TITLE: Advanced *In Vitro* Models for Airman Health and Performance

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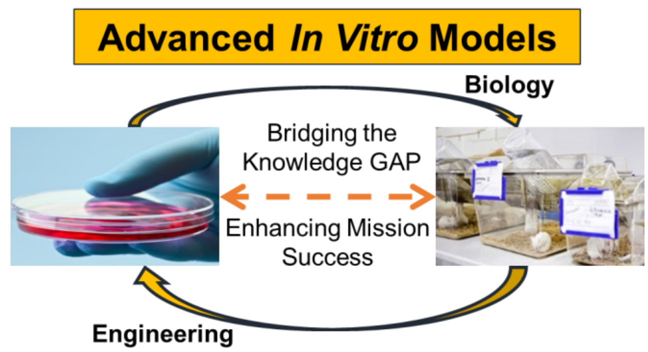
Dr. Nelson, received his B.S. degree from Purdue University in 2010 for Biomedical Engineering. He studied bone mechanotransduction and tissue engineering as an undergraduate student. After completing his B.S., Dr. Nelson attended The Ohio State University, where he developed nano-drug delivery models, constructed tissue engineering scaffolds, and conducted chemotherapeutic drug testing using electrospun nanofiber *in vitro* models. Dr. Nelson completed his Ph.D. in 2015, and moved to the Air Force Research Laboratory as a Consortium Research Fellows Post-doctoral fellow to develop advanced *in vitro* models for toxicology and human performance. Dr. Nelson is currently the advanced *in vitro* model lead as a DR-II government civilian. He has focused efforts on creating mechanically and microstructurally relevant micro-environments using biomaterials fabrication approaches and microfluidics to simulate human physiological processes for assessing operationally derived toxicants and human performance with the ultimate goal of creating intervention strategies to optimize the modern warfighter.



ABSTRACT: The Air Force continues to push the boundaries of weapons systems, the build-up of physical and mental stress on Airmen is extensive. Even as these weapons, aircraft, and technologies become "smarter", faster, and more capable, they continue to be reliant on the human element to enhance, operate and assess operations. As such, it is imperative to develop a "smarter" warfighter where adverse biological changes can be identified and augmented in real-time; ultimately ensuring the highest level of mission success. The ability to capture rapid biological alterations in response to Air Force operational environments, and their effects on human performance requires robust model systems. Yet, current methods to assess operational stressors lack biological relevance and sampling band-width, limiting data collection to arbitrary "snap-shots" in time. Now is a critical time when the military requires reliable model systems that combine biological relevance and rapid analysis of biological outcomes following an Airman stressor event, and such platforms require an interdisciplinary approach with awareness of military operational environments. Establishment of platform technologies utilizing microfluidics and bioengineering to create model physiological systems could serve as a launch-pad for understanding future biological phenomenon. Ultimately, the transition of these in vitro model systems could have lasting impact, providing rapid biological feedback and responsive development of augmentation strategies to enable or enhance Airman performance.

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