<table>
<thead>
<tr>
<th>S</th>
<th>Salivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Lacrimation</td>
</tr>
<tr>
<td>U</td>
<td>Urination</td>
</tr>
<tr>
<td>D</td>
<td>Defecation</td>
</tr>
<tr>
<td>G</td>
<td>Gastrointestinal Upset</td>
</tr>
<tr>
<td>E</td>
<td>Emesis or pulmonary Edema</td>
</tr>
</tbody>
</table>
MARK 1 – Nerve Agent Antidote Kit
Learning Objectives

- Identify the antidotes to be administered in event of nerve agent exposure
- Identify the conditions under which antidote auto-injectors should be used
- Demonstrate use of antidote auto-injectors
- Recognize adverse reactions to use of antidotes
PHARMACEUTICALS

- **Atropine** – alleviates SLUDGE symptoms
- **Pralidoxime** – reactivates enzyme inhibited by nerve agent
- **Diazepam** – prevents or stops seizures that may occur
PHARMACEUTICALS

Mark I
Nerve Agent Antidote Kit (NAAK)
Auto-injectors

Diazepam
Convulsant Antidote Nerve Agent (CANA)
Auto-Injector
Cuyahoga County Plan

• Implement Countywide Nerve Agent Exposure Protocol

• Provide 15 Nerve Agent Antidote Kits (NAAK) for each frontline public safety EMS and Fire Truck in insulated carrying case

• Provide 5 Valium Auto-Injectors (CANA) to each public safety ALS Unit

• Equip 10 hospitals with EMS and Hospital CHEMPACKS of antidote and treatment drugs each capable of treating 1000 patients
Cuyahoga County Plan - Implementation

- Drugs can be distributed when the following conditions have been met:
  - Drug license amended to add new drugs
  - Protocol approved and signed by your local medical control
  - Nerve agent exposure treatment protocol training is completed for all medics
  - Drugs picked up at designated location by paramedic, RN, MD or DO
  - Distribution forms signed
Auto-Injectors

Simple, compact injection systems

- Permit rapid injection of required antidotes
- Pre-measured, controlled dose
- Contain pre-measured doses of nerve agent antidotes atropine and 2-PAM chloride
- Enable rapid and accurate administration even if care giver or patient is clothed
Auto-Injectors

Each Mark 1 Kit contains two auto-injectors:

- 2mg Atropine
- 600 mg Pralidoxime Chloride (2-PAM)
Auto-Injectors

Each CANA Kit contains one auto-injector:

- 10 mg Valium
- CANA = Convulsant Antidote – Nerve Agent
Can All Patients Receive Auto-Injectors?

- Dosage in Auto-Injectors are based upon healthy adult patients
- Age, sex, weight and health of all other patients must first be considered when determining amount of atropine and 2-PAM Cl to administer
- Protocol has specific reduced doses for patients under 10 years of age
Who Can Use Auto-Injectors?

- Current Ohio Law and Cuyahoga County Protocol permit only paramedics who have been trained in recognition and treatment of nerve agent intoxication are permitted to use the Mark 1 Kits (NAAK)

- May change in the near future to allow EMT-B and EMT-I to administer, so all EMS responders should be trained
When To Use Auto-Injectors?

- Patient exhibits some or all of symptoms of nerve agent poisoning
- If you have protected yourself from exposure
- If YOU have the symptoms of exposure, administer the kit to yourself and seek decontamination and medical care
HOW NERVE AGENTS WORK

- They attack the nervous system by Overstimulating
  - nervous system controls body functions through use of chemicals which act as “instructions” to nerves, muscles and glands

- Nerve agents interfere with normal chemical instructions

Nerve synapse
NORMAL NERVOUS SYSTEM

- At nerve ending, acetylcholine is released
- Acetylcholine crosses synapse between nerve endings
  - if junction with skeletal muscle, muscles cells contract
  - if junction with smooth muscles, muscles move rhythmically
  - if junction with gland, glandular cells secrete
- Acetylcholine is inactivated by acetylcholinesterase

Normal activity at nerve synapse
HOW NERVE AGENTS WORK

- Nerve agents block acetylcholinesterase so it cannot destroy acetylcholine
  - acetylcholine accumulates and continue to stimulate target nerve
  - muscles twitch uncontrollably and repetitively
  - excess secretions of glands

Nerve agent interferes with normal synapse activity
Nerve Agent
Signs and Symptoms
Note!

Not all signs and symptoms may appear...

Dose, duration, and route of entry
Of the nerve agent make a difference
Physical Properties of Nerve Agents

• Usually liquid in normal state
• Volatile - many (not all) will generate vapors
• May be aerosolized
# Nerve Agents

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Tabun (GA)</th>
<th>Sarin (GB)</th>
<th>Soman (GD)</th>
<th>VX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Military Symbol</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volatility/Persistence</th>
<th>Semi-Persistent</th>
<th>Persistent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of Action</td>
<td>Extremely rapid</td>
<td></td>
</tr>
<tr>
<td>Route of Entry</td>
<td>• Respiratory</td>
<td>• Skin</td>
</tr>
<tr>
<td>Odor</td>
<td>Fruity</td>
<td>Camphor</td>
</tr>
<tr>
<td>Symptoms</td>
<td>• Pinpointing of Pupils</td>
<td>• Salivation</td>
</tr>
<tr>
<td></td>
<td>• Twitching</td>
<td>• Difficulty in Breathing</td>
</tr>
<tr>
<td>Protection</td>
<td>Respiratory and Skin</td>
<td></td>
</tr>
<tr>
<td>First Aid</td>
<td>• Atropine</td>
<td>• 2-Pam chloride</td>
</tr>
<tr>
<td>Decontamination</td>
<td>• Remove Agent</td>
<td>• Flush With Water</td>
</tr>
</tbody>
</table>
**Signs and Symptoms of Nerve Agent Exposure**

**MILD**
- excessive sweating
- tight chest (smooth muscle constrictions)
- Muscle twitching

**MODERATE**
- severe chest tightness
- diarrhea (rare)
- headache
- blurred vision from pinpoint pupils (miosis)
- tearing (lacrimation)
- salivation
- unexplained runny nose

**VERY SEVERE**
- bluish discoloration of skin (cyanosis)
- respiratory failure
- coma
- unconscious
- convulsions
Factors Affecting Signs and Symptoms

Time Factor (Onset)

- Reaction time depends on:
  - type of agent involved
  - dose (how much patient absorbed)
  - duration
  - route of exposure
  - sensitivity of patient's system
Factors Affecting Signs and Symptoms (Continued)

Time Factor (Onset)

- Reaction time is immediate if:
  - moderate to large amounts inhaled
  - moderate to large amounts spilled on skin

- Reaction time is delayed if:
  - small amounts involved
  - absorbed through skin in localized area
Effects can occur after single breath
Immediate response within seconds
Peak effects within 15-20 minutes
Exposure Through Skin (Absorption)

- Effects can develop up to 18 hours after exposure
- Absorption can continue and effects worsen for hours, even after decon
- Later onset, less likely to be lethal
Absorption through skin:

- All agents can be absorbed
- VX persists longer
- Sarin (GB) evaporates quickly, but still a threat
- Scrape or cut in skin allows immediate entry
Comparative Toxicities

- VX
- Sarin
- Mustard
- Hydrogen Cyanide
- Phosgene
- Cyanogen Chloride
- Chlorine
Other Possible Causes of Symptoms

Signs and symptoms could also apply to:

- Epilepsy
- Gastroenteritis
- Exposure to agricultural insecticides
- Carbon Monoxide Poisoning
- Heat illnesses
- Emphysema
- Stroke
- Head trauma
- Drug overdose
# Adult - Symptoms and Treatment of Nerve Agents

<table>
<thead>
<tr>
<th>No Symptoms</th>
<th>Mild Exposure</th>
<th>Moderate Exposure</th>
<th>Severe Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Sweating</td>
<td>Pinpoint pupils</td>
<td>Unconsciousness</td>
</tr>
<tr>
<td></td>
<td>Muscle Twitching</td>
<td>Runny Nose</td>
<td>Apnea</td>
</tr>
<tr>
<td></td>
<td>Chest Tightness</td>
<td>Headache</td>
<td>Seizures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wheezing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nausea</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diarrhea</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cramping</td>
<td></td>
</tr>
<tr>
<td>Decontamination and Observation</td>
<td>1 Mark 1 Kit</td>
<td>1-2 Mark 1 Kits and repeat atropine every 5-10 minutes</td>
<td>3 Mark 1 Kits and repeat atropine every 5-10 minutes</td>
</tr>
<tr>
<td>Only</td>
<td></td>
<td>until secretions stop</td>
<td>until secretions stop</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AND 1 Valium Auto-injector for seizures, if present</td>
<td></td>
</tr>
</tbody>
</table>
# Peds - Symptoms and Treatment of Nerve Agents

<10 yrs or < 40 kg

<table>
<thead>
<tr>
<th></th>
<th>No Symptoms</th>
<th>Mild Exposure</th>
<th>Moderate Exposure</th>
<th>Severe Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td>Miosis</td>
<td>Miosis and ANY Other Symptom of Exposure</td>
<td>Unconsciousness Apnea Seizures Flaccid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mild Rhinorrhea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decontamination</td>
<td>Decontamination</td>
<td>Atropine 0.05 mg/kg IV or IM, repeated every 5-10 minutes until respirations improve</td>
<td>Atropine and 2-PAM as shown. Valium 0.05 to 0.3 mg/kg IV or IM may also be given if seizures are present</td>
<td></td>
</tr>
<tr>
<td>and Observation</td>
<td>and Observation Only</td>
<td>2-PAM 25-50 mg/kg IV or IM may repeat at 1 hour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Miosis
Mild Rhinorrhea
Miosis
ANY Other Symptom of Exposure

Unconsciousness
Apnea
Seizures
Flaccid

No Symptoms
Mild Exposure
Moderate Exposure
Severe Exposure

Valium 0.05 to 0.3 mg/kg IV or IM may also be given if seizures are present
Treatment For Exposure To Nerve Agents

- Depending on severity of symptoms, immediately administer 1 atropine auto-injector, followed by 1 2-PAM Cl auto-injector
  - Atropine should be given first, followed immediately by 2-PAM Cl
- If nerve agent signs and symptoms are still present after 5–10 minutes, repeat injections
Treatment For Exposure To Nerve Agents

- If signs and symptoms still exist after additional 10 minutes, repeat injections for third time.
- If signs and symptoms remain after third set of injections, do not give any more antidotes but seek immediate definitive medical care.
If severe signs and symptoms are present:

- In case of very severe exposure, all three auto-injector kits (atropine and 2-PAM Cl) may be administered in rapid succession; then medical help should be sought.

- Note: If self administering, if you are able to administer kits to yourself, you don’t have severe symptoms.

- ABC’s still apply. Remove secretions, maintain patient’s airway and, if necessary, use artificial ventilation by BVM.
What does the Atropine do?

- Atropine blocks effects of over-stimulation
- Relieves smooth muscle constriction
- Dries up respiratory secretions
What does 2-PAM Chloride do?

- Removes organophosphate from acetylcholinesterase which can then deactivate acetylcholine
- Re-establishes normal skeletal muscle contraction
- Relieves twitching and paralysis of respiratory muscles
Directions for Use

- Remove safety cap (yellow on atropine; gray on 2-PAM CI)

- Mark I kit clip holds the safety caps; may not notice if using Mark I kits.

- Do not touch colored end of injector after removing cap; injector can and will function into fingers or hand if any pressure applied to this end of injector.
Directions for Use

- Hold injector like a pen.
- Place colored end on thickest part of thigh and press hard until injector functions. May be used thru clothing.
- Pressure automatically activates the spring, plunges the needle into the muscle and simultaneously forces the med through it into the muscle tissue.
Directions for Use

- Hold firmly in place for ten seconds, then remove.
- Massage the area of injection
- Repeat with 2-Pam Chloride
**Directions for Use**

- After auto-injector has been activated, empty syringe should be disposed of properly
  - It cannot be refilled nor can the protruding needle be retracted
  - It should be disposed of in a “sharps” container
  - Consider adding sharps container to kit

- Note dosage on triage tag or write on chest or forehead of patient
**IMPORTANT!**

Antidotes counter or relieve effects of poisons such as nerve agents. Use antidotes only when signs and symptoms of exposure are present; they will not protect if given before exposure.

- Not effective on blister agents, blood agents, pepper spray, mace, tear gas or other TICs
Two Common Problems

- Underdosage
  - administering too little antidote to relieve agent effects
  - most serious problem: failing to administer atropine when needed

- Administering antidote to patients not exposed to nerve agent
Directions for Use

IMPORTANT:
- Avoid exposure to nerve agent
- Use your PPE and respiratory protection
- Avoid contact with patient’s clothing
- Get decontaminated if you are exposed
**Precautions**

- Any patient receiving atropine for nerve agent exposure requires medical observation for at least 24 hours.
- If atropine is used to treat infants and children, smaller amounts should be given.
Adverse Reactions

- 2 to 5 minutes after intramuscular injection of 2-PAM Cl, mild to moderate pain may be experienced at site of injection
2-PAM Cl in a non-exposed person may cause:

- blurred vision
- impaired accommodation
- headache
- nausea
- increased systolic and diastolic blood pressure

- double vision (diplopia)
- dizziness
- drowsiness
- rapid heart rate (tachycardia)
- hyperventilation

These are relatively non-toxic responses when compared to effects of nerve agent or organophosphorus insecticide exposures.
Caring For Auto-Injector Supplies

- Auto-injectors have a five-year shelf life, making them suitable for storage in emergency stockpiles
- Store auto-injectors at room temperature (between 58 and 86 degrees F)
- Keep them from freezing
Caring For Auto-Injector Supplies

- Antidotes will freeze at temperatures below 29°F
- Do not carry auto-injectors in external pocket of BDU when temperature below freezing. Place in inner pocket where body heat will keep them warm
- Frozen auto-injectors still usable after being thawed if they do not appear broken or cracked
Course Summary

• In this training we learned to:
  – Recognize the signs of a terrorist attack
  – Take action to protect ourselves and others
  – Establish hazard control zones
  – Perform emergency decontamination of contaminated patients
  – Identify the signs and symptoms of nerve agent poisoning
  – Provide medical care and administer appropriate medications for those patients with symptoms
  – Notify appropriate hospital facilities
  – Triage and transport patients to appropriate hospitals
Course Summary

• We also learned to:
  – Identify the antidotes to be administered in event of nerve agent exposure
  – Identify the conditions under which antidote auto-injectors should be used
  – Demonstrate use of antidote auto-injectors
  – Recognize adverse reactions to use of antidotes
Course Quiz and Evaluation

- Demonstrate the use of the Mark 1 Kit
- Complete the quiz
- Complete course evaluation form
Thanks for attending!