

Mitochondrial, Immunological, & Surfactant-Based Biosignatures to Assess Stress in Airmen Training Activities and Combat Environments

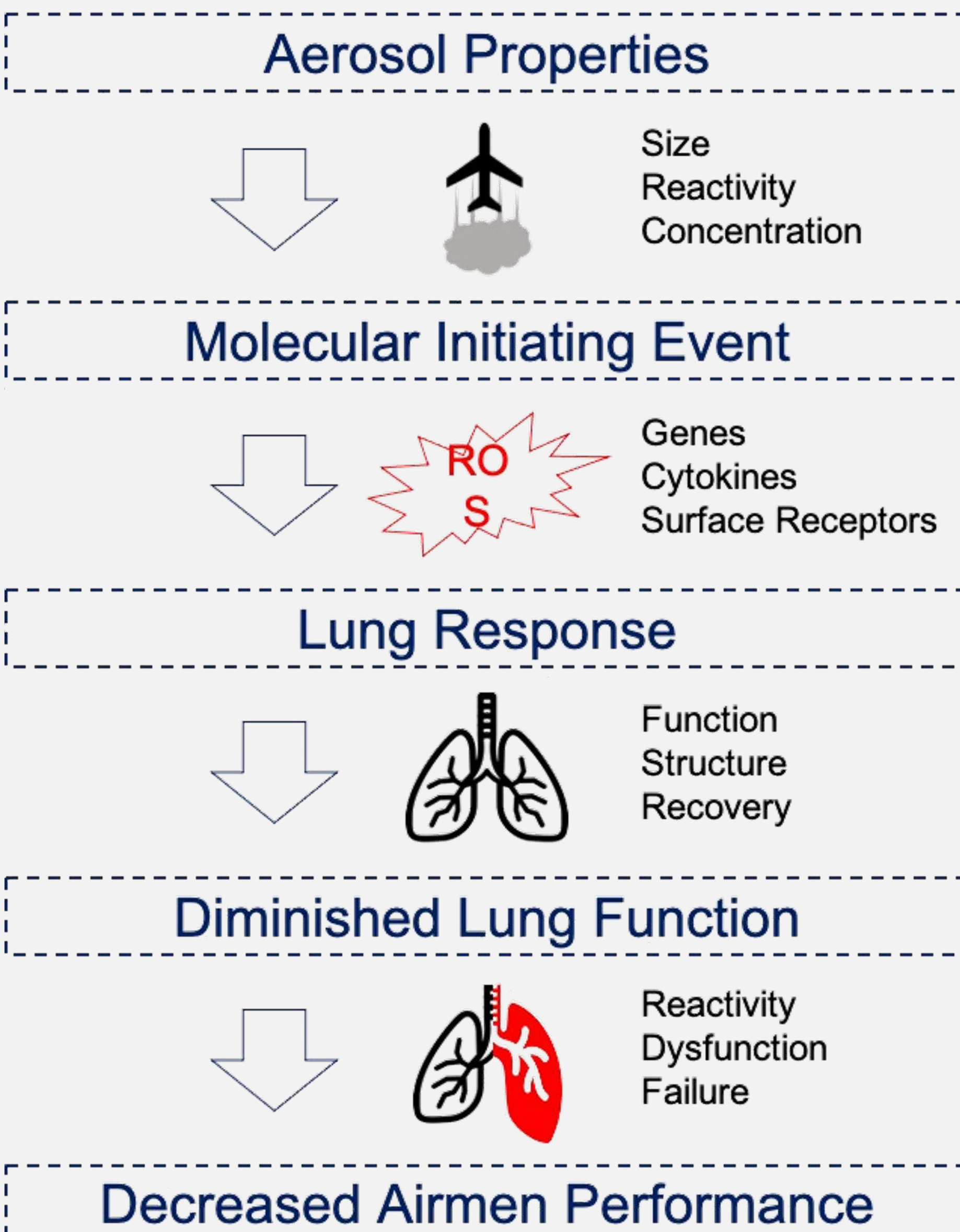
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1. Occupational Exposure

Airmen are exposed to a aerosols which can lead to inflamed airways and potentially long-term adverse outcomes. These experiments simulate aerosol exposures and identify stress markers that lead to impaired health or inhibit active-duty functions.



Our Approach

3. Functional *In Vitro* Lung Models

Four distinct cell-based models are used to assess immunological effects after exposure to Air Force relevant chemicals and particles. Each of these models are designed to produce data as input to predictive models connecting cellular level to organ level potential adverse health & performance effects.



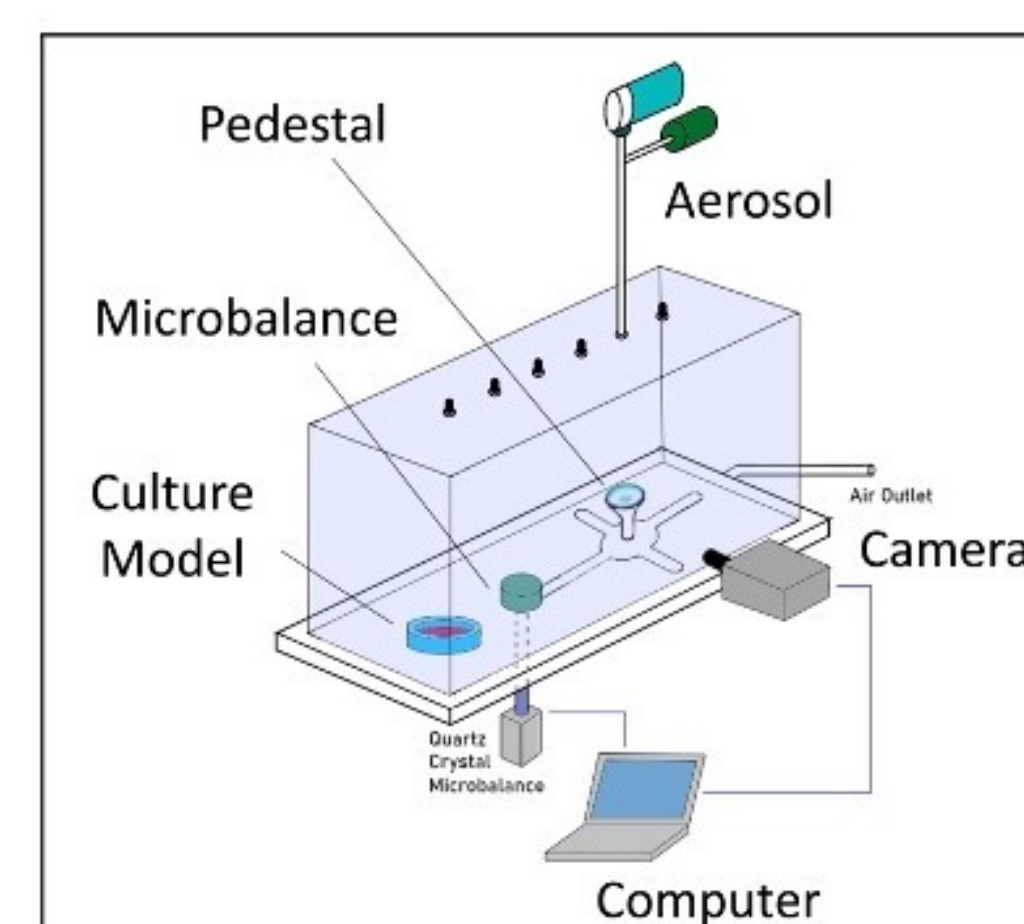
Work Flow



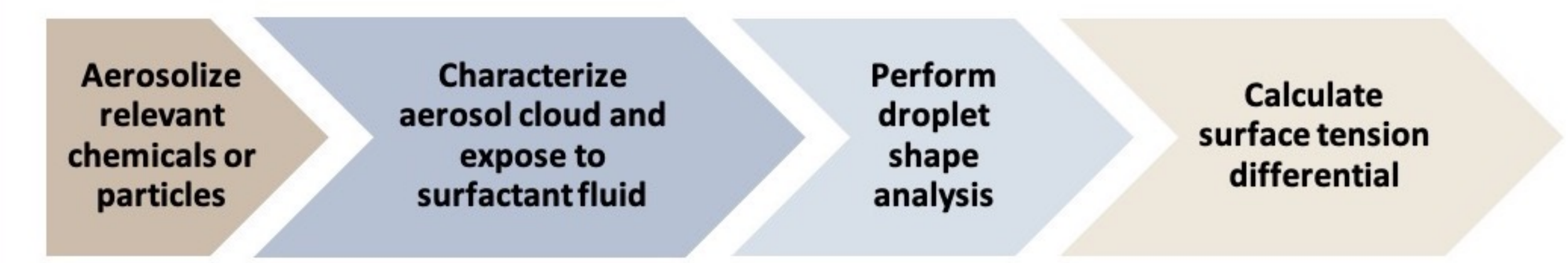
4. Simulated Operational Conditions

A novel device (Aerosol Exposure Surfactometer (AES)) was developed. Lung cells, fluid, and surfactant play a critical role in respiratory health. In these studies, clinical and artificial surfactant fluids are exposed to extreme environmental conditions (including aerosol exposure). Changes in fluid properties are measured and related to pulmonary function.

Air Force Operationally-Relevant Aerosols



Work Flow



2. System Controls

Alveolar Immunological Model Controls

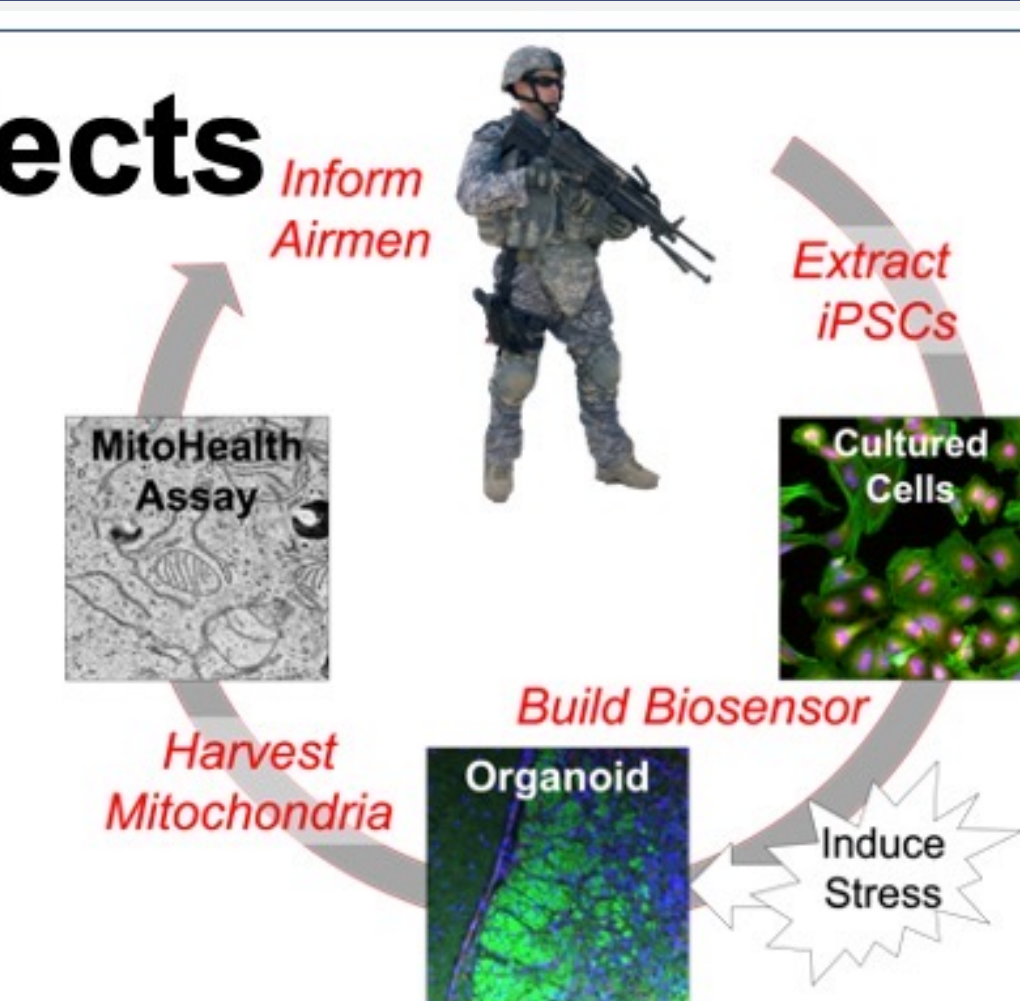
Chemical Structure	Chemical	Type
	Phorbol 12-myristate 13-acetate (PMA), Ionomycin	Positive Control for Cell Activation
	Isophorone Diisocyanate (IPDI)	Positive Control for Sensitization

Surfactant Droplet Model Controls

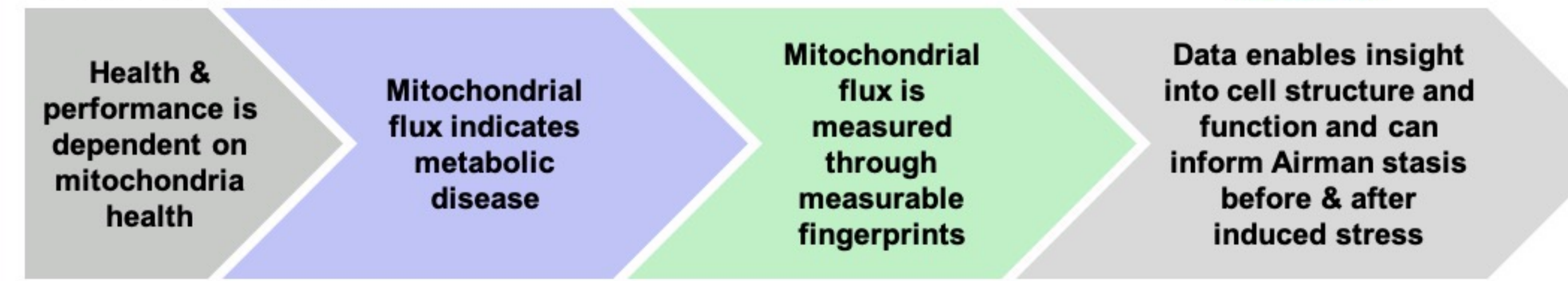
Chemical Structure	Chemical	Type
	Lactose	Negative Control for Surfactant Inhibition
	Albumin	Positive Control for Surfactant Inhibition

5. Predicting Chronic Effects

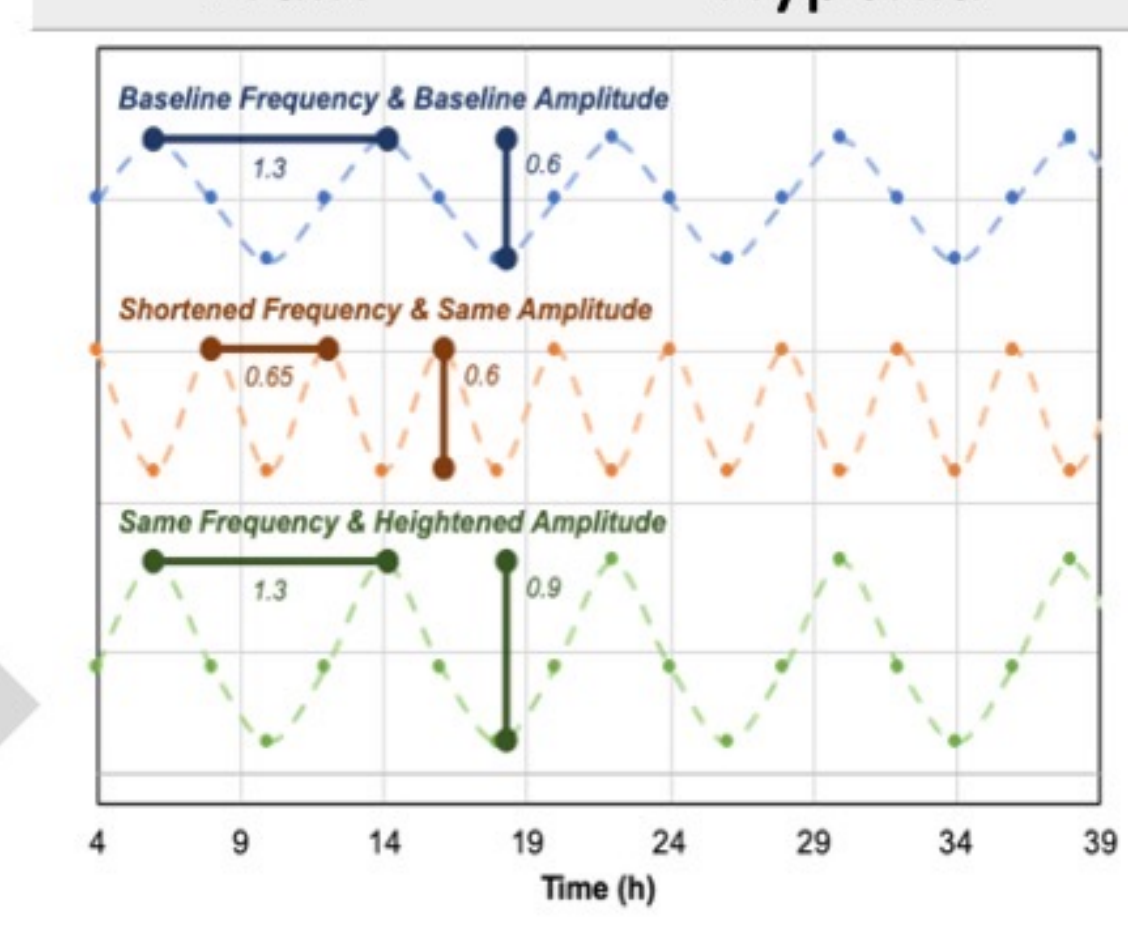
Our objective is to provide translational data on molecular targets in tailored, personalized organoids. The model can be continuously monitored & measure mitochondrial flux.



Work Flow



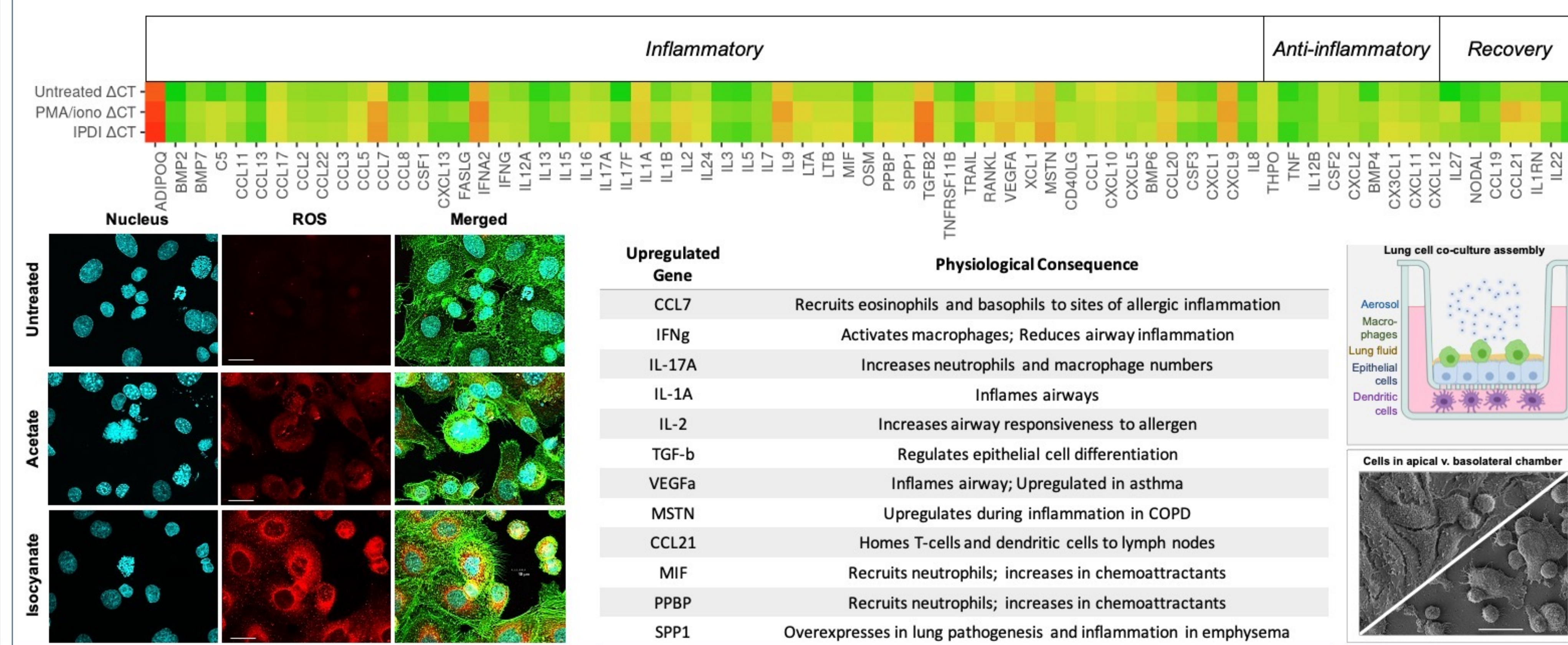
Organoid	Simulated Stress
Lung	Inhaled Particles
Skin	Chemical Burn
Brain	Hypoxia



Impact to Military Health

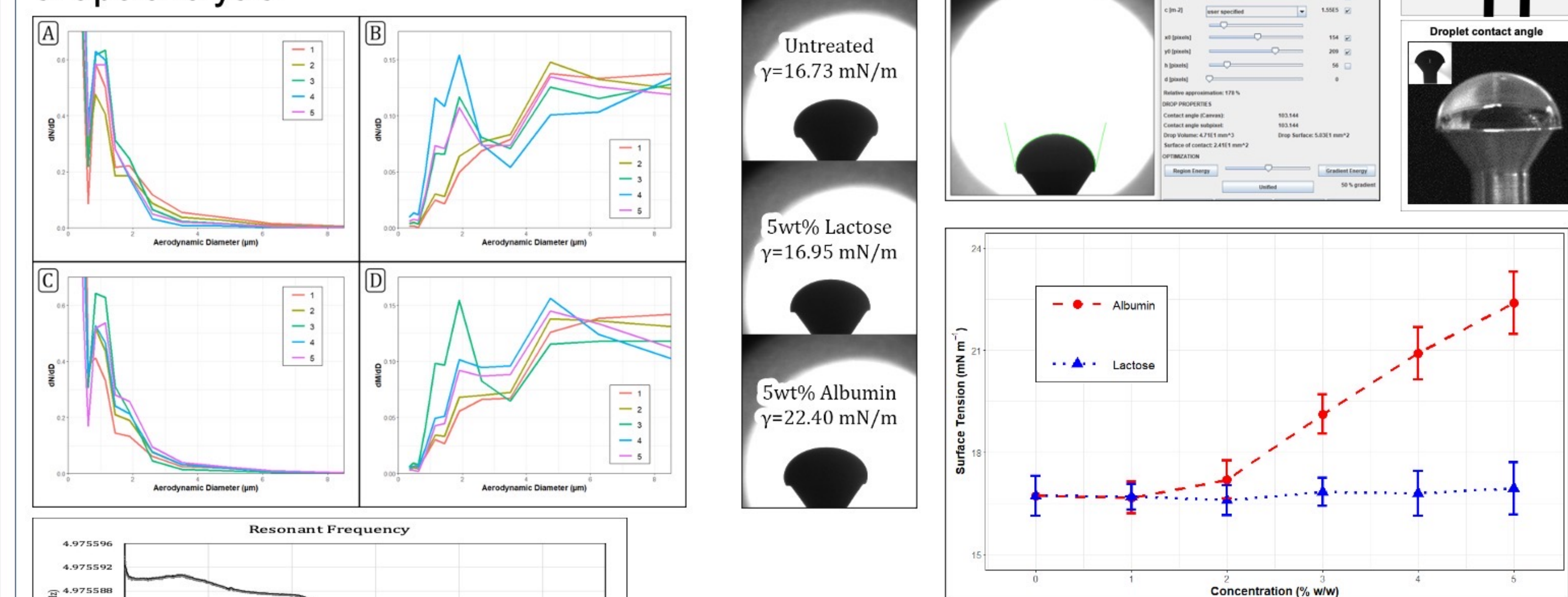
6. Improving READINESS through Performance

Compared to untreated cells, sensitizer treated cells have significant upregulation related to oxidative stress and show significant upregulation of F-actin. Known sensitizers lead to increases in mitochondrial activity as measured by oxygen species and increases in general cell activity as measured by F-actin. The physiological consequence may be an Increased risk for obstructive airway diseases and conditions which can inhibit performance.



7. Addressing RESILIENCE after Exposure

Aerosols are characterized by particle size distribution. Dose is measured by quartz crystal microbalance (QCM). Surface tension is calculated based on droplet shape analysis.



Data includes number/mass distribution vs. particle size, dose via QCM, droplet images, shape analysis, and surface tension

