



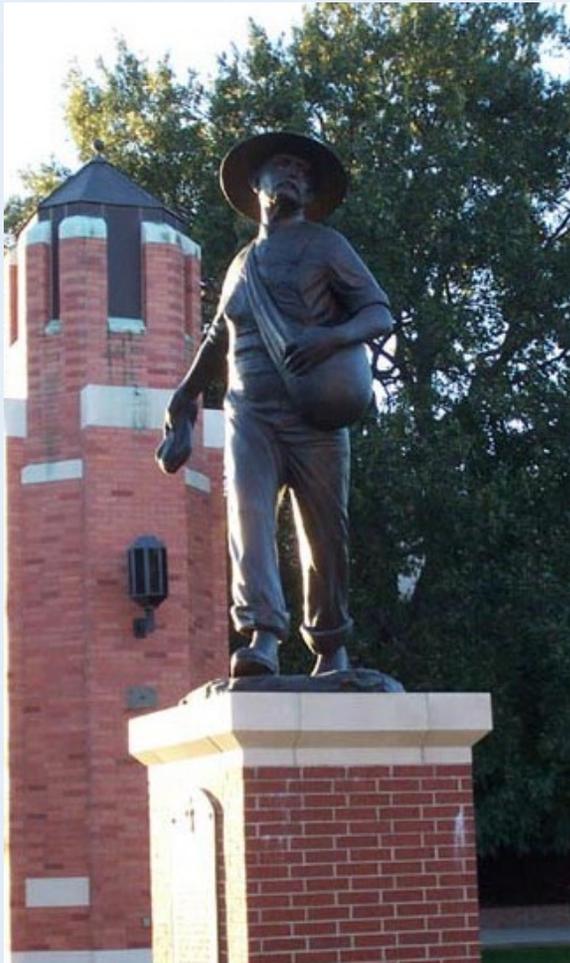
**U.S. Air Force Research Laboratory
Human Effectiveness Directorate
Cooperative Agreement FA8650-05-2-6523**



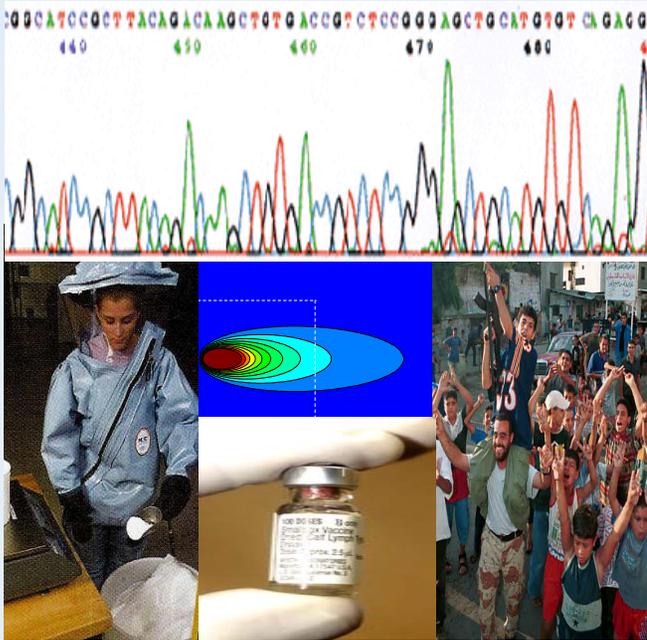
Advances in Biotechnology and the Biosciences for Warfighter Performance and Protection

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University of Oklahoma Health Sciences Center**

**Science and Technology for Chem-Bio
Information Systems
Albuquerque, NM
25-28 October 2005**



Description of Effort



- Focus on terrorist attempts to expose humans to aerosol releases of bacterial, viral, and toxin agents
- Project elements designed to expand knowledge, tools, models, and strategies
- Includes international collaboration with scientists in Israel and Russian Federation



Objective



- Support Defense Threat Reduction Agency efforts to advance state-of-the-art in high-visibility area of paramount national importance by enhancing deterrence, detection, preparedness, response, and recovery from CBRNE terrorism



Benefits to Warfighter

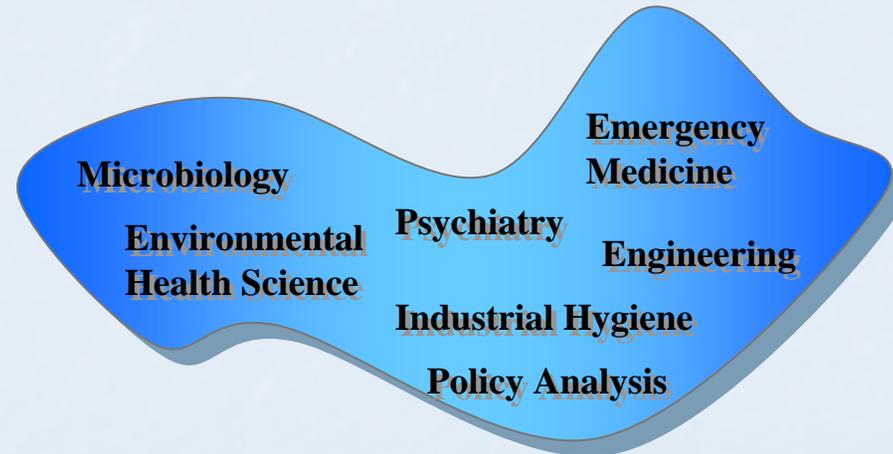


- Protect the Nation against terrorism and provide NORTHCOM and CENTCOM capabilities to support national incident response and support US forces fighting terrorism overseas

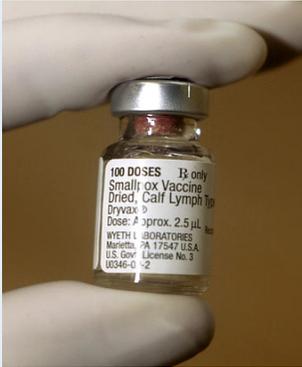
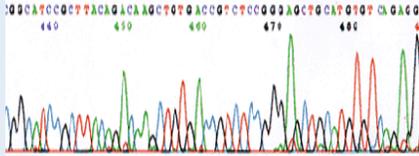
Engages a Broad-Based Interdisciplinary Team for Research Effort

Projects concentrate on four areas:

- **Biomedical Applications**
- **Threat Characterization**
- **Consequence Management**
- **Behavioral Dynamics**



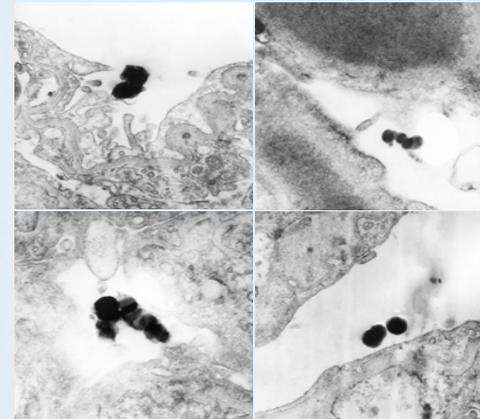
BIOMEDICAL APPLICATIONS



- **Key Challenge: Identify and model cell type-specific, cytotoxic effects and mechanism of lethality**

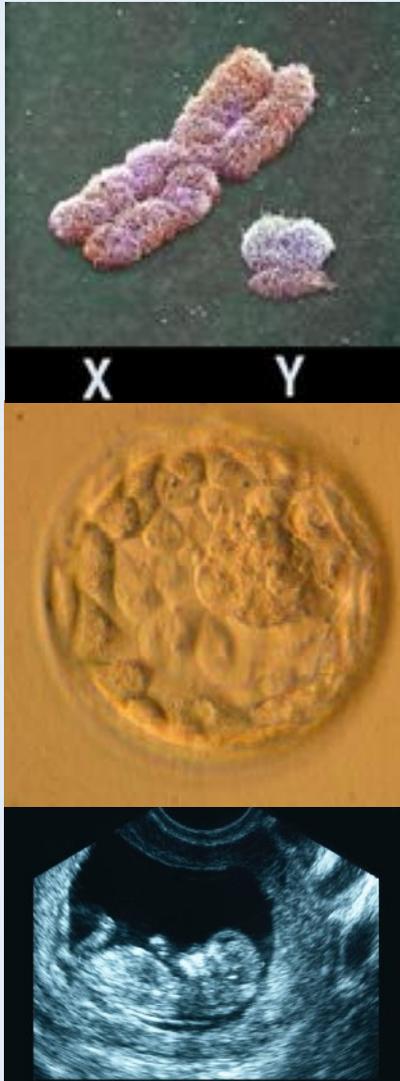
Laboratory Studies to Investigate Cytotoxicity and Immunological Consequences

- **Cell and microorganism interactions (microorganism detection and diagnostics)**
- **Immunology (antivirals and immune system stimulants/suppressors)**
- **Therapeutics**



Electron photography of sections of murine lungs with deposited soot particles. Magnification about 20,000.

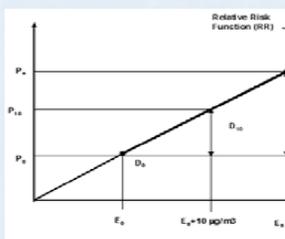
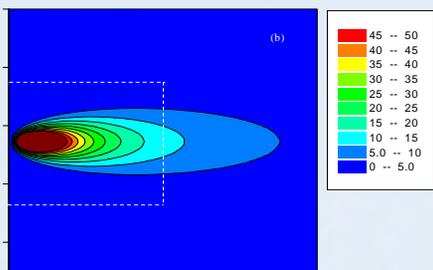
MAJOR GOALS



- **Short-Term:** Define molecular and cellular mechanisms of ET-induced cell death for possible development of therapeutics. Most research and therapeutics designed to treat late stage effects of anthrax focus on blocking LT protein complex due to assumption LT is the major virulence factor. Recent OUHSC study has found that ET is cytotoxic to mammalian cells and is more effect killer of cells than LT.

- **Long-Term:** Determine combined effects of ET and LT on cell physiology in order to develop the first comprehensive model of anthrax toxin's collective impact on mammalian cells. Total impact of anthrax toxin on developing embryos will be determined to make predictions about possible birth defects in infants from women exposed to *B. anthracis* to support diagnosis, vaccines, immunology, and therapeutics.

THREAT CHARACTERIZATION

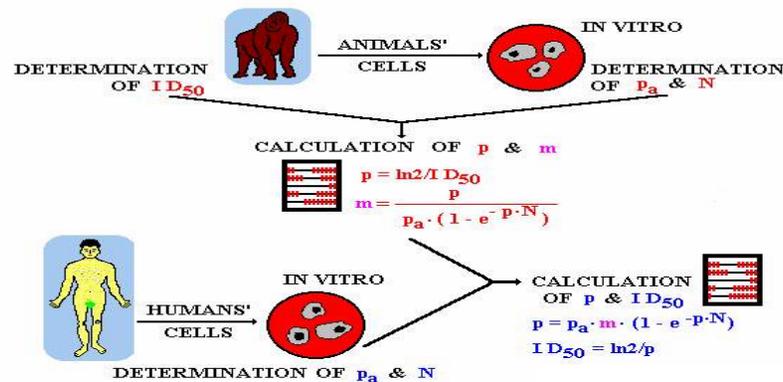


- **Key Challenge:** Model dispersion, estimate human exposures, and assess risk of aerosol releases for in-door and ambient environments

Modeling and Simulation to Investigate Bioaerosol Dispersion

- Aerosol propagation (direct, inverse, statistical)
- Methods for aerosol sampling and detection
- Measurement of particle deposition in respiratory tract

THE SCHEME OF ID₅₀ EXTRAPOLATION FROM ANIMALS TO HUMANS





Posterior View



Left Side

MAJOR GOALS

- **Short-Term:** Develop integrated develop computational fluid dynamic (CFD) predictive models of *B. anthracis* spore inhalation, transport, and deposition for physiologically accurate 3-dimensional representation of adult male, adult female, and child respiratory tract.
- **Long-Term:** Verify predictive models via laboratory experiments with representative simulants and morphologically accurate human respiratory tract airway replicas to support differential exposure-risk assessment. Exposure-dose curves for pulmonary deposition of *B. anthracis* spores in adult males, adult females, and young children under physiologically realistic breathing conditions will provide basis for infection risk assessment for various exposure scenarios and enable more effective consequence management.

CONSEQUENCE MANAGEMENT

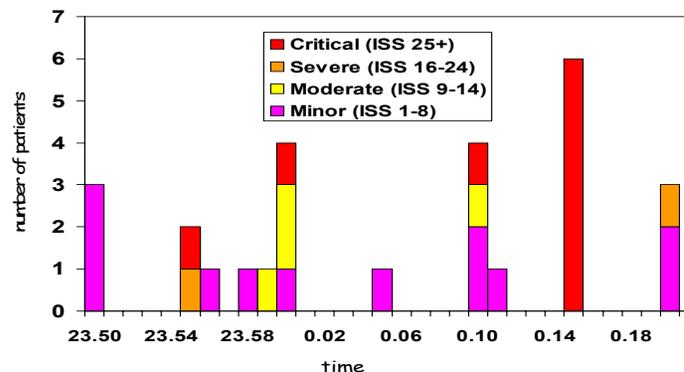


- **Key Challenge:** Delineate information requirements and knowledge transfer mechanisms for effective emergency medical systems

Investigate Strategies for Effective Preparedness and Response

- Models of system capabilities for mass casualty incidents
- Predictors of response
- Lessons learned from prior incidents to enhance resilience
- Collaboration with Israel National Center for Trauma and Emergency Medicine Research

Patient arrival by time and severity, level I trauma center



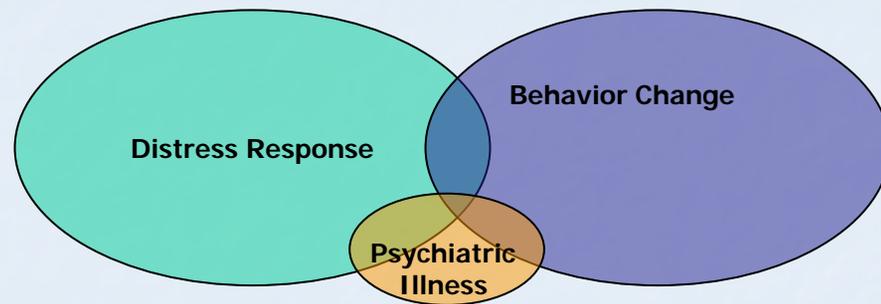
Israel National Center for Trauma and Emergency Medicine Research, Gertner Institute.

MAJOR GOALS



- **Short-Term:** Define key elements in emergency medical response to pediatric mass trauma events utilizing data from Israeli experience. Current US practice is direct transport to hospitals for triage and treatment.
- **Long-Term:** Determine applicability of mass trauma experience for bioterrorism mass casualty events in order to develop integrated model of pediatric mass casualty management strategies in the event of exposure to bacterial, viral, or toxin pathogens used by terrorists.

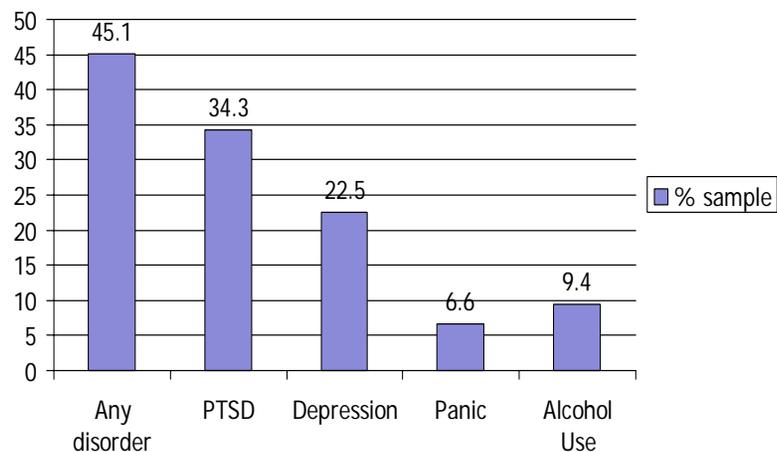
BEHAVIORAL DYNAMICS



Investigate Psychological Consequences

- Emotional, Behavioral, and Cognitive Effects (distress responses, behavioral changes, and psychiatric illness)
- Predictors of Response
- Recovery Environment
- Resilience

Oklahoma City 1995 Bombing Survivors

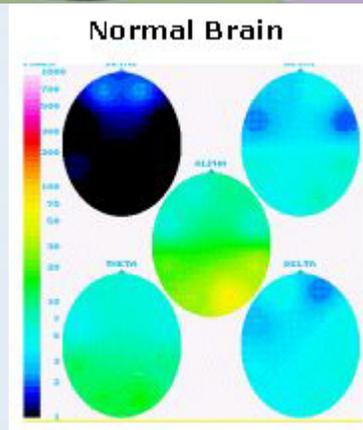


North et al. 1999

MAJOR GOALS



- **Key Challenge:** Assess impact of behavioral dynamics on terrorist actions and response to terrorism
- **Short-Term:** Apply attack-oriented analysis to identify which pathogens are of interest for bioterrorism. Identify emotional and behavioral issues specific to bioterrorism.
- **Long-Term:** Develop models for incorporating prevention and intervention approaches to emotional and behavioral health. Evaluate behavioral dynamics of terrorism to enhance counter measures.



INTERNATIONAL COLLABORATION: RUSSIA



Key Challenge: Developing effective research collaboration on projects with scientists in Russian bio research institutes to reduce the threat of bioterrorism and proliferation

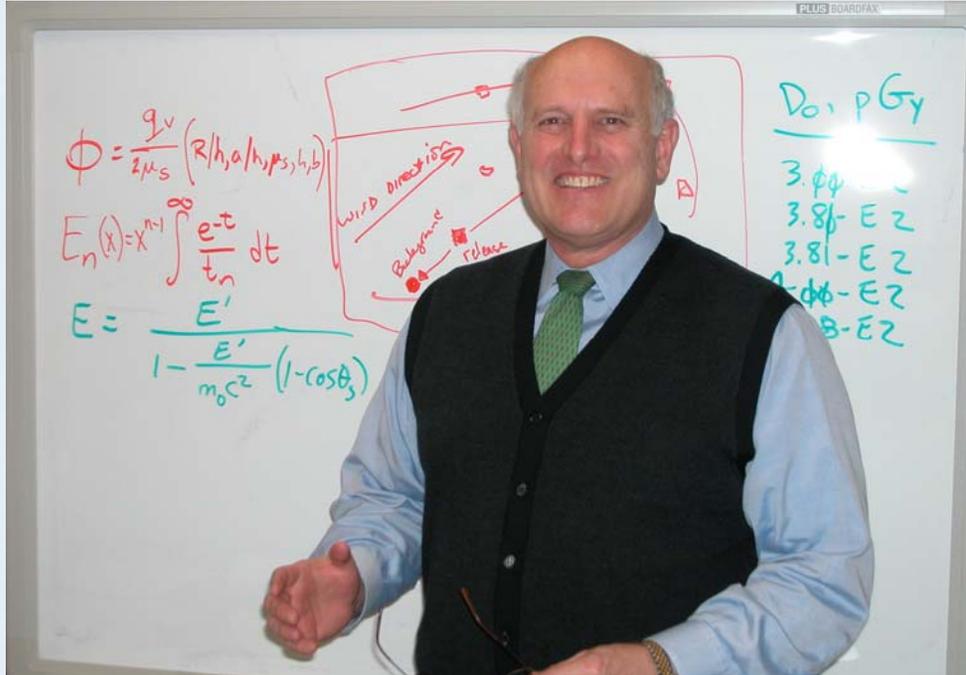
Established Contacts:

- State Research Center for Virology and Biotechnology "VEKTOR" (Koltsovo)
- State Research Center for Applied Microbiology (Obolensk)
- Institute of Immunological Engineering (Lubuchany)
- Gamaleya Research Institute for Epidemiology and Microbiology RAMS (Moscow)
- Institute of Computational Mathematics and Mathematical Geophysics SB RAS (Novosibirsk)
- Institute of Atmospheric Optics SB RAS (Tomsk)
- Institute of Chemical Biology and Fundamental Medicine SB RAS (Novosibirsk)
- Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry RAS (Moscow)

Potential collaborative research areas:

- Anthrax
- Avian Flu
- Tularemia
- Pneumonic Plague
- Aerosol Biology
- Antivirals and Novel Therapeutics

Point-of-Contact



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