BIOMEDICAL ENGINEERING
COLLEGE OF ENGINEERING AND APPLIED SCIENCES

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FOR APPLICATION YEAR: 2024

PROJECT TITLE: Methods for Preserving Macronutrient Content of Expressed Human Breastmilk

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Project Description

Babies born premature (approximately 10% of the population), can experience a range of neurological, ocular, respiratory, gastrointestinal, and musculoskeletal impairments. For these infants, proper nutrition in the early stages of life is crucial to achieving short-term clinical milestones and long-term growth and development. The best nutrition source for premature newborns to achieve these goals is breastmilk but preserving the nutrient benefits of this complex liquid biologic tissue can be very challenging.

It has been established that there is substantial adsorption of macronutrients to the surfaces of containers, feeding tube lines, and other interfaces, a process that often reduces the total nutrient delivery to the infant. For donor milk, the nutritional loss is especially severe because there are a considerable number of steps between expression of the breast milk and its delivery to the infant. These include pasteurizing, screening, pooling, freezing, transporting, thawing, preparing, and administering the milk. Each step offers the potential for macronutrient loss, and it is particularly detrimental to infants that require tube feeding. In order to improve clinical outcomes for at-risk infants, it is critical to ameliorate

this macronutrient loss.

While others have examined single components of the milk transfer system, we propose to apply a systems-level analysis to the entire milk transfer system and identify the points where macronutrient loss is the greatest. We will then use a patented technology to develop a polymer-based lining material that will prevent macronutrient adsorption and significantly improve nutrient delivery to infants, especially those in the NICU. This project's specific aims are:

Aim 1: Characterize the amount of macronutrient loss through current collection, storage, and handling methods utilized in the processing of freshly expressed and frozen (mother's and pasteurized donor human milk (PDHM)) and determine critical points of loss within the system.

Aim 2: Demonstrate the ability of pharmaceutical grade polyethylene glycol (PEG), a strongly hydrophilic molecule, and calfactant (trade name Infasurf), a naturally derived surfactant, to significantly decrease nutrient loss from polymers in the milk handling system.

Aim 3: Demonstrate the successful translation of nutrient-protecting coatings in a prototype milk-transfer system.

This project is in collaboration with Cincinnati Children's and Professor Eric Nauman's Human Injury Research and Regenerative Technologies (HIRRT) lab.