

DEPARTMENT OF BIOMEDICAL ENGINEERING  
COLLEGE OF ENGINEERING AND APPLIED SCIENCES

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PROJECT TITLE: NeoWarm: Kangaroo Mother Care with Integrated Thermal Management and Vital Signs MonitoringOrlando S. Hoilett, Ph.D.  
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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.

While some low-cost warming devices exist, such as the Embrace Infant Warmer, Warmilu), and the Dream Warmer, these warmers are either not compatible with KMC or are not able to monitor vital signs. Hypothesis: Therefore, a low-cost warmer that is compatible with KMC, can provide thermoregulation during breaks in KMC, and can measure key vital signs to prevent SIDS and accidental suffocation would revolutionize neonatal care in the hardest hit global settings.

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 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. NeoWarm is safe and effective as demonstrated in pilot studies using hypothermic newborn piglets. NeoWarm was able to warm hypothermic pigs to normal, core body temperature, while piglets struggled to reach normal body temperature without NeoWarm. Given the strength of our benchtop and preclinical studies, our present study aims to validate NeoWarm in a clinical setting with human babies in collaboration with the Indiana School of Medicine.