BIOMEDICAL ENGINEERING
COLLEGE OF ENGINEERING AND APPLIED SCIENCES

RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: February 8, 2026

PROJECT TITLE: **Decreasing the Incidence of Intraventricular Hemorrhage on Neonatal Populations by Mitigating the Vibrations and Noise Levels Experienced During Transport**

Physical Requirement :
Must be able to work in person

Project's Technical Skills Requirement :
Electrical circuit design, microcontroller programming, MATLAB, Python, C, C++

Project's Available Positions : 1

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Project Description

Premature infants, especially those born over 10 weeks early, are at greater risk for intraventricular hemorrhage (IVH), a condition characterized by bleeding of the ventricles due to underdeveloped blood vessels. This risk is heightened in very low birth weight (VLBW) neonates, who typically have a gestational age of less than 30 weeks and weigh less than 1.5 kg. IVH is classified into four grades. Grades III and IV are the most severe and can potentially lead to long-term developmental and motor issues, as well as increased mortality. Transport is a known risk factor for developing IVH. However, many premature infants must be transported due to their need for specialized neonatal intensive care that may be unavailable at their birth facilities. Studies show that VLBW neonates born outside of tertiary care centers (outborn) and transported to specialized facilities have a higher incidence of severe IVH compared to those born in specialized care centers (inborn). The increased risk of developing IVH due to transport is potentially linked to the forces experienced during transport, including whole-body vibrations, translational forces, rotational moments, and excessive sound. As a result, many have endeavored to characterize these distressing forces and develop novel techniques to reduce them to acceptable levels. Some studies have suggested using a foam, air, or gel mattress inside the isolette to absorb the forces inside the isolette; however, the results were not statistically significant. As a result of this unmet clinical need, our goal is to mitigate the vibrations and noise levels experienced during all forms of transport (ground, fixed-wing, and rotary-wing), towards decreasing the incidence of IVH and improving the outcomes for premature infants worldwide.

In our preliminary work, we have documented the mechanical vibration and sound exposure experienced by a neonatal manikin during ground transport in a Type 1 ambulance provided by Cincinnati Children's Hospital and Medical Center (CCHMC). We used 14 triaxial accelerometers, referred to as "Peapods," and two sound level meters. The Peapods were placed on the manikin, isolette, and throughout the interior of the ambulance (Fig. 1A). The sensor on the manikin was placed on the manikin's forehead (Fig. 1B and 1C). One sound meter was placed inside the isolette, while the other was placed on top of the isolette. The ambulance drove for 25 minutes with a mix of highway and city miles, and briefly activated the siren to simulate authentic transport scenarios. Our results indicated that the manikin experienced forces exceeding the recommended "comfortable" 0.032 g limit for the entire duration of the simulated transport event. The average noise level inside the isolette was 63.4 dBA, which is 18.4 dBA higher than the level recommended by the AAP. Given the strength of our preliminary data, our current study aims to characterize the vibrations and noises experienced during ground transport in a Type II ambulance, as well as during fixed (ambulance) and rotary wing transport (helicopter). We will then evaluate methods to mitigate the mechanical vibrations and noise levels experienced during all forms of transport. We will accomplish these goals with the following specific aims:

Aim 1: Determine forces and noise levels experienced by a neonatal manikin during a non-ambulatory transport event in a type II ambulance, during fixed-wing transport, and during rotary-wing transport. Aim 2: Determine the vibration-damping capabilities of memory foam. Aim 3: Determine the optimum soundproofing material for the transport isolette per weight of material.