

**13<sup>th</sup> Annual Force Health Protection Conference**  
**August 9-13 2010**  
**Phoenix, Arizona**

**Title**

Next Generation Respiratory Viral Vaccine System: Advanced & Emerging Bioengineered Human Lung Epithelia Model (HLEM) Organoid Technology

**Authors**

Thomas J. Goodwin, PhD, Sandra L. Schneider, DrPH, EMBA, FCT, Thomas F. Gibbons, PhD, Major, USAF, MC, Victor H. MacIntosh, MD, MPH, LtCol, USAF, MC. NASA Johnson Space Center, Disease Modeling & Tissue Analogues Laboratory, Houston, Texas, Research & Clinical Laboratory Systems, San Antonio, Texas, US Air Force School of Aerospace Medicine, Brook City Base, Texas

**Additonal Author Information**

**Thomas J. Goodwin** [thomas.j.goodwin@nasa.gov](mailto:thomas.j.goodwin@nasa.gov)

**Sandra L Schneider** <[drsandra@stic.net](mailto:drsandra@stic.net)>

**Victor MacIntosh** <[victor.macintosh@brooks.af.mil](mailto:victor.macintosh@brooks.af.mil)>

**Thomas F. Gibbons** <[thomas.gibbons@brooks.af.mil](mailto:thomas.gibbons@brooks.af.mil)>

**Abstract (150 words)**

Acute respiratory infections, including pneumonia and influenza, are the 8<sup>th</sup> leading cause of United States and worldwide deaths. Newly emerging pathogens signaled the need for an advanced generation of vaccine technology.. Human bronchial-tracheal epithelial tissue was bioengineered to detect, identify, host and study the pathogenesis of acute respiratory viral disease. The 3-dimensional (3D) human lung epithelio-mesechymal tissue-like assemblies (HLEM TLAs) share characteristics with human respiratory epithelium: tight junctions, desmosomes, microvilli, functional markers villin, keratins and production of tissue mucin. Respiratory Syntial Virus (RSV) studies demonstrate viral growth kinetics and membrane bound glycoproteins up to day 20 post infection in the human lung-orgainoid infected cell system. Peak replication of RSV occurred on day 10 at 7 log<sup>10</sup> particles forming units per ml/day. HLEM is an advanced virus vaccine model and biosentinel system for emergent viral infectious diseases to support DoD global surveillance and military readiness.

**References (asked for 2, but listed 4 – you may have to truncate)**

Goodwin, TJ, McCarthy, M, Lin, Y-H, Deatly, AM. Three-Dimensionally Engineered Normal Human Lung Tissue-Like Assemblies: Target Tissues for Human Respiratory Viral Infections. NASA/TP-214771, (2008): 1-23

Suderman, MT, McCarthy, M, Mossell, E, Watts, DM. Peters, CJ, Shope, R, Goodwin, TJ. Three-Dimensional Human Bronchial-Tracheal Epithelial Tissue-Like Assemblies (TLSS) as hosts for Severe Acute Respiratory Syndrome (SARS)-CoV Infection. NASA/TP-213723, (2006): 1-30

Vetrees, R. A, McCarthy, M, Solley, T, Popov, Vselovod, L, Roaten, J, Pauley7, M, Wen, X , Goodwin, TJ. Development of a Three-Dimensional Model of Lung Cancer Using Cultured Transformed Lung Cells. Cancer Biology & Therapy. 8 (4), (2009) 356-365

Goodwin, TJ, Prewett, TL, Wolf, A, Spaulding, GF. Reduced Shear Stress: A Major Component in the Ability of Mammalian Tissues to Form 3-Dimensional Assemblies in Simulated Microgravity. *Journal Cellular Biochemistry* 51, (1993): 301-311

**Objectives (<30 words)**

1. Describe advanced bioengineered model for viral respiratory disease
2. Explain the relevance of using a regenerative, bioengineered human lung model for viral vaccine production

**Intended Audience**

Researchers, epidemiologists, and preventive medicine physicians

**Biographical Data (150 words)**

Thomas J. Goodwin, PhD is Project Manager and Scientist of Non-Exercise Physiological Countermeasures Project and leads the Disease Modeling & Tissue Analogues Laboratory, NASA Johnson Space Center Houston, Texas. His research focuses on organ and regenerative tissue bioengineering and development of *ex vivo* physiological three-dimensional (3D) biological systems in bioreactors for human and animal cells. Additionally, he is a leading expert in the cellular, molecular genetic and physiological effects of ultra low frequency electromagnetic fields on human tissues. His work has been referred to as seminal to the understanding of pulsed electromagnetic field (PEMF) effects on living cells. Dr. Goodwin received his PhD in Physiology and Bioengineering Sciences, The Union Institute and University. He has numerous awards for his NASA Johnson Space Center technical bioreactor inventions, holds over 28 patents and disclosures and served on 18 space shuttle and ISS cellular biotechnology flight experiments.