Chemical Agents of Opportunity for Terrorism: TICs & TIMs

Making Sense of Toxicology: Mass Chemical Exposures: TICs/TIMs

Module 1: DHS Demonstration Cities 2015
By the American College of Medical Toxicology
Course Overview

1. Introduction / Making Sense of Toxicology
2. Why Toxic Industrial Chemicals?
3. Inhalation of Toxic Industrial Gases
4. Agricultural Chemicals of Concern
5. Cyanide and Fumigants
6. Psychological Consequences of Mass Exposure
7. Risk Communication
8. Neurotoxins
9. Water, Food & Medication as Vectors
10. Delayed-Onset Toxins
11. Post-Event Medical Monitoring
12. Tabletop Exercise
Please help us improve this course by filling out the module evaluation.

You will receive an email with instructions following the conclusion of this presentation.
Faculty Disclosure

• Dr. McKay is the Vice-President of the American College of Medical Toxicology, a professional association of physician toxicologists

  – Disclosures:
    • Principal Investigator for clinical trial (Alere)
    • Member, Science Advisory Council, Environmental Health Research Foundation

• Dr. McKay’s presentation should not be taken to represent the views, opinions, or policy of the U.S. Department of Homeland Security or the American College of Medical Toxicology, nor is it intended to promote any commercial product or service.
Medical Toxicology

• Officially recognized as a subspecialty by the American Board of Medical Specialties
• Of ~800,000 physicians in the USA, less than 700 ever board certified in medical toxicology
• ~600 physician members of ACMT board certified in medical toxicology
Examples of Medical Problems Addressed by Medical Toxicologists

- **Unintentional and Intentional Drug Overdose**
  - Therapeutic drugs; drugs of abuse; over-the-counter medicines; vitamins

- **Envenomations**
  - Snake bites, spider bites, scorpion stings

- **Ingestion of Food-Borne Toxins**
  - Botulism, marine toxins (e.g. paralytic shellfish toxin, ciguatoxin)

- **Ingestion of Toxic Plants / Mushrooms**
Examples of Medical Problems Addressed by Medical Toxicologists (2)

- **Drug abuse management**
  - In-patient care for acute withdrawal from addictive drugs and outpatient addiction management and Medical Review Officer services for industry and organizations

- **Hazardous Exposure to Chemical Products**
  - Pesticides, heavy metals (e.g. lead, arsenic, mercury), household products (e.g. cleaning agents), toxic gases (e.g. carbon monoxide, hydrogen sulfide, hydrogen cyanide), toxic alcohols (e.g. methanol, ethylene glycol), and other industrial and environmental agents

- **Independent Medical Examinations**
  - Assessing injury or disability resulting from toxic exposures
Medical Toxicologists Provide Professional Services in Clinical, Industrial, Educational, and Public Health Settings

- Emergency departments, ICU's, other in-patient units
- Outpatient clinics, offices, job sites
- Poison Control Centers
- Medical Schools, universities, and clinical training sites
- Industries and corporations (e.g. chemical, pharmaceutical)
- Governmental agencies (ATSDR, CDC, FDA, DHS)
- Clinical and forensic laboratories
Subspecialty Training Programs

• 30 fellowship programs across the US
• 2 years in length, average 2 fellows/year
• Generally affiliated with Poison Centers and academic medical centers
• Serve as educational sites for many emergency medicine residents in the US
  – Other rotating trainees include: pediatrics, critical care, medical students, pharmacy students, pediatric emergency medicine fellows
Medical Toxicology Training Programs
Chemical Agents of Opportunity for Terrorism: TICs & TIMs

United States Regional Poison Control Centers

Alaska
Guam
Hawaii
Puerto Rico
American College of Medical Toxicology

- ACMT is a professional, nonprofit association of physicians with recognized expertise in medical toxicology.
- The ACMT is dedicated to advancing the science and practice of medical toxicology.
- About 600 board certified or board eligible physicians currently practicing

www.acmt.net
## ACMT Contacts

**Region 1 (and National Network director):**

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Participant Question:
Which of the following best describes the type of work you do?

a) Clinical Medicine or Nursing
b) First Responder
c) Law Enforcement
d) Military
e) Public Health
f) Environmental/Sanitarian
g) Veterinarian
h) Laboratory
i) Administrative
j) Other
Participant Question:
Which of the following best describes who you work for?

a) Federal Government (incl. Military)
b) State Government
c) Local Government (incl. Police, Fire, EMS)
d) Educational (University, High School,...)
e) Hospital or Medical Facility
f) Corporation
g) Consulting Firm
h) Other
Participant Question:

• How many people are in attendance at your site (including yourself)?
Confusing Scene
Participant Question:
What is the “most important” thing?

a) Reestablish traffic flow
b) Identify and transport injured
c) Isolate run-off
d) Identify initiating event/vehicle
e) Determine nature of chemical hazards
f) Cordon off area and deny entry
Chemical Agents of Opportunity for Terrorism: TICs & TIMs

Module Objectives

• Be familiar with important Toxicology principles
  – Dose-response
  – Importance of a completed exposure pathway
  – Specificity of chemical effects (toxidromes)
  – Role of decontamination and PPE

• Be familiar with available resources and tools
  – CHEMM and CHEMM-IST
Dose-Response

“All substances are poisons: there is none which is not a poison. The right dose differentiates a poison and a remedy.”
Paracelsus (1493-1541)

Dose Response Curve

Response

Dose
Ethanol Intoxication

• Dose-Response: The more you drink, the drunker you get
  – 1 beer: buzz
  – 2 beers: intoxicated
  – 6 beers: uncoordinated, slurred speech
  – 24 beers: coma, respiratory arrest
Participant Question:

The concept of dose-response means:

a) All individuals will be affected by the same dose of a chemical

b) Some people will have toxic reactions to very low doses of chemicals

c) If the number of people responding to a chemical increases slowly as the dose increases, the chemical is very potent

d) Most people will respond to high doses of toxic chemicals
TICs and TIMs

• **TIC** = Toxic Industrial Chemical
• **TIM** = Toxic Industrial Material

• Chemical substance that in sufficient available quantity produces a toxic effect through inhalation, ingestion, or other route of absorption
Chemical Agents of Opportunity for Terrorism: TICs & TIMs
Module One – Making Sense of Toxicology
Hazardous Substances Emergency Event Surveillance System (9 states reporting)
Sources of TICs and TIMs (1)

- Airports
- College Labs
- Farm and Garden Supply
- Glass Plants
- Toxic Waste Dumps
Sources of TICs and TIMs (2)

Photographic Supplies

Propane Tanks

Medical Facilities

Railroads

Transformers
NATO ITF-25: High Hazard TICs

- **Tissue Irritants**
  - ammonia
  - boron trichloride
  - chlorine
  - fluorine
  - formaldehyde
  - hydrogen bromide
  - hydrogen chloride
  - phosgene
  - phosphorus trichloride
  - nitric acid
  - sulfur dioxide
  - sulfuric acid

- **Systemic Poisons**
  - arsine
  - boron trifluoride
  - carbon disulfide
  - cyanide
  - diborane
  - ethylene oxide
  - hydrogen fluoride
  - hydrogen sulfide
  - tungsten hexafluoride
Importance of The Completed Exposure Pathway

- In-flight emergency radio call:
  - Cargo plane crew “exposed to cyanide”
- Complaints of anxiety, dizziness, lightheadedness, and numbness
Listen To The Patient…Then Think

- **Symptoms**
  - Organ system-specific?
- **Dose**
  - Amount and duration of exposure
- **Exposure route**
  - Inhalation, ingestion, dermal?
“Bleach gas smell”

Forced to leave scene within minutes because of coughing, burning eyes and nose

Other statements from scene:
- Sodium nitrate
- Methanol

Positive formal identification of chlorine delayed approximately 1 hour
Some “toxidromes” Become Obvious

http://www.liveleak.com/view?i=a02_1232631612&comments=1
While Others Are “Classic”

• Fisherman pulled up a canister while dredging for clams in the Atlantic Ocean
  – Pain onset within minutes-hours
  – Blistering progressed over 24 hours

• ?

Blistering Agent (Vesicants)
Chemical Agents of Opportunity for Terrorism: TICs & TIMs
Participant Question:
A toxidrome is a group of symptoms and signs occurring after an exposure that:

a) Identifies specific chemicals responsible
b) Indicates a likely class of compounds
c) Can only be used after laboratory chemical identification
d) Readily distinguishes mixed chemical classes
e) Dictates a treatment regimen
Examples of Toxidromes as Guides to Diagnosis and Therapy

- Gasp Poisons (Knockdown Agents, Cyanide-like)
- Respiratory Irritants
  - Water soluble
  - Water insoluble
- Central Nervous System
  - Sedatives/Anesthetics
  - Opioids
  - Convulsions
- Pesticide (organophosphate) Syndrome
Chemical Hazards Emergency Medical Management (CHEMMM)

- Comprehensive, user-friendly resource that enables first responders, first receivers, other healthcare providers, & planners to plan for, respond to, recover from, & mitigate the effects of mass-casualty chemical incidents
- Collaboration between NLM & ASPR + many medical, emergency response, toxicology, industrial hygiene experts
- Available on the Internet; downloadable to PCs & Macs
Role-based Navigation and Key Features

http://chemm.nlm.nih.gov/
Mass casualty chemical incident information from CHEMM
Incorporation of CHEMM into WISER apps

Why integrate?

Users won’t remember multiple tools in emergencies/disasters

- Expands WISER’s Audience
  - 1st Responder
  - Hazmat Specialist
  - EMS
  - Hospital Provider
  - Preparedness Planner
  - Role-based content

- iOS and Android
- WISER for Windows and WebWISER
New Help Identify Tool - CHEMM-IST
CHEMM-IST
CHEMM Intelligent Syndromes Tool

- Question and answer driven
- Predicts a toxic syndrome/group as opposed to an individual chemical
CHEMM-IST is expanding the number of toxidromes from four to seven.

http://xnet.nextcentury.com/wiser/Chemmist/chemmist.htm
Module One – Making Sense of Toxicology
Chemical Agents of Opportunity for Terrorism: TICs & TIMs

You are here: Home > Medical Countermeasures Database

Medical Countermeasures Database
— antidotes, agent-specific supportive measures, and decontamination agents

This chemical countermeasures database includes extensive information about mechanism of action, clinical and non-clinical studies, pharmacokinetics and toxicokinetics, approved indications, available formulations and their shelf-life, adverse effects, contraindications, studies in progress, etc. Users should also look at CHEMM’s acute patient care guidelines for dosing and other information relevant to the use of a chemical countermeasure to treat exposures to a specific chemical.

Albuterol

Aminophylline

Amyl Nitrite

Atropine Sulfate

 Diazepam

Module One – Making Sense of Toxicology

Discovering the Event

- Introduction
- Obvious Signs of a Chemical Release
- Less Obvious Signs of a Chemical Release
- What to Look For
- Consider Other Explanations
- References

Introduction

More often than not, first responders arriving on scene will know beforehand if an event involves the accidental or intentional release of chemicals. However, there may be situations in which you will have to make a determination given only what the scene itself can tell you.

When you arrive, consider what the conditions, symptoms, and signs suggest:

- Is there anything unusual in what you see?
- Are there obvious signs that a chemical release is occurring or has occurred?
- Are there less obvious signs?

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Obvious Signs of a Chemical Release
Mass Exposure Treatment Priorities

- Is there a role for patient decontamination?
  - Gas vs Vapor vs Solid/Liquid vs unknown
  - DHS Mass Decontamination Guidance Document

Mass Exposure Treatment Priorities

- Rescuer and Caregiver Protection
  - Exposure?: Gas v. Vapor v. Solid/Liquid
  - OSHA First Receiver guidance

1) Likely exposure pathway
2) Dose (amount, time)
3) Toxidromes
4) Triage of PPE & patient decontamination needs
Summary

• A complete \textit{exposure pathway} is necessary for effect
• \textbf{Dose}: most important toxicology consideration
  – Amount/Concentration & Exposure Duration
• \textbf{Toxidrome} recognition
  – Chemical class recognition
  – Appropriate treatment focus and PPE considerations
• Resources and tools
  – National Library of Medicine
    • Hazardous Substances DataBank
    • ChemMap (TRI Data)
    • CHEMM and CHEMM-IST
  – ChemTrec
  – Poison Control Centers and Medical Toxicologists
Chemical Agents of Opportunity for Terrorism: TICs & TIMs

A Web site for easy access to these tools

Questions?

- Please click on the “raise your hand” icon 🙋‍♀️ and the host will unmute your phone line; or type your question into the “chat” box for the host to pass on to the presenter.

- If you have registered for the course, you will receive an evaluation survey (SurveyMonkey) from Info@acmt.net
  - Please complete the evaluation so we can improve these webinars.
Next Webinar: June 2015

Why Toxic Industrial Chemicals?
APPENDIX

• Additional information regarding NLM resources
NLM Disaster and Emergency Response Tools

- Wireless Information System for Emergency Responders (WISER) --- released about eleven years ago
- Chemical Hazards Emergency Medical Management (CHEMM) --- released in mid-2011
- Radiation Emergency Medical Management (REMM) --- released about seven years ago
Chemical Agents of Opportunity for Terrorism: TICs & TIMs

Updated and Enhanced CHEMM Contents

- Decontamination Procedures
- Discovering the Event
- Training and Education

![Decontamination Procedures](http://chemm.nlm.nih.gov/decontamination.htm)

You are here: Home > Decontamination Procedures

Decontamination Procedures

- Introduction
- Step 1: Set Up the Decontamination and Support Areas
- Step 2: Conduct Decontamination Triage
- Step 3: Decontaminate the Victims
- Step 4: Segregate Victims for Observation or Treatment
- Step 5: Release the Victims
- Cold Weather Considerations
- First Responder Considerations
- References
Discovering the Event

- Introduction
- Obvious Signs of a Chemical Release
- Less Obvious Signs of a Chemical Release
- What to Look For
- Consider Other Explanations
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Obvious Signs of a Chemical Release
Chemical Agents of Opportunity for Terrorism: TICs & TIMs

Module One – Making Sense of Toxicology
REM M – Radiation Emergency Medical Management

- Provides guidance to healthcare providers about clinical diagnosis & treatment of radiation injuries during rad/nuc emergencies

- Mobile REMM:
  - iPhone/iPod Touch/iPad
  - Android
  - BlackBerry
  - Windows Mobile