



Core for Advanced Predictive Analytics in Biomedicine (CAPABio)



Key Research Areas



Warfighter Health & Readiness

Leverages cutting-edge AI algorithms and personalized computational models to optimize Soldier performance and resilience, while developing next-generation decision-support platforms to revolutionize combat casualty care. Utilizes physics and physiological models to predict hemorrhage risk, alertness impairment, and the human body's response to heat, cold, and exertional stress. Evaluates strategies to optimize fluid allocation, manage fatigue, and maintain/restore normal body temperature.



Flow Phenomena Modeling

Uses computational fluid dynamics to understand and characterize flow phenomena in the human body under normal and pathological conditions.



Musculoskeletal & Brain Injury Risk Assessment

Characterizes the risk of overuse musculoskeletal injury associated with military relevant activities and exoskeleton usage. Assesses the brain responses to different mechanical insults, such as blast and blunt impacts, with the goal of delineating the mechanisms of traumatic brain injury and establishing evidence-based injury criteria.



Bioinformatics & Genomic

Develops pathogen diagnostics for different platforms, comparative genomics, sequencing, host-pathogen interactions, viral evolution, and genotype-phenotype analysis.



AI-Driven Drug Discovery

Uses molecular models to develop drugs, engineer proteins, and understand how chemicals interact with biological macromolecules.



Computational Immunology & Therapeutics Development

Focuses on analysis and modeling approaches that combine immunology with pre-clinical and clinical vaccine studies to identify determinants of vaccine efficacy against military-relevant infectious diseases.



Network Science & Systems Biology

Develops advanced physiological models, incorporating protein interactions and metabolic networks. Solves critical Warfighter's health challenges such as coagulopathy, chronic pain, inflammation, and scarring. Our models serve as powerful platforms to find novel treatments, predict outcomes, and identify precision diagnostic and prognostic biomarkers.



Predictive Toxicology & Toxicogenomics

Develops computational tools and experimental approaches to understand the adverse effects of chemical and biological exposures on human health to discover biomarkers and therapeutic countermeasures.

Research Team

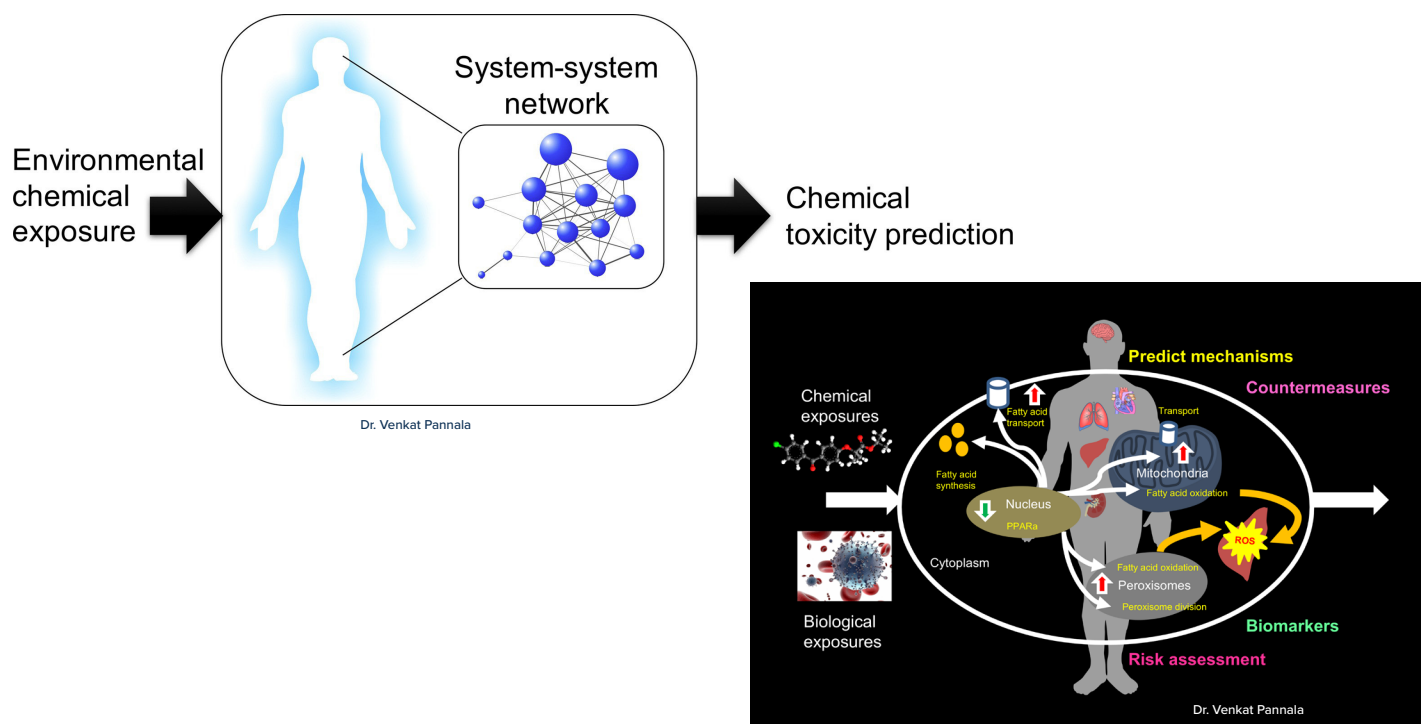
The HJF CAPABio Research Scientists are a multi-disciplinary team with previous working experience in industry, government, and academia, demonstrating expertise in bioinformatics, computer science, artificial intelligence (AI), modeling and simulation, physical chemistry, physics, mathematics, biophysics, biomedical engineering, biochemistry, systems biology, cellular biology, toxicology, drug discovery, physiology, and medicine using both animal and human data.

Research Focus

This research effort aims to develop solutions to support Force Health Protection and Soldier Readiness, while leveraging interdisciplinary (computational-experimental) approaches to enhance military medical research efficiency and efficacy. To this end, the CAPABio Scientists collaborate to develop and integrate computational biology and medical informatics applications, focusing on injury and disease prevention, performance optimization, and enhanced combat casualty care for our military personnel.

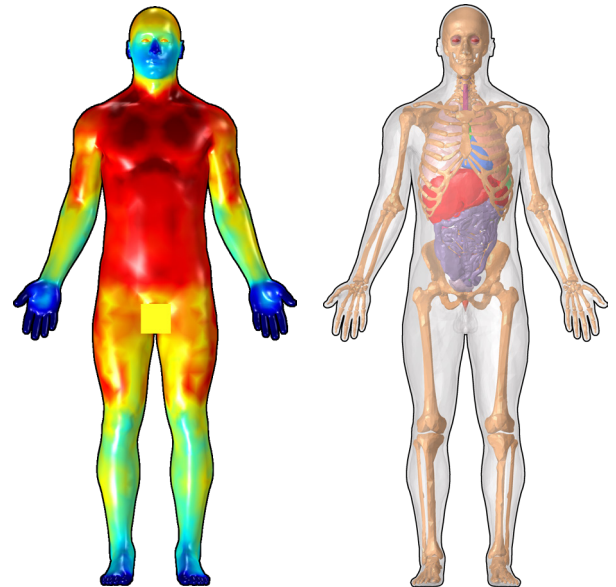
With the ability to model and simulate complex problems on computers, many potential solutions can be quickly evaluated, effectively reducing the dimensionality of the search space to focus on a few hypotheses that can be experimentally tested. The close computational-experimental interactions provide data-informed, readiness-driven operational problem solving, forming a foundation for the successful execution of our mission.

CAPABio's broad scientific expertise in chemical/biological problem-solving, coupled with the computational power of the DoW super-computing assets, provides a unique environment for cutting-edge, computational-experimental interdisciplinary research.



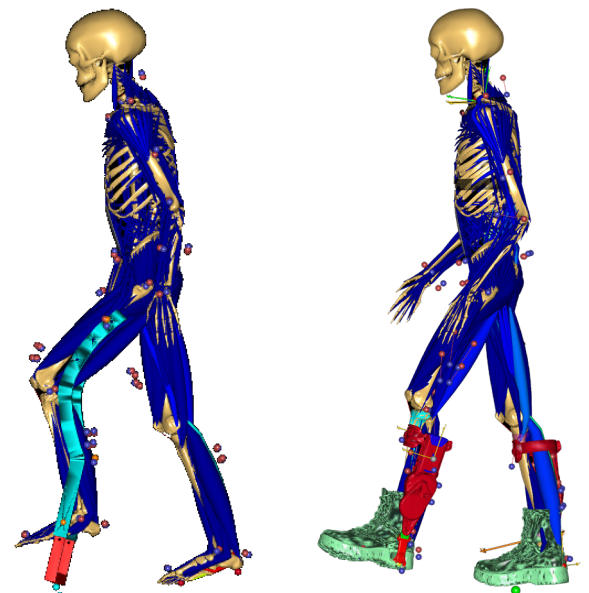
Software Systems & Web Applications

- **2B-Alert:** Helps manage alertness and mental acuity
- **2B-Cool:** Provides warning of an impending heat illness
- **2B-Healthy:** Identifies imminent infection days before symptoms appear
- **2B-Treated:** Optimizes fluid allocation in mass-casualty scenarios
- **APPRAISE-HRI:** AI-enabled SaMD for assessing hemorrhage risk index after trauma (**FDA cleared**)
- **PC-PVT:** Measures alertness and attention through reaction-time testing commonly used in sleep-loss and fatigue research
- Musculoskeletal injury, fatigue, and pain assessments
- A 3-D virtual human model for simulating heat and cold stress
- Individualized musculoskeletal finite-element models to assess tibial response to load carriage
- Finite-element models of the head for traumatic brain injury research
- **Toxidrome:** AI-based computational identification of different toxidromes
- **ToxMet:** Predicts metabolic reaction fluxes and metabolite biomarkers
- AdVerse effects Of Interacting Drug Database (AVOID-DB)
- Dengue Virus Antibody Database (DENV-Ab DB)
- Docking-based Virtual Screening (DOVIS)
- **vNN-ADMET:** Platform to predict absorption, distribution, metabolism, excretion, and toxicity properties from chemical structures
- **ToxProfiler:** Web-based platform to predict toxic liability of a compound
- **ToxPanel:** Assesses liver and kidney injuries from gene-expression data using gene-set analyses
- MOlecular traNSporT inhibitor and substrate predictOr Utility Server (**MONSTROUS**)



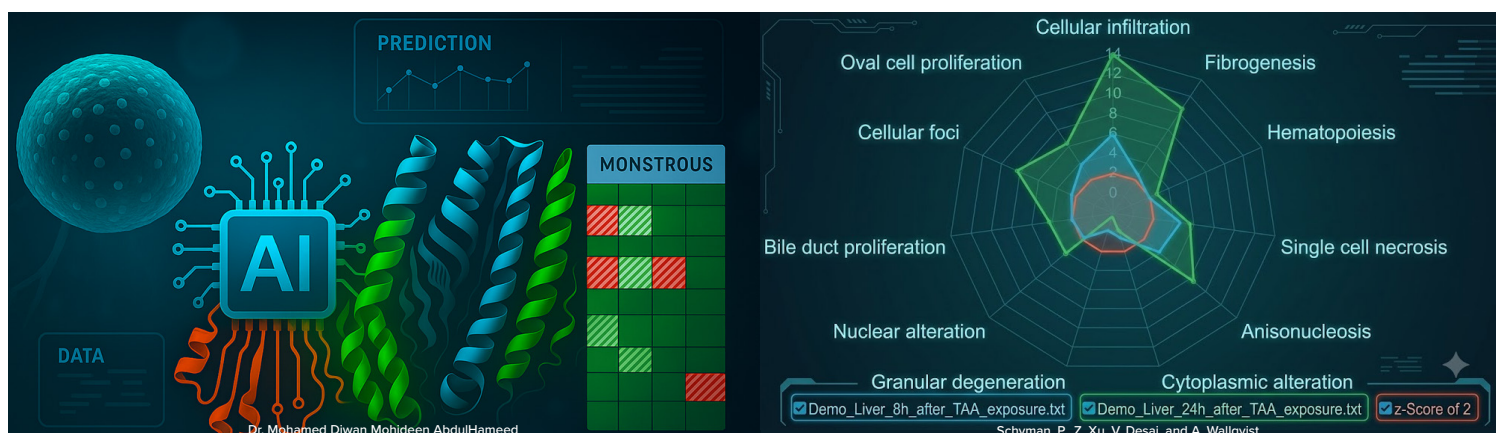
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Dr. Md Arifuzzaman Arif

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