Chemical & Biological Terrorism:
Is your EMS System Prepared?

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Objectives

♦ Define terms and set the stage
♦ Terrorism throughout history
♦ Review specific chem/bio agents
♦ Present general EMS response
♦ Some questions, but what are the answers?
Terrorism Defined

“Premeditated, politically motivated violence perpetrated against noncombatant targets by subnational groups or clandestine agents, usually intended to influence an audience.”

- 22 U.S.C. 2656f (d)
Terrorist Groups

- al-Qaida
- Other jihadist groups
- Hizballah
- Hamas
- IRA
- Aum Shinrikyo

- Timothy McVeigh
- Larry Wayne Harris
- Ramzi Yousef
State Sponsors of Terrorism

- Iran
- Syria
- North Korea
- Sudan
- Libya
- Cuba

- http://www.state.gov/s/ct/
Chem-Bio: How Great a Threat?

♦ Greater than it used to be
♦ One more way for terrorists to strike
♦ An actual attack would most likely cause a limited number of casualties
♦ Psychological toll would be large
♦ Traditional weapons preferred
Acts of Conventional Terrorism

♦ 1993 World Trade Center bombing
♦ 1995 Oklahoma City bombing
♦ 1996 bombing of Khubar Towers
♦ 1998 embassy bombings Kenya & Tanzania
♦ September 11, 2001
♦ 2004 Madrid train bombing
♦ Suicide bombings
Iraq’s Biological Stockpile

- 1995 defection of Hussein’s son-in-law revealed stockpiles of:
  - Anthrax
  - Ricin
  - Aflatoxin
  - Enterovirus
  - Botulinum toxin (130,000 gallons)

Where are they now?
Soviet’s Biowarfare Program

♦ Defection of Ken Alibek, 1992
♦ Biopreparat
  – 40 facilities – 30,000 employees
  – Mass-produced anthrax, plague, smallpox
  – Developed delivery systems
  – Studied “chimeras,” genetic hybrids
“From October 4 to November 2, 2001, the first 10 confirmed cases of inhalational anthrax caused by intentional release of *Bacillus anthracis* were identified in the United States.”

- Centers for Disease Control and Prevention
History of Bioterrorism

- 1346: Tatars use plague victims at Kaffa
- 15th century Spanish use variola in S. America
- WWII: Japanese “Unit 731”
- 1943: U.S. offensive program started
- 1969: Nixon ends offensive program
- 1972: US destroys biological stockpile
History of Bioterrorism

♦ 1972 Biological Weapons Convention
♦ 1978: Georgi Markov killed
  – 7 September 1978 stuck with umbrella
  – Died within days
  – Bulgarians, KGB, and ricin implicated
♦ 1979: Sverdlovsk incident, 66 deaths
History of Bioterrorism

♦ 1984: Rajneeshees in the Dalles, Oregon
♦ Followers of the Bhagwan Shree Rajneesh
♦ Used Salmonella to infect salad bars
♦ 751 sickened. No deaths.
♦ Two members plead guilty
History of Chemical Terrorism

♦ 423 BC: Allies of Sparta use sulfur smoke to take fort
♦ 600 AD: “Greek fire” developed
♦ 1500s: Venice put poisons in shells
♦ WW I: French use of riot agents; Germany’s use of chlorine
The Aum Shinrikyo

♦ June 21, 1994: 7 die, 200 sickened by sarin fumes in Matsumoto
♦ March 5, 1995: 19 sickened by fumes in Yokohama subway
♦ March 15, 1995: 3 suspicious attache cases found in Tokyo subway
♦ March 20, 1995: 12 die, 4500 sickened by sarin in Tokyo subway
The Biological Agents

- Bacteria
- Viruses
- Rickettsiae
- Genetically modified microorganisms
- Toxins
Three different categories based on:

- Ease of dissemination
  - Person-to-person transmission
- Associated mortality rate
- Potential to cause panic or social disruption
- Requirement for special public health measures to respond to an attack
Category A

♦ Highest priority/potentially most dangerous. Etiologic agents for:
  – Anthrax
  – Plague*
  – Tularemia
  – Smallpox*
  – Ebola & other viral hemorrhagic fevers*
  – Botulism

* Readily transmitted from person to person
Category B

- Q fever
- Glanders
- Brucellosis
- Food safety threats:
  - *Salmonella* species
  - *Escherichia coli*

- Threats to water supplies:
  - *Vibrio cholerae*

- Biological toxins:
  - Ricin
  - Staph. enterotoxin B.
Category C

- Emerging infectious diseases such as the hantaviruses
- Organisms that are genetically-engineered or modified to increase ease of transmission or their potential mortality rates
  - Ken Alibek revealed that Biopreparat was investigating smallpox-Ebola hybrid
Category A - Anthrax

- *Bacillus anthracis*, bacterium naturally occurring in soil, among livestock
- Spores easily weaponized, indestructible
- Inhalation most common route of exposure
- Not contagious
- In untreated cases, fatality rate ~100%
Anthrax – Signs and Symptoms

- Fever, weakness, cough, chest pain
- Improvement
- Severe trouble breathing
- Shock, death
- Exposure to death: 3-10 days
Category A - Plague

- *Yersinias pestis*, the Black Death in Europe
- Killed > 50,000,000
- Spread to humans from rodents via fleas
- Contagious
- Mortality of pneumonic plague 100%
Plague – Signs and Symptoms

- Swollen nodes
- Fever, chills, weakness
- Headache
- Cough with bloody sputum
- Trouble breathing, shock, death
- Exposure to death 3-7 days
Category A - Tularemia

- *Francisella tularensis*, bacterium
- Principle reservoir is the tick
- Transmitted by rabbits ("rabbit fever")
- Readily aerosolized
- Highly infectious
  - Inhalational tularemia results from as few as inhalation of 10-50
Tularemia – Signs and Symptoms

♦ Two forms
  – Ulceroglandular
  – Typhoidal

♦ Ulceroglandular - ulcers, enlarged nodes, fever, cough, dyspnea, chest pain, pneumonia (30%)

♦ Typhoidal - smaller lymph nodes and no skin ulcers, pneumonia (80%)

♦ Mortality rate 1-2% with treatment
Category A - Smallpox

- Caused by the variola virus
- The only eradicated infectious disease
  - WHO declared eradicated in 1980
- Inhalation of 10-100 viruses causes disease
- Readily transmitted from person-to-person
- Mortality rate 30% in unvaccinated
- Two known repositories, CDC and Vector
Smallpox – Signs and Symptoms

- Incubation period of 7-17 days
- Fever, myalgias, headache, vomiting, Δ MS
- Rash appears 48-72 hours later
- Macules ⇒ papules ⇒ pustules
  - Oral mucosa ⇒ face, forearms, hands, legs, trunk
  - Lesions develop synchronously
- Chickenpox lesions start on trunk and move out
  - Develop asynchronously
Smallpox - Images
Category A – VHF Viruses

♦ Viral hemorrhage fever
♦ Ebola, Marburg, Lassa, Congo-Crimean HF
  – Ebola first reported in 1976 in Zaire, Sudan
  – Marburg reported 1967 in Marburg, Germany
♦ In the U.S., cases acquired overseas
♦ No cases of Ebola or Marburg in U.S.
  – Any case should raise suspicion for terrorism
VHF – Signs and Symptoms

- Incubation periods 2-21 days
- Fever, HA, fatigue, abdominal pain, myalgias
- Hematemesis, bloody diarrhea, mucous membrane hemorrhage, diffuse bruising, ΔMS, shock
- Mortality rates:
  - 10% (Dengue)
  - 90% (Zaire strain of Ebola)
Category – Botulinum Toxins

♦ Produced by *Clostridium botulinum*
♦ The most potent toxins known
♦ Act by blocking release of acetylcholine
♦ High lethality
♦ Easy to produce
♦ Easy to aerosolize
Botulism – Signs and Symptoms

♦ Symptoms begin hrs. to days post-exposure

♦ Neurological signs and symptoms:
  – Dysphagia, dysarthria, dysphonia, diplopia, ptosis, blurred vision, mydriasis, descending weakness, and respiratory failure.
  – Sensation remains intact.
The Chemical Agents

- Nerve agents
- Cyanide
- Pulmonary agents
- Vesicants
- Incapacitating agents
- Riot control agents
The Pulmonary Agents

♦ Chlorine
  – Water purification, disinfection, industry

♦ Phosgene
  – Synthesis of plastics, product of combustion

♦ Both used “successfully” during WWI

♦ Both can cause severe respiratory damage
  – Phosgene ➔ hydrochloric acid in lungs

♦ Treatment supportive
The Vesicants (Blister Agents)

- Sulfur mustard
  - Used during WW1
- Lewisite
- Attack skin, eyes, airways, GI tract, marrow
- Death from lung damage, shock, infection
- Treatment is supportive (BAL for Lewisite)
Mustard Agent Victim
Riot Control Agents

- CS
- CN
- Pepper spray/foam
- DM (Adamsite, vomiting agent)
- Affect eyes, nose, mouth, airways, skin
- Comfort care
The Incapacitating Agents

♦ Induce disorientation, impair performance
  – Do not kill

♦ BZ (anticholinergic, like Jimson Weed)
  – Large pupils, fast pulse, flushed skin
  – Confused, disrobing, picking behavior

♦ LSD
  – Psychedelic effects

♦ Treatment is supportive
The Nerve Agents

♦ Related to insecticides (Malathion)
  - GA (tabun)
  - GB (sarin)
  - GD (soman)
  - GF (supersarin)
  - VX
The Nerve Agents

- Weaponized by Germany in WWII, never used
- Stockpiled by US, USSR, Iraq
- Used by Aum Shinrikyo
- Threat as aerosol or liquid
- Symptoms can develop within seconds
- Highly toxic
  - 10 mg VX will kill 50% of exposed people
The Nerve Agents

♦ Inhibit breakdown of acetylcholine
  – Pinpoint pupils
  – Salivation, runny nose
  – Shortness of breath, wheezing
  – Muscle twitching, weakness
  – Seizures, coma, respiratory arrest, death
The Nerve Agents

♦ Protect self
  – Personal protective equipment
  – Decontaminate victim

♦ ABCs

♦ Antidotes

♦ Supportive care
The Nerve Agents

- Mark I kit
  - Atropine
  - Pralidoxime (2-PAM)
- Diazepam autoinjector
- The worse the symptoms, the more antidote
  - Up to 3 Mark I kits + diazepam autoinjector
Cyanide

- Found in fruits, vegetables, industry, fires
- Used in:
  - Nazi death camps (Zyklon B)
  - “Gas chambers”
  - Tylenol tampering (1982)
  - The People’s Temple (1978)
- Cells unable to use oxygen ➔ asphyxia
Cyanide

- Either kills you or it doesn’t
- Lethal in high concentrations
  - Will dissipate rapidly in open air
- Within 8 minutes see rapid breathing ➔ seizures ➔ loss of consciousness ➔ respiratory arrest ➔ cardiac arrest ➔ death
Cyanide Management

- Remove patient from toxic environment
- Remove contaminated clothing
  - Decontaminate with soap/water if on skin
- Supportive care
  - ABCs
  - 100% oxygen
  - Sodium bicarbonate
- Antidotes
Cyanide Antidotes

♦ Traditional cyanide antidote kit
  – Amyl nitrite
  – Sodium nitrite
  – Sodium thiosulfate
  – Bind up cyanide from hemoglobin, making it nontoxic

♦ Hydroxycobalamin
  – Hydroxy-B\textsubscript{12}, 4-5 g IV
  – Soon to be FDA approved
Categorization of Casualties

♦ Rapid-onset* respiratory casualties
♦ Delayed-onset respiratory casualties
♦ Rapid-onset neurological casualties
♦ Delayed-onset neurological casualties

* Rapid-onset, less than 4 hours after exposure

- Cieslak TJ. Military Medicine 2000; 165: 659-692
Rapid-Onset Resp. Casualties

- Nerve agents
- Cyanide
- Mustard
- Lewisite
- Phosgene
- SEB inhalation
Delayed-Onset Resp. Casualties

- Inhalational anthrax
- Pneumonic plague
- Pneumonic tularemia
- Q fever
- SEB inhalation
- Ricin inhalation
- Mustard
- Lewisite
- Phosgene
Neurologic Casualties

- **Rapid-onset**
  - Nerve agents, cyanide

- **Delayed-onset**
  - Botulism (peripheral symptoms)
  - VEE (CNS symptoms)
Exposures for which Definitive Therapy is Critical

- Respiratory casualties
  - Nerve agents
  - Cyanide
  - Inhalational anthrax
  - Pneumonic plague
  - Pneumonic tularemia
Exposures for which Definitive Therapy is Critical

- Neurological casualties
  - Nerve agents
  - Cyanide
  - Botulism
Algorithm-Based Therapy

♦ Rapid-onset respiratory casualties
  – Mark I kits and diazepam
  – Cyanide antidote kit*

♦ Delayed-onset respiratory casualties
  – Ciprofloxacin or doxycycline

* Consider if patient fails to respond to Mark I kits and diazepam
Algorithm-Based Therapy

♦ Rapid-onset neurological casualties
  – Mark I kits and diazepam
  – Cyanide antidote kit*

♦ Delayed-onset neurological casualties
  – Botulinum antitoxin therapy

* Consider if patient fails to respond to Mark I kits and diazepam
Response to the Threat

  – Nunn-Lugar-Domenici Act
  – Set aside $35 million for training and to establish metropolitan medical response teams
  – Training of local providers by D.O.D.
  – U.S. Army Soldier and Biological Chemical Command lead agency
Key Components of Response

♦ Preparedness and prevention
♦ Detection and surveillance
♦ Diagnosis and characterization
♦ Response
♦ Communications
Preparedness and Prevention

♦ Update local disaster plan to incorporate chem-bio terrorism
♦ Consider stockpiling needed supplies and pharmaceuticals:
  – PPE, Mark I kits?, cyanide antidote kits?
♦ Get educated (CDC, USAMRIID websites)
♦ Interface with other agencies
♦ Practice
Preparedness and Prevention
Philadelphia

♦ Some local training experiences:
  – Keystone 98 (simulated sarin release)
  – Bioterrorism tabletop drills: 1999 & 2002
  – Army-Navy Games
  – Y2K
  – RNC 2000
  – Annual activations of EOC
Bioterrorism Preparedness Training Exercise, June 5, 2002

Limited smallpox outbreak

Raised several EMS issues:
  – What kind of PPE?
  – Would there be enough PPE?
  – How to track patients and exposed personnel?
  – How to decontaminate the vehicle?
  – Should personnel be vaccinated?
    • Anthrax, smallpox
Detection and Surveillance

♦ Chemical terrorism - sometimes obvious based on classic sx or device found
  – M8/M9 paper: liquid nerve, blister agents
  – M2561A kit: cyanide, blister, nerve agents
  – CAM: detects nerve, blister agents as vapor
Detection and Surveillance

- Biological incidents may be covert
- Know the clues:
  - Evolve over days
  - Health Dept.'s role
  - Cluster of patients
  - High infection rate
  - Unusual organism
  - Unusual location
  - Unusual signs/sx
  - Point source
  - Dead animals
  - Lower attack rates in protected
Detection and Surveillance

SMART Tickets field-test kits:
- High false positive rate
- May need up to 10,000 spores to turn positive
Detection and Surveillance

♦ Surveillance: passive or active
  - Passive: voluntary reporting of disease by health care providers
  - Active: public health officials actively seek data from hospitals, MD offices

- CDC’s EMERGEncy ID NET
- Allows for earlier detection/response
Diagnosis and Characterization

- Easier for chemical terrorism incidents
- Diagnosis of bioterrorism difficult for EMS
- Isolation of some organisms requires BL-4 lab, only available at CDC and USAMRIID
- Leave to the experts
Response

- Establish command structure
- Staging of resources
- Location and rescue of victims
- Triage, transport, definitive care
- Scene mitigation
Unique twists
- Unfamiliar agents
- Need for PPE
- Need to decontaminate?
- Special antidotes
- Need to track patients
- Potential for widespread panic
- Crime scene considerations
Personal Protection Equipment

♦ Must ensure safety of rescuer
  – Level A PPE
  – MOPP gear
  – Standard bunker gear, taped up, with SCBA protective for short periods

♦ For bioagents, cover gown, respiratory protection, face shield, gloves if contagious
  – Change between patients?
Decontamination – Why?

♦ Remove chemical agent from the victims
♦ Protect response and medical personnel
♦ Offer psychological comfort to victims
Decontamination – How?

- Available resources
- Number of potential victims
- Number of symptomatic victims
- Age of victims
- Outdoor ambient temperature
Mass Casualty Decon Principles

- Expect > 5:1 ratio of unaffected/affected
  - The “worried well”
- Decontaminate victim as soon as possible
- Disrobing (head to toe) is decontamination
- Flushing with H₂O very effective
- Emergency responders exposed to liquid agent should be decontaminated ASAP
Temperature & Decontamination

- 65 degrees considered “breakpoint” for outdoor decontamination
- Below 65, individuals hesitant to undergo decon. due to perceived discomfort
- Below 65, risk of “cold shock” increases
- Entering shower gradually may help

- http://ccc.apgea.army.mil
Temperature & Decontamination

♦ T ≥ 65: Disrobe, decon., post-decon.
♦ T 36-64: Disrobe, decon. and/or post-decon. in heated exposure
♦ T < 36: Disrobe, dry decon.*, transport, indoor decon.

* “Dry decon.” = flour/dirt/sand/paper towel
Ladder Pipe Decon. System

♦ Suitable for $T \geq 65$
♦ Large capacity shower of high-volume, low pressure water
♦ Two engines create corridor with water spray from sides while ladder pipe provides low-pressure spray from above
Outdoor Decon. With Enclosure

♦ Suitable for T 36-64
♦ Patients are moved into heated structure (tent, hospital entrance, hotel room, etc.) after decontamination
♦ Dry clothes/linen available in enclosed area
Indoor Decontamination

♦ Suitable for T < 36
♦ Patients disrobe, then move into heated decon. area and heated “clean” area
♦ Buildings with indoor showers or pool
♦ Automatic building sprinkler system
♦ Segregate genders, age groups if feasible
Swimming Pool Decon.

♦ Olympic size pool - 3,000,000 liters H₂O
♦ Severe effects of cutaneous GB - 1000 mg
♦ Dose brought to pool by people with no-effects exposure - 100 mg
♦ No chlorine in water
♦ Can put 1,668,000 people in the pool without exceeding no-effects dose

- http://ccc.apgea.army.mil
Post-Decontamination

- Observe for signs and symptoms
- Prevent unnecessary exposure to elements
- Provide gender segregation when possible
- Communicate to decontaminated population signs and symptoms to watch for and any need for follow-up care
- Track patients
Communications

♦ Assess communications infrastructure
  – Can agencies communicate?
  – Is there redundancy?
  – Role of private radio operators if all else fails
  – Spare radios, batteries, cell phones, pagers
  – Runners?
  – What to do with the media?
    • Who will do the talking?
Be Flexible!
“By Friday, October 12, anthrax had been identified as a threat to the country, and its use as a weapon was documented and widely reported. The Fire Department’s Hazardous Materials Unit quickly became overwhelmed with calls for anthrax scares.”

- PFD press release
The Way It Used To Be

Anthrax threat shuts Hillel; Powder found to be harmless

Penn’s Hillel director found the white powder in a piece of hate mail sent to the Jewish center.

By Jonathan Margulies
The Daily Pennsylvanian
The Response

♦ Engines/ladders
♦ HAZMAT
♦ Deputy/battalion chiefs
♦ Medic units
♦ Health Dept.
♦ Police
♦ FBI
♦ Media
The Solution – the RAT
The Rapid Assessment Team

- Sport utility vehicle staffed by:
  - 2 PFD HAZMAT technicians
  - Phila. Police Dept. officer
  - Representative of Phila. Dept. of Public Health
The RAT’s Role

- Evaluate credibility of anthrax calls
- Take appropriate action
- Reassure caller
- Document incident
RAT Dispatch

♦ Deployed throughout City
♦ Were dispatched on all “anthrax” calls
♦ Accompanied by:
  – First-due engine
  – Battalion Chief
  – Sector police car
The RAT’s Options

- If situation suspicious or threat considered credible, HAZMAT tech could:
  - Bag evidence and give to police evidence team
  - Activate full HAZMAT response
  - Activate full Bomb Disposal Unit response
The Numbers

- 4 units initially, deployed 24 hrs/day
- 2 additional units added October 15 to accommodate mail-related calls
- As of Dec 31, 1263 RAT responses
- No anthrax discovered
Lessons Learned

♦ Sheer anthrax-related call volume mandated common-sense solution
♦ RATs allowed for:
  – Rapid response by qualified personnel
  – Rapid assessment of credibility of threat
  – Reassurance of the public that something was being done
  – Efficient allocation of valuable resources
Summary

♦ Unique problems with old-time solutions
♦ Care is supportive
  – Antidotes
  – Antibiotics when indicated
♦ PPE, patient tracking, decontamination, inter-agency collaboration crucial
♦ Flexibility and willingness to learn are key
Questions?