4D Bio³

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2017 RESEARCHER OF THE YEAR
DR. VINCENT HO
Chair of Radiology, USU
Chief of Radiology, WRNMMC

4-DIMENSIONAL BIOPRINTING, BIOFABRICATION, AND BIOMANUFACTURING PROGRAM

4D Bio³ is a five-year program funded by the Defense Health Program, with the purpose of promoting the development and application of advanced bioprinting, biofabrication, and biomanufacturing technologies for research pursuant to Department of Defense (DoD) priorities and ultimately for translation to clinical medical defense care and training solutions. The program is based at the Uniformed Services University (USU) on America's Medical Campus in Bethesda, Maryland and represents a collaboration between USU, Geneva, the Naval Research Laboratory, and Walter Reed National Military Medical Center (WRNMMC).

MISSION
Develop and deliver biofabrication technologies and novel solutions for advancement of military medicine, biomedical education, and multi-collaboration within the DoD, and other federal agencies, academia, and industry.

GOALS
• Develop and benchmark biofabrication technologies and protocols.

• Provide intramural expertise in biological printing, fabrication research, and product development.

• Engage and foster research collaboration with other DoD, federal and/or non-federal scientists to facilitate advancement of biofabrication technologies for military medicine.

• Develop the next generation of DoD expertise in biofabrication by providing educational opportunities.

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4D BIO³ PROGRAM

4D Bio³ consists of a diverse team of subject matter experts from across the DoD. By aligning bioprinting and biofabrication with military medical research at USU and across the National Capital Region, 4D Bio³ hopes to advance high throughput screening, novel diagnostic testing, and rapid therapeutic assessments for the warfighters and their families.

4D Bio³ includes a 4,000 sq. ft. multi-tool facility supporting a broad array of research and education applications. The facility includes a biofabrication suite, tissue culture room, bioreactor and sensor facility, and medical/surgical simulation room. The capabilities present allow for military medical applications and translations to the fields of precision medicine, biomarker discovery, drug and vaccine development, medical technology validation, bio-sensors, environmental and occupational health, and regenerative medicine.

PROGRAMMATIC EFFORTS

Proof of Concept for Countermeasure Studies: The models below will be used in validation screening studies, including elements such as exposure to infectious diseases and blasts.

1 — **Trace Metals in the Blood-Brain Barrier Model** will create a blood-brain barrier model (3D bioprinted) for evaluation of metals crossing the brain in order to study the penetration of military-relevant metals that wounded warriors are likely exposed to. If proven effective, this model could be used to study metals that play into future neurodegenerative disease prognoses.

2 — **Radiation and the Blood-Brain Barrier Model** will develop a blood-brain barrier model (3D bioprinted) that can be used for evaluation of a variety of radiation effects on the brain. This will enable better investigation of complex radiation mechanisms, providing a rapid model system to improve radiation risk mitigation and improving the understanding of clinical radiotherapy problems.

3 — **Gut/Microbiome Model** will develop a 3D bioreactor system that will produce a robust testing system for the human intestinal microenvironment. This pseudo intestinal system could help clarify the role microflora plays in host health and disease, and provide a testing platform for pharmaceutical probiotic therapies.

4 — **Skin/Hair Follicle Model** will develop a bioprinted dermal hair tissue model, creating next generation skin substitutes that regenerate hair follicles. This will represent a major advance for skin engineering since the biofabricated skin substitute will have superior regenerative properties, function, and appearance.

5 — **Zika and the Blood-Brain Barrier Model** will create a blood-brain barrier model to study Zika's effects on the brain. This testing platform will allow detailed examination of the pathogenesis of this viral infection, how it crosses the blood-brain barrier, and how it potentially impacts fetal development and the onset of microcephaly.

QUESTIONS?

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