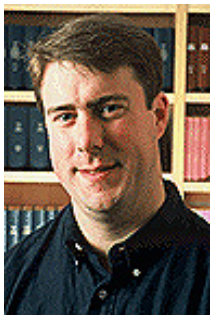
THE HARTWELL FOUNDATION

2008 Individual Biomedical Research Award

Review of Proposed Research



Investigator: **Brian P. Helmke, Ph.D.**
Associate Professor
Department of Biomedical Engineering

Institution: **University of Virginia**

Proposal: **Ciliated Pediatric Endotracheal Tube for Active Prevention of Ventilator-Associated Pneumonia**

Dr. Helmke proposes a radical improvement in endotracheal tube design that makes use of an innovative fluid propulsion system to clear the undesirable accumulation of fluid secretions when the tube is in the airway to assist normal breathing (ventilation). Ventilator-associated pneumonia (VAP) is a severe infection that frequently occurs in mechanically ventilated children in neonatal or pediatric intensive care units. Fluid aspiration of saliva and gastric fluid into the small, air-filled sacs in the lung occurs when there is accumulation of secretions near the endotracheal tube placed in windpipe. Aspiration occurs even in the presence of an inflated cuff designed as an air seal for the ventilator. Suctioning to remove the secretions is often beneficial, but it also provides an opportunity for airway injury and contamination with the bacteria that cause VAP. The incidence of pneumonia is high in patients undergoing this procedure, representing up to 10% of all hospital-acquired infections. However, diagnostic and infection control methods used in adults present difficulties when deployed for children. For example, chest X-rays reveal pneumonia long after the process starts and may be difficult to interpret because of the underlying illness prompting the child's need for mechanical ventilation. To address these issues, Dr. Helmke proposes a radical departure in endotracheal tube design. Based on feasibility demonstrated in cell culture and lab-on-a-chip fluidic applications, he plans to fabricate an endotracheal tube with artificial polymeric finger-like projections (cilia) that extend approximately 0.08 in from the exterior wall of the tube. Such a design reflects scaled-up biogeometry, similar to that encountered in many organisms. Each finger-like projection will contain a ferromagnetic nanorod, which in an appropriate magnetic field will cause all of the cilia to move in a wavelike manner to push any secreted fluid towards the throat for the convenient removal of fluid by suction or swallowing. If successful, he will use a prototype clinical product to collect feasibility data demonstrating effectiveness to reduce the risk of VAP.