

# Health Effects Decision Support Tool for Civilian CB Air and Water Attack Scenarios

Presented by Dr. Shanna Collie  
Toxicologist and Project Manager, Tetra Tech  
NDIA S&T CBIS Conference



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# Outline



- Impetus for chemical/biological (CB) preparedness in civilian settings
- Needs beyond *physical* and *logistical* readiness and response
- Differences in planning for a civilian CB incident response
- Overview and findings in 2005
- Opportunities for expansion, customization, and collaboration

# CB Civilian Setting Preparedness



- Perspective via Threat and Consequence Assessment Division (TCAD) mission within EPA's National Homeland Security Research Center (NHSRC)
- Lessons learned since 2001: Recent popular press, SAB, and OMB assertions

*These provide the impetus-- but not the specific path forward-- for execution of such a daunting task*

# Lessons Learned: Capitol Hill

***EPA called on Tt to provide support activities on Capitol Hill in response to the anthrax-contaminated mail found, including WMD Response; H&S Plan Development; Oversight/Documentation; Remediation and Isolation Design; Extent of Contamination Sampling; Data Management; PPE Level A/B/C Entries; and Sp. Ops.***

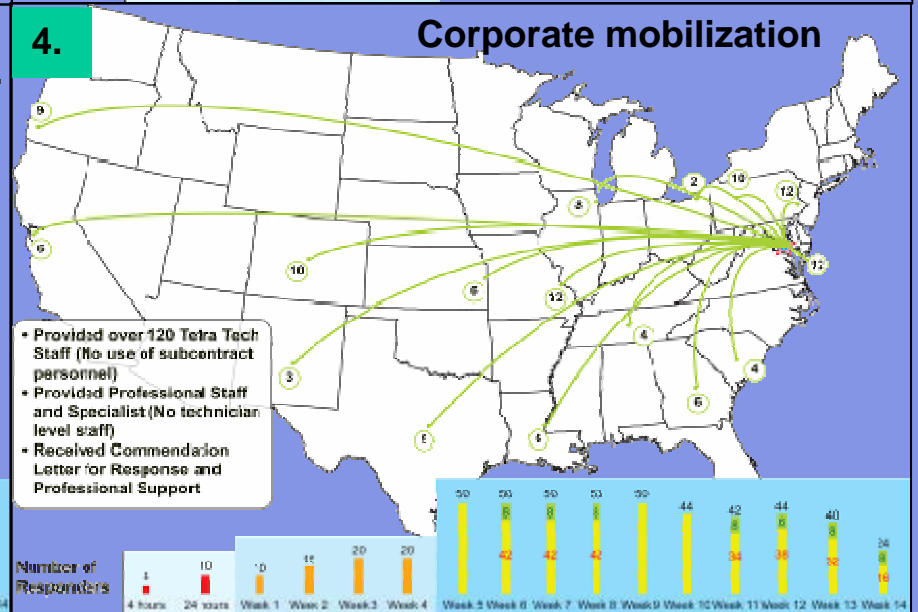
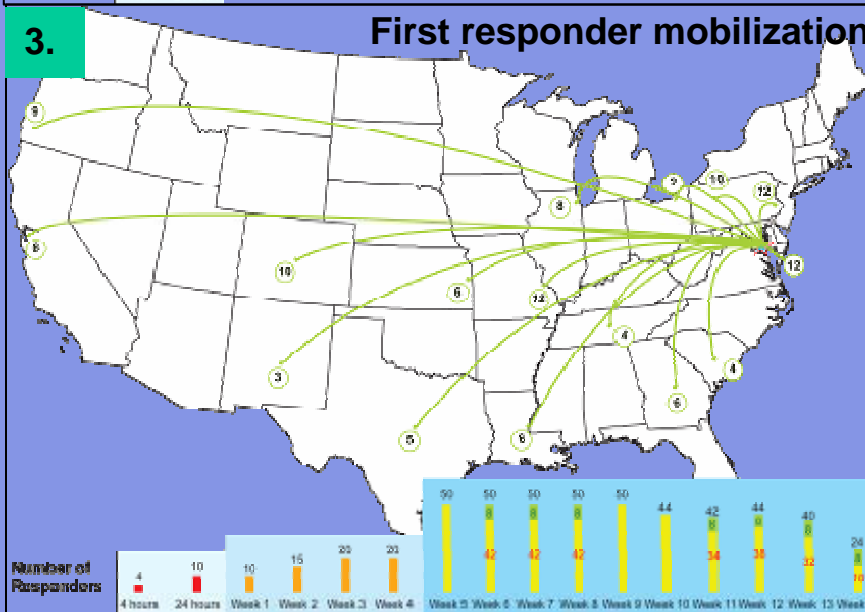
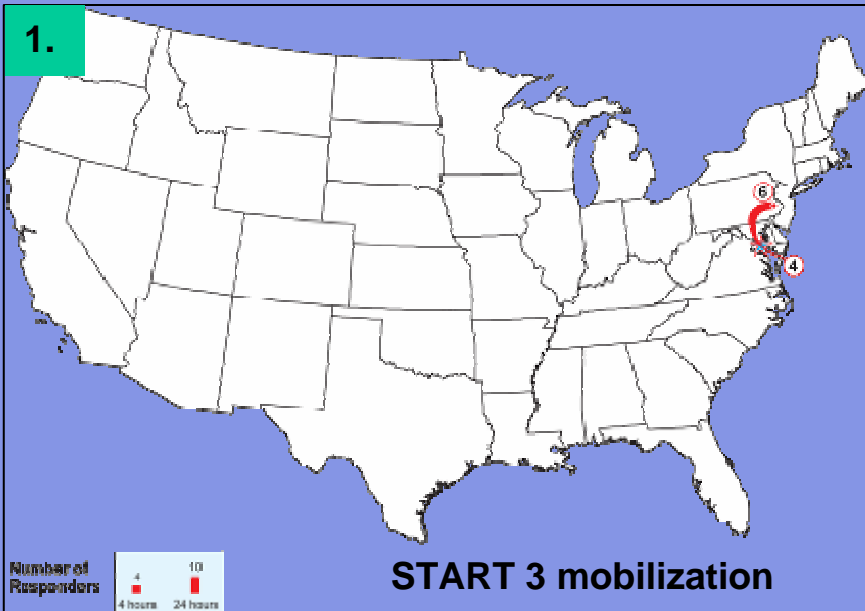


***Tt team at ClO<sub>2</sub> generator on 9<sup>th</sup> floor of Hart Building***

***Tt collecting surface wipe sample for anthrax***



# Anthrax National Response





# START Experience





# What Could It Take?

Beyond preparedness and training, we need--



- Sound scientific bases
- Rapid, transparent assessment
- Consistent, easily shared messages

*To provide for these needs, EPA NHSRC created the ECAT:  
Emergency Consequence Assessment Tool*

# What is Different in Civilian Setting?



What is the *same*?

**NEED ANSWERS FAST  
(we don't have weeks)**

What is **different**?

- Population composition
- Modeling environment
- Decision makers and drivers



*The ECAT addresses these primary differences*





# ECAT Purpose, Scope, and Goals



- Purpose: To enable pre-emergency planning for **rapid and consistent** response and risk assessment
  - Can be pre-programmed at the regional or local level
  - Intended to be flexible rather than prescriptive
  - Customize models, calculations, and specifications beforehand
- Scope: Pilot addressing 10 scenarios in a secure web-based platform for ease of access, flexibility, and utility
- Goals: To design ECAT to be scaled up without investment in reprogramming and exceed functional specs



# ECAT Users, Designers, and Testers

## Potential Users

- On-scene coordinators, responders, and science advisors
- Emergency planners and trainers
- Decision makers, administration, and management

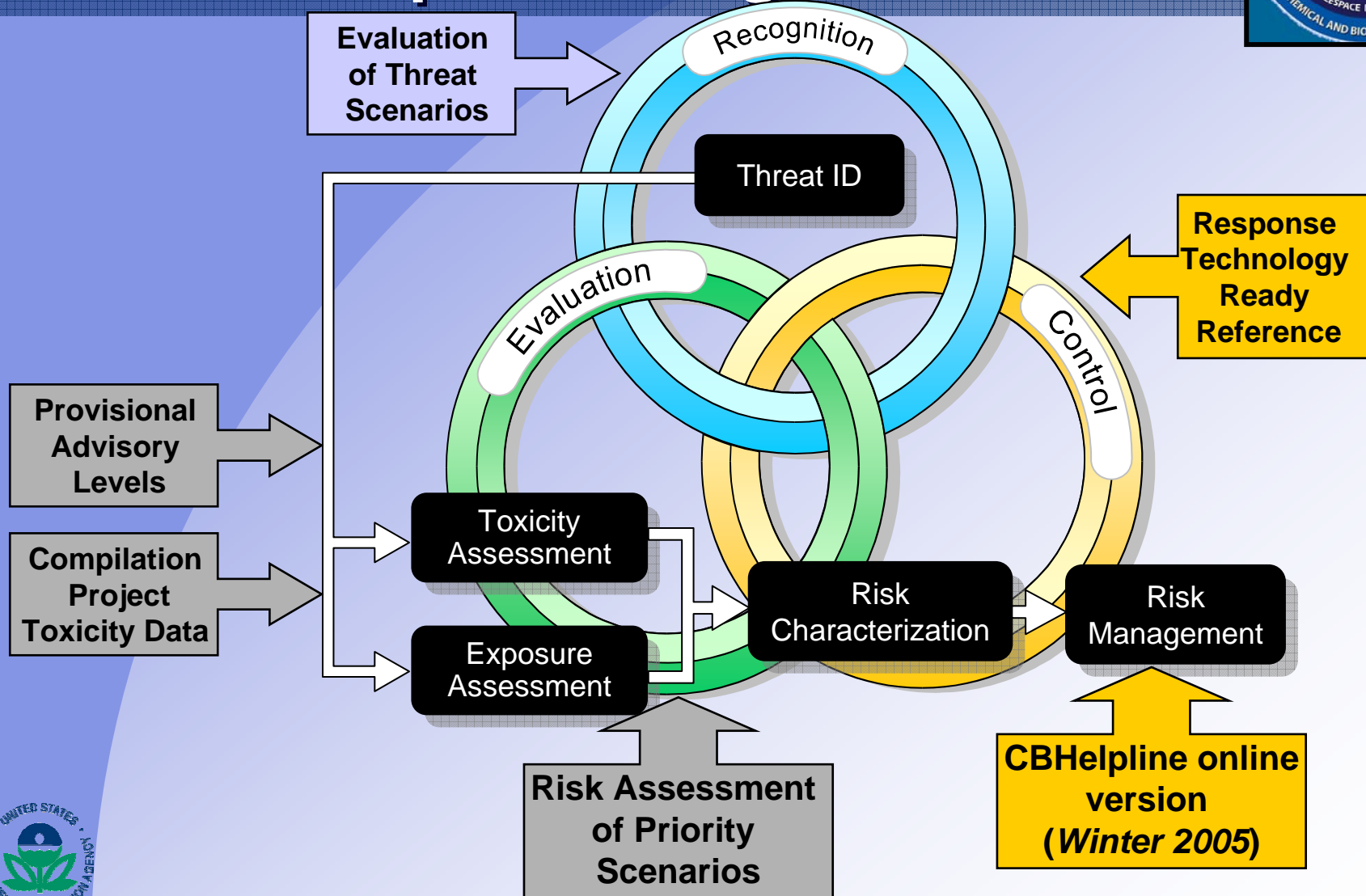
## Designers and Beta Testers

- First responders and technical experts (toxicology, models)
- 37 EPA personnel including scientists and OSCs beta tested Version 1.0 in May 2005
- 8 additional testers commented on Version 2.0 in September 2005





# ECAT Conceptual Design



# ECAT Login Screen



Emergency Consequence Assessment Tool - Microsoft Internet Explorer provided by Tetra Tech EM Inc.

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**U.S. Environmental Protection Agency**

**Risk Management**

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[EPA Home](#) > Emergency Consequence Assessment Tool

## Emergency Consequence Assessment Tool

The EPA National Homeland Security Research Center (NHSRC) has developed the Emergency Consequence Assessment Tool (ECAT) to respond to a terrorist attack involving chemical and/or biological agents.

ECAT is a Web-based application to rapidly evaluate risks to human health after exposure to a chemical or biological agent. In addition, ECAT is an informational tool to provide advice, guidance, and scientific expertise to risk managers. The functionality of ECAT centers on core elements of operational response and risk assessment paradigms. The principal elements include recognition, evaluation, and mitigation of situations involving the presence of chemical and/or biological agents. The estimation of risks provides the basis for responding to terrorist attacks involving chemical and/or biological agents.

The username and password are used to verify access to the tool.

Username:

Password:

**Enter ECAT**

If you do not have an account, click [Sign Up](#) to request one.

**Sign Up**



# ECAT Command Screen



Emergency Consequence Assessment Tool - Microsoft Internet Explorer provided by Tetra Tech EM Inc.

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Shanna Collie  
ADMINISTRATOR



U.S. Environmental Protection Agency

## Emergency Consequence Assessment Tool

Search  Go Advanced

To begin using ECAT for a new incident response or training scenario, please select the appropriate button below. Your existing records are saved under "My Records."

[New Live Incident Response](#)

[New Training Scenario](#)

### My Records

Date/Time	Event Name	Type	Risk Assessment Status	Assessment Date
You currently do not have any records. Click on a button above to initiate a new Live Incident Response or a Training Scenario.				

### Demonstration/Training Records — All Users

Date/Time	Event Name	Type	Risk Assessment Status	Author
29-JUN-05	MINNEAPOLIS MN - ANTHRAX A white powdery substance has been reportedly found in an office building in Minneapolis. The substance was found inside an envelope.	LIVE	COMPLETED	OLGA SHIROKOVA
20-AUG-05	BALTIMORE MD - SMALLPOX An anonymous call claimed that smallpox particles mixed with a powder were laced in confetti used at a recent indoor rally.	TRAINING	COMPLETED	SHANNA COLLIE
20-AUG-05	CHICAGO IL - MUSTARD GAS A 911 call from Wrigley Field during an evening game reported a mist; people are panicking and evacuating the lower deck.	TRAINING	COMPLETED	SHANNA COLLIE
19-AUG-05	ST. CLOUD MN - SARIN At daybreak, a canister marked "GB" is found inside a	LIVE	COMPLETED	SHANNA COLLIE



#### Threat Identification (Scenario Selection)

- General Information / Agent Selection
- Threat Information / Identification
- Agent-specific Information

#### Exposure Assessment

- Receptors, Pathways, and Exposure Parameters
- Exposure Concentration

#### Toxicity Assessment

- Symptoms / Health Effects
- Toxicity Values

#### Risk Characterization

- Risk Characterization
- Benchmarks/Advisories

#### Risk Management

- Evacuation / Stop Use or Reuse
- Personal Protective Equipment



# ECAT Symptom Match



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- Help
- Comments/Bugs
- Administration**
- Account Management
- Event Calculations
- Content Management
- Event Management

- Tools**
- Quick Reference Guides
- RTRR Factsheets
- Information Resources
- Risk Communication (Message Maps)
- Agent FAQ
- HAZUS Database
- Unit Conversion
- Local Weather

- External Links**
- CAMEO
- EPANET
- WCIT
- CBHelpline
- BDRTool
- Blue Book
- American Red Cross
- U.S. Coast Guard

- Notification Centers**
- Report Terrorist Activity
- NRC
- CDC

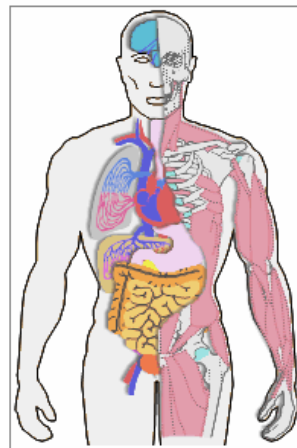
Log Out

Event Summary: Chicago IL - Mustard Gas	
Matrix: Air	Population(s): Adult(s), Pre-adolescent(s)
EPC: 8.25E-035	Pathway(s): Inhalation
Units: mg/L	Duration(s): Acute
Incident Date/Time: 08/20/05 07:54 PM	
Time Elapsed: 47 d, 16 h, 54 m	

THIS EVENT IS READ-ONLY

## THREAT IDENTIFICATION (SCENARIO SELECTION): Reported Symptoms

<< Back Cancel Save and Exit Save and Continue >>



- Symptoms**
- General Panic
  - Psychiatric
  - General
  - Skin
  - Eyes
  - Nose
  - Throat
  - Lungs
  - Heart
  - Gastrointestinal
  - Genitourinary
  - Neurological
  - Musculoskeletal

Select all boxes that apply.

- I** - Immediate symptoms
- D** - Delayed symptoms

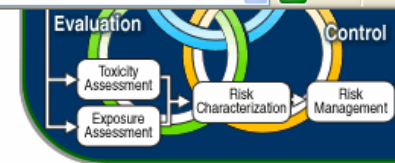
Show symptoms:  All  Mustard Gas specific

### I D GENERAL PANIC

- Blushing/Blotchy Skin
- Chest Pain/Discomfort
- Chills or Hot Flushes
- Choking Sensation/Lump in Throat
- Dizziness/Unsteadiness
- Nausea/Bloating/Indigestion
- Paleness (Skin Losing Color)
- Paresthesias (Numbness/Tingling Sensations)
- Rapid Heartbeat/Pounding Heart/Palpitations

### REPORTED SYMPTOMS: SUMMARY

Immediate	Delayed
None	None

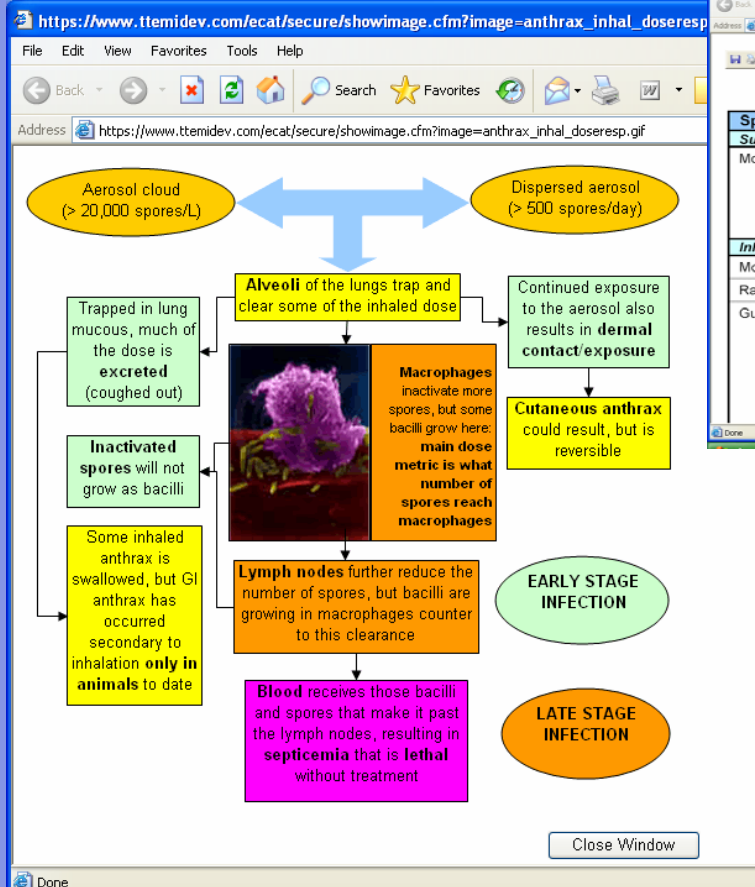


### Threat Identification (Scenario Selection)

- General Information / Agent Selection
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- Agent-specific Information
- Exposure Assessment**
- Receptors, Pathways, and Exposure Parameters
- Exposure Concentration
- Toxicity Assessment**
- Symptoms / Health Effects
- Toxicity Values
- Risk Characterization**
- Risk Characterization
- Benchmarks/Advisories
- Risk Management**
- Evacuation / Stop Use or Reuse
- Personal Protective Equipment
- Treatment
- Decontamination / Confirmation
- Cleanup Levels
- Waste Stream Disposal



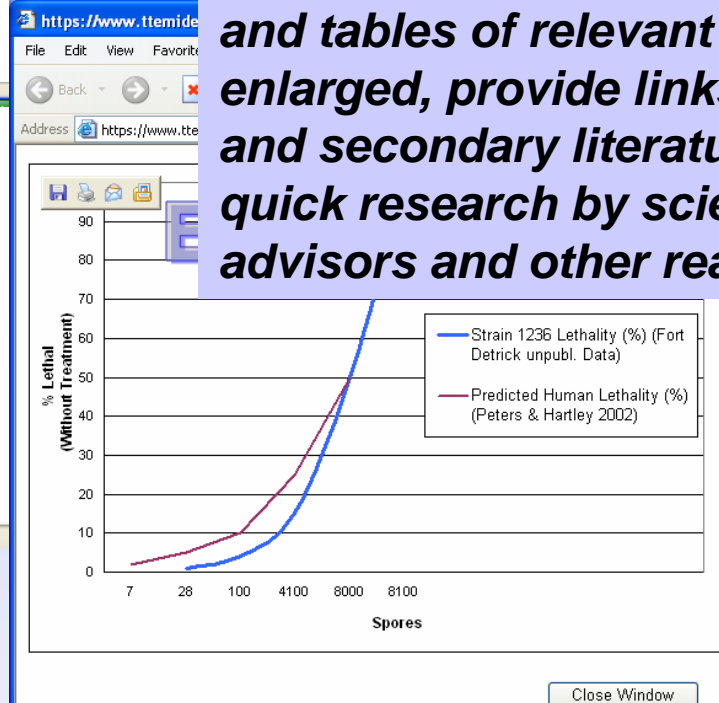
# Biothreat Infectivity Compilation



Summary of Anthrax LD<sub>50</sub>s in Animals  
(Excerpted from Watson and Keir 1994)

Species	Dose (Spores)	Comment
<b>Subcutaneous Route</b>		
Mouse	5 – 30	Virulent strain
	10 <sup>3</sup> – 10 <sup>6</sup>	Sterne strain
	11.7 x 10 <sup>6</sup>	Mean; low virulence strain
	22	Mean; high virulence strain
<b>Inhalation Route</b>		
Mouse	14,500	Virulent strain
Rat	255.	
Guinea Pig	50.0	
	55.0	

**Thumbnail dose-response curves and tables of relevant data, when enlarged, provide links to primary and secondary literature: enables quick research by science advisors and other reachback staff**



# Key Findings Overview



- Exposure and Toxicity Assessments
  - Each chemical & biological threat agent is different
  - Traditional chronic assessments are less relevant
  - Special assessments are generally not needed
  - Assumptions other than chronic are widely varied
  
- Risk Characterization and Management
  - MID opposition and biological quantification exceedingly difficult
  - Critical effect may be different than in chronic predictions
  - Collaboration comes with a cost
  - Policy decisions essential for every recommendation

***The ECAT addresses an interim proposed approach that will evolve during peer and policy review.***







# Exposure & Toxicity Findings

- Each chemical threat is different (parathion vs. GB vs. VX)
- Each biological threat is different (bacteria, viruses, spores)
- Traditional chronic exposure assessment methods are of more limited value
- Special assessments generally not needed for acute/short term minor pathways
- Assumptions other than chronic are widely varied

*Specific examples follow ...*





# ECAT Exposure Findings Example

Agency Consequence Assessment Tool - Microsoft Internet Explorer provided by Tetra Tech EM Inc.

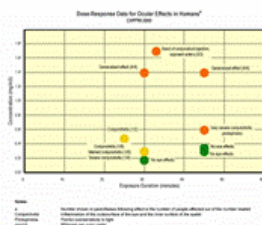
View Favorites Tools Help  
<https://www.ttemidev.com/ecat/secure/ta9a.cfm>

cancer slope factor is not well supported  
 recommended interim airborne exposure

## OCULAR EXPOSURE TO MUSTARD GAS

- Mustard gas can cause irritation
- Eye exposure to both vapor and liquid is absorbed by the eyes

Human dose-response data for ocular effects (enlarge):



## DERMAL EXPOSURE TO MUSTARD GAS

- Direct skin exposure to mustard gas can take 2 to 18 hours to develop
- Delayed and recurrent keratitis can occur after vapor exposure
- Mustard gas (liquid and vapor)

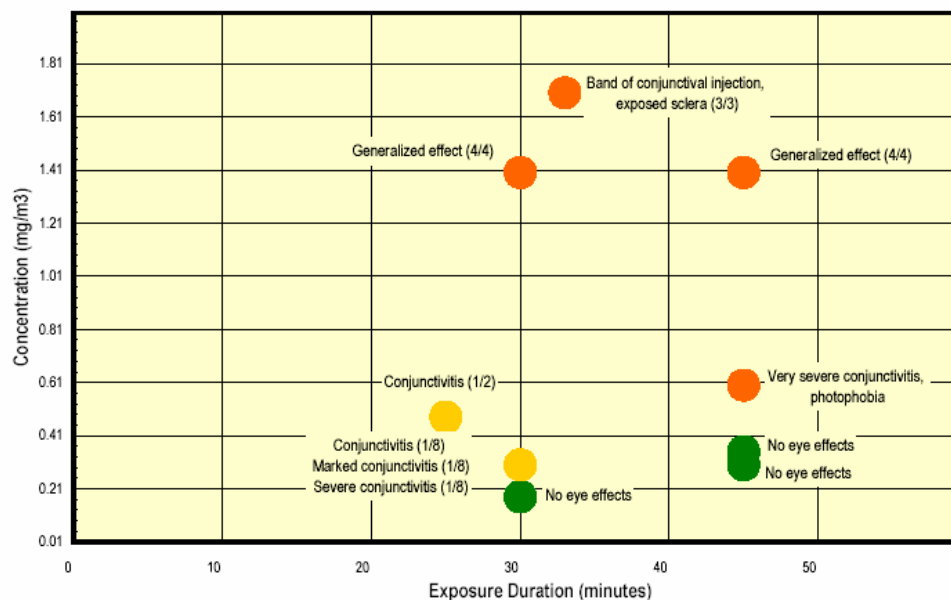
Illustration showing redness produced



[https://www.ttemidev.com/ecat/secure/showimage.cfm?image=Mustard\\_human\\_ocular\\_effects.gif](https://www.ttemidev.com/ecat/secure/showimage.cfm?image=Mustard_human_ocular_effects.gif) - Microsoft Internet Explorer provided by Tetra Tech EM Inc.

File Edit View Favorites Tools Help  
 Address [https://www.ttemidev.com/ecat/secure/showimage.cfm?image=Mustard\\_human\\_ocular\\_effects.gif](https://www.ttemidev.com/ecat/secure/showimage.cfm?image=Mustard_human_ocular_effects.gif)

Dose-Response Data for Ocular Effects in Humans<sup>a</sup>  
 CHPPM 2000



**Notes:**

- <sup>a</sup> Number shown in parentheses following effect is the number of people affected out of the number treated
- Conjunctivitis Inflammation of the outersurface of the eye and the inner surface of the eyelid
- Photophobia Painful oversensitivity to light
- mg/m<sup>3</sup> Milligram per cubic meter





# ECAT Toxicity Findings Example

Emergency Consequence Assessment Tool - Microsoft Internet Explorer provided by Tetra Tech EM Inc.

Responsive to an NHSRC comment on a prototype demo of the ECAT on April 28, the option to customize a reference dose was added. At this time, studies previously reviewed by ATSDR and other secondary sources are shown here to give the look and feel of how the function could work. Therefore, no new criteria for selection or appropriateness of an underlying primary study have been applied by the ECAT developers. Additional studies may be available and/or may be identified for use in future versions. Other studies may be available but may have been determined by ATSDR or others not to have been of sufficient scientific rigor to be tabulated in their toxicological profiles. While the data shown themselves are accurate, the inclusion or exclusion of studies on this table in Version 1.0 of the ECAT does not indicate the expanse or quality of the toxicological database for the threat agent.

SELECT TOXICITY VALUES							
Pathway: <i>Inhalation</i> RfD Type: <i>Acute (Up to 1 day)</i>							
Agent	Species	Route	Duration	Freq.	Target Organ	Effects	Values
1. Mustard Gas	Human		33 min		Eyes	Injection band over sclera	<input type="radio"/> LOAEL: 0.486 mg/kg-day
2. Mustard Gas	Mouse		60 min		Respiratory System	RD50	<input type="radio"/> LOAEL: 0.08 mg/kg-day
3. Mustard Gas	Human		15 min		Eyes	Conjunctival injection	<input type="radio"/> LOAEL: 0.03 mg/kg-day
4. Mustard Gas	Human		10 min		Eyes		<input type="radio"/> HNOAEL: 0.03 mg/kg-day
5. Mustard Gas	Mouse		60 min		Renal	Increased blood and urine uric acid levels	<input type="radio"/> LOAEL: 6.09 mg/kg-day
6. Mustard Gas	Mouse		60 min		Respiratory System	Decreased Respiratory Frequency	<input type="radio"/> LOAEL: 6.09 mg/kg-day <input type="radio"/> HNOAEL: 4.83 mg/kg-day

Uncertainty Factor: -- Select Uncertainty Factor --

Select Cancel





# Characterization & Mgmt Findings

- MID opposition and biological quantification exceedingly difficult
- Critical effect may be different than in chronic predictions (e.g., noncancer vs. cancer), in turn affecting management of risk
- Collaboration downside
- Policy and legal reviews



***The ECAT interim approach will continue to evolve during subsequent peer and policy reviews***



# ECAT Infectivity Findings Examples

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	Receptor	Pathway	EPC (cfu/L)	Contact Rate (L/d)	RfD	HI
1.	Teenager	Ingestion	800	0.75	<a href="#">10 organisms</a>	60
2.	Adult	Ingestion	800	1	<a href="#">10 organisms</a>	80

**Notification Centers**  
 Report Terrorist Activity  
 NRC  
 CDC

**Log Out**

**Risk Characterization**  
 Risk Characterization  
 Benchmarks/Advisories

**Risk Management**  
 Evacuation / Stop Use or Reuse  
 Personal Protective Equipment  
 Treatment  
 Decontamination / Confirmation  
 Cleanup Levels  
 Waste Stream Disposal Options  
 Detection Methods

**DEFINITION OF RfD AND HI IN A BIOLOGICAL CONTEXT**

At the present time, because microbial risk assessment methods are still under development and review, classic EPA terminology borrowed from a chemical context and the Risk Assessment Guidance for Superfund is adapted to give a semiquantitative measure of potential for infection based on minimum infectious doses (MID) reported in the literature.

The MID is used as a "reference dose" (RfD) for a conservative number of organisms that may cause infection. The likelihood of infection is reported as the ratio of the calculated exposure (number of organisms per day) to the MID (RfD). This likelihood of infection is a biological infection "hazard index" (HI). This system is not perfect and is a gross estimate of one "worst-case" estimate based on the infectious dose noted as the RfD. The basis of the RfD can be determined by clicking the hyperlink above, and an alternate RfD can be selected if a different infective dose is desired.

**NOTES ON INFECTIOUS DOSE (ID) ASSUMPTIONS**

The American Biological Safety Association (ABSA) reviewed the concept of the "infectious dose" in 2003 on behalf of OSHA. Findings of the ABSA as of 2003 included the following cautions:

- ABSA concluded ID values developed using past studies would not be accurate, in large part due to the "lack of a clear and universally acceptable definition of the term ID"
- Animal testing is not standardized (making comparisons difficult), extrapolation to humans is unreliable, and inbred animal strains do not represent "outbred" humans
- ID is affected by many other conditions, such as condition of the host, genetics, and previous (potentially immunity-granting) exposure
- Bacteria within a species vary widely in virulence and ID, making generalizations about the ID of a species impossible.

For these and other reasons set forth by the ABSA-OSHA Alliance, the user is cautioned that ID-based estimates are highly uncertain. To view the ABSA position on ID, click [here](#)





# Opportunities Relevant to NDIA

- Expansion
  - Natural disaster recovery and assessment
  - PR and legal reviews for risk communication
- Collaboration
  - DC DOD-EPA liaison
  - Small business partnerships
- Customization
  - Aircraft interiors and shipboard applications
  - OCONUS planning for urban landscape/int'l aid



*Possibilities are nearly unlimited*





# Acknowledgements and Contact

- Grateful for funding by EPA NHSRC TCAD
- Appreciate beta testing comments and time commitment by EPA
- Impossible without contributions by contractor team and DOE

*... and to you, for your time and attention today.*

- Kevin Garrahan, PhD, PE  
EPA NHSRC TCAD Task Order Manager  
[garrahan.kevin@epa.gov](mailto:garrahan.kevin@epa.gov) : phone 202-564-3336
- Shanna Collie, PhD  
Tetra Tech (Contractor) Toxicologist & Project Manager  
[shanna.collie@ttemi.com](mailto:shanna.collie@ttemi.com) : phone 830-537-5565

<http://www.epa.gov/nhsrc/pubs/fsECAT083005.pdf>

<https://www.ttemidev.com/ecat/login.cfm>

