caregivers and leaves newborns with no protection when caregivers require a break to care for themselves. Furthermore, it is very difficult to measure a baby's vitals during KMC as the baby is swaddled tightly to the caregiver and is not accessible. As a result, KMC still leads to deaths due to SIDS or accidental suffocation, as the caregiver is unaware of the baby's vitals during KMC.

Our patented device, NeoWarm, is a disinfection wipe-friendly infant carrier that serves the need for thermal management and vital signs monitoring of premature infants during and in between KMC. NeoWarm has integrated fabric heating pads that generate heat from a lightweight, rechargeable, portable battery pack in a similar fashion to an electric jacket. NeoWarm also includes sensors for heart rate, respiratory rate, blood oxygen, and temperature, to monitor the infant's key vital signs to detect signs of hypothermia and other complications such as apnea or SIDS. Given the strength of our benchtop and preclinical studies, our present study aims to validate NeoWarm in a clinical setting with human babies. To accomplish these goals, we have the following aims:

Aim 1 (Electronic Circuit Design Aim / Option #1 for student): Develop the second-generation NeoWarm device with integrated sensors for heart rate, respiration, blood-oxygen, and temperature. The student will develop a professional-grade printed circuit board as well as firmware that will simultaneously track each physiological signal of interest using a microcontroller and send the resulting data to a previously developed smartphone application using Bluetooth Low-Energy.

Aim 2 (Microbiology Aim / Option #2 for student): While NeoWarm has the potential in reducing neonatal hypothermia, its role as a potential fomite is yet to be determined. Neonatal care settings pose a heightened risk of neonatal sepsis due to the vulnerable population of preterm infants with underdeveloped immune systems. Pathogens such as Enterococcus faecium, Acinetobacter baumannii, and Pseudomonas aeruginosa are implicated in neonatal sepsis. Similarly, indicator organisms, such as Escherichia coli, are noteworthy in neonatal sepsis due to their association with contamination and poor infection control practices in healthcare settings. To further ensure the safety of the NeoWarm prior to clinical trials, a comprehensive microbial risk assessment is imperative.

The interested student can choose to work on Aim 1, Aim 2, or both.