

# DHS Bioterrorism Risk Workshop – Albuquerque, NM, 6-8 October 2009

Public Security Technical Program

## Canada - National Presentation



A Partnership Led by Defence R&D Canada – Centre for Security Science 

Agriculture and Ag-Foods Canada • Atomic Energy of Canada Limited • Canada Border Security Agency • Canadian Food Inspection Agency • Canadian Nuclear Safety Commission • Canadian Security Intelligence Service • Communications Security Establishment • Defence Research and Development Canada • Environment Canada • Fisheries and Oceans Canada • Health Canada • Industry Canada • National Research Council • National Resources Canada • Privy Council Office • Public Health Agency of Canada • Public Safety Canada • Public Works and Government Services Canada • Royal Canadian Mounted Police • Transport Canada • Treasury Board Secretariat

# Content

- DRDC Centre for Security Science (CSS) – Public Security Technical Programme Overview
  - Risk and Capability Section Initiatives
- Bioterrorism Related Initiatives

# DRDC Centre for Security Science (CSS)

## – Programmes

- CBRNE Research and Technology Initiative (CRTI) – CSS, Ottawa
  - Budget 2001: \$175M for 5 years, renewed in 2006
- DRDC Counter-Terrorism Technology Centre (CTTC) – Suffield, Alberta
  - Budget 2001: \$3M/year on-going
- Public Security Technical Program (PSTP) Secretariat – CSS, Ottawa
  - Budget 2005: \$15.5M for 5 years
- Canadian Police Research Centre (CPRC) – Ottawa & Regina
  - Budget 2007: \$25M for 5 years

# A Framework for the management of Public Security S&T Activities

## •Defeat CBRNE Threat

•S&T support in developing capabilities to **prevent, prepare for and respond** to CBRNE threats, whether derived from terrorist or criminal activity, natural causes or accidents.

## •Critical Infrastructure Protection (CIP)

•S&T support for the **assessment of critical vulnerabilities**; and the development of capabilities to **reduce** vulnerabilities.

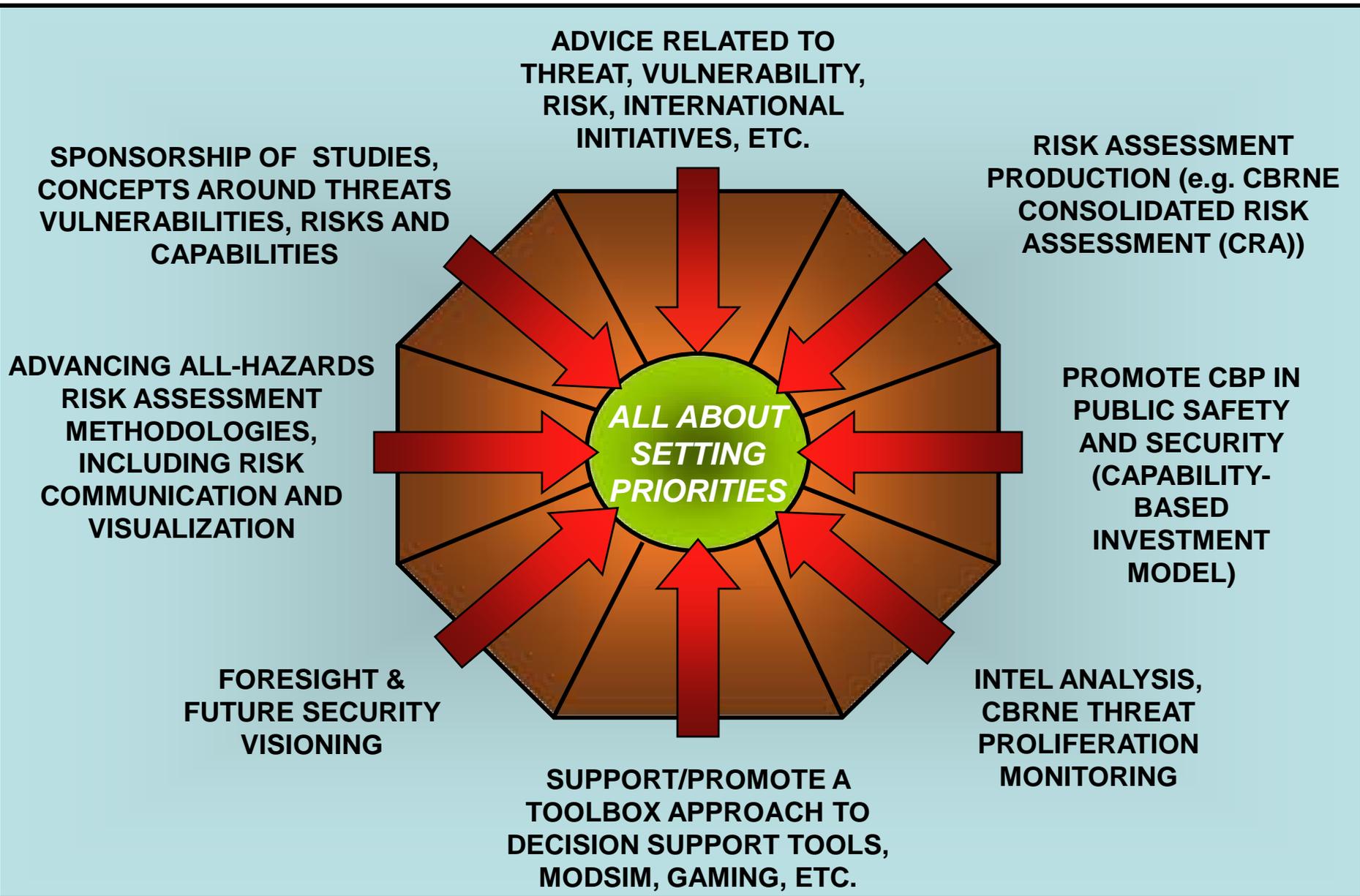
## •Surveillance, Intelligence & Interdiction (SI<sup>2</sup>)

•S&T support to develop capabilities needed to **identify and stop terrorists/criminals and their activities** such as surveillance, monitoring, disruption and interdiction of their activities.

## •Emergency Management & Systems Integration (EMSI)

•S&T support to the development of enabling standards, assessments of the Vulnerability of systems and System-of-System analyses and integration.

# CSS Risk Portfolio – At A Glance



# CSS Initiative: Public Security Capability-Based Investment Model

• **Sponsor:** CSS Risk and Capability Section

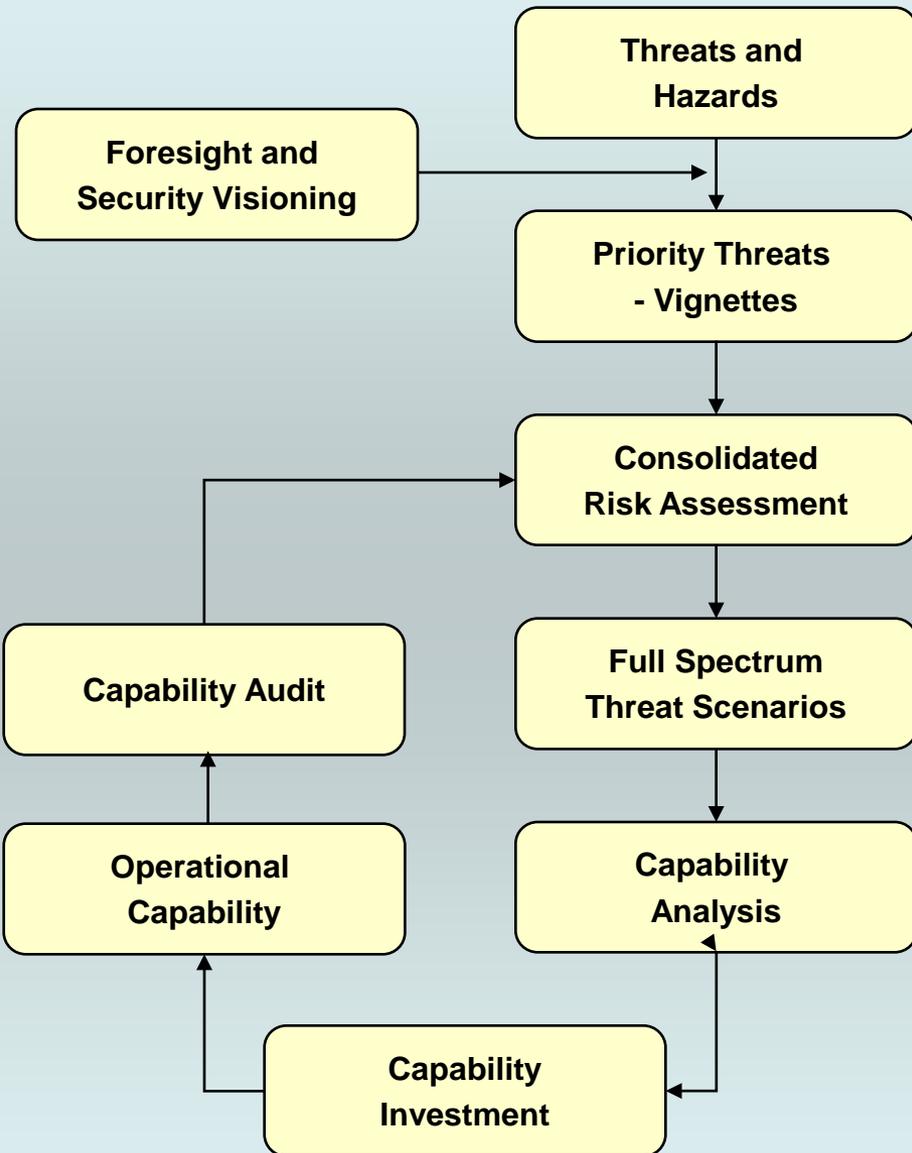
• **Objective(s):** To Implement a Capability-based investment model and associated tools to better inform public security science and technology and other capability related investments.

• **Outcomes:**

- Improved Understanding of Risks and capability options
- Promotion of pan-national understanding around the management of capabilities
- Database and other data management tools ...

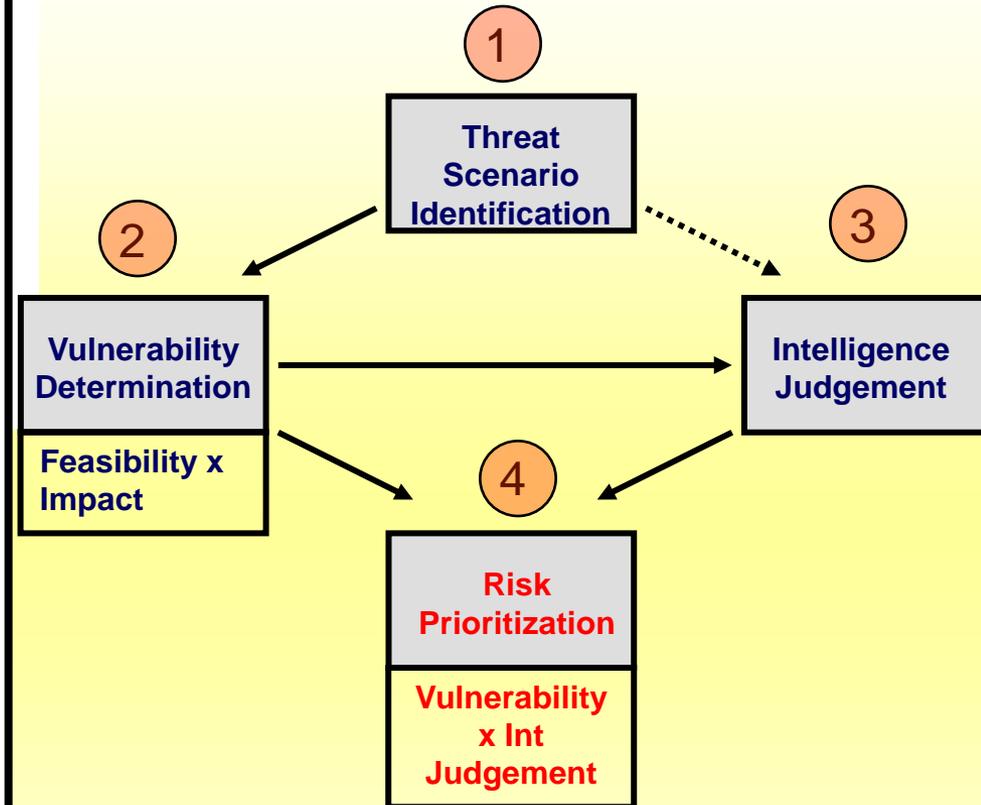
• **Outputs / deliverables:**

- Compendium (to be published) around the capabilities and capability balance of investment
- Associated data capture and management infrastructure ...



# CSS Initiative: CBRNE Consolidated Risk Assessment (CRA) Model

- **Sponsor:** CSS Risk and Capability Section
- **Objective(s):** To further improve the CRA process and implement a similar process in other public security domains (SI<sup>2</sup>, CIP, etc.). Develop the necessary tools and infrastructure to improve the data capture, collation, analysis and dissemination.
- **Outcomes:**
  - Improved Understanding of Risks as one feed into the priority setting process(es)
  - Promotion of a standard in risk assessment across public security S&T programs and capability investments
  - Better management of risk Data over time
- **Outputs / deliverables:**
  - Compendium (to be published) around the CRA Process(es)
  - Associated data capture and management infrastructure ...



# CSS Initiative: Scenario Management Framework

- **Sponsor:** CSS Risk and Capability Section

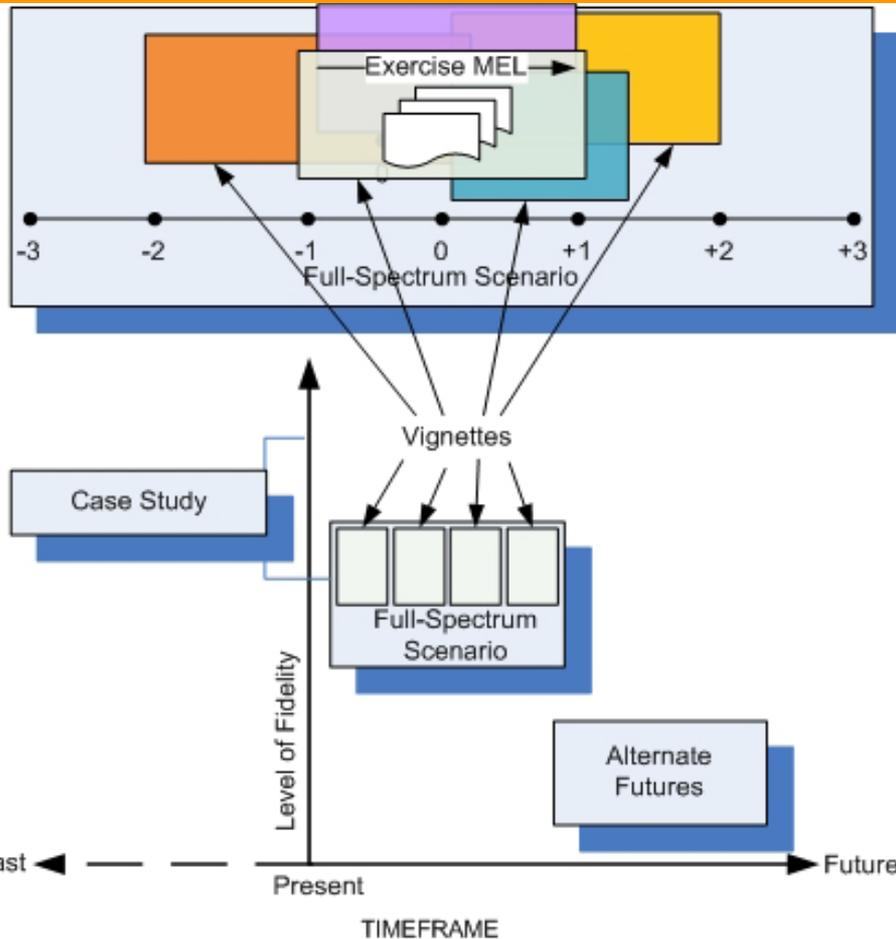
- **Objective(s):** To Implement a Scenario Management Framework and associated tools to frame public security capability analysis and capability investments.

- **Outcomes:**

- Improved Understanding and framing of Risks and capability options
- Promotion of pan-national understanding around the management of capabilities
- Scenario and capability database and other data management tools ...

- **Outputs / deliverables:**

- Compendium (to be published) of scenarios, capabilities and capability balance of investment
- Associated data capture and management infrastructure ...



# CSS Initiative: All-Hazards Risk Assessment (AHRA) Methodology Study

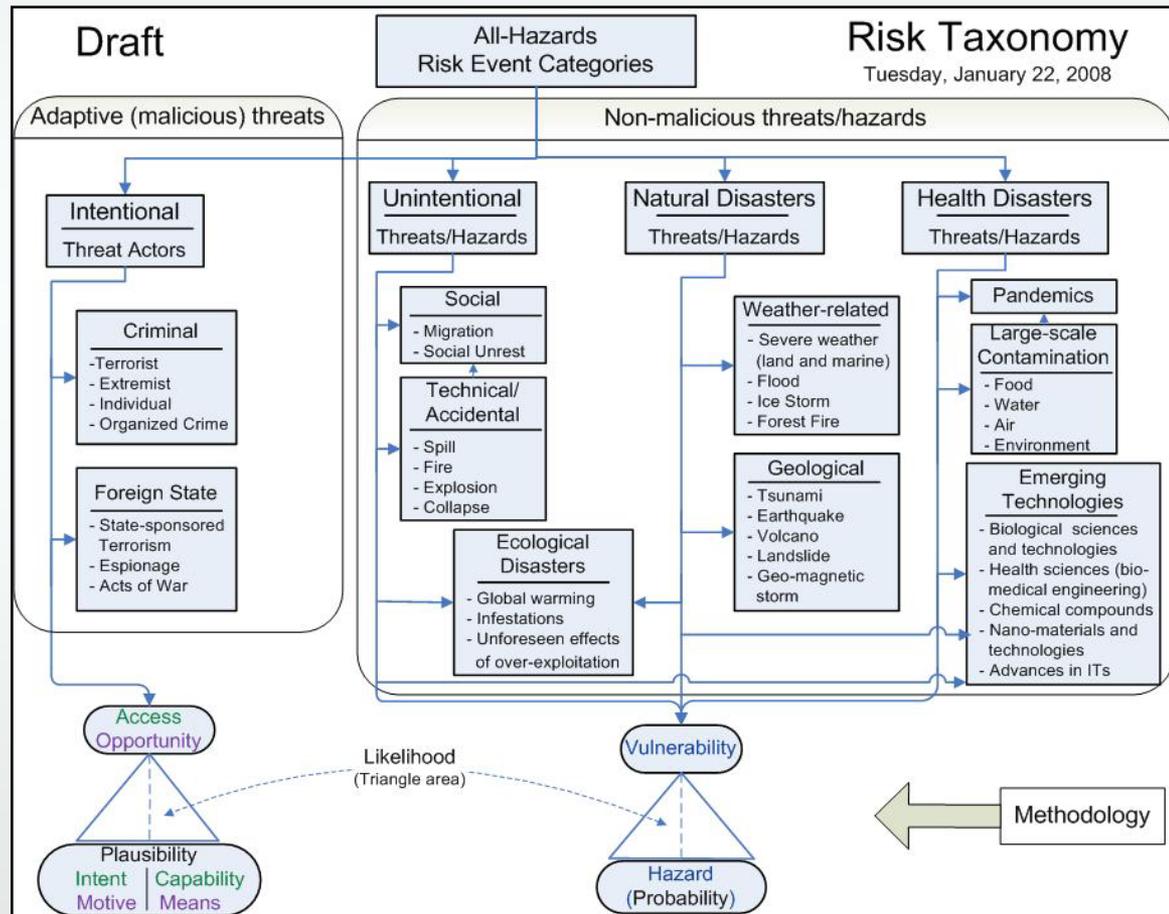
- **Sponsor:** Interdepartmental Working Group and CSS Risk and Capability Section
- **Objective:** To explore a harmonized framework for conducting AHRA across the malicious and non-malicious risk domains.

## • **Potential Outcomes:**

- Promotion of a standard language, approach, principles and methods for conducting risk assessments
- New capability to conduct risk assessments across the malicious and non-malicious risk domains
- Complementary S&T programs and capability investments
- Better management of risk Data over time

## • **Outputs / deliverables:**

- Government level All-hazards Risk Assessment
- Associated data capture, analysis, visualization and management infrastructure



# Areas of Interest

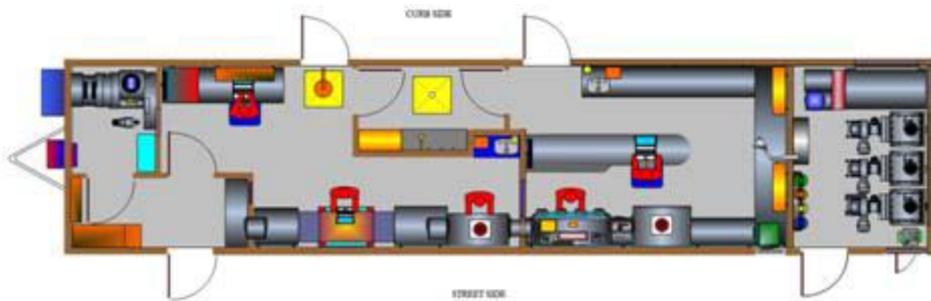
- Approaches and methods for conducting high-level (national, regional and local) Risk Assessments
- Ideas and techniques for communicating risks, uncertainty, confidence and for visualizing risks (e.g. risk maps)
- Developments in the area of the Psycho-social dimension of risk (e.g. risk tolerance, risk perception, etc.)
- Computing tools for the capture, analysis and management of threat, vulnerability, risk and/or capability related information/data
- Processes/frameworks for establishing and tracking public security S&T investments



# Bioterrorism Related Initiatives



# All Hazards Sample Receiving and Storage Capability



## Outputs:

Detailed design drawings and operations and maintenance guide for the facility.

Validated SOPs for receiving, processing, decontaminating, and forwarding submitted materials.

Real-time demonstration of the prototype facility in an operational situation as proof of concept for additional 'like' facilities in Canada.

## Objectives:

To produce a prototype facility for front-end screening, triaging, and short-term storage of suspected CBRN materials.

To develop and validate SOPs for operation and analysis within the facility.

To demonstrate operability of the facility in a live exercise.

## CRTI 05-0123TD

Delivery By: DRDC Suffield

Start/End: Apr 06/Mar 10

Total Funding: \$3.9M

Total FTE: 1.9 PY

Client Sponsors: CRTI, DHS, PSC, CF

Linkages: PHAC, PSC, RCMP, DRDC Ottawa, MTP, OPP, Toronto EMS, CFS, DHS, ECBC, PSTP, CF/CJIRU, APHL, NSWP, HO

Contact: Chris Hough

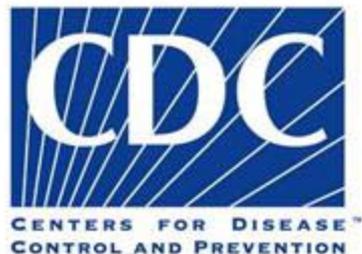
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# Laboratory Response Network (LRN) Reference Laboratory



## Objectives:

To maintain compliance/proficiency as a reference level laboratory in the CDC's LRN, to be able to provide:

- a) Biological threat agent analysis, in support of a response to potential bio-terrorism events, using validated/standardized protocols, equipment and reagents; and
- b) Surge capacity to other LRN partners.

## Outputs:

Judicially valid analysis to allow responder communities to make accurate and informed decisions.

Increased linkages with national and international partners to provide for a heightened readiness for CBRN response.

**Delivery By:** DRDC Suffield

**Start/End:** 2001/Ongoing

**Total Funding:** \$100 K

**Total FTE:** 1 PY

**Client Sponsors:** CDC, DRDC

**Linkages:** PHAC, PSC, RCMP, DHS, CF/CJIRU, CPHLN, APHL

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# Standoff Bioaerosol Chamber



## Outputs:

A fully operational and characterized standoff bioaerosol chamber.

SOPs to support operation of the chamber and evaluation of standoff systems.

Staff trained in the operation of the standoff chamber.

**Delivery By:** DRDC Suffield

**Total Funding:** \$1.1M

**Total FTE:** 2.2 PY

**Client Sponsors:** CF/DCBRND, CRTI Technical Acquisition, NATO DAT

**Linkages:** TESWG, NATO SET, BioSense TDP, DIS

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## Objectives:

- To design and build a chamber for evaluation of standoff biotectors.
- To characterize operation of the chamber using common threat simulants.
- To support testing for the Canadian BioSense System and systems from allied countries.
- To determine appropriate test methods for standoff biotector systems.



# Biological Aerosol Assessment and Detection Team (BADAT)



## Objectives:

Move existing team from 'reachback' capability to a standing or scalable capability

Train/refresh members of the team

Develop and validate new CONOPs and SOPs

Liaise with organizations with which the team may deploy

Design and attend exercises for skill develop and maintenance

## Outputs:

Validated SOPs for sampling, decon, deployment, logistics and communications

Integration with CA federal response network

Coordination with PHAC bio analysis capability

Fully trained, resourced and recognized deployable bioaerosol sampling team

**Delivery By:** DRDC Suffield

**Start/End:** Apr 08/ Mar 12

**Total Funding:** \$1.2 M

**Total FTE:** 2.7 PY

**Client Sponsors:** CF, DRDC

**Linkages:** Canada Command/SJS, PSC, PHAC

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## • TSWG T-750B: Objective Assessment of Anthrax Letter Mitigation Protocols in an Open Office Environment

### Financial Provisions

Share of tasks	FY05	FY06	Total
U.S. (CDC via TSWG)	\$678K		\$678K
U.S. TSWG	\$ 47K	\$44K	\$ 91K
<u>Canada</u>	<u>\$ 33K</u>	<u>\$36K</u>	<u>\$ 69K</u>
<b>Total</b>	<b>\$758K</b>	<b>\$ 80K</b>	<b>\$838K</b>

### •Outcomes:

- Clearly quantified risk and identified areas of weakness in existing and proposed response procedures
- Developed new protocols with reduced risk from secondary aerosolization
- Established capability to conduct further assessments

### •Outputs / deliverables:

- Kournikakis *et al* (2009) Statistical analysis of bacterial spore aerosols created by opening a spore containing “Anthrax Letter” in an office, *Aerosol Science* 40:514-22
- Kournikakis *et al* (2009) Anthrax Letters: Personal Exposure, Building Contamination and Effectiveness of Immediate Mitigation Measures, *J. of Occupational and Environmental Hygiene*. (in press)

### Objectives:

- To assess the risk of anthrax letters in an open office environment.
- Evaluate the effectiveness of existing and proposed first responder protocols using a statistically validated model system developed at DRDC Suffield.
- Establish capability to continue further assessments (Aerosol Dissemination Test Facility; CRTI FOR 008, \$600K)



# Evidence Based Risk Assessment of Improvised Chemical And Biological Weapons



## •CRTI-05-0121RTD

- Start: Jun 06
- Finish: Mar 11
- Financial: \$660,100, in kind: \$768,796
- Partners: CSIS, DRDC Suffield, RCMP, DND J2STI

## •Outcomes:

- Objective procedure for scenario assessment
- Assessed scenarios that can be used in acquisition, design, mitigation and training
- List of potential agents of concern
- List of terrorist indicators

## •Outputs /deliverables:

- Presentations at scientific meetings
- Technical reports and guidebooks

## ▪Contact:

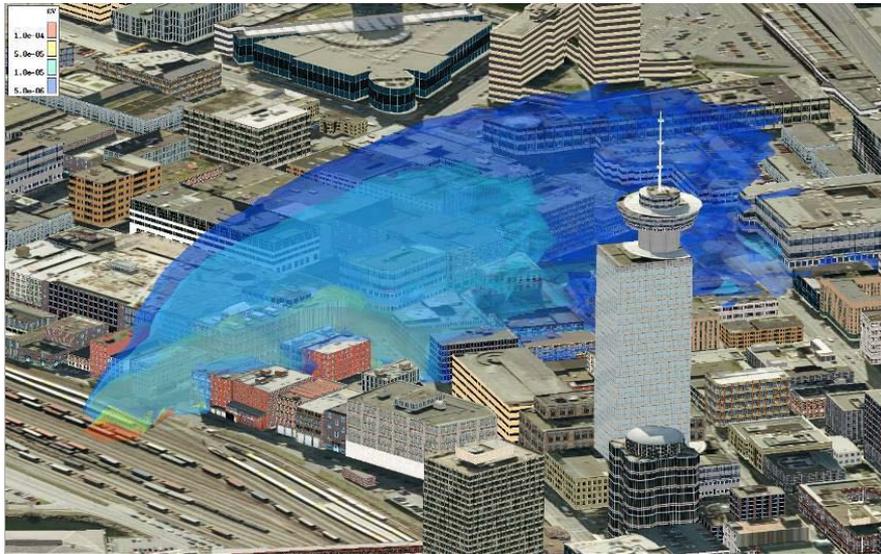
- Dr SJ Armour*
- DRDC Suffield*
- joan.armour@drdc-rddc.gc.ca*

## Objectives:

- a) To develop procedures for assessing terrorist scenarios
- b) To assess potential scenarios of particular concern in the Canadian context
- c) To identify CB agents of concern
- d) To identify indicators of terrorist activity



# Towards an Operational Urban Modeling System for CBRN Emergency Response and Preparedness



## Objective:

- To transition a validated state-of-the-science, multi-scale urban flow and dispersion modeling system towards the status of a fully functional operational system in a government operations centre (CMC-EERS)
- To provide a key-enabling technology for government operations centre to serve as 24/7 National Reachback and Support Centre for CBRN planning, real-time assessment, and emergency response in Canada

## Outcomes/Deliverables:

- Development of unique multi-scale urban flow and dispersion modeling system that will be fully integrated into government operations centre to provide CBRN operational modeling tools and services
- Products and capabilities from modeling system will be accessible to decision makers and emergency response managers at all levels of government to support the full spectrum of CBRN functions (e.g., pre-event scenario planning, emergency preparedness, response, and post-event reconstruction and assessment)
- Provide modeling support for major events of National Significance

## CRTI-07-0196TD:

**Start:** September 2008

**End:** September 2011

**Total Funding:** \$2.2 M + \$1.2 M In-kind

**Partners:** DRDC Suffield, Environment Canada

**Contact:** Dr Eugene Yee

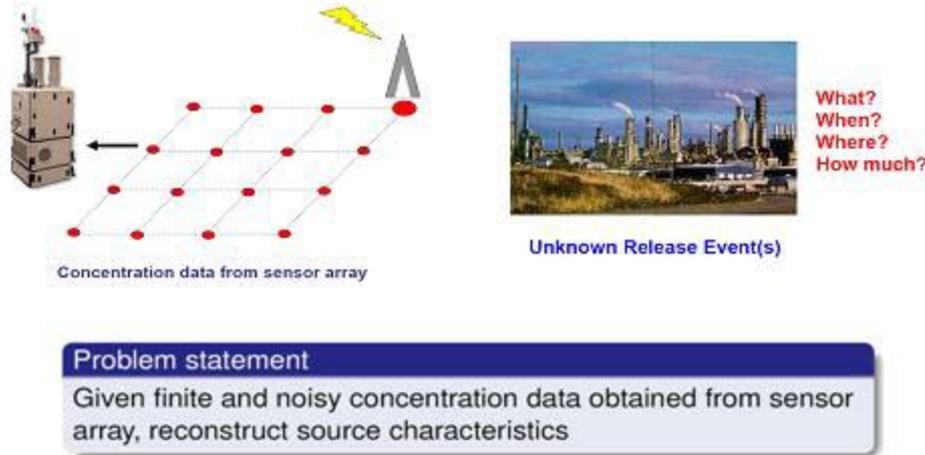
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# Adaptive Sensor/Model Data Fusion for Force Protection

## Outcomes/Deliverables:



- **24/7 National Reach Back Centre for support of civilian/military responder**
  - CBRN sensor data fused with model predictions for source term estimation
  - state-of-the-art consequence assessment and course-of-action analysis products
  - internet and Web-space technologies for rapid/timely dissemination of hazard prediction products
- **Greatly improved situational awareness and COPE for shaping battle space against CB threats**

## Objective:

- **To develop a key-enabling technology for optimal fusion of CBRN concentration sensor data with model concentration data (from advanced dispersion models) for source term characterization**
- **To provide flexible and robust data-driven modeling capabilities that are suitable for future operational integration**

## CRTI-07-0196TD:

**Start:** September 2008

**End:** September 2011

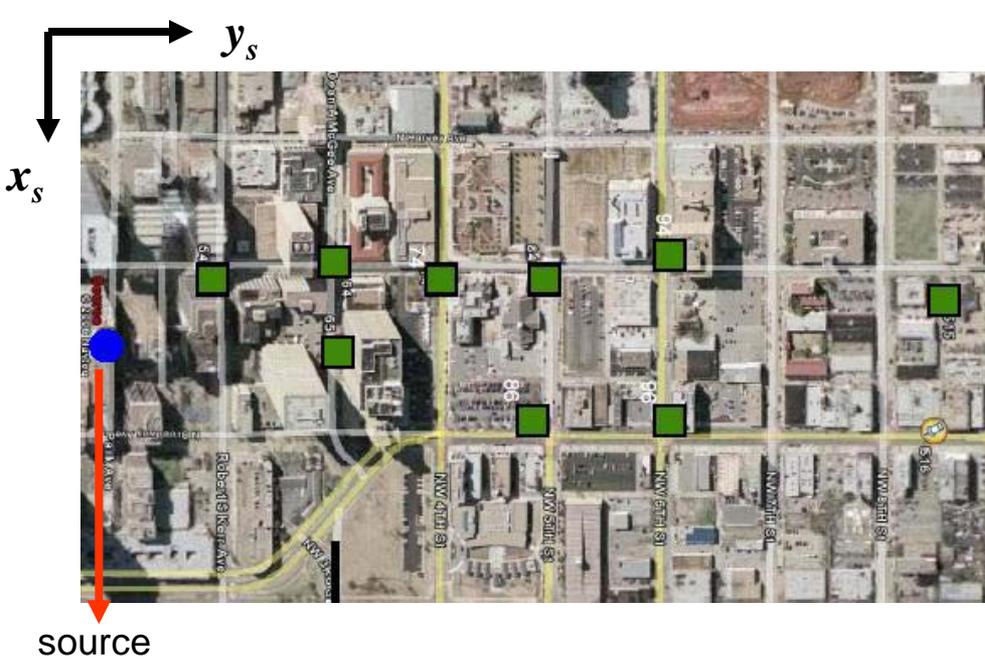
**Total Funding:** \$ 150 K

**Partners:** Environment Canada

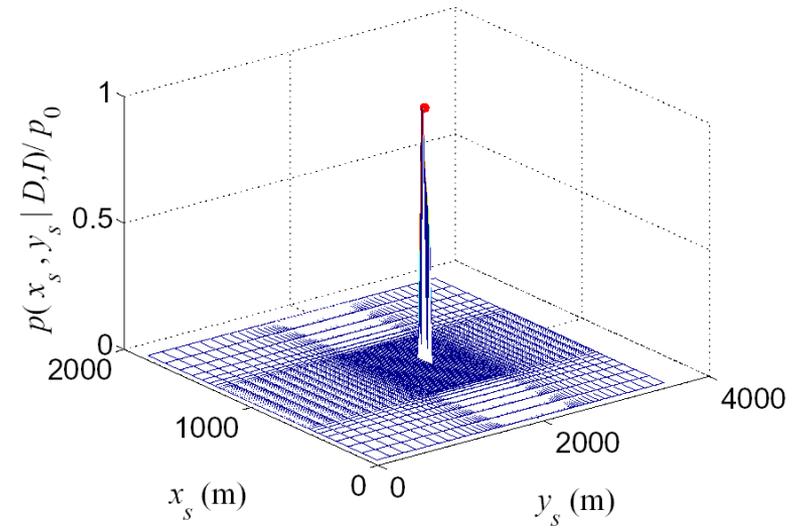
**Contact:** Dr Eugene Yee

DRDC Suffield

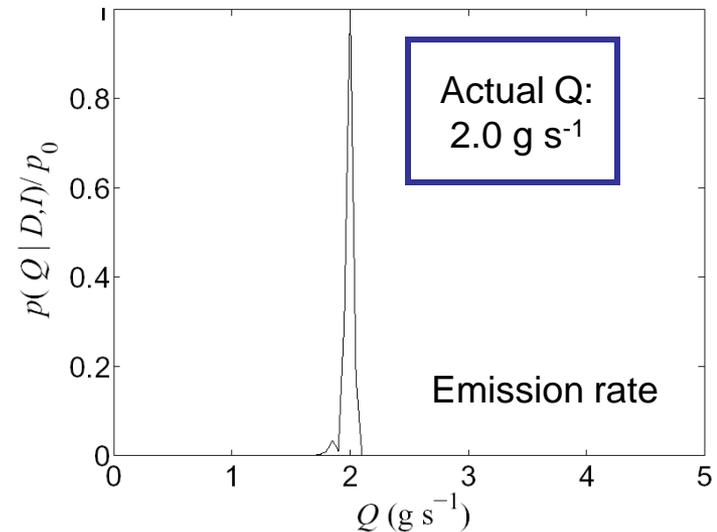
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Posterior PDF of Source Location



- Example of source reconstruction in complex urban environment
- Source location and emission rate determined using concentration measurements from 9 detectors
- Building-aware flow and dispersion models used

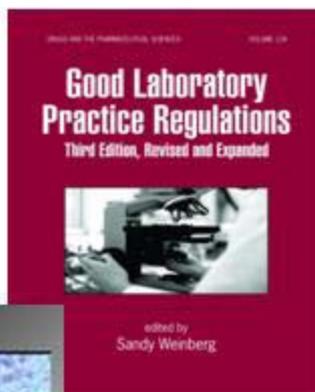


- Capability developed for inverse source determination for **clandestine** releases of CBRN agents
- Sensor-driven modeling paradigm for source reconstruction results in significantly improved situational awareness and COPE in CBRN battle space



# DRDC Suffield Biotechnology Section

- Research into medical countermeasures (MCS) to biological agents and infectious diseases (biological attack, endemic diseases)
  - focus on broad spectrum and post-exposure MCs
    - bioterrorist threat, overseas deployments
- Research in bacterial and viral pathogenesis and infectivity models
- Technology watch/incorporation: advances in biotechnology that impact medical countermeasures or new disruptive threats
- New areas for research – control of inflammation and stem cell technology



**Partners:** Canadian Forces Health Services  
Directorate Science & Technology  
Intelligence  
SOFCOM  
Health Canada  
Canadian Food Inspection Agency  
Canadian universities  
Canadian industry  
NATO Research and Technology Organization

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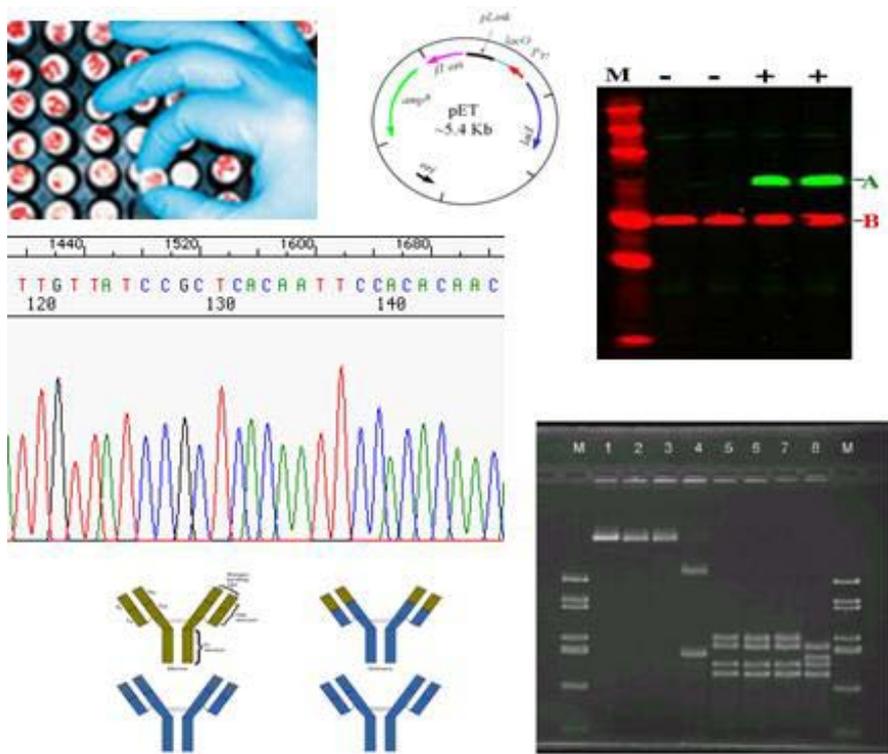
# Core Biotechnology Centre

## Objectives:

- To develop and to provide core molecular biology capabilities and deliverables for the research and development program.
- To develop and to provide core Biosafety Level 3 (BSL-3) capabilities and deliverables for the research and development program.
- To develop humanized antibody therapeutics to biological agents.

## Outputs:

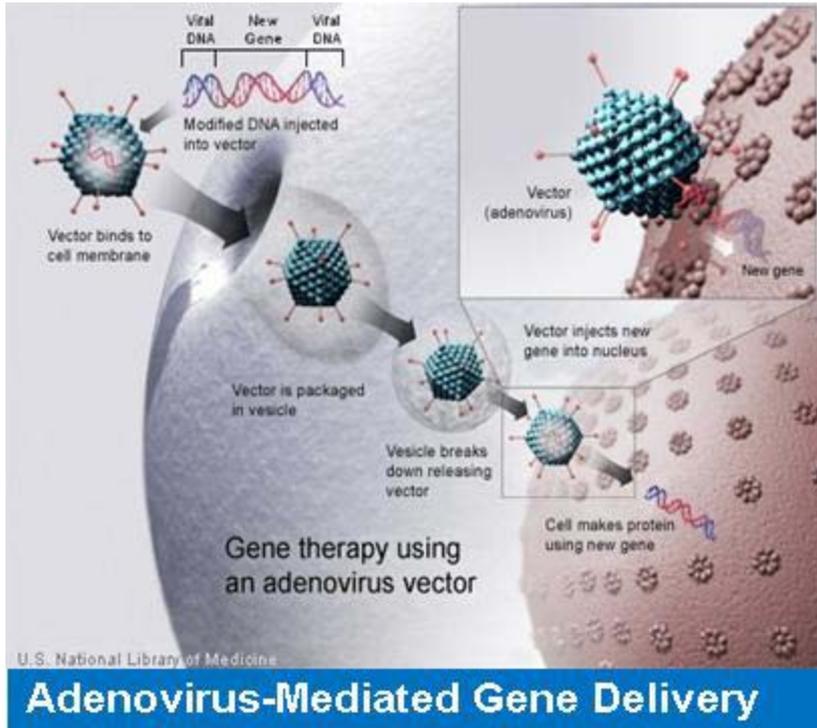
- Proof-of-concept for humanized antibodies to VEE and anthrax
- Perform DNA sequencing
- Clone and sub-clone selected genes for expression
- Produce and purify recombinant and native proteins
- Analyze of gene and protein expression in a variety of samples
- Immunological and physical characterization of cells and isolated proteins
- Design and produce new expression vectors
- Perform pathogenesis studies for BW agents in support of other DRDC projects
- Produce and inactivate antigens (and other subunits such as nucleic acids)
- Perform challenge studies of candidate vaccines and therapeutic products using animal models
- Provide core Quality Assurance/Quality Control/ Good Laboratory Practice capabilities and deliverables for the R&D program



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# Broad Spectrum Antiviral/Adenoviral Vector Technology



## Outputs:

- A trivalent adenovirus-vectored vaccine for the alphaviruses proof-of-principle demonstrated
- A broad-spectrum interferon-based therapeutics for pre- and post-exposure protection against the alphaviruses and Ebola
- Novel antiviral drug candidates by exploring the mechanism of innate immune response against viral threat agents
- Characterization of immune response to adenovirus-based vaccine for the alphaviruses

## Objectives:

- Explore adenovirus-based vector technology
- Develop vaccines and broad-spectrum therapeutics for pre- and post-exposure protection against viral threats
- Develop a single-dose, fast-acting vaccine for the alphaviruses

**Start:** April 2008  
**End:** March 2012  
**Partners:** Canadian Forces Health Services  
**Contact:** Dr Josh Wu  
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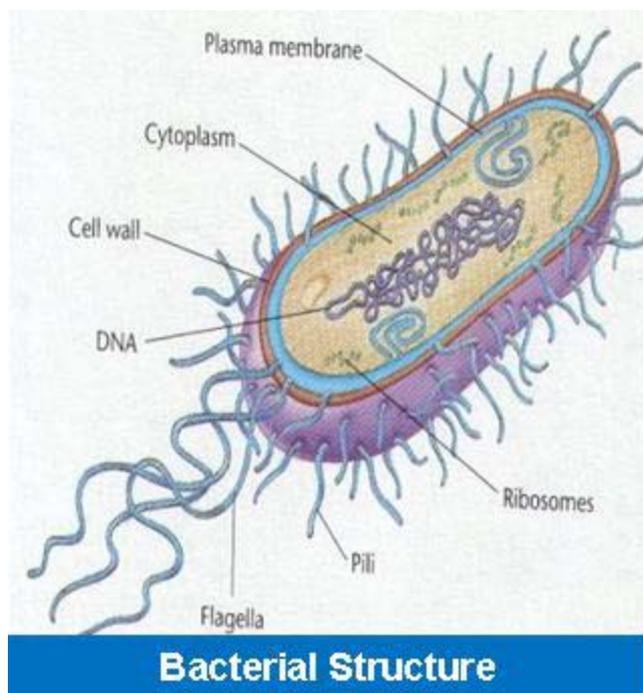
# Bacterial Virulence Factors/ Glanders and Melioidosis

## Objectives:

- Produce a single vaccine/immunomodulator that will protect/treat the CF/First Responders from several bio-threat agents
- Develop medical countermeasures against glanders and melioidosis (*Burkholderia mallei* and *Burkholderia pseudomallei*)

## Outputs:

- **Proof-of-concept for effective subunit vaccine to melioidosis/glanders**
- Cloning and sub-cloning of selected genes for expression
- Production of deletion mutants for selected genes
- Analysis of gene and protein expression in tularemia.
- Evaluation of cross-protection in *Brucella* and tularemia
- Characterization of immune response (cytokines, antibodies, T-cell subsets) to vaccines



**Bacterial Structure**

**Started:** April 2008  
**Ends:** March 2012  
**Partner:** Canadian Forces Health Services  
**Contact:** Dr John Cherwonogrodzky  
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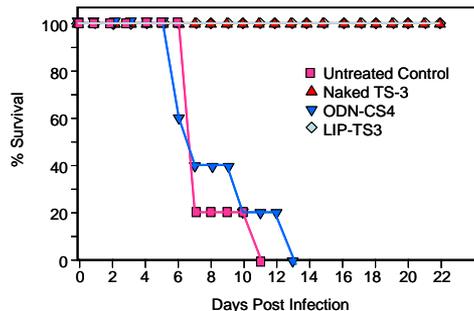
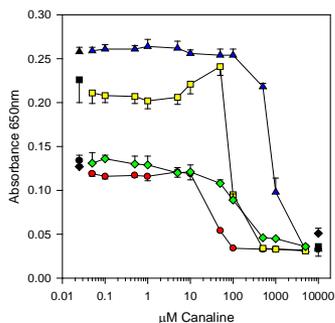
# Antimicrobial Discovery and Development

## Objectives & Rationale

- To discover and develop novel drugs and biologicals for the treatment of BW and endemic disease agents.
- Infectious diseases remain a constant threat to the Canadian Forces and the general public. The lack of effective antimicrobial agents for several identified threat agents, and the increasing evolution of drug-resistant forms of others, requires the identification and development of novel methods and agents for treating these diseases.

## Outputs:

- Evaluation of novel antiviral agents including microRNAs, catalytic nucleic acids and novel natural compounds (dengue, WEE, flu).
- Evaluation of RNA interference as an antiviral strategy (alphaviruses).
- Evaluation of novel formulation and delivery technologies, including PEGylated RNA and nanotechnology (dengue, WEE, flu, alphaviruses).
- Identification of novel drug targets in selected organisms (anthrax, TB, malaria).
- Construction of novel prokaryotic and eukaryotic expression vectors for drug targets.
- Evaluation of antibacterial agents against selected organisms (anthrax, TB).



**Started:** April 2008

**Ends:** March 2011

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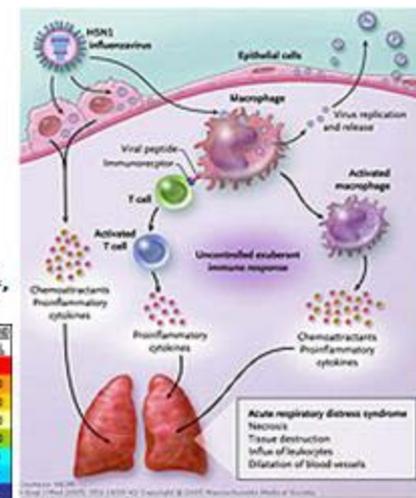
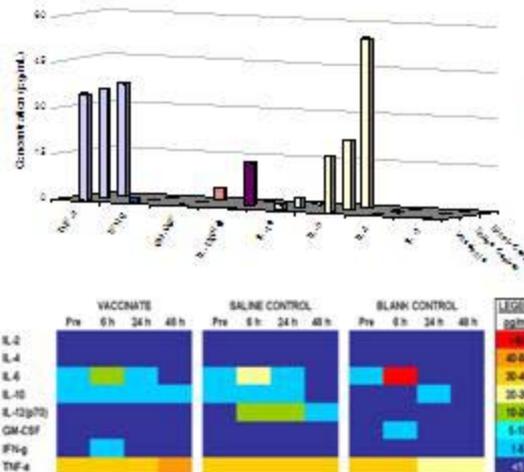


# Mechanisms of Immune Modulation

## Objectives & Rationale

- To delineate mechanisms of protection afforded by vaccine candidates and immunomodulators.
- To develop novel therapeutic agents for the mitigation of deadly cytokine storms caused by BW threat agents.
- Immune responses to vaccines and immunomodulators are complex and involve a variety of biomolecules. The multiparameter evaluation of these responses is essential for the development of countermeasures to BW threat agents. A wide range of BW agents are known to induce a severe overreactive immune response in the body, known as a cytokine storm. Medical countermeasures to control cytokine storms must be an adjunct to agent-specific therapy in order to improve survival.

**Started:** April 2008  
**Ends:** March 2011  
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## Outputs:

- Efficacy testing of oligos in appropriate models for cytokine storm.
- Pre-clinical development of PEGOS.
- Cytokine profiling of ricin exposure.
- Design and development of ricin therapeutic to enhance survival.
- **Mechanisms of protection of *Brucella* polysaccharide subunit vaccine.**
- Determine effectiveness of  $\beta$ 1-3 glucans in mouse influenza model.
- Determine mode of action for  $\beta$ 1-3 glucans against anthrax.
- Immunoprofiling of alphavirus-adenovirus vaccine.

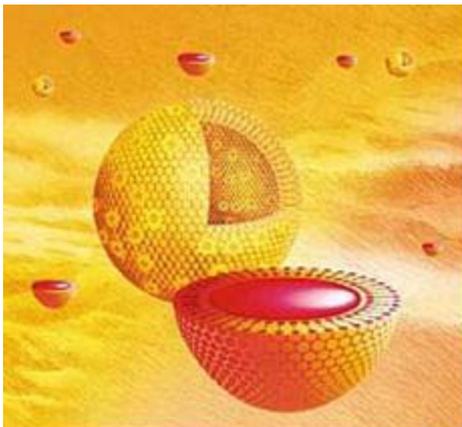


# CiproPlus

## Objectives & Rationale:

To develop a portable fieldable aerosol delivery device formulated with liposome-encapsulated ciprofloxacin for the protection of CF against inhalation forms of bacterial BW agents, including inhalational anthrax.

The respiratory tract is the most common route of entry for infection, and inhaled forms of BW agents are the most deadly and most difficult to treat. The use of aerosol drug delivery employing a liposome delivery platform offers the opportunity to achieve high therapeutic drug levels in lungs and increases the drug therapeutic index. This project aims to formulate liposome-encapsulated ciprofloxacin into a stable dry powder product for delivery by a portable aerosol inhaler device.



## Outputs:

- Completion of pre-clinical development of aerosolized liposome-encapsulated (LE) ciprofloxacin.
- Complete testing of LE Ciprofloxacin against anthrax (collaboration with Southern Research)
- Dstl to test LE Ciprofloxacin against *F. tularensis* in aerosol mouse challenge

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# Counter Terrorism Technology Centre - DRDC Suffield



The mandate of the Counterterrorism Technology Center is to leverage from the knowledge base of the CB research program at DRDC Suffield to;

1. Provide CBRNE advanced, collective **live agent training** to the Canadian Forces, domestic first responders, international military and first response groups.
2. **Test and evaluate** products for use in the CBRN threat environment for the Canadian government and industry.
3. Safely receive and process samples collected from a suspected CBRNE event to **forensics** evidence standards.
4. Provide **scientific specialist** support to agencies responding to a domestic CBRN incident.

## Statistics

FY	No of Nations	Students	Student Training Days	Actual Training Days
06/07	29	2119	7947	221
07/08	13	1596	9121	203
08/09	14	2189	14597	260
09/10 (estimate)	16	2100	15000	250

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# Food Vulnerability Assessments

**Scope:** Government of Canada is assessing vulnerabilities of the food supply to intentional contamination, a risk assessment minus Intent and Capability. All micro and chemical agents are included in the assessment.

**Systems Based:** Characterize the global supply chain for a food of interest and assess the vulnerabilities and impacts of the chain on the agent of choice.

**Methodology:** Three methodologies are being developed and/or validated: facility based, systems based and food processing step based methods.

**Food Processing Based:** Assess the vulnerability to and consequences of an intentional attack at each unique food processing step in the Canadian food supply chain.

